

UNIT 1

Numbers and Operations

Numbers are an important part of your daily life. Have you ever calculated the number of miles between where you are and where you want to go? When was the last time that you estimated whether or not you had enough cash to purchase items in a store? Have you ever paid part of a bill and then figured out how much you had left to pay?

All of these everyday actions rely on your understanding of numbers, number sense, and basic math operations. This unit covers basic number sense and operations with whole numbers, fractions, decimals, and percents. Keep in mind that you will use the skills in this unit on 20 to 30 percent of the questions on the GED Mathematics Test.

Whether you realize it or not, you use many math skills every day.



The lessons in this unit include:

Lesson 1: Number and Operation Sense and

Lesson 2: Operations with Whole Numbers
Understand the relationship between numbers and learn to add, subtract, multiply, and divide.

Lesson 3: Steps for Solving Word Problems and

Lesson 4: Steps for Solving Multi-Step Problems
Learn strategies for solving both simple and multi-step word problems.

Lesson 5: Introduction to Fractions and

Lesson 6: Fractions, Ratios, and Proportions
Understand the forms and sizes of fractions and the relationships among them.

Lesson 7: Operations with Fractions

Learn how to add, subtract, multiply, and divide with fractions.

Lesson 8: Introduction to Decimals and

Lesson 9: Operations with Decimals
Learn to write, compare, and calculate with decimals.

Lesson 10: Decimals and Fractions

Fractions and decimals are both ways to express part of a whole. Learn ways to convert between them and to use them together in problems.

Lesson 11: The Meaning of Percent

Percents are used to find a part or a whole when several numbers are given. Learn to use percents with or interchanged with fractions or decimals.

Lesson 12: Solving Percent Problems—Part 1

Lesson 13: Solving Percent Problems—Part 2

Learn everyday applications of percents including finding the percent by which a value increases or decreases and finding interest on money.

PROBLEM-SOLVING SKILLS

- Choosing the Operation
- Step-by-Step Problem Solving
- Setting Up Problems
- Estimating
- Using Your Calculator
- Writing Answers in a Standard Grid
- Order of Operations
- Solving Proportions
- Using Mental Math
- Solving Multi-Step Problems

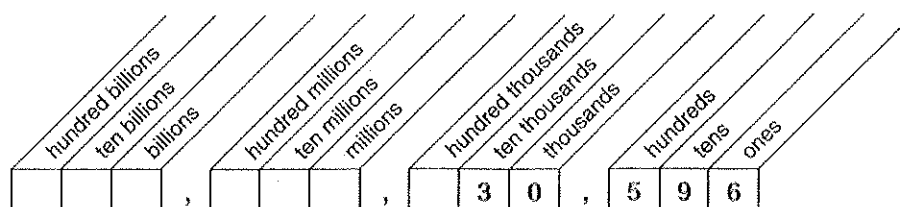
Lesson 1

GED SKILL Number and Operation Sense

Place Value

Whole numbers are made up of these ten **digits**: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The number 3820 has four digits; 1,000,000 is a seven-digit number, although six of the digits are the same.

Our number system is based on place value. **Place value** means that the value of a digit depends on its position, or place, in a number. This chart shows the names of the first 12 whole number places.



The total value of a number is the sum of the values of the digits in each place.

Example What is the value of each digit in 30,596?

3 is in the ten thousands place.	$3 \times 10,000 =$	30,000
0 is in the thousands place.	$0 \times 1,000 =$	0,000
5 is in the hundreds place.	$5 \times 100 =$	500
9 is in the tens place.	$9 \times 10 =$	90
6 is in the ones place.	$6 \times 1 =$	6

Reading and Writing Numbers

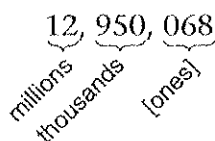


Four-digit numbers can be written with or without a comma. The number four thousand five hundred twenty can be written as 4520 or 4,520. Both are correct.

When writing a number, place commas every three digits counting from the right. Each group of three digits is called a **period** and is named for the number place to the left of the comma. Always read a number from left to right. Read each group of digits before a comma; then say the name of the period the comma represents.

Write a number in words exactly as you read it aloud. Do not say or write the word *and* or *ones* when reading or writing whole numbers.

Example Read the number 12,950,068, and write it in words.



The number is read and written in words as **twelve million, nine hundred fifty thousand, sixty-eight**.

Rounding Whole Numbers

Use **rounding** to make difficult calculations easier to perform. Round the numbers you are working with when you do not need an exact answer.

Example Round the number 24,902 to the thousands place.

- Step 1** Find the digit you want to round to. Circle it. 24,902
Step 2 Look at the digit to the right of the circled digit. 24,902
Step 3 If the digit to the right is 5 or more, add 1 to the circled digit. If the digit is less than 5, do not change the circled digit. Change all digits to the right of the circled digit to zeros. 25,000

Examples Round to the nearest thousand. ③,499 rounds to 3,000
1⑨,930 rounds to 20,000

GED SKILL FOCUS

A. Write the value of the underlined digit in words. Refer to the chart on page 34.

Example: 627 _____ six hundred

- | | |
|----------------------------|-----------------------------|
| 1. 5, <u>5</u> 17 _____ | 4. 4, <u>7</u> 00,510 _____ |
| 2. <u>3</u> ,742,691 _____ | 5. 964, <u>2</u> 51 _____ |
| 3. <u>2</u> 6,154 _____ | 6. 3, <u>4</u> 00,500 _____ |

B. Match each number in Column A with its word form in Column B.

Column A

Column B

- | | |
|---------------------|---|
| _____ 7. 8,416 | a. eighty-four million, two hundred thousand, one hundred sixty |
| _____ 8. 8,420,106 | b. eighty-four thousand, two hundred sixteen |
| _____ 9. 84,200,160 | c. eight hundred forty-two thousand, sixteen |
| _____ 10. 842,016 | d. eight million, four hundred twenty thousand, one hundred six |
| _____ 11. 84,216 | e. eight thousand, four hundred sixteen |

C. Round each number as directed. Refer to the chart on page 34.

12. Round 8,621 to the hundreds place. _____
13. Round 5,099,620 to the nearest million. _____
14. Round 46,055 to the nearest ten thousand. _____
15. Round 10,562 to the nearest thousand. _____

Answers start on page 372.

Comparing, Ordering, and Grouping

When shopping, you often compare prices to find the best buy. You can use the following rules when **comparing** whole numbers.

RULE 1 The whole number with the most digits is always greater.

Example Compare 7235 and 848. The number 7235 (4 digits) is greater than 848 (3 digits).

RULE 2 When two numbers have the same number of digits, compare the digits from left to right.

Example 646 is less than 690 because 40 is less than 90.

To write number comparisons, use the following symbols:

=	means <i>equals</i>	140 = 140	140 equals 140
>	means <i>is greater than</i>	25 > 23	25 is greater than 23
<	means <i>is less than</i>	4 < 5	4 is less than 5

Using the same rules, you can put several numbers in order of value.

Example 1 An Internet company sells books, toys, and videos. Yesterday, the company recorded these sales in each category: books, 1247; toys, 1271; and videos, 990. Arrange the sales in order from least to greatest.

Step 1 Count the digits in the sales numbers. Since 990 has only 3 digits and the other numbers have 4 digits, 990 is less than the other two sales numbers.

Step 2 Compare the digits in 1247 and 1271, working from left to right. The digits in the thousands place and the hundreds place are the same in both numbers. So, look at the tens place in each. Since 40 is less than 70, the number 1247 is less than 1271.

From least to greatest, the sales are **990, 1247, and 1271**.

Understanding place value can also help you find the range that contains a certain number.

Example 2 Samuel is looking for a file #13496. A label on the front of each drawer tells the range of file numbers in the drawer. For example, Drawer A contains files numbered from #13090 to #13274. Which drawer contains file #13496?

Drawer A #13090 to #13274	Drawer B #13275 to #13490	Drawer C #13491 to #13598	Drawer D #13599 to #14701
------------------------------	------------------------------	------------------------------	------------------------------

Compare the number 13496 to the signs. File #13496 will be between the two numbers on the correct drawer. Since 13496 is greater than 13491 and less than 13598, the file is found in **Drawer C**.



Think of the "greater than" and "less than" symbols as arrows that always point to the smaller number.

GED SKILL FOCUS

A. Compare the following numbers. Write $>$, $<$, or $=$ between the numbers.

1. 1,305 _____ 1,503
2. 34,000 _____ 29,989
3. 102,667 _____ 102,657
4. 5,690,185 _____ 5,690,185,100
5. 875,438 _____ 875,438
6. 75,390,000 _____ 75,391,540
7. 9,500,000 _____ 9,500,000,000
8. 45,100 _____ 45,099
9. 7,456,795 _____ 7,500,000
10. 319,002,110 _____ 319,002,011

B. Solve.

Refer to the following chart to answer Questions 11 through 14.

Daily Sales Totals Week Ending March 4	
Monday	\$18,756
Tuesday	12,316
Wednesday	13,940
Thursday	13,772
Friday	21,592
Saturday	28,795

11. Which day had higher sales, Wednesday or Thursday?

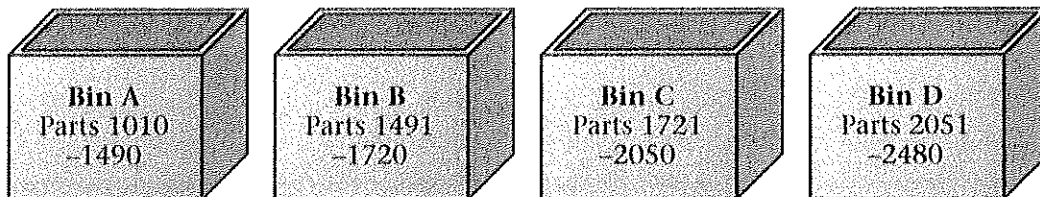
12. Which day had the lowest sales?

13. Which day had the highest sales?

14. Arrange the sales on the chart in order from lowest to highest.

Refer to the following information to answer Questions 15 through 17.

Bob's Auto Parts stores some of its inventory in bins. Each part is assigned a catalog number and sorted into the bins. A range of numbers indicates the contents of each bin.



15. In which bin would you find Part Number 1750? _____

16. Gina needs parts 1488 and 1491. In which bins should she look? _____

17. Part numbers higher than 2050 can be found in which bin? _____

Answers start on page 372.

Choosing the Operation

To solve math word problems, you must make several decisions. You need to decide what the question is asking and what information you require to solve the problem. You must also choose the operation needed to solve the problem: addition, subtraction, multiplication, or division.

Read the word problem carefully, and think about the information you are given in the problem and how you will solve it. Here are some guidelines that may help you choose an operation.

You	When You Need To
Add (+)	Combine quantities Find a total
Subtract (−)	Find a difference Take away a quantity Compare to find "how many more," "how much less," or "how much is left"
Multiply (×)	Put together a number of equal amounts to find a total Add the same number repeatedly
Divide (÷)	Split a quantity into equal parts

Example 1 Victor has a doctor's bill of \$55 and a pharmacy bill of \$12. Which operation shows the total of the bills?

- (1) $\$55 + \$12$
- (2) $\$55 - \$12$
- (3) $\$12 \times \$55$
- (4) $\$55 \div \$12$
- (5) $\$12 - \$55$

You need to find a total, so you add the amounts. The correct answer is **option (1)**.

Example 2 Ahmed, Rita, and Lilia are sharing equally the \$126 profit from their yard sale. Which operation shows how much each person will receive?

- (1) $3 + \$126$
- (2) $\$126 - 3$
- (3) $\$126 \times 3$
- (4) $\$126 \div 3$
- (5) $3 \div \$126$

To split \$126 into equal amounts, divide. The correct answer is **option (4)**.



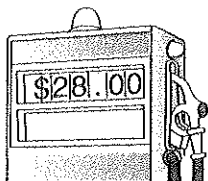
Note that the order in which you write numbers in subtraction and division problems is important. The amount being subtracted from or being divided must come first.

Directions: Choose the one best answer to each question.

1. The Chang family pays a car loan payment of \$269 a month. Which of the following operations shows how much they will pay on the loan in a 12-month period?
 - (1) $12 + \$269$
 - (2) $\$269 - 12$
 - (3) $\$269 \times 12$
 - (4) $\$269 \div 12$
 - (5) $12 - \$269$

2. Last month Teresa paid \$137 to heat her home. This month she paid \$124. Which of the following operations shows the total cost of heating her home for the 2 months?
 - (1) $\$137 + \$124$
 - (2) $\$137 - \$124$
 - (3) $\$124 \times \$137$
 - (4) $\$137 \div \$124$
 - (5) $\$124 \div \$137$

3. Carl filled up the gas tank on his delivery truck. The total cost of the gas is shown on the pump below. If he paid for the gas with a fifty-dollar bill, which of the following operations shows how much money Carl should get back in change?



 - (1) $\$50 + \$28$
 - (2) $\$28 - \$50$
 - (3) $\$28 \times \$50$
 - (4) $\$50 \div \$28$
 - (5) $\$50 - \$28$

4. Kim needs to read a 348-page book for class. She has three weeks to read it, and she plans to read an equal number of pages each week. Which of the following operations shows how many pages Kim must read per week?
 - (1) $3 + 348$
 - (2) $348 - 3$
 - (3) 348×3
 - (4) $348 \div 3$
 - (5) $3 \div 348$

5. Mark starts with \$327 in his checking account. If he writes a check for \$189, which of the following operations shows how much will be left in his account?
 - (1) $\$189 + \$327$
 - (2) $\$327 - \$189$
 - (3) $\$189 \times \$327$
 - (4) $\$327 \div \$189$
 - (5) $\$189 \div \$327$

6. Four friends carpool to work together Monday through Friday. Each week they pay a total of \$62 for gas, parking, and tolls. Which of the following operations shows how they could split the cost evenly?
 - (1) $4 + \$62$
 - (2) $\$62 - 4$
 - (3) $4 \times \$62$
 - (4) $4 \div \$62$
 - (5) $\$62 \div 4$



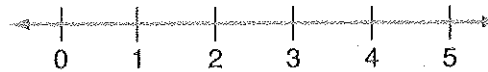
You may need to read a problem carefully to find all of the numbers. Sometimes a number appears as a word, such as "four" friends.

Answers start on page 372.

GED SKILL Using Number Lines

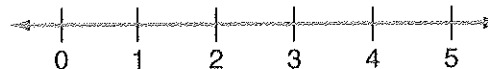
A **number line** can help you compare the value of numbers. Number lines show numbers at equally spaced **intervals**.

On the number line below, the equally-spaced intervals increase by one whole number. Thus, as you move to the right on a number line, the values increase. The arrows at each end of a number line show that the line doesn't end but extends in both directions.



You may see a number line on the GED Mathematics Test, or you may want to draw one to help you see the relationship among several numbers.

Example 1 Place a dot on the number line below to show a whole number that is greater than 2 and less than 4.

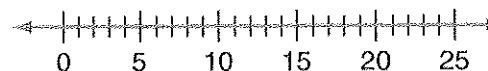


For problems like the example above, there is only one possible correct whole number answer. The number 3 would be correct.

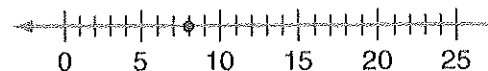


For some number lines, you will need to determine the value of unlabeled intervals. In the example below, every fifth interval is labeled. By counting the intervals between 5 and 10, you'll find each interval represents an increase of 1 as you move from left to right.

Example 2 Place a dot on the number line below to locate the whole number 8.



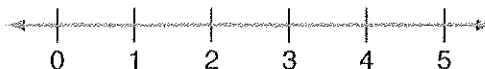
On this number line only every 5th whole number is labeled. You must find an unlabeled whole number by counting the lines between 5 and 10. In this example, you count each line between 5 and 10 and place a dot on the third line, which represents the whole number 8.



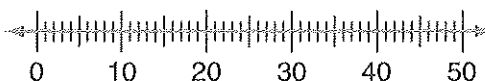
GED SKILL FOCUS

Show your answers by placing one or more dots on the number line below each problem.

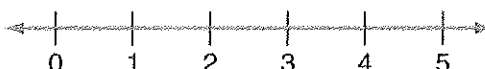
1. Show the location of the whole number 4.



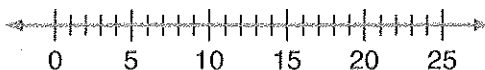
2. Show the location of the whole number 38.



3. Show the location of each whole number including zero that is less than 3.



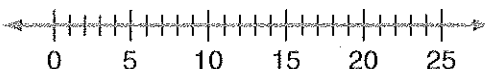
4. Show the location of the whole number eighteen.



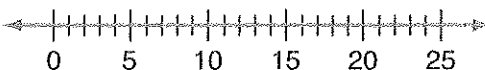
5. Show the location of the whole number that makes this comparison true: $1 < ? < 3$.



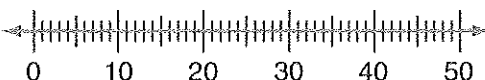
6. Show the location of the whole number twenty-two.



7. Show the location of the whole number that makes this comparison true: $18 > ? > 16$.



8. Show the location of the whole number forty-three.



Answers start on page 372.

Lesson 2

GED SKILL Operations with Whole Numbers

Adding and Subtracting Whole Numbers

One key to success in math is knowing how to perform the basic operations accurately and when to use each operation. Use **addition** to combine quantities, or find a total, or **sum**. Follow these steps to add whole numbers.

Step 1 Line up the numbers being added so digits with the same place value are aligned. Start with the ones column. Working from right to left, add the numbers in each column.

Step 2 When a column of digits has a sum greater than 9, **regroup**, or **carry**, to the next column on the left.

Example 1 EZ Video rented 169 videos on Thursday and 683 videos on Friday. Find the total rentals for the two days.

Step 1 Add the ones column ($9 + 3 = 12$). Write 2 in the ones column; regroup 1 to the tens column.

Step 2 Continue adding the remaining columns, regrouping when necessary.

$$\begin{array}{r} 169 \\ +683 \\ \hline 852 \end{array}$$



On your calculator, enter the numbers to be added.

$$169 + 683 = 852.$$

EZ Video rented a total of **852 videos** on Thursday and Friday.

Use **subtraction** to find the **difference** between two numbers or amounts. Follow these steps to subtract whole numbers.

Step 1 Write the number being subtracted below the other number, making sure to line up the place-value columns. Starting with the ones column, work from right to left, subtracting the numbers in each column.

Step 2 When a digit in the bottom number is greater than the digit above it, you must regroup, or **borrow**, to subtract the column.

Example 2 Jeff's Home Repair charges \$5025 to remodel a kitchen and \$2438 to paint a two-story house. Find the difference in cost.

Step 1 Arrange the numbers in columns. Regroup 1 ten from the tens column to subtract the ones column ($15 - 8 = 7$).

Step 2 Subtract the tens column. Regroup. Since there are no hundreds, borrow from the thousands. Now there are ten hundreds in the hundreds column.

$$\begin{array}{r} \$5025 \\ - \$2438 \\ \hline 7 \end{array}$$

Step 3 Finally, regroup from the hundreds column and complete the subtraction.

Step 4 Check your answer by adding the result and the number you subtracted. The sum should equal the top number in the problem.

$$\begin{array}{r} 911 \\ 43015 \\ \$5025 \\ - 2438 \\ \hline \$2587 \\ 111 \\ \$2587 \\ + 2438 \\ \hline \$5025 \end{array}$$



On your calculator, enter the larger number first.

$$5025 - 2438 = 2587.$$

The remodeling job costs **\$2587** more than the painting job.

GED SKILL FOCUS

A. Solve these problems using paper and pencil.

1.
$$\begin{array}{r} 305 \\ +463 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 6795 \\ + 132 \\ \hline \end{array}$$

5.
$$\begin{array}{r} 86 \\ -51 \\ \hline \end{array}$$

7.
$$\begin{array}{r} 680 \\ -268 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 4172 \\ +4510 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 193 \\ +629 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 494 \\ -167 \\ \hline \end{array}$$

8.
$$\begin{array}{r} 5067 \\ -3795 \\ \hline \end{array}$$

9. $81,427 + 3,541 + 24,625 =$

12. Combine 176 and 54,095.

10. Find the sum of 76 and 58.

13. Subtract 16,567 from 20,000.

11. $10,508 - 3,679 =$

14. What is the total of 950, 308, 77, and 50?



B. Use your calculator to solve these problems.

15.
$$\begin{array}{r} 56,439 \\ + 4,796 \\ \hline \end{array}$$

17.
$$\begin{array}{r} 19,067 \\ +35,196 \\ \hline \end{array}$$

19.
$$\begin{array}{r} 800 \\ -219 \\ \hline \end{array}$$

21.
$$\begin{array}{r} 51,964 \\ -20,651 \\ \hline \end{array}$$

16.
$$\begin{array}{r} 35,075 \\ 1,936 \\ +17,950 \\ \hline \end{array}$$

18.
$$\begin{array}{r} 65,196 \\ 6,725 \\ +27,718 \\ \hline \end{array}$$

20.
$$\begin{array}{r} 1258 \\ - 295 \\ \hline \end{array}$$

22.
$$\begin{array}{r} 3205 \\ -2276 \\ \hline \end{array}$$

23. What is the total of 36, 9, 74, 48, 6, and 15?

24. How much more is 419,003 than 12,018?

25. Find the difference between 37,500 and 18,642.

26. Subtract 75,510 from 100,000.

Answers start on page 373.

Multiplying and Dividing Whole Numbers

Use **multiplication** when you need to add the same number many times. The answer to a multiplication problem is called the **product**. Follow these steps to multiply.

- Step 1** Working from right to left, multiply the digits in the top number by the digit in the ones column of the bottom number to find a **partial product**. Then multiply the top number by the tens digit of the bottom number to find a partial product and so on.
- Step 2** Line up each partial product under the digit you multiplied by. Then add the partial products together.

Example 1 A company spends \$913 per week on advertising. How much will the company spend in 52 weeks?

- Step 1** To multiply \$913 by 52, first multiply \$913 by the ones digit, 2. The partial product 1826 is lined up under the ones column.
- Step 2** Multiply \$913 by the tens digit, 5. The partial product 4565 is lined up under the tens column. Use zero as a placeholder. Add the partial products to find the product.

$$\begin{array}{r} \$913 \\ \times 52 \\ \hline 1826 \\ 45650 \\ \hline \$47,476 \end{array}$$



On your calculator, enter the numbers to be multiplied.

$$913 \times 52 = 47476.$$

The company will spend **\$47,476** on advertising in a 52-week period.

Use **division** when you need to separate a whole (the **dividend**) into equal parts. The answer to a division problem is called a **quotient**. The example will help you understand the steps in long division. Put the dividend inside the bracket. Put the number you are dividing by (the **divisor**) outside the bracket on the left. Work from left to right.

Example 2 Elena is packaging glassware. She packs 18 juice glasses into each carton. If she has 7310 glasses to pack, how many cartons can she completely fill?

- Step 1** Divide 7310 by 18. Since 18 does not go into 7, look at the first two digits: divide 18 into 73. Write 4 in the answer above the hundreds place. Multiply 18 by 4, and then subtract that amount from 73. Bring down the next digit.
- Step 2** 18 will not divide into 11. Write 0 above the tens place in the quotient and bring down the next digit (the ones digit). Continue dividing. Use the letter *r* to show the **remainder**.

$$\begin{array}{r} 4 \\ 18 \overline{) 7310} \\ \underline{72} \\ 11 \\ \underline{36} \\ 406 \text{ r}2 \\ \underline{36} \\ 110 \\ \underline{108} \\ 2 \end{array}$$



If you don't know how many times one number goes into another, make a reasonable guess. Then multiply to see if your guess will work.

Step 3 To check your answer, multiply it by the number you divided by. Then add the remainder. The result should be the number you were dividing.

$$\begin{array}{r} 406 \\ \times 18 \\ \hline 3248 \\ 4060 \\ \hline 7308 \\ + 2 \\ \hline 7310 \end{array}$$



To divide using a calculator, enter the numbers in the order shown below. On a calculator, the remainder is given as a decimal. You will learn more about decimal remainders in Lesson 9.

$$7310 \div 18 = 406.111111$$

This answer tells us Elena can fill **406 cartons** and will have some glasses left over.

GED SKILL FOCUS

A. Solve these problems using paper and pencil.

1.
$$\begin{array}{r} 746 \\ \times 5 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 36 \\ \times 23 \\ \hline \end{array}$$

5. $7 \overline{)3206}$

7. $12 \overline{)76,402}$

2.
$$\begin{array}{r} 4862 \\ \times 9 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 5084 \\ \times 76 \\ \hline \end{array}$$

6. $4 \overline{)23,984}$

8. $24 \overline{)219,315}$

9. $2584 \times 2700 =$

13. $190 \times 2186 =$

10. Multiply 25,097 by 25.

14. Divide 139,400 by 205.

11. Divide 30,321 by 46.

15. $130,112 \div 16 =$

12. $606,450 \div 15 =$

16. Find the product of 8050 and 509.



B. Use your calculator to solve these problems. Round to the nearest whole number.

17.
$$\begin{array}{r} 775 \\ \times 775 \\ \hline \end{array}$$

19.
$$\begin{array}{r} 885 \\ \times 62 \\ \hline \end{array}$$

21. $6 \overline{)3502}$

23. $13 \overline{)100,000}$

18.
$$\begin{array}{r} 3056 \\ \times 2500 \\ \hline \end{array}$$

20.
$$\begin{array}{r} 1247 \\ \times 3014 \\ \hline \end{array}$$

22. $18 \overline{)254,178}$

24. $35 \overline{)38,450}$

25. Find the product of 15,663 and 8.

28. Divide 712,000 by 25.

26. Multiply 1193 by 45.

29. $40,409 \times 9 =$

27. Divide 508,320 by 120.

30. $419,357 \div 163 =$

Answers start on page 374.

Step-by-Step Problem Solving

The key to solving word problems is to read and understand the problem before doing any calculations. Use the following five steps to organize your problem-solving approach.

- Step 1** Read the problem and decide what you are asked to find. Identify what information you need to solve the problem.
- Step 2** Choose the operation (addition, subtraction, multiplication, or division) you will use to solve the problem.
- Step 3** Estimate to find an approximate answer. This will help you determine whether your actual answer is correct.
- Step 4** Solve the problem.
- Step 5** Check your answer to make sure it makes sense. Does it answer the question posed by the problem? Does it seem reasonable? Compare your answer to your estimate.



Some questions require only an estimated answer. The word "about" often indicates that only an estimate is needed. But estimating can always help you be sure that your answer makes sense.

Apply this strategy to the following problem.

Example Roberto drove 357 miles on Monday and 509 miles on Tuesday. How many more miles did he drive on Tuesday than on Monday?

- (1) 146
- (2) 152
- (3) 357
- (4) 509
- (5) 866

- Step 1** You need the number of miles from each day: 357 miles and 509 miles.
- Step 2** Since you need to find the *difference* in miles, subtract. Tuesday's mileage is greater than Monday's mileage, so subtract 357 from 509.
- Step 3** Estimate an answer. Round 509 to 500 and 357 to 350. Subtract. Estimate: $500 - 350 = 150$
- Step 4** Solve the problem.
- Step 5** Check your answer. Is it reasonable?
The answer 152 is close to the estimate of 150 so it is reasonable.

$$\begin{array}{r} 4\ 10 \\ 509 \\ -357 \\ \hline 152 \end{array}$$

Option (2) 152 is correct. Roberto drove 152 more miles on Tuesday than on Monday.

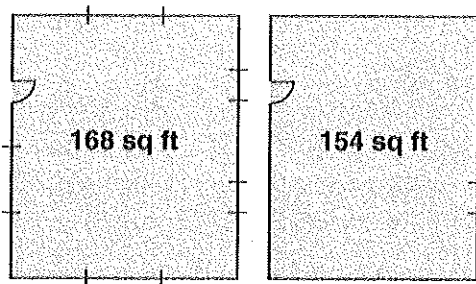
GED PRACTICE

Directions: Choose the one best answer to each question. Use your calculator when indicated.

1. Last month the Lees paid \$137 to heat their home. This month they paid \$124. What is the total cost of heating their home for the two months?
(1) \$ 13
(2) \$130
(3) \$161
(4) \$251
(5) \$261
2. Marcus has \$827 in his checking account. He writes a check for \$189. How much will be left in the account?
(1) \$1016
(2) \$ 762
(3) \$ 738
(4) \$ 648
(5) \$ 638
4. The Valdez family pays \$289 a month on a car loan. How much will the family spend on the car loan in a 1-year period?
(1) \$ 289
(2) \$ 360
(3) \$1200
(4) \$2890
(5) \$3468
5. Six friends commute to work together. Each week, the gas, parking, and tolls cost \$114. If they split the costs equally, how much does each friend pay per week toward the commuting costs?
(1) \$ 17
(2) \$ 18
(3) \$ 19
(4) \$108
(5) \$120



Question 3 refers to the following diagram.



3. Alexa is buying carpet for her home. The diagram shows the amount of carpeting needed for each of two rooms. What is the total square feet of carpet that Alexa needs?
(1) 322
(2) 320
(3) 312
(4) 222
(5) 214
6. Emily worked 68 hours in 2 weeks. She earns \$7 per hour. How much did she earn in the 2 weeks?
(1) \$ 51
(2) \$ 75
(3) \$435
(4) \$476
(5) \$952



On the GED Mathematics Test you will need to know common equivalencies such as:
24 hours = 1 day; 7 days = 1 week
52 weeks = 12 months = 1 year

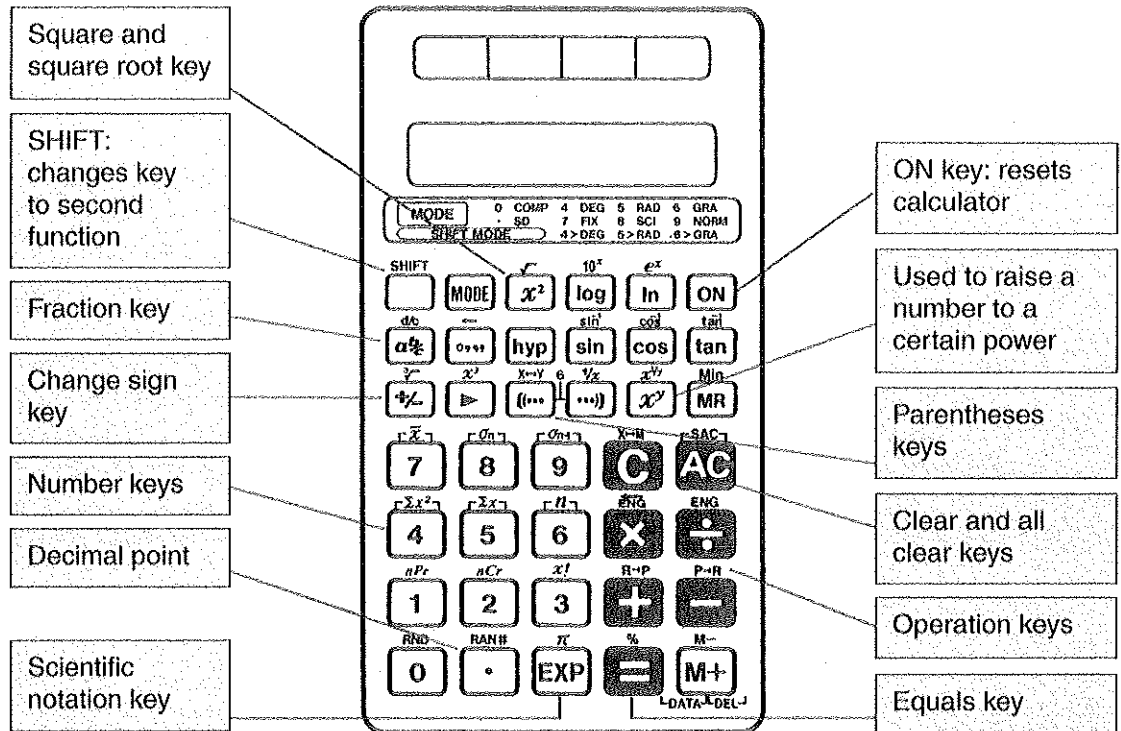
Answers start on page 374.

GED STRATEGY Using Your Calculator



Basic Calculator Functions

On Part One of the GED Mathematics Test, you will be able to use a calculator. This calculator, which will be provided by the testing center, is the CASIO *fx-260SOLAR*. Throughout this book, you will practice solving problems with calculators.



Here are some more important points about calculator use:

- Press the C key to clear your last entry; press the AC key to clear all entries and calculations.
- Even though you may be only entering whole numbers, many calculators will automatically display a decimal point at the end of the whole number.
- When adding or multiplying, it doesn't matter in what order the numbers are entered. However, it is very important to enter the numbers in the correct order when subtracting or dividing.
 - **Subtraction problems**—the number being taken away must be entered second: $32 - 28$
 - **Division problems**—the number being divided must be entered first: $24 \div 3$



You can practice with this calculator at the testing center before taking the test. See pages 469–472 for more review.

Example 1 Katie drove 236 miles on Friday, 304 miles on Saturday, and 271 miles on Sunday. How many miles did she drive during the three-day period?

Add to find the total number of miles that Katie drove.

$$236 + 304 + 271$$

You can enter these numbers in a calculator in any order. It is very important, however, to make sure that the digits within a number stay in the same order. Any of the following entries will give you the same answer.

$$236 \text{ } \boxed{+} \text{ } 304 \text{ } \boxed{+} \text{ } 271 \text{ } \boxed{=} \text{ or } 271 \text{ } \boxed{+} \text{ } 304 \text{ } \boxed{+} \text{ } 236 \text{ } \boxed{=} \\ \text{or } 304 \text{ } \boxed{+} \text{ } 271 \text{ } \boxed{+} \text{ } 236 \text{ } \boxed{=}$$

You should see the answer **811** in the display. It is not necessary to press the $\boxed{=}$ key until you finish entering all the numbers.



Example 2 Malik's workteam made 1056 widgets in 6 hours. How many widgets did they make per hour?

$$1056 \text{ } \boxed{\div} \text{ } 6 \text{ } \boxed{=} \text{ NOT } 6 \text{ } \boxed{\div} \text{ } 1056 \text{ } \boxed{=}$$

You should see the answer **176** in the calculator display.

GED PRACTICE



Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Scott changed the oil in his car when the odometer read 35,297 miles. The next time he changed the oil the odometer read 38,874 miles. How many miles did he drive between oil changes?
 - (1) 3,377 miles
 - (2) 3,477 miles
 - (3) 3,577 miles
 - (4) 3,677 miles
 - (5) 3,777 miles
2. Each month Carlos pays \$595 in rent. How much does he pay in rent for two years?
 - (1) \$ 1,190
 - (2) \$ 5,950
 - (3) \$ 7,140
 - (4) \$14,280
 - (5) \$28,560
3. On Wednesday, J & R Electronics had total sales of \$14,688 for its new stereo system. If each system sold for \$459 (including tax), how many new stereo systems did J & R sell?
 - (1) 31
 - (2) 32
 - (3) 33
 - (4) 34
 - (5) 35
4. Kim's bank statement listed a balance of \$76 in her checking account. Over the next month, she made deposits of \$96, \$873, and \$98. What is the new balance in her account after all these transactions?
 - (1) \$ 603
 - (2) \$1047
 - (3) \$1067
 - (4) \$1134
 - (5) \$1143

Answers start on page 375.

GED Mini-Test • Lessons 1 and 2

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use a calculator.

1. What is the value of $6000 - 2784$?

- (1) 8784
- (2) 4785
- (3) 4784
- (4) 4216
- (5) 3216

2. What is the value of $3024 \div 6$?

- (1) 54
- (2) 504
- (3) 540
- (4) 5004
- (5) 5040

3. Karin needs \$3220 for a used car. If she saves \$230 each month, how many months will it take her to save the entire amount?

- (1) 11
- (2) 12
- (3) 13
- (4) 14
- (5) 15

4. Yvonne pays \$480 for rent each month. How much rent does she pay in one year?

- (1) \$14,400
- (2) \$ 5,760
- (3) \$ 4,800
- (4) \$ 576
- (5) \$ 480

Questions 5 through 7 refer to the following table.

Number of Videotapes Rented	
January	4,320
February	5,980
March	4,987
April	6,007
May	7,985

5. What was the total number of videotapes rented in February and March?

- (1) 10,300
- (2) 10,400
- (3) 10,967
- (4) 11,067
- (5) 15,287

6. How many more videotapes were rented in May than in April?

- (1) 993
- (2) 1,070
- (3) 1,978
- (4) 1,988
- (5) 13,992

7. Twice as many videotapes were rented in June as in January. How many videotapes were rented in June?

- (1) 15,970
- (2) 12,014
- (3) 9,974
- (4) 8,640
- (5) 2,160

Part 2

Directions: Choose the one best answer to each question. You MAY NOT use a calculator.

8. Which of the following represents *two hundred three thousand, forty-nine*?
- (1) 2,349
 - (2) 203,049
 - (3) 203,490
 - (4) 230,049
 - (5) 230,490
9. Which of the following is the value of 39,462 rounded to the nearest thousand?
- (1) 39,000
 - (2) 39,400
 - (3) 39,460
 - (4) 39,500
 - (5) 40,000
10. Tom pays \$387 a month on a school loan. Which of the following operations represents how much he pays in 12 months?
- (1) $12 + \$387$
 - (2) $\$387 - 12$
 - (3) $\$387 \times 12$
 - (4) $\$387 \div 12$
 - (5) $12 \div \$387$
11. Three friends rent an apartment for a total of \$972 per month. If they share the rent equally, which of the following operations represents the amount each one pays per month?
- (1) $3 + \$972$
 - (2) $\$972 - 3$
 - (3) $\$972 \times 3$
 - (4) $\$972 \div 3$
 - (5) $3 \div \$972$
12. Empire Clothing Company presented a training seminar to 35 employees. If the company paid \$12 per person for lunch, how much did the company pay to feed the employees?
- (1) \$700
 - (2) \$420
 - (3) \$350
 - (4) \$336
 - (5) \$ 70
13. Cynthia works 4 hours each day, 6 days a week. How many hours does she work in 3 weeks?
- (1) 12
 - (2) 18
 - (3) 24
 - (4) 48
 - (5) 72
14. Alfredo has \$1200 in his checking account. If he takes out \$140, what is the balance left in his account?
- (1) \$1340
 - (2) \$1160
 - (3) \$1140
 - (4) \$1060
 - (5) \$ 200
15. A computer system costs \$1050. If Roberto has \$985 saved, how much more does he need to purchase the system?
- (1) \$ 65
 - (2) \$ 75
 - (3) \$ 165
 - (4) \$ 985
 - (5) \$1050

Answers start on page 375.

Lesson 3

GED SKILL Steps for Solving Word Problems

Estimating to Solve Problems

To **estimate** means to find an approximate value. Suppose you stop at the grocery store to buy a few items, but you have only \$20. How do you know if you have enough to pay for the items? You could estimate a total by rounding each price up to the nearest whole dollar and adding.

A good way to estimate an answer is to round the numbers in the problem to a convenient place value.

Example 1 The city of Lakewood has 13,968 registered voters. In a recent election, only 4,787 people voted. Approximately how many registered voters did not vote?

- (1) 6,500
- (2) 7,500
- (3) 8,000
- (4) 9,000
- (5) 10,000

To find the difference between the number of registered voters and the number of people who voted, you need to subtract. The word *approximately* tells you to estimate the answer. To estimate the difference, round the numbers to the nearest thousand and subtract.

Estimate: $14,000 - 5,000 = 9,000$. The correct answer is **option (4)**.

You can also use estimation to see if a computed answer makes sense. In the problem below, estimate first to see that your answer should be around 9,000. You subtract and get 9,181 as your answer. Your estimate confirms that this answer makes sense.

Example 2 Lakewood has 13,968 registered voters. In a recent election, only 4,787 people voted. How many voters did not vote?

- (1) 2,917
- (2) 4,787
- (3) 8,221
- (4) 9,181
- (5) 18,755

Use the estimate from Example 1 to eliminate options (1), (2), and (5) as either too low or too high. Subtract: $13,968 - 4,787 = 9,181$. **Option (4)** is correct. Your estimate tells you it makes sense.

TIP

An estimate can help you check whether your answer makes sense. Estimating is also a quick check that you have pressed the correct calculator keys.

Another way to estimate is to work with **compatible numbers**. Numbers that divide exactly and are easy to work with are compatible. To estimate the answer to a division problem, find compatible numbers that are close to the numbers in the problem.

Example 3 Clarissa divides 1935 by 9. She uses her calculator, and the display reads 21.44444444. Is her answer reasonable?

The number 9 is close to 10, and 1935 is close to 2000. You know that $2000 \div 10 = 200$, so the correct answer should be close to 200. Clarissa's answer of a little more than 21 is too low. She may have pressed a wrong key on her calculator. She should rework the problem. The answer is **215**.

GED SKILL FOCUS

Use rounding or compatible numbers to estimate an answer for each problem. Then find the exact answer. Use either pencil and paper or a calculator.

Example:

$$267 + 95 + 308$$

Estimate

700

Exact

670

- | | |
|---|--|
| <p>1. $1424 - 989$ _____</p> <p>2. 18×29 _____</p> <p>3. $1798 \div 62$ _____</p> <p>4. Lotte worked 39 hours last week. She earns \$9 per hour. How much will she be paid for her work?</p> <p>5. Meg needs to have her furnace repaired. A new thermostat will cost \$38. Cleaning and repair of the heating unit will cost \$196. She will also pay \$145 in labor. How much will the repairs cost?</p> <p>6. Last week Lee sold 15 computers, each priced at \$1137. What were his total sales for the week?</p> <p>7. Wrightway Shoes has 1192 employees. If the company has to lay off 315 employees, how many employees will remain?</p> | <p>8. Maya plans to make 12 monthly payments on bedroom furniture. The total cost of the furniture plus interest is \$1152. How much will she pay per month?</p> <p>9. The Bonilla family drove 177 miles on the first day of a three-day trip. If the family drives the same distance every day, how many miles will the Bonilla family drive?</p> <p>10. This week Selma earned \$396 working part-time as a data entry clerk. This amount is \$104 more than she earned last week. How much did Selma earn last week?</p> <p>11. Marshall needs to eat 2400 calories per day to gain weight. So far today he has eaten 685 calories. How many more calories must he consume today to meet his goal?</p> <p>12. A small town spends \$225,125 each year on street maintenance and \$18,725 on tree trimming. How much is spent on both items combined?</p> |
|---|--|

Answers start on page 375.

Choosing and Organizing Information

Some problems present more information than you need to solve a problem. Your first step is to organize the information, if necessary, and then find the facts you need.

Tables and charts contain many items of data organized in columns and rows. To find the information you need, pay close attention to labels, titles, and headings. Don't be distracted by information that you do not need to solve the problem.

Example 1 The Fairfax Public Library kept the following records on book circulation from January through April.

January	February	March	April
10,356	7,542	7,625	9,436

How many more books were borrowed in April than in February?

- (1) 83
- (2) 820
- (3) 1,811
- (4) 1,894
- (5) 16,978

You are asked to find the difference between February and April so you need only the numbers of those two months to solve the problem. Subtract to find the difference: $9,436 - 7,542 = 1,894$. The correct answer is **option (4) 1,894**.

Some problems may not give all the information you need. Read the problem carefully. What facts do you need to answer the question?

Example 2 A driver must transport 200 cartons of shoes, 150 cartons of clothes, and 75 cartons of bedding from the warehouse to the stockroom. Using a truck, how many trips must the driver make to transport all the cartons?

- (1) 3
- (2) 17
- (3) 25
- (4) 75
- (5) Not enough information is given.

Do you see that some information is missing? You need to know how many cartons the truck can hold. It is impossible to solve the problem with only the information given in the problem. The correct answer is **option (5) Not enough information is given**.



Don't use all the numbers given in a problem just because they are there. Always think about what you are asked to find and then use only those amounts that apply.

GED SKILL FOCUS

A. Circle or underline only the facts needed to solve each problem. You do not need to solve the problem.

1. Arcadia Coliseum seats 26,500. The East-West football game has been held at the coliseum for the past 8 years. This year the tickets for the game sold for \$6 each. If the game sold out, how much did the coliseum make in ticket sales?
2. A digital camera is regularly priced at \$89. The sale price for this weekend is \$59. Ramon buys the camera at the sale price using a \$10-off coupon. How much does he pay for the camera?
3. This week, Nita earned \$456 as an administrative assistant. Last month, she earned \$2112 at the same job. If she is paid \$12 per hour, how many hours did she work this week?
4. A public school wants to raise \$25,000 to improve its library. The same school raised \$18,400 last year for new computers. A local manufacturer has offered to donate \$11,450 for the library. How much more does the school need to raise?

B. Solve or state what information is missing.

Refer to the following chart to answer Questions 5 and 6.

SPORTS-WAREHOUSE CLEARANCE		
	Regular Price	Sale Price
T-shirts	\$12	\$ 8
Sweat Shirts	\$18	\$14
Sweat Pants	\$14	\$12
Team Jackets	\$59	\$35

5. On Friday the store sold 24 pairs of sweat pants at the sale price. How much money did the store take in on sweat pants?
6. The store sold 25 T-shirts at the regular price before the sale began. How many T-shirts did the store have in stock to start the sale?
7. Mr. and Mrs. Pierotti are remodeling their kitchen. They spent \$548 for new cabinets and \$618 on plumbing. The tiles for the kitchen floor will cost \$3 each. If they need 240 tiles, how much will the tiles cost?
8. Wilshire Recreation Center has youth athletic programs. Last fall, 320 children (152 boys and 168 girls) between the ages of 8 and 16 signed up to play basketball. In the spring, 432 boys and girls signed up to play baseball.

How many more children signed up to play baseball than signed up to play basketball?

Answers start on page 375.

Writing in Answers in a Standard Grid

One type of special format question that appears on the GED Mathematics Test is the **standard grid** shown below. For this type of question, instead of choosing among five multiple-choice options, you write and bubble in your answer on the grid.

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Here are some important points to keep in mind when using the standard grid:

- The grid is used to enter a single numerical answer.
- The row at the top is blank and is intended for you to write in your answer. Although you can actually leave this row blank, it is helpful to fill it in as a guide for marking in the circled numbers in the rows below.
- Your answer can start in any of the five columns, as long as your answer is complete.
- Any unused columns should be left blank.
- For answers that are whole numbers, you will not use the second row of fraction bars, (/), or the third row of decimal points, (•).

Example Mark drove 157 miles on Saturday and 189 miles on Sunday. How many miles did he drive in all for the two days?

The total number of miles for the two days is $157 + 189 = 346$.

First write the answer 346 in the blank first row. Then darken in the corresponding circled numbers in the standard grid below. Note that since the answer can start in any of the five columns, all three grids shown below are correctly filled in.

3	4	6		
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	3	4	6	
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

		3	4	6
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

GED PRACTICE

Directions: Solve the following problems and enter your answers on the grids provided.

1. Susan's weekly gross salary is \$615. If \$172 is taken out for taxes and \$35 is taken out for other deductions, what is the amount of Susan's weekly take-home salary?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

3. Six sisters send their family a total of \$720 every month. If the contribution is divided equally among the sisters, how much does each sister contribute?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

2. Alberto buys a computer and pays for it in 24 equal monthly installments. If each installment is \$78, how much will Alberto pay in all for the computer?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

4. This week Lourdes earned \$620 in commissions on her sales. If this amount is \$54 more than she earned last week, how much did she earn in commissions last week?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Answers start on page 376.

GED SKILL Steps for Solving Multi-Step Problems

Order of Operations

Multi-step problems require more than one calculation. Often, they involve more than one operation. Read the problem carefully, think about the situation, and do the operations in the order that gives the correct answer. Some questions on the GED Mathematics Test ask you to choose the correct method for solving a problem; others ask you to find the answer. In both situations, you need to know how to write and evaluate mathematical expressions that contain more than one operation.

The order in which you do operations in multi-step problems may affect your answer. Look at the problem $5 \times 3 + 6$. This problem uses both multiplication and addition. There are two ways to work the problem, and they give different results; only one is correct. Do you know which one?

Option 1 Multiply first (5×3), then add: $15 + 6 = 21$

Option 2 Add first ($3 + 6$), then multiply: $5 \times 9 = 45$

The answer could be 21 or 45 depending on the order in which the operations are performed. Mathematicians have agreed upon an **order of operations**. With these rules everyone gets the same solution to a problem. Following the order of operations, the correct answer is **21**.

Step 1 Do operations in parentheses.

Step 2 Do multiplication and division in order from left to right.

Step 3 Do addition and subtraction in order from left to right.

Example 1 $7 \times 4 + 15 \div 3 - 12 \times 2 = ?$

Step 1 There are no parentheses. Go on to the next step.

Step 2 Multiply and divide: $7 \times 4 + 15 \div 3 - 12 \times 2 = ?$

$$28 + 5 - 24 = ?$$

Step 3 Add and subtract: $33 - 24 = 9$

The correct solution is **9**.

Parentheses are used to change the order of operations. Always do an operation in parentheses first.

Example 2 $(12 + 8) \div 4 - 2 = ?$

Without the parentheses, you would begin by dividing 8 by 4, but the parentheses tell you to add first.

Step 1 Do the operation in parentheses: $(12 + 8) \div 4 - 2 = ?$

Step 2 Divide: $20 \div 4 - 2 = ?$

Step 3 Subtract: $5 - 2 = 3$

The correct solution is **3**.



Group numbers that give results of 10 or multiples of 10.

There are other properties of numbers that will help you solve problems. The **commutative property** applies to both addition and multiplication. This property states that you can add or multiply numbers in any order and the result will be the same.

Examples $a + b = b + a$ $a \times b = b \times a$
 $7 + 5 = 5 + 7$ $6 \times 3 = 3 \times 6$

The **associative property** also applies to both addition and multiplication. When adding or multiplying three or more numbers, the way in which you group the numbers does not affect the final result.

Examples $(a + b) + c = a + (b + c)$ $(a \times b) \times c = a \times (b \times c)$
 $(15 + 2) + 8 = 15 + (2 + 8)$ $(18 \times 5) \times 20 = 18 \times (5 \times 20)$

GED SKILL FOCUS

A. Use the order of operations to find the values of the following expressions.

- | | | |
|-------------------------------|---------------------------------|-----------------------------------|
| 1. $25 - 20 \div 4 =$ | 5. $20 + 12 \div 4 =$ | 9. $11 \times (4 + 2) \times 2 =$ |
| 2. $(9 + 5) \times (6 - 3) =$ | 6. $13 + 7 \times 2 + 10 =$ | 10. $7 \times (3 + 6) =$ |
| 3. $18 - 6 \times 3 =$ | 7. $24 \div 6 \times 4 + 2 =$ | 11. $15 + 10 - 9 \times 2 =$ |
| 4. $60 \div (30 - 10) =$ | 8. $12 \div 2 \times (8 - 6) =$ | 12. $54 \div (4 + 5) =$ |

B. Translate the words into numbers and symbols. Then use the order of operations to perform the calculations. The first one is started for you.

13. Multiply the sum of 7 and 12 by the sum of 16 and 3. $(7 + 12) \times (16 + 3) =$

14. Add 20 and 25, and then divide by 5.

15. Add the product of 4 and 5 to the sum of 10 and 12. *Hint:* Remember that the *product* is the answer to a multiplication problem.

C. Answer the following.

16. Suppose you need to add the following: $28 + 15 + 2 + 5$. How could you group the calculations to make the addition easier?

17. Suppose you need to multiply the following: $25 \times 7 \times 4$. How could you group the calculations to make the computation easier?

Answers start on page 376.

Solving Multi-Step Problems



Multi-step problems often contain extra information. Identify the problem you are asked to solve. Then focus on the information that will help you find the answer.

To solve a multi-step problem you perform more than one calculation. The key to solving multi-step problems is to think about the situation, identify the needed information and each step and operation needed *before* you work the problem.

The examples below are based on the following information.

Employee	Hourly Wage	Hours Worked				
		M	T	W	T	F
D. Suddeth	\$8	8	7	8	8	6
S. Bartok	\$9	7	5	6	5	5

Example 1 How much did Dillon Suddeth earn for the week?

- (1) \$259
- (2) \$296
- (3) \$320
- (4) \$333
- (5) Not enough information is given.

There are two steps needed. Determine how many hours Dillon worked and then multiply the number of hours by the hourly wage.

Step 1 Add the hours worked for each day: $8 + 7 + 8 + 8 + 6 = 37$

Step 2 Multiply by the hourly wage of \$8: $37 \times \$8 = \$296$

The correct answer is **option (2) \$296**.

There may be different ways to solve a problem. In Example 1 you could find the daily earnings (hours worked each day $\times$ the hourly wage). Then add the daily earnings to find the earnings for the week.

Example 2 Sharon Bartok set a goal of earning \$342 per week. How many more hours would she have to work this week to reach her goal?

- (1) 10
- (2) 28
- (3) 38
- (4) 90
- (5) 252

Compare the hours Sharon needs to work to earn \$342 to the number of hours she already worked during the week shown in the table.

Step 1 Sharon earns \$9 per hour. Divide to find how many hours she needs to work to earn \$342. $\$342 \div 9 = 38$

Step 2 Add to find the hours she worked during the week shown. $7 + 5 + 6 + 5 + 5 = 28$

Step 3 Compare by subtracting. $38 - 28 = 10$

The correct answer is **option (1) 10**.

GED SKILL FOCUS

Solve as directed.

Refer to the following information to answer Questions 1 and 2.

South Bay Preschool placed the following online order for disposable diapers:

Quantity	Diaper Size	Number in Box
15 boxes	medium	66
18 boxes	large	42
24 boxes	extra-large	24

1. You need to find how many more medium diapers were ordered than extra-large diapers.
 - a. How could you find how many medium diapers were ordered? _____
 - b. How could you find how many extra-large diapers were ordered? _____
 - c. What operation would you use to compare the numbers? _____
 - d. Find the answer. _____
2. Regardless of size, each box of diapers costs the preschool \$13. You need to find out how much the entire order will cost.
 - a. Find the total number of boxes ordered by the preschool. _____
 - b. What operation would you use to find the total cost of the order? _____
 - c. Then find the total cost. _____
 - d. Think of another way to solve the problem and describe it. _____
3. Appliance City is advertising a 27-inch television set for \$650 cash or \$58 per month for 12 months on credit.
 - a. What operations would you need to perform to find out how much a customer would save by paying cash instead of buying on credit? _____
 - b. Find the amount of the savings. _____
4. Felicia and Jay Oser buy a new refrigerator. They must make eight payments of \$115 each and one final payment of \$162.
 - a. What operations would you need to perform to find the total amount the Osers will spend on the refrigerator? _____
 - b. Find the total amount the Osers will spend. _____

Answers start on page 377.

GED STRATEGY Solving Word Problems

Setting Up Problems

Some multi-step GED problems ask you only to recognize the setup needed to solve the problem, without computing the final answer. Your understanding of the order of operations is important to your success with this type of question. The key is to think about what steps are needed to solve the problem before you begin to choose from the answer options.

Example 1 Grace charges \$15 for a haircut and \$45 for a permanent. If she does 10 haircuts and 3 permanents on Tuesday, how much will she earn that day?

- (1) $\$15 + \$45$
- (2) $\$15 \times 10$
- (3) $\$45 \times 3$
- (4) $(\$15 \times 10) + (\$45 \times 3)$
- (5) $(\$15 + 10) \times (\$45 + 3)$

To solve the problem, find the total amount Grace earned for haircuts ($\$15 \times 10$) plus permanents ($\$45 \times 3$). This is represented by **option (4)**.

- Option (1) shows only the cost of one haircut and one permanent.
- Option (2) shows the cost of haircuts only, and option (3) shows the cost of permanents only.
- Option (5) reverses the operations, showing addition where you should multiply and multiplication where you should add.

The use of parentheses and fraction bars is very important in set-up problems. The fraction bar is used as a way to indicate division.

Example 2 Eli and 3 friends met for lunch. The cost of the meal was \$20, plus they left a tip of \$4. If they split the cost of the lunch evenly, how much did each friend pay?

- (1) $3 + \$20 + \$4$
- (2) $3 \times (\$20 + \$4)$
- (3) $4 \times (\$20 + \$4)$
- (4) $\frac{(\$20 + \$4)}{3}$
- (5) $\frac{(\$20 + \$4)}{4}$

To solve the problem, you would need to find the total amount spent for lunch divided by the total number of people splitting the cost. The total cost of the meal included the tip ($\$20 + \$4$). The total number of people would be Eli plus his 3 friends, or 4. **Option (5)** is the only option that shows the total cost of the meal divided by 4.

GED PRACTICE

Directions: Choose the one best answer to each question.

1. West Freight held an awards banquet for its 65 employees. The company paid \$350 for the use of a banquet room and \$9 per person for food. Which expression shows how much the company paid for the room and the food?
 - (1) $65 \times \$350$
 - (2) $65 \times \$9$
 - (3) $(\$350 + \$9) \times 65$
 - (4) $(65 \times \$9) + \$350$
 - (5) $\frac{(\$350 + \$9)}{65}$
2. David can drive 300 miles on 1 tank of gas. Which expression shows how many tanks of gas he will need to drive 1200 miles?
 - (1) $300 + 1200$
 - (2) $1200 - 300$
 - (3) 300×1200
 - (4) $\frac{300}{1200}$
 - (5) $\frac{1200}{300}$
3. A parking garage has spaces for 70 cars and charges each driver \$6 per day for parking. If all of the spaces are full, which expression shows how much more the garage owner could make if he charged \$8 per day?
 - (1) $70 + \$8 + \$6$
 - (2) $70 \times \$8 \times \$6$
 - (3) $70 \times (\$8 - \$6)$
 - (4) $70 \times (\$6 + \$8)$
 - (5) $\frac{(70 \times \$6)}{(70 \times \$8)}$
4. Janet has worked out a payment schedule to pay off an \$1800 debt. The schedule calls for her to pay \$300 the first month and \$150 per month after that. Which expression shows how many \$150 payments it will take for Janet to pay off the debt?
 - (1) $\frac{(\$1800 - \$300)}{\$150}$
 - (2) $\$1800 - \$300 - \$150$
 - (3) $\frac{(\$1800 - \$150)}{\$300}$
 - (4) $\$1800 - (\$300 + \$150)$
 - (5) $\$1800 - \$300 \times \$150$
5. Arturo had \$150 to spend on his college books. He bought 2 textbooks costing \$35 each, and 3 textbooks for \$18 each. Which expression shows how much money he had left after his purchase?
 - (1) $\$150 - (2 \times \$35) + (3 \times \$18)$
 - (2) $\$150 - (2 \times \$35) - (3 \times \$18)$
 - (3) $(2 \times \$35) - (3 \times \$18)$
 - (4) $\$150 - \$35 - \$18$
 - (5) $\$150 \times \$35 \times \$18$
6. Teresa sold 2 cameras for \$175 each and 3 cameras for \$150 each. If she earns a \$35 commission for each sale, which expression shows how much she earned in commissions?
 - (1) $(\$175 + \$150) \times \$35$
 - (2) $(2 \times \$175) + (3 \times \$150)$
 - (3) $\$35 \times 2 \times 3$
 - (4) $(2 + 3) \times \$35$
 - (5) $\frac{(\$175 + \$150)}{\$35}$



Remember there can be more than one way to write some expressions.
 $40 \times (7 - 5)$ is $(40 \times 7) - (40 \times 5)$

Answers start on page 377.

GED STRATEGY Using Your Calculator



Order of Operations

The order of operations also applies when using a calculator.

- Step 1** Do operations in parentheses.
- Step 2** Do multiplication and division in order from left to right.
- Step 3** Do addition and subtraction in order from left to right.

You should always check to see if the calculator you are using is programmed with the order of operations. You can perform this simple test. Key in the following expression:

$$3 + 4 \times 2 =$$

If your calculator is programmed with the order of operations, it will perform the multiplication first ($4 \times 2 = 8$), and then the addition ($3 + 8$). The correct answer is **11**.

If your calculator does not have the order of operations programmed into it, it will perform the operations in the order that you enter the numbers, giving $3 + 4 = 7$ first, and then $7 \times 2 = 14$ as the answer. If your calculator does not perform the order of operations, you need to be extra careful when using your calculator to help you solve problems.

Example 1 Constance, an office assistant, is buying 3 printer cartridges that cost \$24 each. If she gives the cashier a \$100-bill, how much change should she receive?

To solve this problem, you could key in the following expression on your calculator:

$$100 - 3 \times 24 =$$

Remember, be careful if you are using a calculator that does not have the order of operations programmed into it. The calculator will display the wrong answer of 2328.

In order to get the correct answer with this calculator, follow the order of operations by keying in the multiplication first: $3 \times 24 = 72$. Then subtract the result from 100: $100 - 72 = 28$. The correct answer is **\$28**.

Example 2 Anthony has already saved \$272. If he saves \$2 a day for 1 year, how much will he have saved in all?

First think of 1 year as 365 days. Solve by adding how much Anthony has now to how much he will save. Be sure the multiplication is performed first.

$$2 \times 365 + 272 =$$

The final answer is **\$1002**.



The calculator that you will use on the GED Mathematics Test is programmed with the order of operations. See pages 469–472 for more information.

GED PRACTICE



Directions: Choose the one best answer to each item. You MAY use your calculator.

Questions 1 and 2 refer to the following information.

The tenants in two apartment buildings agree to hire a private trash collector to serve their buildings. The total yearly cost of the service will be \$3096. There are 18 apartments in one building and 25 apartments in the other.

1. Which combination of operations would you need to perform to find out how much each apartment will pay per year for the service if each apartment pays an equal share of the cost?

- (1) addition and multiplication
- (2) addition and division
- (3) subtraction and division
- (4) multiplication and subtraction
- (5) multiplication and division

2. How much is each apartment's share of the yearly cost?

- (1) \$ 7
- (2) \$ 43
- (3) \$ 72
- (4) \$124
- (5) \$172

3. What is the value of the expression $2,184 + 1,476 \times 408$?

- (1) 498,982
- (2) 499,982
- (3) 598,093
- (4) 604,392
- (5) 1,493,280

4. What is the value of the expression $(908 + 23 \times 48) \div 2 + 687$?

- (1) 1,092
- (2) 1,693
- (3) 1,963
- (4) 23,031
- (5) 23,301

Questions 5 and 6 refer to the following table.

Stock Purchases	
Stock	Price per Share
Ampex	\$58
Branton	\$87
Comtex	\$92

5. Marissa invests money for her clients. She purchased 112 shares of Ampex and 89 shares of Comtex. What was the total cost?

- (1) \$ 201
- (2) \$ 351
- (3) \$ 6,496
- (4) \$ 8,188
- (5) \$14,684

6. Marissa also bought 68 shares of Branton stock for a different client. If this client had \$6,000 to invest, how much money still remains to be invested?

- (1) \$ 84
- (2) \$ 155
- (3) \$ 5,845
- (4) \$ 5,916
- (5) \$516,084

Answers start on page 377.

GED Mini-Test • Lessons 3 and 4

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Last month, Delta Computers had net sales of \$685,170 for its laptop computers. If each laptop computer cost \$1,986, how many were sold?
 - (1) 694,700
 - (2) 3,500
 - (3) 3,450
 - (4) 345
 - (5) 35
2. Atlas Corp. gave each of its 1,216 employees a \$760 year-end bonus. What was the total amount of the year-end bonuses?
 - (1) \$924,160
 - (2) \$ 92,416
 - (3) \$ 9,242
 - (4) \$ 9,241
 - (5) Not enough information is given.
3. What is the value of $50 + 15,000 \div 25$?
 - (1) 650
 - (2) 602
 - (3) 250
 - (4) 200
 - (5) 25
4. Last year, a bookstore sold 569,346 novels, 234,908 biographies, and 389,782 travel books. What was the total number of books sold in these three categories?
 - (1) 11,940,360
 - (2) 1,194,036
 - (3) 119,404
 - (4) 11,940
 - (5) Not enough information is given.
5. What is the value of $40(50 - 5 \times 2)$?
 - (1) 40
 - (2) 800
 - (3) 1600
 - (4) 3600
 - (5) 3990
6. In a recent election, the winner received 290,876 more votes than his opponent. If the winner received 3,898,705 votes, how many votes did his opponent receive?
 - (1) 4,189,581
 - (2) 4,089,581
 - (3) 3,707,829
 - (4) 3,608,829
 - (5) 3,607,829

Questions 7 through 9 refer to the following table.

Action Athletics	
Department	Net Sales
Footwear	\$20,897
Outerwear	\$57,941
Sporting Goods	\$31,009
Exercise Equipment	\$28,987
Skiing Equipment	\$18,883

7. What were the total net sales for the five departments listed?
 - (1) \$137,717
 - (2) \$147,707
 - (3) \$147,717
 - (4) \$157,717
 - (5) Not enough information is given.
8. Combined net sales for Footwear and Sporting Goods were how much less than the net sales for Outerwear?
 - (1) \$ 6,000
 - (2) \$ 6,035
 - (3) \$20,897
 - (4) \$68,053
 - (5) Not enough information is given.
9. What was the difference in net sales between the department with the largest net sales and the department with the smallest net sales?
 - (1) \$76,828
 - (2) \$57,941
 - (3) \$39,058
 - (4) \$37,644
 - (5) \$28,954

Questions 10 through 12 refer to the following table.

Advertising Expenses		
Category	January	February
Network TV	\$526,987	\$540,987
Magazines	\$420,885	\$398,702
Radio	\$249,342	\$266,981
Newspapers	\$384,692	\$312,908

10. How much more was spent for magazine advertising in January than in February?
 - (1) \$ 4,000
 - (2) \$ 17,639
 - (3) \$ 22,183
 - (4) \$ 71,784
 - (5) \$819,587
11. What was the total amount spent for advertising in the first three months of the year?
 - (1) \$ 134,112
 - (2) \$1,519,578
 - (3) \$1,581,906
 - (4) \$1,653,690
 - (5) Not enough information is given.
12. If the amount spent for advertising on network TV increased by the same amount from February to March as it did from January to February, what would be the amount spent for advertising on network TV in March?
 - (1) \$ 14,000
 - (2) \$ 16,987
 - (3) \$512,987
 - (4) \$554,987
 - (5) \$604,989

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

13. Cooper's Fashions has 2100 employees working at 14 branches. After 200 new employees are hired, what is the total number of employees?

(1) 214
(2) 2114
(3) 2300
(4) 2314
(5) 4900

14. R.J. Landscaping buys supplies at wholesale. To do the landscaping for a model home, the company spent \$560 for bushes and \$638 for river rock. The company also purchased paving blocks at \$3 each. If 250 blocks are needed, which expression shows how much the paving blocks will cost?

(1) $\frac{(\$560 + \$638 + \$3)}{250}$
(2) $(\$560 + \$638 + \$3) \times 250$
(3) $\$560 + \$638 + \$3 - 250$
(4) $250 \times \$3$
(5) $\frac{250}{\$3}$

15. Marcus buys a computer on credit. He makes a down payment of \$720. He also agrees to pay \$85 per month on the remaining balance. What is the total cost of the computer?

(1) \$ 720
(2) \$ 765
(3) \$1020
(4) \$1275
(5) Not enough information is given.

16. What is the value of $3 + 4 \times 2 - 6 \div 2$?

(1) 4
(2) 8
(3) 10
(4) 14
(5) 16

Questions 17 and 18 refer to the following information.

A furniture store advertises a couch for \$760 if paid in cash or for \$75 per month for the next 12 months if paid in installments.

17. Which operation would you use to find the total cost of the couch if you paid in installments?

(1) addition
(2) subtraction
(3) multiplication
(4) division
(5) Not enough information is given.

18. How much money would you save by paying in cash instead of by paying in 12 monthly installments?

(1) \$100
(2) \$140
(3) \$560
(4) \$760
(5) \$900

Questions 19 and 20 refer to the following table.

T-Shirts Ordered		
T-Shirt Size	Quantity	Number in Box
Small	10 boxes	60
Medium	12 boxes	48
Large	20 boxes	20

19. About how many medium sized T-shirts were ordered?

- (1) 12
- (2) 20
- (3) 50
- (4) 120
- (5) 500

20. How many more small T-shirts were ordered than large T-shirts?

- (1) 1000
- (2) 600
- (3) 400
- (4) 200
- (5) 30

21. Rizal sold 2 lawn carts for \$200 each and 3 push mowers for \$130 each. If he earns a \$25 commission for each machine sold, which expression shows his commission for these sales?

- (1) $25(2 \times 200) + 25(3 \times 130)$
- (2) $25(2 \times 200) - 25(3 \times 130)$
- (3) $25(200 + 130)$
- (4) $25(200 + 130)$
- (5) $25(3 + 2)$

Questions 22 through 24 refer to the following table.

Crunch's Rentals	Charge (daily rate)
Wet/Dry Vacuum	\$40
Rotary Hammer, electric	\$30
Air Compressor	\$45
Portable Generator	\$35
Chipper/Shredder	\$75

22. How much more does it cost per day to rent a chipper/shredder than an air compressor?

- (1) \$25
- (2) \$30
- (3) \$35
- (4) \$40
- (5) \$45

23. How much more would it cost to rent the wet/dry vacuum and the air compressor for one day than to rent the chipper/shredder?

- (1) \$10
- (2) \$30
- (3) \$35
- (4) \$70
- (5) \$80

24. The Burkes are clearing some property they bought. If they rent the chipper/shredder for 3 days, what is the total cost?

- (1) \$ 25
- (2) \$ 75
- (3) \$150
- (4) \$225
- (5) \$300

Answers start on page 377.

Lesson 5

GED SKILL Introduction to Fractions

Facts About Fractions

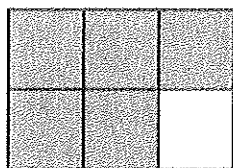
To count, you use whole numbers. To show part of something, you use fractions. Fractions show part of a whole object or part of a group.

A **fraction** is two numbers, separated by a fraction bar. The bottom number, or **denominator**, tells the number of equal parts into which the whole object or group is divided. The top number, or **numerator**, tells the number of equal parts in the object or group being considered. The numerator and denominator are the **terms** of the fraction.

To use a fraction to show a part of a whole, imagine that the object is divided into equal parts. For example, the rectangle below is divided into 6 equal parts, or sixths. The entire rectangle represents $\frac{6}{6}$ or 1 whole. Any fraction with the same numerator and denominator is equal to 1.



When the numerator of a fraction has nearly the same value as the denominator, the value of the fraction is close to 1.



5 of the 6 parts are shaded.

The fraction $\frac{5}{6}$ represents the shaded part.

$\frac{5}{6}$ ← number of shaded parts (numerator)

$\frac{5}{6}$ ← number of equal parts in the whole (denominator)

You can also use a fraction to show part of a group.

Example Nicco received 18 orders on Wednesday. There were 11 phone orders. What fraction of the orders came by phone?

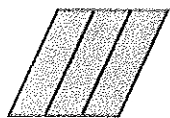
$\frac{11}{18}$ ← number of phone orders

$\frac{11}{18}$ ← number of orders received on Wednesday

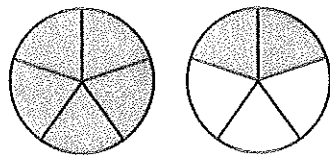
$\frac{11}{18}$ of Wednesday's orders came by phone.

The fractions $\frac{5}{6}$ and $\frac{11}{18}$ are examples of proper fractions. A **proper fraction** shows a quantity that is less than 1. The numerator of a proper fraction is always less than the denominator.

An **improper fraction** is used to show a quantity equal to or greater than 1. The numerator of an improper fraction is equal to or greater than the denominator.



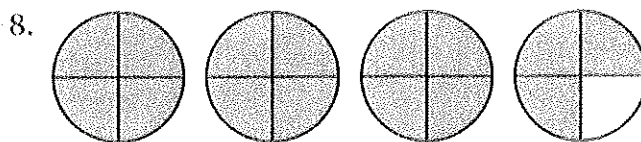
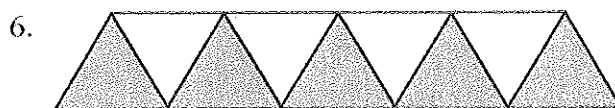
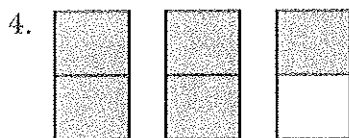
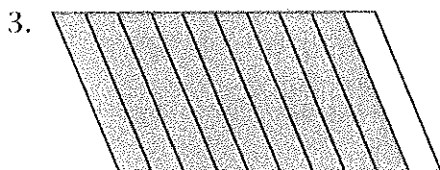
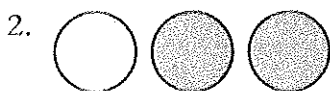
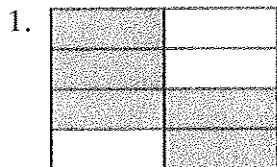
The figure is divided into three equal parts, and three parts are shaded. The fraction $\frac{3}{3}$ represents the shaded part. $\frac{3}{3}$ is an improper fraction because it is equal to 1 whole.



Each circle is divided into 5 equal parts, and 7 parts are shaded. The fraction $\frac{7}{5}$ represents the shaded part. $\frac{7}{5}$ is an improper fraction because the numerator is greater than the denominator. $\frac{7}{5}$ is greater than 1.

GED SKILL FOCUS

A. Write the fraction for the shaded portion.



B. Solve.

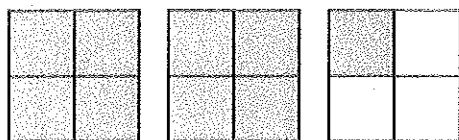
9. On Tuesday, 9 of Steve's 16 customers paid using credit cards. What fraction of his customers used credit cards?
10. Out of the 10 people in Carla's office, 7 regularly watch the evening news on television. What fraction of the workers watches the evening news?
11. In the election for union representative, Carlos received 19 votes. What fraction of the union's 45 members voted for Carlos?
12. Yuki arrived early for work on 47 of the last 50 workdays. What fraction of the time has she been early for work?
13. Of the 70 orders shipped yesterday by AB Technology, 9 were shipped by air. What fraction of the orders was shipped by air?
14. A video rental store has 500 movies in stock. Only 43 are children's movies. What fraction of the movies in stock is for children?

Answers start on page 378.

Changing Improper Fractions and Mixed Numbers

A **mixed number** is another way to show a fraction greater than 1. A mixed number consists of a whole number and a proper fraction.

Example 1 Write a mixed number for the shaded portion.



In the figure, each square is divided into 4 equal parts. Two of the squares are completely shaded, and $\frac{1}{4}$ of the last square is shaded. The shaded portion is $2\frac{1}{4}$. The mixed number $2\frac{1}{4}$ means two and one-fourth or $2 + \frac{1}{4}$.

You have seen that the shaded portion above equals the improper fraction $\frac{9}{4}$. So, you can conclude that $\frac{9}{4} = 2\frac{1}{4}$. Any amount equal to or greater than 1 can be expressed as either an improper fraction or a mixed number. As you work with fractions, you will need to know how to change back and forth between improper fractions and mixed numbers.

Follow these steps to change an improper fraction to a mixed number or whole number.

- Step 1** Think of the fraction bar as a division symbol. Divide the numerator of the improper fraction by the denominator. The whole number answer becomes the whole number part of the mixed number.
- Step 2** Write the remainder over the original denominator. This is the fraction part of the mixed number.

Example 2 Change $\frac{14}{3}$ to a mixed number.

- Step 1** $\frac{14}{3}$ means $14 \div 3$. Divide.
The whole number is 4.

$$\begin{array}{r} 4 \leftarrow \text{whole number} \\ 3 \overline{)14} \\ \underline{12} \\ 2 \leftarrow \text{numerator} \end{array}$$

- Step 2** Write the remainder as the numerator over the divisor as the denominator: 2 over 3.

The improper fraction $\frac{14}{3}$ equals $4\frac{2}{3}$.

A mixed number can also be changed to an improper fraction.

- Step 1** Multiply the whole number part of the mixed number by the denominator of the fraction.
- Step 2** Add the numerator of the fraction part.
- Step 3** Write the total over the original denominator.

Example 3 Change $2\frac{3}{8}$ to an improper fraction.

- Step 1** Multiply 2 by 8.
- Step 2** Add the numerator, 3.
- Step 3** Write the total over the denominator, 8.

$$\begin{array}{r} \text{whole number} \quad \text{denominator} \\ \downarrow \quad \downarrow \\ 2 \times 8 = 16 \\ 16 + 3 = 19 \\ \underline{19} \\ 8 \end{array}$$

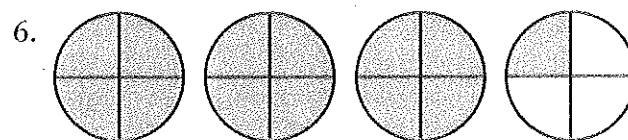
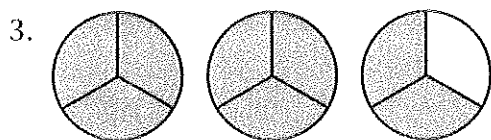
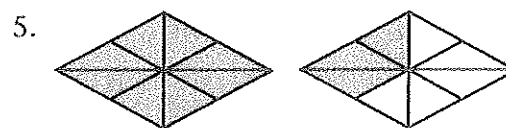
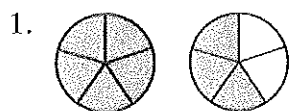
The mixed number $2\frac{3}{8}$ equals $\frac{19}{8}$.



Remember, the denominator tells you how many parts there are in each whole number. The fraction $\frac{3}{4}$ means 3 out of 4 parts.

GED SKILL FOCUS

A. For each shaded portion, write the improper fraction and the mixed number.



B. Change each improper fraction to a whole or a mixed number.

7. $\frac{7}{2} =$

11. $\frac{10}{3} =$

15. $\frac{42}{6} =$

8. $\frac{8}{3} =$

12. $\frac{77}{9} =$

16. $\frac{9}{2} =$

9. $\frac{57}{10} =$

13. $\frac{19}{4} =$

17. $\frac{17}{6} =$

10. $\frac{15}{3} =$

14. $\frac{31}{8} =$

18. $\frac{41}{12} =$

C. Change each mixed number to an improper fraction.

19. $6\frac{1}{2} =$

23. $2\frac{1}{5} =$

27. $10\frac{1}{2} =$

20. $8\frac{1}{2} =$

24. $6\frac{4}{7} =$

28. $4\frac{2}{9} =$

21. $5\frac{3}{8} =$

25. $1\frac{5}{8} =$

29. $5\frac{1}{12} =$

22. $3\frac{5}{6} =$

26. $11\frac{3}{4} =$

30. $9\frac{2}{5} =$

Answers start on page 379.

GED STRATEGY Solving Word Problems

Choosing the Operation

Fraction problems can also appear as word problems. As always, read a problem carefully before you choose which operation to use. Identify what you are trying to find out. Below is an expanded version of the operations chart you used for whole numbers. Review these guidelines for choosing an operation.

You	When You Need To
Add (+)	Combine quantities Find a total
Subtract (−)	Find a difference Take away a quantity Compare to find "how many more," "how much less," or "how much is left"
Multiply (×)	Put together a number of equal amounts to find a total Add the same number repeatedly Find a "part of" a whole item or group
Divide (÷)	Split a quantity into equal parts Find how many equal parts are in a whole

Example 1 A worker at a coffee shop mixed $10\frac{3}{8}$ pounds of gourmet coffee with $6\frac{3}{4}$ pounds of regular grind coffee. How many more pounds of the gourmet coffee were used than the regular grind coffee?

- (1) $10\frac{3}{8} + 6\frac{3}{4}$
- (2) $10\frac{3}{8} - 6\frac{3}{4}$
- (3) $6\frac{3}{4} \times 10\frac{3}{8}$
- (4) $10\frac{3}{8} \div 6\frac{3}{4}$
- (5) $6\frac{3}{4} - 10\frac{3}{8}$

The correct answer is **option (2)**. You subtract to find "how many more."

Example 2 Of Ed's 128 employees, $\frac{3}{8}$ volunteered to work on Saturday. How many employees volunteered to work on Saturday?

- (1) $\frac{3}{8} + 128$
- (2) $128 - \frac{3}{8}$
- (3) $128 \times \frac{3}{8}$
- (4) $128 \div \frac{3}{8}$
- (5) $\frac{3}{8} \div 128$

The correct answer is **option (3)**. You need to find "part of" a group.



When solving a fraction problem that asks you to find a "part of" a whole or other fraction, you multiply.

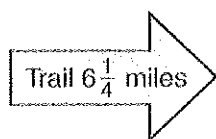
GED PRACTICE

Directions: Choose the one best answer to each question.

1. A recipe calls for $5\frac{3}{4}$ cups of flour. Brian has only $2\frac{3}{8}$ cups left in the bag. How much more does he need?

- (1) $5\frac{3}{4} + 2\frac{3}{8}$
- (2) $5\frac{3}{4} - 2\frac{3}{8}$
- (3) $2\frac{3}{8} \times 5\frac{3}{4}$
- (4) $5\frac{3}{4} \div 2\frac{3}{8}$
- (5) $2\frac{3}{8} \div 5\frac{3}{4}$

Question 2 refers to the following diagram.



2. Steve is taking the path shown by the sign above. If he averages $2\frac{1}{2}$ miles per hour, how many hours will it take him to reach the end of the trail?

- (1) $6\frac{1}{4} + 2\frac{1}{2}$
- (2) $6\frac{1}{4} - 2\frac{1}{2}$
- (3) $2\frac{1}{2} \times 6\frac{1}{4}$
- (4) $6\frac{1}{4} \div 2\frac{1}{2}$
- (5) $2\frac{1}{2} \div 6\frac{1}{4}$

3. A restaurant ordered $15\frac{3}{4}$ pounds of almonds. The nut supplier sent only $\frac{1}{2}$ of the order. How many pounds of almonds did the supplier send?

- (1) $\frac{1}{2} + 15\frac{3}{4}$
- (2) $15\frac{3}{4} - \frac{1}{2}$
- (3) $15\frac{3}{4} \times \frac{1}{2}$
- (4) $15\frac{3}{4} \div \frac{1}{2}$
- (5) $\frac{1}{2} \div 15\frac{3}{4}$

4. Kim's driving class lasts $\frac{3}{4}$ of an hour. How many classes can she teach in $4\frac{1}{2}$ hours?

- (1) $4\frac{1}{2} + \frac{3}{4}$
- (2) $4\frac{1}{2} - \frac{3}{4}$
- (3) $\frac{3}{4} \times 4\frac{1}{2}$
- (4) $4\frac{1}{2} \div \frac{3}{4}$
- (5) $\frac{3}{4} \div 4\frac{1}{2}$

5. Phil rode his bike $18\frac{1}{2}$ miles on Friday and $12\frac{2}{5}$ miles on Saturday. How many miles did he ride in the two days?

- (1) $18\frac{1}{2} + 12\frac{2}{5}$
- (2) $18\frac{1}{2} - 12\frac{2}{5}$
- (3) $12\frac{2}{5} \times 18\frac{1}{2}$
- (4) $12\frac{2}{5} \div 18\frac{1}{2}$
- (5) $18\frac{1}{2} \div 12\frac{2}{5}$

6. At Howard Brothers Manufacturing, $\frac{5}{8}$ of the employees takes the bus to work. Of these, $\frac{2}{5}$ takes the express bus. What fraction of the employees takes the express bus?

- (1) $\frac{5}{8} + \frac{2}{5}$
- (2) $\frac{5}{8} - \frac{2}{5}$
- (3) $\frac{2}{5} \times \frac{5}{8}$
- (4) $\frac{5}{8} \div \frac{2}{5}$
- (5) $\frac{2}{5} \div \frac{5}{8}$



To find a fraction of a fraction multiply just like when finding a fraction of a whole. For example, to find $\frac{1}{2}$ of $\frac{1}{4}$, multiply: $\frac{1}{2} \times \frac{1}{4}$.

Answers start on page 379.

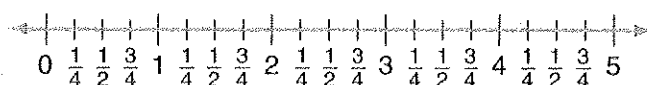
GED SKILL Fractions on Number Lines

Earlier in this book you used number lines to locate whole numbers. You can also use number lines to locate and compare fractions. Remember these facts about number lines:

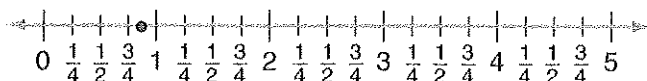
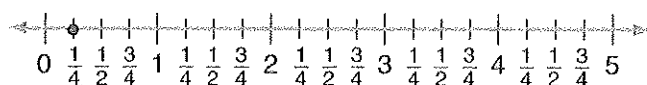
- values are equally spaced
- as you move to the right on a number line, the values increase
- arrows at the ends of the number line mean that the line extends indefinitely in both directions

Also, note that all proper fractions are somewhere between 0 and 1 on the number line, and all improper fractions and mixed numbers are located at 1 or to the right of 1.

Example 1 Place a dot on the number line below to locate a fraction with a numerator less than its denominator.



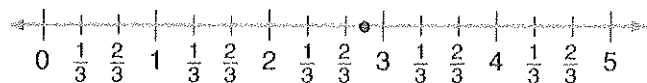
If the numerator of a fraction is less than its denominator, its value is less than 1. Therefore, a dot placed anywhere between 0 and 1 would be correct. Two possible answers are shown below.



Example 2 Place a dot on the number line below to locate a number that makes this comparison true: $2 < ? < 3$.



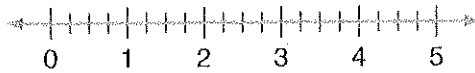
Remember, the expression, $2 < ? < 3$, means a *number greater than 2 and less than 3*. Therefore, a dot placed anywhere between 2 and 3 would be correct. Two possible answers are shown below.



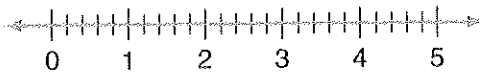
GED SKILL FOCUS

Solve the following problems. Show your answers by placing a dot on the number line below each problem.

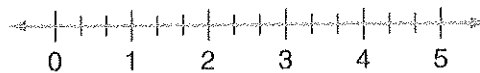
1. Place a dot on the number line below to locate the mixed number $3\frac{3}{4}$.



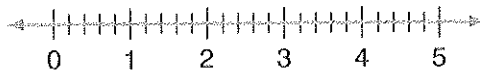
2. Place a dot on the number line below to show the location of the mixed number $1\frac{3}{5}$.



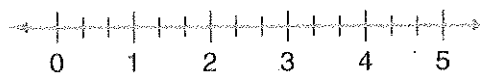
3. Place a dot on the number line below to show the mixed number $4\frac{1}{3}$.



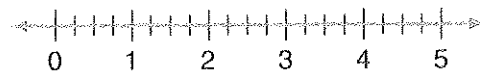
4. Polls for the upcoming election predict that candidate Manning can expect to receive $\frac{4}{5}$ of the votes. Place a dot on the number line below to show the fraction of the votes that candidate Manning is predicted to receive.



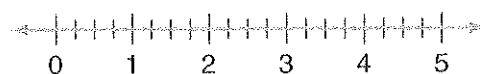
5. A ring is made of $\frac{2}{3}$ pure gold and $\frac{1}{3}$ other metals. Place a dot on the number line below to show the fraction of the ring that is pure gold.



6. Jan arrived at work at 8:30 A.M. and went home at 4:15 P.M. Place a dot on the number line below to show the time Jan went home as a mixed number.



7. Amy needs $3\frac{3}{4}$ yards of material for a size 6 dress. Place a dot on the number line below to show how much material she needs.



Answers start on page 379.

GED SKILL Fractions, Ratios, and Proportions

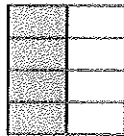
Equal Fractions

You know from experience that different fractions can have the same value.

- Since there are 100 pennies in a dollar, 25 pennies is equal to $\frac{25}{100}$ of a dollar. The same amount also equals a quarter, or $\frac{1}{4}$ of a dollar.
- On a measuring cup, $\frac{1}{2}$ cup is the same amount as $\frac{2}{4}$ cup.
- On an odometer, $\frac{5}{10}$ of a mile is the same as $\frac{1}{2}$ mile.
- Out of a dozen doughnuts, six doughnuts equal $\frac{6}{12}$, or $\frac{1}{2}$ dozen.

Fractions that have the same value are called **equivalent** or **equal fractions**. You can tell if two fractions are equal by finding **cross products**.

Example Are $\frac{4}{8}$ and $\frac{3}{6}$ equal fractions?



Multiply diagonally as shown by the arrows below. If the cross products are equal, the fractions are equal.

$$\begin{array}{ccc} \frac{4}{8} & \begin{array}{c} \nearrow \searrow \\ \nwarrow \nearrow \end{array} & \frac{3}{6} \end{array} \quad \begin{array}{l} 4 \times 6 = 24 \\ 8 \times 3 = 24 \end{array}$$

Since the cross products are equal, $\frac{4}{8} = \frac{3}{6}$.

Reducing Fractions

Reducing a fraction means finding an equal fraction with a smaller numerator and denominator. The fraction is reduced to **lowest terms** when there is no number other than 1 that will divide evenly into both the numerator and the denominator.

To reduce a fraction, divide both the numerator and the denominator by the same number, and write the new fraction.

Example 1 In one hour, 10 customers visited Stuart's newsstand. Of those, 6 bought a magazine. What fraction of the customers purchased a magazine?

Write a fraction: $\frac{6}{10}$. Reduce the fraction to lowest terms by dividing both the numerator and denominator by 2.

$$\frac{6}{10} = \frac{6 \div 2}{10 \div 2} = \frac{3}{5} \quad \frac{3}{5} \text{ of the customers made a purchase.}$$



If both the numbers in the fraction are even numbers, you can always divide by 2.



Answer choices on the GED Math Test are written in lowest terms. If your answer does not match any answer choice, make sure your answer is reduced to lowest terms.

You may need to divide more than once to reduce a fraction to lowest terms. Remember, keep dividing until there is no number other than 1 that will divide evenly into both numerator and denominator.

Example 2 Write $\frac{24}{30}$ in lowest terms.

Step 1 First divide the numerator and denominator by 3. However, the fraction $\frac{8}{10}$ is not in lowest terms. $\frac{24}{30} = \frac{24 \div 3}{30 \div 3} = \frac{8}{10}$

Step 2 Divide the numerator and denominator by 2. The fraction $\frac{4}{5}$ is in lowest terms. $\frac{8}{10} = \frac{8 \div 2}{10 \div 2} = \frac{4}{5}$

Note: If you noticed that 6 divides evenly into both 24 and 30, you could reduce the fraction to lowest terms in one step.

GED SKILL FOCUS

A. Reduce each fraction to lowest terms.

1. $\frac{2}{4} =$

4. $\frac{6}{8} =$

7. $\frac{5}{20} =$

10. $\frac{12}{30} =$

2. $\frac{6}{9} =$

5. $\frac{6}{15} =$

8. $\frac{12}{48} =$

11. $\frac{7}{42} =$

3. $\frac{10}{25} =$

6. $\frac{18}{27} =$

9. $\frac{16}{20} =$

12. $\frac{24}{36} =$

B. Circle the two equal fractions in each line. You may find it helpful to reduce each fraction to lowest terms.

13. $\frac{4}{6}$ $\frac{8}{12}$ $\frac{6}{10}$ $\frac{2}{4}$ $\frac{10}{12}$

15. $\frac{3}{12}$ $\frac{8}{16}$ $\frac{2}{8}$ $\frac{4}{20}$ $\frac{2}{6}$

14. $\frac{8}{16}$ $\frac{2}{3}$ $\frac{5}{12}$ $\frac{3}{6}$ $\frac{3}{4}$

16. $\frac{5}{8}$ $\frac{6}{8}$ $\frac{6}{10}$ $\frac{4}{16}$ $\frac{3}{5}$

C. Solve. Express each answer in lowest terms.

17. Sadrac worked 8 hours on Monday. If he worked 40 hours during the week, what fraction of the total time did he work on Monday?

19. Crown Manufacturing completed 1000 assemblies today. Of those, 50 were defective. What fraction of the assemblies was defective?

18. Morley's Paint advertised its store sale in the newspaper. On Friday, the store had 50 customers. Of those, 15 saw the advertisement. What fraction of Friday's customers saw the advertisement?

20. Jean withdrew \$40 from her savings account. She spent \$24 at the pharmacy. What fraction of the withdrawal did she spend at the pharmacy?

Answers start on page 380.

Raising Fractions to Higher Terms

Sometimes you need to find an equal fraction with higher terms. You raise a fraction to higher terms by multiplying both the numerator and the denominator by the same number (except 0).

$\frac{5}{8}$ and $\frac{20}{32}$ are equal fractions.

Often you will need to find an equal fraction with a specific denominator. To do this, think, "What number multiplied by the original denominator will result in the new denominator?" Then multiply the original numerator by the same number.

Example $\frac{3}{4} = \frac{?}{24}$

Since $4 \times 6 = 24$, multiply the numerator 3 by 6.

$$\frac{3 \times 6}{4 \times 6} = \frac{18}{24}$$

The fractions $\frac{3}{4}$ and $\frac{18}{24}$ are equal fractions.

Comparing Fractions

When two fractions have the same number as the denominator, they are said to have a **common denominator**, and the fractions are called **like fractions**. When you compare like fractions, the fraction with the greater numerator is the greater fraction.

Example 1 Which fraction is greater, $\frac{3}{5}$ or $\frac{4}{5}$?

The fractions $\frac{3}{5}$ and $\frac{4}{5}$ are like fractions because they have a common denominator, 5. Compare the numerators.

Since 4 is greater than 3, $\frac{4}{5}$ is greater than $\frac{3}{5}$.

Fractions with different denominators are called **unlike fractions**. To compare unlike fractions, you must change them to fractions with a common denominator.

The common denominator will always be a **multiple** of both of the original denominators. The multiples of a number are found by going through the times tables for the number. For instance, the multiples of 3 are 3, 6, 9, 12, 15, 18, and so on.

You can often find a common denominator by using mental math. If not, try these methods:

1. See whether the larger denominator could be a common denominator. In other words, if the smaller denominator can divide into the larger denominator evenly, use the larger denominator as the common denominator.
2. Go through the multiples of the larger denominator. The first one that can be divided evenly by the smaller denominator is the **lowest common denominator**.



Finding common denominators is important to your success on the GED Mathematics Test. Practice writing the first 12 multiples of the numbers 2 through 12.

Example 2 Which is greater, $\frac{5}{6}$ or $\frac{3}{4}$?

Go through the multiples of the larger denominator: 6, 12, 18, 24, 30 . . .
Since 12 can be divided evenly by both 4 and 6, 12 is the lowest common denominator.

Build equal fractions, each with the denominator 12:

$$\frac{5 \times 2}{6 \times 2} = \frac{10}{12} \quad \frac{3 \times 3}{4 \times 3} = \frac{9}{12}$$

Compare the like fractions. Since $\frac{10}{12} > \frac{9}{12}$, the fraction $\frac{5}{6} > \frac{3}{4}$.

GED SKILL FOCUS

A. Find an equal fraction with the given denominator.

1. $\frac{2}{3} = \frac{?}{12}$

4. $\frac{5}{8} = \frac{?}{32}$

7. $\frac{3}{4} = \frac{?}{36}$

2. $\frac{2}{7} = \frac{?}{21}$

5. $\frac{7}{9} = \frac{?}{63}$

8. $\frac{4}{9} = \frac{?}{81}$

3. $\frac{4}{5} = \frac{?}{25}$

6. $\frac{3}{10} = \frac{?}{120}$

9. $\frac{9}{50} = \frac{?}{150}$

B. Compare the fractions. Write $>$, $<$, or $=$ between the fractions.

10. $\frac{1}{3}$

$\frac{1}{4}$

13. $\frac{2}{3}$

$\frac{1}{2}$

16. $\frac{7}{10}$

$\frac{2}{3}$

11. $\frac{3}{4}$

$\frac{7}{8}$

14. $\frac{5}{6}$

$\frac{15}{18}$

17. $\frac{7}{15}$

$\frac{2}{5}$

12. $\frac{3}{9}$

$\frac{1}{3}$

15. $\frac{9}{12}$

$\frac{3}{4}$

18. $\frac{9}{10}$

$\frac{3}{4}$

C. Solve.

Refer to the following information to answer Questions 19 through 22.

A manufacturing plant has five assembly lines. The table shows the fraction of assigned work that each team has completed.

Team A	$\frac{2}{5}$ of goal
Team B	$\frac{1}{2}$ of goal
Team C	$\frac{1}{4}$ of goal
Team D	$\frac{3}{5}$ of goal
Team E	$\frac{3}{4}$ of goal

19. Which team has completed the smallest part of its goal?

20. Which team has completed the greatest part of its goal?

21. Which teams have completed more than $\frac{1}{2}$ of their goal?

22. Which teams have completed between $\frac{3}{8}$ and $\frac{5}{8}$ of their goal?



If you have trouble finding the lowest common denominator, multiply the two denominators. The result will be a common denominator, although probably not the lowest one.

Answers start on page 380.

Working with Ratios

A **ratio** is a comparison of two numbers. A ratio can be written with the word *to*, with a colon (:), or as a fraction. Always write the terms of the ratio in the same order as the problem compares them.

Example 1 A painter mixes 4 quarts of white paint and 2 quarts of blue paint. What is the ratio of white paint to blue paint?

The ratio of white paint to blue paint can be written as **4 to 2**, **4:2**, or $\frac{4}{2}$.

Just as you can reduce fractions to lowest terms, you can simplify ratios to their lowest terms. The ratio $\frac{4}{2}$ can be simplified to $\frac{2}{1}$, which means for every 2 quarts of white paint, there is 1 quart of blue paint. Ratios are written as a fraction even if the denominator is 1.

Ratios have much in common with fractions, but there is an important difference. A ratio may look like an improper fraction, but it should not be changed to a whole or mixed number because it is a comparison of two items, not just a part of a whole.

Ratios often express rates. A ratio with the denominator 1 is called a **unit rate**. Unit rates are often expressed using the word *per*.

Example 2 If Barbara earns \$180 in 15 hours, how much does she earn per hour?

Write the ratio of earnings to hours. Then divide to find the unit rate.

$$\frac{\text{dollars earned}}{\text{hours}} = \frac{\$180}{15} = \frac{180 \div 15}{15 \div 15} = \frac{\$12}{1 \text{ hr}}$$

Barbara earns \$12 for every 1 hour she works. In other words, she earns **\$12 per hour**.

Some ratio problems require more than one step. You may not be given both of the numbers you need to write a ratio. Instead, you may have to solve for one of the numbers.

Example 3 Kimball Discount has 25 employees. Of those 25 employees, 15 are women. What is the ratio of the number of men to the number of women employees?

You need to write a ratio comparing the number of men to the number of women. You have been given the total number of employees and the number of women employees.

Step 1 Subtract to find the number of men. $25 - 15 = 10$ men

Step 2 Write the ratio of men to women. $\frac{\text{men}}{\text{women}} = \frac{10}{15}$

Step 3 Simplify the ratio. $\frac{10}{15} = \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$

The ratio of men to women employees at Kimball Discount is $\frac{2}{3}$.



Writing the ratio in words will help you keep the numbers in the correct order. The words will also help you remember the meaning of the numbers. Including labels in your final ratio is also helpful.

A. Write each ratio as a fraction in lowest terms.

1. 18 wins to 6 losses
2. 80 full-time workers to 100 part-time workers
3. 16 fiction books to 12 non-fiction books
4. \$21 to \$9
5. 69 female employees to 90 total employees
6. 16 minutes to 30 minutes
7. 85 miles to 100 miles
8. 35 customers to 7 sales
9. 10 adults to 120 children
10. 15 wins to 20 games played

B. Find each unit rate.

11. 400 miles in 5 hours
12. \$216 in 18 hours
13. 54 calories in 6 grams of fat
14. 432 people for 36 teams
15. \$10 for 10 pounds of grass seed
16. 5400 oranges in 60 bags
17. 1024 feet in 16 seconds
18. \$150 for 25 yards of fabric
19. 135 pages in 3 hours
20. 460 calories in 2 servings

C. Solve as directed.

21. The Monarchs won 30 games and lost 6 games.
 - a. What is the ratio of games won to games lost?
 - b. What is the ratio of games lost to games played?
 - c. What is the ratio of games won to games played?
 - d. What is the ratio of games lost to games won?
22. In a factory, there are 35 union workers and 14 non-union workers.
 - a. What is the ratio of non-union to union workers?
 - b. What is the ratio of union workers to the total number of workers?
 - c. What is the ratio of the number of non-union workers to the total number of workers?
 - d. What is the ratio of union workers to non-union workers?
23. On a quiz, Denzel answered 16 questions correctly and 4 questions incorrectly.
 - a. What is the ratio of correct to incorrect answers?
 - b. What is the ratio of correct answers to total questions?
 - c. What is the ratio of incorrect answers to total questions?
24. A manufacturer produced 1000 electric switches. Of these, 50 were found to have defects.
 - a. What is the ratio of defective switches to total switches?
 - b. What is the ratio of defective to good switches?
 - c. What is the ratio of good switches to total switches?

Answers start on page 381.

Solving Proportions

When two ratios are written as equal ratios, the equation is called a **proportion**. Think about the following statement:

Example 1 If Paul earns \$8 in 1 hour, then he will earn \$56 in 7 hours.

From the information in the sentence, you can write a proportion. Use cross products to make sure the ratios are equal.

$$\frac{\text{dollars earned}}{\text{hours}} = \frac{8}{1} = \frac{56}{7}$$

Cross products: $1 \times 56 = 8 \times 7$
 $56 = 56$

As you can see from the example above, every proportion has four terms. In a proportion problem, one of the four terms is missing. The proportion can be solved using this rule:

Cross-product Rule: To find the missing number in a proportion, cross multiply and divide the product by the third number.

Example 2 Gayla drove 165 miles in 3 hours. At the same rate, how far can she drive in 5 hours?

In this problem, you are comparing miles to hours. Set up two equal ratios. Write x to stand for the missing term.

$$\frac{\text{miles}}{\text{hours}} = \frac{165}{3} = \frac{x}{5}$$

Step 1 Find the cross product.

$$165 \times 5 = 825$$

Step 2 Divide by 3, the remaining term.

$$825 \div 3 = 275$$

Gayla can drive **275 miles** in 5 hours.



In a proportion, the terms in both ratios must be written in the same order. In this example, both ratios have miles on the top and hours on the bottom. Use labels to keep track of the order.



You can easily solve proportion problems using a calculator. Enter the numbers and operations in this order:

$$165 \times 5 \div 3 = 275.$$

Some proportion problems state a ratio using a colon. Read carefully to understand what the numbers in the ratio represent.

Example 3 At a school board meeting, the ratio of parents to teachers is 3:2. If there are 72 parents at the meeting, how many teachers are there?

Step 1 The ratio 3:2 compares parents to teachers. Write the second ratio in the same order.

$$\frac{\text{parents}}{\text{teachers}} = \frac{3}{2} = \frac{72}{x}$$

Step 2 Find the cross product, and divide by the remaining term.

$$2 \times 72 = 144$$

$$144 \div 3 = 48$$

There are **48 teachers** at the meeting.

GED SKILL FOCUS

A. Solve for the missing term in each proportion.

1. $\frac{2}{3} = \frac{x}{15}$

6. $\frac{15}{24} = \frac{5}{x}$

11. $\frac{49}{7} = \frac{x}{10}$

2. $\frac{28}{12} = \frac{14}{x}$

7. $\frac{12}{15} = \frac{24}{x}$

12. $\frac{32}{8} = \frac{x}{15}$

3. $\frac{9}{10} = \frac{x}{20}$

8. $\frac{14}{6} = \frac{7}{x}$

13. $\frac{18}{6} = \frac{3}{x}$

4. $\frac{5}{6} = \frac{x}{18}$

9. $\frac{115}{30} = \frac{x}{6}$

14. $\frac{6}{120} = \frac{5}{x}$

5. $\frac{3}{4} = \frac{9}{x}$

10. $\frac{5}{20} = \frac{8}{x}$

15. $\frac{64}{8} = \frac{x}{5}$

B. For each situation, the first ratio has been written for you. Write the second ratio to complete the proportion and solve.

16. A recipe that serves 8 people calls for 2 cups of milk. How many cups of milk will be needed for 36 servings?

$$\frac{\text{servings}}{\text{cups of milk}} = \frac{8}{2} = \frac{?}{?}$$

18. A person uses about 315 calories to jog 3 miles. How many calories will be used in a 10-mile jog?

$$\frac{\text{calories}}{\text{miles}} = \frac{315}{3} = \frac{?}{?}$$

17. Sandra can drive 32 miles on 2 gallons of gasoline. How far can she drive on a full tank of 13 gallons?

$$\frac{\text{miles}}{\text{gallons}} = \frac{32}{2} = \frac{?}{?}$$

19. An architect is planning a city parking lot. For every 12 commuters, the parking lot will need 5 parking spaces. How many parking spaces will be needed for 132 commuters?

$$\frac{\text{commuters}}{\text{parking spaces}} = \frac{12}{5} = \frac{?}{?}$$

C. Write a proportion and solve for the missing term.

20. The scale on a map says that 2 inches equal 150 miles. If two cities are actually 750 miles apart, how many inches apart will they be on the map?

22. Ky bought 2 gallons of paint for \$27. How much would he spend for 10 gallons?

21. The ratio of full-time to part-time employees at Kelly Manufacturing is 5:3. If there are 48 part-time employees at the plant, how many full-time workers are there?

23. The ratio of wins to losses for the Bulldogs was 7:2. If the team won 21 games, how many did they lose?

Answers start on page 382.

GED STRATEGY Working with Special Formats

Writing Fractions in a Standard Grid

The standard grid that you used earlier in the book to write whole number answers can also be used to write fractional answers.

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Here are some important points to keep in mind when using the standard grid with fractional answers:

- The grid is used to enter a single fractional answer.
- Your answer can start in any of the five columns, as long as your answer is complete. Any unused columns should be left blank.
- Fill in the corresponding circle in each column to show the numerator of the fraction, then the fraction bar in the second row of the grid, (/), and then the denominator of the fraction.
- Mixed numbers cannot be entered on the grid. Therefore, change all mixed number answers to improper fractions before entering them on the grid.

Example On Thursday morning, 7 out of the 15 clients at Maya's Hair Salon paid with a credit card. What fraction paid with a credit card?

The fraction is $\frac{7}{15}$.

Note that since the answer can start in any of the five columns, both grids shown below are filled in correctly.

7	/	1	5	
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	7	/	1	5
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

GED PRACTICE

Directions: Solve the following problems. Write your answer in the top row of each grid, and then fill in the corresponding bubbles to match your answer.

1. In an election for club president, Naomi received 23 out of the 47 votes cast. What fraction of the votes did Naomi receive?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

3. Casey fills a carpet cleaner with 3 gallons of water and adds 6 ounces of carpet cleaning solution. What is the ratio of ounces of cleaning solution to gallons of water?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

2. At dinner, Neil paid \$17 and Sam paid \$15. What is the ratio of the amount paid by Sam to the amount paid by Sam and Neil together?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

4. Karen typed 7 pages in 21 minutes. What is the simplified ratio of minutes to typed pages?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9



Be sure to write your answer in the blank row at the top of each grid. This will help you fill in the bubbles in the correct order.

Answers start on page 302.

Adding and Subtracting Fractions

Adding and subtracting can only be performed with the same kinds of objects. You can add dollars to dollars and inches to inches, but not dollars to inches. This is also true of fractions. You can add or subtract only **like fractions**, those with the same, or common, denominator.

With like fractions, add or subtract the numerators and write the answer over the common denominator. If necessary, reduce the answer to lowest terms. Rewrite an improper fraction as a whole or mixed number.

Example 1 Add $\frac{3}{8}$ and $\frac{4}{8}$.

Step 1 Add the numerators.

$$3 + 4 = 7$$

Step 2 Write sum of numerators over common denominator.

$$\frac{7}{8}$$

The sum of $\frac{3}{8}$ and $\frac{4}{8}$ is $\frac{7}{8}$.

Example 2 Subtract $\frac{2}{12}$ from $\frac{11}{12}$.

Step 1 Remember the order of the numbers in subtraction. The fraction being subtracted from must be written first. Then subtract the numerators.

$$\frac{11}{12} - \frac{2}{12} = \frac{11 - 2}{12} = \frac{9}{12}$$

Step 2 Reduce to lowest terms.

$$\frac{9 \div 3}{12 \div 3} = \frac{3}{4}$$

The difference of $\frac{11}{12}$ and $\frac{2}{12}$ is $\frac{3}{4}$.

Unlike fractions have different denominators. Use these steps to add or subtract unlike fractions.

Step 1 Find a common denominator and change one or both of the fractions to make like fractions.

Step 2 Add or subtract the like fractions.

Step 3 Reduce the answer if necessary. If the answer is an improper fraction, rewrite it as a whole or mixed number.

Example 3 Jarod bought $\frac{1}{2}$ pound of dark chocolate and $\frac{3}{4}$ pound of white chocolate. How many pounds of chocolate did he buy?

Step 1 The lowest common denominator for both fractions is 4. Raise $\frac{1}{2}$ to an equal fraction with a denominator of 4.

$$\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4}$$

Step 2 Add $\frac{2}{4}$ and $\frac{3}{4}$.

$$\frac{2}{4} + \frac{3}{4} = \frac{5}{4}$$

Step 3 Reduce the improper fraction to lowest terms.

$$\frac{5}{4} = 1\frac{1}{4}$$

Jarod bought **$1\frac{1}{4}$ pounds** of chocolate.



Whenever possible, use the lowest common denominator. The numbers in the problem will be smaller and easier to work with.

GED SKILL FOCUS

A. Add. Reduce answers to lowest terms. Change improper fractions to whole or mixed numbers.

$$\begin{array}{r} 1. \quad \frac{2}{3} \\ + \frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad \frac{1}{6} \\ + \frac{3}{6} \\ \hline \end{array}$$

$$\begin{array}{r} 5. \quad \frac{3}{4} \\ + \frac{1}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 7. \quad \frac{1}{6} \\ + \frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad \frac{1}{9} \\ + \frac{5}{9} \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad \frac{3}{10} \\ + \frac{9}{10} \\ \hline \end{array}$$

$$\begin{array}{r} 6. \quad \frac{1}{3} \\ + \frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 8. \quad \frac{5}{8} \\ + \frac{1}{4} \\ \hline \end{array}$$

B. Subtract. Reduce answers to lowest terms.

$$\begin{array}{r} 9. \quad \frac{3}{4} \\ - \frac{1}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 11. \quad \frac{13}{15} \\ - \frac{9}{15} \\ \hline \end{array}$$

$$\begin{array}{r} 13. \quad \frac{3}{4} \\ - \frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 15. \quad \frac{5}{6} \\ - \frac{1}{2} \\ \hline \end{array}$$

$$\begin{array}{r} 10. \quad \frac{7}{8} \\ - \frac{3}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 12. \quad \frac{7}{12} \\ - \frac{5}{12} \\ \hline \end{array}$$

$$\begin{array}{r} 14. \quad \frac{2}{3} \\ - \frac{1}{6} \\ \hline \end{array}$$

$$\begin{array}{r} 16. \quad \frac{6}{9} \\ - \frac{1}{12} \\ \hline \end{array}$$

C. Add or subtract as directed. Simplify your answers.

$$17. \quad \frac{2}{5} + \frac{1}{3} =$$

$$20. \quad \frac{2}{8} + \frac{1}{5} =$$

$$23. \quad \frac{5}{8} + \frac{1}{6} + \frac{1}{4} =$$

$$18. \quad \frac{3}{4} - \frac{1}{3} =$$

$$21. \quad \frac{1}{2} + \frac{3}{10} + \frac{1}{5} =$$

$$24. \quad \frac{5}{6} - \frac{3}{4} =$$

$$19. \quad \frac{9}{10} - \frac{1}{2} =$$

$$22. \quad \frac{7}{16} - \frac{1}{4} =$$

$$25. \quad \frac{1}{2} + \frac{5}{8} + \frac{1}{4} =$$

D. Decide whether to add or subtract. Solve. Simplify your answers.

26. Chris estimates that he spends $\frac{1}{4}$ of his income on rent and $\frac{1}{6}$ on transportation. What fraction of his income does he spend on these two items?

27. Shedon is making a vest for her daughter. The pattern calls for $\frac{3}{8}$ yard of ribbon. If she has $\frac{3}{4}$ yard of ribbon, how much will be left over?

28. A walkway will require $\frac{2}{3}$ cubic yard of concrete. A worker has already mixed $\frac{4}{9}$ cubic yard. How many more cubic yards of concrete will he need?

29. Ariel walked $\frac{3}{10}$ mile to the market, $\frac{1}{2}$ mile to her child's school, and then $\frac{1}{4}$ mile to a friend's house. How many miles did she walk in all?

Answers start on page 382.

Adding and Subtracting Mixed Numbers



If you can't decide which operation to use in a fraction word problem, think about how you would solve it using only whole numbers. Then use the same operation with the fractions.

A mixed number is a whole number and a proper fraction. To add or subtract mixed numbers, work with each part separately and then combine the results.

Example 1 For a painting job, Leland spent $6\frac{1}{3}$ hours preparing the rooms to be painted and $4\frac{3}{4}$ hours doing the painting and cleanup. How many hours did he spend on the job?

Step 1 Write the fractions with common denominators.

$$\begin{array}{r} 6\frac{1}{3} = 6\frac{1 \times 4}{3 \times 4} = 6\frac{4}{12} \\ + 4\frac{3}{4} = 4\frac{3 \times 3}{4 \times 3} = 4\frac{9}{12} \end{array}$$

Step 2 Add the fractions first. Add the numerators and put the sum over the common denominator. Then add the whole numbers.

$$\begin{array}{r} 6\frac{4}{12} \\ + 4\frac{9}{12} \\ \hline 10\frac{13}{12} \end{array}$$

Step 3 Change the improper fraction to a mixed number. Add this to the whole number answer.

$$\begin{array}{r} \frac{13}{12} = 1\frac{1}{12} \\ 10 + 1\frac{1}{12} = 11\frac{1}{12} \end{array}$$

Leland spent $11\frac{1}{12}$ hours on the job.

When subtracting mixed numbers, sometimes the fraction you are subtracting from will be smaller than the fraction you are subtracting. In this situation, you will need to regroup, or borrow, 1 from the whole number and rewrite it as a fraction. Remember, a fraction with the same numerator and denominator equals 1.

Example 2 A pipe is $5\frac{1}{8}$ feet long. If a piece measuring $3\frac{3}{4}$ feet is cut from the pipe, what is the length of the remaining piece? Is the remaining piece long enough to cut a piece that measures $1\frac{1}{8}$ feet long?

Step 1 Write the fractions with common denominators. The lowest common denominator is 8.

Step 1 **Step 2** **Step 3**

Step 2 Because $\frac{1}{8}$ is less than $\frac{6}{8}$, you need to regroup. Regroup 1 from the whole number 5, rewriting 5 as $4\frac{8}{8}$. Then add the fractional parts $\frac{1}{8}$ and $\frac{8}{8}$.

$$\begin{array}{r} 5\frac{1}{8} = 5\frac{1}{8} = 4\frac{8}{8} + \frac{1}{8} = 4\frac{9}{8} \\ - 3\frac{3}{4} = -3\frac{6}{8} \\ \hline 1\frac{3}{8} \end{array}$$

Step 3 Subtract. The fraction is already reduced to lowest terms.

The remaining piece of pipe is $1\frac{3}{8}$ feet in length. Since $\frac{3}{8}$ is greater than $\frac{1}{8}$, $1\frac{3}{8}$ is greater than $1\frac{1}{8}$. The remaining piece is long enough to cut a piece of pipe $1\frac{1}{8}$ feet long.

GED SKILL FOCUS

A. Add or subtract as directed. Reduce answers to lowest terms.

$$\begin{array}{r} 1. \quad 3\frac{3}{4} \\ + 4\frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 5. \quad 2\frac{3}{10} \\ + 9\frac{4}{5} \\ \hline \end{array}$$

$$\begin{array}{r} 9. \quad 6\frac{1}{2} \\ - 3\frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 13. \quad 20\frac{1}{3} \\ - 8\frac{2}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad 1\frac{1}{2} \\ + 5\frac{5}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 6. \quad 22\frac{1}{9} \\ + 21\frac{2}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 10. \quad 8\frac{5}{6} \\ - 2\frac{1}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 14. \quad 5\frac{2}{3} \\ - 3\frac{3}{4} \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 12\frac{3}{5} \\ + 9\frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 7. \quad 7\frac{3}{10} \\ + 2\frac{1}{5} \\ \hline \end{array}$$

$$\begin{array}{r} 11. \quad 11\frac{1}{4} \\ - 3\frac{2}{5} \\ \hline \end{array}$$

$$\begin{array}{r} 15. \quad 25\frac{1}{3} \\ - 17\frac{4}{7} \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad 6\frac{7}{8} \\ + 8\frac{2}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 8. \quad 5\frac{3}{5} \\ + 12\frac{1}{3} \\ \hline \end{array}$$

$$\begin{array}{r} 12. \quad 16\frac{1}{4} \\ - 12\frac{1}{6} \\ \hline \end{array}$$

$$\begin{array}{r} 16. \quad 40\frac{3}{4} \\ - 15\frac{7}{8} \\ \hline \end{array}$$

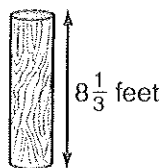
B. Solve. Reduce your answers.

17. Belinda kept records of her gasoline purchases for one month. She bought $8\frac{1}{2}$ gallons, $9\frac{3}{10}$ gallons, and $8\frac{7}{10}$ gallons. How many gallons of gasoline did she buy that month?

18. Paul earns 10 vacation days per year. He has used $4\frac{1}{2}$ days this year. How many vacation days does he have left?

19. Maria planned to spend $3\frac{1}{2}$ hours organizing the stockroom. She has been working for $1\frac{3}{4}$ hours. How many more hours does she plan to work on this task?

20. Evan needs to shorten this fence post to $5\frac{3}{4}$ feet. How much should he cut off the fence post?



21. A recipe calls for $1\frac{2}{3}$ cups of milk, $\frac{1}{2}$ cup of cooking oil, and $\frac{3}{4}$ cup of water. What is the total amount of liquid used in the recipe?

22. Ted estimated he would need 35 square yards of carpet to cover his living room floor. The job required $30\frac{3}{4}$ square yards of carpet. By how much did his estimate exceed the actual amount of carpet needed?

23. John exercises by power walking at a local park. This week John walked $2\frac{1}{2}$ miles, $1\frac{3}{4}$ miles, $2\frac{5}{8}$ miles, and $2\frac{3}{4}$ miles. How many miles did John power walk this week?

24. Kyra can work up to 20 hours per week at a part-time job. She has already worked $16\frac{1}{4}$ hours this week. How many more hours can she work this week?

Answers start on page 384.

Multiplying Fractions and Mixed Numbers

To multiply fractions, you do not need to change the fractions to like fractions. Simply multiply the numerators, then the denominators, and reduce your answer.

Example 1 A piece of electric wire is $\frac{1}{6}$ yard long. Max used $\frac{2}{3}$ of the wire for a job. How much wire did he use?

Step 1 Multiply one numerator by the other numerator. Then multiply one denominator by the other denominator.

$$\frac{1}{6} \times \frac{2}{3} = \frac{1 \times 2}{6 \times 3} = \frac{2}{18}$$

Step 2 Reduce the answer to lowest terms.

$$\frac{2 \div 2}{18 \div 2} = \frac{1}{9}$$

Max used $\frac{1}{9}$ yard of wire.

As you know, reducing a fraction means to divide the numerator and the denominator by the same number. You can use this principle to simplify before you work the problem. This process is called **canceling**.

Example 2 Find $\frac{1}{6}$ of $\frac{2}{3}$.

Both the numerator of one fraction and the denominator of the other fraction can be divided by 2. Since $2 \div 2 = 1$, draw a slash through the numerator 2 and write 1.

Since $6 \div 2 = 3$, draw a slash through the denominator 6 and write 3. Then multiply the simplified fractions.

$$\frac{1}{6} \times \frac{2}{3} = \frac{1 \times \cancel{2}}{\cancel{6} \times 3} = \frac{1}{9}$$

Since you used canceling before multiplying, there is no need to reduce the answer: $\frac{1}{6}$ of $\frac{2}{3}$ is $\frac{1}{9}$. Notice that canceling gives the same answer as in Example 1 above.

When you cancel, make sure you divide a numerator and a denominator by the same number. The canceling shown here is incorrect. Although 6 and 3 can both be divided by 3, both numbers are in the denominator.

Incorrect:

$$\frac{1}{6} \times \frac{2}{3} = \frac{1 \times 2}{\cancel{6} \times \cancel{3}} = \frac{2}{2}$$

To multiply with mixed numbers, change the mixed numbers to improper fractions before you multiply.

Example 3 Multiply $1\frac{2}{3}$ by $7\frac{1}{2}$.

Step 1 Change to improper fractions.

$$1\frac{2}{3} \times 7\frac{1}{2} = \frac{5}{3} \times \frac{15}{2}$$

Step 2 Cancel and multiply.

$$\frac{5}{3} \times \frac{15}{2} = \frac{5 \times 5}{1 \times 2} = \frac{25}{2}$$

Step 3 Write as a mixed number.

$$\frac{25}{2} = 12\frac{1}{2}$$

The product of $1\frac{2}{3}$ and $7\frac{1}{2}$ is $12\frac{1}{2}$.



A fraction followed by the word *of* means that you should multiply by that fraction. For example, when you find $\frac{1}{6}$ of $\frac{2}{3}$, you multiply $\frac{1}{6} \times \frac{2}{3}$.



You can also use proportions to solve fraction problems. Here, $\frac{2}{5}$ means 2 out of 5 customers.

$$\frac{2}{5} = \frac{?}{125}$$

Example 4 A restaurant had 125 customers during the lunch rush hour on Monday. Two-fifths of the customers ordered the lunch special. How many customers ordered the special?

This problem asks you to find a fractional part of a whole number. You need to find $\frac{2}{5}$ of 125. To write a whole number as an improper fraction, write the whole number over 1.

$$\frac{2}{5} \times \frac{125}{1} = 50$$

Of the 125 customers, **50 customers** ordered the lunch special.

GED SKILL FOCUS

A. Multiply. Use canceling when needed. Make sure your answers are reduced to lowest terms.

1. $\frac{7}{8} \times \frac{4}{5} =$

6. $9 \times 5\frac{1}{3} =$

11. $2\frac{3}{4} \times 6 =$

2. $\frac{3}{4} \times \frac{3}{7} =$

7. $2\frac{2}{5} \times 2\frac{1}{2} =$

12. What is $\frac{4}{7}$ of $1\frac{2}{5}$?

3. Find $\frac{1}{2}$ of 11.

8. $3\frac{1}{3} \times 4\frac{1}{8} =$

13. $4 \times 1\frac{7}{8} =$

4. What is $\frac{8}{9}$ of $\frac{5}{6}$?

9. Find $\frac{5}{6}$ of $4\frac{1}{2}$.

14. $3\frac{1}{9} \times 2\frac{1}{4} =$

5. Find $\frac{2}{15}$ of $\frac{3}{8}$.

10. $\frac{4}{5} \times 1\frac{2}{3} =$

15. What is $\frac{2}{9}$ of 24?

B. Solve. Answers should be in lowest terms. You may use your calculator.

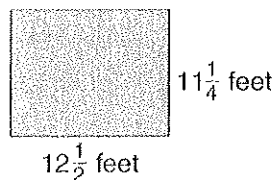
16. A restaurant ordered $55\frac{3}{4}$ pounds of mozzarella cheese. The cook used $\frac{1}{2}$ of the order over the weekend. How many pounds of mozzarella are left for the rest of the week?



18. Last year, Elio earned \$18,720. His boss gave him a raise equal to $\frac{1}{12}$ of last year's salary. What is the dollar amount of the raise?



17. The measurements of a den are shown in the diagram. Find the area of the den in square feet by multiplying the length by the width.



19. A furniture factory has a stack of 40 tabletops. If each tabletop is $1\frac{3}{4}$ inches thick, what is the height of the stack?
20. In a survey, $\frac{7}{8}$ of the people said that recycling is important. Of those, only $\frac{1}{2}$ buy products made from recycled goods. What fraction of the people surveyed buy products made from recycled goods?

Answers start on page 386.

Dividing Fractions and Mixed Numbers

Multiplication and division are **inverse** (opposite) operations. You use this relationship to divide fractions.

Example 1 $\frac{6}{8} \div \frac{1}{4} = ?$

To solve this problem, you need to find out how many $\frac{1}{4}$ s there are in $\frac{6}{8}$. Follow these steps:

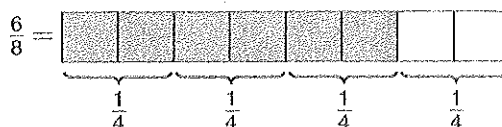
Step 1 Invert, or turn over, the divisor (the fraction you are dividing by) and change the operation to multiplication.

$$\frac{6}{8} \div \frac{1}{4} = \frac{6}{8} \times \frac{4}{1}$$

Step 2 Complete the problem as you would any multiplication problem. Always simplify your answer by reducing to lowest terms and changing improper fractions to mixed or whole numbers.

$$\frac{6}{8} \times \frac{4}{1} = \frac{\overset{8}{\cancel{6}}}{\cancel{8}} \times \frac{\cancel{4}^1}{1} = \frac{6}{2} = 3$$

The fraction $\frac{6}{8}$ divided by $\frac{1}{4}$ is **3**. In other words, there are three $\frac{1}{4}$ s in $\frac{6}{8}$. This picture shows that this is true.



Many real-world situations involve dividing a mixed or whole number by a fraction.

Example 2 A housing subdivision has 24 acres of land available for sale. If this land is divided into home lots that are each $\frac{3}{4}$ of an acre, how many lots are in the housing subdivision?

Step 1 Change the whole number 24 to an improper fraction by writing it over the denominator 1. Invert the number you're dividing by and change the operation to multiplication.

$$24 \div \frac{3}{4} = \frac{24}{1} \times \frac{4}{3}$$

Step 2 Multiply. Write your answer in lowest terms.

$$\frac{24}{1} \times \frac{4}{3} = \frac{\overset{8}{\cancel{24}}}{1} \times \frac{4}{\cancel{3}} = \frac{32}{1} = 32$$

The land will be divided into **32** home lots.

Always think about your answer to see whether it makes sense. You can always use multiplication to check a division problem.

$$\text{Check: } 32 \times \frac{3}{4} = \frac{\overset{8}{\cancel{32}}}{1} \times \frac{3}{\cancel{4}} = \frac{24}{1} = 24$$



When you divide by a proper fraction, the answer will be greater than the number you divided. Knowing this can help you see whether your answer makes sense.



Remember, as in any division problem, the fraction you are dividing must be written first.

GED SKILL FOCUS

A. Divide. Write your answers in lowest terms.

1. $\frac{1}{3} \div \frac{5}{6} =$

9. $12 \div 1\frac{1}{2} =$

17. $2\frac{2}{3} \div \frac{1}{3} =$

2. $\frac{2}{3} \div \frac{2}{5} =$

10. $3\frac{3}{4} \div 1\frac{2}{3} =$

18. $4 \div 1\frac{1}{4} =$

3. $\frac{7}{10} \div 2 =$

11. $6\frac{1}{2} \div \frac{1}{4} =$

19. $9\frac{1}{8} \div 1\frac{2}{3} =$

4. $\frac{5}{6} \div \frac{5}{24} =$

12. $2\frac{1}{4} \div 1\frac{1}{2} =$

20. $10 \div 1\frac{1}{5} =$

5. $\frac{6}{7} \div 3 =$

13. $18 \div \frac{2}{3} =$

21. $8\frac{3}{4} \div \frac{1}{4} =$

6. $\frac{4}{9} \div \frac{2}{3} =$

14. $2\frac{2}{5} \div \frac{6}{25} =$

22. $12 \div \frac{4}{9} =$

7. $\frac{7}{8} \div \frac{1}{4} =$

15. $4\frac{9}{10} \div 1\frac{1}{6} =$

23. $16 \div \frac{4}{5} =$

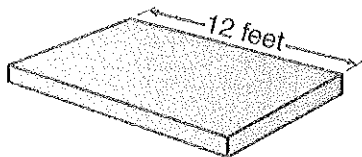
8. $4\frac{1}{2} \div \frac{1}{8} =$

16. $6\frac{1}{9} \div 1\frac{5}{6} =$

24. $4 \div 2\frac{1}{5} =$

B. Solve. Simplify your answers.

25. Hal has a board similar to this one. He needs to cut it into pieces, with each piece measuring $\frac{3}{4}$ foot. How many pieces can he cut from the board?



26. A cook uses $\frac{1}{3}$ pound of hamburger to make the lunch special. How many specials can he make from 15 pounds of hamburger?

27. A stack of books is 24 inches high. Each book in the stack is $\frac{3}{4}$ inch thick. How many books are in the stack?

28. Carina works part-time at a toy store as a bike assembler. She can build a bicycle in $2\frac{1}{2}$ hours. If she works 25 hours in a week, how many bicycles can she assemble?

29. You have 10 cups of sugar. Your cookie recipe calls for $1\frac{1}{4}$ cups of sugar for one batch. What is the greatest number of batches of cookies you could make with the sugar that you have?

Answers start on page 386.

GED STRATEGY Solving Word Problems

Estimating with Fractions



Remember: The words *about* and *approximately* mean you should estimate the answer.

Knowing the approximate value of fractions makes working with these numbers easier. Rounding fractions to the nearest whole number is a good way to estimate answers to problems that involve fractions. To round a fraction to the nearest whole number, compare the fraction to $\frac{1}{2}$.

RULE If a fraction is less than $\frac{1}{2}$, round down the fraction to 0. In a mixed number, the whole number part stays the same.

Example Round $5\frac{1}{3}$ to the nearest whole number. Compare $\frac{1}{3}$ and $\frac{1}{2}$.
Change to like fractions with a common denominator of 6.
 $\frac{1}{3} = \frac{2}{6}$ and $\frac{1}{2} = \frac{3}{6}$

Since $\frac{2}{6}$ is less than $\frac{3}{6}$, $\frac{1}{3}$ is less than $\frac{1}{2}$. Round $5\frac{1}{3}$ down to **5**.

RULE If a fraction is $\frac{1}{2}$ or more, round up the fraction to 1. In a mixed number, add 1 to the whole number part.

Example Round $8\frac{5}{8}$ to the nearest whole number. Change $\frac{1}{2}$ to a fraction with a denominator of 8 in order to compare $\frac{5}{8}$ and $\frac{1}{2}$.
 $\frac{1}{2} = \frac{4}{8}$

Since $\frac{5}{8}$ is greater than $\frac{4}{8}$, $\frac{5}{8}$ is greater than $\frac{1}{2}$. Round $8\frac{5}{8}$ up to **9**.

Estimation with fractions is more accurate in addition and subtraction than in multiplication and division.

Example Kiko and Maria each jog twice a week. Kiko jogged $4\frac{3}{4}$ miles and $4\frac{1}{5}$ miles during the week. Maria jogged $3\frac{1}{4}$ miles and $3\frac{7}{8}$ miles during the week. About how many more miles did Kiko jog than Maria?

- (1) 0
- (2) 1
- (3) 2
- (4) 3
- (5) 4

Step 1 Round the miles that Kiko jogged, then add. $5 + 4 = 9$
 $4\frac{3}{4}$ rounds up to 5, and $4\frac{1}{5}$ rounds down to 4.

Step 2 Round the miles that Maria jogged, then add. $3 + 4 = 7$
 $3\frac{1}{4}$ rounds down to 3, and $3\frac{7}{8}$ rounds up to 4.

Step 3 Compare the two amounts by subtracting. $9 - 7 = 2$

Option (3) is correct. Kiko jogged about **2 miles** more than Maria.



If the numerator of a fraction is more than half its denominator, the fraction is more than $\frac{1}{2}$. If the numerator is less than half the denominator, the fraction is less than $\frac{1}{2}$.

- $\frac{3}{8}$ is less than $\frac{1}{2}$
- $\frac{5}{8}$ is more than $\frac{1}{2}$

GED PRACTICE

Directions: Choose the one best answer to each question.

Questions 1 through 3 refer to the table.

Ace Repair: Monday Morning Sales

Paint	$14\frac{1}{3}$ gallons red paint $6\frac{3}{4}$ gallons green paint $9\frac{1}{4}$ gallons white paint
Hardware	$12\frac{1}{6}$ pounds of nails
Lumber	$9\frac{5}{8}$ feet of 2-by-4 boards $27\frac{1}{4}$ feet of 2-by-8 boards $4\frac{2}{3}$ feet of 1-by-4 boards $36\frac{3}{8}$ feet of 1-by-6 boards

- What is the best estimate for the number of gallons of paint sold on Monday morning?
 - 26
 - 28
 - 30
 - 32
 - 34
- About how many feet of lumber were sold?
 - 70
 - 74
 - 76
 - 78
 - 82
- An additional $10\frac{2}{5}$ pounds of nails are sold Monday afternoon. Approximately how many pounds of nails were sold on Monday?
 - 20
 - 22
 - 24
 - 26
 - 28

Questions 4 through 6 refer to the following information.

Walton Nut Company sells two mixtures.

- Mix A: $2\frac{2}{3}$ pounds of cashews
 $2\frac{3}{8}$ pounds of peanuts
 $3\frac{1}{2}$ pounds of salted walnuts
 $2\frac{1}{8}$ pounds of Brazil nuts
- Mix B: $6\frac{1}{2}$ pounds of almonds
 $3\frac{7}{8}$ pounds of black walnuts
 $4\frac{1}{5}$ pounds of peanuts

- Approximately how many more pounds of peanuts are in Mix B than in Mix A?
 - 2
 - 4
 - 6
 - 10
 - Not enough information is given.
- Estimate the number of pounds of cashews and Brazil nuts in Mix A.
 - 1
 - 2
 - 3
 - 5
 - 15
- Mix B contains approximately how many more pounds of nuts than Mix A?
 - 26
 - 15
 - 11
 - 4
 - Not enough information is given.

Answers start on page 387.

GED STRATEGY Working with Special Formats

Writing Fractions in a Standard Grid

When using the standard grid to write fractional answers to problems, it is important to remember the following points:

- Write your answer at the top of the grid box.
- In the second row of the grid, the symbol $\frac{\quad}{\quad}$ is the fraction bar.
- Your answer can start in any of the five columns, as long as your answer is complete. Any unused columns should be left blank.
- Mixed numbers cannot be entered on the grid. Therefore, change all mixed number answers to improper fractions.

Example 1 Felipe ran for $1\frac{1}{8}$ hours on Tuesday and for $\frac{1}{2}$ hour on Wednesday. How many more hours did he run on Tuesday than on Wednesday?

$$1\frac{1}{8} - \frac{1}{2} = \frac{9}{8} - \frac{4}{8} = \frac{5}{8}$$



When answering in the grid, remember to write your answer in the top row, fill the correct bubble below, and leave unused columns blank.

The difference between the number of hours Felipe ran on Tuesday and the number of hours he ran on Wednesday is $\frac{5}{8}$ hour. All three grids shown at right are filled in correctly.

5	/	8		
$\frac{\quad}{\quad}$				
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	5	/	8	
$\frac{\quad}{\quad}$				
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

		5	/	8
$\frac{\quad}{\quad}$				
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Example 2 Angie worked $5\frac{1}{2}$ hours on Monday and $4\frac{3}{4}$ hours on Tuesday. How many hours did Angie work in all for the two days?

$$5\frac{1}{2} + 4\frac{3}{4} = 5\frac{2}{4} + 4\frac{3}{4} = 9\frac{5}{4} = 10\frac{1}{4}$$

The total number of hours Angie worked is $10\frac{1}{4}$. Since you cannot enter mixed numbers on the standard grid, first change $10\frac{1}{4}$ to the improper fraction $\frac{41}{4}$. Both grids shown at right are correct.

4	1	/	4	
$\frac{\quad}{\quad}$				
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	4	1	/	4
$\frac{\quad}{\quad}$				
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

GED PRACTICE

Directions: Solve the following problems and enter your answers on the grids provided.

1. A piece of wood is $2\frac{7}{8}$ feet long. If you cut off $1\frac{3}{4}$ feet, how many feet are left?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

3. Rachel has 4 cups of flour and uses $\frac{2}{3}$ of it for a recipe. How many cups of flour are left?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

2. Andrea cuts a piece of ribbon that is $2\frac{3}{4}$ yards long into 3 equal pieces. What is the length of each piece?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

4. A map scale shows that $\frac{1}{3}$ inch on the map equals an actual distance of 3 miles. If a distance on the map is $\frac{3}{4}$ inch, what is the actual distance in miles?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9



Be sure you are answering the question asked. When asked to find "how much is left," check to see what value you found. Did you find how much was used or how much was left?



There are different approaches to problem solving. For example, if a map scale is $\frac{1}{3}$ inch = 3 miles, then 1 inch equals 9 miles.

Thus, $\frac{1}{9} = \frac{\frac{3}{4}}{x}$ or $\frac{3}{4} \times 9 = x$.

Answers start on page 387.

GED Mini-Test • Lessons 5–7

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Of the 24,000 cellular phones inspected in the last production run, 50 were defective. What fraction of the cellular phones inspected was defective?
 - (1) $\frac{1}{4,800}$
 - (2) $\frac{1}{960}$
 - (3) $\frac{1}{480}$
 - (4) $\frac{1}{96}$
 - (5) $\frac{1}{48}$
2. Keisha can drive her car 354 miles on 15 gallons of gasoline. At the same rate, how many miles can she drive her car on 20 gallons of gasoline?
 - (1) 472
 - (2) 359
 - (3) $265\frac{1}{2}$
 - (4) 236
 - (5) Not enough information is given.
3. What is the value of $7\frac{3}{4} + 1\frac{7}{8}$?
 - (1) $8\frac{5}{8}$
 - (2) $8\frac{5}{6}$
 - (3) $8\frac{7}{8}$
 - (4) $9\frac{5}{8}$
 - (5) $10\frac{5}{6}$
4. Usually, Ramon drives $\frac{3}{5}$ mile to pick up Joe. They then drive another $\frac{4}{5}$ mile to work. Today Joe is sick, so Ramon drives 1 mile directly to the office. How much shorter is the direct route?
 - (1) $\frac{2}{5}$ mile
 - (2) $\frac{3}{5}$ mile
 - (3) $\frac{4}{5}$ mile
 - (4) $1\frac{2}{5}$ miles
 - (5) $2\frac{2}{5}$ miles
5. Kathy can type 74 words per minute. At this rate, which expression shows how many words she can type over a period of 7 hours?
 - (1) 74×7
 - (2) $74 \times 60 \times 7$
 - (3) $74 \times \frac{7}{60}$
 - (4) $74 \times \frac{60}{7}$
 - (5) $\frac{74}{60} \times 7$
6. A tank holds 5075 gallons of water. How many containers of water can be filled from the tank if each container holds $6\frac{1}{4}$ gallons?
 - (1) 813
 - (2) 812
 - (3) 811
 - (4) 810
 - (5) Not enough information is given.

7. Which expression could be used to find the number of feet in $\frac{1}{4}$ mile (1 mile = 5280 ft)?

- (1) $\frac{1}{4} + 5280$
- (2) $5280 - \frac{1}{4}$
- (3) $5280 \times \frac{1}{4}$
- (4) $5280 \div \frac{1}{4}$
- (5) $\frac{1}{4} \div 5280$

8. Charles has an annual salary of \$39,000. If he receives a bonus of $\frac{1}{20}$ of his annual salary, what is the approximate amount of his bonus?

- (1) \$ 20
- (2) \$ 200
- (3) \$ 2,000
- (4) \$20,000
- (5) Not enough information is given.

9. Carolyn worked $7\frac{2}{3}$ hours yesterday and $6\frac{3}{5}$ hours today. How many hours did she work in the two days?

- (1) $13\frac{4}{15}$
- (2) $13\frac{5}{8}$
- (3) $14\frac{4}{15}$
- (4) $14\frac{5}{8}$
- (5) Not enough information is given.

10. The scale on the plans for a new highway is $2\frac{1}{2}$ inches equal 2200 feet. If the actual distance between two exits on the highway is 5500 feet, how many inches apart are the two exits on the plans?

- (1) $5\frac{3}{4}$
- (2) 6
- (3) $6\frac{1}{4}$
- (4) $6\frac{1}{2}$
- (5) $6\frac{3}{4}$

Questions 11 through 13 refer to the following table.

Company Profit	
Region	Fraction of Profit
Northeast	$\frac{1}{8}$
Southeast	$\frac{1}{4}$
Northwest	$\frac{1}{8}$
Southwest	$\frac{1}{5}$
Central	$\frac{3}{10}$

11. Which region had the highest fraction of the company's profit?

- (1) Northeast
- (2) Southeast
- (3) Northwest
- (4) Southwest
- (5) Central

12. The fraction of combined profit from the Northeast and Northwest regions is how much greater than the fraction of profit from the Southwest region?

- (1) $\frac{1}{20}$
- (2) $\frac{3}{20}$
- (3) $\frac{1}{5}$
- (4) $\frac{1}{4}$
- (5) $\frac{2}{5}$

13. If the total company profit last year was \$1,987,865, how much profit came from the Southwest region?

- (1) \$ 248,483
- (2) \$ 397,573
- (3) \$ 496,966
- (4) \$ 596,966
- (5) \$9,939,325

Part 2

Directions: Choose the one best answer to each item. You may NOT use your calculator.

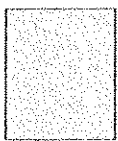
14. On Monday, 4 of the 32 students in the class were absent. What fraction of the class was absent?

(1) $\frac{1}{32}$
(2) $\frac{1}{8}$
(3) $\frac{1}{4}$
(4) $\frac{4}{7}$
(5) $\frac{7}{8}$

15. A flight from New York City to Chicago took $2\frac{4}{5}$ hours. The return flight took $3\frac{1}{8}$ hours. Which of the following expressions represents how much longer the return flight was?

(1) $2\frac{4}{5} + 3\frac{1}{8}$
(2) $3\frac{1}{8} - 2\frac{4}{5}$
(3) $3\frac{1}{8} \times 2\frac{4}{5}$
(4) $3\frac{1}{8} \div 2\frac{4}{5}$
(5) $2\frac{4}{5} \div 3\frac{1}{8}$

16. If you cut $3\frac{7}{16}$ inches off this art paper, how many inches do you have left?



$18\frac{1}{4}$ inches

(1) $12\frac{9}{16}$
(2) $13\frac{1}{4}$
(3) $13\frac{3}{4}$
(4) $14\frac{13}{16}$
(5) Not enough information is given.

17. Richard has a piece of rope that is $6\frac{1}{3}$ feet long, and he cuts off a piece $2\frac{7}{8}$ feet long. After he cuts the piece, approximately how many feet of rope does he have left?

(1) 3
(2) 4
(3) 5
(4) 9
(5) 10

18. A plant grows at a rate of $5\frac{1}{2}$ inches per week. At this rate, which expression shows how many inches the plant will grow in $2\frac{1}{2}$ weeks?

(1) $5\frac{1}{2} + 2\frac{1}{2}$
(2) $5\frac{1}{2} - 2\frac{1}{2}$
(3) $2\frac{1}{2} \times 5\frac{1}{2}$
(4) $2\frac{1}{2} \div 5\frac{1}{2}$
(5) $5\frac{1}{2} \div 2\frac{1}{2}$

19. Kim worked for $5\frac{1}{2}$ hours on Monday, $4\frac{2}{3}$ hours on Tuesday, and $4\frac{3}{5}$ hours on Wednesday. About how much did she earn in the three days?

(1) 15
(2) 30
(3) 40
(4) 80
(5) Not enough information is given.

20. Arnie gets 15 vacation days per year. If he has already used $6\frac{1}{4}$ days this year, which expression shows how many vacation days he has left?

- (1) $6\frac{1}{4} + 15$
- (2) $15 - 6\frac{1}{4}$
- (3) $15 \times 6\frac{1}{4}$
- (4) $15 \div 6\frac{1}{4}$
- (5) $6\frac{1}{4} \div 15$

21. An insurance company estimates that 75 out of every 100 renters do not have insurance on their personal belongings. What fraction of renters do have insurance?

- (1) $\frac{1}{25}$
- (2) $\frac{2}{3}$
- (3) $\frac{1}{10}$
- (4) $\frac{1}{4}$
- (5) $\frac{2}{5}$

22. At Johan's Cafe the cook uses $\frac{1}{3}$ cup of gravy on each serving of mashed potatoes. How many servings can he make from 12 cups of gravy?

- (1) 3
- (2) 4
- (3) 12
- (4) 24
- (5) 36

23. Sarah jogs at an average rate of $\frac{2}{15}$ mile per minute. At this rate, how many miles will she jog in 30 minutes?

- (1) 2
- (2) 4
- (3) $4\frac{1}{2}$
- (4) $7\frac{1}{2}$
- (5) 15

24. A scale on a map shows that $\frac{3}{4}$ inch on the map equals an actual distance of 5 miles. If the actual distance between two cities is 45 miles, how many inches apart are they on the map?

- (1) $6\frac{3}{4}$
- (2) 9
- (3) $9\frac{3}{4}$
- (4) 12
- (5) $12\frac{3}{4}$

Questions 25 and 26 refer to the following table.

Monthly Budget	
Expense	Fraction Budgeted
Rent	$\frac{3}{8}$
Salaries	$\frac{1}{4}$
Advertising	$\frac{1}{5}$
Supplies	$\frac{1}{8}$
Miscellaneous	$\frac{1}{20}$

25. Which of the expenses received the highest amount of the monthly budget?

- (1) Rent
- (2) Salaries
- (3) Advertising
- (4) Supplies
- (5) Miscellaneous

26. If the total amount of the budget for March was \$16,000, how much was budgeted for Salaries and Supplies combined?

- (1) \$ 2,000
- (2) \$ 4,000
- (3) \$ 6,000
- (4) \$ 8,000
- (5) \$10,000

Answers start on page 388.

Lesson 8

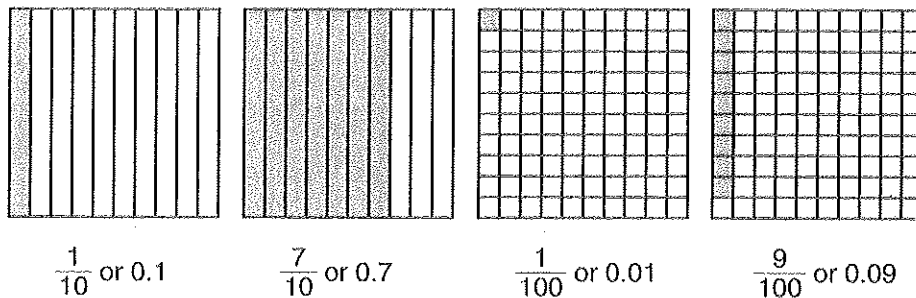
GED SKILL Introduction to Decimals

Understanding Decimals

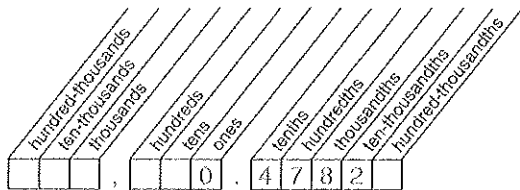
In Lessons 5 through 7, you used fractions to represent quantities less than one. A **decimal number** is another way to express a fractional amount. A decimal is a fraction that uses the place value system. For each diagram below, the shaded portion is expressed as both a fraction and a decimal.



To show thousandths, imagine dividing each box on a hundredths chart into 10 equal pieces. To show ten-thousandths, imagine dividing each box into 100 equal pieces.



The chart shows the names of the first five decimal place values. Notice that the whole numbers are to the left of the decimal point and the decimals are to the right.



Compare the whole number and decimal place values. Do you see a pattern? Think of the ones column and decimal point as the center of the chart. As you move out from the center, the column names are related.

As you move to the left on the chart, each column is 10 times greater than the column to its right. As you move to the right, the value of the columns becomes smaller. Each column is $\frac{1}{10}$ the value of the column to its left.

As with whole numbers, the sum of the values of the digits equals the total value of the number.

Example 1 What is the value of each digit in 0.4782?

4 is in the tenths place.	4×0.1	= 0.4
7 is in the hundredths place.	7×0.01	= 0.07
8 is in the thousandths place.	8×0.001	= 0.008
2 is in the ten-thousandths place.	$+ 2 \times 0.0001$	= 0.0002
		0.4782

Note: When a decimal number does not have a whole number part, a zero is often written to the left of the decimal point. The zero has no value.



The zero in the tenths place of 16.034 is a **placeholder**. Its only purpose is to fill the space between the whole number and the digits farther to the right.

Example 2 How do you write 16.034 in words?

Read the whole number part of the number. Say *and* to represent the decimal point. Read the digits to the right of the decimal point, and say the place name of the last digit on the right. Note that there are no commas setting off groups of three digits in the decimal part of the number to the right of the decimal point.

The number 16.034 is read *sixteen and thirty-four thousandths*.

GED SKILL FOCUS

A. Write the value of the underlined digit in words. Refer to the chart on page 98.

Example: 1.5409 four hundredths

1. 10.9251 _____

4. 36.0029 _____

2. 7.85 _____

5. 4.162 _____

3. 255.07 _____

6. 17.296 _____

B. Match each number in Column A with its word form in Column B.

Column A

Column B

_____ 7. 1.35

a. one and three hundred five thousandths

_____ 8. 1.035

b. one and thirty-five thousandths

_____ 9. 1.305

c. one and thirty-five hundredths

_____ 10. 1.0305

d. one and three hundred five ten-thousandths

_____ 11. 1.2

a. twelve hundredths

_____ 12. 0.12

b. twelve thousandths

_____ 13. 0.0012

c. twelve ten-thousandths

_____ 14. 0.012

d. one and two tenths

C. Write each number in word form.

Example 20.08 twenty and eight hundredths

15. 5.25 _____

20. 4.05 _____

16. 6.008 _____

21. 3.9 _____

17. 0.37 _____

22. 0.08 _____

18. 1.01 _____

23. 3.004 _____

19. 2.005 _____

24. 12.6 _____

Answers start on page 389.

Rounding, Comparing, and Ordering Decimals

The steps for rounding decimals are similar to those you used for rounding whole numbers. There is one important difference in **Step 3**.

Example 1 Round 5.362 to the nearest tenth.

- Step 1** Find the digit you want to round to.
It may help to circle it. 5.362
- Step 2** Look at the digit immediately to the right of the circled digit. 5.362
- Step 3** If the digit to the right is 5 or more, add 1 to the circled digit. If the digit to the right is less than 5, do not change the circled digit. *Drop the remaining digits.* 5.4

Examples Round to the indicated place value.

Round 1.832 to the nearest hundredth. $1.8\textcircled{3}2$ rounds to **1.83**

Round 16.95 to the nearest tenth. $16.\textcircled{9}5$ rounds to **17.0**

Round 3.972 to the ones place. $\textcircled{3}.972$ rounds to **4**



Remember that $>$ means *is greater than* and $<$ means *is less than*. The arrow points to the smaller number.

Comparing decimals uses an important mathematical concept. You can add zeros to the right of the last decimal digit without changing the value of the number. Study these examples.

RULE When comparing decimals with the same number of decimal places, compare them as though they were whole numbers.

Example Which is greater, 0.364 or 0.329?
Both numbers have three decimal places. Since 364 is greater than 329, the decimal **0.364** $>$ **0.329**.

The rule for comparing whole numbers in which the number with more digits is greater does not hold true for decimals. The decimal number with more decimal places is not necessarily the greater number.

RULE When decimals have a different number of digits, write zeros to the right of the decimal with fewer digits so the numbers have the same number of decimal places. Then compare.

Example Which is greater, 0.518 or 0.52?
Add a zero to 0.52: 0.518 ? 0.520
Since $520 > 518$, the decimal **0.52** $>$ **0.518**.

RULE When numbers have both whole number and decimal parts, compare the whole numbers first.

Example Compare 32.001 and 31.999.
Since 32 is greater than 31, the number **32.001 is greater than 31.999**. It does not matter that 0.999 is greater than 0.001.

Using the same rules, you can put several numbers in order according to value. When you have several numbers to compare, write the numbers in a column and line up the decimal points. Then add zeros to the right until all the decimals have the same number of decimal digits.



The values of the digits can help you compare decimals. Both decimals in the example have 5 tenths, but 0.52 has 2 hundredths and 0.518 has only 1 hundredth, so **0.52** $>$ **0.518**.

Example 2 A digital scale displays weight to thousandths of a pound.
Three packages weigh 0.094 pound, 0.91 pound, and
0.1 pound. Arrange the weights in order from greatest to least.

- | | | |
|---------------|--|-------|
| Step 1 | Write the weights in a column, aligning the decimal point. | 0.094 |
| Step 2 | Add zeros to fill out the columns. | 0.910 |
| Step 3 | Compare as you would whole numbers. | 0.100 |

In order from greatest to least, the weights are **0.91, 0.1, and 0.094 pound.**

GED SKILL FOCUS

A. Round each number as directed. Refer to the chart on page 98.

1. Round 3.5719 to the tenths place. _____
2. Round 5.132 to the hundredths place. _____
3. Round 0.543 to the ones place. _____
4. Round 7.0813 to the tenths place. _____
5. Round 1.0699 to the thousandths place. _____

B. Compare the following numbers. Write $>$, $<$, or $=$ between the numbers.

- | | |
|----------------------|----------------------|
| 6. 0.32 _____ 0.3109 | 10. 1.075 _____ 1.57 |
| 7. 0.98 _____ 1.9 | 11. 0.18 _____ 0.108 |
| 8. 0.5 _____ 0.50 | 12. 2.38 _____ 2.83 |
| 9. 0.006 _____ 0.06 | 13. 3.60 _____ 3.600 |

C. Solve as directed.

14. Russ inspects transistors. In one test, he measures the masses of four transistors as given below. He needs to report the mass of the transistors in grams (g) rounded to the nearest tenth. What mass should Russ report for each?

Transistor A: 0.3619 g
Transistor B: 0.7082 g
Transistor C: 0.0561 g
Transistor D: 0.9357 g

15. The weights of four packages are given below. Arrange the weights in order from greatest to least.

Package 1: 0.5 pound
Package 2: 0.05 pound
Package 3: 0.15 pound
Package 4: 1.1 pounds

16. A fifth package weighs 0.55 pound. Does it weigh more or less than Package 1?

Answers start on page 389.

GED STRATEGY Solving Word Problems

Estimation and Money

Estimating with money can be a very useful skill. In many everyday situations involving money, you do not need exact amounts. For example, you can estimate when you want to know if you have enough cash to pick up the three things you want at the grocery store or about how much each person should contribute to split the cost of lunch. In such cases, you can use amounts rounded to the nearest dollar (the ones place).

Example 1 Using the price list, about how much would Pat pay for a steering wheel cover, a wide-angle mirror, and an oil drip pan?

- (1) between \$31 and \$33
- (2) between \$33 and \$35
- (3) between \$35 and \$37
- (4) between \$37 and \$39
- (5) between \$39 and \$41

Auto Parts Price List	
Outside Wide-Angle Mirror	\$13.45
Steering Wheel Cover	\$15.95
Oil Drip Pan	\$ 8.73
Windshield Washer Fluid	\$ 2.85
Brake Fluid	\$ 6.35

Round the cost of each item to the nearest dollar and find the total of the estimates.

Item	Cost	Estimate
Steering wheel cover	\$15.95	\$16
Wide-angle mirror	13.45	13
Oil drip pan	8.73	+ 9
Total:		\$38

The best estimate is **option (4) between \$37 and \$39**.

You can also use estimation in multiplication and division problems.

Example 2 Use the price list to estimate the number of bottles of brake fluid a customer could buy for \$20.

- (1) 1
- (2) 2
- (3) 3
- (4) 4
- (5) 5

Round the price of one bottle of brake fluid to the nearest dollar: \$6.35 rounds to \$6. Divide \$20 by \$6: $\$20 \div \$6 = 3$ with a remainder of 2. The customer could expect to buy 3 bottles and have some change left over. The correct answer is **option (3) 3**.



Some remainders must be ignored. Since you cannot buy a partial package of most items you must ignore any remainder—this is your "change." For example, \$20 is only enough to buy 3 bottles of \$6 brake fluid; you have \$2 change.

GED PRACTICE

Directions: Choose the one best answer to each question.

Questions 1 through 3 refer to the chart.

Computer Game	Regular Price	Sale Price
Fast Pitch	\$11.79	\$8.99
Par 4	8.85	6.29
Dugout Derby	17.25	12.78
Crown of Power	13.72	10.09
Thunderclap Mine	12.99	9.25
Batwing	10.77	7.98

- Lee wants to buy Fast Pitch, Crown of Power, and Dugout Derby. About how much will the three games cost on sale?
 - between \$5 and \$10
 - between \$10 and \$15
 - between \$15 and \$25
 - between \$25 and \$35
 - between \$35 and \$45
- Ana has \$20 to spend on computer games. If she buys Dugout Derby on sale, which other game can she afford to buy on sale?
 - Batwing
 - Thunderclap Mine
 - Crown of Power
 - Fast Pitch
 - Par 4
- Mark wants to buy Dugout Derby and Crown of Power. About how much will he save by buying the games on sale?
 - \$ 4
 - \$ 8
 - \$11
 - \$12
 - Not enough information is given.
- Hank's Hardware sells carbon monoxide detectors for \$38.83 and smoke detectors for \$12.39. Choose the best estimate for the cost of 4 smoke detectors.
 - \$12
 - \$24
 - \$40
 - \$48
 - \$52
- Hank's Hardware sells a carton containing 6 boxes of nails. If the carton costs \$17.85, about how much does each box of nails cost?
 - \$ 3
 - \$ 6
 - \$18
 - \$26
 - \$36
- Twice a month, \$27.50 is deducted from Petra's paycheck for health insurance. About how much does she contribute per year for health insurance?
 - \$ 30
 - \$ 60
 - \$360
 - \$600
 - \$700

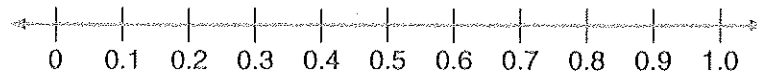


It's often helpful to round dollar amounts to the nearest \$5 or \$10. Although these estimates may not be as accurate as rounding to the nearest dollar, they are easier to work with.

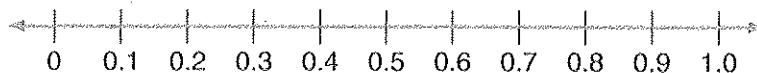
Answers start on page 390.

GED SKILL Decimals on Number Lines

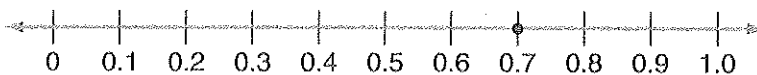
Earlier in the book you used number lines for locating whole numbers and fractions. Number lines can also be used to compare decimals. On the number line below, each of the ten equally spaced intervals represents an increase of $\frac{1}{10}$, or 0.1, as you move to the right.



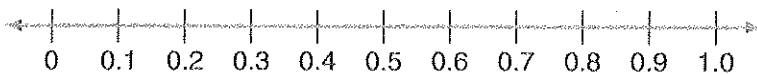
Example 1 Place a dot on the number line below to show the location of the decimal equivalent of $\frac{7}{10}$.



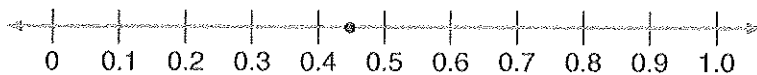
Seven-tenths, or **0.7**, is located at the seventh hash mark to the right of 0.



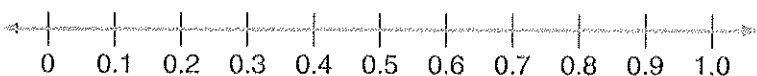
Example 2 Place a dot on the number line below to locate the decimal equivalent of $\frac{45}{100}$.



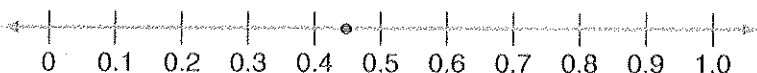
The decimal equivalent of $\frac{45}{100}$ is **0.45**, which is halfway between the hash marks labeled 0.4 and 0.5 on the number line. The dot shown on the number line below is correct.



Example 3 Place a dot on the number line to show 0.453 rounded to the nearest hundredth.



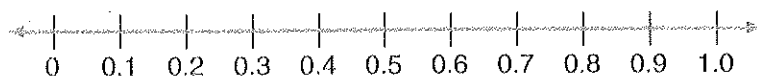
Since 3 in the thousandths place is less than 5, 0.453 rounds down to **0.45**.



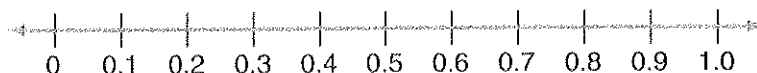
GED SKILL FOCUS

Solve the following problems. Show your answers by correctly placing a dot on the number line below each problem.

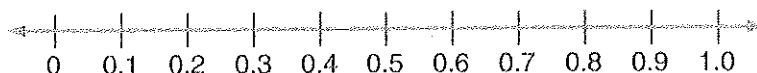
1. Place a dot on the number line below to show the location of the decimal equivalent of five-tenths.



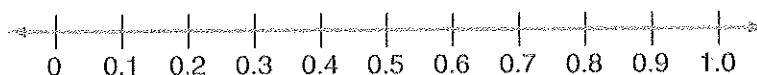
2. Place a dot on the number line below to show the location of the decimal halfway between five-tenths and six-tenths.



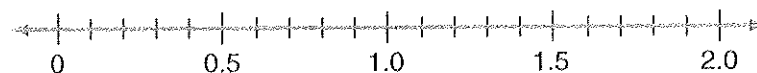
3. Place a dot on the number line below that shows 0.825 rounded to the nearest tenth.



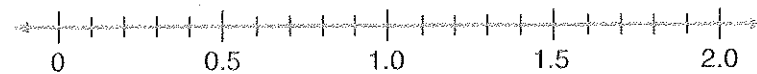
4. Place a dot on the number line below to show the decimal equivalent of $\frac{245}{1000}$ rounded to the nearest hundredth.



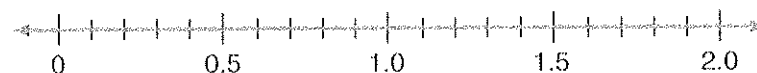
5. Place a dot on the number line below to show the decimal equivalent of one and three-tenths.



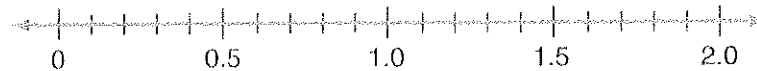
6. Place a dot on the number line below that shows the mixed number one and six hundred twenty-five thousandths rounded to the nearest tenth.



7. Place a dot on the number line below that shows the decimal equivalent of $1\frac{1}{4}$ rounded to the nearest tenth.



8. Place a dot on the number line below that shows 1.025 rounded to the nearest tenth.



Answers start on page 390.

Adding and Subtracting Decimals

Example 1 Anna assembles machine parts. One part comes in two sections with lengths of 4.875 and 3.25 centimeters. Once assembled, what is the total length of the two sections?

Step 1 To add, write the numbers so that the decimal points are aligned. If necessary, write zeros to the right of the last digit so that all the numbers have the same number of decimal places.

$$\begin{array}{r} 4.875 \\ + 3.250 \\ \hline \end{array}$$

Step 2 Add as you would with whole numbers. Regroup as needed.

$$\begin{array}{r} 11 \\ 4.875 \\ + 3.250 \\ \hline 8.125 \end{array}$$

Step 3 Align the decimal point in the answer with the decimal points in the problem.

$$\begin{array}{r} 4.875 \\ + 3.250 \\ \hline 8.125 \end{array}$$



When adding decimals with a calculator, be sure to enter the decimal points where they are needed.

4 . 8 7 5 + 3 . 2 5 = 8 . 1 2 5

The total length of the assembled parts is **8.125 centimeters**.



When you work with money amounts on a calculator, be careful how you read the results. The sum of \$5.55 and \$3.75 would appear as 9.3 on the calculator display, but the answer is \$9.30.

Example 2 Cesar has \$213 in a checking account. If he writes a check for \$32.60, how much will be left in the account?

Step 1 To subtract, write the numbers so that the decimal points are aligned. Note that a number without a decimal point is understood to have one to the right of the ones place. If necessary, write zeros to the right of the last digit in a number.

$$\begin{array}{r} \$213.00 \\ - 32.60 \\ \hline \end{array}$$

Step 2 Subtract as you would with whole numbers. Regroup as needed.

$$\begin{array}{r} 1012 \\ 10 \\ 210 \\ \$213.00 \\ - 32.60 \\ \hline \$180.40 \end{array}$$

Step 3 Align the decimal point in the answer with the decimal points in the problem.

$$\begin{array}{r} \$213.00 \\ - 32.60 \\ \hline \$180.40 \end{array}$$

Cesar will have **\$180.40** left in his checking account.

GED SKILL FOCUS

A. Solve the decimal problems using paper and pencil. Align problems on decimal points.

$$\begin{array}{r} 1. \quad 0.03 \\ + 2.60 \\ \hline \end{array}$$

$$\begin{array}{r} 9. \quad 1.85 \\ \quad 0.03 \\ 19.007 \\ + 62 \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad 1.35 \\ + 4.05 \\ \hline \end{array}$$

$$\begin{array}{r} 10. \quad 12.4 \\ \quad 11.08 \\ \quad 16.1 \\ + 4.575 \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 6.90 \\ - 1.353 \\ \hline \end{array}$$

$$\begin{array}{r} 11. \quad 16,004.1 \\ - 6,972.1 \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad 5.075 \\ - 2.15 \\ \hline \end{array}$$

$$\begin{array}{r} 12. \quad 3.8 \\ - 1.006 \\ \hline \end{array}$$

$$5. \quad 7.1 + 8.003$$

$$13. \quad 12.87 - 9.923$$

$$6. \quad 10.3 - 6.125$$

$$14. \quad 23.07 - 5.965$$

$$7. \quad 3.61 + 1.2$$

$$15. \quad 14.01 + 8.6 + 0.058$$

$$8. \quad 16.05 - 4.27$$

$$16. \quad 56.8 - 24.95$$



B. Use your calculator to solve these problems.

$$17. \quad 0.95 + 1.843 + 3.008 + 0.9$$

$$20. \quad 39.05 - 15.7$$

$$18. \quad 0.6 - 0.3407$$

$$21. \quad 0.125 + 1.4 + 3.76 + 0.01$$

$$19. \quad 3.15 + 2.816 + 4.05 + 0.3$$

$$22. \quad 25.6 - 12.85$$

Answers start on page 391.

Multiplying and Dividing Decimals



To multiply by a power of 10 (10, 100, . . .), count the number of zeros and move the decimal point that number of places to the right.

$$1.4 \times 100 = 140$$

Example 1 In the deli department at a grocery store, a block of cheese weighs 1.6 pounds and costs \$1.79 per pound. To the nearest whole cent, what is the cost of the cheese?

- Step 1** Multiply the price per pound by the number of pounds. Multiply as you would with whole numbers. Note that there is no need to align the decimal points when multiplying.
- $$\begin{array}{r} \$1.79 \\ \times 1.6 \\ \hline 1074 \\ + 1790 \\ \hline 2864 \end{array}$$
- Step 2** Count the decimal places in the original problem to find how many decimal places are needed in the answer. Place the decimal point in the answer. Starting at the right, count three decimal places.
- $$\begin{array}{l} \$1.79 \leftarrow 2 \text{ decimal places} \\ \times 1.6 \leftarrow 1 \text{ decimal place} \\ \hline \$2.864 \leftarrow 3 \text{ decimal places} \end{array}$$
- Step 3** The problem says to round your answer to the nearest whole cent. Therefore, round to the hundredths place.
- $$\$2.864 \text{ rounds to } \$2.86$$



Enter the numbers to be multiplied. Notice that dollar signs are not entered into a calculator.

$$1.79 \times 1.6 = 2.864$$

The block of cheese costs **\$2.86**.



To divide by a power of 10, count the number of zeros and move the decimal point that number of places to the left.

$$1.4 \div 100 = .014$$

Example 2 Marvin bought a portable CD player for \$74.55. He plans to pay for it in 6 payments. How much will each payment be? Round your answer to the nearest cent.

- Step 1** Set up the problem. Place the decimal point in the answer directly above the decimal point in the problem.
- $$\begin{array}{r} \$12.425 \\ 6 \overline{) \$74.550} \end{array}$$
- Step 2** Divide as you would with whole numbers. If there is a remainder, write a zero to the right of the last decimal place in the number you are dividing. Continue this process until either there is no remainder or you reach one place to the right of the desired place value.
- $$\begin{array}{r} 12 \\ 6 \overline{) 74.550} \\ \underline{6} \\ 14 \\ \underline{12} \\ 25 \\ \underline{24} \\ 15 \\ \underline{12} \\ 30 \\ \underline{30} \\ 0 \end{array}$$
- Step 3** Round your answer to the nearest whole cent.
- $$\$12.425 \text{ rounds to } \$12.43$$



Enter the numbers to be divided. Remember that it's important to enter the number being divided *first*.

$$74.55 \div 6 = 12.425$$

Each payment is **\$12.43**.

Example 3 A pharmacist is preparing capsules with 0.007 gram of aspirin each. How many capsules can be prepared with 14 grams of aspirin?

- Step 1** Set up the problem. To divide by a decimal, make the divisor (the number you are dividing by) a whole number. In this problem, move the decimal point three places to the right in the divisor. Write zeros to the right of the number you are dividing so that you can move the decimal point the same number of places: three.
- Step 2** Place the decimal point in the answer directly above the decimal point in the number you are dividing. Divide as you would with whole numbers.

$$0.007 \overline{)14.000}$$

$$\begin{array}{r} 2,000. \\ 7 \overline{)14,000} \\ \underline{14} \end{array}$$



Enter the numbers to be divided. Notice that you do not need to move the decimal point when working with a calculator.

$$14 \div 0.007 = 2000.$$

The pharmacist can prepare **2,000 capsules**.

GED SKILL FOCUS

A. Place the decimal point in each answer. You may need to add zeros.

1. $8.5 \times 0.4 =$ 3 4 0

4. $12 \times 3.06 =$ 3 6 7 2

2. $0.04 \times 0.6 =$ 2 4

5. $21.1 \times 14.7 =$ 3 1 0 1 7

3. $5.6 \times 0.002 =$ 1 1 2

6. $0.008 \times 12 =$ 9 6

B. Solve the decimal problems using paper and pencil.

7. 1.07×12

11. 2.27×1.8

15. 0.008×2.5

8. 0.09×6.1

12. 5.04×15

16. 1.05×0.11

9. $8 \overline{)20.48}$

13. $3.6 \overline{)7.704}$

17. $6 \overline{)0.021}$

10. $3 \overline{)3.2916}$

14. $1.05 \overline{)6.3987}$

18. $0.07 \overline{)4.34}$



C. Use your calculator to solve these problems. Round answers to the nearest hundredth.

19. 0.012×12

21. 7.15×0.03

23. 12.25×1.5

20. $7 \overline{)2}$

22. $11 \overline{)3}$

24. $6 \overline{)5}$

Answers start on page 391.

GED STRATEGY Solving Word Problems

Solving Multi-Step Problems



Remember to use the order of operations:

1. First, do all operations in parentheses.
2. Next, do multiplication or division.
3. Then, do addition or subtraction.

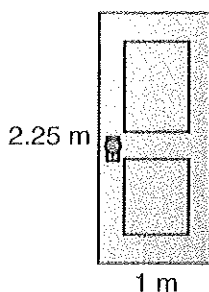
Example 1 Jeri buys an item that costs \$5.24. She also pays \$0.31 sales tax. If Jeri pays with a \$20 bill, which expression shows how much change Jeri should receive?

- (1) $\$20 + \$5.24 + \$0.31$
- (2) $\$5.24 + \$0.31 - \$20$
- (3) $\$20 - \$5.24 + \$0.31$
- (4) $\$5.24 - (\$0.31 + \$5.24)$
- (5) $\$20 - (\$5.24 + \$0.31)$

Read the problem carefully. What do you need to know to solve the problem? You need to know the total cost (cost of the item plus sales tax). You also need to find the difference between the amount paid and the total cost. In other words, subtract the total cost from \$20.

- Option (1) is incorrect because it adds the three amounts.
- In option (2), \$20 is subtracted from the total of \$5.24 and \$0.31. Subtracting \$20 from the total is not the same as subtracting the total from \$20.
- Option (3) is incorrect because no parentheses means that only \$5.24, rather than the sum of \$5.24 and \$0.31, is subtracted from \$20.
- Option (4) is incorrect because the sum is subtracted from \$5.24, not from \$20.
- **Option (5) is correct.** Because of the parentheses, finding the total cost of the item is the first step ($\$5.24 + \$0.31$). Then the total cost is subtracted from \$20.

Example 2 Martin is putting weather stripping around the sides and top of his home's doorways. If the weather stripping comes in packages of 15.47 meters, how many meters of weather stripping will be left after Martin lines two doors like the one shown here?



- (1) 4.47
- (2) 5.5
- (3) 9.97
- (4) 11.0
- (5) Not enough information is given.

- Step 1** Find the total distance around the two sides and top of the doorway. $(2.25 + 1 + 2.25)$
- Step 2** Since Martin lined two doorways, find twice the amount found in Step 1. $2(2.25 + 1 + 2.25)$
- Step 3** Subtract the amount of weather stripping used for two doorways from the 15.47 meters that Martin started with. $15.47 - 2(2.25 + 1 + 2.25)$
 $15.47 - 2(5.5)$
 $15.47 - 11 = 4.47$

Option (1) is correct. There will be 4.47 meters of weather stripping left.

GED PRACTICE

Directions: Choose the one best answer to each question.

Questions 1 and 2 refer to the following information.

Wanda has \$35 in cash. She buys a blouse for \$12.98, a belt for \$10.67, and a poster for \$5.98.

1. Which expression shows how much money Wanda has left to pay for sales tax?
 - (1) $\$35 - \$12.98 + (\$10.67 - \$5.98)$
 - (2) $\$35 - (\$12.98 + \$10.67 + \$5.98)$
 - (3) $(\$35 + \$12.98) - (\$10.67 + \$5.98)$
 - (4) $\$35 + (\$12.98 - \$10.67 - \$5.98)$
 - (5) $\$35 - \$12.98 + \$10.67 + \$5.98$
2. If Wanda pays \$2.37 in sales tax, how much does she have left?
 - (1) \$ 3.00
 - (2) \$ 5.37
 - (3) \$22.02
 - (4) \$29.63
 - (5) \$32.00

Question 3 refers to the following information.

The Computer Center sells recordable CDs for \$0.89 each. Computer Warehouse sells the same CDs for \$1.05 each.

3. Which expression shows how much a customer will save by buying 25 recordable CDs at The Computer Center?
 - (1) $25(\$1.05 - \$0.89)$
 - (2) $25(\$1.05 + \$0.89)$
 - (3) $25 - (\$1.05 + \$0.89)$
 - (4) $25 + (\$1.05 - \$0.89)$
 - (5) $25 \div (\$1.05 - \$0.89)$

Questions 4 and 5 refer to the following information.

Sam's Garage	
Tire	\$45.79
Brakes	\$89.99
Oil Change	\$18.25

4. Antonio bought two tires and an oil change at Sam's Garage. Which expression shows how much Antonio spent?
 - (1) $2(\$45.79 + \$18.25)$
 - (2) $2(\$45.79 - \$18.25)$
 - (3) $2(\$45.79) + \$18.25$
 - (4) $2(\$45.79) - \$18.25$
 - (5) $2(\$45.79) \div 2(\$18.25)$
5. Another garage had the same tires for sale for \$50 each. How much did Antonio save on two tires by going to Sam's?
 - (1) \$ 4.21
 - (2) \$ 8.42
 - (3) \$ 45.79
 - (4) \$ 91.58
 - (5) \$100.00
6. Angelo's yearly salary increased from \$18,575 to \$21,000. What was the monthly increase? Round your answer to the nearest dollar.
 - (1) \$2,425
 - (2) \$2,021
 - (3) \$1,750
 - (4) \$1,548
 - (5) \$ 202

Answers start on page 392.

GED STRATEGY Working with Special Formats

Writing Decimals in a Standard Grid

Earlier in this book you learned how to use the standard grid with whole numbers and fractions. You'll be using the same grid when working with decimals.

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Points to remember:

- Each grid is used to enter a single answer.
- When filling in a grid for a decimal answer, your answer can start in any of the columns as long as the final answer is complete.
- Note that the $\odot$ stands for a decimal point.
- Leave any unused columns blank.
- Fill in only one value for each column.

Example Sarah is responsible for tracking her time on a job. She spent 3.75 hours, 4.5 hours, and 1.25 hours getting a customer's computer system running. How many hours did she spend in all on this customer's computer problem?

The problem asks you to find the total number of hours Sarah spent on the customer's computer problem. Add together the hours she worked:

$$3.75 + 4.5 + 1.25 = 9.5$$

Fill in your answer on the grid. Note that all three grids are filled in correctly.

9	.	5		
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	9	.	5	
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

		9	.	5
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

GED PRACTICE

Directions: Solve the following problems. Enter your answers on the grids provided.

1. Marta rides her bike three times a week. She tries to ride a short distance farther each time. This week she rode 4.5 miles, 5.25 miles, and 6 miles. What was her total distance for the week?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

3. A piece of copper tubing is 60 inches long. Assuming there is no waste, how many pieces measuring 1.2 inches in length can be cut from the piece of tubing?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

2. Manny's batting average was .275 last year. This year his batting average reached a career high of .340. By how much did his average increase?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

4. Marita ordered 14 parts that cost \$2.99 per part. How much was the total order?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Answers start on page 392.

Changing Decimals to Fractions

Both decimals and fractions can be used to show part of a whole. Sometimes it is easier to calculate using fractions. At other times, decimals are more useful. If you know how to change from one form to the other, you can solve any problem using the form that is best for the situation.

Example 1 Josh is solving a problem using a calculator. The calculator display reads 0.375, but he needs to write the answer in the form of a fraction. Change 0.375 to a fraction.

Step 1 Write the number without the decimal point as the numerator of the fraction.

$$0.375 = \frac{375}{?}$$

Step 2 Write the place value for the last decimal digit as the denominator.

$$0.375 = \frac{375}{1000}$$

Step 3 Reduce the fraction to lowest terms.

$$\frac{375 \div 125}{1000 \div 125} = \frac{3}{8}$$

The decimal 0.375 is equal to the fraction $\frac{3}{8}$.

As you work with money, you will sometimes see decimals with a fraction part. This combination is commonly found as a **unit price**, the cost of one item or unit.

Example 2 On a grocery store shelf, Rita reads that the price per ounce for a brand of shampoo is $\$0.33\frac{1}{3}$. What fraction of a dollar is the unit price?

Step 1 Write the fraction as you did in the example above.

$$0.33\frac{1}{3} = \frac{33\frac{1}{3}}{100}$$

Step 2 In your work with improper fractions, you learned that the fraction bar indicates division.

$$\frac{33\frac{1}{3}}{100} \text{ means}$$

$$33\frac{1}{3} \div 100$$

Step 3 Use the rules for dividing mixed numbers. Change both numbers to improper fractions, invert the number you are dividing by, and multiply.

$$33\frac{1}{3} \div 100 = \frac{100}{3} \div \frac{100}{1} = \frac{100}{3} \times \frac{1}{100} = \frac{1}{3}$$

The unit price is $\frac{1}{3}$ of a dollar.



To find the number of zeros you need in the denominator of a fraction, count the number of decimal places in the decimal you are converting. For example:

$$0.375 = \frac{375}{1000}$$

3 decimal places 3 zeros

GED SKILL FOCUS

A. Change these decimals to fractions. Reduce all fractions to lowest terms.

1. $0.25 =$

7. $0.128 =$

13. $0.26\frac{2}{3} =$

2. $0.4 =$

8. $0.05 =$

14. $0.06\frac{2}{3} =$

3. $0.35 =$

9. $0.31\frac{1}{4} =$

15. $0.23\frac{3}{4} =$

4. $0.875 =$

10. $0.08\frac{1}{3} =$

16. $0.08\frac{1}{6} =$

5. $0.8 =$

11. $0.46\frac{2}{3} =$

17. $0.10\frac{5}{6} =$

6. $0.76 =$

12. $0.93\frac{3}{4} =$

18. $0.12\frac{3}{4} =$



B. For each calculator display, write the decimal in fraction form. Then reduce each fraction to lowest terms if needed.

19. $0.9 = \frac{?}{10}$

22. $0.125 =$

20. $0.625 =$

23. $0.55 =$

21. $0.28 =$

24. $0.3125 =$

C. Solve. Simplify your answers. Remember to change all mixed numbers to improper fractions.

25. A brand of raspberry jam costs $\$0.43\frac{3}{4}$ per ounce. What fraction of a dollar is the unit price?

27. The unit price of a bagel is $37\frac{1}{2}$ cents. What fraction of a dollar is the unit price?

26. A brand of frozen drink concentrate is $\$0.16\frac{2}{3}$ per ounce of concentrate. Write the unit price as a fraction.

28. A company announces a unit price increase of $\$0.02\frac{1}{2}$ per pound. Write the decimal as a fraction.

Answers start on page 393.

Changing Fractions to Decimals

To solve some problems, you may need to change a fraction to a decimal. To do so, you perform the division indicated by the fraction bar.

Example 1 Change $\frac{2}{5}$ to a decimal.

Step 1 Divide the numerator by the denominator:

$$\begin{array}{r} 5 \overline{)2} \end{array}$$

Step 2 Set the decimal point in the answer directly above the decimal point in the problem. Add zeros and continue dividing until the remainder is zero, or until you reach the desired number of decimal places.

$$\begin{array}{r} 0.4 \\ 5 \overline{)2.0} \\ \underline{2.0} \end{array}$$

The fraction $\frac{2}{5}$ equals the decimal **0.4**.

A few fractions have decimal equivalents that contain a digit or group of digits that repeats. Round **repeating decimals** to a certain decimal place or express the remainder as a fraction.

Example 2 Change $\frac{2}{9}$ to a decimal. Show the answer to the hundredths place with the remainder expressed as a fraction.

Step 1 Divide the numerator by the denominator:

$$\begin{array}{r} 9 \overline{)2} \end{array}$$

Step 2 You can see that the division will continue repeating because the subtraction is the same each time. Write the remainder as a fraction by writing the remainder, 2, over the divisor, 9.

$$\begin{array}{r} 0.22 \\ 9 \overline{)2.00} \\ \underline{18} \\ 20 \\ \underline{18} \end{array}$$

The fraction $\frac{2}{9}$ equals the decimal **0.22 $\frac{2}{9}$** .

As you may know, a unit price is often stated as a decimal with a fraction. The fraction expresses part of one cent.

Example 3 The unit price of a brand of fruit punch is $8\frac{1}{2}$ cents per ounce. What is the cost of 32 ounces of the punch?

Multiply 32 by $8\frac{1}{2}$ or $\$0.08\frac{1}{2}$ to solve the problem.

$$\begin{array}{r} 32 \end{array}$$

Change the fraction part of the decimal to a

$$\begin{array}{r} \times 0.085 \end{array}$$

decimal digit. The fraction $\frac{1}{2}$ converts to

$$\begin{array}{r} 160 \end{array}$$

0.5 ($1 \div 2 = 0.5$). So $8\frac{1}{2}$ cents can be written

$$\begin{array}{r} + 2.560 \end{array}$$

as 8.5 cents or \$0.085. Multiply.

$$\begin{array}{r} 2.720 \end{array}$$

The cost of 32 ounces of fruit punch is **\$2.72**.

Example 4 What is the cost per pound of a 20-pound bag of dog food that sells for \$12.75?

Divide \$12.75 by 20 to two decimal places.

$$\begin{array}{r} 0.63 \\ 20 \overline{)12.75} \end{array}$$

Write the remainder as a fraction and reduce

$$\begin{array}{r} 120 \end{array}$$

to lowest terms. $\frac{15}{20} = \frac{3}{4}$

$$\begin{array}{r} 75 \end{array}$$

$$\begin{array}{r} 60 \end{array}$$

$$\begin{array}{r} 15 \end{array}$$

The unit price of one pound of dog food is **63 $\frac{3}{4}$ cents**.



If you prefer working with fractions, multiply 32 by $8\frac{1}{2}$. Then express your answer as 2 dollars and 72 cents. Always choose a method for solving a problem that makes the most sense to you.

GED SKILL FOCUS

A. Change these fractions to decimals. Round to three decimal places.

1. $\frac{4}{5} =$

5. $\frac{11}{20} =$

9. $\frac{3}{5} =$

2. $\frac{3}{8} =$

6. $\frac{5}{8} =$

10. $\frac{7}{25} =$

3. $\frac{2}{3} =$

7. $\frac{17}{40} =$

11. $\frac{7}{10} =$

4. $\frac{5}{12} =$

8. $\frac{3}{4} =$

12. $\frac{1}{8} =$

B. Change these fractions to decimals. Divide to two decimal places and write the remainder as a fraction.

13. $\frac{5}{6} =$

16. $\frac{1}{16} =$

14. $\frac{8}{9} =$

17. $\frac{3}{11} =$

15. $\frac{7}{15} =$

18. $\frac{1}{3} =$

C. Solve.

19. An all-purpose cleaner costs $10\frac{3}{4}$ cents per ounce. What is the cost of a 32-ounce bottle?

20. A breakfast cereal costing \$4.23 contains 18 servings per box. What is the cost of 1 serving?

21. A store sells two brands of masking tape. Brand A comes in 50-yard rolls and sells for \$2.70. Brand B comes in 60-yard rolls and sells for \$3.18. Which brand has the best price per yard?

22. A brand of hot cereal costs $6\frac{1}{2}$ cents per serving. What is the price of a box containing 24 servings?

23. A 28-ounce jar of Zesty spaghetti sauce costs \$2.59. The store brand comes in a 26-ounce jar and sells for \$2.47. Find the price per ounce for each brand. Which is the better buy?

24. A brand of peanut butter costs $13\frac{1}{4}$ cents per ounce. What is the cost of a 16-ounce jar?

Answers start on page 394.

Using Decimals and Fractions with a Standard Grid

When using the standard grid shown below to write decimal or fractional answers, you may choose the form of your answer. You may write your answer either as a decimal or as a fraction. Both forms will be marked correct. For example, if you get the fractional answer $\frac{3}{4}$, you may enter either the fraction or the decimal 0.75 on the grid. The reverse is also true. An answer of 0.5 could be entered as either .5 (without the zero) or $\frac{1}{2}$.

Here are some important points to keep in mind when using the standard grid with decimals or fractions:

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

- The grid is used to enter a single answer.
- Your answer can start in any of the five columns, as long as your answer is complete. Any unused columns should be left blank.
- Write your answer in the blank row at the top of the grid. Use this as a guide to filling in the "bubble" rows.
- If you express the answer as a decimal, fill in the whole number part of the answer, then the decimal point in the third row of the grid, then the decimal.
- If you express the answer as a fraction, fill in the numerator of the fraction, then the fraction bar in the second row of the grid, /, and then the denominator of the fraction.
- Mixed fractions cannot be entered on the grid. Therefore, change a mixed fraction to either a decimal or an improper fraction.

Example In a recent election, Felicia received $\frac{3}{8}$ of the vote, Steve received 0.5 of the vote, and Bill received the rest. What fraction of the votes did Bill receive?

Together, Felicia and Steve received $\frac{3}{8} + 0.5 = \frac{3}{8} + \frac{1}{2} = \frac{7}{8}$ of the vote. Therefore, Bill received $1 - \frac{7}{8} = \frac{1}{8}$ of the vote. Note that since the answer can be entered on the grid either as the fraction $\frac{1}{8}$ or its equivalent decimal 0.125, all the grids shown below are filled in correctly.

1	/	8		
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	1	/	8	
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

		1	/	8
		/	/	/
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

.	1	2	5	
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

	.	1	2	5
	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

GED PRACTICE

Directions: Solve the following problems and enter your answers on the grids provided.

1. Jim runs $2\frac{1}{4}$ miles on Monday, 1.5 miles on Tuesday, and $3\frac{3}{4}$ miles on Wednesday. How many total miles did Jim run in the 3 days?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

3. A can of green beans contains $40\frac{1}{2}$ ounces. If one serving is 3.75 ounces, how many servings are in 1 can?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

2. If gasoline sells for \$1.25 per gallon, how much would $3\frac{3}{5}$ gallons cost? Express your answer as a decimal.

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

4. Ho Chin has a board that is 9.375 feet long. If Ho Chin cuts off a piece that is $3\frac{1}{8}$ feet long, how many feet are left of the original board?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9



If the answer you need to enter on a grid contains an end zero after the decimal point, you can include it or leave it off. For example, 1.20 could be correctly filled in as 1.20 or 1.2.



Questions involving both fractions and decimals may ask for the answer to be in a certain form. Be sure your answer is in the form asked for, as either a fraction or a decimal.

Answers start on page 395.

GED STRATEGY Using Your Calculator

Fractions and Decimals

Most calculators use only decimal numbers and whole numbers. Even whole numbers entered in a calculator usually appear with a decimal point after the ones place. For example, 32 entered on a calculator would probably be displayed as 32. with a decimal point. When using a calculator, you need to change a fraction to a decimal, for example, $\frac{3}{4}$ to 0.75.

Here are some important points to keep in mind when using fractions and decimals on the calculator.

- To change a fraction to a decimal, divide the numerator by the denominator.

Example Change $\frac{3}{8}$ to a decimal by dividing 3 by 8 = 0.375.

- When working with a mixed number on a calculator, leave the whole number part as it is and change only the fraction to a decimal.

Example $17\frac{1}{2}$ would become 17.5.

- All decimals that do not contain a whole number part will be displayed with a 0 as the whole number part, even if you do not key in a 0.

Example The decimal .64, when keyed in, will appear as 0.64.

- When working with decimals, you do not need to key in zeros that are to the right of the last digit in the decimal part of the number.

Example 24.600 can be keyed in as 24.6.

Example Sam bought a laptop computer for \$1620 and made a down payment of $\frac{1}{4}$ of the cost. How much was the down payment?

- (1) \$ 25.00
- (2) \$ 40.00
- (3) \$ 64.80
- (4) \$ 405.00
- (5) \$1595.00

Since the problem asks you to find $\frac{1}{4}$ of \$1620, you need to multiply. To do this problem on a calculator, you could change $\frac{1}{4}$ to .25. Then you would press the calculator keys in the sequence shown below.



Since $\frac{1}{4}$ also means 1 divided by 4, you could also use either of these sequences:

.25 $\times$ 1620 = or 1 $\div$ 4 $\times$ 1620 =

You should see the answer 405 in the display. **Option (4) \$405** is correct.

GED PRACTICE



Directions: Choose the one best answer to each item. You MAY use your calculator.

1. Carolyn rode her bike 26.8 miles on Thursday, $14\frac{3}{8}$ miles on Friday, and $27\frac{3}{4}$ miles on Saturday. How many miles did she ride in all for the 3 days?
 - (1) 26.825
 - (2) 67.05
 - (3) 67.825
 - (4) 68.925
 - (5) 80.4
4. If gasoline sells for \$1.39 per gallon, how much would $16\frac{1}{8}$ gallons cost, rounded to the nearest cent?
 - (1) \$31.12
 - (2) \$22.49
 - (3) \$22.41
 - (4) \$22.24
 - (5) \$11.60

2. During a recent storm, snow fell at the rate of 1.24 inches per hour. At this rate, how many inches of snow would fall in $6\frac{1}{4}$ hours?

- (1) $5\frac{1}{10}$
- (2) $5\frac{2}{5}$
- (3) $7\frac{1}{4}$
- (4) $7\frac{61}{100}$
- (5) $7\frac{3}{4}$

3. Michael is paid at the rate of \$9.50 per hour for the first 40 hours worked in a week, and $1\frac{1}{2}$ times that rate for all hours over 40. If he works for $52\frac{1}{4}$ hours in 1 week, what is his gross pay, rounded to the nearest cent?

- (1) \$550.56
- (2) \$552.56
- (3) \$554.56
- (4) \$557.56
- (5) \$560.56

Questions 5 and 6 refer to the following table.

Miles Jogged	
Alicia	4.875
Brett	$3\frac{3}{5}$
Krystyna	$4\frac{3}{4}$

5. How many more miles did Alicia jog than Brett did?
 - (1) 1.275
 - (2) 1.375
 - (3) 1.400
 - (4) 1.500
 - (5) 1.575
6. What was the total number of miles jogged by the three people listed?
 - (1) 13.525
 - (2) 13.425
 - (3) 13.325
 - (4) 13.225
 - (5) 13.125

Answers start on page 395.

GED Mini-Test • Lessons 8–10

Directions: This is a 30-minute practice test. After 30 minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Which of the following decimals has the same value as the fraction $\frac{3}{7}$, rounded to the nearest hundredth?
 - (1) 0.04
 - (2) 0.42
 - (3) 0.43
 - (4) 0.44
 - (5) 0.45
2. For the first five months of the year Menchu had electric bills of \$64.16, \$78.92, \$63.94, \$50.17, and \$42.87. What was the total amount of these bills?
 - (1) \$287.86
 - (2) \$298.06
 - (3) \$299.06
 - (4) \$300.06
 - (5) Not enough information is given.
3. Stuart purchased three items at Rite Pharmacy priced at \$17.60, \$9.25, and \$3.68. If the tax was \$2.40, and he gave the salesperson a \$50 bill, how much change did he receive?
 - (1) \$17.07
 - (2) \$17.93
 - (3) \$18.07
 - (4) \$18.93
 - (5) \$19.07
4. Marilyn had a checking account balance of \$528.60. If she made deposits of \$45.24, \$17.50, and \$67.45, and wrote checks for \$412.72 and \$53.19, what was the balance in her account after these transactions?
 - (1) \$ 67.50
 - (2) \$192.88
 - (3) \$406.88
 - (4) \$492.88
 - (5) \$558.79
5. Last year Jing drove 28,606.8 miles and used 1,538 gallons of gasoline. How many miles per gallon of gasoline did he average?
 - (1) 20.6
 - (2) 19.2
 - (3) 18.6
 - (4) 18.4
 - (5) 17.8
6. An insurance policy costs \$6.87 for every \$1,500 of insurance. At this rate, what would a \$25,000 insurance policy cost, rounded to the nearest dollar?
 - (1) \$ 17
 - (2) \$ 115
 - (3) \$ 218
 - (4) \$1,145
 - (5) \$3,639

Questions 7 and 8 refer to the following table.

Clarkson's Computer Supplies Sales Receipt		
Item	Quantity	Unit Price
Boxes of Computer Disks	65	\$7.95
Reams of Paper	25	\$3.75
Printer Cartridges	30	\$14.85

7. What was the total amount paid for the reams of paper?

- (1) \$ 90.75
- (2) \$ 93.75
- (3) \$ 96.75
- (4) \$ 99.75
- (5) \$102.75

8. How much more was paid for the boxes of computer disks than for the printer cartridges?

- (1) \$75.25
- (2) \$74.25
- (3) \$73.25
- (4) \$72.25
- (5) \$71.25

9. Millie went on a $32\frac{1}{2}$ mile hike that took three days. If she hiked 10.6 miles the first day and $11\frac{7}{8}$ miles the second day, how many miles did she hike on the third day?

- (1) 10.025
- (2) 10.250
- (3) 12.025
- (4) 15.275
- (5) Not enough information is given.

10. A plant grows at the rate of $3\frac{1}{4}$ inches per week. At this rate, how many weeks will it take the plant to grow 16.25 inches?

- (1) 4.5
- (2) 5.0
- (3) 5.5
- (4) 6.0
- (5) 6.5

Questions 11 and 12 refer to the following information.

William earns a gross annual salary of \$34,000. He budgets $\frac{3}{8}$ of this amount for taxes and 0.25 for food.

11. How much more does William budget for taxes than for food?

- (1) \$ 425
- (2) \$ 850
- (3) \$ 4,250
- (4) \$ 8,500
- (5) \$12,750

12. After budgeting for taxes and food, what fraction of William's gross annual salary is left to budget for other items?

- (1) $\frac{1}{4}$
- (2) $\frac{3}{8}$
- (3) $\frac{1}{2}$
- (4) $\frac{5}{8}$
- (5) $\frac{7}{8}$

Part 2

Directions: Choose the one best answer to each item. You may NOT use your calculator.

13. Which of the following represents the number written as "23 and 37 thousandths?"

(1) 23.370
(2) 23.037
(3) 2.337
(4) 0.237
(5) 0.2337

14. Which of the following is the value of 2.1374 rounded to the nearest hundredth?

(1) 2.10
(2) 2.13
(3) 2.14
(4) 2.17
(5) 2.20

15. John paid \$1224.96 in 12 equal monthly installments. Estimate the amount of each monthly installment.

(1) \$1200
(2) \$1000
(3) \$ 120
(4) \$ 100
(5) \$ 12

16. Yaffa has \$175. She spends \$54.25 and \$30.50. Which of the following expressions shows how much money Yaffa has left after the two purchases?

(1) $\$175 + \$54.25 + \$30.50$
(2) $\$175 - (\$54.25 + \$30.50)$
(3) $(\$175 + \$54.25) - (\$175 + \$30.50)$
(4) $\$175 + \$54.25 - \$30.50$
(5) $\$175 - \$54.25 + \$30.50$

Questions 17 through 19 refer to the following table.

Paul's Plants Price List	
3-inch Potted Plant	\$1.79
4-inch Potted Plant	\$2.89
5-inch Potted Plant	\$3.69
Bag of Potting Soil	\$3.19
Watering Can	\$1.89

17. What is the greatest number of 3-inch potted plants that Mohammed can buy with \$10?

(1) 2
(2) 3
(3) 5
(4) 8
(5) 10

18. Anya buys two 5-inch potted plants and one watering can. What is the greatest number of 4-inch potted plants she can buy so that the total cost is less than \$20?

(1) 2
(2) 3
(3) 5
(4) 8
(5) 10

19. Roberto buys two bags of potting soil and one 5-inch potted plant. Approximately how much change should he receive from \$15?

(1) \$ 2
(2) \$ 3
(3) \$ 5
(4) \$10
(5) \$15

20. Atlas Gas charges \$1.25 per gallon of gas and Bradley Gas charges \$1.29 per gallon. Which expression shows how much more 14 gallons of gas would cost at Bradley Gas than at Atlas Gas?

- (1) $14 + \$1.25 + \$1.29$
- (2) $14 - \$1.25 - \$1.29$
- (3) $14(\$1.29 + \$1.25)$
- (4) $14(\$1.29 - \$1.25)$
- (5) $14(\$1.29 \times \$1.25)$

21. How much would 2.6 pounds of Swiss cheese cost at \$4.85 per pound?

- (1) \$ 1.26
- (2) \$ 1.87
- (3) \$12.61
- (4) \$13.61
- (5) \$18.70

22. A package of ground sirloin costs \$8.24. If the price per pound is \$3.45, how many pounds of ground sirloin are in the package, rounded to the nearest tenth of a pound?

- (1) 2.3
- (2) 2.4
- (3) 2.5
- (4) 2.6
- (5) 2.7

23. Marcos earns a gross monthly salary of \$2383.20. If his monthly mortgage is $\frac{1}{5}$ of this amount, about how much does he pay each month for his mortgage?

- (1) \$12,000
- (2) \$ 4,800
- (3) \$ 1,200
- (4) \$ 480
- (5) \$ 120

24. Fabrice is paid \$7.90 per hour for the first 35 hours of work in a week, and $1\frac{1}{2}$ times that rate for all hours over 35. What is his gross weekly pay?

- (1) \$154.05
- (2) \$276.50
- (3) \$379.20
- (4) \$430.55
- (5) Not enough information is given.

Questions 25 and 26 refer to the following table.

Price per Share (\$) Year to Date		
Stock	High	Low
Ampex	$24\frac{1}{4}$	$18\frac{1}{2}$
Intex	$36\frac{1}{2}$	$29\frac{3}{4}$
Microx	$28\frac{3}{8}$	$24\frac{1}{4}$

25. What was the difference between the high value and the low value of Microx stock?

- (1) 4
- (2) $4\frac{1}{8}$
- (3) $4\frac{1}{4}$
- (4) $4\frac{1}{2}$
- (5) $4\frac{3}{4}$

26. Which expression shows how much 30 shares of Ampex stock and 40 shares of Intex stock would be worth, if they were both at their high prices?

- (1) $30\left(24\frac{1}{4}\right) + 40\left(18\frac{1}{2}\right)$
- (2) $40\left(24\frac{1}{4}\right) - 30\left(18\frac{1}{2}\right)$
- (3) $30\left(24\frac{1}{4}\right) + 40\left(36\frac{1}{2}\right)$
- (4) $40\left(24\frac{1}{4}\right) - 30\left(36\frac{1}{2}\right)$
- (5) $30\left(36\frac{1}{2}\right) + 40\left(18\frac{1}{2}\right)$

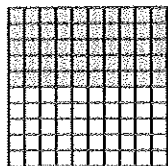
Answers start on page 396.

Lesson

11

GED SKILL The Meaning of Percent

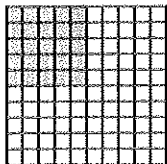
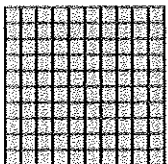
A



Percent is another way to show part of a whole. With fractions, the whole can be divided into any number of equal parts. With decimals, the number of parts must be 10, 100, 1000, or another power of 10. With percents, the whole is always divided into 100 equal parts.

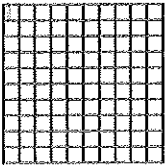
Drawing A is divided into 100 equal parts. The entire square represents 100%. Fifty parts, or one-half of the whole square, are shaded. The shaded part is 50% of the whole. The percent sign, %, means "out of 100." Fifty out of 100 parts are shaded. The drawing also represents the fraction $\frac{1}{2}$ and the decimal 0.5.

B



Percents can be greater than 100%. Drawing B represents 125%. One whole square and 25 parts of the second square are shaded. Since 100 parts equal 1 and 25 out of 100 parts is $\frac{1}{4}$, 125% equals $1\frac{1}{4}$ or 1.25.

C



Drawing C represents $\frac{1}{2}\%$, or 0.5%. Only one-half of one part is shaded. A percent that is less than 1% is less than $\frac{1}{100}$.

$$0.5\% = 0.005 = \frac{5}{1000} = \frac{1}{200}$$

Changing Percents to Decimals

To solve percent problems using pencil and paper, you need to change the percent to either a decimal or a fraction.



There is always an understood decimal point to the right of the ones digit; 7 is understood to be the same as 7.0.

Example 1 Change 45% to a decimal.

Drop the percent sign, and insert a decimal point to the right of the ones digit. Then move the decimal point two places to the left.

$$\begin{array}{r} 45.\% \\ \hline 0.45 \end{array}$$

The percent 45% is equal to the decimal **0.45**.

Example 2 Change 7.5% to a decimal.

Drop the percent sign, and move the decimal point two places to the left. Write a zero in the tenths place as a placeholder.

$$\begin{array}{r} 7.5\% \\ \hline 0.075 \end{array}$$

The percent 7.5% is equal to the decimal **0.075**.



To change a percent to a decimal using a calculator, enter the number of the percent and divide by 100.

$$7.5 \div 100 = 0.075$$

Changing a Decimal to a Percent

The examples below show how to change a decimal to a percent.

Example Change 0.15 to a percent.
Move the decimal point two places to the right, and write the percent sign. (Notice that the zero placeholder is no longer needed.) $0.15 = 15\%$

The decimal 0.15 is equal to **15%**.

Examples Add a zero in order to move the decimal point two places. $2.5 = 2.50 = 250\%$

Do not show the decimal point after a whole number or between a whole number and a fraction. $0.33\frac{1}{3} = 0.33\frac{1}{3} = 33\frac{1}{3}\%$



To change a decimal to a percent using a calculator, enter the decimal and multiply by 100.

0.15 $\times$ 100 = 15.

GED SKILL FOCUS

A. Change each percent to a decimal, mixed decimal, or whole number.

- | | | |
|----------|---------------------|---------------------|
| 1. 60% | 4. 4% | 7. 130% |
| 2. 38% | 5. 200% | 8. $9\frac{1}{4}\%$ |
| 3. 10.8% | 6. $5\frac{1}{2}\%$ | 9. 325% |

B. Change each decimal to a percent.

- | | | |
|-----------|-----------------------|-----------------------|
| 10. 0.85 | 13. 0.4 | 16. 8.75 |
| 11. 0.36 | 14. 4.5 | 17. 0.375 |
| 12. 0.144 | 15. $0.16\frac{2}{3}$ | 18. $0.07\frac{1}{3}$ |



C. Use a calculator to make the indicated changes.

- | | |
|-------------------------------|--------------------------------|
| 19. Change 225% to a decimal. | 23. Change 0.6 to a percent. |
| 20. Change 1.5 to a percent. | 24. Change 3% to a decimal. |
| 21. Change 80% to a decimal. | 25. Change 0.125 to a percent. |
| 22. Change 0.24 to a percent. | 26. Change 550% to a decimal. |

Answers start on page 397.

Changing a Fraction or Mixed Number to a Percent

You can convert a fraction to a percent by first changing the fraction to a decimal and then changing the decimal to a percent.

Example 1 Change $\frac{3}{4}$ to a percent.

Step 1 Divide the numerator by the denominator.

$$3 \div 4 = 0.75$$

Step 2 Multiply the decimal by 100. Move the decimal point two places to the right; write a percent sign.

$$0.75 = 75\%$$

The fraction $\frac{3}{4}$ is equal to **75%**.

You can also change a fraction or a mixed number directly to a percent.

Example 2 Change $\frac{3}{4}$ to a percent.

Step 1 Multiply the fraction by $\frac{100}{1}$.

Step 2 Simplify to a whole or mixed number and write the percent sign.

$$\frac{3}{4} \times \frac{100}{1} = 75\%$$

The fraction $\frac{3}{4}$ is equal to **75%** by this method as well.

Example 3 Change $3\frac{1}{4}$ to a percent.

Step 1 Change the mixed number to an improper fraction.

$$3\frac{1}{4} = \frac{13}{4}$$

Step 2 Multiply by $\frac{100}{1}$ and add the percent sign.

$$\frac{13}{4} \times \frac{100}{1} = 325\%$$

The mixed number $3\frac{1}{4}$ is equal to **325%**.



On the calculator provided for the GED Mathematics Test, you need to press **(SHIFT)** **(=)** for the percent key. See page 150 to learn more about using percent keys on calculators.



To change a fraction to a percent using a calculator, divide the numerator by the denominator and press the percent key.

Change $\frac{3}{4}$ to a percent. $3 \div 4$ **(SHIFT)** **(=)** 75. or 75%

Change $\frac{2}{5}$ to a percent. $2 \div 5$ **(SHIFT)** **(=)** 40. or 40%

Changing a Percent to a Fraction or Mixed Number

As you know, the word *percent* means "out of 100." To change a percent to a fraction or mixed number, drop the percent sign and write the number as a fraction with a denominator of 100. Then reduce.

Example 1 Change 35% to a fraction.

Write as a fraction with a denominator of 100 and reduce.

$$\frac{35}{100} = \frac{35 \div 5}{100 \div 5} = \frac{7}{20}$$

So the percent 35% is equal to the fraction $\frac{7}{20}$.

Example 2 Change 150% to a mixed number.

Write as an improper fraction (denominator of 100); simplify.

$$\frac{150}{100} = \frac{150 \div 50}{100 \div 50} = \frac{3}{2} = 1\frac{1}{2}$$

So the percent 150% is equal to the mixed number $1\frac{1}{2}$.



Your calculator display may look different than the one shown here. Read the instructions that came with your calculator to learn how to use it to solve problems with fractions.

Converting percents with fraction or decimal parts requires extra steps.

Example 3 Change $41\frac{2}{3}\%$ to a fraction.

Write $41\frac{2}{3}$ over 100 and divide.
$$\frac{41\frac{2}{3}}{100} = 41\frac{2}{3} \div 100 = \frac{125}{3} \times \frac{1}{100} = \frac{5}{12}$$

The percent $41\frac{2}{3}\%$ is equal to the fraction $\frac{5}{12}$.

Example 4 Change 37.5% to a fraction.

Step 1 Change the percent to a decimal: $37.5\% = 37.5 \div 100 = 0.375$
move the decimal point 2 places left.

Step 2 Change decimal to a fraction; reduce. $\frac{375}{1000} \div \frac{125}{125} = \frac{3}{8}$

So the percent 37.5% is equal to the fraction $\frac{3}{8}$.

Some calculators have special keys to change percents to fractions.



To change 150% to a fraction: enter the percent number, press the fraction key, enter 100, then press $\frac{\square}{\square}$.

150 $\frac{\square}{\square}$ 100 $\frac{\square}{\square}$ 1 $\frac{1}{2}$.

This calculator display means $1\frac{1}{2}$.

GED SKILL FOCUS

A. Change each percent to a fraction or mixed number.

1. 65%

3. 140%

5. 39%

2. 84%

4. 275%

6. 450%



B. Use a calculator to make the indicated changes.

7. Change $\frac{3}{8}$ to a percent.

9. Change 125% to a decimal or mixed number.

8. Change $\frac{15}{16}$ to a percent.

10. Change 87.5% to a decimal or mixed number.

C. Fill in the missing numbers.

	Decimal	Fraction	Percent
11.			20%
12.		$\frac{1}{4}$	
13.	0.3		
14.		$\frac{1}{3}$	
15.			40%

	Decimal	Fraction	Percent
16.			60%
17.	$0.66\frac{2}{3}$		
18.		$\frac{3}{4}$	
19.			80%
20.	0.9		

Answers start on page 397.

GED STRATEGY Solving Word Problems

Using Proportions with Percents

There are three basic elements in a percent problem: **base** $\times$ **rate** = **part**. Think about this statement:

Example Of 200 applicants, 25% or 50 cannot work weekends.

- The **base** is the whole amount. In this statement, the base is 200.
- The **part** is a piece of the whole or base. In this statement, 50 tells what part of the 200 applicants (the base) cannot work weekends.
- The **rate** is always followed by a percent sign (%). The rate tells the relationship of the part to the base. In this statement, it is 25%.

In a percent problem, one of the three elements is missing. To find the missing element set up a proportion using the base, part, and rate. Substitute the known values, and solve for the missing element.



The base, or whole, is often an original amount such as an original price, starting balance, or total amount.

$$\frac{\text{Part}}{\text{Base}} = \frac{\text{Rate}\%}{100\%}$$

To find the missing element, cross multiply and divide by the third number.

Example 1 12 is 75% of what number?

- (1) 1200
- (2) 75
- (3) 63
- (4) 16
- (5) 12

Here, you know the part and the rate. You need to solve for the base.

Step 1 Set up the proportion.

$$\frac{12}{?} = \frac{75}{100}$$

Step 2 Cross multiply.

$$12 \times 100 = 1200$$

Step 3 Divide by 75.

$$1200 \div 75 = 16$$

So, 12 is 75% of 16. **Option (4)** is correct.

Example 2 16 is what percent of 80?

- (1) 16
- (2) 20
- (3) 64
- (4) 80
- (5) 100

You know the part and the base. You must find the rate (percent).

Step 1 Set up the proportion.

$$\frac{16}{80} = \frac{?}{100}$$

Step 2 Cross multiply.

$$16 \times 100 = 1600$$

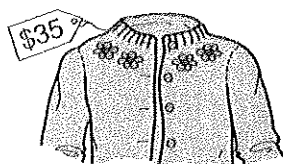
Step 3 Divide by 80.

$$1600 \div 80 = 20$$

Write a percent sign after 20: 16 is 20% of 80. **Option (2)** is correct.

GED PRACTICE

Directions: Choose the one best answer to each question. Use your calculator when indicated.



1. The sweater shown above is on sale for 20% off. If the price tag lists the original price, how much would you save by buying it on sale?

(1) \$ 7
(2) \$ 9
(3) \$12
(4) \$14
(5) \$15



2. Sidney's insurance paid 90% of the cost of getting his car fixed. If the repair bill was \$625, how much did the insurance pay?

(1) \$437.50
(2) \$468.75
(3) \$500.00
(4) \$562.50
(5) \$605.15



3. Aldora earns \$1344 per month. If 2.5% of her earnings goes to state income tax, how much does she pay per month in state income tax?

(1) \$ 20.16
(2) \$ 26.88
(3) \$ 33.60
(4) \$ 42.20
(5) \$336.00

4. On a test, a student got 80% of the items correct. If the student got 56 items correct, how many items were on the test?

(1) 64
(2) 70
(3) 72
(4) 84
(5) 90

5. The Bulldogs won 18 games out of 45. What percent of their games did the Bulldogs win?

(1) 40%
(2) 45%
(3) 50%
(4) 55%
(5) 60%



6. Eighty percent of the Usagi Express Company's employees are drivers. If there are 300 drivers in the company, how many employees work for Usagi Express?

(1) 320
(2) 335
(3) 342
(4) 365
(5) 375



To solve a percent problem set up a proportion:

$$\frac{\text{Part}}{\text{Base}} = \frac{\text{Rate}\%}{100\%}$$

Determine which element is missing: the base, part, or rate; substitute the numbers into the proportion and solve.

Answers start on page 397.

The Elements of a Percent Problem

You now know that percent problems have three basic elements—the base, the part, and the rate. Think about this statement:

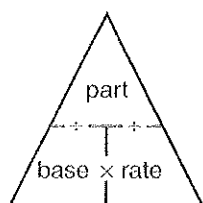
Kina spends \$320, or 20%, of her monthly income of \$1600 on groceries.

The base, \$1600, is the whole amount. The other numbers in the problem are compared to the base. The part, \$320, is a portion of the base. The rate, 20%, tells the relationship of the part to the base.

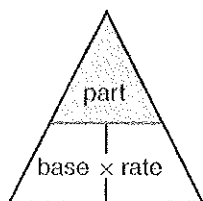
In a percent problem, one of the three elements is missing. You learned earlier how to solve a percent problem by using a proportion. You can also find the missing element using the percent formula:

$$\text{base} \times \text{rate} = \text{part}$$

The triangle diagram shows the relationship among the three elements. You will learn how to use the diagram in the examples throughout this lesson.



Finding the Part



Example Aretha puts 5% of her weekly paycheck in her savings account. If her weekly paycheck is \$326, how much does she put in savings?

Step 1 Identify the elements you know. The base, or whole amount, is \$326. Aretha puts a *part* of this amount in savings. The rate is 5%. You need to solve for the part.

Step 2 Use the diagram to find out which operation to perform. Cover the word *part*. The remaining elements are connected by the multiplication symbol. Multiply: **base × rate**.

Step 3 Change the rate to a decimal. $5\% = 0.05$
Multiply. $326 \times 0.05 = \$16.30$

When you solve any word problem, take a moment to decide whether your answer makes sense. Since 5% is a small part of 100%, you know Aretha's savings should be a small part of her paycheck. The answer \$16.30 is a reasonable amount.



If the rate is greater than 100%, the part will be greater than the base. 150% of 200 is 300.



You need to find 5% of \$326. Multiply. Enter the base first.

326 $\times$ 5 SHIFT = 16.3

(Remember: SHIFT = gives the % key on the GED calculators.)

Aretha puts **\$16.30** of her weekly paycheck in savings.

GED SKILL FOCUS

A. Solve using pencil and paper.

1. Find 3% of 500.
2. What is 15% of \$950?
3. Find 90% of 72.
4. Find 85% of 140.
5. Find 125% of \$220. (*Hint: Since 125% is greater than 100%, the part is greater than \$220.*)
6. What is 150% of 184?
7. What is 75% of 80?
8. Find 5% of \$200.
9. Find 8% of \$1600.
10. What is 55% of \$20?
11. Find $5\frac{1}{2}\%$ of 300.
12. What is $33\frac{1}{3}\%$ of \$600?



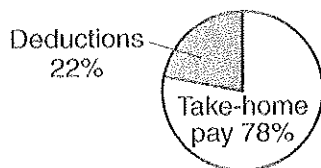
B. Use your calculator to solve these problems. Round answers to the nearest hundredth or cent.

13. Find 6% of \$84.50.
14. Find 4% of 1278.
15. What is 210% of \$158.75?
16. What is 45% of \$10.80?
17. Find $8\frac{3}{4}\%$ of \$575.00.
18. What is $1\frac{1}{2}\%$ of \$50.00?
19. What is 7% of 49.5?
20. Find 135% of \$17.50.

C. Solve.

21. During the winter, Green Art, a landscaping service, contacted 1200 homeowners. Of these, 15% hired the company to do work at their homes. How many homeowners hired Green Art?

Use the following graph to answer Questions 22 and 23.



22. Angelo earns \$2080 per month. What amount is deducted from his pay each month?
23. Of Angelo's \$2080 monthly earnings, how much is his take-home pay?
24. Paul bought a sofa for \$690. He paid 8% sales tax on the purchase. What was the total amount of his purchase? (*Hint: This problem has two steps. Find the amount of the sales tax, and add it to the price of the sofa.*)
25. For a party of 8 or more, a restaurant automatically adds a 15% tip to the bill. The bill for a birthday party of 20 diners comes to \$186.35. What is the amount of the tip rounded to the nearest cent?
26. Carol's utility bill for April of this year is 150% of her bill for the same month last year. If her April bill last year was \$74.22, what is the amount of her bill for April this year?

Answers start on page 398.

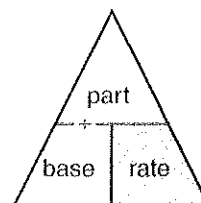
Finding the Rate

Example Joel earns \$1700 per month. He decides to take out a loan to buy a used car. His monthly loan payments are \$204. What percent of his monthly income is the loan payment?

Step 1 Think about the problem. The whole amount Joel earns each month is the base. Part of these earnings is spent on the loan payment. You need to solve for the percent, or rate.

Step 2 Use the diagram to find out which operation to perform. Cover the word *rate*. The remaining elements are connected by the division symbol:
 $\text{part} \div \text{base} = \text{rate}$.

Step 3 Divide. $204 \div 1700 = 0.12$.
Convert to a percent. $0.12 = 12\%$



You can do both calculations in one step using your calculator's percent key or the **SHIFT** $\div$ keys on the GED Test calculator.

$204 \div 1700 = 12\%$ or $204 \div 1700 \text{ SHIFT } \div = 12\%$

Joel spends **12%** of his monthly earnings on the loan payment.

Finding Percent of Increase or Decrease

Some percent problems ask you to find the rate that an amount has changed over time. The change may be either an increase or a decrease. To solve these problems, follow these steps.

Step 1 Subtract to find the difference between the original amount and the new amount.

Step 2 Divide the difference from Step 1 by the original amount.

Step 3 Convert the decimal to a percent.

Example Brent works as a sales clerk in a clothing store. When he started the job, he was paid \$7.50 an hour. Recently, he received a raise. He now earns \$8.10 per hour. Find the rate of increase in his hourly pay.

Brent's pay started at \$7.50 per hour (the original amount) and increased to \$8.10, the new amount.

Step 1 Subtract to find the difference. $\$8.10 - \$7.50 = \$0.60$

Step 2 Divide by the original hourly wage. $\$0.60 \div \$7.50 = 0.08$

Step 3 Convert the decimal to a percent. $0.08 = 8\%$

Brent's raise is an **8% increase**.



Look for clues in the words of the problem to help you identify the original amount. For example, "what percent of" is usually followed by the base.

GED SKILL FOCUS

A. Solve using pencil and paper.

1. What percent is 123 of 820?
2. What percent is \$4.50 of \$6.00?
3. \$18.00 is what percent of \$22.50?
4. 350 is what percent of 2000?
5. The number 240 is what percent of 60?
6. What percent of 4000 is 120?
7. \$5 is what percent of \$160?
8. What percent of \$40.00 is \$72.00?



B. Use your calculator to solve these problems.

9. \$3.50 is what percent of \$175.00?
10. What percent is 326 of 1304?
11. What percent of 5000 is 225?
12. \$144 is what percent of \$150?
13. What percent of \$110.00 is \$82.50?
14. 40 is what percent of 16?

C. Find the percent of increase or decrease.

15. Original amount: 1500
New amount: 1725
16. Original amount: \$520.00
New amount: \$582.40
17. Original amount: 280
New amount: 70
18. Original amount: \$1200
New amount: \$1140

D. Solve.

19. Rae supervises a loading dock. She needs to have 140 cartons loaded into a truck for delivery. By lunch, 119 cartons have been loaded. What percent of the job is finished?
20. Jorge stocked the store shelves with 25 cases of soft drinks. Of these, 10 are cola drinks, 8 are root beer, and 7 are orange soda. Of the total cases of soft drinks, what percent is cola? (*Hint: There is extra information.*)
21. Stacey was given a raise. Her new monthly pay is \$1508. Previously, her monthly pay was \$1450. What percent raise did she receive?
22. Ahmad took a test with 50 items. He answered 44 of the items correctly. What percent of the test items did he answer correctly?

Refer to the following information to answer Questions 23 and 24.



23. Smith's Electronics has the camcorder shown above on sale. To the nearest percent, by what percent did the store discount the camcorder?
24. Lucia receives a \$44 commission for each camcorder that she sells. What percent of the sale price is her commission?

Answers start on page 398.

GED STRATEGY Solving Word Problems

Using Mental Math



Remember that a whole number is understood to have a decimal point after the ones place.

$$\$40 = \$40.00$$

You use mental math every day. Whether it's estimating the amount to tip on your restaurant bill or figuring out sale prices, you are calculating in your head. Mental math involving percents is easiest when you use 10%.

Remember, $10\% = 0.10 = 0.1$. To multiply by 0.1, move the decimal point one place to the left. For example, if a sweater originally cost \$40 and is on sale for 10% off, how much would you save? You would save \$4.

$$\$40.00$$

Using this method for finding 10%, you can develop mental math strategies for quickly finding 5%, 15%, and 20% of an amount.

Example 1 Jan's monthly paycheck is \$900. If 5% of that amount is deducted for medical and dental insurance, what amount is deducted?

Step 1 To find 5% of an amount, first find 10%, and then divide that amount by 2. In this example, find 10% of \$900 by moving the decimal point one place to the left.

$$\$900.00$$

Step 2 Since 5% is half of 10%, divide \$90 by 2.

$$\$90 \div 2 = \$45$$

So, 5% of \$900 is \$45.

Example 2 Carlos wants to leave a 15% tip on a \$20 restaurant bill. How much money should he leave for the tip?

Step 1 To find 15% of an amount, find 10%, divide that result by 2 to find 5%, and add the 10% and 5% amounts. In this example, find 10% of \$20 by moving the decimal point one place to the left.

$$\$20.00$$

Step 2 Since 5% is half of 10%, divide \$2 by 2.

$$\$2 \div 2 = \$1$$

Step 3 $10\% + 5\% = 15\%$, so add $\$2 + \$1$.

$$\$2 + \$1 = \$3$$

The total tip is \$3.

Example 3 Sharon received \$82 in tips. She gives 20% to her assistant. How much should Sharon give her assistant?

Step 1 To find 20% of an amount, find 10%, then multiply that amount by 2. In this example, find 10% of \$82 by moving the decimal point 1 place to the left.

$$\$82.00$$

Step 2 Multiply by 2 to find 20%.

$$\$8.2 \times 2 = \$16.40$$

Sharon should give her assistant \$16.40.

GED PRACTICE

Directions: Choose the one best answer to each question.

1. The Gardner Public Library records the number of books borrowed each month. Of the 8520 books borrowed in May, 10% were children's books. How many children's books were borrowed in May?

(1) 85
(2) 170
(3) 852
(4) 1704
(5) 2000

Question 2 refers to the diagram below.



2. Estelle works as a waitress. A customer left a 15% tip based on the total of the check shown above. How much was Estelle's tip?

(1) \$1.30
(2) \$1.60
(3) \$2.75
(4) \$3.90
(5) \$5.00

3. Martin bought some stereo equipment for \$150 plus 5% sales tax. How much sales tax did he pay?

(1) \$155.00
(2) \$ 50.00
(3) \$ 30.00
(4) \$ 15.00
(5) \$ 7.50

4. Sara sold a radio/CD player originally priced at \$70 and discounted 20%. How much was the discount?

(1) \$20.00
(2) \$14.00
(3) \$ 7.00
(4) \$ 1.40
(5) \$ 0.70

5. Zoila's take-home pay is \$1500 a month. Of that amount, 25% goes towards paying rent. How much does she pay each month for rent?

(1) \$ 60
(2) \$150
(3) \$300
(4) \$375
(5) \$500

6. The Johnson Community Center is selling tickets to its fundraising concert. They have sold 30% of the 1800 tickets. How many tickets have they sold?

(1) 600
(2) 540
(3) 60
(4) 54
(5) 6



It is sometimes helpful to both estimate and use mental math. For example, in order to leave a 15% tip on an amount of \$8.69, round the amount to \$9 and then find 15% of \$9.

Answers start on page 399.

Lesson 13

GED, SKILL Solving Percent Problems (Part 2)

Finding the Base

Example 1 The employees at Galindo Printing are required to complete a safety course during their first year of work. Of the current employees, 90% have completed the course. If 63 employees have completed the course, how many employees work at Galindo Printing?

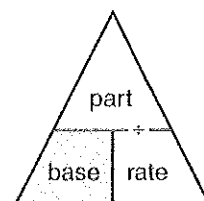


You can also use a proportion to solve for the base:

$$\frac{63}{x} = \frac{90\%}{100\%}$$

Step 1 Think about the problem. The base or whole amount is the total number of employees at Galindo Printing. The number 63 is part of the number of employees. The 63 employees are 90% of the total employees. You need to solve for the base.

Step 2 Use the diagram to find out what operation to perform. Cover the word *base*. The remaining elements are connected by the division symbol. Divide: **part ÷ rate**.



Step 3 Convert the rate to a decimal. $90\% = 0.9$
Divide.

$$\begin{array}{r} 70. \\ 0.9 \overline{)63.0} \\ \underline{63} \\ 00 \end{array}$$

There are **70** employees at Galindo Publishing.



You can perform the calculations in one step using your calculator. Divide.

$$63 \div 90 \text{ SHIFT } = 70.$$

Galindo Printing has **70 employees**.



Always read carefully. At first glance, this may seem to be a rate-of-increase problem. Make sure you know what you are solving for before you begin calculations.

As you know, the part may be greater than the base. You can recognize these situations because the rate is greater than 100%.

Example 2 Regina recently started a better-paying job. Her new weekly salary is 120% of the weekly earnings at her old job. If her new weekly salary is \$326.40, how much did she earn per week at her old job?

Step 1 Analyze the situation. Regina's new salary is 120% of her old salary. The new salary, \$326.40, is the part even though it is the greater amount. The old salary is the base.

Step 2 Convert the rate to a decimal and divide the part by the rate.

$$120\% = 1.2 \quad \$326.40 \div 1.2 = \$272.00$$

Regina's old salary is **\$272.00**.

A. Solve using pencil and paper.

1. \$54 is 60% of what amount?
2. 720 is 9% of what number?
3. 6% of what amount is \$1.92?
4. 17% of what number is 85?
5. \$495 is 90% of what amount?
6. 270% of what number is 810?
7. 115% of what amount is \$207?
8. \$1020 is 85% of what amount?
9. \$0.21 is 7% of what amount?
10. 125% of what number is 660?
11. \$6.30 is 15% of what amount?
12. 6000 is $66\frac{2}{3}\%$ of what number?



B. Use your calculator to solve these problems.

13. \$3.75 is 75% of what amount?
14. 15% of what number is 9.6?
15. 35% of what amount is \$157.50?
16. \$26.88 is 24% of what amount?
17. \$62.40 is 104% of what amount?
18. 3.8% of what amount is \$0.76?
19. \$679.35 is $5\frac{1}{4}\%$ of what amount?
20. \$1.26 is $3\frac{1}{2}\%$ of what amount?

C. Solve.

21. Jeff's insurance paid \$7500 for his surgery. If the insurance paid 80% of the total bill, what was the amount of the total bill?

22. Last year Florence paid 15% of her annual income in federal income tax. If her tax bill was \$3555, what was her annual income?

Refer to the following information to answer Question 23.

89% of CAA Members Vote to Elect Elena Richards

23. If 178 members voted for Elena, how many did not vote for her? (*Hint: You need to find the base, but the base is not the final answer.*)
24. Lori knew that 25% of the store's customers in May made a purchase. If 207 customers made a purchase, how many visited the store?

25. Carmen bought a new jacket for \$98. The sale price was 70% of the original price. What was the original price?

Refer to the following table to answer Questions 26 through 28.

Northwest Custom Furniture Catalog Sales for New Items		
Product	Number of Returns	Percent of Total Sales
Folding Step Chair	8	4%
Art Glass Table	3	20%
Rolling Table	15	$12\frac{1}{2}\%$

26. How many art glass tables were sold?
27. How many of the rolling tables that were sold were not returned to the furniture store?
28. What percent of the folding step chairs were not returned?

Answers start on page 399.

Solving Interest Problems

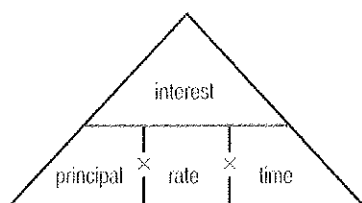


See page 16 for a copy of the GED formulas page that you will be given for use on the GED Mathematics Test. Be familiar with these formulas and know how to use them before you take the test.

Interest is a fee charged for using someone else's money. When you borrow money for a purchase, you pay interest to the company that loans you the money. When you put your money into a savings account, the bank pays you interest for the use of your money.

If you have had a credit card or have borrowed money, you have had experience with paying interest. There are several different types of interest and ways to calculate it. On the GED Mathematics Test, you will be tested on your understanding of simple interest. **Simple interest** is based on the time of the loan in years.

The formula for finding simple interest is $i = prt$. This formula is similar to the percent formula you have been using. When the letters, or variables, in a formula are written next to each other, they are to be multiplied. This interest formula can also be written in a triangle.



i = interest

p = principal, the amount borrowed or invested

r = interest rate, as a percent

t = time of the loan, in years

Example Lynn Alvarez borrows \$2500 for 6 months at a 12% rate of interest. How much interest will Lynn pay on the loan?

The principal (p) is \$2500, the amount of the loan. The interest rate (r) is 12%. The time (t) is 6 months, or $\frac{1}{2}$ of a year.

Step 1 Change the interest rate to a decimal. $12\% = 0.12$

Step 2 Write the time in terms of years. $6 \text{ months} = \frac{6}{12} = \frac{1}{2} \text{ year}$.
(If the problem states the time in months, write the time as a fraction of a year. Write the number of months as the numerator and the number 12 as the denominator. Reduce the fraction to lowest terms.)

Step 3 Multiply: **principal $\times$ rate $\times$ time.** $\$2500 \times 0.12 \times \frac{1}{2} =$
The result is the interest. $\$300 \times \frac{1}{2} = \$150$

Lynn will owe **\$150** in interest.

Some problems ask you to find the **amount paid back**. This includes the principal and any interest owed. In the example above, Lynn borrowed \$2500 and must pay \$150 in interest. But this does not answer the question. To find the payback amount, add the principal and the interest: $\$2500 + \$150 = \$2650$.

Lynn must pay back **\$2650**.



To solve interest problems using a calculator, change the fractional part of a year to a decimal. For example, 6 months equals 0.5 year.

GED SKILL FOCUS

A. Find the interest on the following loans. Use pencil and paper.

1. A loan of \$1250 at 12% for 2 years
2. A loan of \$2400 at 9.5% for 1 year
3. A loan of \$900 at 8% for 6 months
4. A loan of \$4000 at 5% for 3 months
5. A loan of \$840 at 9% for 18 months
6. A loan of \$1100 at 7.5% for 4 years



B. Find the interest earned on these investments. You may use a calculator.

7. \$3200 invested at $5\frac{1}{2}\%$ interest for 1 year
8. \$500 invested at 8% interest for $6\frac{1}{2}$ years
9. \$2300 invested at 4% interest for 6 months
10. \$800 invested at 7.5% interest for 3 months
11. \$600 invested at $3\frac{3}{4}\%$ interest for 2 years

C. Find the total amount to be paid back on these loans.

12. A loan of \$600 at 10% for 6 months
13. A loan of \$5400 at 8% for 9 months
14. A loan of \$8000 at 12% for 5 years
15. A loan of \$300 at 6% for 4 months

D. Solve.

16. Mr. Bradford bought a delivery van. He borrowed \$20,000 at $8\frac{1}{4}\%$ interest for 4 years. How much will he pay in interest on the loan?
17. Ji Sun took out a student loan of \$1500 for 18 months at 3% interest. How much will she pay back when the loan is due?
18. To buy a computer, Rene borrowed \$900 from her brother for 12 months. She agreed to pay 4% interest on the loan. What is the total amount she will owe her brother in 12 months?
19. Tony borrows \$9500 to make repairs to his warehouse. He borrows the money at $9\frac{1}{2}\%$ for 2 years. How much will he pay in interest on the loan?
20. Sandy borrowed \$4500 for 3 years to buy a used car. Interest on the loan is 7.5%. How much will she pay in all for the car?

Refer to the following information to answer Questions 21 and 22.

Capital Investments

Earn 5% interest
6-months required
Minimum principal:
\$1500

New Vista Accounts

Earn 6% interest
9-months required
Minimum principal:
\$2500

21. The Grahams plan to invest \$2500 for up to 1 year. How much interest would they earn at Capital Investments if they invest their money for 1 year?
22. How much would they earn on an investment of \$2500 for 9 months at New Vista Accounts?

Answers start on page 399.

GED STRATEGY Solving Word Problems

Solving Multi-Step Problems

Sometimes percent problems require more than one step to solve. Read the problem carefully, decide what information you need to solve the problem, and break the problem down into steps.



Saving 40% means paying 60% of the original price. The percent you paid is the rate that when multiplied by the base gives you the sale price.

$$100\% - 40\% = 60\%$$

$$\$80 \times 0.6 = \$48$$

Example 1 Wendy bought an \$80 dress on sale for 40% off. How much did she pay for the dress?

- (1) $\$80 \times 0.4$
- (2) $\$80 - \$40$
- (3) $\$80 - (\$80 \times 0.4)$
- (4) $\$80 - (\$80 \times 0.6)$
- (5) Not enough information is given.

Step 1 You know the base and the rate. You need to find the discount amount. Multiply the base by the rate. This tells how much Wendy saved by buying the dress on sale. $\$80 \times 0.4$

Step 2 Find the sale price. Subtract the discount amount from the original price. $\$80 - (\$80 \times 0.4)$

The sale price is **option (3)**.

Example 2 John makes small picture frames to sell at craft shows. Each frame uses \$10 worth of materials. If John wants to sell the frames at a 15% profit, how much should he charge for each frame?

- (1) \$ 1.50
- (2) \$10.00
- (3) \$11.50
- (4) \$25.00
- (5) Not enough information is given.

Step 1 Find the amount of profit. $\$10 \times 15\% = \$10 \times 0.15 = \$1.5 = \$1.50$
Multiply the base by the rate.

Step 2 Find the price John should charge for a picture frame by adding the amount of profit to the cost of materials. $\$10.00 + \$1.50 = \$11.50$

John should sell his picture frames for **option (3) \$11.50** each.

Example 3 The sale price of a sofa with a 40% discount is \$348. What is the original price of the sofa?

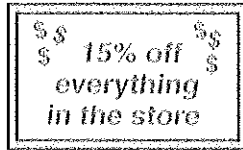
Step 1 Find the rate that represents the sale price. $100\% - 40\% = 60\%$

Step 2 Find the original price (base). $\$348 \div 0.6 = \$580$
Divide the part by the rate.

The original price of the sofa is **\$580**.

GED PRACTICE

Directions: Choose the one best answer to each question.



1. Murray's Bargain Basement is having a sale on household goods. What would be the sale price of a twin-size blanket originally priced at \$20?
 - (1) \$ 3.00
 - (2) \$ 5.00
 - (3) \$ 7.50
 - (4) \$17.00
 - (5) \$18.67
2. Flora received a 6% raise on her hourly wage of \$9.00. Choose the expression that shows Flora's new hourly wage.
 - (1) $\$9 + 0.06$
 - (2) $\$9 + 0.06 \times \$9$
 - (3) $\$9 - 0.06 \times \$9$
 - (4) $\$9 \times 0.06$
 - (5) $\$9 \times (1 - 0.06)$
3. Alfredo bought a used car for \$1500. He replaced the engine and repaired the body. He sold the car for \$4500. What was the rate of increase in the price of the car?
 - (1) 67%
 - (2) 133%
 - (3) 200%
 - (4) 300%
 - (5) 400%
4. At a factory, Gloria supervises 30 employees. Next month, her staff will be increased by 40%. Which expression shows the number of employees Gloria will supervise next month?
 - (1) $0.4(30) + 0.4$
 - (2) $0.4(30) + 30$
 - (3) $0.4(30) - 0.4$
 - (4) $0.04(30) + 0.4$
 - (5) $0.4(30) - 30$
5. Lavina put on layaway a coat that costs \$160. She paid 10% down and will pay the rest in 6 monthly installments. Which expression can be used to find the amount of each monthly payment?
 - (1) $\frac{\$160 - (\$160 \times 0.1)}{6}$
 - (2) $\frac{\$160}{6}$
 - (3) $\$160 - (\$160 \times 0.1)$
 - (4) $\$160 \times 0.1$
 - (5) $\$160 + (\$160 \times 0.1)$
6. Grantsville Copper Mines employs 1400 workers. The company must lay off 5% of its workforce immediately and another 20% of the remaining workforce by the end of the year. How many workers will be laid off?
 - (1) 350
 - (2) 336
 - (3) 280
 - (4) 210
 - (5) 70

Answers start on page 400.

GED STRATEGY Using Your Calculator



Calculators and Percents

One of the most useful keys on a calculator is the percent key. When using this key, you won't have to change a percent to a decimal or a decimal to a percent—the calculator will do it for you automatically.

Example Julia paid 32% of her monthly salary of \$3540 for taxes. How much did she pay for taxes?

If you don't use the percent key, you would first have to change 32% to decimal form, or 0.32, before multiplying by \$3540. This method for using a calculator is shown below.

3540 $\times$.32 =

You would see the answer 1132.8, or **\$1132.80 in taxes**, in the display.

By using the percent key, you would not change the percent to a decimal, but simply key in the numbers as they appear in the problem. This is shown below. (Note that some calculators do not require the equals key at the end.)

3540 $\times$ 32 % =

Remember: There is no percent “key” on the calculator used for the GED Mathematics Test. You must press the **SHIFT** **=** keys to work with a percent.

3540 $\times$ 32 **SHIFT** **=** 1132.8

Using the Percent Key

Here are some important points to keep in mind when using the percent key on the calculator.

- **When solving for the base or part, you should key in the percent exactly as it appears in the problem.** Do not move the decimal point. For example, if you want to find 8% of a number, do not change 8% to the decimal 0.08. Simply multiply the number by 8 and press the % key after the 8.
- **When solving for the rate, the answer you see in the display is the percent, not the decimal equivalent.** Do not move the decimal point. For example, divide the part (1) by the base (4) followed by the percent key. (If your calculator display shows 0.04, press the equals key.) The display shows 25, which is 25%. There is no need to move the decimal point.
- **Be careful about the order in which you key in numbers.** When solving for the part, you multiply the base by the percent. When solving for the percent or base, you divide. Be careful to key in the part first.

GED PRACTICE



Directions: Choose the one best answer to each item. You MAY use your calculator.

1. At the end of the first quarter, the *Gazette* had 3450 employees. In the second quarter, 12% more employees were hired. How many new employees did the *Gazette* hire in the second quarter?
 - (1) 41
 - (2) 404
 - (3) 414
 - (4) 424
 - (5) 4140
2. The Smith family went to dinner at a restaurant and had a total bill of \$120. If they left a tip of \$21.60, what percent of the total bill did they leave?
 - (1) 15%
 - (2) 16%
 - (3) 17%
 - (4) 18%
 - (5) 19%
3. The vice president of a bank contributed $8\frac{3}{4}\%$ of her salary to a retirement plan. If she contributed \$4,375 to the plan in one year, what was her annual salary that year?
 - (1) \$42,000
 - (2) \$43,750
 - (3) \$49,383
 - (4) \$50,000
 - (5) \$50,383
4. The office expenses at Delta Products were reduced from \$1400 last month to \$1225 this month. What was the percent of reduction in office expenses?
 - (1) 12.0%
 - (2) 12.5%
 - (3) 13.0%
 - (4) 13.5%
 - (5) 14.0%
5. Axelle bought a microwave oven regularly priced at \$394. If the oven was on sale for 40% off the regular price, how much did she pay for the microwave?
 - (1) \$226.95
 - (2) \$232.60
 - (3) \$236.40
 - (4) \$240.25
 - (5) \$250.00

Question 6 refers to the following table.

Daly's Pharmacy		
Item	April Sales	May Sales
Toothpaste	\$4200	\$4956
Soap	\$3980	\$4293
Shampoo	\$3420	\$3290

6. Toothpaste sales in May were what percent higher than the toothpaste sales in April?
 - (1) 15%
 - (2) 16%
 - (3) 17%
 - (4) 18%
 - (5) 19%

Answers start on page 400.

GED Mini-Test • Lessons 11–13

Directions: This is a 30-minute practice test. After 30 minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each item. You MAY use your calculator.

1. Last year, Anne paid \$13,600 in taxes, which was 32% of her gross annual salary. What was her gross annual salary?
 - (1) \$30,000
 - (2) \$34,500
 - (3) \$36,000
 - (4) \$38,500
 - (5) \$42,500
2. In its current catalog, Sheridan Office Supplies lists an electric stapler for \$69.95. If it offers a discount of 35%, what is the price after the discount, rounded to the nearest cent?
 - (1) \$24.48
 - (2) \$34.47
 - (3) \$42.43
 - (4) \$45.47
 - (5) \$94.43
3. The value of the inventory at Sam's Sporting Goods store increased from \$46,400 to \$52,200 during the first quarter of the year. What is the percent of increase in the value of the inventory?
 - (1) 10.5%
 - (2) 12.0%
 - (3) 12.5%
 - (4) 58.3%
 - (5) Not enough information is given.
4. On Friday, Lambert stock closed at \$52.36 per share, a price 23% lower than when it closed on Thursday. What was the closing price on Thursday?
 - (1) \$40
 - (2) \$52
 - (3) \$64
 - (4) \$68
 - (5) \$70
5. Daniel bought a couch that listed for \$950. If he gave a down payment of \$209, what percent of the list price did he give?
 - (1) 20%
 - (2) 21%
 - (3) 22%
 - (4) 23%
 - (5) 24%
6. John receives a fixed salary of \$325 per week and a commission of $7\frac{1}{4}\%$ on his gross sales. How much does he earn in one week?
 - (1) \$2800
 - (2) \$2725
 - (3) \$2700
 - (4) \$2525
 - (5) Not enough information is given.

Questions 7 and 8 refer to the following table.

Company Sales (Millions of Dollars)	
Month	Sales
Jan.	\$ 2
Feb.	\$ 6
Mar.	\$ 8
Apr.	\$ 8
May	\$14
June	\$18

7. The sales in February were what percent of the total sales for the six months listed? Round to the nearest whole percent.

(1) 10%
(2) 11%
(3) 12%
(4) 13%
(5) 14%

8. Between which two consecutive months was the percent of increase in company sales the greatest?

(1) January to February
(2) February to March
(3) March to April
(4) April to May
(5) May to June

9. Larry borrows \$12,500 at 16% simple annual interest for $3\frac{1}{2}$ years. How much interest will he owe on the loan at the end of that period?

(1) \$2,000
(2) \$3,000
(3) \$4,000
(4) \$5,000
(5) \$7,000

10. Lars has a current annual salary of \$38,650. If he gets a raise of \$3,280, what percent is the raise of his current annual salary? Round to the nearest whole percent.

(1) 6%
(2) 7%
(3) 8%
(4) 9%
(5) 10%

11. Jim buys a coat for \$136 and pays sales tax of $8\frac{1}{4}\%$. Which expression shows the amount that Jim paid for the coat, including the sales tax?

(1) $\$136 + 0.0825$
(2) $\$136 \times 0.0825$
(3) $(\$136 \times 0.0825) + \$136$
(4) $(\$136 + \$136) \times 0.0825$
(5) $\frac{\$136}{0.0825}$

12. Attendance at a craft show dropped from 1420 last year to 1209 this year. What was the percent of decrease in attendance, rounded to the nearest percent?

(1) 15%
(2) 16%
(3) 17%
(4) 18%
(5) 19%

13. In October, the circulation of the local newspaper was 247,624. The circulation of the newspaper in September was 238,100. What is the percent of change in circulation from September to October?

(1) increase of 3%
(2) decrease of 3%
(3) increase of 4%
(4) decrease of 4%
(5) increase of 5%

Part 2

Directions: Choose the one best answer to each item. You may NOT use your calculator.

14. New car sales at a local dealership increased from 150 in July to 180 in August. Which of the following expressions can be used to find the percent of increase in new car sales from July to August?
- (1) $180 \div 150$
 - (2) $150 \div 180$
 - (3) $180 - (150 \div 180)$
 - (4) $(180 - 150) \div 180$
 - (5) $(180 - 150) \div 150$
15. A quality control officer finds that 5% of the 2600 telephones inspected are defective. How many inspected telephones are not defective?
- (1) 130
 - (2) 247
 - (3) 1300
 - (4) 2470
 - (5) 2500
16. Lana has an annual salary of \$26,000. After completing a training program, she receives a raise of \$2,080. The raise represents what percent of her current annual salary?
- (1) 5%
 - (2) 6%
 - (3) 7%
 - (4) 8%
 - (5) 9%
17. Willa receives a commission of \$1,020 for selling a car. If the commission is 5% of the selling price, what is the selling price of the car?
- (1) \$20,000
 - (2) \$20,400
 - (3) \$20,800
 - (4) \$21,200
 - (5) \$21,600
18. Louis pays \$420 for a CD/DVD player, including a 5% sales tax. What is the price of the CD/DVD before the sales tax is added?
- (1) \$398
 - (2) \$399
 - (3) \$400
 - (4) \$401
 - (5) \$402
19. Meg borrowed \$2500 from her employer for 2 years at $2\frac{1}{2}\%$ interest. What is the total amount she will pay back?
- (1) \$2625
 - (2) \$3137
 - (3) \$3426
 - (4) \$5000
 - (5) \$6150

20. Net sales in August were reported as 120% of net sales in February. If February's net sales were \$13,985, what were the net sales in August?

- (1) \$11,188
- (2) \$11,654
- (3) \$14,782
- (4) \$16,782
- (5) \$17,481

21. During a sale, an office furniture store marks down the price of a swivel chair by 30%. If the regular price of the chair is \$180, what is the price after the markdown?

- (1) \$ 54
- (2) \$120
- (3) \$126
- (4) \$184
- (5) \$234

Question 22 refers to the following table.

Expense Budget Total: \$60,000	
Category	% of Budget
Advertising	16%
Salaries	35%
Supplies	25%
Rent	24%

22. How much more is budgeted for supplies than for advertising?

- (1) \$5000
- (2) \$5400
- (3) \$6400
- (4) \$7400
- (5) \$9000

23. Debra invested \$5000 in an account that paid 8% simple annual interest. At the end of 3 years, how much money was in the account, including the interest earned?

- (1) \$ 400
- (2) \$1200
- (3) \$5400
- (4) \$5800
- (5) \$6200

24. During the holiday season, the price of a particular toy rose from \$1 to \$3. What is the percent of increase in the price of the toy?

- (1) 100%
- (2) 200%
- (3) 300%
- (4) 400%
- (5) 500%

25. Sam bought a new television for \$440. If he paid 20% of this amount as a down payment, and paid the rest in 8 equal monthly installments, how much was the amount of each installment?

- (1) \$43
- (2) \$44
- (3) \$45
- (4) \$46
- (5) \$47

Answers start on page 401.

Unit 1 Cumulative Review Numbers and Operations



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Sondra buys an insurance policy that costs \$7.43 for every \$2,500 of insurance. If she buys a policy worth \$30,000 of insurance, how much does it cost her?

(1) \$86.08
(2) \$87.16
(3) \$88.08
(4) \$89.16
(5) \$90.08
2. Roberto borrows \$14,000 and agrees to pay $9\frac{3}{4}\%$ simple annual interest. Which of the following expressions shows how much interest he will pay if he borrows the amount for $3\frac{1}{2}$ years?

(1) $\$14,000 + 0.0975 + 3.5$
(2) $\$14,000 \times 9.75 \times 3.5$
(3) $\$14,000 \times 0.0975 \times 3.5$
(4) $\$14,000 \times \frac{0.0975}{3.5}$
(5) $\frac{\$14,000}{3.5} \times 0.0975$
3. Jocelyn works in a computer store and earns a 7% commission on her sales. If she sold 10 computers to the local school district for a total of \$14,000, how much commission did she receive?

(1) \$ 980
(2) \$ 1,302
(3) \$13,020
(4) \$14,980
(5) Not enough information is given.

4. A business has \$15,000 in its checking account. The company deposits checks in the amount of \$1,800, \$3,000, and \$900. It also writes checks for \$3,600 and \$2,800 to pay bills. How much is in the account after these transactions?

(1) \$27,100
(2) \$16,800
(3) \$14,300
(4) \$ 3,800
(5) Not enough information is given.

Questions 5 and 6 refer to the following table.

Item	Regular Price	Sale Price
Jackets	\$168.99	\$135.99
Pants	\$ 87.50	\$ 62.00
Shirts	\$ 38.95	\$ 27.95

5. Richard bought 3 pairs of pants and 2 shirts at the sale price. How much did he save on these items by buying them at the sale price instead of at the regular price?

(1) \$11.00
(2) \$22.00
(3) \$25.50
(4) \$76.50
(5) \$98.50
6. What is the percent of discount for shirts from the regular price to the sale price? Round to the nearest percent.

(1) 26%
(2) 27%
(3) 28%
(4) 29%
(5) 30%

7. A 16-pound turkey costs \$15.92. Which of the following could be used to find how much a 20-pound turkey would cost at the same price per pound?

- (1) $\frac{16}{\$15.92} = \frac{20}{?}$
 (2) $\frac{\$15.92}{16} = \frac{20}{?}$
 (3) $\frac{16}{\$15.92} = \frac{?}{20}$
 (4) $\frac{16}{20} = \frac{?}{\$15.92}$
 (5) $\frac{20}{16} = \frac{\$15.92}{?}$

8. A lamp regularly priced at \$45 is part of an Internet promotion of 15% off all lamps. What is the price of the lamp during the promotion?

- (1) \$ 6.75
 (2) \$17.75
 (3) \$38.25
 (4) \$44.25
 (5) \$51.25

9. Mark used $4\frac{1}{2}$ gallons of paint to paint the living room, $2\frac{7}{8}$ gallons to paint the dining room, and $3\frac{1}{8}$ gallons to paint the kitchen. How many gallons did he use in all?

- (1) 9
 (2) $10\frac{1}{4}$
 (3) $10\frac{1}{2}$
 (4) $10\frac{3}{4}$
 (5) 11

10. From January to February the price of Argon stock rose from \$2 per share to \$8 per share. What was the percent of increase?

- (1) 6%
 (2) 40%
 (3) 75%
 (4) 300%
 (5) Not enough information is given.

11. The price of a stereo system on Friday was \$272, a discount of 15% from its price on Thursday. What was the price of the stereo system on Thursday?

- (1) \$231.20
 (2) \$312.80
 (3) \$318.20
 (4) \$320.00
 (5) \$328.00

12. Mateo jogs 3 times a week. This week he jogged 3 miles on Monday, 3.25 miles on Thursday, and 3.9 miles on Friday. How many more miles did Mateo jog this week than the week before?

- (1) 3
 (2) 9
 (3) 10.15
 (4) 30.45
 (5) Not enough information is given.

Question 13 refers to the following table.

Miles Driven Last Week	
Anne	1348.6 miles
Barbara	2098.4 miles
Kristen	1984.9 miles

13. Last week, Barbara drove how many more miles than Anne?

- (1) 749.8
 (2) 730.8
 (3) 720.8
 (4) 719.8
 (5) 709.8

Directions: Solve the following questions and enter your answers on the grids provided.

14. Roxanne is buying supplies for a catering job. She bought a piece of salmon for \$31.28. If the cost of the salmon was \$9.20 per pound, how many pounds did she buy?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

16. Peter went on a diet and lost 5% of his weight by the end of the first month. If Peter weighed 238 pounds when he started his diet, how many pounds did he weigh at the end of the first month?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

15. Kumiko made a fruit salad for the cafeteria. She used 3 pounds of apples, 2 pounds of oranges, 4 pounds of bananas, 2 pounds of grapes, and 3 pounds of peaches. If she usually uses 20 pounds of fruit, how many fewer pounds of fruit did she use this time?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

17. Areta borrowed \$42.48 from Julia on Monday and another \$64.76 on Friday. On Saturday she paid back $\frac{1}{4}$ of the total amount she owed. How much did she still owe?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

18. Jonathan is saving \$80 each month for a vacation that costs \$720. If he has already saved \$480, how many more months will it take him to save the whole amount?
- (1) 3
(2) 5
(3) 7
(4) 9
(5) 11
19. Marta worked $2\frac{3}{4}$ hours on Monday, $4\frac{1}{2}$ hours on Tuesday, and $5\frac{7}{8}$ hours on Wednesday. How many hours did she work in all for the three days?
- (1) $11\frac{1}{8}$
(2) $12\frac{3}{4}$
(3) $13\frac{1}{8}$
(4) $14\frac{1}{2}$
(5) $15\frac{1}{8}$
20. Cheryl drives to work and back five days each week. If her job is 14.82 miles from her home, approximately how many miles does she drive to work and back each week?
- (1) 15
(2) 30
(3) 50
(4) 75
(5) 150
21. The Jordans borrow \$5000 for 3 years at 14% interest. What is the total amount they will pay back to the bank?
- (1) \$2100
(2) \$5042
(3) \$6400
(4) \$7100
(5) \$8000
22. A car odometer reads 8,867.3 miles. How many more miles will it take to reach 10,000?
- (1) 832.7
(2) 982.7
(3) 1,132.7
(4) 1,133.3
(5) 1,133.7
23. A box of cereal costs \$1.59. If a case holds 8 boxes, how much would $3\frac{1}{2}$ cases cost?
- (1) \$ 5.57
(2) \$12.72
(3) \$28.00
(4) \$38.92
(5) \$44.52
24. Sonia can pick 14.5 baskets of strawberries per hour. At this rate, how many baskets can she pick in $5\frac{1}{2}$ hours?
- (1) 70
(2) $72\frac{1}{2}$
(3) $79\frac{3}{4}$
(4) $82\frac{1}{2}$
(5) 87

Directions: Solve the following questions and enter your answers on the grids provided.

25. In a recent company survey, $\frac{3}{4}$ of the employees said they drove to work. Of those who drive to work, $\frac{3}{5}$ said they drive in a carpool. What fraction of the employees drives in a carpool?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

26. Kathy cuts a piece of board 19.6 inches long into 4 equal parts. How many inches long is each piece?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

27. Shanti drove 78 miles in $1\frac{1}{2}$ hours. At the same rate, how many miles could she drive in 2.5 hours?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

28. Stefan pays \$33 per month for the insurance and pays \$5 for each visit to the doctor. He went to the Eastside Health Clinic six times in two months. How much did Stefan pay for insurance and treatment for the two months?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Answers start on page 402.

Cumulative Review Performance Analysis

Unit 1 • Numbers and Operations

Use the Answers and Explanations starting on page 402 to check your answers to the Unit 1 Cumulative Review. Then use the chart to figure out the skill areas in which you need more practice.

On the chart, circle the questions that you answered correctly. Write the number correct for each skill area. Add to find the total number of questions that you got correct on the Cumulative Review. If you feel that you need more practice, go back and review the lessons for the skill areas that were difficult for you.

Questions	Number Correct	Skill Area	Lessons for Review
4, 12, 15, 18, 20, 28	____/6	Number Sense and Problem Solving	1, 2, 3, 4
1, 7, 9, 19, 24, 25, 27	____/7	Fractions	5, 6, 7
5 , 13, 14, 17, 22, 23, 26	____/7	Decimals	8, 9, 10
2, 3, 6 , 8, 10, 11, 16, 21	____/8	Percents	11, 12, 13
TOTAL CORRECT: ____/28			

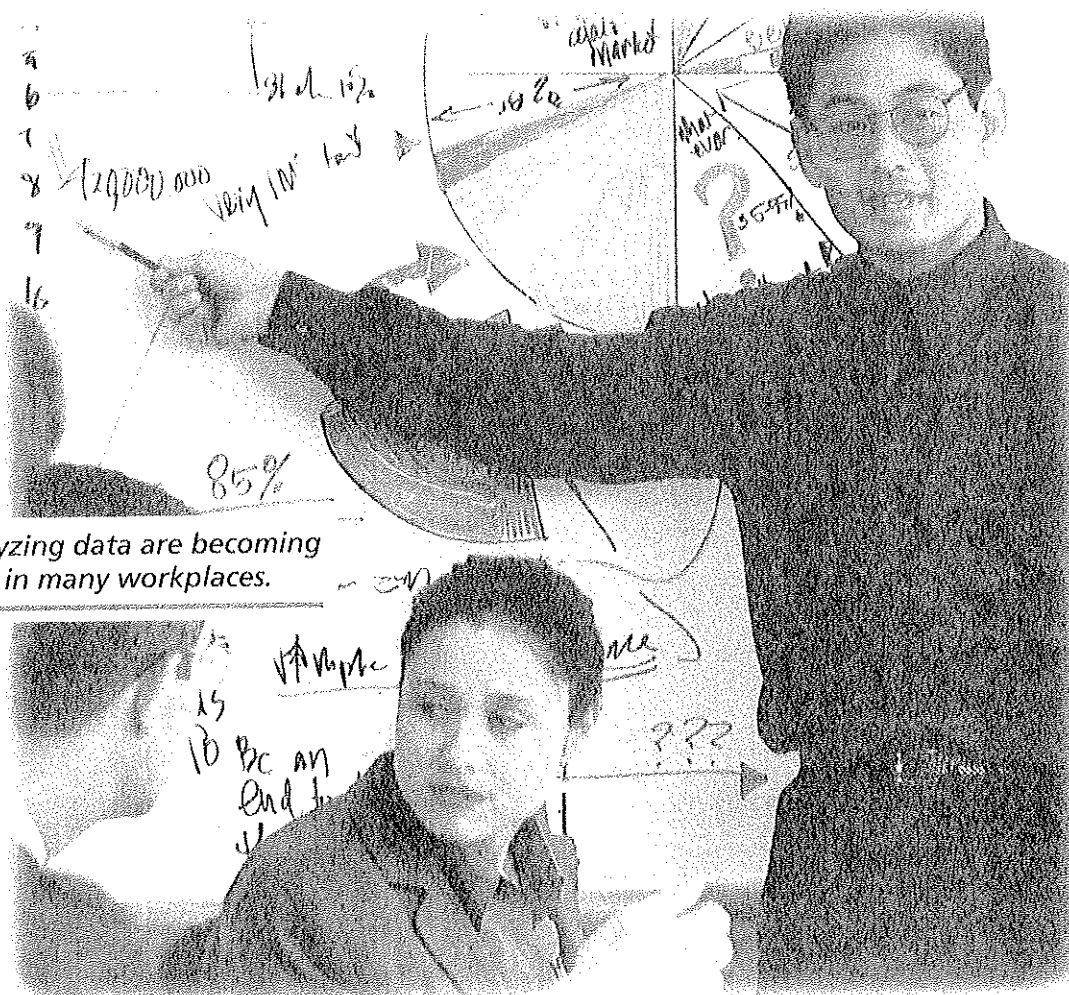
Question numbers in **boldface** are based on graphics.

UNIT 2

Measurement and Data Analysis

Measurement and data analysis are important areas of math that we use every day. We use measurement when we make things. Sometimes we measure items such as gallons of paint or cups of chocolate chips. At other times we measure length or space, such as the perimeter or area of a floor, wall, or garden or the volume of a container. Data analysis is becoming an increasingly important activity in our lives. The increasing use of computers has accelerated the collection, display, and analysis of data, especially information in numerical form. Most often, we see such data presented in the form of tables, charts, and graphs.

Questions related to measurement and data analysis will account for more than 25 percent of the GED Mathematics Test. Additionally, you will find that you can use many of the skills in this unit in your personal life and on the job.



Measuring and analyzing data are becoming important functions in many workplaces.

The lessons in this unit include:

Lesson 14: Measurement Systems

Currently there are two systems of measurement in use. The customary U.S. or English system of measurement is used widely in the United States, and the metric system is used throughout the rest of the world. Measurement problems using either system of measurement require conversion of units as well as addition, subtraction, multiplication, and division.

PROBLEM-SOLVING STRATEGIES

- Choosing Perimeter, Area, or Volume
- Drawing a Picture

Lesson 15: Measuring Common Figures

On the GED Mathematics Test, you will encounter problems that require finding the perimeter, area, or volume of common figures. This includes finding the perimeter and area of squares and rectangles as well as the volume of common rectangular containers.

Lesson 16: Measures of Central Tendency and Probability

Some of the most useful applications of data analysis are finding the mean (average), median (middle number), and mode (most frequent values), as well as the range (the difference between greatest and least values). Analyzing data also includes determining probability, which is used to predict how likely it is that an event will happen.

Lesson 17: Tables, Charts, and Graphs

Tables, charts, and graphs are different ways to present data. Tables and charts organize numbers in columns and rows. Graphs display data visually in a number of ways. For instance, bar graphs present comparisons, line graphs can show comparisons or changes over time, and circle graphs represent parts of a whole.

The Customary U.S. System

Length

1 foot (ft) = 12 inches (in)
1 yard (yd) = 3 ft
1 mile (mi) = 5280 ft

Volume

1 cup (c) = 8 fluid ounces (fl oz)
1 pint (pt) = 2 c
1 quart (qt) = 2 pt
1 gallon (gal) = 4 qt

Weight

1 pound (lb) = 16 ounces (oz)
1 ton (t) = 2000 lb

Time

1 minute (min) = 60 seconds (sec)
1 hour (hr) = 60 min
1 day = 24 hr
1 week = 7 days
1 year = 12 months = 365 days

Many math problems involve measurement. A measurement is a number labeled with a unit of measure. For instance, you could say that a board is 4 feet long, a bucket holds 2 gallons, or a letter weighs 1 ounce. Feet, gallons, and ounces are units of measure.

The table above shows the units of measure and their equivalencies for the **customary system of measurement** used in the United States. You must know this information.

Converting Measurements

It is often necessary to change from one unit of measure to another. Writing a proportion is one of the simplest methods for converting units.

Example 1 Kiel has 1200 long-distance minutes per month on his phone-calling plan. How many hours of calls does this represent?

- Step 1 Use the appropriate conversion factor.** $1 \text{ hr} = 60 \text{ min}$
Step 2 Write a proportion. Write both ratios in the same order (like units on top). $\frac{\text{hours}}{\text{minutes}} = \frac{1}{60} = \frac{x}{1200}$
Step 3 Solve for x . Find the cross product and divide by the remaining term. $1 \times 1200 \div 60 = 20$

Kiel has **20 hours** per month on his calling plan.



Write the proportion, then do the arithmetic on a calculator.

$$1 \times 1200 \div 60 = 20.$$

Example 2 A board is $5\frac{3}{4}$ feet long. What is its length in inches?

- Step 1** Use the appropriate conversion factor. $1 \text{ ft} = 12 \text{ in}$
Step 2 Then write a proportion. $\frac{\text{inches}}{\text{feet}} = \frac{12}{1} = \frac{x}{5\frac{3}{4}}$
Step 3 Cross-multiply, divide, and solve. $12 \times 5\frac{3}{4} \div 1 = x$

$$12 \times \frac{23}{4} \div 1 = 69$$

The length of the board is **69 inches**.

Not all conversions come out evenly. When you have a remainder, you can write it as either a smaller unit, a fraction, or a decimal.

Example 3 Convert 56 ounces to pounds.

Step 1 Use the appropriate conversion factor.

$$1 \text{ lb} = 16 \text{ oz}$$

Step 2 Write and solve a proportion.

$$\frac{\text{pounds}}{\text{ounces}} = \frac{1}{16} = \frac{x}{56} \quad 1 \times 56 \div 16 = 3 \text{ r}8 = 3 \frac{8}{16} = 3 \frac{1}{2} = 3.5$$



A fraction or decimal remainder uses the same unit name as the whole number portion of the answer.

$$1 \times 56 \div 16 = 3.5$$

The answer is **3 pounds 8 ounces**, **$3\frac{1}{2}$ pounds**, or **3.5 pounds**.

GED SKILL FOCUS

A. Solve. Refer to the chart on page 164. You may use your calculator for Questions 7 through 12. The first problem is started for you.

1. Change 4 minutes to seconds.

$$\frac{\text{seconds}}{\text{minutes}} = \frac{60}{1} = \frac{x}{4}; 60 \times 4 \div 1 = \underline{\hspace{2cm}}$$

2. Change 18 cups to pints.

3. Change $3\frac{1}{2}$ yards to feet and inches.

4. How many minutes are equal to $2\frac{1}{3}$ hours?

5. Change 72 fluid ounces to cups.

6. How many inches are in $1\frac{1}{2}$ yards?



7. Change $4\frac{1}{4}$ pounds to ounces.

8. How many quarts are in $5\frac{3}{4}$ gallons?

9. Change 6 feet 9 inches to yards.

10. Change 74 ounces to pounds.

11. How many feet are equal to 5 miles?

12. How many cups are in 2 gallons?



B. Solve. You may use your calculator.

13. Which is less, $3\frac{1}{4}$ hours or 200 minutes?

14. Which is less, $4\frac{1}{2}$ pounds or 75 ounces?

15. Lauren has a board that measures 30 inches in length. Can she cut a piece 3 feet long from the board?

16. Chase needs $1\frac{1}{2}$ gallons of a neutral latex base paint. He has 13 pints in the storeroom. Does he have enough?

Refer to the following information to answer Questions 17 and 18.



75 oz



$4\frac{3}{4}$ lb



4 lb 13 oz

17. What is the weight of Package C in ounces?

18. Which package above (A, B, or C) weighs the least?

Answers start on page 403.

Operations with Measurements



Another approach for working with measurements is to convert each to a mixed fraction using the larger unit. For example:

$$\begin{aligned} 2 \text{ ft } 6 \text{ in} &= 2\frac{1}{2} \text{ ft} \\ 2 \text{ ft } 9 \text{ in} &= 2\frac{3}{4} \text{ ft} \\ 2\frac{1}{2} + 2\frac{3}{4} &= 5\frac{1}{4} \text{ ft} \\ 5\frac{1}{4} \text{ ft} &= 5 \text{ ft } 3 \text{ in} \end{aligned}$$



Look at the form and units of the answer choices to help you decide how to solve a GED Mathematics problem. For example, see if the remainder is written as a fraction or decimal or in a smaller unit of measure.

To add, subtract, multiply, or divide measurements, they must be in the same units. You may need to convert one or more measurements.

Example 1 One board is $2\frac{1}{2}$ feet in length. Another board is 2 feet 9 inches. What is the total length of the two pieces?

Step 1 **Convert to like units.** Use the appropriate conversion factor. $1 \text{ ft} = 12 \text{ in}$
 $2\frac{1}{2} \text{ ft} = 2 \text{ ft } 6 \text{ in}$

Step 2 **Set up** the addition problem and add like units. $2 \text{ ft } 6 \text{ in}$
 $+ 2 \text{ ft } 9 \text{ in}$

Step 3 **Reduce** your answer. $4 \text{ ft } 15 \text{ in} = 4 \text{ ft} + 12 \text{ in} + 3 \text{ in}$
 $= 4 \text{ ft} + 1 \text{ ft} + 3 \text{ in} = 5 \text{ ft } 3 \text{ in}$

The combined length of the boards is **5 feet 3 inches**.

To subtract measurements, you may need to regroup, or borrow, from the column containing the larger measurement unit.

Example 2 John weighed 11 lb 11 oz at 2 months of age. At 4 months he weighed 14 lb 8 oz. How much weight did he gain?

Step 1 **Regroup** as needed—here, borrow 1 lb from the 14 lb and convert it to 16 oz. $13 \text{ lb } 24 \text{ oz}$
 $14 \text{ lb } 8 \text{ oz}$

Step 2 **Combine** like units—here add 16 oz to 8 oz. Then subtract to find the difference. $13 \text{ lb } 24 \text{ oz}$
 $- 11 \text{ lb } 11 \text{ oz}$
 $2 \text{ lb } 13 \text{ oz}$

John gained **2 pounds 13 ounces**.

You may also need to convert units and reduce your answer to multiply or divide measurements. To divide, convert to the smaller unit of measure.

Example 3 A plan calls for 4 boards, each 4 ft 3 in long. What is the total length of the boards?

Step 1 Set up the problem and multiply each part of the measure separately. $4 \text{ ft } 3 \text{ in}$
 $\times 4$
 $16 \text{ ft } 12 \text{ in} = 16 \text{ ft} + 1 \text{ ft}$
 $= 17 \text{ ft}$

Step 2 Convert units and reduce the answer.

The total length is **17 feet**.

Example 4 Mel has a pipe that is 14 ft 2 in long. If he cuts the pipe into five equal pieces, what will be the length of each piece?

Step 1 To divide, convert mixed units to the smaller unit. Write a proportion using the appropriate conversion factor. $\frac{\text{inches}}{\text{feet}} = \frac{12}{1} = \frac{x}{14}$

Solve—here, for the inches in 14 feet.

Add the remaining smaller unit—here, 2 inches to get the total inches.

$$12 \times 14 \div 1 = 168 \text{ in}$$

$$168 \text{ in} + 2 \text{ in} = 170 \text{ in}$$

Step 2 Divide—here, by 5 to make 5 equal pieces. $170 \text{ in} \div 5 = 34 \text{ in}$

Step 3 Convert to mixed units—here, feet and inches. $34 \text{ in} = 2 \text{ ft } 10 \text{ in}$

Each piece of pipe will be **34 inches** or **2 feet 10 inches**.

GED SKILL FOCUS

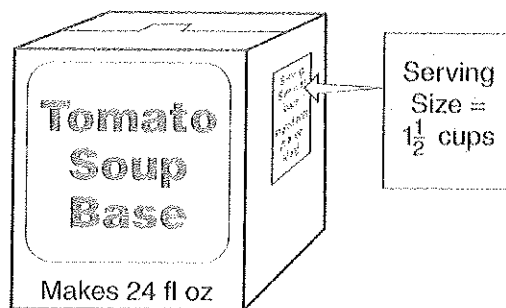
A. Solve. You may not use your calculator.

1. Add 8 ft 8 in, 3 ft 5 in, and 4 ft 9 in.
2. Subtract 20 min 45 sec from $\frac{1}{2}$ hr.
3. Subtract 1 ft 7 in from 2 ft 2 in.
4. Add 3 gal to 5 qt. Write your answer in quarts.
5. Find the total of 3 lb 8 oz, 5 lb 13 oz, and 2 lb 9 oz.
6. Find the difference between 2 ft 6 in and 18 inches.
7. Multiply 3 lb 4 oz by 5.
8. Divide 1 yd 4 in by 5. Write your answer in inches.
9. Multiply 2 yd 1 ft by 8. Write your answer in yards and feet.
10. Divide 3 gallons by 4. Write your answer in quarts.

B. Solve.

11. A piece of plastic tubing is 12 feet long. How many pieces measuring 1 foot 9 inches long can be cut from the length of tubing?
12. Dorie is canning raspberry jam. She makes 2 gallons of jam. If she plans to keep 6 pints for herself, how many pints will she give away?
13. Zola buys $3\frac{1}{4}$ yards of fabric to make a blouse. She uses 2 yards 2 feet 9 inches of fabric. How many inches of fabric are left?
14. Meg needs 15 pieces of wood to make supporting posts for a stairway. If each supporting post is 2 feet 9 inches, what is the total length (in feet) she will need?
15. Marco can assemble one cabinet in 25 minutes. How many cabinets can he assemble in $3\frac{3}{4}$ hours?

Refer to the drawing below to answer Questions 16 through 18.



16. How many cups of soup will each box of soup base make?
17. How many ounces are in one serving of the soup?
18. A restaurant uses the soup base to prepare its vegetable soup. How many servings will 5 packages of the soup mix make?

Answers start on page 404.

The Metric System

The **metric system** is used throughout most of the world. It uses these basic metric units:

meter (m) unit of length A meter is a few inches longer than one yard.
gram (g) unit of weight or mass It takes 28 grams to make one ounce.
liter (L) unit of volume A liter is slightly more than one quart.

Other units of measure are made by adding the prefixes shown below to the basic units listed above.

milli-	means $\frac{1}{1000}$	A milligram (mg) is $\frac{1}{1000}$ of a gram.
centi-	means $\frac{1}{100}$	A centimeter (cm) is $\frac{1}{100}$ of a meter.
deci-	means $\frac{1}{10}$	A deciliter (dL) is $\frac{1}{10}$ of a liter.
deka-	means 10	A dekagram (dag) is 10 grams.
hecto-	means 100	A hectoliter (hL) is 100 liters.
kilo-	means 1000	A kilometer (km) is 1000 meters.

The metric system is based on the powers of ten. Convert metric units by moving the decimal point. Use this chart to make metric conversions.

To convert to smaller units, move the decimal point right. ----->

kilo- 1000	hecto- 100	deka- 10	meter gram liter	deci- $\frac{1}{10}$	centi- $\frac{1}{100}$	milli- $\frac{1}{1000}$
---------------	---------------	-------------	------------------------	-------------------------	---------------------------	----------------------------

<----- **To convert to larger units, move the decimal point left.**

Example 1 How many milligrams are in 2 dekagrams?

Step 1 You need to change from a larger unit (dekagrams) to a smaller unit (milligrams). Put your finger on either unit measure in the chart and **count the spaces** to the other measure.

There are 4 spaces.

Step 2 Since you are converting a larger unit to a smaller unit, **move the decimal point** 4 places to the right, adding zeros as needed.

$$2.0000 = 20,000.$$

There are **20,000 milligrams** in 2 dekagrams.

Example 2 A piece of wire is 150 centimeters long. How many meters in length is the wire?

Step 1 You need to change from centimeters to meters. Count the spaces in the chart from one measurement to the other. There are 2 spaces.



Think about the meaning of the metric prefixes. Since *centimeter* means $\frac{1}{100}$ meter, there are 100 centimeters in 1 meter.

Step 2 Since you are converting a smaller unit to a larger unit, move the decimal point 2 spaces to the left.

$$150. \div 100 = 1.5$$

The wire is **1.5 meters** long.



Working with metric units uses the same steps as working with decimals. The steps for working with decimals can be found on pages 104–115.

Since metric measurements use decimals instead of fractions, perform calculations with these measurements as you would in other decimal problems. Remember, you can add and subtract like units only.

Example 3 Ty walked 2.8 kilometers one day and 1575 meters the next day. How many total kilometers did he walk?

Step 1 Change meters to kilometers. Move the decimal point 3 places to the left.

$$1575 \text{ m} = 1.575 \text{ km}$$

Step 2 Line up the decimal points and add the like units

$$\begin{array}{r} 2.8 \\ + 1.575 \\ \hline 4.375 \end{array}$$

Ty walked a total of **4.375 kilometers**.

GED SKILL FOCUS

A. Solve using pencil and paper.

1. Change 5000 millimeters to meters.
2. How many milligrams are in 3.4 grams?
3. A CD-player weighs 3 kg. What is its weight in grams?
4. Change 2950 centimeters to meters.
5. How many liters are in 3000 milliliters?
6. A bookcase is 2.4 meters tall. What is the height in centimeters?



B. Solve. You may use your calculator.

7. Hank has three lengths of wire: 75 centimeters, 126 centimeters, and 4.6 meters. What is the total length of the wire in centimeters?
8. Graham Industries makes lamps. Each finished lamp has a mass of 1200 grams. An order of 14 lamps is shipped. What is the total mass in kilograms of the shipment?

Refer to the following diagram to answer Question 9.



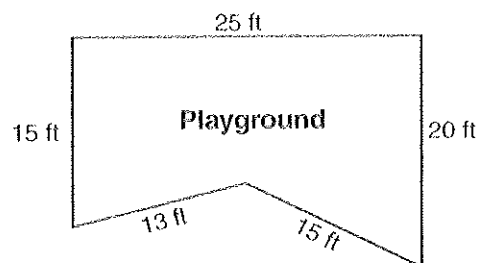
9. The diagram shows the checkpoints for a 10-kilometer race. What is the distance in meters from the starting point to the second checkpoint?

Answers start on page 405.

Perimeter

Perimeter is a measure of the distance around the edge of any flat shape. To find the perimeter of a polygon, add the lengths of its sides.

Example 1 The county supervisor plans to fence in the area shown at the left for a playground. How much fencing is needed?



The fence will go around the perimeter of the playground. Find the perimeter by adding the lengths of the sides.

$$15 + 13 + 15 + 20 + 25 = 88$$

It will take **88 feet** of fencing to enclose the playground.

Sometimes not all sides of a figure in a problem are labeled. To find the missing lengths, you will need to apply your knowledge of the properties of that figure.



A **rectangle** has 4 sides, 4 square corners or right angles, and opposite sides of equal length. Opposite sides are directly across from each other.

Example 2 Monica needs to glue yarn around the perimeter of a rectangular piece of poster board that is 18 inches long and 15 inches wide. How much yarn does she need?

Step 1 Fill in the measures of the opposite sides.

Step 2 Add the measurements. $18 + 18 + 15 + 15 = 66$ inches

Another way to approach the problem is to double the length and the width and add the results. $(18 \times 2) + (15 \times 2) = 36 + 30 = 66$ inches

If your calculator is programmed with the order of operations (like the one provided on the GED Mathematics Test), you can enter the second method without parentheses. The calculator automatically does the multiplication operations before it adds.

$$18 \times 2 + 15 \times 2 = 66.$$

The perimeter of the poster board is **66 inches**.



If you use a calculator that is not programmed with the order of operations, you must enter the calculation as an addition problem:
 $18 + 18 + 15 + 15 = 66.$

A **square** has 4 equal sides and 4 right angles. If you know the length of one side, you can find the perimeter of the square by multiplying by 4.

Example 3 A business owns a square lot of land. If one side of the lot measures 87 feet, what is the perimeter of the lot?

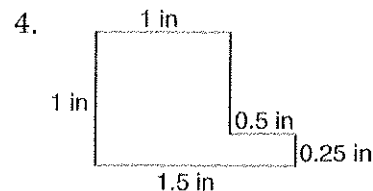
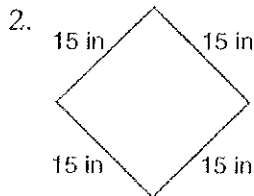
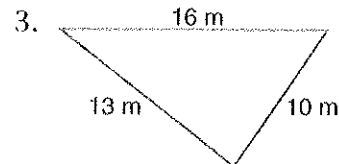
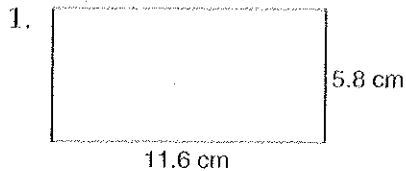
You haven't been given a diagram of the lot, but you know that the figure is a square and that a square has 4 equal sides. Multiply 87 feet by 4 to find the perimeter.

$$87 \text{ ft} \times 4 = 348 \text{ ft}$$

The perimeter of the square lot is **348 feet**.

GED SKILL FOCUS

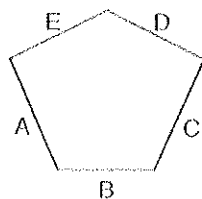
A. Find the perimeter of each figure. Do not use a calculator.



B. Solve. You may use a calculator.

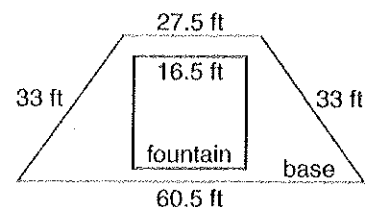
5. A rectangular room is 14 feet by 12 feet. A carpenter plans to install molding along the top of each wall. What is the perimeter of the room in feet?

Refer to the following drawing to answer Question 6.



6. The design for a company logo is shown above. If sides A and C are 14.3 cm long, sides D and E are 13.5 cm long, and side B is 12.4 cm long, what is the perimeter in centimeters of the logo?

Refer to the following drawing to answer Questions 7 and 8.

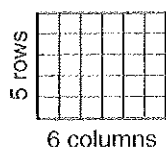
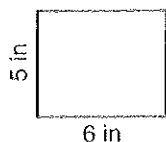


7. The City Civic Center is planning to install a fountain sculpture. The square fountain will sit on a four-sided concrete base. What is the perimeter of the base in feet?
8. What is the perimeter in feet of the square fountain?

Answers start on page 405.

Area of Squares and Rectangles

Area is a measure of the surface of a flat figure. Area is measured in **square units**. Area tells how many square units it takes to cover the space inside the figure.



Example 1 A rectangle is 6 inches by 5 inches. What is the area of the rectangle in square inches?

Step 1 The rectangle is 6 inches along the bottom, so 6 squares, each 1 inch by 1 inch, can be lined up on the bottom row. It will take 5 of these rows to fill the rectangle.

Step 2 The area is the number of squares inside the rectangle. A quick way to count the squares is to multiply the number of columns by the number of rows. $6 \text{ in} \times 5 \text{ in} = 30 \text{ square inches}$

The area of the rectangle is **30 square inches**.



Example 2 Kim's laundry room floor has the shape of a square. He wants to tile the room. If one side of the room measures 11 feet, what is the area of the floor in square feet (sq ft)?

A square is actually a special kind of rectangle. To find the area of a rectangle, you multiply length by width. Use the same method to find the area of a square. The room is 11 ft by 11 ft. To find the area, multiply the length by the width. $11 \text{ ft} \times 11 \text{ ft} = 121 \text{ square feet}$



When you multiply a number by itself, you **square** the number. On a calculator, square a number by multiplying or using the x^2 key. This key multiplies any number, x , by itself. The raised 2 in x^2 (an **exponent**) tells how many times the number should appear in the multiplication problem.

$$11 \times 11 = 121. \quad 11 x^2 = 121.$$

The area of the laundry room is **121 square feet**.



Practice all kinds of problems with and without a calculator. Use the official GED calculator if possible. You will be issued a GED calculator at the test site and will be allowed to use it on the first part of the GED Mathematics Test.

Some complex shapes are actually a combination of squares and rectangles. To find the area of these shapes, break the figure into smaller pieces, find the area of each piece, and add to find the total area.

Example 3 An office suite has the shape shown below. What is the area in square feet of the office suite?

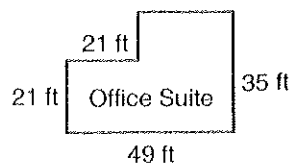
Step 1 Break the shape into squares and rectangles. There may be more than one way to do this. Choose the way that makes sense to you. No matter how the shape is broken up, the area remains the same.

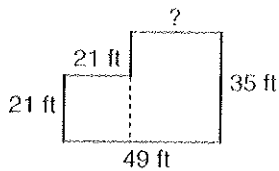
Step 2 Find the area of each piece.

Square: The dimensions are 21 ft by 21 ft.

Multiply to find the area.

$$21 \text{ ft} \times 21 \text{ ft} = 441 \text{ square feet}$$





Rectangle: One side measures 35 ft. The other measurement is not given. However, you know that the side of the square is 21 ft and the length of the entire figure is 49 ft. Subtract to find the missing measurement.
 $49 \text{ ft} - 21 \text{ ft} = 28 \text{ ft}$
 Multiply the rectangle's dimensions.
 $35 \text{ ft} \times 28 \text{ ft} = 980 \text{ sq ft}$
Step 3 Add the areas of the square and rectangle to find the total area.
 $441 \text{ ft} + 980 \text{ ft} = 1421 \text{ sq ft}$



Key in the problem in one step using the parentheses keys on a calculator not programmed with the order of operations.

$$(21 \times 21) + (35 \times 28) = 1421.$$

The area of the office suite is **1421 square feet**.

GED SKILL FOCUS

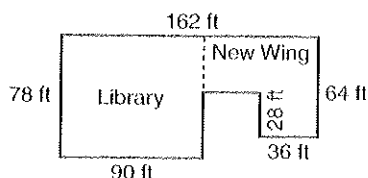
A. Solve. You may not use a calculator.

1. A rectangular room is 4.5 meters by 12 meters. What is the area of the room in square meters?
2. An artist is using a canvas that measures 24 inches by 24 inches. What is the area of the canvas in square inches?
3. A flat section of a roof is 35 feet long and 18 feet wide. The cost to repair the roof is based on the area of the roof. Find the area of this section of the roof in square feet.
4. One side of a square is 4.6 centimeters. What is the square's area to the nearest square centimeter?
5. A rectangular hallway measuring 28 feet by 6 feet needs new carpeting. What is the area of the hallway in square feet?
6. The city wants to preserve a rectangular mural that is 32 feet by 15 feet. One quart of protective coating covers 100 square feet. How many quarts should the city buy to cover the mural?



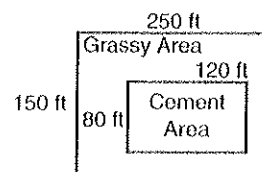
B. Solve. You may use a calculator.

Refer to the following diagram to answer Questions 7 and 8.



7. What is the area in square feet of the library before the addition of the new wing?
8. What is the area in square feet of the new wing?

Refer to the following drawing to answer Questions 9 and 10.

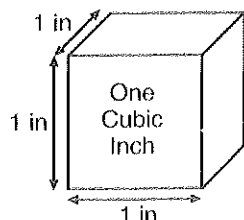


9. What is the area in square feet of the cement surface being built?
10. What is the area in square feet of the grassy area? (*Hint: Total – cement*)

Answers start on page 405.

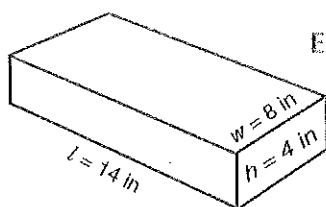
Volume

Measures of length can be used to calculate area—the space inside a two-dimensional figure. Area is the square units that cover the space.



Measures of length are also used to calculate volume. **Volume** is a measure of the amount of space inside a three-dimensional object. Volume is measured in three-dimensional units or **cubic units**—cubic inches (cu in), cubic feet (cu ft), cubic yards (cu yd), and cubic centimeters (cu cm) and other metric units. Each of these units is a **cube** with identical square sides.

One of the most common three-dimensional objects is the **rectangular container**. Boxes, crates, and rooms are examples of rectangular containers. To find the volume of these objects, multiply the length times the width times the height.



Example 1 What is the volume of a rectangular container that is 14 inches long, 8 inches wide, and 4 inches high?

Multiply: length times width times height.

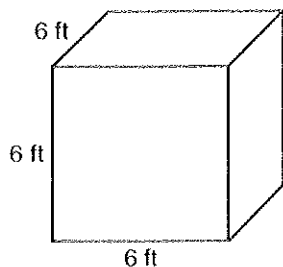
$$14 \text{ in} \times 8 \text{ in} \times 4 \text{ in} = 448 \text{ cubic inches}$$



Multiply the numbers as shown.

$$14 \times 8 \times 4 = 448.$$

The volume of the container is **448 cubic inches**. In other words, you could fit 448 one-inch cubes inside the container.



A **cube** is a special rectangular container, so you can find the volume in the same way. However, since each side has the same measure, you are multiplying the same number three times, or “cubing” the number.

Example 2 A shipping crate has the shape of a cube that is 6 feet long on each edge. What is its volume in cubic feet?

$$\begin{aligned} \text{Volume} &= \text{length} \times \text{width} \times \text{height} \\ &= 6 \text{ ft} \times 6 \text{ ft} \times 6 \text{ ft} = 216 \text{ cubic feet} \end{aligned}$$



Using a scientific calculator, you can cube a number using the x^y key. Enter the number you want to multiply, press x^y , enter the exponent 3, and press the $=$ key. Remember, the exponent is the number of times the number is used in the multiplication problem, $x \times x \times x$. Try both methods to see that you get the same answer.

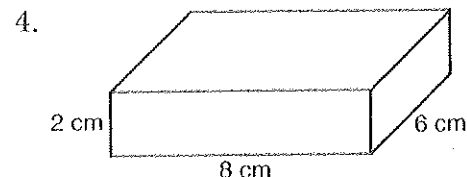
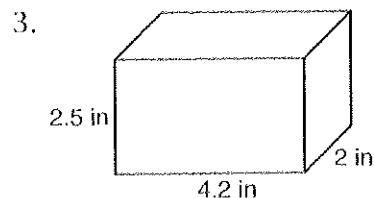
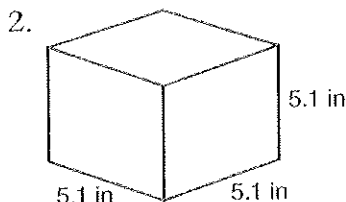
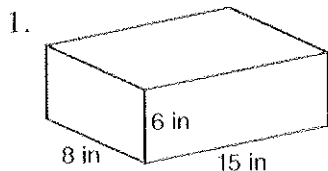
$$6 \times 6 \times 6 = 216.$$

$$6 x^y 3 = 216.$$

Note: the GED calculator also has a x^3 key: $6 \text{ SHIFT } x^3 = 216$. The volume of the shipping crate is **216 cubic feet**.

GED SKILL FOCUS

A. Find the volume of each object shown. Do not use a calculator for these questions.



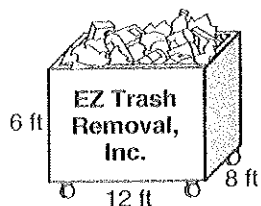
B. Solve. You may use your calculator for these items.

5. What is the volume in cubic inches of a rectangular solid with these measurements: length = 15 inches, width = 24 inches, and height = 4 inches?

6. What is the volume in cubic yards of a cube that measures 3 yards on each side?

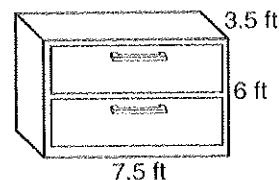
8. What is the volume in cubic yards of a rectangular container with these measurements: length = 6 feet, width = 3 feet, and height = 9 feet? (Hint: 1 cu yd = 27 cu ft)

Refer to the following drawing to answer Question 7.



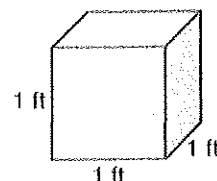
7. A contractor has hired a trash hauling service to remove trash from a job site. The trash bins are rectangular containers with the measurements shown in the diagram. How many cubic feet of trash can each container hold?

Refer to the following drawing to answer Question 9.



9. The dimensions of a filing cabinet are shown in the diagram. What is the volume of the cabinet in cubic feet?

Refer to the following drawing to answer Question 10.



10. How many cubic inches are in 1 cubic foot? (Hint: 1 ft = 12 in)

Answers start on page 405.

GED STRATEGY Solving Word Problems

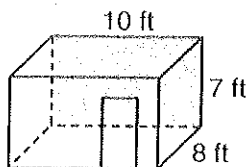
Choosing Perimeter, Area, or Volume

Making repairs or improvements at home may involve finding perimeter, area, or volume. Solving math word problems like the ones on the GED Mathematics Test may also involve deciding which calculation is needed. Study the information below so that you can quickly recognize whether you need to solve for perimeter, area, or volume.

Type of Problem	Measurement Unit	Common Situations
perimeter 	units of length	putting finishing trim on a room; building a frame; finding the distance around a track; fencing in a yard
area 	square units	finding how much paint is needed to cover a wall, or tile or carpet to cover a floor; finding how much space a garden or lawn covers
volume 	cubic units	finding how much a container will hold; comparing the space inside (the capacity) of refrigerators; finding the space inside a room to install air conditioning



To remember the definition of perimeter, notice that **perimeter** contains the word *rim*. The rim is the edge that goes around an object, such as the rim of a glass or the rim of a basketball hoop.



- **Perimeter is a measure of length.** Perimeter is the distance around an object or figure. To find the perimeter, add the lengths of all the sides.
- **Area is the measure of the space that covers a flat object or two-dimensional figure.** Measure area by calculating how many square units it takes to fill the space. To find the area of rectangles or squares, multiply the two dimensions: length $\times$ width.
- **Volume is the measure of space inside a three-dimensional object.** Measure volume by calculating how many cubic units it takes to fill the space. To find the volume of a rectangular container, multiply the three dimensions: length $\times$ width $\times$ height.

Word problems often contain extra information. Read the problem carefully to decide whether to solve for perimeter, area, or volume.

Example The dimensions of a home office are shown in the diagram. How many square feet of wallpaper are needed to cover the wall that is shaded?

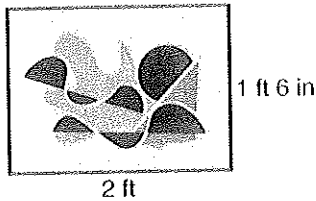
- (1) 34
- (2) 56
- (3) 70
- (4) 80
- (5) 560

The correct answer is **option (3) 70**. You are asked to find square feet—this is the area of the shaded wall. Multiply the length of the wall, 10 ft, by the width, 7 ft: $10 \times 7 = 70$ square feet. Ignore the 8 ft measurement.

GED PRACTICE

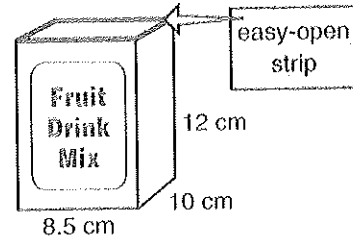
Directions: Choose the one best answer to each question.

Questions 1 and 2 refer to the following diagram.



1. Cherise wants to frame the painting in the diagram. How many feet of wood will she need to frame the picture?
 - (1) 3
 - (2) $3\frac{1}{2}$
 - (3) 5
 - (4) 7
 - (5) 9
2. Cherise plans to cover the painting with glass. How many square inches of glass will it take to cover the surface?
 - (1) 84
 - (2) 168
 - (3) 432
 - (4) 1008
 - (5) Not enough information is given.
3. Cathy wants to install an air conditioner in her office, which measures 10 feet by 8 feet by 7 feet. Which expression could be used to find the measure of the office space in cubic feet?
 - (1) $8 + 10 + 8 + 10$
 - (2) $(7 + 8 + 10) \times 2$
 - (3) 8×7
 - (4) 10×8
 - (5) $10 \times 8 \times 7$

Questions 4 through 6 refer to the following diagram.



4. A new drink mix is packaged in rectangular containers. An easy-open strip goes around the top of the package as shown. What is the length in centimeters of the strip?
 - (1) 30.5
 - (2) 37
 - (3) 61
 - (4) 85
 - (5) 1020
5. A label completely covers the front of the container. Which of the following expressions could be used to find the area of the label?
 - (1) $8.5 + 12 + 8.5 + 12$
 - (2) $(8.5 \times 2) + (12 \times 2)$
 - (3) 8.5×4
 - (4) 8.5×12
 - (5) $8.5 \times 10 \times 12$
6. The label shows how much the container holds. What is the measure of the space inside the container in cubic centimeters?
 - (1) 85
 - (2) 102
 - (3) 120
 - (4) 183
 - (5) 1020

Answers start on page 406.

GED STRATEGY Solving Word Problems

Drawing a Picture



The more accurate your drawing is, the easier it is to visualize the answer. Draw the basic shapes and write in the measurements given in the problem. But, if a measurement is about twice another, show that in your drawing.

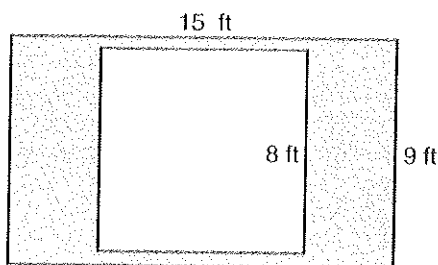
Drawing a diagram is a strategy that helps you see how the information in a problem is related. Diagrams are especially helpful for solving measurement and geometry problems. In general, you can use these steps to make a diagram of the information given in a problem.

- Step 1** Draw the shapes described in the problem. If the problem has more than one shape, your sketch should show how the shapes are placed in relation to each other.
- Step 2** Write the measurements given in the problem in the correct place on your drawing. This will let you see what information you have, what is missing, and what you can calculate from the information. If possible, calculate any missing dimensions.
- Step 3** Identify what you are asked to find and **solve** the problem.
- Step 4** Think about your answer in relation to the diagram. Make sure your answer is reasonable.

Example A rectangular room has a hardwood floor. The room is 15 feet long and 9 feet wide. Part of the floor is covered with a square rug measuring 8 feet per side. In square feet, what is the area of the floor not covered by the rug?

- (1) 26
- (2) 71
- (3) 99
- (4) 135
- (5) 199

This problem contains a great deal of information. Since you must picture the room and work with numbers at the same time, a drawing would be helpful. Apply the steps above to draw the information in the problem.



- Step 1** Make a sketch showing the square inside the rectangle.
- Step 2** Label the drawing with the measurements given in the problem. Your sketch should look something like the drawing on the left.
- Step 3** The problem asks you to find the area of the floor not covered by the rug. This is represented by the shaded portion of the drawing. Find the area of the floor and subtract the area of the rug.

Area of the floor: $15 \text{ ft} \times 9 \text{ ft} = 135 \text{ sq ft}$

Area of the rug: $8 \text{ ft} \times 8 \text{ ft} = 64 \text{ sq ft}$

Area of the uncovered floor: $135 \text{ ft} - 64 \text{ ft} = 71 \text{ sq ft}$

- Step 4** Does your answer make sense? Look at the diagram. The rug covers about half the space of the floor. The shaded area should be close to half the entire area of the floor. Since 71 is close to half of 135 sq ft, the answer seems reasonable.

The area of the floor not covered by the rug is **option (2) 71** square feet.

GED PRACTICE

Directions: Choose the one best answer to each question.

1. A rectangular school playground measures 100 meters by 75 meters. There is a square blacktop area in the center of the playground with sides that measure 40 meters. The rest of the playground is seeded with grass. What is the area in square meters of the grassy portion of the playground?
 - (1) 9100
 - (2) 7660
 - (3) 7500
 - (4) 5900
 - (5) 1600
2. One side of the square base of a milk carton measures 4 inches. If the carton can be filled to a height of 8 inches, how many cubic inches can the carton hold?
 - (1) 112
 - (2) 128
 - (3) 132
 - (4) 138
 - (5) 146
3. A baby quilt is 4 squares wide and 6 squares long. A tassel is sewn on each point where 4 squares touch. How many tassels are needed to complete the quilt?
 - (1) 10
 - (2) 15
 - (3) 20
 - (4) 24
 - (5) 35
4. A 5-kilometer race has three checkpoints between the start and finish line. Checkpoint 1 is 1.8 km from the starting point. Checkpoint 3 is 1.2 km from the finish line. Checkpoint 2 is halfway between checkpoints 1 and 3. How far in kilometers is checkpoint 2 from the finish line?
 - (1) 1.2
 - (2) 1.5
 - (3) 1.8
 - (4) 2.0
 - (5) 2.2
5. Janice is trying to find her way to a job interview downtown. She starts at a parking garage and walks 4 blocks north, 5 blocks east, 2 blocks south, 2 blocks west, and 2 blocks farther south. How many blocks east of the parking garage does she end up?
 - (1) 1
 - (2) 2
 - (3) 3
 - (4) 4
 - (5) Not enough information is given.
6. A new game is played on a rectangular field that is 150 feet by 60 feet. A chalk line is drawn on the field exactly 2 feet inside the outer rectangle at all points. What is the total length in feet of the chalk line?
 - (1) 112
 - (2) 202
 - (3) 210
 - (4) 292
 - (5) 404



Note the unit of measure used in the problem: the volume of a cube with sides of 6 ft (= 2 yd) is both 216 cu ft and 8 cu yd.

Answers start on page 406.

GED Mini-Test • Lessons 14 and 15

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last question you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



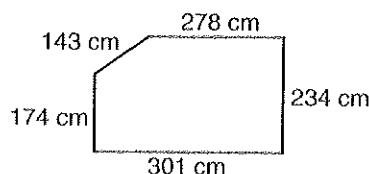
Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. The length of a rectangle is 36 centimeters. What is its area in square centimeters?

- (1) 324
- (2) 432
- (3) 504
- (4) 576
- (5) Not enough information is given.

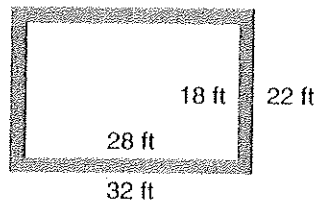
2. What is the perimeter in centimeters of the figure below?



- (1) 829
 - (2) 852
 - (3) 956
 - (4) 987
 - (5) 1130
3. In January, Sue's puppy weighed 8 pounds 15 ounces. In April, he weighed 11 pounds 12 ounces. How much weight did the puppy gain?

- (1) 3 pounds 13 ounces
- (2) 3 pounds 3 ounces
- (3) 2 pounds 13 ounces
- (4) 2 pounds 10 ounces
- (5) 2 pounds 3 ounces

Questions 4 and 5 refer to the figure below.



4. The figure is formed by two rectangles. What is the area, in square feet, of the shaded part?

- (1) 100
- (2) 200
- (3) 504
- (4) 704
- (5) 1208

5. How many more feet is the perimeter of the larger rectangle than the perimeter of the smaller rectangle?

- (1) 8
- (2) 16
- (3) 56
- (4) 92
- (5) 108

6. One gallon of paint covers 200 square feet. How many gallons are needed to paint a rectangular floor that is 40 feet by 60 feet?

- (1) 12
- (2) 24
- (3) 40
- (4) 60
- (5) 120

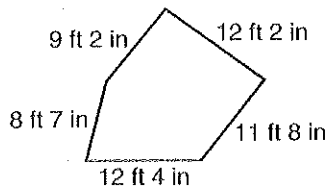
7. Ralph is building a bookcase and uses 4 boards, each 3 yards 2 feet in length. What is the total length of the boards?

(1) 16 yards 2 feet
(2) 15 yards 2 feet
(3) 14 yards 2 feet
(4) 13 yards 2 feet
(5) 12 yards 2 feet

8. The three sides of a triangle measure 16.52 inches, 17.24 inches, and 22.19 inches. What is the perimeter of the triangle, in inches?

(1) 53.95
(2) 54.45
(3) 54.95
(4) 55.45
(5) 55.95

9. Anthony has an odd-shaped plot of grass that he would like to border with a hedge. How many feet long is the border of the plot, rounded to the nearest foot?



(1) 41 feet
(2) 44 feet
(3) 54 feet
(4) 60 feet
(5) Not enough information is given.

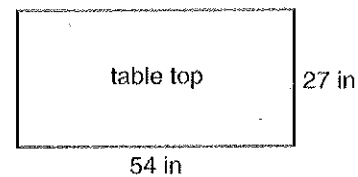
10. What is the volume, in cubic feet, of a cube that measures 3.5 feet on one side?

(1) 12.250
(2) 22.875
(3) 32.875
(4) 42.250
(5) 42.875

11. A swimming pool having the shape of a rectangular prism has a length of 100 feet, a width of 32 feet, and a depth of 8 feet. If the pool is $\frac{3}{4}$ full with water, how many cubic feet of water are in the pool?

(1) 2,400
(2) 6,400
(3) 10,400
(4) 19,200
(5) 25,600

Question 12 refers to the rectangle below.



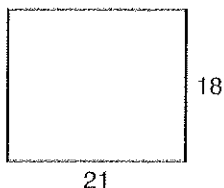
12. Anna wants to protect the top of her coffee table with a piece of glass. How many square inches of glass would she need to cover the top of her coffee table?

(1) 81
(2) 100
(3) 162
(4) 1169
(5) 1458

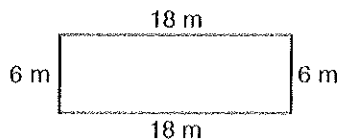
Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

13. Which expression can be used to find the perimeter of the figure below?

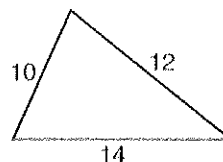


- (1) $21 + 21 + 12 + 12$
 - (2) $21 + 21 + 18 + 18$
 - (3) $2(12 + 18)$
 - (4) $12 + 18$
 - (5) 21×18
14. What is the distance in feet around a rectangular flower bed that measures 25 feet by 3 feet?
- (1) 56
 - (2) 60
 - (3) 65
 - (4) 66
 - (5) 75
15. How many square meters is the surface of the rectangle?



- (1) 24
- (2) 36
- (3) 72
- (4) 108
- (5) 144

Question 16 refers to the figure below.



16. What is the perimeter of the figure?
- (1) 22
 - (2) 24
 - (3) 26
 - (4) 36
 - (5) Not enough information is given.

17. Two pieces of wood are 6 feet 8 inches and 4 feet 7 inches in length. What is the total length of the two pieces?
- (1) 10 feet 1 inch
 - (2) 10 feet 3 inches
 - (3) 11 feet 1 inch
 - (4) 11 feet 3 inches
 - (5) 15 feet 10 inches

18. Mark has a piece of rope 7 feet 9 inches long. If he cuts the rope into 3 equal pieces, what is the length of each piece?
- (1) 2 feet 3 inches
 - (2) 2 feet 4 inches
 - (3) 2 feet 5 inches
 - (4) 2 feet 6 inches
 - (5) 2 feet 7 inches

19. The area of a rectangle is the same as the area of a square with a side of 8 cm. If the length of the rectangle is 16 cm, what is its width in centimeters?

(1) 4
(2) 8
(3) 16
(4) 24
(5) 64

20. How many cubes, each having an edge of 2 inches, will fit exactly inside a larger cube with an edge of 4 inches?

(1) 2
(2) 8
(3) 12
(4) 16
(5) 48

21. The sides of a triangle measure 10 yards, 12 yards, and 13 yards. What is the distance around the triangle, in feet?

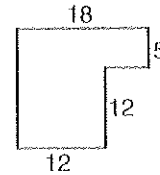
(1) 35
(2) 105
(3) 420
(4) 1560
(5) Not enough information is given.

22. A rectangular frame is 8 feet long. If its width is 2 feet more than half its length, what is the perimeter of the frame, in feet?

(1) 6
(2) 8
(3) 14
(4) 28
(5) 48

Questions 23 and 24 refer to the figure below.

A kitchen and dining room have the dimensions as shown below, in feet. All corner angles are right angles.



23. How many feet of border are needed to go around the edge of the rooms?

(1) 72
(2) 70
(3) 66
(4) 60
(5) 57

24. How many square feet of tile are needed for flooring?

(1) 378
(2) 306
(3) 234
(4) 162
(5) 144

25. A computer was left on for 10 weeks in a row. For how many hours was the computer left on?

(1) 70
(2) 168
(3) 240
(4) 1680
(5) 2400

Answers start on page 407.

Mean, Median, and Mode

Finding the “center” of a group of numbers helps us to make comparisons with numbers. There are three ways to measure the center of a group of numerical data: mean, median, and mode. Each of these measures adds to our understanding of the data.

You may know the **mean** as the **average**. The average is generally thought of as typical or normal. To find the mean of a group of numbers, add the values and divide the sum by the number of items in the list. Remember: average means the mean.

Example 1 David had scores of 82, 92, 75, 82, and 84 on five tests. What was his average score?

Step 1 Add the data values. $82 + 92 + 75 + 82 + 84 = 415$

Step 2 Divide by 5, the number of scores. $415 \div 5 = 83$



Scientific calculators perform multiplication or division steps before addition steps. To make sure your calculator does the addition step first, press $\Rightarrow$ before you divide.

$82 \Rightarrow 92 \Rightarrow 75 \Rightarrow 82 \Rightarrow 84 \Rightarrow \div 5 \Rightarrow 83.$

David's average test score is **83**.



Always ask yourself whether your answer makes sense. For example, when solving for the mean, median, or mode, the answer must be between the highest and lowest values in the group of numbers.

The **median** is the middle value in a set of numbers. To find the median, arrange the data in order from lowest to highest or highest to lowest and find the middle number. The median value is often used when one value would dramatically affect the average of a group of values.

Example 2 Find the median of David's scores.

Step 1 Arrange the test scores in order. 92, 84, 82, 82, 75

Step 2 Find the middle value. 92, 84, 82, 82, 75

David's median score is **82**.

If there is an even number of data items, the median is the average (mean) of the two middle numbers.

Example 3 Ami's point totals for six games of basketball were 24, 16, 19, 22, 6, and 12 points. Find the median of her point totals.

Step 1 Arrange the data in order. 24, 22, 19, 16, 12, 6

Step 2 The two middle numbers are 19 and 16.
Average these to find the median. $19 + 16 = 35$
 $35 \div 2 = 17.5$

Ami's median point total is **17.5 points**.

The **mode** of a group of numbers is the number that occurs most often. In Example 1, the mode of David's test scores is 82, the only score that occurs twice in the data. In Example 3, since every item of data occurs only once, there is no mode. A set of data may have no mode, one mode, or several modes. Mode is often used in business to find out which size, price, or style is most popular. (Note: The **MODE** key on the GED calculator is *not* used to find the mode of data.)

Another measure that can help us understand data is **range**. To find the range, subtract the lowest number in the set from the greatest number. If the range is a small number, you know that the data values are grouped close together. If the range is large, you know the data values are spread out.

Examples: The range of David's test scores:

$$92 - 75 = 17$$

The range of Ami's point totals:

$$24 - 6 = 18$$

GED SKILL FOCUS

Solve. You may use a calculator for Questions 4 through 6.

1. Find the mean, median, mode, and range of Carla's test scores.

Carla's Test Scores Science—Fall Semester			
Test 1:	85	Test 5:	94
Test 2:	100	Test 6:	80
Test 3:	65	Test 7:	92
Test 4:	100		

2. The attendance figures for a community theater production for four nights were 135, 174, 128, and 215. Find the average attendance.

3. The daily video rentals for Box Office Video are shown in the table below. Find the mean, median, mode, and range of the data.

Daily Video Rentals Box Office Video—Week of May 4	
Monday	57
Tuesday	24
Wednesday	28
Thursday	57
Friday	136
Saturday	164
Sunday	38



4. Find Gordon's average weekly earnings to the nearest cent.

Weekly Earnings	
Week of Feb 2:	\$315.35
Week of Feb 9:	\$369.82
Week of Feb 16:	\$275.58
Week of Feb 23:	\$305.83
Week of Mar 2:	\$289.68

5. The outdoor temperature was measured in eight locations throughout Los Angeles at 10 A.M. on April 14. The readings are shown below. Find the mean and median temperature to the nearest tenth degree and the range of the data.

61.5°F 64.8°F 69.0°F 67.3°F
65.6°F 60.8°F 61.1°F 65.4°F

6. Find the mean, median, mode, and range of Stan's bills to the nearest whole dollar.

Jan	\$58	Jul	\$51
Feb	\$74	Aug	\$55
Mar	\$42	Sept	\$44
Apr	\$46	Oct	\$36
May	\$38	Nov	\$68
Jun	\$42	Dec	\$52

Answers start on page 408.

Simple Probability

Probability is the study of chance. Probability tells how likely it is that an event will happen. For instance, you may hear on the news that there is a 10% chance of rain tomorrow. From the report, you know that it is unlikely to rain tomorrow, but there is a small chance it might. Probability doesn't tell you what will happen, only the chance that an event will happen.

Probability is often expressed as a percent from 0%, meaning the event cannot occur, to 100%, meaning the event is certain to occur.

You can also express probability as a ratio, fraction, or decimal. For example, the chance of tossing a coin and getting heads can be expressed as a

ratio: 1 out of 2, or 1:2

fraction: $\frac{1}{2}$

decimal: 0.5

percent: 50%

In any probability situation, there are two numbers to consider:

1. the number of favorable outcomes (events you want to happen)
2. the total number of possible outcomes or trials

To find probability (P), write the ratio of favorable outcomes to possible outcomes.

$$P = \frac{\text{favorable outcomes}}{\text{total possible outcomes}}$$

Example 1 Aaron bought 4 raffle tickets at a community fundraiser. If 200 tickets are sold, what is the probability that one of Aaron's tickets will be the winner?

Step 1 Use the information from the problem to write the probability ratio.

$$P = \frac{\text{favorable outcomes}}{\text{total possible outcomes}} = \frac{4}{200}$$

Step 2 The ratio has been written as a fraction. Reduce the fraction and convert it to a decimal and percent.

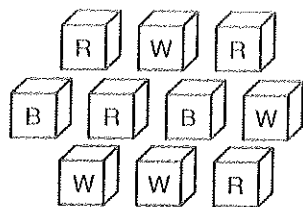
$$\frac{4}{200} = \frac{1}{50} = 0.02 = 2\%$$

The probability that one of Aaron's tickets will win is $\frac{1}{50}$, or **1 out of 50**. This converts to **0.02**, or **2%**.

Sometimes probability is based on the results of an experiment. The experiment is repeated a certain number of times. Each repetition is called a trial. The results of the experiment are recorded. **Experimental probability** is the ratio of favorable outcomes to the total number of trials.



To change a decimal to a percent, move the decimal point two places to the right. For example, $0.25 = 25\%$



Example 2 A bag holds red, white, and blue cubes of the same size. A cube is drawn at random from the bag, the color is recorded, and the cube is replaced. The results of 10 trials are shown to the left. What is the experimental probability, expressed as a percent, of drawing a red cube?

Step 1 Write the ratio of favorable outcomes (red cubes) to the number of trials (10). $\frac{4}{10}$

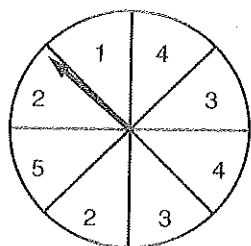
Step 2 Reduce and convert to a percent. $\frac{4}{10} = \frac{2}{5} = 0.4 = 40\%$

There is a **40%** experimental probability of drawing a red cube.

GED SKILL FOCUS

A. Express each probability as a fraction, decimal, and percent.

Questions 1 through 4 refer to the spinner below.



1. The spinner has 8 equal sections. What is the probability of spinning an even number?

2. Evan spins the spinner once. What is the probability of spinning 3 or greater?
3. Jan needs either a 1 or a 2 to win the game. What is the probability that Jan will win on her next spin?
4. What is the probability of spinning a number other than 4? (*Hint: The favorable outcomes are all numbers that are not 4.*)

B. Solve. Express your answer as a fraction, decimal, and percent.

Questions 5 and 6 refer to the following information.

A bag contains red, white, and green marbles. A marble is drawn at random from the bag, the color is recorded, and the marble is replaced.

Results of 20 Trials				
red	white	red	green	white
white	green	white	green	red
red	white	red	red	green
white	white	green	red	white

5. Based on the results, what is the probability of selecting a white marble?
6. What is the experimental probability of not drawing a green marble?

Questions 7 and 8 refer to the following information.

An appliance store has identical boxes containing electric mixers on a stockroom shelf. There are 5 of Model A, 8 of Model B, 10 of Model C, and 2 of Model D, stacked randomly on the shelf. A stockroom employee takes one box from the shelf to fill an order.

7. What is the probability that the box chosen contains a Model A mixer?
8. What is the probability that the box chosen is a Model A or Model C mixer?

Answers start on page 408.

Independent and Dependent Probability

The probability of heads up when you flip a coin is $\frac{1}{2}$, but what is the probability of heads up on two coins? To find the combined probability of more than one event, make a chart or use multiplication.

Example 1 A dime and nickel are tossed in the air. What is the probability that both will land heads up?

One way to solve the problem is to make an organized list of all the possible outcomes. There are 4 possible outcomes. Only 1 outcome shows both coins as heads. In other words, $\frac{1}{4}$ of the possibilities shows two heads.

Nickel	Dime
H	H
H	T
T	H
T	T

There are 4 possible outcomes. Only 1 outcome shows both coins as heads. In other words, $\frac{1}{4}$ of the possibilities shows two heads.

You can also find the probability that two events will both occur by multiplying the probabilities of each event occurring alone.

The probability that the nickel will land heads up:

$$\frac{1}{2}$$

The probability that the dime will land heads up:

$$\frac{1}{2}$$

The probability that both will land heads up:

$$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

Using either method, the probability that both coins will land heads up is $\frac{1}{4}$, 0.25, 25%, or 1 out of 4 (which is sometimes shown as 1:4).

In Example 1, the two events are **independent**. The first event does not affect the second event. The position of the first coin does nothing to change the probability of getting heads on the second coin.

Two events are **dependent** if the result of the first event does affect the result of the second event.

Example 2 Three white socks and two brown socks are in a drawer. Gloria removes one sock at **random**, without looking. Then, without replacing the first sock, she takes out a second sock. What is the probability that both socks are white?

Step 1 To find the probability that both socks are white, assume that the first sock Gloria selects is white. With 5 socks in the drawer, of which 3 now are white, her chance of selecting white is $\frac{3}{5}$.

Step 2 Now there are 4 socks left in the drawer, and 2 are white. Gloria's chance of selecting white the second time is $\frac{2}{4}$, or $\frac{1}{2}$.

Step 3 Multiply to find the combined probability. $\frac{3}{5} \times \frac{1}{2} = \frac{3}{10}$

The probability that both socks will be white is $\frac{3}{10}$, 0.3, or 30%.

These events are dependent. The first event, taking the first sock, affects the second event by changing the number of socks in the drawer.



To figure out whether events are dependent, ask yourself, "Do the conditions change after the first event?"

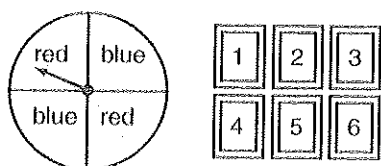


Problems with dependent events often involve selecting an object and not replacing it, that is, removing it from the set.

A. Solve.

Refer to the following information to answer Questions 1 and 2.

A game is played by spinning a spinner and then, without looking, drawing a card. After each turn, the card is replaced and the cards are shuffled.

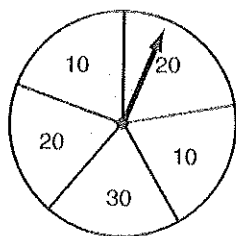


1. What is the percent chance that a player will spin red and then draw a 4 or higher?
2. Rounded to the nearest percent, what is the chance that a player will spin either red or blue and then draw a 5?

-
3. Max rolls two standard six-sided dice. What is the chance, expressed as a fraction, that both will show a 6?

B. Solve.

Refer to the following information to answer Questions 7 and 8.



7. Kelli spins the spinner twice. What is the probability expressed as a percent that she spins 20 each time?
8. The spinner is spun twice. What is the probability expressed as a fraction, that neither spin is a 10?

4. A golf bag contains 5 white golf tees and 1 blue tee. John reaches into the bag and selects two tees at random. What is the probability, expressed as a fraction, that both are white? (*Hint: Taking two at a time is the same as taking one, not replacing it, and then taking another.*)

Refer to the following information to answer Questions 5 and 6.

A company decides to select two workers at random to attend a computer class. Stephanie and Yuki both hope to be chosen. The names of ten workers are put in a box. Two names will be drawn randomly from the box.

5. What is the probability, expressed as a decimal, that the first name drawn is either Stephanie or Yuki?
6. Suppose Stephanie's name is chosen first. What is the chance, expressed as a fraction, that Yuki's name will be chosen second?

9. Ace Manufacturing builds air-conditioning units. On Friday, 20 units were built with defective parts. The company built a total of 100 units on Friday. Before the mistake was discovered, the company shipped two air conditioners. What is the probability (to the nearest hundredth) that both air conditioners had defective parts?
10. Alex has 10 cards: 5 hearts and 5 diamonds. Sharon draws and keeps two of Alex's cards. What is the probability that both cards are hearts?

Answers start on page 408.

GED STRATEGY Using Your Calculator

Mean and Median

To calculate the mean (average) of a set of numbers, first add the numbers and then divide the sum by the number of values in the set.

Example 1 During the past semester, Pat's test scores in U.S. history class were 86, 76, 82, and 92. What was her mean test score?

Step 1 First add Pat's test scores. $86 + 76 + 82 + 92 = 336$

Step 2 Then divide the sum by 4, the number of values in the data set. $336 \div 4 = 84$

Pat's mean test score was **84**.



Check how your calculator solves this type of problem.

86 $+$ 76 $+$ 82 $+$ 92 $\div$ 4 $=$

If your calculator is not programmed with the order of operations, it will give you the correct answer, 84.

However, if a calculator uses the order of operations, as the calculator used on the GED Test does, it will first perform all multiplication and division before it performs any addition and subtraction. This results in the wrong answer of 267.

In order to obtain the correct answer on a calculator that uses the order of operations, press the equals key after entering the last score to be added. This will total all the scores before dividing. Complete the problem by dividing by the number of values.

86 $+$ 76 $+$ 82 $+$ 92 $=$ $\div$ 4 $=$ 84.

Remember that to find the median, list the numbers in increasing or decreasing order and then choose the middle number. If there is an even number of values in the set (and therefore no middle number in the list), find the average (mean) of the two middle numbers. You can use your calculator to find this average.

Example 2 In the last four days, Claudio earned tips of \$28, \$6, \$30, and \$20. What was the median amount he earned in tips?



Write the four amounts earned in a list of increasing or decreasing order: \$6, \$20, \$28, \$30. Since there is an even number of amounts, there is no middle amount. Therefore, find the average (mean) of the two middle amounts, \$20 and \$28:

20 $+$ 28 $=$ $\div$ 2 $=$ 24.

The median amount Claudio earned in tips was **\$24**.

GED PRACTICE



Directions: Choose the one best answer to each item. You MAY use your calculator.

Questions 1 and 2 refer to the table below.

Game	Score
1	94
2	73
3	86
4	102
5	96
6	71

- What was the average (mean) score for the six games listed?
 - 94.0
 - 90.0
 - 87.0
 - 86.5
 - 86.0
- What was the median score for the games shown?
 - 94.0
 - 90.0
 - 87.0
 - 86.5
 - 86.0
- For the past five days the high temperatures in San Francisco were 64.4° , 59.3° , 68.0° , 48.8° , and 53.6° . What was the average (mean) high temperature for those days, rounded to the nearest tenth of a degree?
 - 58.8°
 - 59.3°
 - 62.0°
 - 64.4°
 - 68.8°

Questions 4 and 5 refer to the table below.

Rainfall in Union City	
Month	Inches
June	6.3
July	4.5
August	3.8
September	10.2

- What was the average (mean) rainfall in Union City during the months shown in the table, rounded to the nearest inch?
 - 4
 - 5
 - 6
 - 7
 - 10
- What was the median rainfall in Union City during the months shown in the table, rounded to the nearest inch?
 - 4
 - 5
 - 6
 - 7
 - 10
- Karen's electric bills for six months were \$28.84, \$18.96, \$29.32, \$16.22, \$17.98, and \$21.80. What was the median bill for these months, rounded to the nearest cent?
 - \$ 6.79
 - \$16.22
 - \$18.96
 - \$20.38
 - \$21.80

Answers start on page 409.

Lesson

17

GED SKILL Tables, Charts, and Graphs

Tables and Charts

Tables and **charts** organize information or **data** in columns and rows. Specific items of data are found where columns and rows intersect, or meet. To use a table to find information, first read all **titles** and **labels** carefully. Then find the column and row that relate to the information you need.

Example 1 Greg uses **mileage tables** in his work as a driver. He needs to drive from Lamesa to Canyon and from Canyon to Guthrie. Use the table below. How many miles will he drive?

Mileage Between Cities

	Lubbock	Lamesa	Plainview	Canyon	Guthrie
Lubbock		61.4	48.0	8.0	92.8
Lamesa	61.4		108.6	67.1	140.5
Plainview	48.0	108.6		46.3	109.1
Canyon	8.0	67.1	46.3		87.6
Guthrie	92.8	140.5	109.1	87.6	



Tables usually contain more information than you need. Double-check to make sure you are using the correct items of data for your calculations.

- Step 1** Find the distance from Lamesa to Canyon. Locate Lamesa in the second row and go across to the column for Canyon. Or locate Canyon in the fourth row and go across to the column for Lamesa. Both methods give the same answer. 67.1 miles
- Step 2** Find the distance from Canyon to Guthrie. Locate Canyon and find where it intersects with Guthrie. 87.6 miles
- Step 3** Add to find the total miles. $67.1 + 87.6 = 154.7$

The total distance of Greg's trip is **154.7 miles**.

A **frequency table** tracks how often certain events occur.

Example 2 A software company wants to know the reasons customers call customer support. Alli used a frequency table to track the calls he received. How many more callers placed orders than needed tech support?

Frequency Table: Reason for Call

Placed order	
Exchanged product	
Returned product for refund	
Needed technical support	

- Step 1** Count the tally marks for "Placed order" (32). Count the tally marks for "Needed technical support" (26).
- Step 2** Subtract to find the difference. $32 - 26 = 6$

There were **6 more calls** from customers placing orders than from those needing technical support.

GED SKILL FOCUS



Solve. You may use your calculator.

Refer to the following table to answer Questions 1 through 4.

Appliance Central—Refrigerators

Model	Size	Price	Annual Energy Use*
TR8	15.5 cu ft	\$459	624 kwh
AD7	18.5 cu ft	\$599	895 kwh
KT6	16.8 cu ft	\$479	922 kwh
CV9	20.4 cu ft	\$699	1108 kwh
GC2	21.6 cu ft	\$699	1484 kwh

*energy use in kilowatt-hours

- Refer to the table to find:
 - the cost of model CV9
 - the kilowatt-hours used by model AD7
 - the size in cubic feet of the refrigerator that costs \$479
- Alicia plans to replace her 14.8 cu ft refrigerator with a new one. If she buys the CV9 model from Appliance Central, how many more cubic feet of storage will she have than she has now?
- Alicia pays \$0.09 for each kilowatt-hour of electricity she uses. How much more would it cost Alicia each year to operate the GC2 than the CV9 model?
- Which model has the lower price per cubic foot of storage, TR8 or KT6?

Refer to the frequency table in Example 2 on page 192 to answer Questions 5 through 7.

- What is the ratio of customers who returned a product for refund to those who placed an order?
- What fraction of the calls to customer service needed technical support?
- To the nearest percent, what percent of the callers either placed an order or exchanged a product?

Refer to the following information to answer Questions 8 and 9.

Baseball coach Tomas compiled the statistics below on five of his best hitters.

Valley Park Little League—Dodgers

Name	At Bats	Hits	Walks
Max	16	5	2
Katrina	17	6	3
David	15	7	2
Andy	18	5	3
Ruvy	16	4	6

- A player's batting average is the number of hits divided by the number of at bats, rounded to the thousandths place. What is Katrina's batting average?
- A player can reach first base by getting a hit or a walk. Which player has reached first base the greatest number of times?

Refer to the following frequency table to answer Questions 10 through 12.

Sixty Value Barn customers rated their shopping experience at a special sale.

Value Barn Customer Satisfaction Survey

Excellent	
Very good	
Average	
Below average	
Poor	

- How many customers rated the experience as average, very good, or excellent?
- What percent of the customers said their experience was poor?
- What is the ratio of customers who rated their experience as excellent to those who rated their experience as poor?

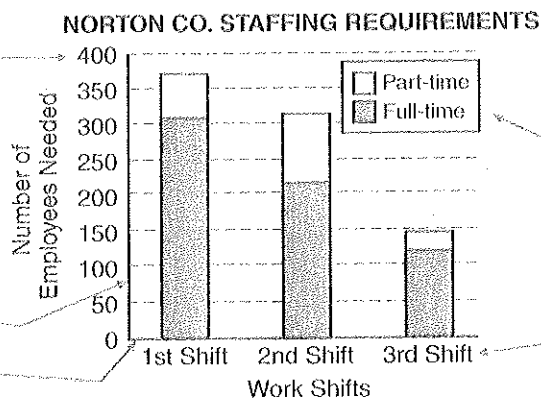
Answers start on page 409.

Bar and Line Graphs

Graphs represent data visually to compare data from different sources, show change over a period of time, and make projections about the future. This **bar graph** was created to show the difference in staffing levels for each of a company's three shifts. Notice these parts of the graph:

Scale — A scale is like a ruler. It is marked with numbers that represent some unit of measure.

Axis lines — A graph has two axis lines. The **vertical axis** runs along the side of the graph. The **horizontal axis** runs across the bottom.



Title — The title tells what kind of information is found on the graph.

Key — A key, or legend, gives any additional information needed to read the graph.

Bar Labels — Labels tell what individual parts of the graph describe.



Often bar-graph bars show two items of data: the height of the top portion is the height of the entire bar minus the bottom portion.

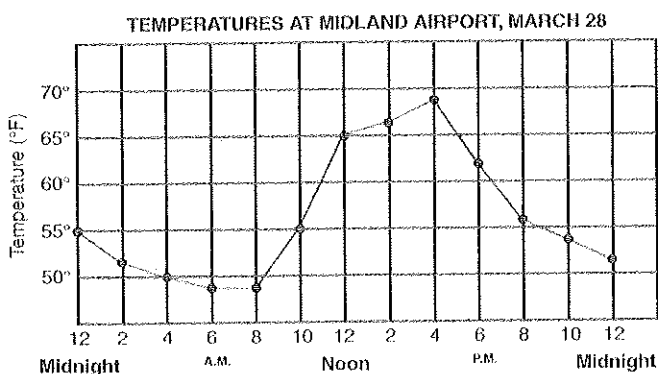
A graph key is needed only when data about more than one category are shown. Each axis line is labeled. Graphs may have scales on one or both axis lines. A bar graph has only one scale. Each bar has a label. These labels replace the second scale. Always read all labels carefully.

Example 1 About how many full-time and part-time employees are needed during the 2nd shift?

Step 1 Find the bar for the 2nd shift. The entire bar represents the total of part-time and full-time workers.

Step 2 Follow the top of the bar to the scale at the left. The bar ends just above 300.

Slightly more than 320 employees work during the 2nd shift.



Line graphs often show changes over time with some measure on the vertical scale and time on the horizontal scale. Line graphs have two scales and often have a key as well. Points plotted on the graph connect the two scales. On this graph each point represents the temperature at a specific time.

The points are then connected by a line. The line shows a **trend** or a pattern of change over time. For example, this line graph shows a warming trend from 8 A.M. until 4 P.M. Then the temperature cools steadily until midnight. We can use trends to make predictions of how data may change in the near future.

Example 2 What was the temperature at 10 A.M. on March 28?

Step 1 Find the dot directly above 10 A.M. on the horizontal scale.

Step 2 Follow across from the dot to the temperature scale.

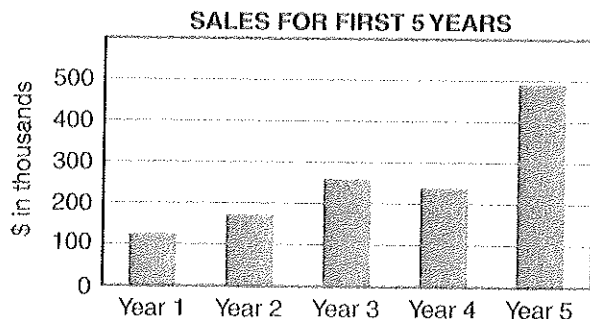
It was **55°F** at 10 A.M. on March 28.

GED SKILL FOCUS



Solve. You may use a calculator.

Refer to the bar graph below to answer Questions 1 through 5.



1. What was the approximate dollar amount in sales for Year 3?
2. Which year showed a decrease in sales?
3. Estimate the difference in sales from Year 4 to Year 5.
4. Approximate the ratio of sales in Year 5 to sales in Year 1.
5. Approximate the average yearly sales for the five-year period.

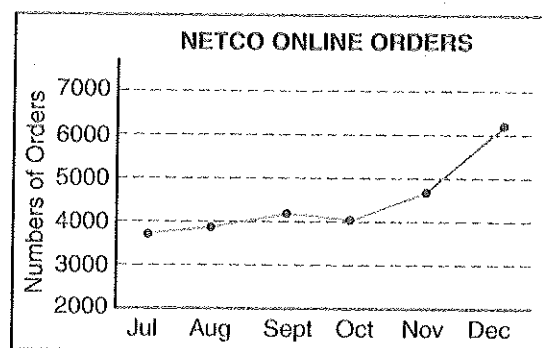
Refer to the bar graph in Example 1 on page 194 to answer Questions 6 through 10.

6. About how many full-time employees work during the 1st shift?
7. About how many more people work the 1st shift than work the 3rd shift?
8. What is the approximate ratio of full-time to part-time workers during the 2nd shift?
9. About how many more part-time employees work during the 2nd shift than work during the 1st shift?
10. Approximately how many employees are needed to fill all shifts at Norton Co?

Refer to the line graph in Example 2 on page 194 to answer Questions 11 and 12.

11. About how many degrees did the temperature fall between 4 P.M. and 6 P.M.?
12. In which two-hour time period did the temperature rise the most?

Refer to the following graph to answer Questions 13 through 17.



13. Netco sells its products online. The graph shows the number of orders placed during the final six months of the year. In which month did the number of orders decline from the previous month?
14. About how many more orders were there in December than in September?
15. The rate of increase from December to January is expected to equal the rate of increase from October to November. Estimate the number of orders for January.
16. The average number of orders per month during the six-month period was about 4400. Which two months were closest to the average?
17. Netco reported that the average sale during November was \$35. Find November's gross sales by multiplying \$35 by the number of sales.

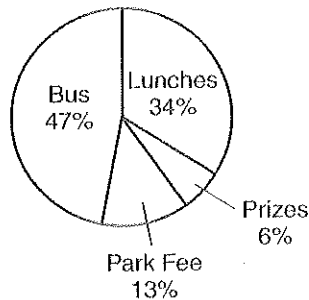
Answers start on page 409.

Circle Graphs

Circle graphs show how parts of an amount are related to the whole amount; the entire circle equals 100%. Most circle graphs show percents, but fractions, decimals, or whole numbers can also be used.

Example 1 Cliff has a budget of \$400 to plan a day trip for 50 children. The circle graph on the left shows how he plans to spend the money. On which item will he spend about $\frac{1}{3}$ of his budget?

DAY TRIP BUDGET: \$400



The sections of the graph are labeled with the name of the budget item and the percentage that will be spent on the item. The size of each section represents a fraction of the budget. For instance, a half-circle represents $\frac{1}{2}$ of the budget, or 50%. A quarter-circle represents $\frac{1}{4}$, or 25%, of the total budget. Since $\frac{1}{3}$ equals $33\frac{1}{3}\%$, the section labeled "Lunches 34%" is about $\frac{1}{3}$ of the circle.

Cliff will spend about $\frac{1}{3}$ of the budget on **lunches**.

You can also use the graph to find the dollar amount that is budgeted for an item.

Example 2 How much does Cliff plan to spend on the bus?

Step 1 Read the graph. Cliff will spend 47% of his total budget of \$400 to pay for the bus. Find 47% of \$400.

Step 2 Use a proportion. $\frac{47}{100} = \frac{x}{\$400}$, $47 \times \$400 \div 100 = \$188$

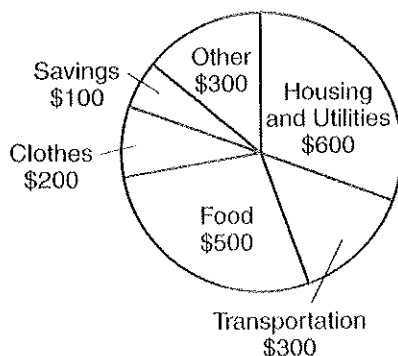
Using a calculator:



$400 \times 47 \% = 188$. or $400 \times 47 \text{ SHIFT} = 188$.

Cliff will spend **\$188** of the \$400 budget to pay for the bus.

MARTINEZ FAMILY MONTHLY BUDGET



The circle graph to the left is labeled with dollar amounts. You can still use the size of the sections to understand how each part compares to the whole.

Example 3 Which item requires $\frac{1}{4}$ of the family's entire budget?

Step 1 Find the total value of the circle.

$$\$600 + \$300 + \$500 + \$200 + \$100 + \$300 = \$2000$$

Step 2 Find the fraction closest to $\frac{1}{4}$.

$$\frac{\$500}{\$2000} = \frac{1}{4}$$

The amount budgeted for **food** is $\frac{1}{4}$ of \$2000, or \$500.



A circle graph represents the whole. In a circle graph using percents, the sections total 100%. In circle graphs using fractions or decimals, the sections total 1.

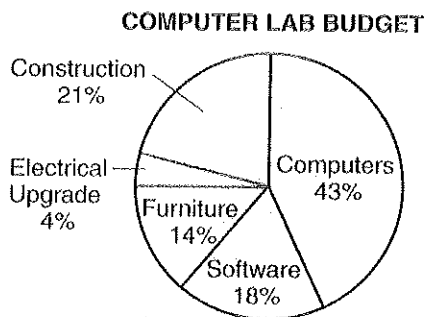
GED SKILL FOCUS



Solve. You may use a calculator.

Refer to the following information to answer Questions 1 through 7.

A high school has received \$56,000 in donations and grants to build a new computer lab. The following graph shows how the school plans to spend the money.



1. What percent of the money will be spent on construction and electrical upgrade?
2. How much money is budgeted to buy computers?
3. How much money is budgeted to buy furniture?
4. What percent of the money will not be spent on either computers or software?
5. Which two items combined equal about $\frac{1}{3}$ of the budget?
6. For which item has the school budgeted a little more than \$10,000?
7. How much money is budgeted for construction and electrical upgrading?

Refer to the Day Trip Budget in Example 1 on page 196 to answer Questions 8 and 9.

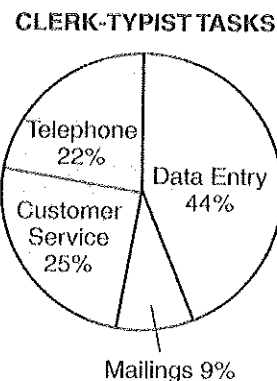
8. How much money has Cliff budgeted to pay for prizes and the park fee?
9. Which item will cost about five times the cost of the prizes?

Refer to the Martinez Family Monthly Budget on page 196 to answer Questions 10 and 11.

10. What fraction of the family's budget is spent on transportation, food, and clothes?
11. What percent of the family's budget is spent on housing and utilities?

Refer to the following information to answer Questions 12 through 16.

Mrs. Reid is an office manager. She has prepared this circle graph to show the workers in the clerk-typist pool how their time will be spent in her office.



12. On which task will the clerk-typists spend $\frac{1}{4}$ of their time?
13. What percent of their time do clerk-typists spend on mailings and data entry?
14. What is the ratio of time spent entering data to time spent answering telephones?
15. Mark works 40 hours per week as a clerk-typist. About how many hours per week should Mark spend doing data entry?
16. Angelina works 36 hours per week. To the nearest whole hour, how many hours per week should she expect to spend on customer service and telephone tasks?

Answers start on page 410.

GED Mini-Test • Lessons 16 and 17

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last question you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

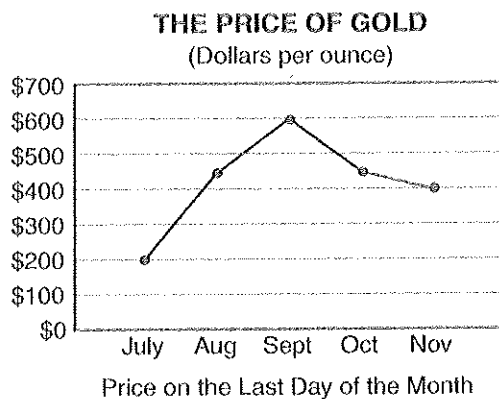
Directions: Choose the one best answer to each question. You MAY use your calculator.

Questions 1 and 2 refer to the following information.

Five Acme employees have salaries of \$27,560, \$30,050, \$22,750, \$42,800, and \$28,900.

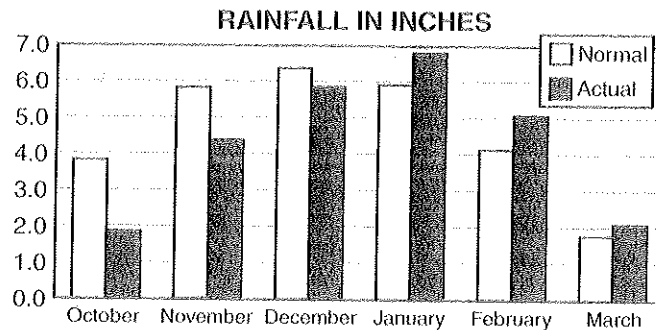
1. What is the average (mean) salary of the employees at Acme?
 - (1) \$20,050
 - (2) \$27,560
 - (3) \$28,900
 - (4) \$29,475
 - (5) \$30,412
2. What is the median salary of the employees at Acme?
 - (1) \$20,050
 - (2) \$27,560
 - (3) \$28,900
 - (4) \$29,475
 - (5) \$30,412
3. A dresser drawer contains 2 red socks, 4 blue socks, and 8 black socks. What is the probability that a sock chosen at random from the drawer is not a black sock?
 - (1) $\frac{4}{7}$
 - (2) $\frac{3}{7}$
 - (3) $\frac{2}{7}$
 - (4) $\frac{1}{7}$
 - (5) $\frac{1}{14}$

Questions 4 and 5 refer to the graph.



4. By how much did the price of gold increase, in dollars per ounce, from July to September?
 - (1) \$100
 - (2) \$200
 - (3) \$400
 - (4) \$500
 - (5) \$600
5. What was the ratio of the price of gold in September to the price of gold in July?
 - (1) 1:3
 - (2) 1:2
 - (3) 2:1
 - (4) 3:1
 - (5) 6:1

Questions 6 through 9 refer to the following graph.



6. For which months was the actual rainfall less than normal?

- (1) October, November, and December
- (2) October, November, and January
- (3) October, December, and March
- (4) October, February, and March
- (5) January, February, and March

7. For how many months was the actual rainfall greater than 5.0 inches?

- (1) 2
- (2) 3
- (3) 4
- (4) 5
- (5) 6

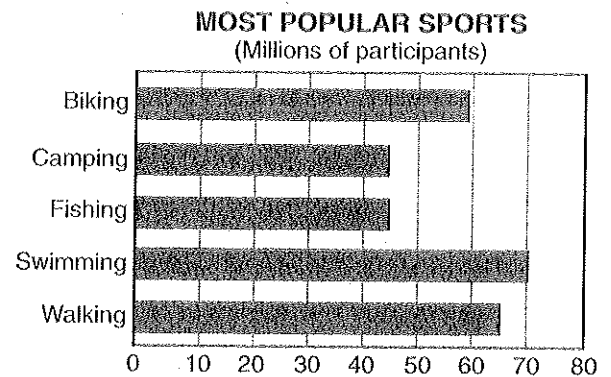
8. How many more inches of rain fell in January than in March?

- (1) 2.2
- (2) 3.5
- (3) 4.0
- (4) 4.6
- (5) 5.8

9. Approximately what is the average (mean) normal rainfall for November, December, and January?

- (1) 4.5
- (2) 5.0
- (3) 5.5
- (4) 6.0
- (5) 6.5

Questions 10 and 11 refer to the following graph.



10. Approximately how many more millions of people participated in swimming than in camping?

- (1) 65
- (2) 60
- (3) 40
- (4) 35
- (5) 25

11. For the five sports listed, what was the average (mean) number of millions of participants, rounded to the nearest million?

- (1) 46
- (2) 50
- (3) 52
- (4) 57
- (5) 62

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

Questions 12 and 13 refer to the following information.

Last week, Karla exercised every day for the following number of minutes each day: 42, 54, 62, 40, 57, 50, and 38.

12. What was the average number of minutes that Karla exercised per day last week?

- (1) 45
- (2) 46
- (3) 47
- (4) 48
- (5) 49

13. What was the median number of minutes that Karla exercised last week?

- (1) 42
- (2) 50
- (3) 54
- (4) 57
- (5) 62

Question 14 refers to the following information.

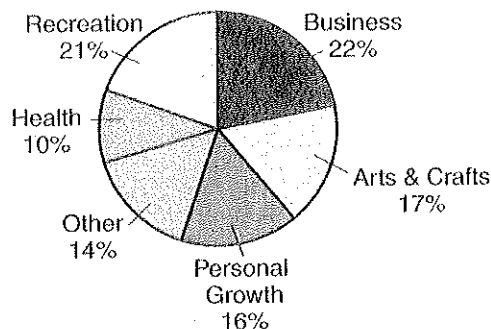
A bag contains 20 table tennis balls, each one painted with a different number from 1 to 20.

14. If a ball is chosen at random from the bag, what is the probability that it is painted with a number greater than 15?

- (1) $\frac{1}{20}$
- (2) $\frac{1}{5}$
- (3) $\frac{1}{4}$
- (4) $\frac{1}{2}$
- (5) $\frac{3}{4}$

Questions 15 through 17 refer to the following graph.

ADULT EDUCATION COURSES
(Total: 500 Courses Offered)



15. How many Personal Growth courses are offered?

- (1) 8
- (2) 16
- (3) 64
- (4) 80
- (5) 100

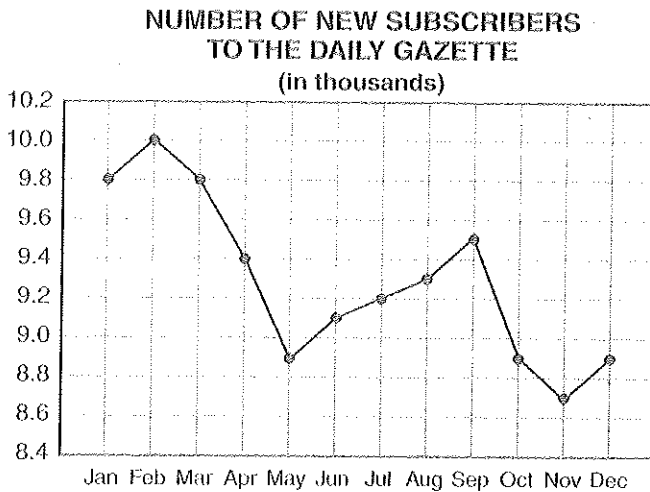
16. What is the ratio of Business courses offered to Health courses offered?

- (1) 5:7
- (2) 21:22
- (3) 17:10
- (4) 11:8
- (5) 11:5

17. How many more Business courses are offered than Recreation courses?

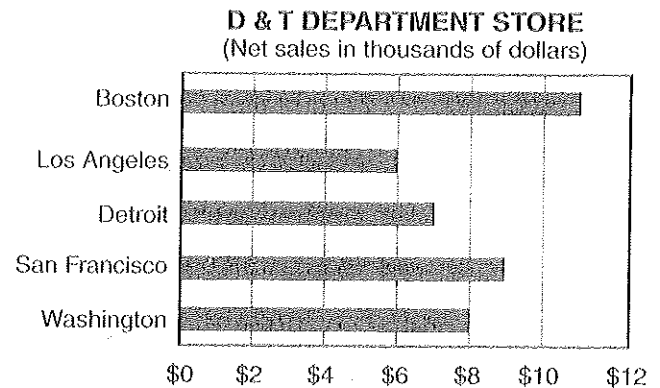
- (1) 1
- (2) 5
- (3) 10
- (4) 12
- (5) 50

Questions 18 through 20 refer to the following graph.



18. What is the range of new subscribers per month, from lowest to highest?
- (1) 8,400 to 10,200
 - (2) 8,700 to 9,800
 - (3) 8,700 to 10,000
 - (4) 8,800 to 10,000
 - (5) 9,800 to 10,000
19. A turn-around is a point on the graph where the direction of the line changes. How many turn-arounds are shown on this graph?
- (1) two
 - (2) three
 - (3) four
 - (4) five
 - (5) six
20. Which of the following consecutive months showed an increase in new subscribers?
- (1) February to March
 - (2) March to April
 - (3) September to October
 - (4) October to November
 - (5) November to December

Questions 21 through 23 refer to the following graph.



21. Approximately how much more were net sales for the Boston store than net sales for the Detroit store?
- (1) \$2000
 - (2) \$2500
 - (3) \$3000
 - (4) \$4000
 - (5) \$5000
22. What is the ratio of the net sales of the Los Angeles store to the net sales of the San Francisco store?
- (1) 1:2
 - (2) 2:3
 - (3) 6:7
 - (4) 3:2
 - (5) 7:6
23. What is the average (mean) net sales of the five stores shown, in thousands of dollars?
- (1) \$ 6.0
 - (2) \$ 7.2
 - (3) \$ 8.2
 - (4) \$10.5
 - (5) \$41.0

Answers start on page 411.

Unit 2 Cumulative Review Measurement and Data Analysis



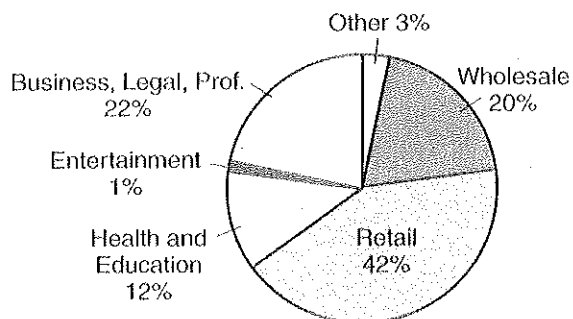
Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

Questions 1 and 2 refer to the following graph.

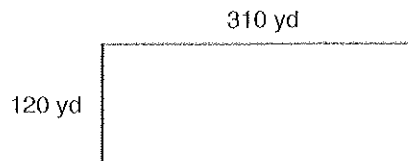
PERSONS EMPLOYED IN VARIOUS OCCUPATIONS

Total: 25,000 People



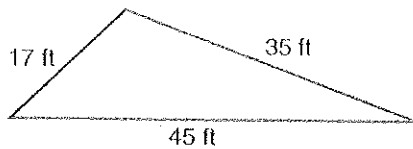
1. What was the total number of people employed in a wholesale occupation or a health and education occupation?
(1) 2000
(2) 3000
(3) 5000
(4) 7000
(5) 8000
2. How many more people were employed in a business, legal, or professional occupation than in an entertainment occupation?
(1) 4000
(2) 4350
(3) 5000
(4) 5250
(5) 5500
3. The length of one side of a square is 1 foot 4 inches. What is the distance around the entire square in inches?
(1) 64
(2) 52
(3) 48
(4) 28
(5) 16

Questions 4 and 5 refer to the following figure.



4. The city parks committee plans to fence in the rectangular driving range shown in the drawing. How many yards of fencing will it take to enclose the driving range?
(1) 240
(2) 430
(3) 620
(4) 860
(5) 980
5. The city needs to buy grass seed to cover the driving range. If one bag of grass seed covers 75 square yards, how many bags will the city need to buy to seed the driving range?
(1) 160
(2) 357
(3) 496
(4) 653
(5) 744
6. In a bag of candies, 12 are red, 10 are green, and 28 are yellow. What is the probability that a candy chosen at random from the bag is red?
(1) 0.02
(2) 0.08
(3) 0.20
(4) 0.24
(5) 0.32

Question 7 refers to the figure below.



7. The park district wants to use landscaping blocks to protect the edges of the flower bed shown above. Which expression can be used to find how many feet of landscaping blocks are needed?

- (1) $17 + 35$
- (2) 17×45
- (3) $17 + 35 + 45$
- (4) $17 \times 35 \times 45$
- (5) $17 \times 35 - 45$

8. Miguel has two pieces of pipe. One is 2 yards long, and the other is 4 feet long. How many feet longer is the first pipe?

- (1) 10
- (2) 9
- (3) 6
- (4) 4
- (5) 2

9. Sarah buys 6 raffle tickets. If a total of 300 raffle tickets is sold, what is the probability that one of Sarah's tickets will win?

- (1) $\frac{1}{4}$
- (2) $\frac{1}{20}$
- (3) $\frac{1}{25}$
- (4) $\frac{1}{50}$
- (5) $\frac{1}{300}$

Questions 10 and 11 refer to the table below.

UTILITY PAYMENTS	
Period	Amount
Jan--Feb	\$89.36
Mar--Apr	\$90.12
May--Jun	\$74.47
Jul--Aug	\$63.15
Sept--Oct	\$59.76
Nov--Dec	\$84.31

10. What is the median of the amounts in the table?

- (1) \$84.31
- (2) \$79.39
- (3) \$74.47
- (4) \$63.15
- (5) Not enough information is given.

11. What is the average (mean) of the amounts in the table, rounded to the nearest cent?

- (1) \$ 76.86
- (2) \$ 79.28
- (3) \$ 79.39
- (4) \$230.58
- (5) Not enough information is given.

12. A comedy club had the following ticket sales: 184, 176, 202, 178, and 190. What was the average (mean) number of tickets sold?

- (1) 184.0
- (2) 186.0
- (3) 188.0
- (4) 190.0
- (5) 232.5

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

Questions 13 and 14 refer to the information below.

Martin took a writing workshop and received the following grades on papers he wrote for the course: 60, 85, 95, 80, 95, 95.

13. What was the mean score for the papers, rounded to the nearest whole number?

- (1) 95
- (2) 90
- (3) 85
- (4) 80
- (5) 60

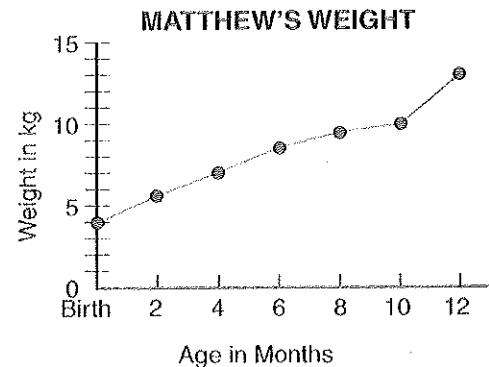
14. A student's grade in the writing workshop is either the average of the scores or the median score, whichever is greater. What was Martin's median score?

- (1) 95
- (2) 90
- (3) 85
- (4) 80
- (5) 60

15. Carrie has three projects. The first project will take 20 minutes, the second project will take the same amount of time as the first project, and the third project will take 30 minutes. What is the latest time she can start to work in order to finish all three projects by 12 o'clock noon?

- (1) 10:10 A.M.
- (2) 10:50 A.M.
- (3) 10:53 A.M.
- (4) 11:07 A.M.
- (5) 11:10 A.M.

Questions 16 through 18 refer to the following graph.



16. Over which two-month period did Matthew have the greatest weight gain?

- (1) birth to 2 months
- (2) 4 to 6 months
- (3) 6 to 8 months
- (4) 8 to 10 months
- (5) 10 to 12 months

17. The average weight for a male infant at one year of age is 10.5 kilograms. About how many more kilograms than average did Matthew weigh at one year?

- (1) 0.5
- (2) 0.8
- (3) 1.1
- (4) 1.3
- (5) 2.5

18. During which two-month period did Matthew have the smallest weight gain?

- (1) birth to 2 months
- (2) 2 to 4 months
- (3) 6 to 8 months
- (4) 8 to 10 months
- (5) Not enough information is given.

19. A photograph is $3\frac{3}{4}$ inches wide and $5\frac{1}{4}$ inches long. If the dimensions of the photograph are doubled, how many inches wide will the photograph be?

(1) $10\frac{1}{2}$
(2) $10\frac{1}{4}$
(3) $7\frac{3}{4}$
(4) $7\frac{1}{2}$
(5) $6\frac{3}{4}$

20. A wall in Andrea's living room is 12 feet long. She buys four bookcases to fit along this wall. If each bookcase is 35 inches wide, which of the following statements is true?

(1) They will be 8 inches too wide.
(2) They will be 4 inches too wide.
(3) They will fit exactly.
(4) They will fit with 4 inches left over.
(5) They will fit with 8 inches left over.

21. Sam uses 5 gallons of fertilizer on his lawn. How many pints of fertilizer does he use?

(1) 40
(2) 32
(3) 8
(4) 5
(5) 4

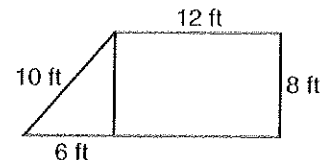
22. A rectangular box measures 5 yards long, 4 yards wide, and 2 yards high. What is the volume of the box in cubic feet?

(1) 40
(2) 120
(3) 180
(4) 360
(5) 1080

23. A cube measures 5 feet on a side. When the cube is two-fifths filled with water, how many cubic feet of water are in the cube?

(1) 15
(2) 25
(3) 50
(4) 125
(5) 250

Questions 24 and 25 refer to the figure below.



A homeowner is having a new deck built in the shape shown above. The longest side of the deck will attach to the house.

24. How many feet of railing are needed if the side attached to the house will not have a railing?

(1) 30
(2) 36
(3) 40
(4) 48
(5) 56

25. After the wood has aged and weathered, it can be stained. The area of the triangular section is one quarter the area of the rectangular section. Which expression could be used to find the surface area of the deck?

(1) $12 \times 8 + 6$
(2) $(12 \times 8) + (10 \times 8)$
(3) $\frac{1}{4}(12 \times 8)$
(4) $(12 \times 8) + \frac{1}{4}(12 \times 8)$
(5) $4 \times 12 \times 8$

Questions 26 through 29 refer to the information below.

A box contains 15 cards, each one numbered with a different whole number from 1 to 15.

26. If a card is chosen at random from the box, what is the probability that it is less than 4?

- (1) $\frac{1}{15}$
- (2) $\frac{1}{5}$
- (3) $\frac{4}{15}$
- (4) $\frac{1}{2}$
- (5) $\frac{11}{15}$

27. If a card is chosen at random, what is the probability that it is an even number?

- (1) $\frac{1}{15}$
- (2) $\frac{7}{15}$
- (3) $\frac{1}{2}$
- (4) $\frac{7}{8}$
- (5) $\frac{14}{15}$

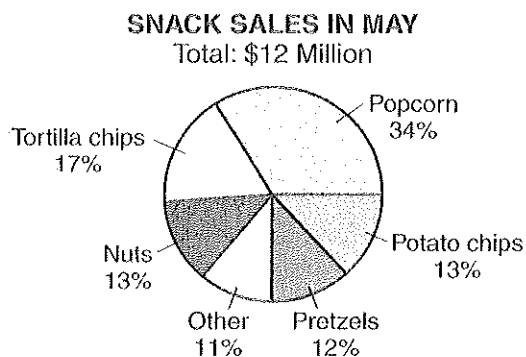
28. What is the ratio of even-numbered cards to odd-numbered cards?

- (1) 1:15
- (2) 7:8
- (3) 15:15
- (4) 8:7
- (5) 15:1

29. A card is chosen at random and replaced. What is the probability that the same card would be chosen twice in a row?

- (1) $\frac{1}{7}$
- (2) $\frac{2}{15}$
- (3) $\frac{1}{8}$
- (4) $\frac{1}{15}$
- (5) $\frac{1}{225}$

Questions 30 through 32 refer to the graph below.



30. How much money, in millions of dollars, was spent on popcorn in May?

- (1) \$1.32
- (2) \$1.44
- (3) \$1.56
- (4) \$2.04
- (5) \$4.08

31. What was the total amount, in millions of dollars, spent on nuts, pretzels, and tortilla chips in May?

- (1) \$ 1.44
- (2) \$ 1.56
- (3) \$ 5.04
- (4) \$10.56
- (5) \$15.60

32. What was the ratio of the amount spent on popcorn to the amount spent on tortilla chips in May?

- (1) 34:13
- (2) 2:1
- (3) 17:13
- (4) 13:34
- (5) 1:2

Answers start on page 412.

Cumulative Review Performance Analysis

Unit 2 • Measurement and Data Analysis

Use the Answers and Explanations starting on page 412 to check your answers to the Unit 2 Cumulative Review. Then use the chart to figure out the skill areas in which you need more practice.

On the chart, circle the questions that you answered correctly. Write the number correct for each skill area. Add the number of questions that you got correct on the Cumulative Review. If you feel that you need more practice, go back and review the lessons for the skill areas that were difficult for you.

Questions	Number Correct	Skill Area	Lessons for Review
3, 8, 15, 17 , 19, 20, 21	____/7	Measurement Systems	14
4 , 5, 7, 22, 23, 24 , 25	____/7	Measuring Common Figures	15
6, 9, 10 , 11 , 12, 13, 14, 26, 27, 28, 29	____/11	Measures of Central Tendency and Probability	16
1 , 2, 16 , 18 , 30 , 31 , 32	____/7	Tables, Charts, and Graphs	17
TOTAL CORRECT ____/32			

Question numbers in **boldface** are based on graphics.

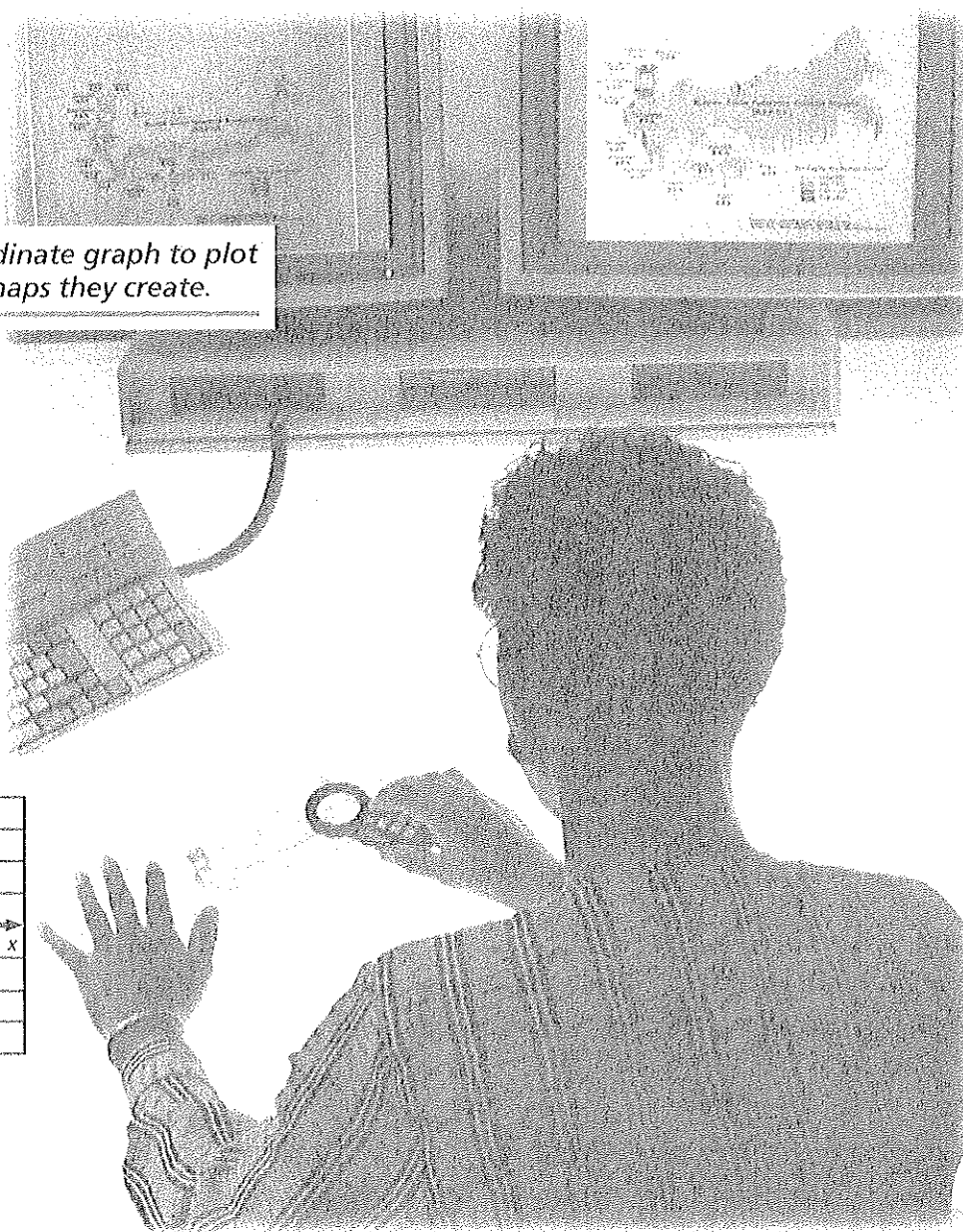
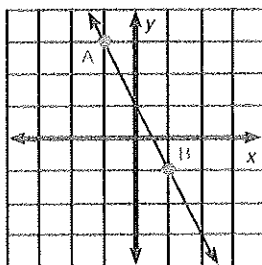
UNIT 3

Algebra

Algebra is one of the most important areas of mathematics. It involves translating everyday situations into mathematical symbols and language. We can use algebra to solve problems and to learn to think more logically. Understanding algebra is also an important springboard into the advanced areas of mathematics that are required for jobs in science and technology.

Questions related to algebra will account for more than 25 percent of the GED Mathematics Test. Additionally, you will find that you can use many of the skills in this unit to solve problems in arithmetic and geometry.

Cartographers use the coordinate graph to plot latitude and longitude on maps they create.



The lessons in this unit include:

Lesson 18: Integers and Algebraic Expressions

Integers include positive numbers, negative numbers, and zero. The number line is an important mathematical tool that uses integers. An algebraic expression involves integers, operation signs, and variables that stand for unknown numbers.

Lesson 19: Equations

An equation is a mathematical statement that two quantities are equal. When an equation uses a variable to stand for an unknown number or quantity, we can solve the equation for the unknown.

Lesson 20: Exponents and Roots

Exponents, also called powers, are used to represent repeated multiplication. The most commonly used exponents are used to “square” and “cube” numbers. A root is a number that when multiplied by itself a specified number of times gives a certain result. The most common type of root is a “square root.” The square root is the base number of a squared number.

Lesson 21: Factoring and Inequalities

Factors are numbers and letters that are multiplied together. We may need to factor an expression to determine the numbers, terms, and variables that make up the expression. While an equation is a statement that two expressions are equal, an inequality is a statement that two expressions are not equal.

Lesson 22: The Coordinate Plane

A coordinate plane is a type of graph that is formed from two lines that cross at a point. We can find points, graph equations, and find distances on the coordinate graph.

PROBLEM-SOLVING STRATEGIES

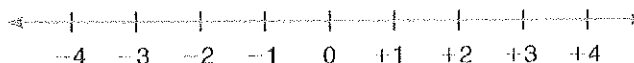
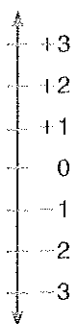
- Using Number Lines
- Translating Problems into Equations
- Using Distance and Cost Formulas
- Working Backwards
- Applying Patterns and Functions
- Solving Quadratic Equations
- Plotting Ordered Pairs
- Finding the Equation of a Line

Lesson 18

GED SKILL Integers and Algebraic Expressions

Understanding Integers

Integers, also called **signed numbers**, are positive whole numbers, their negatives, and zero. To show the complete set of numbers called integers, we extend the positive number line that we used earlier to the left of zero (0) to include negative numbers.



Positive numbers show an increase, a gain, or an upward movement (on a vertical number line). A positive number can be written with or without a plus sign. **Negative numbers** show the opposite: a decrease, a loss, or a downward movement. A negative number is always written with a minus sign. Note that the number zero is neither positive nor negative.

Adding and Subtracting Integers

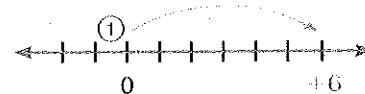


The order of operations is always the same. But you must also apply the rules for signed numbers as you perform each operation.

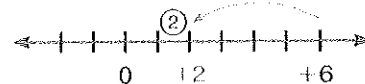
We can show the addition of integers on a **number line**. Move to the right for positive numbers and to the left for negative numbers.

Example 1 Add: $(+6) + (-4)$.

Step 1 Start at 0 and move 6 units to the right.



Step 2 Start at +6; move 4 units left.



The number line shows $(+6) + (-4) = +2$.

Use these rules to add integers:

RULE 1 If the integers have like signs, add the numbers and keep the same sign. $(+3) + (+5) = +8$
 $(-2) + (-6) = -8$

RULE 2 If the integers have unlike signs, find the difference between the numbers without the signs (the absolute values) and give the answer the sign of the larger number. $(-9) + (+3) = ?$
 $9 - 3 = 6$
 9 is negative
 $(-9) + (+3) = -6$

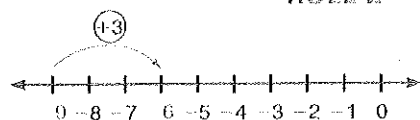
Since the larger number (-9) is negative, the answer is negative, -6 .

To add more than two integers find the sum of the positive numbers and the sum of the negative numbers. Then use Rule 2 to find the total.

Example 2 $(+30) + (-8) + (-15) + (+3) + (-20) = ?$

Step 1 Add the positive numbers. Add the negative numbers. (Rule 1) $(+30) + (+3) = +33$
 $(-8) + (-15) + (-20) = -43$

Step 2 Add the unlike sums. (Rule 2) $(+33) + (-43) = -10$





Do not confuse the sign of the operation with the sign of the integer. For example, $(+5) - (-2)$ is "five minus negative 2."

Subtracting signed integers requires additional steps: (1) first rewrite the subtraction operation as addition, (2) then change the sign of the number to be subtracted, (3) add as usual.

Example 3 Subtract: $(+5) - (-2)$

Step 1 Change subtraction to addition.

$$(+5) - (-2) = (+5) + ()$$

Step 2 Change the sign of the number being subtracted.

$$(+5) - (-2) = (+5) + (+2)$$

Step 3 Add.

$$(+5) + (+2) = +7$$

The answer to $(+5) - (-2)$ is $+7$.



To subtract integers on a calculator, enter the expression without rewriting it as an addition problem. To enter negative numbers on a calculator, simply enter the number first, then press $\pm$ to change the sign of the number to negative. $5 \pm 2 = 7$.

GED SKILL FOCUS

A. Solve. You may use your calculator for questions 11 through 15.

1. $(+7) + (+5)$

6. $(-1) - (+5)$



11. $(-118) - (-628)$

2. $(-10) + (-6)$

7. $(+6) + (-8)$

12. $(+315) - (+456)$

3. $(-6) + (+5)$

8. $(+15) - (-5)$

13. $(-1028) + (+598)$

4. $(+10) - (+7)$

9. $(+10) + (-24)$

14. $(-1482) + (-59)$

5. $(-3) - (+7)$

10. $(-12) - (-60)$

15. $(+824) + (-155)$



B. Solve each problem. You may use a calculator.

16. $(+7) + (-5) + (-4) + (+9)$

19. $(+13) - (+34) + (-12)$

17. $(-6) - (+9) + (+10) - (+1)$

20. $(-12) + (-38) + (+75) - (+52)$

18. $(-5) - (-4) - (-8)$

C. Write an expression using signed numbers. Then find the value of the expression.

21. At its lowest point, a desert is 250 feet below sea level. At its highest point, its elevation is 1000 feet above sea level. What is the difference in height between the highest and lowest points? (Hint: Think of sea level as 0 feet.)

22. Nita had \$318 in her checking account on Monday. On Tuesday, she withdrew \$60. On Wednesday, she deposited \$289 and wrote a check for \$50. What was her balance after writing the check?

Answers start on page 413.

Multiplying and Dividing Integers



To subtract, multiply, or divide signed numbers, two negatives become a positive:

$$(+5) - (-2) = 5 + 2$$

$$(4)(-3)(-2) =$$

$$(4)(6) = 24$$

$$\frac{-9}{-3} = \frac{9}{3} = 3$$

Multiply and divide integers as you would whole numbers. Then use the rule below to determine whether the answer is negative or positive.

Multiplication/Division Rule

If the signs are the same, the answer is positive.

If the signs are different, the answer is negative.

Examples

$$(3)(5) = +15$$

$$-3(5) = -15$$

$$3(-5) = -15$$

$$(-3)(-5) = 15$$

$$\frac{24}{6} = 4$$

$$\frac{-24}{6} = -4$$

$$\frac{24}{-6} = -4$$

$$\frac{-24}{-6} = 4$$

Applying the Order of Operations

When an algebraic expression contains several operations, you must follow the order of operations. Use parentheses to change the order in which operations are performed.



Parentheses serve two purposes: as a grouping symbol and to indicate multiplication: in $(+5) - (-2)$ and $(+5) - (6 - 2)$ parentheses mean grouping; in $(4)(-3)(-2)$ or $4(-3)(-2)$ they mean both grouping and multiplication.

Order of Operations

- | Order of Operations | |
|---------------------|---|
| Step 1 | Perform all work inside grouping symbols such as parentheses or brackets: multiply and divide first; then add and subtract. The fraction bar is also a grouping symbol. |
| Step 2 | Find the values of powers (exponents) and roots. (See Lesson 20.) |
| Step 3 | Multiply and divide, working from left to right. |
| Step 4 | Add and subtract, working from left to right. |

Example 1 $3^2 + (-4)(2) - (4 + 6 \times 3)$

Step 1 Begin with the operations grouped in parentheses. Multiply. (6×3) Then add. $(4 + 18)$

$$3^2 + (-4)(2) - (4 + 6 \times 3)$$

$$3^2 + (-4)(2) - (4 + 18)$$

$$3^2 + (-4)(2) - 22$$

Step 2 Find the value of the power. (3×3)

$$9 + (-4)(2) - 22$$

Step 3 Perform the remaining operations in order: multiply, then add and subtract from left to right. Apply the rules for signed numbers.

$$9 + (-8) - 22$$

$$1 - (+22)$$

$$1 + (-22) = -21$$

The answer is **-21**.

The division bar groups the top numbers and the bottom numbers as if they were in parentheses. Apply the order of operations to the numerator and denominator separately. Then do the final division.

Example 2 $\frac{3 + 5}{2 - 4}$

$$\frac{3 + 5}{2 - 4} = \frac{8}{-2} = -4$$

This is the same as $(3 + 5) \div (2 - 4) = 8 \div -2 = -4$.

Since the signs are different, the answer is **-4**.



Use the parentheses keys on your calculator to group certain operations. You know that the addition and subtraction operations must be performed first in Example 2, so use the parentheses keys to group these operations.

$$(3 + 5) \div (2 - 4) = -4.$$

Performing this calculation on a scientific calculator without using parentheses results in an incorrect answer. Without the parentheses, the calculator does the division operation first.
 $3 + 5 \div 2 - 4 = 1.5$

GED SKILL FOCUS

A. Multiply or divide.

1. $(-2)(+3)$

5. $(-6)(-1)(+2)$

9. $(+20) \div (+5)$

2. $(-4)(-7)$

6. $(+9)(-2)(-3)$

10. $(-36) \div (-12)$

3. $(+6)(-5)$

7. $(-64) \div (+4)$

11. $\frac{-132}{11}$

4. $(+12)(+3)$

8. $(+15) \div (-3)$

12. $\frac{-4}{-1}$



B. Solve. You may use your calculator.

13. $(12)(-4)(-2)$

16. $\frac{-1000}{-8}$

19. $(7)(350)(-5)(-2)$

14. $\frac{54}{-27}$

17. $(-8)(-9)(-1)$

20. $\frac{-42}{-21}$

15. $(2)(-112)$

18. $\frac{126}{-9}$

C. Solve each expression.

21. $6 + 8 \times 2^2$

25. $(-25) - 4 \times 3^2$

29. $\frac{-2 - 19}{-3 + -4}$

22. $\frac{-2 - (+8)}{(6) \div (-6)}$

26. $6 - (4 \times 8 + (-1))$

30. $2^2 + \frac{-25}{-4 + 9}$

23. $(-9 \times 4) - (-3 \times 2)$

27. $\frac{(-4) + (-6)}{(+4) - (-1)}$

31. $(2)(-7) - (3)(-4)$

24. $10 + (-3 + 4 \times (-2))$

28. $(-2 \times 5)^2 + (-3 \times 6)$



TIP To use any calculator, break an expression into parts, work each part, and write down the result from each operation; then perform the final operations.

Answers start on page 413.

Variables and Algebraic Expressions

An **algebraic expression** is a group of numbers, operation signs, and variables.

Examples $2x + 3$ $4x + \frac{1}{3}$ $3x - 4$ $3(6x)$

Expressions like these are formed by translating number relationships into symbols. Analyze the following expressions carefully.



Remember that order is critical in subtraction and division: "The difference between 4 and 2" means $4 - 2$. But, "4 less than 2" means $2 - 4$. "The quotient of 4 and 2" means $\frac{4}{2}$.

In words

4 times a number
6 more than a number
2 less than a number
one-half a number is then increased by 7
the product of 6 and a number
the quotient of x and 5
a number times itself or a number squared
the product of x and 8 added to the sum of 2 and x

In symbols

$4x$
 $x + 6$
 $x - 2$
 $\frac{1}{2}x + 7$ or $\frac{x}{2} + 7$
 $6x$
 $\frac{x}{5}$ or $x \div 5$
 x^2
 $8x + (2 + x)$

An algebraic expression always contains **variables**. Variables are letters that are used to represent numbers. Whenever the value of x changes, the expression also changes in value.

This table shows how the value of the expression $2x + 1$ changes as the value of x changes.

x	$2x + 1$
3	$2(3) + 1 = 7$
0	$2(0) + 1 = 1$
-2	$2(-2) + 1 = -3$
-4	$2(-4) + 1 = -7$



Placement of the negative sign, within or outside parentheses, affects the answer: $(-4)^2 = (-4)(-4) = 16$, while $-(4^2) = -(4 \times 4) = -16$.

An algebraic expression has a value only when all the variables are replaced by numbers. Finding the value of an expression when the variables are known is called **evaluating an expression**.

Example Find the value of $x^2 - 3y$, when $x = -4$ and $y = 2$.

Step 1 Substitute the given values for the variables.

Step 2 Follow the order of operations.
Raise -4 to the second power.
Multiply.
Subtract.

$$\begin{aligned} x^2 - 3y \\ (-4)^2 - 3(2) \\ 16 - 3(2) \\ 16 - 6 \\ 10 \end{aligned}$$



After substituting the values for the variables in Step 1, you can use your calculator to find the value of the expression.

$4 \div (-) \times 2 = (-) 3 \times 2 = 10$

Note: The GED calculator does not require the $(-)$ keys. The value of the expression is **10**, when $x = -4$ and $y = 2$.

GED SKILL FOCUS

A. Translate the following into algebraic expressions. Use the variable x to represent the unknown number in each expression unless otherwise noted.

1. the difference between a number and 2
2. twice a number, increased by 4
3. 9 less than three times a number
4. five times the sum of a number and -3
5. the product of a number and 11
6. 10 less than the product of 4 and a number
7. the quotient of a number and 3
8. 5 minus twice a number
9. twice a number increased by the product of 3 and 8
10. the quotient of 3 minus a number and 6
11. 8 minus the sum of 15 and a number
12. 5 divided by the product of x and y
13. the product of 3 and x divided by the sum of x and y
14. x multiplied by itself, then increased by the product of 12 and y
15. the product of 2 and the difference of x and y

B. Evaluate these expressions as directed.

16. What is the value of $3(x - 6) + 2y$?
 - a. when $x = -7$ and $y = 10$?
 - b. when $x = 5$ and $y = -2$?
 - c. when $x = 0$ and $y = 6$?
 - d. when $x = 3$ and $y = 3$?
17. What is the value of $x^2 - y^2$?
 - a. when $x = 0$ and $y = 2$?
 - b. when $x = -2$ and $y = 1$?
 - c. when $x = 5$ and $y = -5$?
 - d. when $x = -1$ and $y = -2$?
18. What is the value of $\frac{(x + 5)^2}{x - 5}$?
 - a. when $x = 0$?
 - b. when $x = 1$?
 - c. when $x = 3$?
 - d. when $x = 4$?
19. What is the value of $8x + \frac{-2y}{-1}$?
 - a. when $x = 4$ and $y = 2$?
 - b. when $x = 9$ and $y = -4$?
 - c. when $x = -1$ and $y = 0$?
 - d. when $x = 5$ and $y = -5$?
20. What is the value of $\frac{(6 + x)^2}{y}$?
 - a. when $x = 4$ and $y = -1$?
 - b. when $x = 0$ and $y = 6$?
 - c. when $x = 0$ and $y = -6$?
 - d. when $x = 2$ and $y = 2$?
21. What is the value of $x^2 + 2x - 6$?
 - a. when $x = -3$?
 - b. when $x = 2$?
 - c. when $x = 4$?
 - d. when $x = 8$?
22. What is the value of $-3y(y^2 + 2)$?
 - a. when $y = 2$?
 - b. when $y = 10$?
 - c. when $y = -9$?
 - d. when $y = 0$?
23. What is the value of $\frac{2(x^2 + y)}{z}$?
 - a. when $x = 4$, $y = -2$, and $z = 7$?
 - b. when $x = 3$, $y = 0$, and $z = 6$?
 - c. when $x = -1$, $y = -9$, and $z = -1$?
 - d. when $x = -5$, $y = -5$, and $z = -5$?

Answers start on page 414.

Simplifying Expressions



A number next to a letter means multiplication; all these mean "2 multiplied by y":

$$2y \quad 2 \times y \quad 2 \cdot y \quad 2(y)$$

Simplifying an expression means combining like terms. A **term** is a number or the combination of a number and one or more variables or a variable raised to a power. The **factors** of a number are the values that, when multiplied together, result in that number.

Examples	5	x	$2x$	xy	$4x^2$
Factors	5 and 1	1 and x	2 and x	x and y	4 and x^2

In an algebraic expression, a positive or negative sign is part of the term that follows it: the term "owns" the sign that comes before it. An addition sign is understood in front of the negative sign.

Example The expression $3x^2 - 7x + 14$ has three terms.

This expression can also be written as $3x^2 + (-7x) + (+14)$.

Like terms have the same variable or variables raised to the same power. Study these examples to identify like terms.

Examples $4x$ and $9x$ are like terms. Both terms contain x .
 $7xy$ and $8xy$ are like terms. Both terms contain xy .
 4 and $6y$ are not like terms. An integer and y are different.
 $3x$ and $3y$ are not like terms. Variables x and y are different.
 $5y^2$ and $6y$ are not like terms. The powers are different.

We combine like terms in an expression so that there is only one term containing that variable. Simplified expressions are easier to evaluate.

Example 1 Simplify $4x + 6y - 3x - 4y$.

Step 1 Group the like terms. Group the x terms and group the y terms. (The sign travels with the term.)

Step 2 Combine like terms.

$$\begin{aligned} 4x + 6y - 3x - 4y &= \\ 4x + 6y + -3x + -4y &= \\ (4x + -3x) + (6y + -4y) &= \\ (4x - 3x) + (6y - 4y) &= \\ x + 2y & \end{aligned}$$

In simplified form, $4x + 6y - 3x - 4y$ is equal to $x + 2y$.

The order of operations says to perform operations in parentheses first. However, in algebraic expressions parentheses often contain unlike terms that cannot be combined. To simplify an expression that contains parentheses, use the **distributive property** to remove the parentheses.

Distributive Property

To multiply a factor by a sum of terms, multiply the factor by each term in parentheses. Then combine the products. $5(x + y) = 5x + 5y$

Example 2 Simplify $2x(3x - 6) + 5x$.

Step 1 To remove parentheses multiply each term in the parentheses by the factor.

Step 2 Combine like terms.

$2x(3x - 6) + 5x$ is equal to $6x^2 - 7x$.

$$\begin{aligned} 2x(3x - 6) + 5x &= \\ 2x(3x) + 2x(-6) + 5x &= \\ 6x^2 - 12x + 5x &= \\ 6x^2 - 7x & \end{aligned}$$



It may be helpful to rewrite an expression grouping like terms next to each other. Remember: keep the sign that precedes each term with that term and add an addition sign.

A. Simplify each expression.

1. $7x - 8y + 9x$
2. $5y^2 - 4y - 2y^2$
3. $4m - 9n - 3 + 6n$
4. $-5x + 16 - 8x - 14 + 10x$
5. $9x - 6 + 8x^2 + 13$
6. $25 - 3n + 16n$
7. $12(x + 3y)$
8. $5x(-y + 9)$
9. $4(2x + y) - 3(x - 5)$
10. $15 + 6(x - 4) + 8x$
11. $3m + 2(m - n) - 5(m + n)$
12. $x - 2(xy - y) + 4xy - x(3 + y)$

B. Simplify. Then evaluate each expression as directed.

13. Find the value of $3x + 5(x + 9) - 4x$, when $x = -5$.
14. Find the value of $2m - 3(m + 5) - 15$, when $m = 10$.
15. Find the value of $xy + 4x(1 - y) + 2x$, when $x = -1$ and $y = 5$.
16. Find the value of $3y(2xz + 2) - 6xyz$, when $x = -4$, $y = -3$, and $z = 7$.
17. Find the value of $4(2x - y) - 3x + 2y$, when $x = 0$ and $y = -2$.
18. Find the value of $9a - 8b(2 + a) + 16b$, when $a = -4$ and $b = -1$.

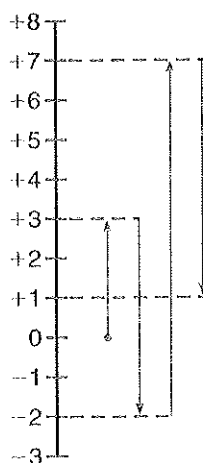
C. Choose the best answer to each question.

19. The expression $4(x + 2y) - (x + y)$ is equal to which of the following expressions?
 - (1) $3x + y$
 - (2) $3x + 3y$
 - (3) $3x + 5y$
 - (4) $3x + 7y$
 - (5) $3x + 9y$
20. The expression $8n - 2(n^2 + n) + 12$ is equal to which of the following expressions?
 - (1) $2n + 12$
 - (2) $4n + 12$
 - (3) $2n^2 + 10n + 12$
 - (4) $-2n^2 + 6n + 12$
 - (5) $-2n^2 + 6n + 24$
21. Which of the following expressions is equal to the expression $-m(2m + 2n) + 3mn + 2m^2$?
 - (1) mn
 - (2) $5mn$
 - (3) $-4m^2 + mn$
 - (4) $4m^2 + mn$
 - (5) $4m^2 + 5mn$
22. The expression $3(-4b) - 2(a - b - c)$ is equal to which of the following expressions?
 - (1) $-2a - 10b - 2c$
 - (2) $-2a - 10b + 2c$
 - (3) $-2a - 5b + 2c$
 - (4) $-2a - 4b - 2c$
 - (5) $2a - 4b - 2c$

Using Number Lines



A number line can be vertical or horizontal. A vertical number line can help you show situations like temperature, the height of a building, or land above and below sea level.



As you have seen, number lines are useful for showing addition and subtraction operations. On the GED Mathematics Test, drawing a number line can help you solve problems that describe several increases and decreases.

Example 1 An office building has 3 floors below and 8 floors above ground level. After entering the building on the ground level, a delivery person takes the elevator to four locations, where she makes deliveries at each stop. She travels 3 floors up, 5 floors down, 9 floors up, and 6 floors down. Where does she make the final delivery?

- (1) 2 floors below ground level
- (2) 1 floor below ground level
- (3) ground level
- (4) 1 floor above ground level
- (5) 2 floors above ground level

You may have realized that ground level can be represented by the integer 0. The floors above ground level can be assigned positive numbers, and the floors below ground level can be represented by negative numbers.

One way to solve the problem is to draw a vertical number line that shows the integers from -3 to $+8$. Then start at 0 (ground level) and count out each change described in the problem. Count up 3, down 5, up 9, and down 6.

You finish counting at $+1$, so the correct answer is **option (4) 1 floor above ground level**.

Note: You can also solve this problem by writing and evaluating an algebraic expression: $+3 - 5 + 9 - 6 =$, which can be written as follows: $(+3) + (-5) + (+9) + (-6)$

$$\begin{array}{r} \text{To solve: } (+3) + (+9) + (-5) + (-6) \\ \phantom{\text{To solve: }} +12 + -11 = +1 \end{array}$$

Example 2 On a number line, a certain number x is 5 units greater than the number found halfway between -5 and -1 . What is the value of x ?

- (1) -8
- (2) -3
- (3) 0
- (4) 2
- (5) 5

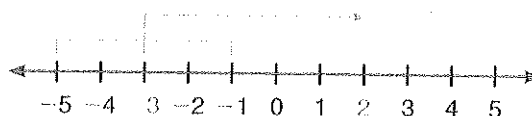


Remember, subtracting a positive number is the same as adding a negative number. For example,

$$-3 - 5 = -3 + (-5)$$

$$-4 - 2 = -4 + (-2)$$

Since you are not given a diagram, quickly sketch a number line, find the point halfway between -5 and -1 , and count 5 spaces to the right.



The correct answer is **option (4) 2**.

GED PRACTICE

Directions: Choose the one best answer for each question.

1. In a card game, Rita loses 1 point, gains 5 points, and loses 8 points. Jerry has 6 points. What is the difference in their scores?

(1) 4
(2) 6
(3) 8
(4) 10
(5) 12

2. On a number line, Max places a mark 3 units to the left of the point halfway between 1 and -3 . On what point is Max's mark?

(1) 2
(2) 0
(3) -1
(4) -3
(5) -4

3. At 10 A.M., it is 5°F below zero. By 11 A.M., the temperature rises 6°F . If it drops 3°F by 1 P.M., what is the temperature at 1 P.M.?

(1) -4°F
(2) -2°F
(3) 0°F
(4) 2°F
(5) 14°F

Question 4 refers to the following information.

Aaron's Dice Rolls

Round	Red Die	Green Die
3	4	6
4	2	1
5	6	4

4. In a dice game, each player rolls two dice, one red and one green. The number on the red die is added to the player's score from the previous round. The number on the green die is subtracted from the player's score. If Aaron had $+4$ points after the first two rounds, how many points does he have after five rounds?

(1) -5
(2) -3
(3) 1
(4) 3
(5) 5

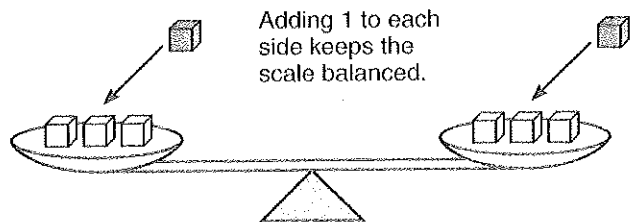
5. On a number line, -2 is located halfway between which of the following points?

(1) -3 and 0
(2) -4 and 1
(3) -4 and -1
(4) -4 and 0
(5) -5 and 0

Answers start on page 416.

Solving One-Step Equations

An **equation** is a mathematical statement that shows that two quantities are equal. When an equation contains a variable, we use algebra to find the value of the variable. To **solve** an equation means to find the number that makes the statement true.



Solve the equation. $2x - 1 = 9$
 When x equals 5, $2(5) - 1 = 9$
 the statement is true. $10 - 1 = 9$
 $9 = 9$

To solve an equation, you must keep the two sides of the equation equal. Think of an equation as a balance scale. Whatever you do to one side of the scale, you must also do to the other side to keep the scale balanced.

The basic strategy in solving an equation is to **isolate the variable**, that is, get the variable alone on one side of the equation by performing **inverse**, or opposite, operations to both sides of the equation.

- Remember:
- Addition and subtraction are inverse operations.
 - Multiplication and division are inverse operations.



You may be able to solve simple equations using mental math. However, writing out each step will improve your understanding of algebra and make it easier to check your work.

Example 1 Solve: $x - 13 = 25$.

- Step 1** **Think about the meaning** of the equation, the operation, and its inverse: here, the operation is subtraction; the inverse operation is addition. $x - 13 = 25$
- Step 2** **Perform the inverse operation to both sides of the equation** to isolate the variable and keep the equation balanced. Here, add 13 to both sides. $x - 13 + 13 = 25 + 13$
 $x = 38$
- Step 3** **Check.** Substitute your solution, 38, into the original equation for the variable x . $38 - 13 = 25$
 $25 = 25$

The value **38** makes the equation true.

Example 2 Solve: $5x = -35$.

- Step 1** The operation is multiplication; the inverse of multiplication is division. $5x = -35$
- Step 2** Divide both sides by 5. $\frac{5x}{5} = \frac{-35}{5}$
 $x = -7$
- Step 3** Substitute and check. $5(-7) = -35$
 $-35 = -35$

The value **7** makes the equation true.

Study these examples to see how subtraction and multiplication can be used as inverse operations to solve equations.

Examples

Subtract 40 from both sides.
 $x + 40 = 75$
 $x + 40 - 40 = 75 - 40$
 $x = 35$

$$\frac{x}{9} = 4$$

$$1 \frac{x}{9} \times 9 = 4(9)$$

$$x = 36$$

Multiply both sides by 9.

(Note that cancellation applies only to the left side of the equation.)

Check. $35 + 40 = 75$

$$\frac{36}{9} = 4$$

GED SKILL FOCUS

A. Solve. Do not use a calculator.

1. $x - 15 = 4$

7. $x - 8 = -10$

2. $x - 7 = 3$

8. $\frac{x}{-3} = 18$

3. $\frac{x}{2} = 12$

9. $5x = -45$

4. $-6x = -42$

10. $9 + x = -18$

5. $x + 9 = 22$

11. $-11x = -132$

6. $-12x = 60$

12. $7x = 63$



B. Solve. You may use a calculator for these items.

13. $x - 94 = 52$

17. $-69 + x = 124$

14. $6.5 + x = 12.25$

18. $-3.6x = -17.28$

15. $0.25x = 12$

19. $0.38 + x = 2.5$

16. $200x = 25$

20. $6x = 3.3$

C. Translate each question into an algebraic equation and solve.

21. -13 added to what number equals 20 ?
 (Hint: $-13 + x = 20$)

25. What number divided by 4 is 32 ?

22. What number multiplied by 10 equals 900 ?

26. What number multiplied by -6 equals 48 ?

23. What number divided by 4 equals 60 ?

27. 52 added to what number equals 100 ?

24. 5 subtracted from what number equals -14 ?

28. 4 subtracted from what number equals -17 ?

Answers start on page 417.

Solving Multi-Step Equations

Some equations involve more than one operation. Remember: your goal is to isolate the variable on one side of the equation. Also, when solving multi-step equations, use the reverse order of operations.

Example 1 $5x - 10 = 35$

- Step 1** Perform the inverse operations for addition and subtraction first.
Add 10 to both sides.
- $$5x - 10 + 10 = 35 + 10$$
- $$5x = 45$$
- Step 2** Perform the inverse operations for multiplication and division second.
Divide both sides by 5.
- $$\frac{5x}{5} = \frac{45}{5}$$
- $$x = 9$$
- Step 3** Check. Substitute the value for x .
- $$5(9) - 10 = 35$$
- $$45 - 10 = 35$$
- $$35 = 35$$

The solution is $x = 9$.

Some equations may have variable terms on both sides. If so, you need to group all of the variable terms on one side of the equation.

Example 2 $12x + 9 = 10x + 1$

- Step 1** Group the variable.
Subtract $10x$ from both sides.
- $$12x - 10x + 9 = 10x - 10x + 1$$
- $$2x + 9 = 1$$
- Step 2** Subtract 9 from both sides.
- $$2x + 9 - 9 = 1 - 9$$
- $$2x = -8$$
- Step 3** Divide both sides by 2.
- $$\frac{2x}{2} = \frac{-8}{2}$$
- $$x = -4$$
- Step 4** Check.
- $$12(-4) + 9 = 10(-4) + 1$$
- $$-48 + 9 = -40 + 1$$
- $$-39 = -39$$

The solution is $x = -4$.

Some equations contain parentheses. Remove the parentheses by multiplying each term within the parentheses by the factor.

Example 3 $3(x + 1) = -12$

- Step 1** Multiply both terms inside the parentheses by 3.
- $$3(x + 1) = -12$$
- $$3x + 3 = -12$$
- Step 2** Subtract 3 from both sides.
- $$3x + 3 - 3 = -12 - 3$$
- $$3x = -15$$
- Step 3** Divide both sides by 3.
- $$\frac{3x}{3} = \frac{-15}{3}$$
- $$x = -5$$
- Step 4** Check.
- $$3(-5 + 1) = -12$$
- $$(-15 + 3) = -12$$
- $$-12 = -12$$
- The solution is $x = -5$.



There is often more than one way to solve equations, such as first adding or subtracting the integer and then the variable. But, you must always follow the basic rules for solving equations: always add or subtract first; then multiply or divide.



The integer for a lone variable is understood to be 1: $x = 1x$ and $-x = -1x$.

The first step in solving some equations is to **combine like terms**. Always simplify each side of the equation before solving.

Example 4 $2x + 5 - 3x = 8 + 2$

Step 1	Simplify by combining like terms.	$2x + 5 - 3x = 8 + 2$ $2x - 3x = -x; 8 + 2 = 10$ $-x + 5 = 10$
Step 2	Isolate the variable. Here, subtract 5 from each side.	$-x + 5 - 5 = 10 - 5$ $-x = 5$
Step 3	Solve for x. Multiply each side by -1 so that you solve for x , not $-x$.	$-x(-1) = 5(-1)$ $x = -5$
Step 4	Check.	$2(-5) + 5 - 3(-5) = 8 + 2$ $-10 + 5 - (-15) = 10$ $-10 + 5 + 15 = 10$ $10 = 10$

The solution is -5 .

GED SKILL FOCUS

Solve each equation.

- | | |
|---|---------------------------------|
| 1. $6x + 7 = 37$ | 16. $6(2 + x) = 5x + 15$ |
| 2. $4x + 5x - 10 = 35$ | 17. $4x + 5 = 21$ |
| 3. $3x - 6x + 2 = -4x$ | 18. $2x - 5x + 11 = 38$ |
| 4. $6 - x + 12 = 10x + 7$ | 19. $3x - 8 = x + 4$ |
| 5. $5x + 7 - 4x = 6$ | 20. $7(x - 2) = 21$ |
| 6. $9x + 6x - 12x = -7x + 2x - 12 + 5x$ | 21. $5x - 13x + 2x = -70 + x$ |
| 7. $7x + 3 = 31$ | 22. $8x + 12 = 44 + 4x$ |
| 8. $3x - 8 = 28$ | 23. $2(x + 4) = 14 + x$ |
| 9. $8x + 6 = 5x + 9$ | 24. $5x + 3 = 8(x - 3)$ |
| 10. $11x - 10 = 8x + 5$ | 25. $2(x + 2x) - 6 = 30$ |
| 11. $-2x - 4 = 4x - 10$ | 26. $11x + 12 = 9x - 32$ |
| 12. $5x + 8 = x - 8$ | 27. $3(x - 9) - 2 = -35$ |
| 13. $11x - 12 = 9x + 2$ | 28. $3(4x + 3) = -9(-x + 2)$ |
| 14. $5(x + 1) = 75$ | 29. $x + 11 + 3x = 20 + 7x$ |
| 15. $5(x - 7) = 5$ | 30. $4(2x + 5) + 4 = 3(5x - 6)$ |

Answers start on page 418.

GED STRATEGY Solving Word Problems

Translating Problems into Equations

To solve word problems translate the information in the problem into algebraic symbols and write an algebraic equation relating the information. Read the problem carefully to figure out which quantities or numbers are unknown. Label all other quantities in terms of one unknown amount.

Example 1 During lunch one day, a cafe sold 8 more turkey sandwiches than ham sandwiches. If there were 32 sandwiches sold in all, how many were ham sandwiches?



As a general rule, let x equal the quantity you know the least about; this is usually the amount to which the other amount is compared or related.

- Step 1 Identify the unknown amount(s); assign the variable.** There are 2 unknown amounts: the number of ham sandwiches and the number of turkey sandwiches. Pick one to be the unknown x . Here, let x = the number of ham sandwiches.
- Step 2 Label the other quantities in terms of x .** Since there were 8 more turkey sandwiches than ham, let $x + 8$ equal the number of turkey sandwiches. If you had let x = the number of turkey sandwiches, then the number of ham sandwiches would be $x - 8$.
- Step 3 Write an equation.** You know 32 sandwiches in all were sold. Thus, the sum of the number of turkey sandwiches ($x + 8$) and the number of ham sandwiches (x) is 32: $(x + 8) + x = 32$.

The equation $(x + 8) + x = 32$ can be used to solve the problem.

Some algebra items on the GED Mathematics Test are set-up problems. Instead of solving the equation, you choose a correct method to solve the problem. To work with these items, analyze the situation and write an equation. Then compare your equation to the answer choices.

Example 2 Rae's weekly income is \$250 less than twice her husband's. Together they earn \$890 per week. Which equation could be used to find her husband's weekly earnings (x)?

- (1) $(2x + 250) + x = 890$
- (2) $(2x - 250) + x = 890$
- (3) $(2x + 250) - x = 890$
- (4) $(2x - 250) - x = 890$
- (5) $2x + 2x - 250 = 890$

- | | | |
|---------------|---|--|
| Step 1 | The problem tells you to let x equal the husband's earnings. | Let x = husband's earnings |
| Step 2 | Rae's income is \$250 less than twice x , or $2x - 250$. | Let $2x - 250$ = Rae's earnings |
| Step 3 | The sum of their incomes is \$890. | $x + 2x - 250 = 890$ |
| Step 4 | Since none of the choices match, rearrange your equation and compare again. | $x + 2x - 250 = 890$ is the same as $(2x - 250) + x = 890$ |

Option (2) $(2x - 250) + x = 890$ is correct.



There is often more than one way to write an equation: $x + (x + 8) = 32$ and $2x + 8 = 32$ are the same as $(x + 8) + x = 32$.

Directions: Choose the one best answer to each question.

1. Birnham Mills has 360 employees. The number of production employees is twelve more than three times the number of employees who work in management. Which equation could be used to find the number of management employees?
 - (1) $3x + 12 = 360$
 - (2) $4x = 360$
 - (3) $3x - 12 + x = 360$
 - (4) $(3x + 12) - x = 360$
 - (5) $x + (3x + 12) = 360$

2. At a gym Frank did a certain number of pushups. Tom did 12 more than Frank. The total number both men did was 66. Which equation could be used to find the number of pushups Frank did?
 - (1) $x(x + 12) = 66$
 - (2) $x + 12x = 66$
 - (3) $2x + 12 = 66$
 - (4) $2x = 66 + 12$
 - (5) $x + 12 = 66 + x$

3. Eva got two parking tickets. The fine for the second ticket was \$4 less than twice the fine for the first ticket. If the fines total \$65, which equation could be used to find the amount of the first fine?
 - (1) $3x = 65 - 4$
 - (2) $2(x - 4) = 65$
 - (3) $x(x - 4) = 65$
 - (4) $x + (2x - 4) = 65$
 - (5) $2(2x - 4) = 65$

4. Eight times a number, divided by 4, equals two times that number. Which of the following equations could be used to find the number?
 - (1) $\frac{8y}{4} = 2y$
 - (2) $8\left(\frac{4}{y}\right) = 2y$
 - (3) $\frac{8}{4y} = 2y$
 - (4) $8y(4) = 2$
 - (5) $\frac{8y}{4y} = 2y$

5. The number of girls signed up for a sports program is 12 fewer than twice the number of boys (x). If 60 children are signed up for the program, which of the following equations could be used to find the number of boys?
 - (1) $2x - 12 = 60$
 - (2) $2(x + x - 12) = 60$
 - (3) $x + 2x = 60 - 12$
 - (4) $x + 2(x - 12) = 60$
 - (5) $3x = 60 + 12$

6. An adult ticket is twice the cost of a child's ticket. Angela paid \$28 for two adult tickets and three children's tickets. Which of the following equations could be used to find the price of a child's ticket?
 - (1) $x + 2x = 28$
 - (2) $3x + 2(2x) = 28$
 - (3) $2(x + 2x) = 28$
 - (4) $3(2x) + 2x = 28$
 - (5) $3x + 2x = 28$

Answers start on page 419.

Solving Algebraic Equations

Algebra word problems describe the relationship among the numbers in a situation. To solve an algebra problem, translate the information into algebraic symbols, write and solve an equation, and check your answer.

Example 1 The total of three **consecutive numbers** is 189. What is the greatest of the three numbers?

- Step 1 Identify the unknown amounts; assign x .** Let x represent the smallest number.
- Step 2 Label the other quantities in terms of x .** If x is the smallest number, the next two numbers are $x + 1$ and $x + 2$.
- Step 3 Write an equation.** The sum of the three numbers is 189.
- $$x + (x + 1) + (x + 2) = 189$$
- $$x + x + 1 + x + 2 = 189$$
- Step 4 Combine like terms and solve for x .**
- $$x + x + x + 1 + 2 = 189$$
- $$3x + 3 = 189$$
- $$3x = 186$$
- $$x = 62$$
- Step 5 Solve the problem.** The value of x represents the smallest of three consecutive numbers: the three numbers are 62, 63, and 64.
- Step 6 Check your answer.** Read the problem again to make sure your answer is reasonable. Since $62 + 63 + 64 = 189$, the answer makes sense.

The correct answer is **64**.

In some problems, a chart is useful to clarify the information and show relationships between and among the quantities.

Example 2 Ralph is three times as old as his daughter Ella. In ten years, he will be only two times as old as Ella. How old is he now?

There are four unknowns: two present ages and two future ages.

	Ella's Age	Ralph's Age
Now	A: x	B: $3x$
In 10 years	C: $x + 10$	D: $3x + 10$

A: Let x equal Ella's age now.

B: Ralph is 3 times as old as Ella, so his age now is $3x$.

C: In ten years, Ella will be $x + 10$ years old.

D: In ten years, Ralph will be $3x + 10$ years old.

We know Ralph's age in ten years ($3x + 10$)

will be 2 times Ella's age in 10 years ($x + 10$).

Then solve for x .

$$3x + 10 = 2(x + 10)$$

$$3x + 10 = 2x + 20$$

$$3x - 2x + 10 - 10 = 2x - 2x + 20 - 10$$

$$x = 10$$

Use the chart to find the answer to the problem.

Substitute 10 for the variable x in each box.

Ella's age now is 10.

Ralph's age now is 30.

As a check, note that in 10 years, Ella will be 20

and Ralph will be 40, twice as old as Ella.

Ralph is now **30 years old**.



Make sure that you answer the question that is asked in the problem. The value of x may not be the answer to the question.

GED SKILL FOCUS

Translate each statement into an algebraic equation. Then solve.

1. The sum of a number and twice that number is 15. What is the number?
2. The sum of 7 and twice a certain number is 10 more than the number. What is the number?
3. One number is 5 less than another. The sum of the two numbers is 181. Find the two numbers.
4. When the sum of 8 and a certain number is increased by 12, the result is the same as the product of 3 and the number. What is the number?
5. The sum of two consecutive numbers is 49. What is the lesser number?
6. George is 5 times as old as his son. In 15 years he will be only twice as old as his son. How old will his son be in 15 years?
7. The sum of three consecutive even numbers is 30. What is the greatest of the three even numbers? (*Hint: Let x represent the first even number. Let $x + 2$ represent the second even number.*)
8. Nora is 4 years older than Diana. Two years from now Nora will be twice as old as Diana. How old is Diana now?
9. A bank teller had 125 \$10 and \$5 bills to start a day. If the total value of the bills was \$1000, how many \$5 bills did the teller have? [*Hint: If x equals the number of \$5 bills, then $5x$ equals the value of the \$5 bills. The number of \$10 bills is $125 - x$, and the total value of the \$10 bills is $10(125 - x)$.*]
10. Twice a number divided by 4 is 16. What is the number?
11. The sum of three consecutive odd numbers is 315. What are the numbers? (*Hint: If x represents the first odd number, the second number is $x + 2$.*)
12. One number is two more than three times another. The sum of the numbers is 26. What is the lesser number?
13. Armando works part-time at a pet store. This week he earned \$18 less than 4 times the amount he earned last week. His total earnings for the two weeks were \$262. How much did he earn this week?
14. There are two consecutive numbers. The sum of the lesser number and three times the greater number is 103. Find the two numbers.
15. A shoe store sold 340 pairs of shoes in one day. The number of pairs of athletic shoes sold was 4 more than twice the number of pairs of dress shoes sold. How many pairs of athletic shoes were sold?
16. A school sold 200 tickets to a play. Ticket prices were \$8 per adult and \$5 per child. If the total sales for the tickets came to \$1414, how many children's tickets were sold? (*Hint: If x adult tickets were sold, then $200 - x$ children's tickets were sold.*)
17. Erika's uncle is three times as old as she is now. Four years ago, he was four times as old as she was then. How old is Erika now?

Answers start on page 419.

GED STRATEGY Solving Word Problems

Using Distance and Cost Formulas

A **formula** is a special type of equation. A formula relates information to solve a certain kind of problem. When you take the GED Mathematics Test, you will be given a page of formulas to use in solving problems.

Two important formulas are the distance and cost formulas.

Distance distance = rate $\times$ time or $d = rt$

Total Cost total cost = (number of units) $\times$ (cost per unit) or $c = nr$

To use formulas, first choose the formula that shows how the facts in the problem are related. Then substitute the known quantities and solve.

Example 1 A plane travels at an average speed of 525 miles per hour for 4 hours. How many miles does it travel?

- (1) 60.0
- (2) 131.25
- (3) 240.0
- (4) 525.0
- (5) 2100.0

Step 1 Use the distance formula where d = distance, r = rate (average speed), and t = time.

$$d = rt$$

Step 2 Substitute the known quantities.

$$d = 525 \times 4$$

Step 3 Solve for d .

$$d = 2100$$

The plane traveled **2100 miles**.

You can solve for any variable in a formula if you know the values of the other variables. Substitute the values you know for the variables in the problem. Then use inverse operations to solve for the unknown variable.

Example 2 The total cost of a shipment of chairs is \$2250. If each chair costs \$75, how many chairs are in the shipment?

- (1) 30
- (2) 75
- (3) 225
- (4) 2,250
- (5) 168,750

Step 1 Use the cost formula, where c = total cost, n = number of units, and r = cost per unit, to solve for n , the number of chairs.

$$c = nr$$

Step 2 Substitute the known quantities.

$$\$2250 = n(\$75)$$

Step 3 Solve for n . Divide both sides of the equation by \$75.

$$\begin{array}{r} \$2250 \div \$75 = n(\$75) \div \$75 \\ \$75 \qquad \qquad \$75 \\ 30 = n \end{array}$$

There are **option (1) 30 chairs** in the shipment.



The variables in a formula use related units of measure: if the rate is in *miles per hour*, the distance will be in *miles*, and the time will be in *hours*.



You can use a formula to solve for any of its variables. Using $c = nr$, you can also find $n = \frac{c}{r}$ or $r = \frac{c}{n}$.

GED PRACTICE

Directions: Choose the one best answer to each question.

1. A hardware store purchased 6 dozen hammers for a total cost of \$345.60. What was the cost of one dozen hammers?
 - (1) \$ 4.80
 - (2) \$ 9.60
 - (3) \$ 28.80
 - (4) \$ 57.60
 - (5) \$115.20
2. Marta bought 3 yards of fabric at \$6.98 per yard and 4 yards of a different fabric for \$4.50 per yard. Which of the following expressions could be used to find the amount of her purchase? (*Hint: You would need to find the total cost of each type of fabric and then find the sum.*)
 - (1) $7(\$6.98)(\$4.50)$
 - (2) $7(\$6.98 + \$4.50)$
 - (3) $3(\$6.98) + 4(\$4.50)$
 - (4) $4(\$6.98) + 3(\$4.50)$
 - (5) $(3 + 4)(\$6.98 + \$4.50)$
3. Steve drove for 6 hours and traveled 312 miles. Which of the following expressions could be used to find his average speed during the trip?
 - (1) $6 + 312$
 - (2) $\frac{312}{6}$
 - (3) $\frac{6}{312}$
 - (4) $6(312)$
 - (5) $6(6)(312)$
4. A label on the grocery store shelf states that the store brand of shampoo sells for 14.5 cents per ounce. What is the cost of a 24-ounce bottle of the shampoo?
 - (1) \$0.60
 - (2) \$1.66
 - (3) \$3.48
 - (4) \$6.00
 - (5) \$7.65
5. Kate drove $2\frac{1}{2}$ hours at an average speed of 55 miles per hour and $1\frac{1}{2}$ hours at an average speed of 65 miles per hour. How many miles did she travel?
 - (1) 260
 - (2) 235
 - (3) 220
 - (4) $137\frac{1}{2}$
 - (5) $97\frac{1}{2}$

Question 6 refers to the following information.

Bakery Goods Price List	
Party Tray	\$ 9.99
Party Platter	\$13.99
Half Sheet Cake	\$26.99

6. Rodrigo is organizing a party for his office. He orders three party trays, two party platters, and a half sheet cake. How much will he spend for the order?
 - (1) \$ 29.97
 - (2) \$ 50.97
 - (3) \$ 80.94
 - (4) \$ 84.94
 - (5) \$305.82

Answers start on page 420.

GED Mini-Test • Lessons 18 and 19

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.

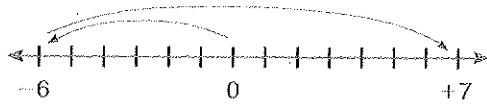


Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. Which of the following expressions shows the product of 9 and x , subtracted from the quotient of 2 and x ?
 - (1) $\frac{2}{x} - 9x$
 - (2) $-9x - \frac{2}{x}$
 - (3) $2x(-9x)$
 - (4) $9 - x - \frac{2}{x}$
 - (5) $(2 + x) - 9x$
2. Which of the following expressions has the greatest value?
 - (1) $(-2) + (-7)$
 - (2) $(-6) + (+8)$
 - (3) $(-3) - (-4)$
 - (4) $(+4) - (+10)$
 - (5) $(-8) + (+9)$
3. When 13 is subtracted from the sum of two consecutive numbers, the answer is 18. What are the two consecutive numbers?
 - (1) 6 and 7
 - (2) 9 and 10
 - (3) 10 and 11
 - (4) 15 and 16
 - (5) 31 and 32
4. Ten less than a number is equal to the same number divided by 2. What is the number?
 - (1) 8
 - (2) 10
 - (3) 14
 - (4) 20
 - (5) 28
5. Bill is one year less than twice as old as his sister Caroline. The total of their ages is 26. How old is Bill?
 - (1) 9
 - (2) 12
 - (3) 17
 - (4) 19
 - (5) 24
6. Eunsook drives an average speed of 62 miles per hour for $4\frac{1}{2}$ hours. How many miles does she travel?
 - (1) 67
 - (2) 137
 - (3) 248
 - (4) 279
 - (5) 725

7. Which expression does this number line show?



- (1) $(-6) + (+7)$
 (2) $(+7) + (-6)$
 (3) $(-6) + (+13)$
 (4) $(+7) + (-13)$
 (5) $(+6) + (-13)$
8. What is the value of $-4x - \frac{3y}{2x}$ when $x = -4$ and $y = 8$?

- (1) -19
 (2) -13
 (3) 10
 (4) 13
 (5) 19

9. Coop and Carni are cats. Coop is 4 months older than Carni. Three months ago, 5 times Coop's age in months was the same as 7 times Carni's age in months. Complete the chart. What is the entry for box 4?

	Coop's Age in months	Carni's Age in months
Now	1: x	2: $x - 4$
3 months ago	3:	4:

- (1) $(x - 4) - 3$
 (2) $5(x - 4)$
 (3) $7(x - 4)$
 (4) $\frac{7}{5}(x - 4)$
 (5) $\frac{5}{7}(x - 4)$

10. A car travels 406 miles at an average speed of 58 miles per hour. How many hours does it take the car to travel this distance?

- (1) 4
 (2) 5
 (3) 6
 (4) 7
 (5) 8

11. Brittany bought 5 plastic storage bins to help organize her closets. After adding sales tax of \$2.06, the total cost of the bins was \$31.51. Which of the following equations could be used to find the price of one bin (x)?

- (1) $5 + x = \$31.51 - \$2.06$
 (2) $5(x + \$2.06) = \$31.51$
 (3) $5x = \$31.51$
 (4) $5x - \$2.06 = \$31.51$
 (5) $5x + \$2.06 = \$31.51$

12. The expression $-5(x - 6) - 2(x + 8)$ is equal to which of the following expressions?

- (1) $7x + 14$
 (2) $7x + 2$
 (3) $-7x - 5$
 (4) $-7x + 14$
 (5) $-7x + 46$

13. In a certain game, points you win are positive numbers and points you lose are negative numbers. What is the value of this series of plays: win 8, lose 6, lose 7, win 11, lose 2?

- (1) -15
 (2) -4
 (3) 4
 (4) 12
 (5) 19

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

14. Which of the following expressions represents the difference of 5 and -2 divided by a number multiplied by itself?

- (1) $\frac{5 - (-2)}{x^2}$
- (2) $\frac{5}{(-2) - 2x}$
- (3) $\frac{5 + 2}{2x}$
- (4) $\frac{5}{(-2) - x^2}$
- (5) $\frac{5 - 2}{x^2}$

15. The sum of three consecutive even numbers is 138. What is the greatest number?

- (1) 52
- (2) 50
- (3) 48
- (4) 46
- (5) 44

16. Which of the following expresses this equation?

$$x + 4 = \frac{x}{5} - 6$$

- (1) Four more than x equals 6 less than the quotient of 5 and x .
- (2) The sum of 4 and x is the same as 6 less than the quotient of x and 5.
- (3) Four added to x equals the product of x and 5 decreased by 6.
- (4) The product of x and 4 is the same as x divided by the difference of 5 and 6.
- (5) Four increased by x equals the difference of x and 6 divided by 5.

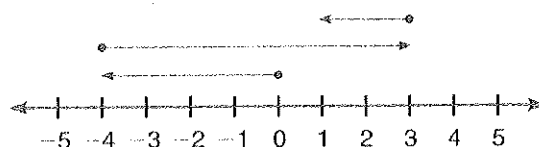
17. In the equation $-2(x + 4) = 5x + 6$, what is the value of x ?

- (1) -2
- (2) $-\frac{1}{2}$
- (3) 1
- (4) $\frac{1}{2}$
- (5) 2

18. Sybil is taking her Cub Scout pack to the Police Expo. Each adult ticket is \$2 more than the price of a children's ticket. Sybil pays \$78 to buy 12 children's tickets and 5 adult tickets. What is the price of a children's ticket?

- (1) \$3.00
- (2) \$3.50
- (3) \$4.00
- (4) \$5.00
- (5) \$6.00

Question 19 refers to the following number line.



19. Which of the following expressions represents the changes shown on the number line?

- (1) $-4 + 3 + (-1)$
- (2) $-4 + 7 + (-2)$
- (3) $-4 + 7 - (-2)$
- (4) $4 + (-7) + 2$
- (5) $4 - (-7) - 2$

20. Drew and Linda each contributed to the cost of a gift for a friend. Linda spent \$15 less than 4 times the amount Drew spent. If the gift cost \$30, how much did Linda spend?

(1) \$ 9
(2) \$11
(3) \$15
(4) \$19
(5) \$21

21. Marco is four times as old as Lindsay. In six years, he will be three times her age. How old will Marco be in six years?

(1) 54
(2) 48
(3) 24
(4) 18
(5) 12

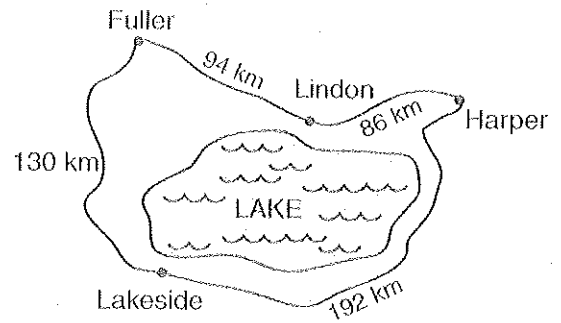
22. Which of the following is equal to the expression $6(x + 5) - (x + 10)$?

(1) $7x + 10$
(2) $7x + 20$
(3) $5x - 4$
(4) $5x + 20$
(5) $5x + 40$

23. A store sells two brands of computer scanners. Brand B costs \$40 more than twice the cost of Brand A. If Brand B costs \$135 more than Brand A, what is the cost of Brand B?

(1) \$ 95
(2) \$125
(3) \$220
(4) \$230
(5) Not enough information is given.

Question 24 is based on the following diagram.



24. A trucker drives from Harper to Lakeside to Fuller and back the same way at an average speed of 88 kilometers per hour. Which of the following equations could be used to find the time (t) in hours the trip will take?

(1) $88t = 192 + 130$
(2) $88t = 2(192 + 130)$
(3) $88t = 192 + 130 + 94 + 86$
(4) $\frac{192 + 130}{2} = 88t$
(5) $\frac{192 + 130}{88} = 2t$

25. One number is $\frac{1}{5}$ of another number. The sum of the numbers is 78. What is the greater of the two numbers?

(1) 13
(2) 15.6
(3) 39
(4) 65
(5) 73

26. Lucia's rent is \$100 less than three times her car payment. If the total of the bills is \$800, how much does she pay for rent?

(1) \$275
(2) \$375
(3) \$525
(4) \$575
(5) \$775

Answers start on page 421.

Lesson 20

GED SKILL Exponents and Roots

Exponents

Exponents are used to simplify problems that call for repeated multiplication. The expression 5^3 , which is read “five to the third power” or “five cubed,” has a base of 5 and an exponent of 3. The exponent tells how many times the base should appear in the multiplication problem.

Examples $5^3 = 5 \times 5 \times 5 = 125$
 $12^2 = 12 \times 12 = 144$
 $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$



To raise a number to the second power, use the x^2 key.

Find the value of 13^2 . $13 \text{ } x^2 \text{ } 169$. or $13 \text{ } \times \text{ } 13 \text{ } =$

To raise a number to a higher power, use the x^y key.

Find the value of 5^3 . $5 \text{ } x^y \text{ } 3 = 125$. or $5 \text{ } \times \text{ } 5 \text{ } \times \text{ } 5 \text{ } =$

An exponent can also be 1, 0, or a negative number. Remember:

- Any number with an exponent of 1 equals itself.
- Any number (except 0) with an exponent of 0 equals 1.

Examples $2^1 = 2$ $9^1 = 9$ $7^1 = 7$
 $4^0 = 1$ $3^0 = 1$ $10^0 = 1$

Our number system is based on the idea of grouping by tens. Powers of 10 are especially important.

$10^1 = 10$
 $10^2 = 10 \times 10 = 100$
 $10^3 = 10 \times 10 \times 10 = 1000$
 $10^4 = 10 \times 10 \times 10 \times 10 = 10,000$

Negative powers of 10 are useful for writing very small numbers. Any number to a negative power represents a fraction or decimal.

$10^{-1} = \frac{1}{10} = 0.1$
 $10^{-2} = \frac{1}{10} \times \frac{1}{10} = 0.01$
 $10^{-3} = \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = 0.001$

Scientific notation is a method that uses powers of ten to write very small and very large numbers. A number in scientific notation is expressed as a product of a number between one and ten and a power of ten.



The exponent for a power of 10 is the same as the number of zeros in the product.

$10^6 = 1,000,000$



The negative exponent for a power of 10 and the number of decimal places are the same.

$10^{-4} = 0.0001$

Example 1 The distance to the sun is about 93,000,000 miles. Write the distance in scientific notation.

- Step 1** Move the decimal point to the left until the last digit on the left is in the ones column. 9.3000000
- Step 2** Drop the zeros and multiply by 10 raised to a power equal to the number of places the decimal point was moved, here, 7. $93,000,000 = 9.3 \times 10^7$

Example 2 In a scientific experiment, the mass of a sample is 2×10^{-5} kilogram. Write the mass in standard notation.

- Step 1** Write the given number with a string of zeros in front of it. You haven't changed the value. 0000002.
- Step 2** Move the decimal point to the left by the number of places shown in the exponent. 00.00002.
- Discard extra zeros. $2 \times 10^{-5} = 0.00002$



If you perform operations that result in a very large or very small number, your calculator may display the solution in scientific notation. Enter this operation: $30,000 \times 5,000,000 =$

Your display may read: 1.5^{11} or $1.5 \ 11$ which equals 1.5×10^{11} .

GED SKILL FOCUS

A. Find each value. Do not use a calculator.

- | | | | |
|-----------|----------|-------------|--------------|
| 1. 2^4 | 4. 1^6 | 7. 3^3 | 10. 8^2 |
| 2. 4^3 | 5. 5^0 | 8. 7^2 | 11. 5^{-3} |
| 3. 16^1 | 6. 3^4 | 9. 3^{-2} | 12. 12^0 |



B. Find each value. Use a calculator for these problems.

- | | | | |
|-----------|--------------|------------|--------------|
| 13. 6^4 | 15. 3^6 | 17. 12^5 | 19. 2^{-5} |
| 14. 9^5 | 16. 8^{-2} | 18. 5^7 | 20. 7^4 |

C. Solve.

- | | |
|--|---|
| 21. The distance across the sun (its diameter), in scientific notation, is 8.65×10^5 miles. What is this distance written in standard notation? | 23. Which of these numbers is greatest: 5.4×10^2 , 3.02×10^3 , or 9.55×10^{-1} ? |
| 22. In very dense fog, a person can see about 0.019 mile. What is this distance written in scientific notation? | 24. Fingernails grow approximately 2.8×10^{-3} inches per day. What is this distance written in standard notation? |
| | 25. Which is less: 4.2×10^3 or 42,000? |

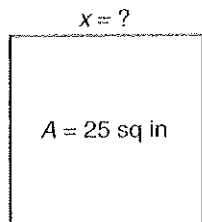
Answers start on page 422.

Square Roots

Raising a number to the second power is also called squaring the number. You have already seen that to find the area of a square, you multiply the length of one side of the square by itself. In other words, you square the length of one side to find the area.

The **square root** of a number is the number that when multiplied by itself equals the given number. The symbol for square root is $\sqrt{}$. To find the square root of a certain number, ask yourself: "What number times itself equals this number?"

Example 1 What is the measure of a side of a square if the area of the square is 25 square inches?



Step 1 The area of the square is found by multiplying the length of one side by itself. Ask: What number times itself equals 25?

Step 2 Since $5 \times 5 = 25$, the square root of 25 is 5.

Each side of the square measures **5 inches**.

Memorize the following list of squares to help you find square roots.

$1^2 = 1$	$4^2 = 16$	$7^2 = 49$	$10^2 = 100$
$2^2 = 4$	$5^2 = 25$	$8^2 = 64$	$11^2 = 121$
$3^2 = 9$	$6^2 = 36$	$9^2 = 81$	$12^2 = 144$

Example 2 What is $\sqrt{81}$?
The problem asks, "What is the square root of 81?"
Since $9^2 = 81$, $\sqrt{81} = 9$.

Most square roots are not whole numbers. You can use the list of common squares above to help you estimate an answer, or you can find a more exact answer using your calculator.

Example 3 What is $\sqrt{55}$?
What number times itself equals 55? You know that 7^2 equals 49 and 8^2 equals 64. Therefore, the square root of 55 must be **between 7 and 8** because 55 is between 49 and 64.



It is always a good idea to estimate an answer. A good estimate can help you decide whether the number in your calculator's display makes sense.



To find the square root of 55 using a calculator, use the square root key. You may need to press **SHIFT** or **2ndF** to access the square root function.

The key sequence on your calculator may be:

55 $\sqrt{}$ 7.416198487 or 55 $\sqrt{x}$

55 **SHIFT** x^2 7.416198487

Some square roots are whole numbers or have a limited number of decimal digits. Some are repeating decimals. Others continue without repeating a pattern of digits. Read problems carefully to see whether you should round to a particular decimal digit.

GED SKILL FOCUS

A. Write the square roots. Do not use a calculator.

1. $\sqrt{16}$

4. $\sqrt{9}$

7. $\sqrt{25}$

2. $\sqrt{0}$

5. $\sqrt{49}$

8. $\sqrt{1}$

3. $\sqrt{100}$

6. $\sqrt{121}$

9. $\sqrt{144}$

B. Find the length of the side of each square.

10. $x = ?$

$A = 36$
sq cm

12. $x = ?$

$A = 16$
sq yd

14. $x = ?$

$A = 81$
sq m

11. $x = ?$

$A = 100$
sq ft

13. $x = ?$

$A = 49$
sq in

15. $x = ?$

$A = 64$
sq cm



C. Use a calculator to find the square roots. Round your answers to the nearest hundredth.

16. $\sqrt{28}$

19. $\sqrt{6}$

22. $\sqrt{130}$

17. $\sqrt{95}$

20. $\sqrt{324}$

23. $\sqrt{169}$

18. $\sqrt{32}$

21. $\sqrt{44}$

24. $\sqrt{228}$

D. Choose the best answer to each question.

25. The square root of 22 is between which of the following pairs of numbers?

- (1) 2 and 3
- (2) 3 and 4
- (3) 4 and 5
- (4) 5 and 6
- (5) 21 and 22

26. The area of a square platform is about 72 square feet. The length in feet of each side is between which two measurements?

- (1) 4 and 5
- (2) 5 and 6
- (3) 6 and 7
- (4) 7 and 8
- (5) 8 and 9

Answers start on page 423.

GED STRATEGY Solving Word Problems

Working Backwards

Each multiple-choice question on the GED Mathematics Test has five answer options. You must choose the best answer for each question.

For most questions, it is faster to solve the problem directly. Read the problem carefully, decide what the question asks, choose the operations to use, and solve. Always make sure your answer makes sense. Then, look at the five options to see whether your answer is among them.

For some algebra problems, however, working backwards from the answer choices may save time. Most algebra problems ask you to solve for a particular variable. Ordinarily, you would write an equation and solve it. However, it may be faster to try each answer choice in the given situation to see which one is true.

Example 1 The sum of three consecutive numbers is 30. What are the numbers?

- (1) 6, 7, and 8
- (2) 8, 9, and 10
- (3) 9, 10, and 11
- (4) 11, 12, and 13
- (5) 14, 15, and 16



Use your knowledge of averages to solve problems asking for consecutive numbers. If the sum of 3 numbers is 30, the average is 10. Look for a choice with a middle value of 10.

It is not necessary to write an equation to solve this problem. You know the numbers add up to 30, so simply add the numbers for each option. You can quickly eliminate options (4) and (5) since $10 + 10 + 10 = 30$, and all the numbers in these options are greater than 10. Clearly, options (4) and (5) total more than 30. Quickly add the numbers for the first three options.

Option (1): $6 + 7 + 8 = 21$

Option (2): $8 + 9 + 10 = 27$

Option (3): $9 + 10 + 11 = 30$

Option (3) 9, 10, and 11 is the correct answer.

Example 2 A test has two parts. Each part is worth 50 points. When Jan took the test, she earned 10 points more on the first part than on the second part. Her total score was 86. What did she score on each part of the test?

- (1) 46 and 50
- (2) 38 and 48
- (3) 36 and 46
- (4) 44 and 42
- (5) 32 and 54

You can narrow your choice to options (2) and (3) since these are the only answer choices with numbers 10 points apart. **Option (2) 38 and 48** is the only pair of numbers that is ten points apart and totals 86 points.

GED PRACTICE

Directions: Choose the one best answer to each question.

1. The sum of three consecutive numbers is 45.
What are the three numbers?
 - (1) 10, 11, and 12
 - (2) 12, 13, and 14
 - (3) 13, 14, and 15
 - (4) 14, 15, and 16
 - (5) 15, 16, and 17
2. Jess and David took an 800-mile driving trip.
Jess drove 200 miles more than David did on the trip. How many miles did David drive?
 - (1) 200
 - (2) 250
 - (3) 300
 - (4) 400
 - (5) 500
3. The sum of two consecutive numbers is 95.
What are the two numbers?
 - (1) 40 and 41
 - (2) 42 and 43
 - (3) 47 and 48
 - (4) 52 and 53
 - (5) 57 and 58
4. Four consecutive numbers total 38. What are the four numbers?
 - (1) 7, 8, 9, and 10
 - (2) 8, 9, 10, and 11
 - (3) 9, 10, 11, and 12
 - (4) 10, 11, 12, and 13
 - (5) 11, 12, 13, and 14
5. Bill works two jobs. Last week, he worked 30 hours in all. If he worked two hours more at one job than he worked at the other, how many hours did he work at each job?
 - (1) 9 and 11
 - (2) 13 and 15
 - (3) 14 and 16
 - (4) 19 and 21
 - (5) 24 and 26
6. Marta scored a total of 93 points on her English test. She scored 5 points lower on the writing part of the test than on the reading part. What were her scores on each part of the test?
 - (1) 43 and 48
 - (2) 44 and 49
 - (3) 45 and 50
 - (4) 47 and 52
 - (5) 54 and 59
7. Evelyn drove a total of 334 miles on Monday and Tuesday. She drove 50 miles farther on Tuesday than she did on Monday. How many miles did she drive each day?
 - (1) 92 and 142
 - (2) 125 and 175
 - (3) 142 and 192
 - (4) 234 and 284
 - (5) 284 and 334

Answers start on page 423.

Applying Patterns and Functions



To identify a mathematical pattern, find how one term becomes the one following it. That is, what function is applied to the first term to obtain the next? Then test your function on the rest of the pattern.

A mathematical **pattern** is an arrangement of numbers or terms formed by following a particular rule. If you know the rule, you can find other terms in the pattern.

Example 1 Find the eighth term in the sequence: 1, 7, 13, 19, 25, ...

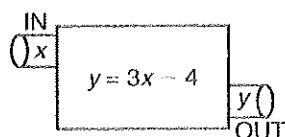
Step 1 Identify the rule used to make the pattern. Study the sequence. Each number in the sequence is six more than the preceding number. The rule is "add 6."

Step 2 Apply the rule to continue the pattern. The number 25 is the 5th term in the pattern. You need to find the 8th term.

1st	2nd	3rd	4th	5th	6th	7th	8th
1	7	13	19	25	31	37	43
\		/ \	/ \	/ \	/ \	/ \	/
+6		+6	+6	+6	+6	+6	+6

The correct answer is **43**.

An algebraic rule is sometimes called a **function**. You can think of a function as a machine that performs certain operations. For each number that enters the machine (x), there will be only one number that comes out (y). The function shown here multiplies a number by 3 and then subtracts 4. We can write the function as an equation: $y = 3x - 4$.



Example 2 For the function, $y = 3x - 4$, what numbers are needed to complete the table below?

x	-3	-2	-1	0	1	2
y	-13	-10	-7		-1	

- (1) -6 and 2
- (2) -5 and 2
- (3) -5 and 3
- (4) -4 and 2
- (5) -4 and 4

Use substitution to find the value of y . Replace x with 0 and 2. Solve for y .

$y = 3x - 4$	$y = 3x - 4$
$y = 3(0) - 4$	$y = 3(2) - 4$
$y = 0 - 4$	$y = 6 - 4$
$y = -4$	$y = 2$

The missing numbers are **-4** and **2**. Check your work by testing the pattern. Each value for y is 3 more than the number before it. Continue the pattern to make sure -4 and 2 are correct.

Directions: Choose the one best answer for each question.

1. Which of the following rules can be used to form the following sequence?

$-19, -15, -11, -7, -3, \dots$

- (1) Add -5 .
- (2) Add -4 .
- (3) Subtract 4.
- (4) Subtract 6.
- (5) Add 4.

2. What is the 5th term in the sequence below?

$64, -32, 16, -8, \dots$

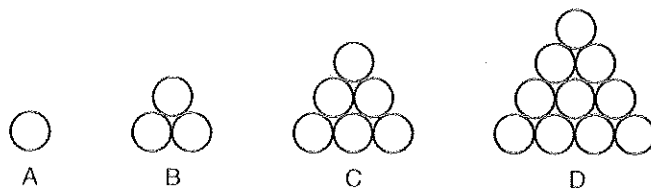
- (1) 8
- (2) 4
- (3) 2
- (4) -2
- (5) -4

3. The function $y = 10x - 5$ has been used to create the following table. Which numbers are missing from the table?

x	-2	0	2	4	6
y	-25	-5			55

- (1) 5 and 25
- (2) 10 and 30
- (3) 15 and 35
- (4) 20 and 40
- (5) 25 and 45

Question 4 refers to the following diagram.



4. If you were to continue the pattern above, how many circles would be in figure E?

- (1) 12
- (2) 15
- (3) 20
- (4) 21
- (5) Not enough information is given.

5. What is the 8th term in the sequence below?

$3, 6, 12, 24, 48, \dots$

- (1) 96
- (2) 144
- (3) 192
- (4) 288
- (5) 384

6. For the function $y = \frac{x}{4}$, which of the following values for x results in a fractional value of y (that is, y is not a whole number)?

- (1) 42
- (2) 32
- (3) 28
- (4) 12
- (5) 8

Answers start on page 423.

Multiplying Factors with Two Terms

You have already learned how to use the distributive property to multiply a single term, here 2, by a factor that has two terms, here $(x + 5)$: $2(x + 5) = 2x + 10$. Each term inside the parentheses is multiplied by the integer 2 outside the parentheses.

You can also use the distributive property to multiply two factors when each has two terms. Each term in the first factor is multiplied by each term in the second factor. To make sure you remember each step of the process, use the **FOIL method** shown in the example below.

Example 1 Multiply: $(x + 7)(x - 3)$.

Step 1 Multiply the terms. The letters in the word FOIL stand for First, Outer, Inner, and Last. If you multiply the terms in this order, you can be sure that you have multiplied every possible combination of terms. Remember that a term owns the operation sign that precedes it.

F	first	$(x + 7)(x - 3)$	$x(x) = x^2$
O	outer	$(x + 7)(x - 3)$	$x(-3) = -3x$
I	inner	$(x + 7)(x - 3)$	$7(x) = 7x$
L	last	$(x + 7)(x - 3)$	$7(-3) = -21$

Step 2 Find the sum of the products from each FOIL step. Simplify the expression.

$$x^2 + (-3x) + (7x) + (-21) = x^2 + 4x - 21$$

The product of $x + 7$ and $x + 3$ is $x^2 + 4x - 21$.

When using the FOIL method, your answer could have two, three, or four terms. In Example 2, the solution has only two terms.

Example 2 Multiply: $(x + 4)(x - 4)$.

Step 1 Use the FOIL method to multiply the terms.

F	$x(x) = x^2$
O	$x(-4) = -4x$
I	$4(x) = 4x$
L	$4(-4) = -16$

Step 2 Find the sum of the products.

$$x^2 + (-4x) + 4x + (-16) = x^2 - 16$$

Since the sum of $-4x$ and $4x$ is 0, the answer has only two terms. The product of $x + 4$ and $x - 4$ is $x^2 - 16$.



Remember, when simplifying an expression, you can only combine like terms.

GED SKILL FOCUS

A. Find the product of each pair of factors.

1. $(x + 1)(x + 4)$
2. $(x + 6)(x + 3)$
3. $(x - 5)(2x - 7)$
4. $(x + 2)(x - 2)$
5. $(x - 4)(y + 6)$
6. $(2x + 8)(3x + 9)$
7. $(x - 4)(x + 1)$
8. $(x - 5)(4x - 3)$
9. $(x - 1)(x + 5)$
10. $(2x - 10)(x - 6y)$
11. $(x - 8)(x - 5)$
12. $(x - 6)(x + 6)$
13. $(x + 2)(x + 3)$
14. $(3x + 8)(3x - 8)$
15. $(x - 6)(y + 9)$
16. $(4x - 1)(x - 5)$
17. $(x + 7)(x - 2)$
18. $(2x + 4)(3x + 10)$
19. $(x - 3)(x + 3)$
20. $(x + 10)(x - 12)$

B. Choose the best answer to each question.

21. Which of the following is equal to $x^2 - 14x + 48$? (*Hint: Work backwards. Multiply the factors of each answer choice until you find the solution.*)
 - (1) $(x + 12)(x - 4)$
 - (2) $(x - 12)(x - 4)$
 - (3) $(x + 6)(x - 8)$
 - (4) $(x - 6)(x - 8)$
 - (5) $(x + 6)(x + 8)$
22. If $3x - 1$ is one factor of $3x^2 + 8x - 3$, which of the following is the other factor?
 - (1) $x - 3$
 - (2) $x + 3$
 - (3) $3x - 3$
 - (4) $3x + 3$
 - (5) $x^2 + 3$
23. Which of the following is equal to $(x - 9)^2$? (*Hint: The entire expression $x - 9$ is multiplied by itself.*)
 - (1) $x^2 + 18x - 81$
 - (2) $x^2 - 18x + 81$
 - (3) $x^2 - 18x - 81$
 - (4) $x^2 + 18x + 81$
 - (5) $x^2 - 81$
24. If $2x + 1$ is one factor of $6x^2 - x - 2$, which of the following is the other factor?
 - (1) $x - 2$
 - (2) $3x + 2$
 - (3) $3x - 1$
 - (4) $3x - 2$
 - (5) $4x - 2$

Answers start on page 424.

Factoring



Make sure you divide both terms in the factor by 2.

$$\frac{6x + 10}{2} = \frac{6x}{2} + \frac{10}{2} = 3x + 5$$

Factors are numbers that are multiplied together. In the algebraic term $7x$, 7 and x are factors. An expression of more than one term can sometimes be **factored**. To factor an expression, look for a number and/or a variable that divides evenly into each term in the expression.

Example 1 Factor the expression $6x + 10$.

Step 1 Find a factor that divides evenly into both terms. Both $6x$ and 10 can be divided by 2 . One of the factors is the number 2 .

Step 2 Divide to find the other factor.
$$\frac{6x + 10}{2} = \frac{6x}{2} + \frac{10}{2} = (3x + 5)$$

Step 3 Check by multiplying the factors.
$$2(3x + 5) = 6x + 10$$

The factors of $6x + 10$ are 2 and $3x + 5$.

A **quadratic expression** is one that contains a variable raised to the second power, or "squared," as in $x^2 + 2x$. Both factors of quadratic expressions will always contain the variable.

Example 2 Factor $x^2 + 2x$.

Step 1 Both terms divide evenly by x . One factor is x .

Step 2 Divide by one factor (x) to find the other factor.
$$\frac{x^2 + 2x}{x} = \frac{x^2}{x} + \frac{2x}{x} = (x + 2)$$

Step 3 Check by multiplying the two factors.
$$x(x + 2) = x^2 + 2x$$

The factors are x and $x + 2$.

A quadratic expression in this form, $x^2 - 3x - 4$, results when you multiply two expressions, each with a variable and an integer. To factor quadratic expressions with three terms, work backwards.

Example 3 Factor $x^2 - 3x - 4$.

Step 1 Find all the possible factors for the third term.

The third term in this example is -4 .

The possible factors are: $(-4)(1)$, $(4)(-1)$, $(-2)(2)$, and $(2)(-2)$

Step 2 Find the two factors from Step 1 that when added give the integer part of the middle term, here, $-3x$.

The sum of only the factors -4 and 1 equals -3 . $-4 + 1 = -3$

None of the other possible factors equal -3 when added together: $4 + (-1) = 3$, $-2 + 2 = 0$, and $2 + -2 = 0$.

Step 3 Write the two factors using the variable as the first term in each factor and the integers from Step 2 as the second term. The factors are $(x - 4)$ and $(x + 1)$.

Step 4 Check. Multiply using the FOIL method.

$$(x - 4)(x + 1) = x^2 + 1x - 4x - 4 = x^2 - 3x - 4$$

The factors are $(x - 4)$ and $(x + 1)$.



Remember, each term "owns" the sign preceding it. The third term in the quadratic expression $x^2 - 3x - 4$ is -4 , not 4 .

GED SKILL FOCUS

A. Factor each expression.

1. $5x + 30$

11. $x^2 + 9x + 20$

21. $x^2 - 13x + 40$

2. $6y + 15$

12. $x^2 - 5x + 6$

22. $x^2 - x - 12$

3. $8x - 2$

13. $x^2 + 5x - 6$

23. $x^2 - 8x - 20$

4. $4z - 14$

14. $x^2 - 3x - 28$

24. $x^2 - 11x + 18$

5. $b^2 + 9b$

15. $x^2 + 8x + 12$

25. $x^2 - 6x - 55$

6. $y^2 + 3y$

16. $x^2 + 2x - 3$

26. $x^2 + 16x + 48$

7. $2x^2 + 4x$

17. $x^2 - 7x + 12$

27. $x^2 + 7x - 18$

8. $3x^2 + 9x$

18. $x^2 + 7x - 8$

28. $x^2 + 10x + 25$

9. $7y^2 - y$

19. $x^2 + 3x - 10$

29. $x^2 - 10x + 24$

10. $4x^2 + 2x$

20. $x^2 + 10x + 21$

30. $x^2 - 6x - 7$

B. Choose the best answer to each question.

31. Which of the following are the factors of $x^2 - 10x + 16$?

(1) $(x - 4)(x - 4)$

(2) $(x + 4)(x - 4)$

(3) $(x - 2)(x - 8)$

(4) $(x + 2)(x - 8)$

(5) $(x - 2)(x + 8)$

32. What are the factors of $x^2 - 5x - 24$?

(1) $x - 4$ and $x + 6$

(2) $x - 4$ and $x - 6$

(3) $x - 3$ and $x - 8$

(4) $x + 3$ and $x - 8$

(5) $x - 3$ and $x + 8$

Answers start on page 424.

Solving Quadratic Equations

As you have learned, a quadratic expression contains a variable that is raised to the second power, or squared. When an equation contains a squared variable, it is called a **quadratic equation**. Quadratic equations usually have two different solutions. In other words, there are two values for the variable that will make the equation true. Follow these steps to solve a quadratic equation.

Example 1 If $x^2 + 3x = 10$, then what values of x make the equation true?

Step 1 Rewrite the equation to set the quadratic expression equal to 0. $x^2 + 3x = 10$
 $x^2 + 3x - 10 = 10 - 10$
 $x^2 + 3x - 10 = 0$
 In this case, subtract 10 from both sides of the equation.

Step 2 Factor the quadratic expression. $x^2 + 3x - 10 = 0$
 $(x + 5)(x - 2) = 0$

Step 3 For each factor, determine the value of x that will make that factor equal to 0. Since any number multiplied by 0 equals 0, if either factor equals 0, the entire expression will equal 0.
 If $x + 5 = 0$
 and $x - 2 = 0$
 then, $x = -5$ and $x = 2$

Step 4 Check both values by substituting them into the original equation.

$x^2 + 3x = 10$	$x^2 + 3x = 10$
$(-5)^2 + 3(-5) = 10$	$(2)^2 + 3(2) = 10$
$25 + (-15) = 10$	$4 + 6 = 10$
$10 = 10$	$10 = 10$

The two solutions for the equation $x^2 + 3x = 10$ are **-5** and **2**.

When a quadratic equation is presented in a multiple-choice question, you may be able to solve the problem more quickly by working backwards from the answer choices.

Example 2 What are the possible values for x if $x^2 - 7x = 60$?

- (1) -20 and 3
- (2) -12 and 5
- (3) -10 and 6
- (4) -6 and 10
- (5) -5 and 12

Substitute one of the numbers from each option into the equation. You may find it easier to work with the positive number from each option.



Often working backwards is a good test-taking strategy for any multiple-choice problem that involves lengthy computations.

Option 1	Option 2	Option 3	Option 4	Option 5
$x^2 - 7x = 60$	$x^2 - 7x = 60$	$x^2 - 7x = 60$	$x^2 - 7x = 60$	$x^2 - 7x = 60$
$3^2 - 7(3) = 60$	$5^2 - 7(5) = 60$	$6^2 - 7(6) = 60$	$10^2 - 7(10) = 60$	$12^2 - 7(12) = 60$
$9 - 21 = 60$	$25 - 35 = 60$	$36 - 42 = 60$	$100 - 70 = 60$	$144 - 84 = 60$
$-12 \neq 60$	$-10 \neq 60$	$-6 \neq 60$	$30 \neq 60$	$60 = 60$
false	false	false	false	true

Note: The symbol $\neq$ means "is not equal to."

Option (5) is the correct answer. If you have time, you could substitute -5 , the other value from option 5, to check your work.

$$(-5)^2 - 7(-5) = 60 \quad 25 + 35 = 60 \quad 60 = 60 \quad \text{true}$$

GED PRACTICE

Directions: Choose the one best answer for each question.

- In the equation $x^2 + 72 = 18x$, what are the possible values for x ?
 - -9 and -8
 - -9 and 8
 - -6 and 12
 - 8 and 9
 - 12 and 6
- If $2x^2 - 10x + 12 = 0$, what is one possible value for x ?
 - -4
 - -3
 - 3
 - 6
 - 12
- In the equation $x^2 - x = 12$, what are the possible values for x ?
 - 6 and -2
 - 4 and -3
 - 3 and -4
 - 2 and -6
 - -3 and -4
- If $x^2 + 13x = -40$, what are the possible values for x ?
 - 10 and 4
 - 8 and 5
 - -4 and -10
 - -5 and -8
 - -6 and -7
- In the quadratic equation $9x^2 - 36 = 0$, which pair of solutions makes the equation true?
 - 9 and -4
 - 6 and -6
 - 4 and -9
 - 3 and -12
 - 2 and -2
- In the equation $2x^2 - x = 45$, what is one possible value of x ?
 - 9
 - 5
 - 3
 - -5
 - -9

Answers start on page 425.

Solving and Graphing Inequalities



To remember the meanings of the symbols $>$ and $<$, just remember that the symbol points to the lesser amount.

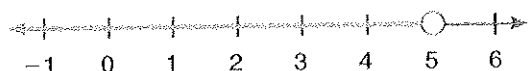
An **inequality** means two algebraic expressions are not equal. Other inequality symbols in addition to greater than and less than symbols are:

$\geq$ means "is greater than or equal to" $4 \geq 2$
 $\leq$ means "is less than or equal to" $7 \leq 9$

In an inequality, a variable may have many values that make the statement true. Consider $x < 5$. The numbers 4, 3, 2, 1, and so on are all possible values for x . We can graph the possible solutions to an inequality.

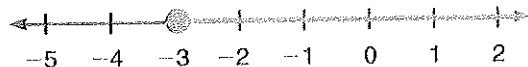
Example 1 Graph the solution set of the inequality $x < 5$.

On a number line, every number to the left of 5 is a solution. Graph the solution by drawing a solid line on the number line. An empty circle at the number 5 shows that 5 itself is not included as a solution. Five is not "less than" 5.

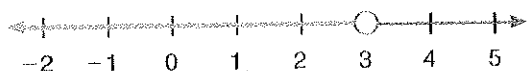


Example 2 Graph the solution set of the inequality $x \geq -3$.

The solution set of the inequality $x \geq -3$ includes the number -3 and all numbers to the right of -3 . The circle at -3 is filled in to show that -3 is included as a solution.



An inequality can be solved much like an equation. The same number can be added to or subtracted from both sides of an inequality.



Example 3 Solve $2x + 7 < x + 10$.

Step 1 Subtract x from both sides.

$$x + 7 < 10$$

Step 2 Subtract 7 from both sides.

$$x < 3$$

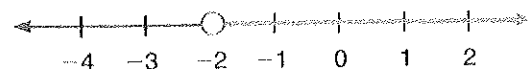
Step 3 Check using a number less than 3 (such as 2).

$$2(2) + 7 < 2 + 10$$

$$11 < 12 \text{ is true}$$

The solution to the inequality is $x < 3$.

Both sides of an inequality can also be multiplied or divided by the same number to simplify the inequality. But there is an important rule to remember: If you multiply or divide an inequality by a negative number, the inequality sign must be reversed.



Example 4 Solve: $3x - 4 < 5x$.

$$3x - 5x - 4 < 5x - 5x$$

Step 1 Subtract $5x$ from both sides.

$$-2x - 4 < 0$$

Step 2 Add 4 to both sides.

$$-2x - 4 + 4 < 0 + 4$$

Step 3 Divide by -2 , and reverse the inequality sign.

$$\frac{-2x}{-2} < \frac{4}{-2}$$

$$x > -2$$

Step 4 Check using a number greater than -2 .

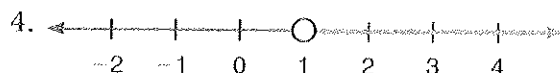
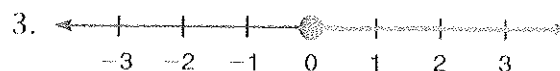
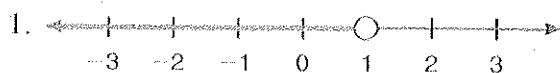
$$3(2) - 4 < 5(2)$$

The solution to the inequality is $x > -2$.

$$2 < 10 \text{ true}$$

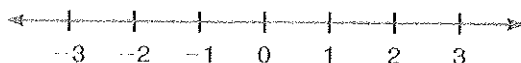
GED SKILL FOCUS

A. Write the inequality for each number line.

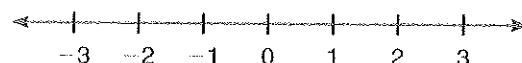


B. Solve and graph the solution set for each inequality.

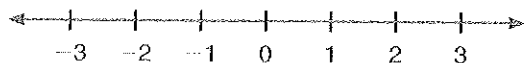
5. $2x < 6$



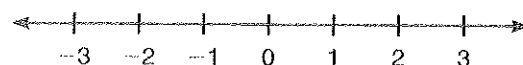
8. $8x < 7x$



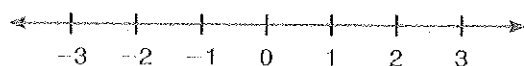
6. $x + 1 > 0$



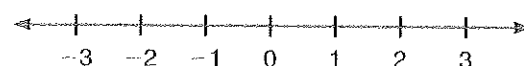
9. $4x - 2 < 3x$



7. $5x \leq 3x - 4$



10. $3x - 1 \geq 2$



C. Solve the following inequalities.

11. $3x - 7 < 2x + 1$

15. $5 + 8(x - 2) < x + 3$

12. $5x + 2 > 4x + 1$

16. $x + 12 < 5(x + 8)$

13. $6x - 4 \leq 3x + 2$

17. $2x + (4 - 3x) \leq 21$

14. $3(x + 1) \geq x + 4x - 5$

18. $7x - 3x - x < 3x + 2x + 10$

D. Solve.

19. When five times a number is added to 6, the result is less than 4 times that same number added to 10. What is the solution to the inequality?

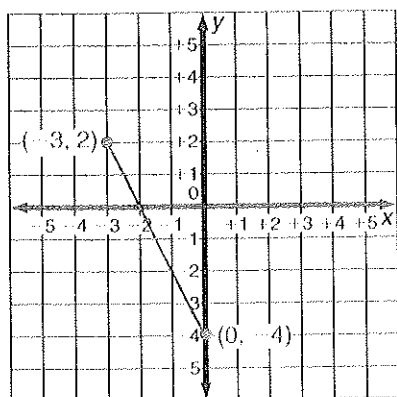
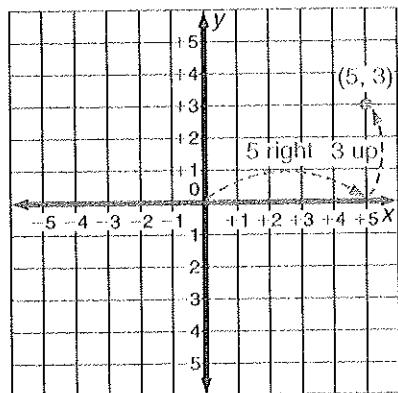
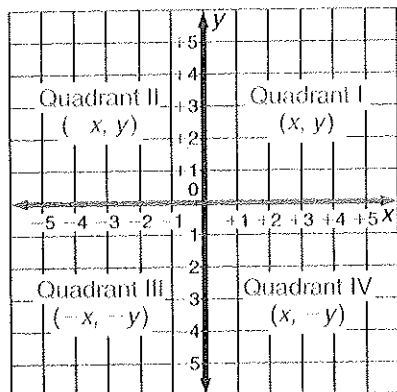
20. The three sides of a triangle must add up to a number less than or equal to 65 inches. One side is 21 inches. Another side is 18 inches. What is the longest the third side can be (in inches)?

Answers start on page 425.

Lesson 22

GED SKILL The Coordinate Plane

Coordinate Graphs



Imagine a blank sheet of paper with one dot on it. How could you describe the exact location of the dot? You might use the edges of the paper to give directions. For example, you could say that the dot was four inches from the top edge and three inches from the left edge. A coordinate graph works the same way.

A **coordinate graph** is a system for finding the location of a point on a flat surface called a **plane**. A coordinate graph is formed from two axis lines that cross at a point called the **origin**. The horizontal line is the **x-axis** and the vertical line is the **y-axis**. Both lines are marked as number lines with the origin at zero. The axes divide the graph into four **quadrants**.

Each point on the grid is named by two numbers, an **x-coordinate** and a **y-coordinate**. The x-coordinate is always written first; the y-coordinate is always written second. Together, the coordinates are called an **ordered pair** and are enclosed in parentheses, separated by a comma.

Example 1 Plot the point (5,3) on a coordinate grid.

- Step 1** Start at the origin—coordinates (0,0). Move the number of units of the x-coordinate in the appropriate direction, here 5 units to the right, the positive x direction.
- Step 2** From that point, move the number of units of the y-coordinate in the appropriate direction, here 3 units upwards, the positive y direction.

The location of point (5,3) is shown by the dot on the grid.

You may be asked to use coordinates to draw a line segment or a figure on a coordinate system.

Example 2 Draw a line segment on the coordinate grid connecting points (0, -4) and (-3, 2).

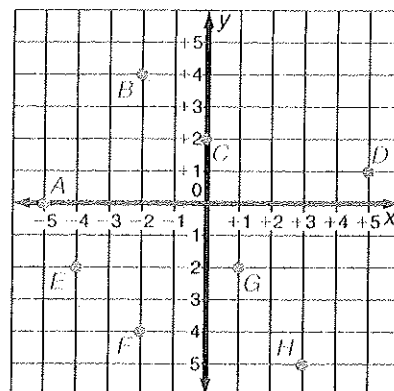
- Step 1** Plot point (0, -4). Start at the origin. The 0 indicates that no move along the x-axis is required. Move -4 on the y-axis (down from the origin), and plot the point.
- Step 2** Plot point (-3, 2). Start at the origin; move 3 units to the left on the x-axis, then 2 units up; plot the point.
- Step 3** Connect the points by drawing a line segment.

The location of the points and segment are shown on the grid.

GED SKILL FOCUS

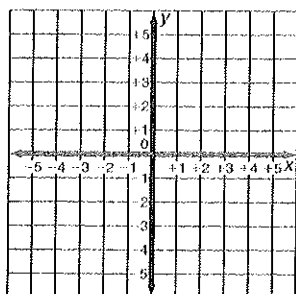
A. Use the coordinate grid to answer the following questions.

1. What are the coordinates of Point A?
2. Which point is found at $(-4, -2)$?
3. Which point is on the y -axis?
4. What are the coordinates of Point D?
5. Which point has a negative x -value and a positive y -value?
6. For which points are the x -values greater than the y -values?
7. Which points are found in Quadrant IV?

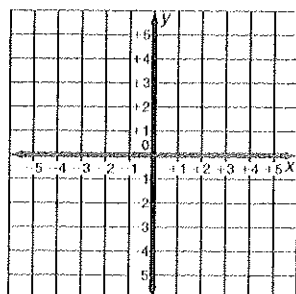


B. Graph as directed.

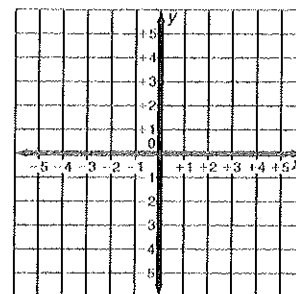
8. Plot the ordered pairs $(1, -4)$, $(0, 5)$, and $(-2, -3)$ on the coordinate graph below.



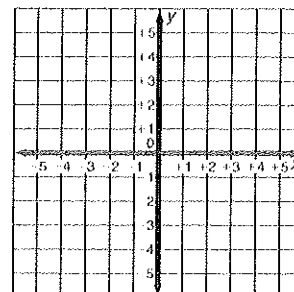
9. Draw a line segment connecting Point A at $(4, 3)$ and Point B at $(2, -5)$.



10. Graph the following points and connect them to form a square: Point D at $(-3, 3)$, Point E at $(1, 3)$, Point F at $(1, -1)$, and Point G at $(-3, -1)$.



11. Connect each pair of points to form two intersecting line segments. Point J $(-5, -4)$ and Point K $(5, 2)$
Point P $(-3, 4)$ and Point Q $(0, -3)$



The ordered pairs $(5, 3)$ and $(3, 5)$ have different locations. Remember, the location on the x -axis (horizontal axis) is always named first. (x, y)

Answers start on page 426.

GED STRATEGY Working with Special Formats

Polynomial Ordered Pairs

A 10x10 grid of circles. The first row contains the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. The first column contains the numbers -1, -2, -3, -4, -5, -6, -7, -8, -9, -10. All other circles are empty.

Some questions on the GED Mathematics Test ask you to show the location of a point on a coordinate grid. A special coordinate grid will be provided on the answer sheet to record your answers. This grid uses bubbles to represent each ordered pair on the coordinate plane.

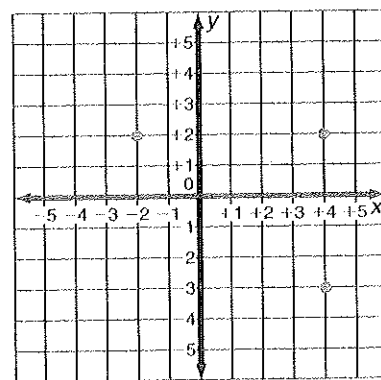
The answer grid shown to the left is a sample of this GED answer format. Since positive and negative numbers are shown on the axis lines, there are no bubbles for points that lie directly on either the x - or y -axis. The origin $(0,0)$ is not labeled, but you know that it lies at the intersection of the x - and y -axes.

To use the grid to record an answer, carefully bubble in the circle at the correct location. Be careful not to make stray marks on the grid.

Most questions that test your understanding of the coordinate grid will refer to a diagram or graph.

Example

Jesse has graphed three points on the coordinate grid at right. The points will become three corners of a rectangle. Where must he place the fourth point to complete the rectangle? Graph your answer on the coordinate grid.



The x- and y-axes on a graph may not be labeled with numbers. Remember that the origin on either scale (the point where the axes cross) is always 0.

A 10x10 dot grid. The bottom row contains numbers 1 through 6 in circles, repeated twice. The 7th column from the left has a shaded dot in the 7th row from the bottom.

Step 1 Complete the rectangle to find the location of the fourth point. You know that a rectangle has four sides. The opposite sides must be the same length. From the three points already shown on the graph, you know the length and the width of the rectangle. The remaining point must be located at point $(-2, -3)$.

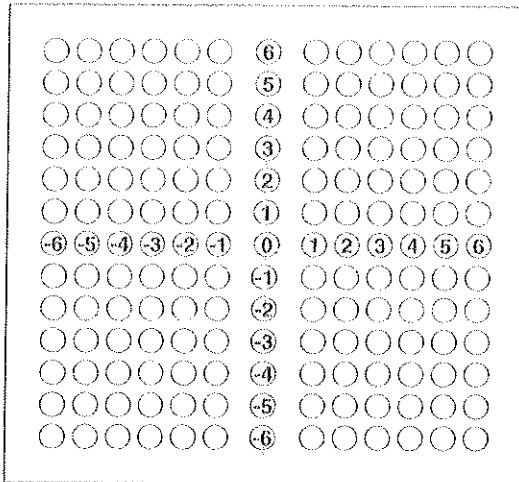
Step 2 Bubble in your answer on the coordinate grid. Starting at the origin, count two units left and three down. Fill in the circle neatly and completely.

The grid to the left shows the correct location of the fourth point.

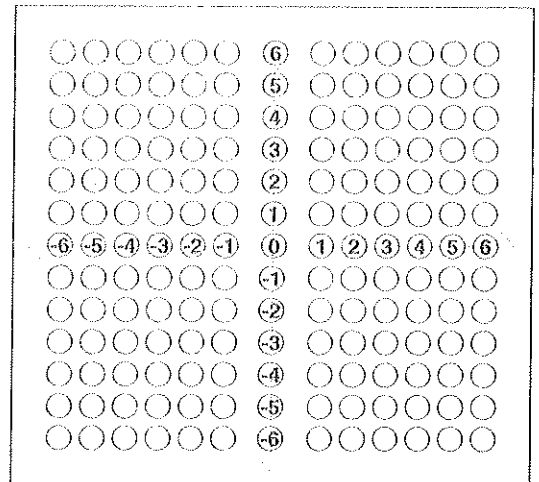
GED PRACTICE

Directions: Grid in the answer to each question on the answer grid provided.

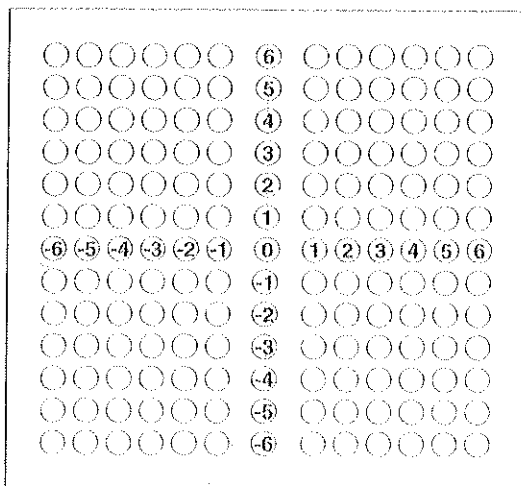
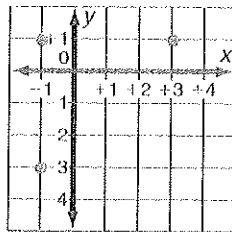
1. A point has an x-coordinate of 4 and a y-coordinate of -1 . Show the location of the point on the coordinate grid.



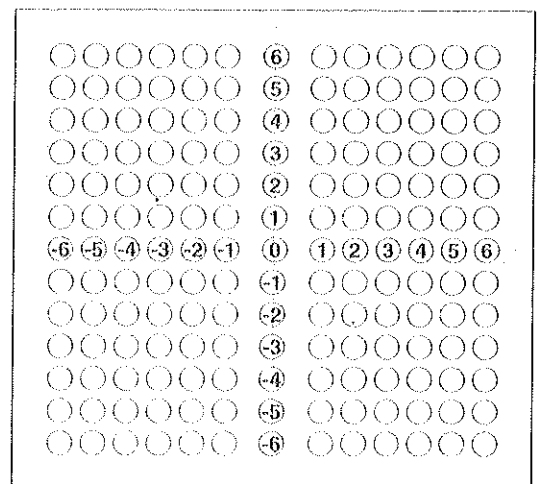
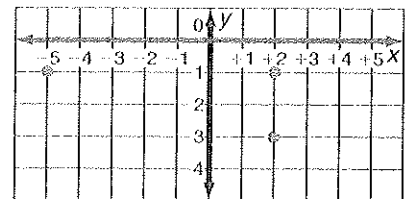
3. A point has an x-coordinate of -5 and a y-coordinate of 3. Show the location of the point on the coordinate grid.



2. On the coordinate plane below, three points are drawn to mark the corners of a square. Graph the location of the fourth corner needed to complete the square.



4. On the coordinate plane below, three points are drawn to mark the corners of a rectangle. Graph the location of the fourth corner needed to complete the figure.



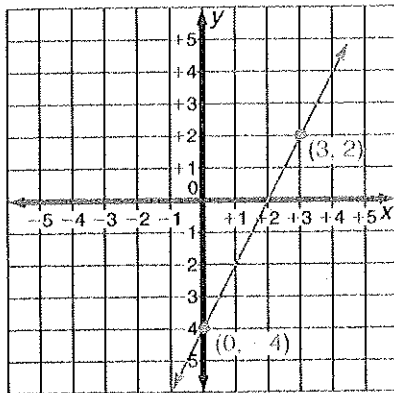
Answers start on page 427.

Graphing Equations

You know that some equations have two different variables. For example, the equation $y = 2x - 4$ has two variables, x and y . For each specific value substituted for x , there is a unique value of y . One way to show the possible solutions for such an equation is to draw the graph of the equation on a coordinate grid.

The equation $y = 2x - 4$ is called a **linear equation** because its graph forms a straight line. To draw the line, you need to know at least two points on the line.

Example 1 Graph the equation $y = 2x - 4$.



Step 1 Identify a point on the line.

Choose any value for x ; 0 is usually ideal. Substitute x into the equation. Solve for y . This ordered pair makes the equation true.

$$\begin{aligned}\text{Let } x &= 0 \\ y &= 2(0) - 4 \\ y &= 0 - 4 = -4 \\ &(0, -4)\end{aligned}$$

Step 2 Find another point on the line.

Choose another value for x and solve for the new y . Write the coordinates.

$$\begin{aligned}\text{Let } x &= 3 \\ y &= 2(3) - 4 \\ y &= 6 - 4 = 2 \\ &(3, 2)\end{aligned}$$

Step 3 Locate both ordered pairs on a grid and draw a line through them.

The graph of the equation is shown to the left. Every point on the line satisfies, or solves, the equation.



Although you only need two points to draw the graph of a line, it is always a good idea to find a third point to check your work.

Some questions refer to the graph of an equation, but they can be solved without drawing the graph.

Example 2 Which of the following points lies on a graph of the equation $x = 3 + y$?

- (1) $(4, -1)$
- (2) $(3, 1)$
- (3) $(2, -1)$
- (4) $(1, 2)$
- (5) $(0, -4)$

Instead of drawing the graph, substitute the coordinates from each answer choice for x and y in the equation. The correct option is the ordered pair that makes the equation true.

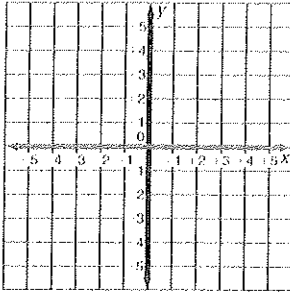
Only **option (3) $(2, -1)$** makes the equation true.

$$\begin{aligned}2 &= 3 + (-1) \\ 2 &= 2\end{aligned}$$

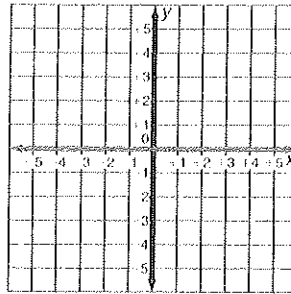
GED SKILL FOCUS

A. Graph each equation on a coordinate grid.

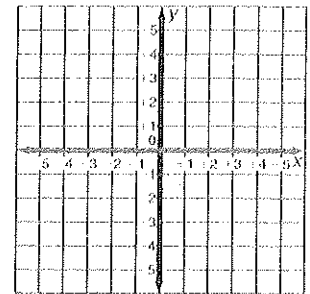
1. $y = 3x - 4$



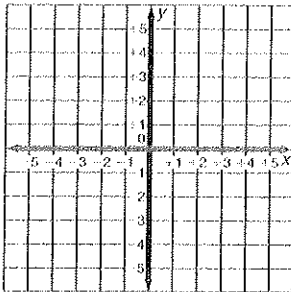
3. $x - 2y = 1$



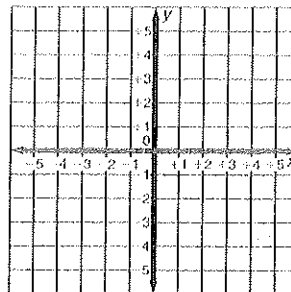
5. $-x = y + 2$



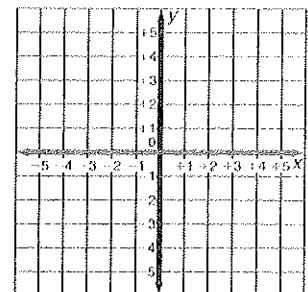
2. $2x + y = 5$



4. $-2y = 4x$

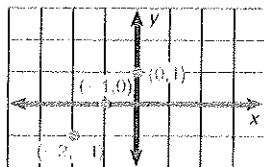


6. $y = 6 - 3x$



B. Choose the best answer to each question.

7. The points graphed on the grid below satisfy which of the following equations?



- (1) $x - y = 1$
- (2) $x - y = -1$
- (3) $2y - x = 0$
- (4) $x = 0$
- (5) $y = 0$

9. Which equation of a line is shown on the graph?



- (1) $x + y = -4$
- (2) $x + y = -2$
- (3) $x + y = 0$
- (4) $x + y = 2$
- (5) $x + y = 4$

8. Which ordered pair is a solution of $x - y = 1$?

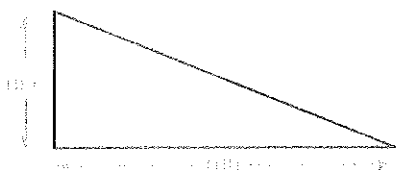
- (1) $(-3, -4)$
- (2) $(-3, -2)$
- (3) $(-1, 0)$
- (4) $(0, 1)$
- (5) $(1, -2)$

10. What is the missing x-value if $(?, 1)$ is a solution of $-4x + 7y = 15$?

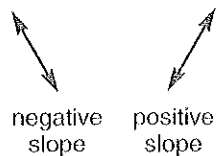
- (1) $-\frac{11}{2}$
- (2) -2
- (3) 2
- (4) $\frac{19}{7}$
- (5) $\frac{11}{2}$

Answers start on page 427.

Finding the Slope of a Line

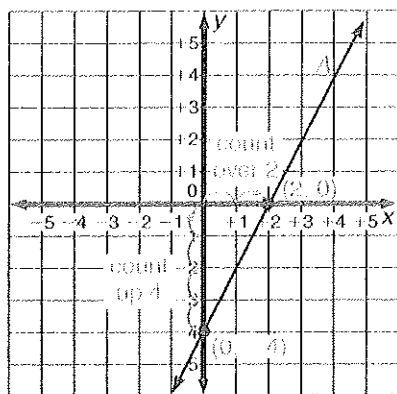


Slope is a number that measures the steepness of a line. In everyday life, we use slope to calculate the steepness of a ramp or flight of stairs. We may determine the slope of a roof or a roadway. Slope is the ratio of *rise to run*, where rise is a measurement of vertical distance and run is a measurement of horizontal distance.



Slope can be positive or negative. All lines that rise as they move from left to right have a positive slope. All lines that fall as they move from left to right have a negative slope. If you have a graph of a line, you can find its slope by examining the line and counting grid units to find the rise and run.

Example 1 Find the slope of Line A.



- Step 1** Select two points on the line. Starting at either point, count the number of units up or down to reach the level of the second point. This is the rise of the line. Here, start at $(0, -4)$ and count up 4.
- Step 2** From this intermediate point, count the units left or right to reach the second point. This is the run of the line. Here, count 2 to the right.
- Step 3** Write the slope as the fraction $\frac{\text{rise}}{\text{run}}$. $\frac{4}{2} = 2$
- Step 4** Decide whether the slope is positive or negative. Here, the slope is positive since the line rises as it moves from left to right.

The slope of Line A is $+2$.

You can also find the slope of a line by using an algebraic formula. It will be listed on the page of formulas you will be given when you take the GED Mathematics Test.

slope (m) of a line = $\frac{\text{rise}}{\text{run}} = m = \frac{y_2 - y_1}{x_2 - x_1}$, where (x_1, y_1) and (x_2, y_2) are two points on the line

Example 2 Find the slope of Line B with points $(-1, 2)$ and $(1, -4)$.

- Step 1** Let one point be (x_1, y_1) and the other be (x_2, y_2) . In this case, let $(-1, 2) = (x_1, y_1)$ and $(1, -4) = (x_2, y_2)$.
- Step 2** Substitute into the formula and solve.

$$m = \frac{-4 - 2}{1 - (-1)} = \frac{-6}{2} = -3$$

The slope of the line is -3 .

Some unique features of slope to remember:

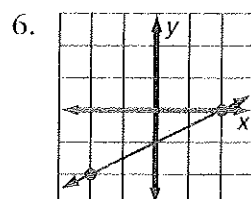
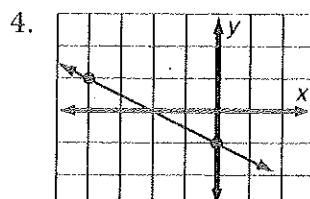
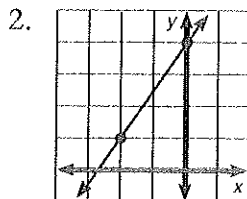
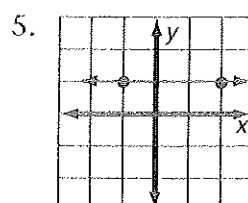
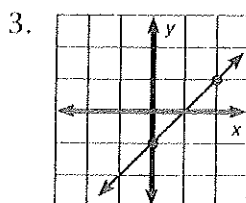
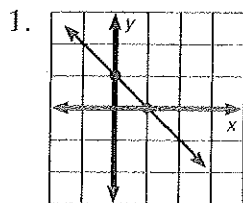
- The slope of any horizontal line, including the x -axis, is 0.
- A vertical line, including the y -axis, has no slope.
- All lines with the same slope are parallel.



Use the grid-unit counting method whenever you are given a graph of the line. Use the formula method when it is not practical to draw a graph of the line.

GED SKILL FOCUS

A. Find the slope of each line.



B. Find the slope of the line that passes through each pair of points.

7. $(1, -3)$ and $(0, 1)$

9. $(4, 5)$ and $(3, -4)$

11. $(-3, -3)$ and $(-2, 0)$

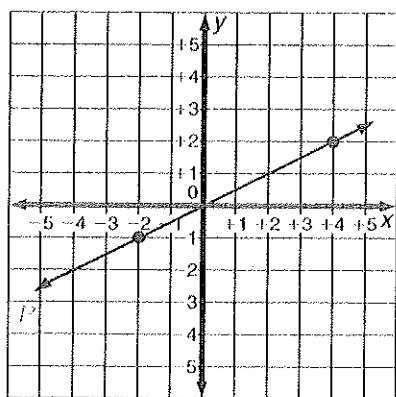
8. $(2, 1)$ and $(4, 2)$

10. $(-4, 2)$ and $(5, 3)$

12. $(-6, -2)$ and $(3, 4)$

C. Solve.

Use the following graph to answer question 13.



13. What is the slope of Line P?

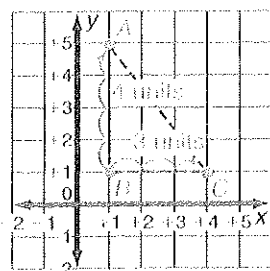
14. The following points lie on Line R: $(-4, 3)$, $(1, 3)$, and $(5, 3)$. What is the slope of Line R?

15. Line X has a slope of 3. The line passes through Point Y at $(-2, -1)$ and also passes through Point Z, which has an x -coordinate of 0. What are the coordinates of Point Z? (Hint: Substitute the given values in the slope formula.)

16. The following points lie on Line K: $(-3, -3)$ and $(5, 2)$. What is the slope of Line K?

Answers start on page 428.

Finding the Distance Between Points



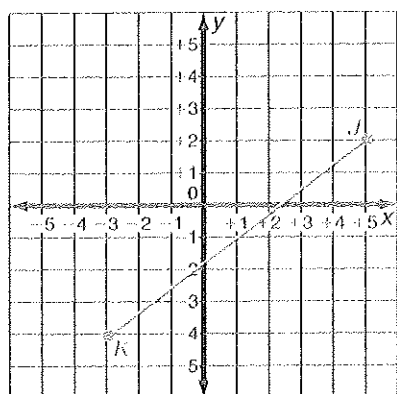
It is sometimes necessary to find the distance between two points on a coordinate grid. You can easily find the distance between points on a vertical or a horizontal line by counting. For example, on the grid at left, point A is 4 units from point B, and point B is 3 units from point C. Note that points ABC form a right triangle.

To find the distance between two points that are not on the same grid line such as points A and C, you can use a formula. This formula is on the GED formulas page that you will be given when you take the GED Mathematics Test.

$$\text{distance between points} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

To use the formula, you need to know the coordinates for the two points. Assign one point to be (x_1, y_1) and the other point to be (x_2, y_2) . Then substitute the values into the formula and solve. It does not matter which point you choose to be (x_1, y_1) .

Example 1 In the coordinate grid at left, what is the distance between points J and K?



Step 1 Find the coordinates of the points.

Point J = $(5, 2)$; K = $(-3, -4)$

Step 2 Assign the variables.

Let J $(5, 2) = (x_1, y_1)$

Let K $(-3, -4) = (x_2, y_2)$

Step 3 Substitute the coordinates into the formula and solve.

$$\begin{aligned} d &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(-3 - 5)^2 + (-4 - 2)^2} \\ &= \sqrt{(-8)^2 + (-6)^2} \\ &= \sqrt{64 + 36} \\ &= \sqrt{100} \\ &= 10 \end{aligned}$$

The distance between points J and K is **10 units**.

The distance between points will rarely be a whole number. If you need to find the answer to a certain decimal place, use your calculator.

Example 2 Find the distance to the nearest tenth between point A at $(0, -2)$ and point B at $(1, 4)$.

Step 1 Decide which point will be (x_1, y_1) .

Let $(0, -2) = (x_1, y_1)$

Let $(1, 4) = (x_2, y_2)$

Step 2 Use the formula for distance between points.

$$\begin{aligned} d &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(1 - 0)^2 + (4 - (-2))^2} \\ &= \sqrt{(1)^2 + (6)^2} \\ &= \sqrt{1 + 36} \end{aligned}$$

Step 3 Estimate the square root.

Think: $6^2 = 36$ and $7^2 = 49$.

Since 37 is between 36 and 49,

$$= \sqrt{37}$$

d is between 6 and 7.



Most calculators require you to enter the number first, then press the square root key.

37 SHIFT $\sqrt{}$ 6.08276253

Round to the nearest tenth. 6.08 rounds to 6.1.

The distance between the points is about **6.1 units**.

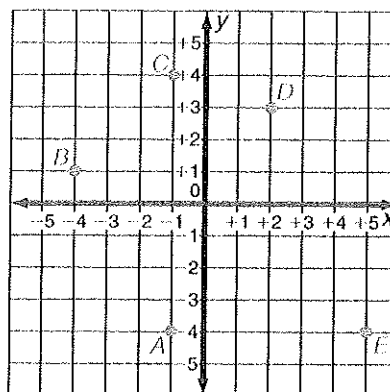
GED SKILL FOCUS



- A. Find the distance between the following points. Round to the nearest tenth, if necessary. You may use a calculator.**

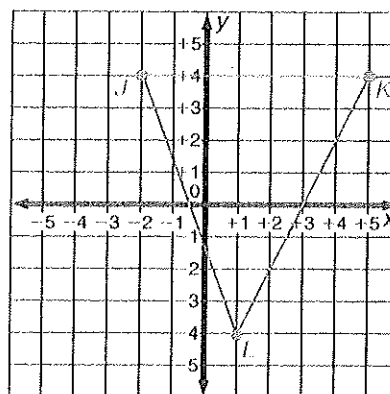
Use the coordinate grid on the right to answer questions 1 through 5.

1. Points *A* and *C*
2. Points *B* and *D*
3. Points *A* and *E*
4. Points *A* and *D*
5. Points *C* and *E*



Use the coordinate grid on the right to answer questions 6 through 8.

6. A triangle is drawn by connecting points *J*, *K*, and *L*. What is the length of side *JL*?
7. What is the length of side *KL*?
8. What is the length of side *JK*?



B. Solve as directed.

9. Point *X* is located at (9,3) on a coordinate grid. If a line were drawn directly to the origin, what would be the length of the line to the nearest tenth unit?
10. Two points are located at (2,5) and (-4,5). What is the distance between the points?
11. A line is drawn from point *B* at (0,6) to point *C* at (8,0). What is the length of the line to the nearest tenth unit?
12. Two points are located at (2,-1) and (2,4). What is the distance between the points?

Answers start on page 428.

GED STRATEGY Solving Word Problems

Finding the Equation of a Line

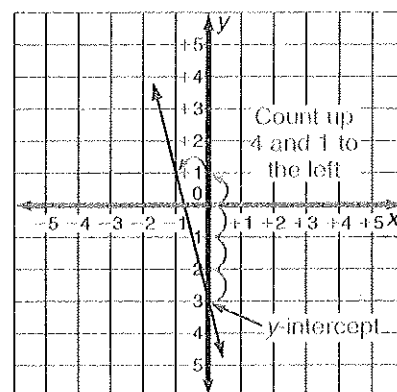
You know how to graph an equation by finding ordered pairs that make the equation true and drawing a line through those points. You may be asked to work backwards from points to determine the equation of a line.

On the GED Mathematics Test the answer choices to such questions are written in a format called the **slope-intercept form of a line**. The variable m is the slope of the line. The variable b is the **y -intercept**, the point at which the line crosses the y -axis. The sum of $mx + b$ when $y = 0$ is the x -intercept.

$$y = mx + b, \text{ where } m = \text{slope and } b = y\text{-intercept}$$

Example 1 What is the equation of the line shown on the graph?

- (1) $y = -2x - 3$
- (2) $y = -3x + 2$
- (3) $y = -4x + 2$
- (4) $y = -4x - 3$
- (5) $y = -4x + 3$



You can check your work by substituting the coordinates of a point on the line for x and y in the equation. If the equation is true, your answer is correct.

Step 1 Find the y -intercept of the line. The line shown crosses the y -axis at $(0, -3)$. Therefore:

the y -intercept is -3

Step 2 Find the slope of the line using the grid-unit counting method. Count from the y -intercept to another point on the line with whole numbers as the ordered pair, here, $(-1, 1)$. The line rises 4 units for every 1 unit of run to the left (a negative direction).

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{4}{-1} = -4$$

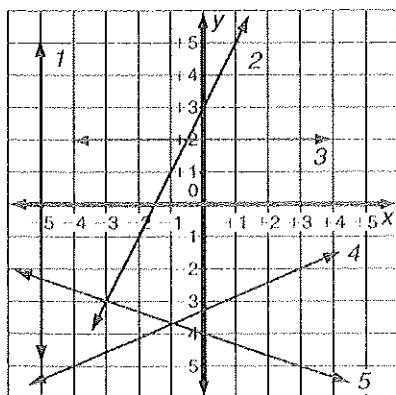
Step 3 Use the slope-intercept form to write the equation.

$$y = mx + b \quad y = -4x + (-3) \text{ or } y = -4x - 3$$

The correct answer is **option (4) $y = -4x - 3$** .

You may need to rewrite an equation in slope-intercept form.

Example 2 Which of the lines shows the graph of the equation $2x - y = -3$?



Step 1 Rewrite the equation in slope-intercept form.

Isolate the variables.

Eliminate the negative variable.

Rearrange the terms.

The slope of the line is 2 and the y -intercept is 3.

Step 2 Examine the lines on the graph. Only Line 2 has a slope of positive 2 and passes through point $(0, 3)$.

The correct answer is **Line 2**.

Directions: Choose the one best answer to each question.

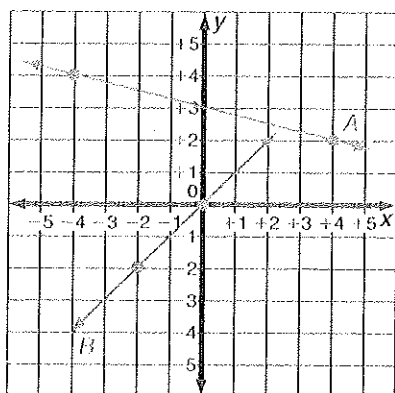
1. What are the coordinates of the y -intercept of the line $y = -3x - 2$?

- (1) $(0, -5)$
- (2) $(0, -3)$
- (3) $(0, -2)$
- (4) $(-2, 0)$
- (5) $(-3, 0)$

4. The point $(0, -5)$ is the y -intercept of which of the following lines?

- (1) $y = 2x$
- (2) $y = -x + 5$
- (3) $y = 3x - 5$
- (4) $y = -2x - 3$
- (5) Not enough information is given.

Questions 2 and 3 refer to the following graph.



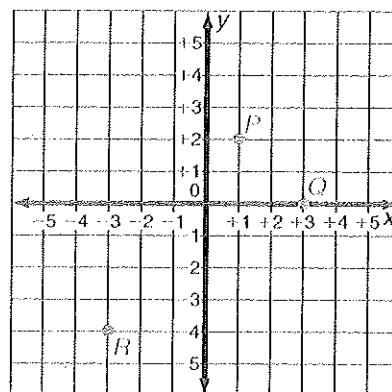
2. What is the equation of Line A?

- (1) $y - 4x = 3$
- (2) $y - \frac{1}{4}x = -2$
- (3) $y = 4x$
- (4) $y + \frac{1}{4}x = -2$
- (5) $y + \frac{1}{4}x = 3$

3. What is the equation of Line B?

- (1) $y = -x$
- (2) $y = x$
- (3) $y = 2x$
- (4) $y = -2x$
- (5) $y = x + 1$

Questions 5 and 6 refer to the following graph.



5. What would be the equation of a line drawn through points P and Q?

- (1) $y = -x + 3$
- (2) $y = -x - 3$
- (3) $y = 2x - 3$
- (4) $y = 3x + 2$
- (5) $y = 3x + 3$

6. Which of the following is the y -intercept of a line drawn through points R and Q?

- (1) $(-3, -4)$
- (2) $(0, -2)$
- (3) $(0, -3)$
- (4) $(0, -4)$
- (5) $(3, -4)$

Answers start on page 429.

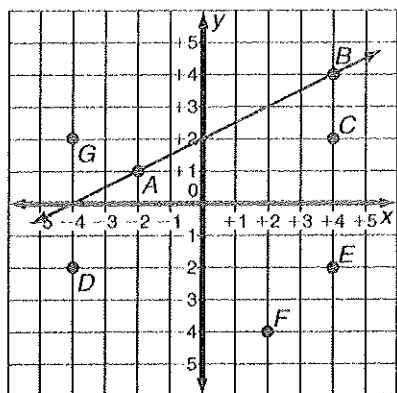
Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Choose the one best answer to each question. You MAY use your calculator.

Questions 1 and 2 refer to the following diagram.



1. Which point lies at coordinates $(4, -2)$?

- (1) Point C
- (2) Point D
- (3) Point E
- (4) Point F
- (5) Point G

2. What is the slope of the line that passes through points A and B on the graph?

- (1) $-\frac{1}{2}$
- (2) $\frac{1}{3}$
- (3) $\frac{1}{2}$
- (4) $\frac{2}{3}$
- (5) 2

3. Which of the following best represents the solution set to the inequality $5x + 2 < 6x + 3x + 10$?

- (1) $x > -2$
- (2) $x < -2$
- (3) $x < 3$
- (4) $x > -3$
- (5) $x < -3$

4. The sum of three consecutive odd numbers is 135. What are the three numbers?

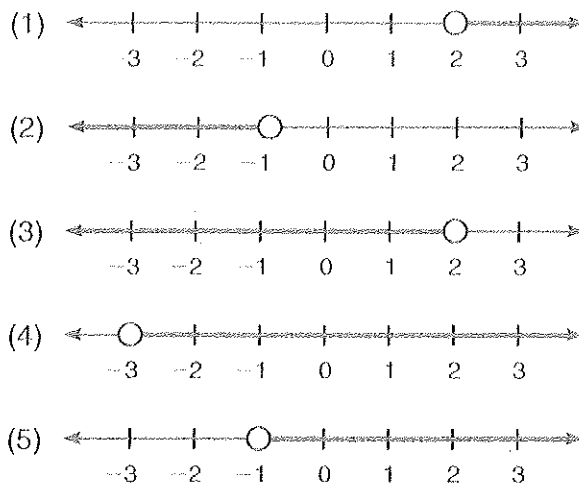
- (1) 41, 43, and 45
- (2) 43, 45, and 47
- (3) 44, 45, and 46
- (4) 44, 46, and 48
- (5) 45, 47, and 49

5. If the pattern continues, what is the next term in the sequence below?

0 1 3 7 15 _____

- (1) 25
- (2) 27
- (3) 29
- (4) 31
- (5) 33

6. Which graph shows the solution of $x - 3 < -1$?



7. In which of the following are the numbers arranged in order from least to greatest?

- (1) 2.34×10^2 , 5.2×10^2 , 4.7×10^{-1}
 (2) 2.34×10^2 , 4.7×10^{-1} , 5.2×10^2
 (3) 4.7×10^{-1} , 5.2×10^2 , 2.34×10^2
 (4) 4.7×10^{-1} , 2.34×10^2 , 5.2×10^2
 (5) 5.2×10^2 , 4.7×10^{-1} , 2.34×10^2

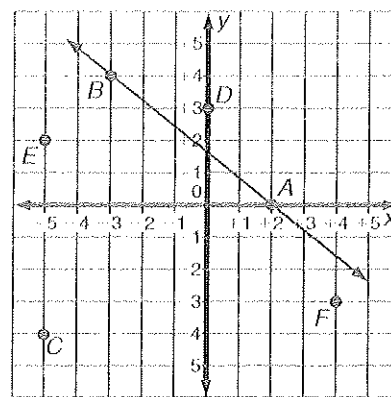
8. Which of the following shows the correct factors of the expression $x^2 - 12x + 36$?

- (1) $(x + 6)(x + 6)$
 (2) $(x - 6)(x - 6)$
 (3) $(x - 6)(x + 6)$
 (4) $(x - 3)(x - 12)$
 (5) $(x + 3)(x + 12)$

9. Which ordered pair is a solution of $5x - y = 1$?

- (1) (1, -4)
 (2) (0, 4)
 (3) (-1, 6)
 (4) (-2, -11)
 (5) Not enough information is given.

Questions 10 and 11 refer to the following figure.



10. The graph of the equation $y = -\frac{3}{2}x + 3$ would pass through which of the following points on the coordinate grid?

- (1) A and B
 (2) A and C
 (3) A, D, and F
 (4) A and E
 (5) C and D

11. What is the distance from point C to point A to the nearest whole unit?

- (1) 7
 (2) 8
 (3) 9
 (4) 10
 (5) 11

12. The average human heart pumps 114,000 gallons of blood per day. Which of the following expressions represents that amount in scientific notation?

- (1) 1.14×10^5
 (2) 1.14×10^{-4}
 (3) 1.14×10^3
 (4) 1.14×10^6
 (5) 1.14×10^6

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

13. If $x^2 + x = 20$, what are the values for x that will make the equation true?

- (1) -5 and 4
- (2) -5 and -4
- (3) 5 and 4
- (4) 5 and -4
- (5) Not enough information is given.

14. Aaron's weekly pay (p) can be represented by $p = \$200 + \$6s$, where s is the number of sales he makes in a week. How much will Aaron earn in a week if he makes 32 sales?

- (1) \$192
- (2) \$232
- (3) \$238
- (4) \$384
- (5) \$392

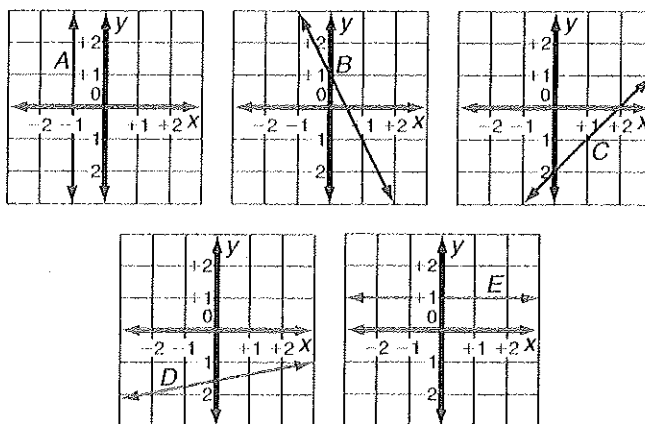
15. Which ordered pair is a solution of $4x - y = 3$?

- (1) $(-5, 2)$
- (2) $(-1, 1)$
- (3) $(0, 3)$
- (4) $(1, -1)$
- (5) $(2, 5)$

16. A square mural has an area of about 240 square feet. What is the approximate length of one side of the mural?

- (1) between 18 and 19 feet
- (2) between 17 and 18 feet
- (3) between 16 and 17 feet
- (4) between 15 and 16 feet
- (5) between 14 and 15 feet

Question 17 refers to the following graphs.



17. Which of the lines shown above has a negative slope?

- (1) A
- (2) B
- (3) C
- (4) D
- (5) E

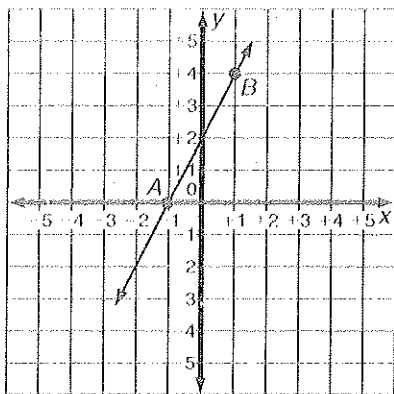
18. Which of the following is equal to the expression $\frac{x + 4x}{x^2 - 2x}$?

- (1) 2
- (2) $\frac{5}{x - 2}$
- (3) $x + 2$
- (4) $1 + 2x$
- (5) $2x$

19. Which point is not on a graph of the line $2x - y = -1$?

- (1) $(-3, -5)$
- (2) $(-1, -1)$
- (3) $(1, 3)$
- (4) $(2, 5)$
- (5) $(3, 6)$

Question 20 refers to the following figure.



20. What is the equation of the line shown on the graph?

- (1) $y = 2x + 2$
- (2) $y = 2x - 1$
- (3) $y = x + 2$
- (4) $y = x - 1$
- (5) $y = \frac{1}{2}x + 2$

21. A repair company charges a flat fee of \$40 plus \$30 for each hour (h) spent making a repair. Which of the following equations could be used to find the charge (c) for any service call?

- (1) $c = \$30h$
- (2) $c = \$40h$
- (3) $c = \$40 + \$30h$
- (4) $c = \$40h + \$30h$
- (5) $c = \$30 + \$40h$

22. What is the slope of a line that passes through points at $(-2, -2)$ and $(-4, 4)$?

- (1) -3
- (2) -1
- (3) $-\frac{1}{3}$
- (4) $\frac{1}{3}$
- (5) 3

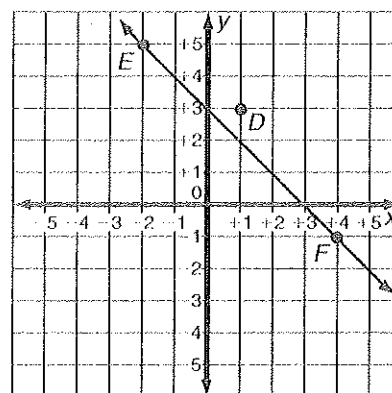
23. The following amounts were deposited in a savings account each month.

January	\$20	March	\$44
February	\$32	April	\$56

If the pattern continues, how much will be deposited in December?

- (1) \$112
- (2) \$140
- (3) \$144
- (4) \$152
- (5) \$164

Questions 24 and 25 refer to the following graph.



24. What is the equation of the line that passes through points E and F ?

- (1) $y = -3x - 3$
- (2) $y = 3x + 3$
- (3) $y = x + 3$
- (4) $y = -x + 3$
- (5) $y = -x - 3$

25. What is the distance in units from point F to point D ?

- (1) 3
- (2) 4
- (3) 5
- (4) 6
- (5) 7

Answers start on page 430.

Unit 3 Cumulative Review Algebra

Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. What is the value of the expression $4x - 2y + xy$, when $x = -1$ and $y = 5$?

- (1) -26
- (2) -19
- (3) -9
- (4) -1
- (5) 1

2. Which of the following expressions is equal to $2 - (x + 7)$?

- (1) $x - 9$
- (2) $-x - 5$
- (3) $-x - 9$
- (4) $-x + 9$
- (5) $-x + 14$

3. If $-6(x + 1) + 4 = 8x - 9$, what is the value of x ?

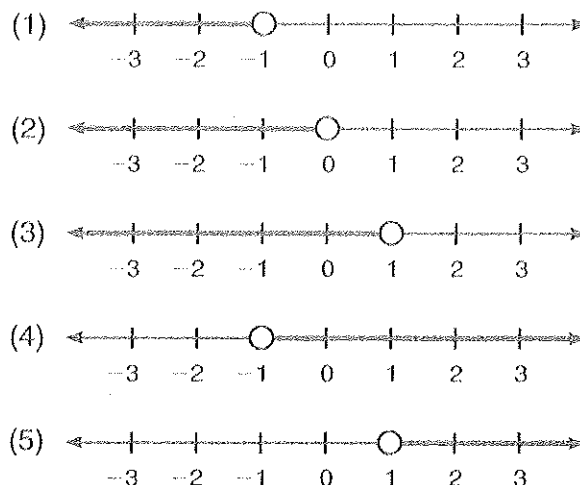
- (1) $\frac{1}{2}$
- (2) $-\frac{1}{2}$
- (3) -1
- (4) -3
- (5) -5

4. A certain number decreased by two is equal to seven increased by the quotient of the same number and four. What is the number?

- (1) -12
- (2) -5
- (3) 5
- (4) 7
- (5) 12

5. Which of the following graphs shows the solution set for the inequality?

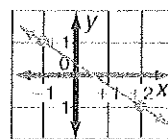
$$6 - 5x < 7x - 6$$



6. The product of a number (x) and -4 is 8 more than 2 added to -5 times that number. Which of the following equations could be used to find the value of x ?

- (1) $-4x - 8 = 2x + (-5x)$
- (2) $-4x + 8 = -5x + 2$
- (3) $-4x = -5x + 2 + 8$
- (4) $-4x = 8 + 2 + (-5)$
- (5) $-4x = 8 + x(-5 + 2)$

7. What is the slope of the line on the graph?



- (1) 2
- (2) $\frac{3}{2}$
- (3) $\frac{2}{3}$
- (4) $-\frac{2}{3}$
- (5) $-\frac{3}{2}$

8. The ordered pair $(0, -2)$ is a solution of which of the following equations?

- (1) $2x - 3y = -6$
- (2) $2x + 3y = 6$
- (3) $-2x + 3y = -6$
- (4) $-2x - 3y = 5$
- (5) $x + 2y = 4$

9. For its standard checking account, Northwest Bank charges a monthly fee of \$2.50 plus \$0.10 per check. The function used to determine total monthly charges is $C = \$2.50 + \$0.10n$, where C = monthly charges and n = the number of checks. If a customer writes 24 checks during a month, how much will the customer be charged?

- (1) \$ 2.40
- (2) \$ 2.50
- (3) \$ 4.90
- (4) \$ 6.00
- (5) \$26.50

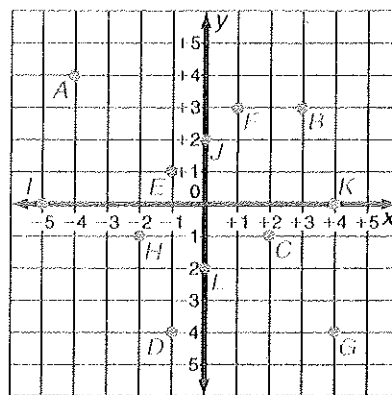
10. Which of the following expresses the product of 6,000 and 14,000 in scientific notation?

- (1) 8.4×10^8
- (2) 8.4×10^7
- (3) 8.4×10^6
- (4) 84×10^8
- (5) 84×10^7

11. Which value for x makes the following inequality true: $x < 500$?

- (1) 8^3
- (2) 7^3
- (3) 6^4
- (4) 5^4
- (5) 4^6

Questions 12 through 14 refer to the following graph.



12. Which points have positive x -values and negative y -values?

- (1) A, E
- (2) A, E, I
- (3) C, G
- (4) C, G, L
- (5) C, G, L, K

13. If the line for $x + 2y = -4$ were drawn on the graph, which of the following points would be on the line?

- (1) D
- (2) I
- (3) J
- (4) K
- (5) L

14. What would be the slope of a line passing through points J and K?

- (1) -2
- (2) $-\frac{1}{2}$
- (3) $\frac{1}{4}$
- (4) $\frac{1}{2}$
- (5) 2

Directions: Solve the following questions and enter your answers on the grids provided.

15. The pattern below is formed using the rule "multiply by 3, add 1." Grid in the 6th term in the pattern.

1 4 13 40

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

17. Show the location of the point whose coordinates are $(3, -4)$.

							6							
							5							
							4							
							3							
							2							
							1							
-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6		
						-1								
						-2								
						-3								
						-4								
						-5								
						-6								

18. Show the location of the x-intercept for the line $-2x + 3y = 6$.

							6							
							5							
							4							
							3							
							2							
							1							
-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6		
						-1								
						-2								
						-3								
						-4								
						-5								
						-6								

16. Grid in the value of the following expression:
 $\sqrt{81} + 2^4 - \sqrt{169} + 5^2$

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

19. The length of a rectangle is 6 times its width. The perimeter must be more than 110 feet. Which inequality can be solved to find the width (x)?

- (1) $7x > 110$
- (2) $6x^2 > 110$
- (3) $x + 6x > 110$
- (4) $2(6x) + x > 110$
- (5) $x + 6x + x + 6x > 110$

20. What is the solution set of the inequality $-5x + (-3) \leq 2x - 17$?

- (1) $x \leq -2$
- (2) $x \geq -2$
- (3) $x \leq 2$
- (4) $x \geq 2$
- (5) $x \leq 3$

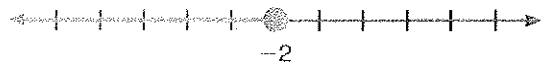
21. Which of the following shows the product of -6 and x , decreased by the sum of -6 and y ?

- (1) $-6x - (-6 + y)$
- (2) $-6y - (-6x)$
- (3) $(-6 + x) - (-6y)$
- (4) $(-6 + y) - (-6x)$
- (5) $(-6 + x) - (-6 + y)$

22. Twice a number, added to 3, is equal to the negative of the number. What is the number?

- (1) -3
- (2) -1
- (3) $-\frac{1}{3}$
- (4) 1
- (5) 3

Question 23 refers to the following graph.



23. Which inequality is graphed on the number line?

- (1) $-2 > x$
- (2) $x < -2$
- (3) $-2 \leq x$
- (4) $x \leq -2$
- (5) $2 = x$

24. In the equation $x^2 - 7x = 18$, what are the possible values for x ?

- (1) 2 and -9
- (2) 3 and -6
- (3) 6 and -3
- (4) 9 and -2
- (5) 9 and -9

25. What is the equation of a line that passes through points $(0,4)$ and $(-4,2)$?

- (1) $y = \frac{1}{2}x + 4$
- (2) $y = \frac{1}{2}x - 4$
- (3) $y = \frac{1}{2}x + 2$
- (4) $y = 2x + 4$
- (5) $y = 2x - 4$

Directions: Solve the following problems and enter your answers on the grids provided.

26. What is the value of the following expression if $x = 2$ and $y = -2$?

$$6x^2 - 5xy - 4y^2$$

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

28. Show the location of the point whose coordinates are $(-3, 2)$.

							6							
							5							
							4							
							3							
							2							
							1							
-6	-5	-4	-3	-2	-1	0		1	2	3	4	5	6	
							-1							
							-2							
							-3							
							-4							
							-5							
							-6							

27. Albert is five times as old as Timothy. In five years, Albert will be four times as old as Timothy. How old will Timothy be in five years?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

29. Show the location of the y-intercept for the line $2x - y = 4$.

							6							
							5							
							4							
							3							
							2							
							1							
-6	-5	-4	-3	-2	-1	0		1	2	3	4	5	6	
							-1							
							-2							
							-3							
							-4							
							-5							
							-6							

Answers start on page 431.

Cumulative Review Performance Analysis

Unit 3 • Algebra

Use the Answers and Explanations starting on page 431 to check your answers to the Unit 3 Cumulative Review. Then use the chart to figure out the skill areas in which you need more practice.

On the chart, circle the questions that you answered correctly. Write the number correct for each skill area. Add to find the total number of questions that you got correct on the Cumulative Review. If you feel that you need more practice, go back and review the lessons for the skill areas that were difficult for you.

Questions	Number Correct	Skill Area	Lessons for Review
1, 2, 21, 26	_____/4	Integers and Algebraic Expressions	18
3, 4, 6, 22, 27	_____/5	Equations	19
9, 10, 11, 15, 16	_____/5	Exponents and Roots	20
5 , 19, 20, 23 , 24	_____/5	Factoring and Inequalities	21
7 , 8, 12 , 13 , 14 , 17 , 18 , 25, 28 , 29	_____/10	The Coordinate Plane	22
TOTAL CORRECT	_____/29		

Question numbers in **boldface** are based on graphics.

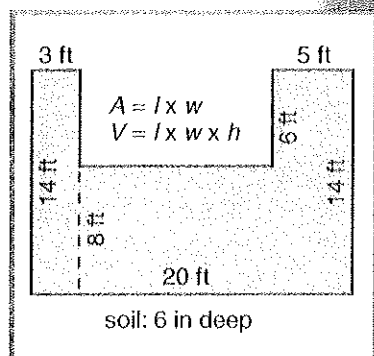
UNIT 4

Geometry

Geometry is the area of mathematics that deals with points, lines, angles, two-dimensional shapes, and three-dimensional figures and is used to solve many common everyday problems. Geometric shapes are everywhere. You can see them indoors in rooms, furniture, clothing, and household objects and outside in buildings, streets, and bridges. One of the most important parts of geometry is learning to use formulas, such as those for perimeter, area, and volume, and the Pythagorean Relationship.

The principles of geometry show how the measurements of a shape or figure are related to its characteristics and how two-dimensional shapes and three-dimensional figures are related. Geometry is a very important topic on the GED Mathematics Test. Questions related to geometry will account for about 25 percent of the test.

Every day landscapers and other workers use geometry to do their jobs.



The lessons in this unit include:

Lesson 23: Applying Formulas

There is a wide variety of geometric shapes. In addition to squares and rectangles, some of the most common shapes are triangles, parallelograms, circles, pyramids, and cones. We use formulas to find the perimeter, area, and volume of these shapes.

Lesson 24: Lines and Angles

Many of the plane (flat) shapes that we work with are made up of lines and angles. The relationships between angles—vertical, complementary, supplementary, and congruent—are the basis for solving many common geometry problems.

Lesson 25: Triangles and Quadrilaterals

Some of the most common plane shapes are three-sided (triangles) and four-sided (quadrilaterals). Two plane shapes may be congruent (the same shape and size) or similar (equal angles and proportional sides).

Lesson 26: Irregular Figures

Not all plane figures are regular. Irregular figures—those that have unequal sides or are made up of several smaller shapes—are commonplace. Working with these figures involves using logical reasoning to determine what regular shapes make up the larger one.

Lesson 27: Working with Right Triangles

A right triangle is a special type of triangle involved in many problem-solving situations. You can use the Pythagorean Relationship to find the lengths of the sides of a right triangle—the legs (the two short sides) and the hypotenuse (the longest side). Sine, cosine, and tangent are important ratios that compare the lengths of specific sides of a right triangle.

PROBLEM-SOLVING STRATEGIES

- Converting Measurements
- Solving for Variables in Formulas
- Using Logical Reasoning
- Using Proportion in Geometry
- Recognizing Applications of the Pythagorean Relationship

Lesson 23

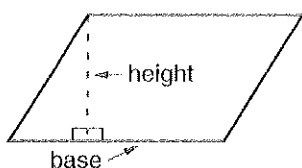
GED SKILL Applying Formulas

Triangles and Parallelograms

Triangles



Parallelograms



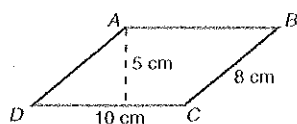
Two common shapes are triangles and parallelograms. A **triangle** has three sides and three angles. The sides of triangles can have different lengths, and their angles can have different measures.

A **parallelogram** is a four-sided figure whose opposite sides are parallel. *Parallel* means the extended lines would never intersect, or meet. Rectangles and squares are special parallelograms, although we usually think of a parallelogram as a rectangle leaning to one side.

The perimeter of geometric figure is the distance around a figure found by adding the lengths of all the sides of a figure regardless of the number or lengths of the sides.

Area is the measure of the surface of a two-dimensional shape. The area of a parallelogram is the product of the base and the height. The **base** can be any side. The **height** is the distance from a point on the opposite side straight down to the base. The height and base form a 90° angle.

Area = base $\times$ height or $A = bh$, where b = base and h = height



Example 1 Find the perimeter and area of parallelogram ABCD.

Step 1 Find the perimeter. Add the lengths of the sides.

$$10 + 10 + 8 + 8 = 36 \text{ centimeters}$$

Step 2 Find the area. **Choose the formula.**

$$A = bh$$

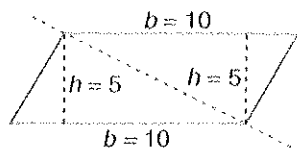
Substitute the measures.

$$A = 10(5)$$

Solve.

$$A = 50 \text{ sq cm}$$

The perimeter is **36 centimeters**; the area is **50 sq cm**.



A diagonal line drawn through the opposite corners divides the parallelogram into two identical triangles. Each triangle is one-half of the parallelogram. The formula for the area of a triangle is based on this fact.

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height or } A = \frac{1}{2}bh$$

Example 2 Find the perimeter and area of triangle DEF.

Step 1 Find the perimeter. Add the lengths of the sides.

$$4.5 + 6 + 5.8 = 16.3 \text{ inches}$$

Step 2 Find the area. Choose the formula.

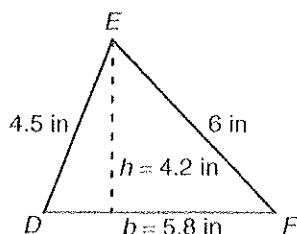
$$A = \frac{1}{2}bh$$

Substitute the measures.

$$A = \frac{1}{2}(5.8)(4.2)$$

Solve.

$$A = 12.18 \text{ sq in}$$





Use the decimal 0.5 for the $\frac{1}{2}$ in the area formula when using a calculator to solve problems.

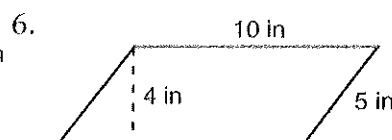
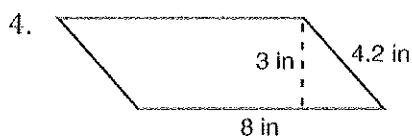
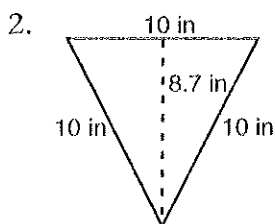
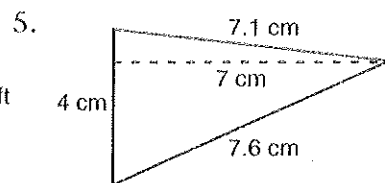
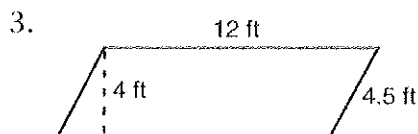
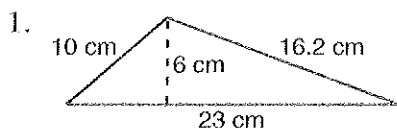
$$\text{area: } 0.5 \times 5.8 \times 4.2 = 12.18$$

The perimeter of triangle *DEF* is **16.3 inches**;
the area is **12.18 square inches**.

GED SKILL FOCUS

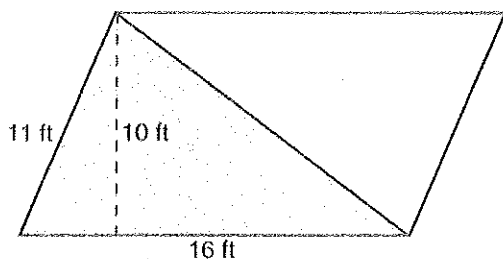


A. Find the perimeter and area of each figure. You may use your calculator.



B. Choose the best answer to the problem. Do not use a calculator.

Refer to the figure below to answer Question 7.



7. Which of the following expressions can be used to find the area in square feet of the shaded portion of the parallelogram?

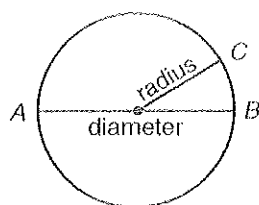
- (1) 11^2
- (2) $16(11)$
- (3) $(16)(10)$
- (4) $\frac{1}{2}(16)(10)$
- (5) $\frac{1}{2}(16)(11)$



The "base" is the side that forms a 90° angle with the height. Any side of the figure can be the base, not just the side the figure is "sitting" on.

Answers start on page 434.

Circles



Estimate the circumference of a circle by multiplying its diameter by 3.

Most shapes have straight sides. A circle, on the other hand, has a curved edge. The perimeter, or the distance around a circle, is called the **circumference**. To find the circumference of a circle, you need to know either the diameter or radius of the circle.

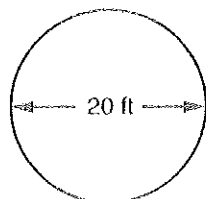
The **diameter** of a circle is a line segment drawn through the center of the circle with endpoints on the circle. The **radius** is a line segment connecting the circle's center to a point on the circle. The length of the radius is one-half the length of the diameter.

$$r = \frac{1}{2}d = \frac{d}{2} \quad \text{or} \quad 2r = d$$

For any circle, the ratio of the circumference to the diameter $\left(\frac{C}{d}\right)$ is always the same value. This value is represented by the Greek letter π (pi). The value of π is $\frac{22}{7}$ or about 3.14. The GED Mathematics Test uses the value 3.14 for pi.

Thus, since $\frac{C}{d} = \pi$, then the formula for finding circumference (C) is $C = \pi \times d$, where d = diameter, or, in words, pi times diameter.

Example 1 Flo plans to put a railing around a circular pool. The diameter of the pool is 20 feet. What will be the length of the railing?



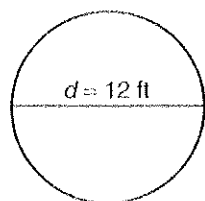
- Step 1** Choose the formula.
Step 2 Substitute the values.
Step 3 Solve.

$$\begin{aligned} C &= \pi d \\ C &= 3.14(20) \\ C &= 62.8 \text{ feet} \end{aligned}$$

The railing will be about **62.8 feet** long.

The formula for finding the area of a circle is $A = \pi r^2$, where r is the radius. In other words, the area of a circle is found by multiplying π (3.14) by the square of the radius.

Example 2 Paul wants to paint a circle on a wall of his store as part of a sign. What is the area of the circle in square feet if the diameter is 12 feet?



- Step 1** Choose the formula.
Step 2 Find the radius.
Step 3 Substitute the values.
Step 4 Solve.

$$\begin{aligned} A &= \pi r^2 \\ r &= \frac{1}{2}d \\ r &= \frac{1}{2}(12) = 6 \text{ feet} \\ A &= 3.14 \times 6 \times 6 \\ A &= 113.04 \text{ square feet} \end{aligned}$$



Even though the GED calculator has a pi key, you will probably save time by entering 3.14 for pi.

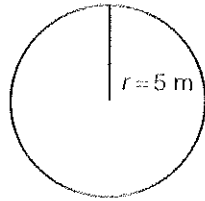
$$3.14 \times 6 \times 6 = 113.04$$

The area of the circle in Paul's sign is about **113 square feet**.



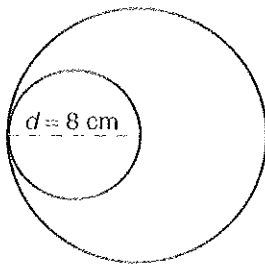
A. Solve. You may use a calculator.

Refer to the diagram below to answer Questions 1 and 2.



1. What is the diameter of the circle in meters?
2. What is the circumference of the circle to the nearest tenth meter?

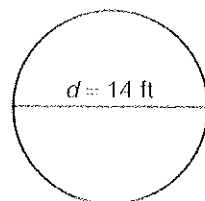
Refer to the diagram below to answer Questions 3 and 4.



3. The diameter of the smaller circle is equal to the radius of the larger circle. What is the diameter of the larger circle in centimeters?
4. What is the radius of the smaller circle in centimeters?

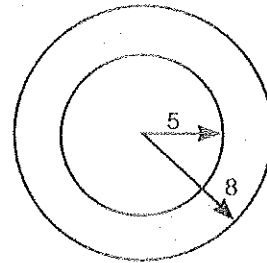
B. Solve.

9. The figure below shows the surface of a circular patio to be painted. About how many square feet is the surface of the patio? (*Hint: Which formula gives square feet?*)



5. The diameter of a circle is 7 inches. What is the circumference to the nearest inch?
6. If the radius of a circle is 2 feet, what is the area of the circle in square feet?

Refer to the diagram below to answer Questions 7 and 8.



7. What is the circumference to the nearest inch of the larger outer circle?
8. What is the area of the shaded ring to the nearest square inch? (*Hint: Subtract the area of the smaller circle from the area of the larger one.*)

10. A circle has a radius of 3 yards. What is its area to the nearest square yard?
11. What is the circumference to the nearest centimeter of a circle with a radius of 7 centimeters?

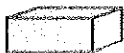
Answers start on page 434.

Volume is a measure in cubic units of the amount of space inside a three-dimensional (or “solid”) object. Each cubic unit is a cube made up of 6 identical square sides (called *faces*). For example, a cubic inch is a cube with 1-inch edges on each face. Imagine filling a space with neat layers of ice cubes. The volume of the space equals the number of cubes.

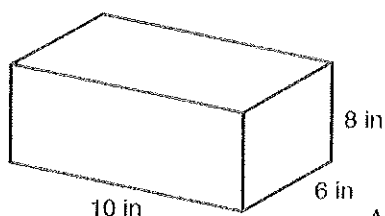
Three common solid shapes are a **rectangular solid**, a **cube**, and a **cylinder**. The volume (V) is the area (A) of the base (the side making a 90° angle to the height) multiplied by the height of the object. The general formula is $V = Ah$. This general formula is rewritten for each type of shape. Note that the base of each solid figure is a shape you already know.



Save time by memorizing the basic formulas for perimeter, area, and volume.

Rectangular solid	Cube	Cylinder
		
$V = (\text{area of rectangle})h$ $= (\text{length} \times \text{width}) \times \text{height}$ $= lwh$	$V = (\text{area of square})h$ $= (\text{edge} \times \text{edge}) \times \text{edge}$ $= s^3$ (edge = side)	$V = (\text{area of circle})h$ $= (\pi \times \text{radius}^2) \times \text{height}$ $= \pi r^2 h$

Example 1 What is the volume of the block shown at left?



Step 1 Choose the formula.

$$V = lwh$$

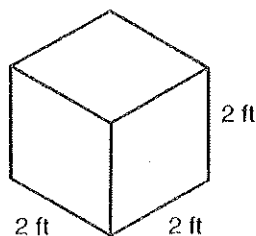
Step 2 Substitute and solve.

$$V = 10 \times 6 \times 8 = 480 \text{ cu in}$$

The volume of the block is **480 cubic inches**.

A cube is a special rectangular solid. The volume formula is still the product of length, width, and height, but the formula is written differently.

Example 2 What is the volume of a cube that is 2 feet long on each side?



Step 1 Choose the formula.

$$V = s^3$$

Step 2 Substitute.

$$V = 2^3$$

Step 3 Solve.

$$V = 2 \times 2 \times 2 = 8 \text{ cu ft}$$

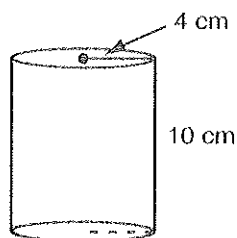
Use the $[x^y]$ or $[x^3]$ key to cube a number.

$$2 \text{ } x^y \text{ } 3 = 8, \text{ or } 2 \text{ } \text{SHIFT} \text{ } \text{ } = 8.$$

The volume of the cube is **8 cubic feet**.

The base of a cylinder is a circle. To find the volume of the cylinder, find the area of the circle (πr^2) and multiply this area by the height (h).

Example 3 What is the volume of the cylinder shown at left?



Step 1 Choose the formula.

$$V = (\text{area of a circle}) \times h = \pi r^2 h$$

Step 2 Substitute.

$$V = 3.14 \times 4^2 \times 10$$

Step 3 Solve.

$$V = 3.14 \times 16 \times 10 = 502.4 \text{ cu cm}$$



You can use either the x^2 or x^y key when solving volume problems on a calculator. Try the key strokes below to solve the cylinder problem in Example 3.

$$3.14 \times 4 \times 4 \times 10 \approx 502.4 \quad \text{or}$$

$$3.14 \times 4 \times^2 \times 10 \approx 502.4$$

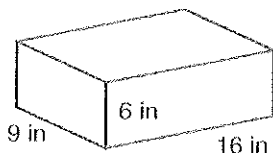
The volume of the cylinder is about **502.4 cubic centimeters**.

GED SKILL FOCUS

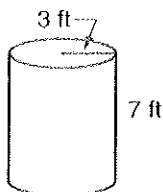


A. Find the volume of each figure to the nearest whole unit. You may use your calculator.

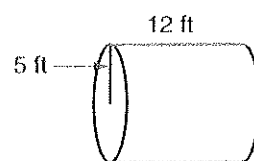
1.



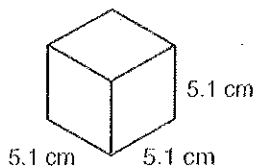
3.



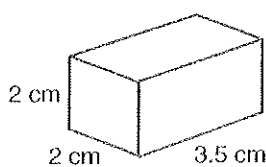
5.



2.



4.



B. Solve. You may use your calculator for question 9.

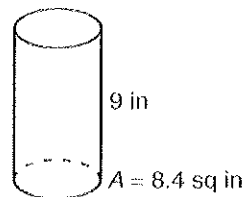
6. What is the volume in cubic feet of a rectangular crate with these measurements: length = 4 feet, width = 5 feet, and height = 6 feet?

7. The rectangular trash containers at an apartment complex are 10 feet long, 6 feet wide, and 5 feet high. How many cubic feet of trash does each container hold?

8. A health club is going to build a swimming pool. The hole needs to be 100 feet long by 25 feet wide with a depth of 5 feet. How many cubic feet of dirt will be removed to dig the hole?

9. Paul needs to store a box that measures $1\frac{1}{2}$ yards on each side. What is the volume in cubic yards of the box?

Refer to the diagram below to answer Question 10.



10. Which of the following expressions can be used to find the volume in cubic inches of the vase?

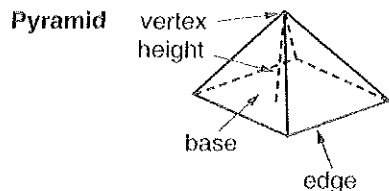
- (1) $(8.4)9$
- (2) $(8.4^2)(9)$
- (3) $(3.14)(8.4)(9)$
- (4) $(3.14)(8.4^2)(9)$
- (5) $(3.14)(8.4)(9^2)$



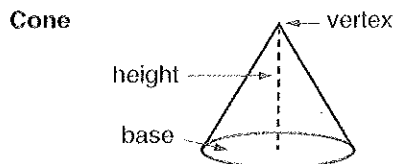
Answers start on page 435.

Pyramids and Cones

The three-dimensional solids studied so far—rectangular containers, cubes, and cylinders—all have two identical bases. You may think of these bases as the top and bottom sides of the figure. Pyramids and cones are also three-dimensional solids, but they have only one base.



A **pyramid** has one base with sides of the same length. A pyramid can have either a square or triangular base. However, the volume formula used on the GED Mathematics Test is for only a pyramid with a square base. The base is connected to a single point, called a **vertex**, by triangular **faces** (sides).



A **cone** has one circular base and one vertex. A curved surface connects the base and vertex.

The volume of a pyramid or a cone is $\frac{1}{3}$ of the area of its base multiplied by its height.

$$V = \frac{1}{\sqrt{\pi}} \times \left(\frac{1}{\sqrt{\pi}} \times \frac{1}{\sqrt{\pi}} \right) \times \left(\frac{1}{\sqrt{\pi}} \times \frac{1}{\sqrt{\pi}} \right) \times \left(\frac{1}{\sqrt{\pi}} \times \frac{1}{\sqrt{\pi}} \right)$$

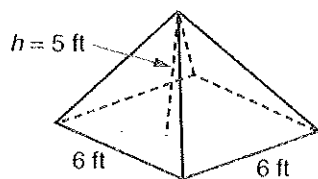
$$V = \frac{1}{2} A \frac{dV}{dt}$$

pyramid Volume = $\frac{1}{3} \times (\text{area of square}) \times \text{height}$
 = $\frac{1}{3} \times (\text{base edge})^2 \times \text{height}$

$$V = \frac{1}{3} s^2 h$$

cone Volume $= \frac{1}{3} \times (\text{area of circle}) \times \text{height}$
 $= \frac{1}{3} \times \pi \times \text{radius}^2 \times \text{height}$

$$V = \frac{1}{3} \pi r^2 h$$



Example 1 Find the volume of the pyramid in cubic feet.

Step 1 Find the area of the base (a square).

Choose the formula.

$$A = S^2$$

Substitute and solve.

$$A = 6^2 = 36 \text{ sq ft}$$

Step 2 Choose the volume formula.

$$V = \frac{1}{2}At^2$$

Substitute.

$$V = \frac{1}{3}(36)(5)$$

Solve.

$V = 60 \text{ cu ft}$

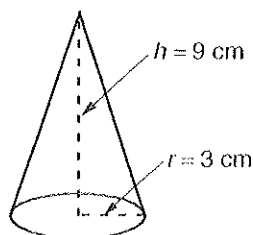


You can use the fraction key to multiply by a fraction.

Or multiply the area and height and divide by 3.

$$1 \text{ a/b/c } 3 \times 36 \times 5 = 60, \text{ or } 36 \times 5 \div 3 = 60.$$

The volume of the pyramid is **60 cubic feet**.



Example 2 Find the volume of the cone to the nearest cubic centimeter.

Step 1 Use the formula for finding the volume of a cone.

$$V = \frac{1}{3} \pi r^2 h$$

Step 2 **Substitute.**

$$V = \frac{1}{3}(3.14)(3^3)(9)$$

Step 3 Solve.

$$V = \frac{1}{3}(3.14)(9)(9) = 84.78,$$

which rounds to 85 cu cm.

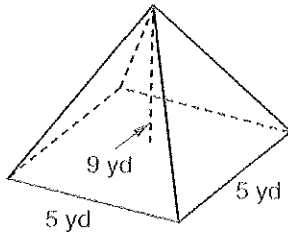
The volume of the cone is about **85 cubic centimeters**.

GED SKILL FOCUS

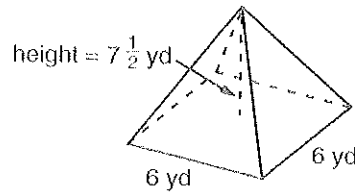


A. Find the volume of each figure. Round your answers to the nearest whole number. You may use a calculator.

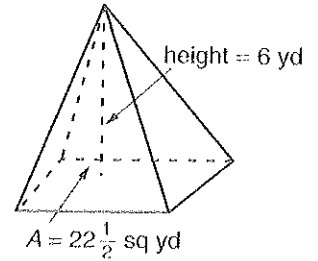
1.



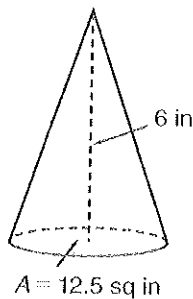
3.



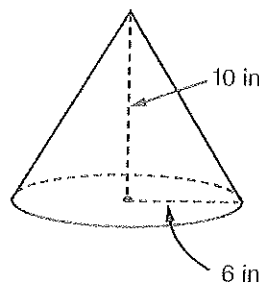
5.



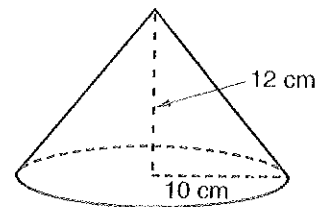
2.



4.



6.



B. Solve.

7. What is the volume in cubic centimeters of a cone with a height of 8 centimeters and a base area of 12.6 square centimeters? (*Hint:* You already know the area of the circular base. Use $V = \frac{1}{3}Ah$ instead of $V = \frac{1}{3}\pi r^2h$.)

9. A pyramid has a square base with one edge labeled 9 centimeters and a height of 18.25 centimeters. Which of the following expressions can be used to find the volume of the pyramid in cubic centimeters?

(1) $9^2(18.25)$

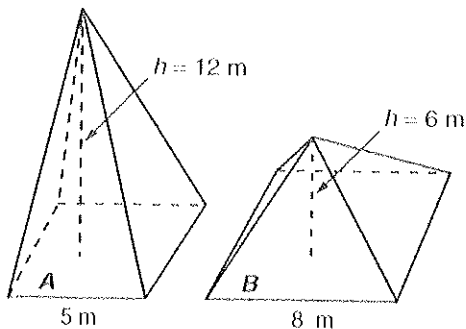
(2) $9^3(18.25)$

(3) $\frac{1}{3}(9)(18.25)$

(4) $\frac{1}{3}(9^2)(18.25)$

(5) Not enough information is given.

8. The area of the base of pyramid A is 25 square meters. The area of the base of pyramid B is 64 square meters. In cubic meters, how much greater is the volume of pyramid B than the volume of pyramid A?

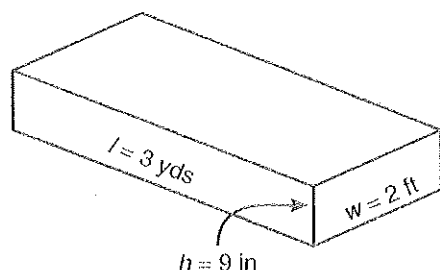


Answers start on page 435.

GED STRATEGY Solving Word Problems

Converting Measurements

To solve perimeter, area, and volume problems, all the measurements must be written using the same units. Converting measurements involves using conversion factor ratios to change from one unit to another.



Example What is the volume in cubic inches of the rectangular solid shown to the left?

- (1) 54
- (2) 648
- (3) 1,944
- (4) 23,328
- (5) 93,312

Step 1 Convert measurements. Convert the length and width to inches. (To review converting measurements, see pages 158–159.) The length is 3 yards. Convert to inches using the conversion factor: 1 yard = 36 inches. Cross multiply to solve.

$$\frac{\text{yard}}{\text{inches}} \cdot \frac{1}{36} = \frac{3}{l} \quad l = 3(36) \quad l = 108 \text{ inches}$$

The width is 2 feet. Convert to inches: 1 foot = 12 inches.

$$\frac{\text{foot}}{\text{inches}} \cdot \frac{1}{12} = \frac{2}{w} \quad w = 2(12) \quad w = 24 \text{ inches}$$

Step 2 Choose the appropriate formula.

$$V = lwh$$

Substitute and solve.

$$V = 108 \times 24 \times 9 = 23,328 \text{ cu in}$$

The correct option is **(4) 23,328**.

You could also have solved this problem in terms of feet or yards.

In feet:

$$V = lwh$$

$$= 3 \text{ yd} \times 2 \text{ ft} \times 9 \text{ in}$$

$$= 9 \text{ ft} \times 2 \text{ ft} \times \frac{3}{4} \text{ ft}$$

$$= 13\frac{1}{2} \text{ cu ft}$$

In yards:

$$V = lwh$$

$$= 3 \text{ yd} \times 2 \text{ ft} \times 9 \text{ in}$$

$$= 3 \text{ yd} \times \frac{2}{3} \text{ yd} \times \frac{1}{4} \text{ yd}$$

$$= \frac{1}{2} \text{ cu yd}$$

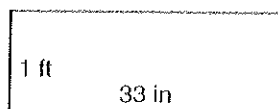
Often you must decide which measurement unit to use. Generally, it is best to convert to the smallest unit so that you will not have to work with fractions. Also, read the question. You usually save time by converting all measures to the unit of measure called for in the question.



More than one unit of measure may appear in the same problem. Convert all measurements to the same unit before using formulas.

Directions: Choose the one best answer to each question.

Questions 1 and 2 refer to the following figure.



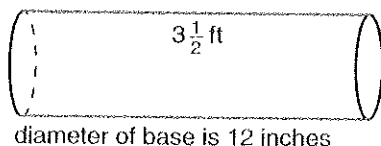
1. What is the perimeter of the rectangle in feet?

- (1) $6\frac{1}{2}$
- (2) $7\frac{1}{2}$
- (3) 8
- (4) $8\frac{1}{4}$
- (5) $8\frac{1}{2}$

2. What is the area of the rectangle in square inches?

- (1) 364
- (2) 386
- (3) 396
- (4) 412
- (5) 432

Question 3 refers to the following diagram.



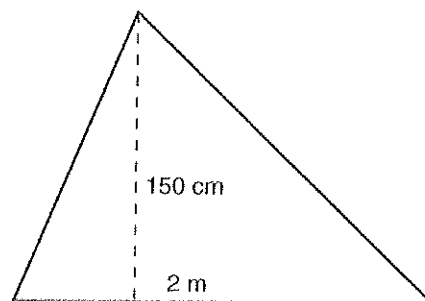
3. Which of the following expressions can be used to find the volume of the cylinder in cubic inches?

- (1) $42(12)$
- (2) $3.14(6^2)$
- (3) $3.14(6^2)(3.5)$
- (4) $(3.14)(6^2)(42)$
- (5) $(3.14)(12^2)(42)$

4. What is the approximate volume in cubic feet of a box with a length of $2\frac{1}{2}$ ft, a width of 1 ft 6 in, and a height of 1 ft 9 in?

- (1) between 3 and 4
- (2) between 4 and 5
- (3) between 5 and 6
- (4) between 6 and 7
- (5) between 7 and 8

Question 5 refers to the following diagram.



5. What is the area in square centimeters of the triangle in the figure?

(Hint: 1 meter = 100 centimeters)

- (1) 12,000
- (2) 12,500
- (3) 15,000
- (4) 20,000
- (5) 22,500

6. A cone has a height of 1 foot 4 inches and a base with an area of 18 square inches. What is the volume of the cone in cubic inches?

- (1) 84
- (2) 96
- (3) 144
- (4) 252
- (5) 288

Answers start on page 436.

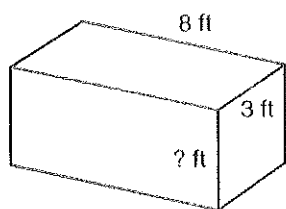
GED STRATEGY Solving Word Problems

Solving for Variables in Formulas

You have already worked with various geometric formulas. Formulas are a type of equation that contains variables used to solve measurement and geometry problems. The algebraic properties that you learned in Unit 3 can be used to solve formulas for a specific variable.

Remember that an equation shows two equal mathematical statements, called *expressions*. In order to keep the expressions equal, apply the same operation to both sides of the equation.

Example 1 The volume of the rectangular container is 120 cubic feet. What is the height of the container?



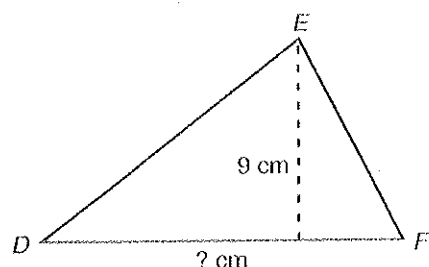
- Step 1** Choose the appropriate formula.
Step 2 Substitute the known values.
Step 3 Simplify.
Step 4 Solve for the unknown variable.

$$\begin{aligned} V &= lwh \\ 120 &= 8(3)h \\ 120 &= 24h \\ \frac{120}{24} &= \frac{24h}{24} \\ 5 &= h \end{aligned}$$

The height of the container is **5 feet**.

Often, the way to answer a set-up question on the GED Mathematics Test is to rewrite the equation to solve for a certain variable. The five multiple-choice options for such questions show possible ways to solve the problem. You have to choose the correct one as shown below.

Example 2 The area of triangle *DEF* is 72 sq cm. Which of the following expressions could be used to find the length of the base of triangle *DEF*?



- (1) $\frac{72}{2}(9)$
 (2) $2(9)(72)$
 (3) $\frac{2(9)}{72}$
 (4) $\frac{2(72)}{9}$
 (5) $\frac{9}{2(72)}$

- Step 1** Choose the formula (area of a triangle).
Step 2 Rewrite the formula to solve for the base (*b*).

$$\begin{aligned} A &= \frac{1}{2}bh \\ 2 \times A &= \frac{1}{2}bh \times 2 \\ 2A &= bh \\ \frac{2A}{h} &= b \\ \frac{2(72)}{9} &= b \end{aligned}$$

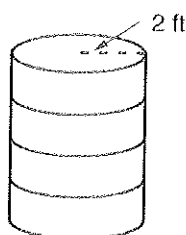
- Step 3** Substitute the known values.
Option (4) $\frac{2(72)}{9}$ is correct.

Directions: Choose the one best answer to each question.

1. The area of a rectangular mural is 180 square feet. If the mural is 15 feet in length, what is its width in feet?

- (1) 6
- (2) 12
- (3) 165
- (4) 2700
- (5) Not enough information is given.

Question 2 refers to the following diagram.



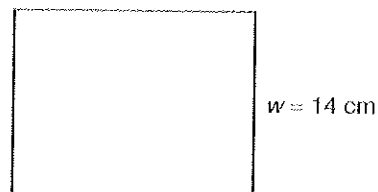
2. A storage barrel has the shape of a cylinder. The volume of the barrel is about 81.64 cubic feet. Which of the following expressions could be used to find its height in feet?

- (1) $\frac{81.64}{(3.14)(2^2)}$
- (2) $\frac{(3.14)(2^2)}{81.64}$
- (3) $\frac{81.64(2^2)}{(3.14)}$
- (4) $81.64(3.14)(2^2)$
- (5) $81.64 - (3.14)(2^2)$

3. A small section of a roof has the shape of a triangle. The total area of the section is 10.5 square feet. If the height of the section is 3.5 feet, what is the measure of the base in feet?

- (1) 3
- (2) 6
- (3) 7
- (4) 14
- (5) 36.75

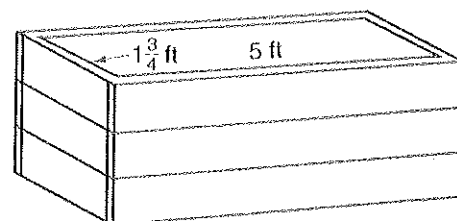
Question 4 refers to the following figure.



4. The perimeter of the rectangle is 64 cm. Which of the following expressions could be used to find the length of the rectangle?

- (1) $\frac{64}{14}$
- (2) $\frac{64}{2(14)}$
- (3) $64 - 14$
- (4) $\frac{64 - 2(14)}{2}$
- (5) $\frac{64 + 2(14)}{2}$

Question 5 refers to the following diagram.



5. Mike plans to build a wooden flower box similar to the one shown in the diagram. He wants the box to have a volume of $17\frac{1}{2}$ cubic feet. If base of the box has the dimensions shown above, what should the height of the box measure in feet?

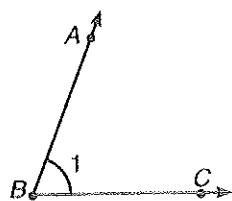
- (1) 2
- (2) $2\frac{1}{2}$
- (3) $3\frac{1}{2}$
- (4) 10
- (5) Not enough information is given.

Answers start on page 436.

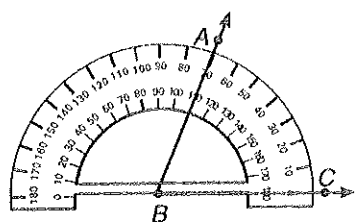
Lesson 24

GED SKILL Lines and Angles

Kinds of Angles



An **angle** is the space or opening between a pair of lines, called **rays**, that extend from a common point, the **vertex**. Angles can be named using three letters: a point on one ray, the vertex, and a point on the other ray. They can also be named by the letter of the vertex alone or by a number written inside the angle. The symbol for angle is $\angle$. This angle can be named $\angle ABC$, $\angle B$, or $\angle 1$.



Angles are measured in degrees ($^\circ$) using a protractor. When ray BC is placed along the bottom of the protractor, the measure of the angle is read along the scale that starts at 0. The measure (m) of angle ABC equals 70° or in symbols, $m\angle ABC = 70^\circ$.

Angles are classified by their measures. These measures are based on the fact that a circle contains 360° . When measuring an angle, you are actually measuring the number of degrees (or part of the circle) contained in the opening between two rays.

A right angle measures exactly 90° .	An acute angle measures less than 90° .	An obtuse angle measures more than 90° but less than 180° .	A straight angle measures exactly 180° .	A reflex angle measures more than 180° but less than 360° .

Angles are also related based on the sum of their measures. (Here's a memory aid: 90 comes before 180; c comes before s.)

- If the sum of the measures of two angles equals 90° , the angles are called **complementary angles**.
- If the sum of the measures of two angles equals 180° , the angles are called **supplementary angles**.

Example 1 If the measure of $\angle BXC$ is 25° , what is the measure of $\angle AXB$?

The angles are complementary because $\angle AXC$ has a right angle symbol, and a right angle measures 90° .

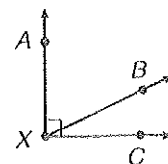
Step 1 Write an equation.

Step 2 Substitute the known measures.

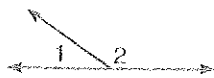
Step 3 Solve. Subtract 25 from both sides.

The measure of $\angle AXB$ is 65° .

$$\begin{aligned}
 m\angle AXB + m\angle BXC &= 90^\circ \\
 m\angle AXB + 25^\circ &= 90^\circ \\
 m\angle AXB &= 65^\circ
 \end{aligned}$$



It often helps to write the given measures on the diagram. Make a sketch of the facts in a problem if there is no diagram.



Example 2 Angles 1 and 2 are supplementary angles. If the measure of $\angle 1$ is 35° , what is the measure of $\angle 2$?

Step 1 Write an equation.

Step 2 Substitute the known measures.

Step 3 Solve.

$$m\angle 1 + m\angle 2 = 180^\circ$$

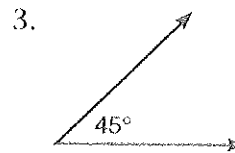
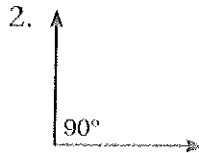
$$35^\circ + m\angle 2 = 180^\circ$$

$$m\angle 2 = 145^\circ$$

The measure of $\angle 2$ is 145° .

GED SKILL FOCUS

A. Label each angle as acute, obtuse, right, or straight.



B. Solve.

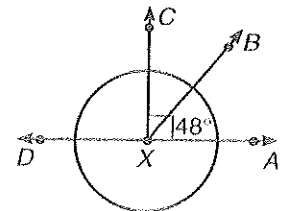
Refer to the figure below to answer Questions 5 through 8. $\angle AXB$ and $\angle BXC$ are complementary.

5. What is $m\angle BXC$?

6. What is $m\angle DXC$?

7. What is $m\angle BXD$?

8. Which angle forms a supplementary angle with $\angle DXB$?



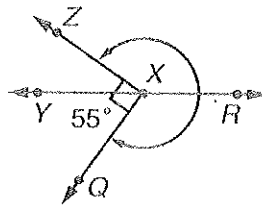
Refer to the figure below to answer Questions 9 through 12. $\angle ZXY$ and $\angle YXQ$ are complementary.

9. What is $m\angle ZXY$?

10. What is $m\angle ZXR$?

11. What is $m\angle QXR$?

12. What is the measure of the reflex angle marked by the curved arrow?



C. Choose the best answer to each question.

13. The measure of $\angle A$ is 28° . The measure of $\angle B$ is 62° . Which of the following is true?

- (1) $\angle A$ is complementary to $\angle B$.
- (2) $\angle A$ and $\angle B$ are supplementary angles.
- (3) $\angle A$ and $\angle B$ are obtuse angles.
- (4) $\angle A$ and $\angle B$ are reflex angles.
- (5) $\angle A$ is an acute angle; $\angle B$ is an obtuse angle.

14. $\angle M$ and $\angle R$ are supplementary angles. The measure of $\angle M$ is 40° . What is the measure of $\angle R$?

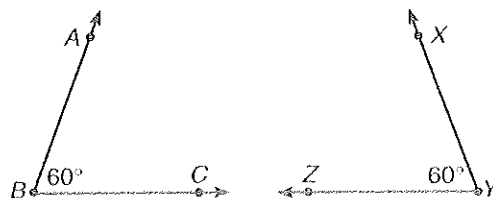
- (1) 40°
- (2) 50°
- (3) 90°
- (4) 140°
- (5) 180°

Answers start on page 437.

Congruent and Vertical Angles

Angles can be related in other ways. Angles that have equal measures are **congruent angles**. In the figure below, angle ABC is congruent to angle XYZ . The angles are congruent even though they are not turned in the same direction. The symbol $\cong$ means "is congruent to."

$$\angle ABC \cong \angle XYZ$$

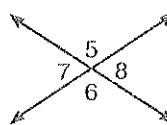


Learn the meaning of terms used in geometry. A simple problem is impossible if you don't know the vocabulary.

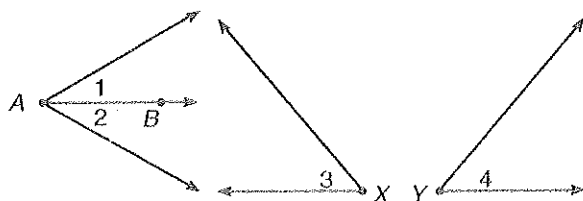
Some angles have a special relationship because of their location with respect to each other. When two lines intersect, or cross, four angles are formed. The angles that are across from each other are called **opposite angles**, or **vertical angles**. Each pair of vertical angles is congruent.

$$\angle 5 \cong \angle 6 \quad m\angle 5 = m\angle 6$$

$$\angle 7 \cong \angle 8 \quad m\angle 7 = m\angle 8$$



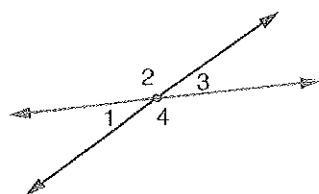
Angles can also be described as **adjacent** or **non-adjacent**. Adjacent angles have a common vertex and a common ray.



$\angle 1$ and $\angle 2$ are adjacent. They share vertex A and ray AB (also written as $\overrightarrow{AB}$).

$\angle 3$ and $\angle 4$ are non-adjacent angles.

Many geometry problems require you to apply logical reasoning to find congruent angles. Use your understanding of the properties of angles to solve geometry problems.



Example In the figure, angle 1 measures 30° . Find the measures of angles 2, 3, and 4.

Step 1 Assign the known values.

$$m\angle 1 = 30^\circ$$

Step 2 Identify known relationships.

(a) supplementary angles

$$m\angle 1 + m\angle 2 = 180^\circ$$

(b) vertical angles

$$m\angle 1 = m\angle 3; m\angle 2 = m\angle 4$$

Step 3 Solve for unknown values.

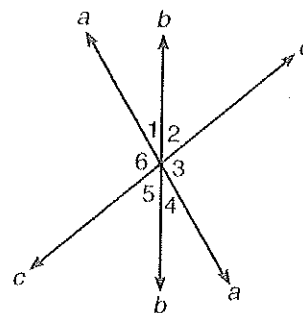
$$(a) \quad m\angle 1 + m\angle 2 = 30^\circ + m\angle 2 = 180^\circ; m\angle 2 = 150^\circ$$

$$(b) \quad m\angle 3 = 30^\circ; m\angle 4 = 150^\circ$$

The angle measures are $m\angle 2 = 150^\circ$, $m\angle 3 = 30^\circ$, and $m\angle 4 = 150^\circ$.

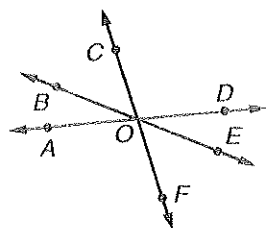
A. Refer to the figure shown at the right to answer Questions 1 through 9.

1. Name an angle adjacent to $\angle 3$.
2. Name the angle that is the vertical angle to $\angle 2$.
3. Name the angle that is the vertical angle to $\angle 6$.
4. Name the angle that is the vertical angle to $\angle 1$.
5. Name two angles that are adjacent to $\angle 1$.
6. Name two angles that are adjacent to $\angle 5$.
7. Name the angle congruent to $\angle 5$.
8. Name the angle congruent to $\angle 4$.
9. Name the angle congruent to $\angle 3$.



B. Solve.

Refer to the following information to answer Questions 10 through 15.



$$m\angle AOB = 30^\circ$$

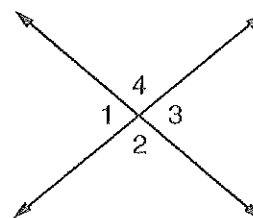
$$m\angle EOF = 50^\circ$$

10. Since $m\angle EOF = 50^\circ$, what other angle also has a measure equal to 50° ?
11. The sum of the measures of $\angle AOB$, $\angle BOC$, and $\angle COD$ is 180° . What is the measure of $\angle COD$?
12. What is the measure of $\angle AOF$? (Hint: You already found the measure of the vertical angle to $\angle AOF$.)
13. What is the sum of the measures of $\angle DOE$ and $\angle EOF$?
14. What is the measure of the reflex angle for $\angle EOF$?
15. Which two angles are supplementary to $\angle DOF$?

16. Angle Q is congruent to its vertical angle, $\angle R$. Which of the following must be true?

- (1) $\angle Q$ and $\angle R$ are complementary angles.
- (2) $\angle Q$ and $\angle R$ are acute angles.
- (3) $\angle Q$ and $\angle R$ are obtuse angles.
- (4) $\angle Q$ and $\angle R$ are adjacent angles.
- (5) $\angle Q$ and $\angle R$ have equal measures.

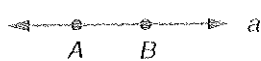
Refer to the figure below to answer Question 17.



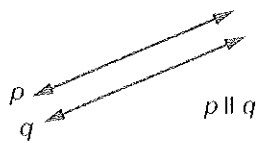
17. The measure of $\angle 4 = 100^\circ$. Which of the following statements is true?
- (1) $\angle 4$ and $\angle 2$ are complementary
- (2) $m\angle 2 = 100^\circ$
- (3) $m\angle 1 = 100^\circ$
- (4) $m\angle 1 + m\angle 3 = 100^\circ$
- (5) $m\angle 4 + m\angle 2 = 180^\circ$

Answers start on page 437.

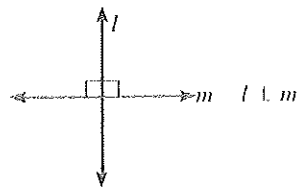
Lines and Angles



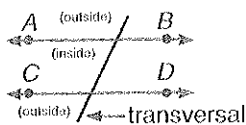
In geometry, arrows are drawn at both ends of a line to show that the line extends indefinitely in both directions. A line can be named by two points on the line. The line shown here is "line AB" ($\overleftrightarrow{AB}$). The line can also be named by a lower case letter (line a).



Two lines in the same plane (flat surface) either intersect (cross) or are parallel. **Parallel lines** never intersect. They have exactly the same slope. The symbol $\parallel$ means "is parallel to."

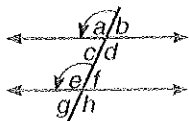


As you have seen, intersecting lines form vertical angles. When two lines intersect to form right angles, the lines are **perpendicular**. The symbol for perpendicular lines is $\perp$.



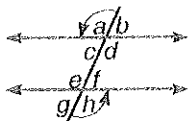
Special pairs of angles are formed when a line, called a **transversal**, crosses two or more parallel lines. In the figure at right, the transversal intersects line AB and line CD. Notice that some of the angles formed are inside the parallel lines and some are outside.

You already know that vertical angles are equal in measure ($\angle a$ and $\angle d$; $\angle b$ and $\angle c$; $\angle e$ and $\angle h$; $\angle f$ and $\angle g$). The following pairs of angles are also always equal in measure (congruent).



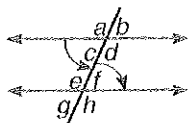
Corresponding angles are in the same position with respect to the transversal. That is, they are on the same side of the transversal and either both above or both below the parallel lines

$$\angle a \text{ and } \angle e \quad \angle b \text{ and } \angle f \quad \angle c \text{ and } \angle g \quad \angle d \text{ and } \angle h$$



Alternate exterior angles are always outside the parallel lines and on opposite sides of the transversal.

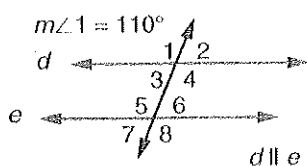
$$\angle a \text{ and } \angle h \quad \angle b \text{ and } \angle g$$



Alternate interior angles are always inside the parallel lines and on opposite sides of the transversal.

$$\angle c \text{ and } \angle f \quad \angle d \text{ and } \angle e$$

If you know the measure of one angle, you can find the measures of the others. There are often several ways to determine the other angles.



Example If the measure of $\angle 1$ is 110° , what is the measure of $\angle 6$?

Step 1 Identify an angle that is related to both the known and unknown angles.

Angles 1 and 5 are corresponding (congruent) angles. $m\angle 1 = m\angle 5$
Angles 5 and 6 are supplementary angles. $m\angle 5 + m\angle 6 = 180^\circ$

Step 2 Find the measure of the angle identified in Step 1.

Since $m\angle 1 = 110^\circ$, and $m\angle 1 = m\angle 5$, $m\angle 5 = 110^\circ$

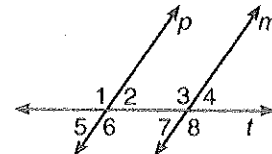
Step 3 Find the measure of the unknown angle.

$m\angle 5 + m\angle 6 = 180^\circ$; $m\angle 5 = 110^\circ$ $m\angle 6 = 180^\circ - 110^\circ = 70^\circ$

The measure of $\angle 6$ is 70° .

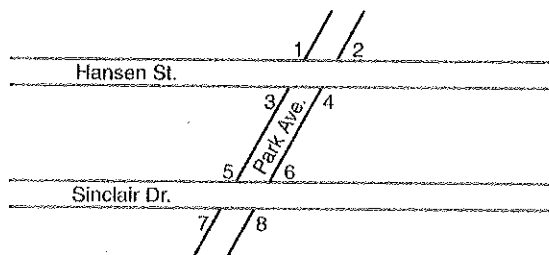
A. Refer to the figure shown at the right to answer Questions 1 through 10. Lines p and m are parallel.

1. Name the interior angles.
2. Name the interior angle on the same side of the transversal as $\angle 6$.
3. Name the exterior angles.
4. Name the exterior angle on the same side of the transversal as $\angle 4$.
5. Which angle corresponds to $\angle 1$?
6. Which angle corresponds to $\angle 7$?
7. Which angle corresponds to $\angle 8$?
8. Which angle corresponds to $\angle 2$?
9. Which angle is an alternate interior angle with $\angle 2$?
10. Which angle is an alternate exterior angle with $\angle 5$?



B. Choose the best answer to each question.

Refer to the diagram below to answer Questions 11 and 12.



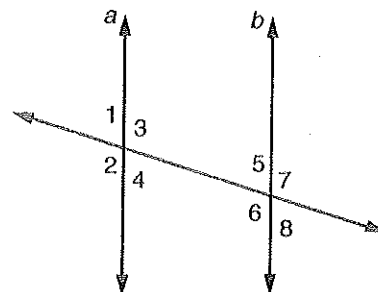
11. Hansen Street runs parallel to Sinclair Drive. Which statement is true?

- (1) $m\angle 1 = m\angle 7$
- (2) $m\angle 2 + m\angle 6 = 90^\circ$
- (3) $\angle 5$ is complementary to $\angle 6$.
- (4) $\angle 4$ is adjacent to $\angle 6$.
- (5) $m\angle 1 + m\angle 7 = 180^\circ$

12. The measure of $\angle 2$ is equal to 60° . Which other angles must also measure 60° ?

- (1) Only $\angle 3$
- (2) $\angle 3$, $\angle 6$, and $\angle 7$
- (3) $\angle 3$, $\angle 5$, and $\angle 8$
- (4) $\angle 4$, $\angle 6$, and $\angle 8$
- (5) Only $\angle 7$

Refer to the diagram below to answer Questions 13 and 14.



13. Line a is parallel to line b . Which of the following statements is true?

- (1) $m\angle 2 + m\angle 5 = 180^\circ$
- (2) $\angle 1$ is complementary to $\angle 2$.
- (3) $\angle 6$ is supplementary to $\angle 7$.
- (4) $\angle 2$ and $\angle 6$ are vertical angles.
- (5) $\angle 1$ and $\angle 6$ are corresponding angles.

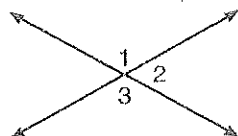
14. Which of the following are not supplementary angles?

- (1) $\angle 1$ and $\angle 2$
- (2) $\angle 1$ and $\angle 3$
- (3) $\angle 3$ and $\angle 7$
- (4) $\angle 3$ and $\angle 8$
- (5) $\angle 4$ and $\angle 6$

Answers start on page 438.

Using Logical Reasoning

Some questions on the GED Mathematics Test are solved using logic. Based on statements called **assumptions** given in the problem and any labels on the figure, decide which of the five answer options is true.



Example 1 The sum of the measures of angles 1 and 2 is 180° . The sum of the measures of angles 2 and 3 is 180° . Based on this information, which of the following statements is true?

- (1) $m\angle 1 = 120^\circ$
- (2) $m\angle 2 = 60^\circ$
- (3) $m\angle 3 = 100^\circ$
- (4) $m\angle 1 = m\angle 2$
- (5) $m\angle 1 = m\angle 3$

Angles 1 and 3 are vertical angles so **option (5) $m\angle 1 = m\angle 3$** is correct.

Options (1), (2), (3), and (4) are incorrect because no information is provided about specific angle measures. Although the measure of angle 1 looks greater than the measure of angle 2 in the figure, do not base a conclusion on the appearance of a figure; you must rely only on supporting evidence. Option (4) would be correct only if the intersecting lines were perpendicular.



To have a better chance of choosing the correct option eliminate any answer options you know are incorrect.

You often need to apply algebraic reasoning to solve geometry problems involving complementary and supplementary angles.

Example 2 The measure of an angle is twice the measure of its complement. What is the smaller angle's measure?

- (1) 20°
- (2) 30°
- (3) 45°
- (4) 90°
- (5) Not enough information is given.

Step 1 Assign the variables.

Let x = the measure of the smaller angle.

Let $2x$ = the measure of the larger angle.

Step 2 Write an equation. The sum of the measures of the two angles is 90° because the angles are complementary. $x + 2x = 90^\circ$

Step 3 Solve.

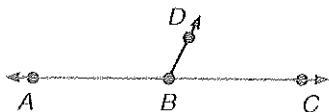
$$3x = 90^\circ$$

$$x = 30^\circ$$

The smaller angle measures 30° . **Option (2)** is correct. If the question had asked for the larger angle, the answer would be $2(30^\circ) = 60^\circ$.

Directions: Choose the one best answer to each question.

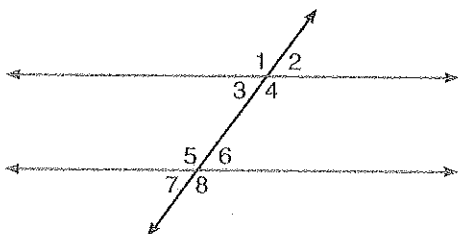
Question 1 is based on the following figure.



1. Angle ABC is a straight angle. Which of the following statements is true?

- (1) $m\angle DBC = 90^\circ$
- (2) $\angle ABD$ and $\angle DBC$ are supplementary.
- (3) $m\angle ABD = 90^\circ$
- (4) $\angle ABD$ and $\angle DBC$ are complementary.
- (5) $m\angle ABC = 90^\circ$

2. Angle 1 is congruent to $\angle 5$. Which of the following pairs of angles is also congruent?

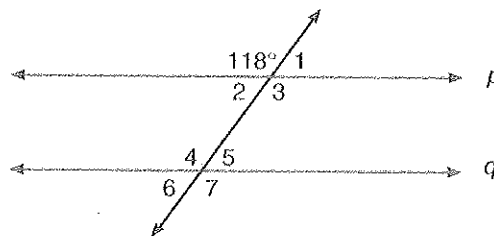


- (1) $\angle 1$ and $\angle 2$
- (2) $\angle 3$ and $\angle 4$
- (3) $\angle 3$ and $\angle 7$
- (4) $\angle 3$ and $\angle 8$
- (5) $\angle 7$ and $\angle 8$

3. One angle is 12° less than its complement. If the measure of the larger angle is x , which of the following statements must be true?

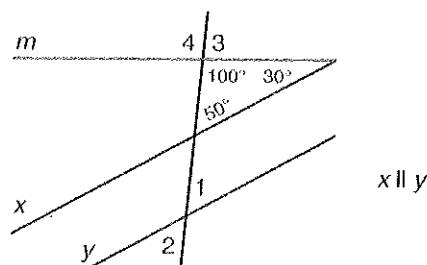
- (1) $x + (x - 12^\circ) = 180^\circ$
- (2) $x + (x - 12^\circ) = 90^\circ$
- (3) $x + (12^\circ - x) = 90^\circ$
- (4) $x + (x + 12^\circ) = 180^\circ$
- (5) $x - 90^\circ = x + 12^\circ$

4. The measure of $\angle 7$ is 116° . Which of the following is a true statement?



- (1) $\angle 1$ and $\angle 5$ are congruent.
- (2) $\angle 1$ and $\angle 4$ are supplementary.
- (3) $m\angle 1 + m\angle 4 = 180^\circ$
- (4) Lines p and q are not parallel.
- (5) Lines p and q are perpendicular.

5. Which conclusion is true?



- (1) $m\angle 1 = 50^\circ$
- (2) $m\angle 2 = 80^\circ$
- (3) $m\angle 3 = 50^\circ$
- (4) $m\angle 4 = 80^\circ$
- (5) $m\angle 4 = m\angle 3$

6. What is the measure of $\angle AXB$ if it is four times the measure of its supplement, $\angle BXC$?

- (1) 36°
- (2) 45°
- (3) 72°
- (4) 135°
- (5) 144°

Answers start on page 438.

GED Mini-Test • Lessons 23 and 24

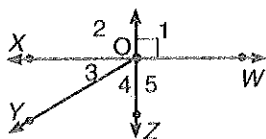
Directions: This is a thirty-minute practice test. After thirty minutes, mark the last item you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

Questions 1 through 3 refer to the figure.



1. Which of the following angles is supplementary, but not adjacent, to $\angle 2$?

- (1) $\angle 1$
- (2) $\angle 3$
- (3) $\angle 4$
- (4) $\angle 5$

(5) Not enough information is given.

2. The measure of $\angle 3$ is 25° . What is the measure of $\angle WOY$?

- (1) 65°
- (2) 115°
- (3) 135°
- (4) 155°
- (5) 165°

3. If an angle is supplementary to $\angle XOZ$, the angle must also be which of the following?

- (1) an acute angle
- (2) a right angle
- (3) an obtuse angle
- (4) a vertical angle
- (5) congruent to $\angle 3$

4. A circular pool has a circumference of about 40 meters. Which of the following expressions could be used to find the diameter of the pool in meters?

- (1) 40π
- (2) $\frac{40}{\pi}$
- (3) $\frac{\pi}{40}$
- (4) $\frac{2(40)}{\pi}$
- (5) $\frac{\pi}{2(40)}$

5. One side of the square base of a container measures 4 inches. If the container can be filled to a height of 4 inches, how many cubic inches of liquid can the container hold?

- (1) 12
- (2) 16
- (3) 20
- (4) 32
- (5) 64

6. A rectangular frame is $2\frac{1}{2}$ feet by 18 inches. What is the frame's perimeter in feet?

- (1) $3\frac{3}{4}$
- (2) 4
- (3) 8
- (4) $8\frac{3}{5}$
- (5) 9

7. $\angle A$ and $\angle B$ are adjacent angles.
If $m\angle A = 30^\circ$, what is the measure of $\angle B$?

- (1) 30°
- (2) 60°
- (3) 90°
- (4) 120°
- (5) Not enough information is given.

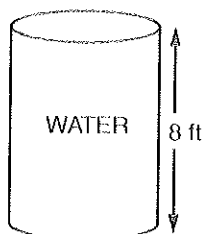
Question 8 refers to the following information.

	length	width	height
Bin A	7.6 ft	5 ft	8 ft
Bin B	8 ft	4.5 ft	8 ft
Bin C	7 ft	5.5 ft	8 ft

8. An apartment manager is having rectangular storage bins built. Which statement about the bins is true?

- (1) Bin A has the greatest volume.
- (2) Bin B has the greatest volume.
- (3) Bin C has the greatest volume.
- (4) Bins A and C have the same volume.
- (5) All three bins have the same volume.

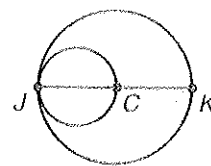
Question 9 refers to the following figure.



9. The diameter of the base of the water tank shown above is 6 feet. What is the volume of the water tank to the nearest cubic foot?

- (1) 28
- (2) 48
- (3) 72
- (4) 226
- (5) 904

Question 10 refers to the following diagram.



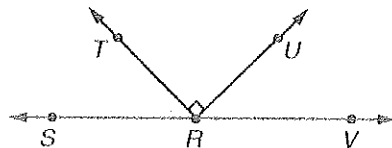
10. Two circles intersect at point J . If C is the center of the larger circle, and the diameter of the larger circle is 28 inches, what is the radius of the smaller circle in inches?

- (1) 1.75
- (2) 3.5
- (3) 7
- (4) 14
- (5) Not enough information is given.

11. What is the volume in cubic feet of a rectangular crate that is $3\frac{1}{2}$ feet by 1 foot 9 inches by 24 inches?

- (1) $6\frac{1}{2}$
- (2) $7\frac{1}{4}$
- (3) $12\frac{1}{4}$
- (4) $13\frac{1}{3}$
- (5) 147

Question 12 refers to the following figure.



12. If $m\angle URV = 53^\circ$, what is the measure of $\angle TRS$?

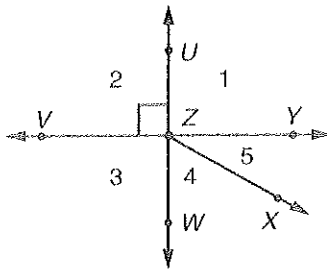
- (1) 37°
- (2) 53°
- (3) 106°
- (4) 127°
- (5) 143°

Answers start on page 438.

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

Questions 13 and 14 refer to the following figure.



13. Line UW intersects line VY at point Z . The measure of $\angle 4$ is 60° . What is the measure of $\angle UZX$?

- (1) 30°
- (2) 100°
- (3) 120°
- (4) 150°
- (5) 180°

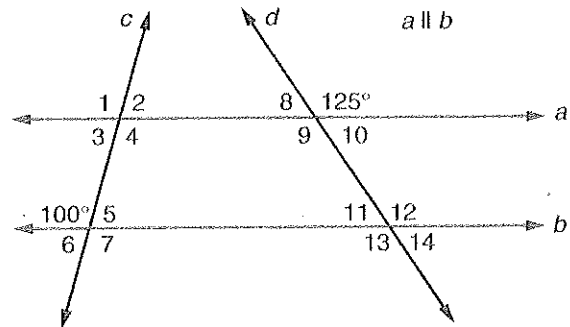
14. If $m\angle 4 = 60^\circ$, what is the measure of $\angle 5$?

- (1) 30°
- (2) 100°
- (3) 120°
- (4) 150°
- (5) 180°

15. Susan has a cabinet with the following measurements: length = 4 feet, width = 3 feet, and height = 10 feet. What is the volume of the cabinet in cubic feet?

- (1) 60
- (2) 80
- (3) 100
- (4) 120
- (5) 160

Questions 16 through 18 refer to the following figure.



16. Which of the following statements is true?

- (1) $\angle 3$ is complementary to $\angle 4$.
- (2) $\angle 12$ is supplementary to $\angle 13$.
- (3) $\angle 4$ and $\angle 10$ are congruent angles.
- (4) $\angle 1$ is a right angle.
- (5) $\angle 5$ is supplementary to $\angle 1$.

17. Which of these groups contains only angles that are congruent to $\angle 4$?

- (1) $\angle 1$, $\angle 2$, and $\angle 3$
- (2) $\angle 1$ and $\angle 7$
- (3) $\angle 1$, $\angle 8$, and $\angle 10$
- (4) $\angle 2$ and $\angle 7$
- (5) $\angle 7$, $\angle 10$, and $\angle 14$

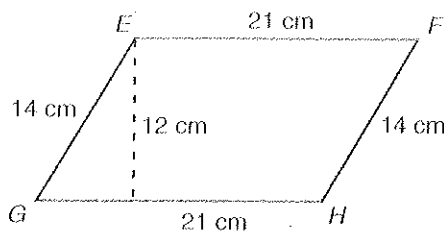
18. What is the measure of $\angle 12$?

- (1) 55°
- (2) 65°
- (3) 80°
- (4) 100°
- (5) 125°



Do not consider lines parallel or perpendicular unless the problem gives the information in either words or symbols.

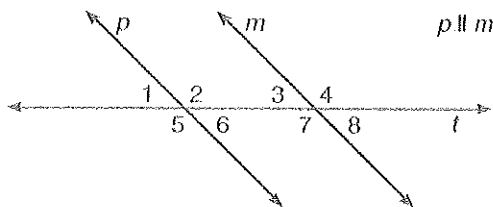
Question 19 refers to the following figure.



19. If $\overline{EF} \parallel \overline{GH}$ and $\overline{EG} \parallel \overline{FH}$, which expression can be used to find the area in square centimeters of figure $EFHG$?

- (1) $2(21) + 2(14)$
- (2) $21(14 + 12)$
- (3) $12(14)$
- (4) $21(12)$
- (5) $21(14)$

Questions 20 and 21 refer to the following figure.



20. Which of the following angles is equal in measure to angle 4?

- (1) $\angle 5$
- (2) $\angle 6$
- (3) $\angle 8$
- (4) $\angle 3$
- (5) $\angle 1$

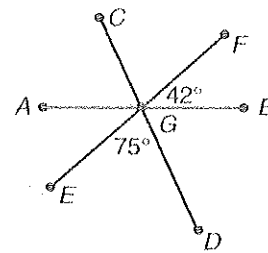
21. If $m\angle 8 = 45^\circ$, which of the following statements is true?

- (1) $m\angle 8 = m\angle 1$
- (2) $m\angle 7 = 45^\circ$
- (3) $m\angle 6 = 135^\circ$
- (4) $\angle 4$ and $\angle 8$ are complementary.
- (5) $\angle 3 \cong \angle 4$

22. Which of the following expressions can be used to find the circumference of a circle with a radius of 5 centimeters?

- (1) 2.5π
- (2) 3π
- (3) 6π
- (4) 10π
- (5) 25π

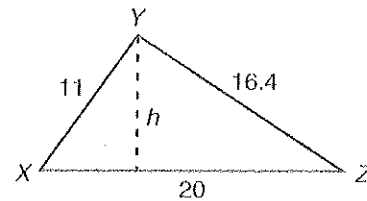
Question 23 refers to the following figure.



23. Which of the following explains why the measure of $\angle FGC = 75^\circ$?

- (1) $\angle FGC$ and $\angle FGB$ are adjacent angles.
- (2) $\angle FGC$ and $\angle CGA$ are supplementary angles.
- (3) $\angle FGC$ and $\angle DGE$ are vertical angles.
- (4) $\angle FGC$ and $\angle BGD$ are corresponding angles.
- (5) $\angle FGC$ and $\angle FGB$ are acute angles.

Question 24 refers to the following figure.



24. The area of $\triangle XYZ = 90$ square units. What is the measure of the height in units?

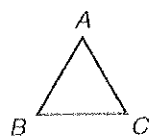
- (1) 9
- (2) 10
- (3) 21
- (4) 43
- (5) Not enough information is given.

Answers start on page 438.

Lesson 25

GED SKILL Triangles and Quadrilaterals

Triangles



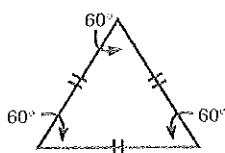
A triangle has three sides and three angles and is named by its vertices (in any order). Identify a side of a triangle by the two letters that name the vertices at the ends of the side. In $\triangle ABC$, the sides are $\overline{AB}$, $\overline{BC}$, and $\overline{AC}$.

A triangle is named by the lengths of its sides and the measures of its angles. The triangles below are named by the lengths of their sides.

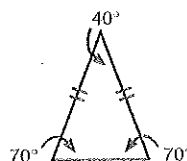


The symbols I, II, and III marked on a side show which sides are congruent. Remember: *Congruent means equal.*

Equilateral triangle
All sides and angles are congruent; each angle measures 60° .



Isosceles triangle
Two sides and the two angles opposite these sides are congruent.

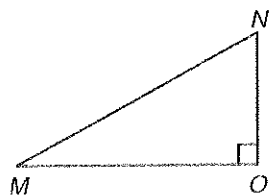


Scalene triangle
No sides and no angles are congruent.

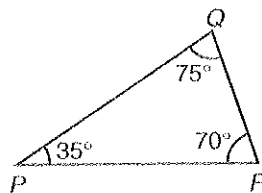


The following triangles are named by the measures of their angles.

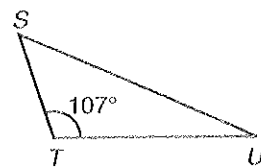
Right triangle
One angle is a right angle (equal to 90°).



Acute triangle
All three angles are acute (less than 90°).



Obtuse triangle
One angle is obtuse (greater than 90°).



In any triangle, the sum of the measures of the angles is 180° . (Note: A triangle can have only one right or obtuse angle. The other two angles must be acute.)

Example In a right triangle, one acute angle is twice the measure of the other acute angle. What is the measure of the larger angle?

Step 1 Make a sketch. A right triangle has one right angle ($m = 90^\circ$).

Step 2 Assign the unknowns.

Let x = the measure of the smaller acute angle.

Let $2x$ = the measure of the larger acute angle.

Step 3 Write an equation.

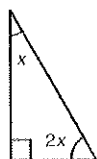
$$x + 2x + 90^\circ = 180^\circ$$

Step 4 Solve.

$$3x + 90^\circ = 180^\circ$$

$$3x = 90^\circ; \text{ so } x = 30^\circ \text{ and } 2x = 60^\circ$$

The larger acute angle measures 60° .

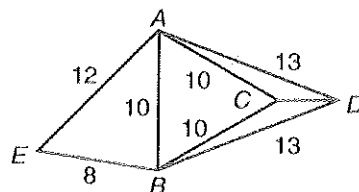


Questions on the GED Mathematics Test may include more information than you need to solve a problem. Use only the information you need based on what the question asks.

A. Solve.

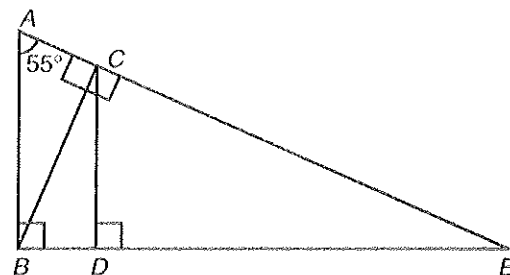
Refer to the figure at right to answer Questions 1 through 5. (*Hint: The figure contains 5 triangles.*)

1. Name an equilateral triangle.
2. Name an isosceles triangle.
3. Name an obtuse triangle.
4. Name an acute triangle.
5. Name a scalene triangle.



Refer to the figure at right to answer Questions 6 through 14.

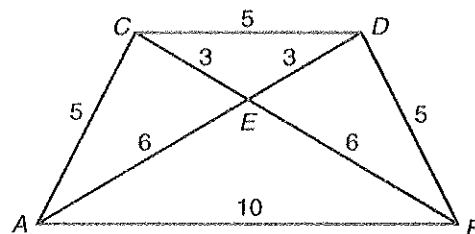
6. Name the triangle that has a right angle at B .
7. Name two triangles that have right angles at D .
8. Name two triangles that have right angles at C .
9. If $m\angle A = 55^\circ$, then what is $m\angle E$?
10. What is $m\angle ABC$?
11. What is $m\angle DCE$?



12. What is $m\angle CBD$?
13. What is $m\angle BCD$?
14. How are the five triangles in the figure alike?

Refer to the figure at right to answer Question 15.

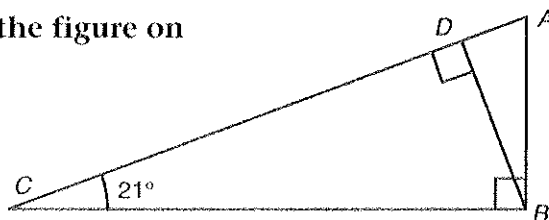
15. How many isosceles triangles are there in the figure? (*Hint: The figure contains 8 triangles.*)



16. In a right triangle the measure of one acute angle is 4 times the measure of the other acute angle. What is the measure of the smaller angle?
17. In a triangle the measure of one angle is 16° more than the measure of the smallest angle, and the measure of the third angle is twice the measure of the smallest angle. What are the three angle measures?

B. Write *True* or *False* for each statement. Refer to the figure on the right to answer Questions 18 through 23.

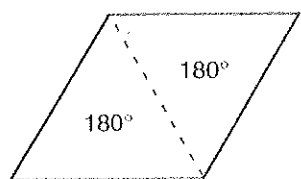
18. $\triangle ABC$ is an equilateral triangle.
19. $\triangle ABC$ is an obtuse triangle.
20. $m\angle BAC$ is equal to $m\angle CBD$.
21. $m\angle ABD$ is less than $m\angle ACB$.
22. $\triangle ABC$ is an acute triangle.
23. There are exactly three right triangles in the figure.



Answers start on page 440.

Quadrilaterals

A **quadrilateral** is any geometric figure with four (*quad*) sides (*lateral*). A figure with four sides also has four angles, and the sum of these four angle measures always equals 360° .

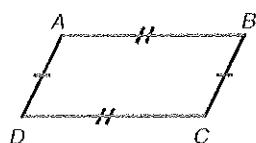


To prove this is so, draw any quadrilateral and draw a line segment called a **diagonal** between the vertices of two opposite angles. The diagonal divides the quadrilateral into two triangles. You know that the sum of the three angles in a triangle is 180° . Since there are two triangles, the sum of the angles in the quadrilateral must be $180^\circ + 180^\circ = 360^\circ$.

The following quadrilaterals appear on the GED Mathematics Test.

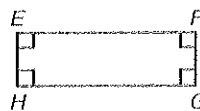
Parallelogram

opposite sides are parallel and congruent; opposite angles are of equal measure



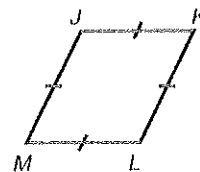
Rectangle

special parallelogram with four right angles



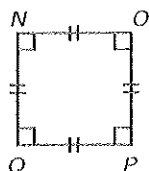
Rhombus

special parallelogram with four sides of equal length



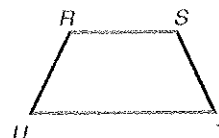
Square

special parallelogram/rhombus/rectangle with four sides of equal length and four right angles

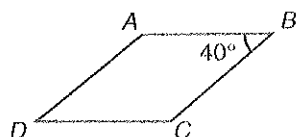


Trapezoid

only one pair of parallel sides (called bases)



Write algebraic expressions on the drawing to remember what the variables represent.



On the GED Mathematics Test, you must combine your knowledge of algebra and geometric principles to solve problems.

Example Angle B of the rhombus shown at the left measures 40° . What is the measure of $\angle C$?

Step 1 Identify known values.

$$m\angle B = 40^\circ$$

Step 2 Identify known relationships.

$$\text{sum of angles} = 360^\circ$$

Opposite angles are equal.

$$m\angle D = 40^\circ; m\angle C = m\angle A$$

Step 3 Assign the unknown values.

$$\text{Let } x = m\angle C \text{ (and } m\angle A)$$

Step 4 Write an equation.

$$m\angle A + m\angle B + m\angle C + m\angle D = 360^\circ$$

Step 5 Substitute known values.

$$x + 40^\circ + x + 40^\circ = 360^\circ$$

$$2(40^\circ) + 2x = 360^\circ$$

$$80^\circ + 2x = 360^\circ$$

$$2x = 280^\circ; x = 140^\circ$$

Step 6 Solve for unknown values.

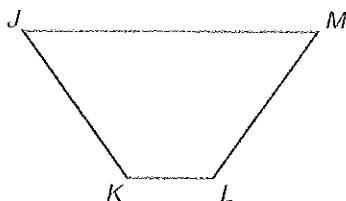
The measure of $\angle C$ is 140° .

A. Give all possibilities for the names of the following four-sided figures.

1. All sides have lengths of 10 inches.
2. All corners are right angles.
3. Opposite sides are parallel.
4. Only two sides are parallel.
5. There are no right angles.
6. Only one pair of opposite sides is equal in length.

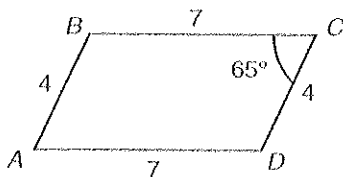
B. Solve.

Refer to the figure below to answer Questions 7 through 9.



7. Side $JM \parallel$ side KL . What is the most common name of this figure?
8. What is the sum of the four inside angle measures?
9. $m\angle K = m\angle L$ and $m\angle J = m\angle M$. If the measure of $\angle K$ is 125° , what is the measure of $\angle J$?

Refer to the figure below to answer Questions 10 through 12.



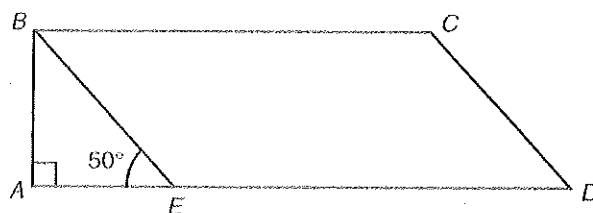
10. In the figure, $\overline{AB} \parallel \overline{CD}$ and $\overline{AD} \parallel \overline{BC}$. What is the most common name of this figure?
11. What is the measure of $\angle A$?
12. What is the measure of $\angle D$?

13. Quadrilateral $ABCD$ has two pairs of parallel opposite sides. Angle A measures 90° . What are the possible names of the quadrilateral?

14. In a quadrilateral, one angle is 20° less than another angle. The remaining two angles are right angles. What are the measures of the four angles?

15. The lengths of the sides of a four-sided figure, in order, are 8, 12, 8, and 12. There are no right angles, and opposite sides are parallel. What is the figure?

Refer to the figure to answer Questions 16 through 18.



16. Quadrilateral $BCDE$ is a parallelogram. What two things must be true about sides BC and ED ?
17. What is the measure of $\angle C$?
18. Quadrilateral $ABCD$ is a trapezoid. What is the measure of $\angle ABC$?

Answers start on page 441.

Congruent Figures



Always follow steps of logical reasoning to solve for the needed information.

Congruent figures are the same shape and size. One way to find out whether two figures are congruent is to place one figure on top of the other to see whether the sides and angles align perfectly. You may even be able to tell whether figures are congruent simply by looking at them. However, on the GED Mathematics Test, you need to be able to do more than identify which figures “look” congruent; you must be able to prove that the two figures are congruent.

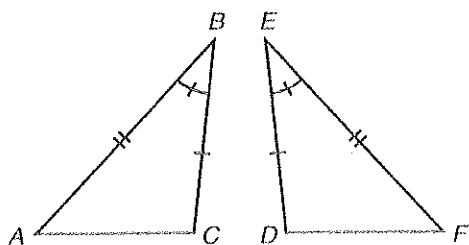
Let’s look at triangles. Congruent triangles are exactly the same shape and size. They have matching, or corresponding, vertices; sides; and angles. Marks are used to show which parts correspond.

There are three rules used to prove that two triangles are congruent. Two triangles are congruent if any one of the following rules is true:

RULE 1 Three sides (SSS) are congruent.

RULE 2 Two sides and the angle between them (SAS) are congruent.

RULE 3 Two angles and the side between them (ASA) are congruent.



Example 1 Are triangles ABC and FED congruent?

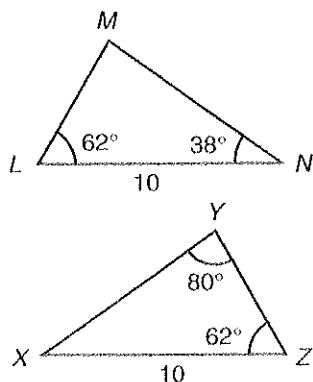
Step 1 Identify the given corresponding congruent parts. $\overline{AB} \cong \overline{FE}$, $\overline{BC} \cong \overline{ED}$
 $\angle B \cong \angle E$

Step 2 Identify what relationships are known.
There are two pairs of corresponding congruent sides. The angles between the congruent sides are also congruent. (SAS)

Step 3 Identify additional information needed.
None.

Step 4 Draw a conclusion. Rule 2 is true;
the triangles are congruent.

The triangles are congruent. $\triangle ABC \cong \triangle FED$



Example 2 Is $\triangle LMN$ congruent to $\triangle ZYX$?

Step 1 Identify the given congruent parts. $\angle L \cong \angle Z$; $\overline{LN} \cong \overline{ZX}$

Step 2 Identify known relationships. $\triangle LMN$: the measures of two angles and the length of the side between them (ASA)
 $\triangle ZYX$: the measure of one angle and the length of the adjacent side corresponding with $\triangle LMN$

Step 3 Identify needed information. measure of $\angle X$

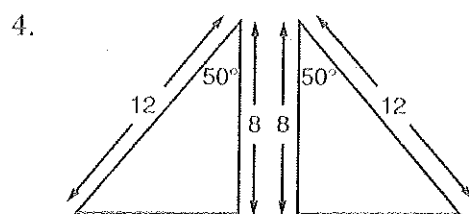
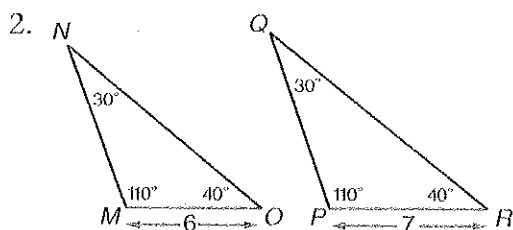
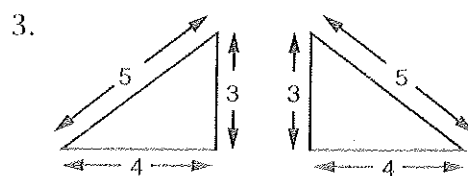
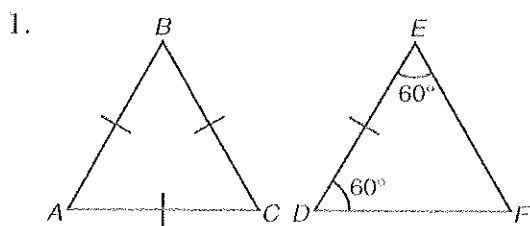
Step 4 Solve for needed information. Sum of the measures of the angles of a triangle = 180° , so $m\angle X + 80^\circ + 62^\circ = 180^\circ$
 $m\angle X = 180^\circ - 80^\circ - 62^\circ = 38^\circ$

Step 4 Draw a conclusion. $m\angle X = 38^\circ$; so $\angle X$ is congruent to $\angle N$
Rule 3 (ASA) is true; the triangles are congruent.

The triangles are congruent. $\triangle LMN \cong \triangle ZYX$

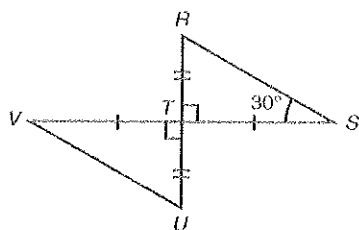
GED SKILL FOCUS

A. Decide whether each pair of triangles is congruent or not. Explain your reasoning.



B. Answer each question. If you do not have enough information to solve a problem, write *Not enough information is given*.

Refer to the figure below to answer Questions 5 through 7.

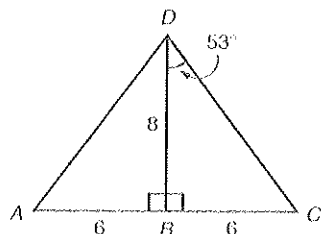


5. Is $\triangle TRS \cong \triangle TUV$? How do you know?

6. What is the measure of $\angle V$?

7. What is the measure of $\angle U$?

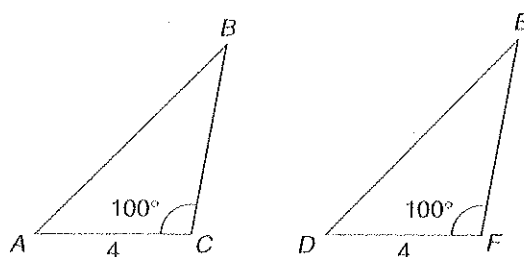
Refer to the figure below to answer Questions 8 and 9.



8. Is $\triangle BDA \cong \triangle BDC$? How do you know?

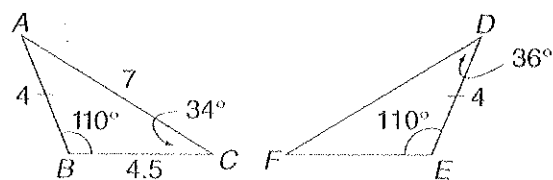
9. What is the measure of $\angle A$?

Refer to the figure below to answer Question 10.



10. Is $\triangle ABC \cong \triangle DEF$? How do you know?

Refer to the figure below to answer Questions 11 and 12.



11. What is the measure of $\angle A$?

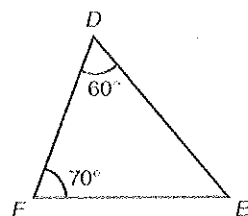
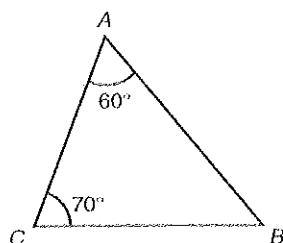
12. What is the length of $\overline{EF}$?

Answers start on page 441.

Similar Figures

Two figures are **similar** ($\sim$) if their corresponding angles have equal measure and the corresponding sides are in proportion. Similar figures have the same shape, but they are *not necessarily* the same size.

If the measures of two angles of one triangle are equal to two angle measures in another triangle, the measures of the third angles will also be equal (AAA) and the triangles are similar.



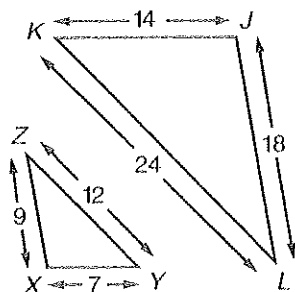
Example 1 Is $\triangle ABC$ similar to $\triangle DEF$?

In $\triangle ABC$, $m\angle A = 60^\circ$. In $\triangle DEF$, $m\angle D = 60^\circ$.

In $\triangle ABC$, $m\angle C = 70^\circ$. In $\triangle DEF$, $m\angle F = 70^\circ$.

Since the measures of two angles of $\triangle ABC$ are equal to two angle measures in $\triangle DEF$, the triangles are similar. $\triangle ABC \sim \triangle DEF$

If the lengths of the sides of one triangle are proportional to the lengths of the sides of the other triangle, the triangles are similar.



Example 2 Is $\triangle XYZ$ similar to $\triangle JKL$?

In $\triangle XYZ$, $\overline{XY}$ measures 7. In $\triangle JKL$, $\overline{JK}$ measures 14.

In $\triangle XYZ$, $\overline{XZ}$ measures 9. In $\triangle JKL$, $\overline{JL}$ measures 18.

In $\triangle XYZ$, $\overline{YZ}$ measures 12. In $\triangle JKL$, $\overline{KL}$ measures 24.

Write ratios comparing a side in $\triangle XYZ$ to its corresponding side in $\triangle JKL$. Reduce to simplest terms.

$$\frac{7}{14} = \frac{9}{18} = \frac{12}{24} \text{ Each ratio equals } \frac{1}{2}; \text{ they are equal.}$$

Since the ratios are equal, the lengths of the sides of $\triangle XYZ$ are proportional to the lengths of the sides of $\triangle JKL$. $\triangle XYZ \sim \triangle JKL$

Similar triangles are often used to solve problems when it is not possible to find a distance by measuring.

Example 3 At 4 p.m., a flagpole casts a 20-foot shadow. At the same time, a person 6 feet tall casts a 4-foot shadow. What is the height of the flagpole?

The sun strikes the person and flagpole at the same angle (since measurements are taken at the same place and same time). So, the objects and shadows form similar triangles.

Set up a proportion. $\frac{\text{person's height}}{\text{flagpole's height}} = \frac{6}{x} = \frac{4}{20} = \frac{\text{person's shadow}}{\text{flagpole's shadow}}$

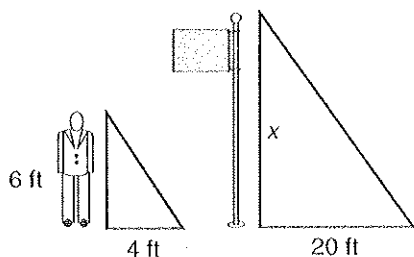
Solve.

$$4x = 6(20)$$

$$x = 120 \div 4$$

$$x = 30$$

The height of the flagpole is **30 feet**.

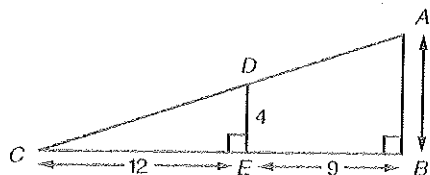


If the second triangle is turned differently than the first one, redraw one of the triangles to make it easier to see which sides correspond.

GED SKILL FOCUS

Solve.

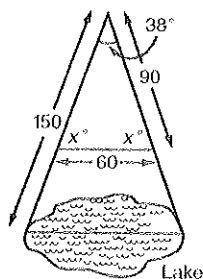
Refer to the figure below to answer Questions 1 and 2.



1. In the figure, $\triangle ABC \sim \triangle DEC$. Side $\overline{EC}$ is similar to which side of $\triangle ABC$?
2. What is the length of $\overline{AB}$?

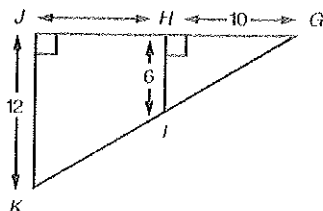
Refer to the information and figure below to answer Questions 3 and 4.

To determine the width of a lake, surveyors measure off two similar isosceles triangles as shown.



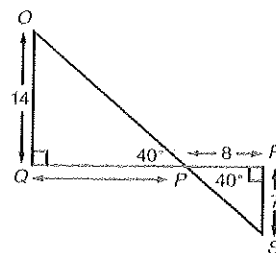
3. What is the value of x ?
4. What is the distance across the longest part of the lake?

Refer to the figure below to answer Questions 5 and 6.



5. In the figure, $\triangle GHI$ and $\triangle GJK$ are similar. What is the length of $\overline{GJ}$?
6. The measure of $\angle GIH$ is equal to the measure of what other angle?

Refer to the figure below to answer Questions 7 and 8.



7. $\angle S$ has the same measure as what other angle?

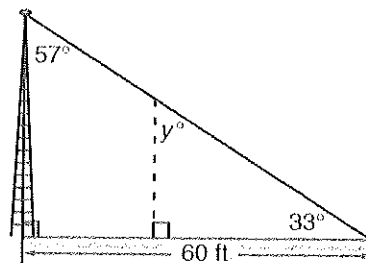
8. What is the length of $\overline{PQ}$?

9. At 11 A.M., a 5-foot post casts a 3-foot shadow. At the same time, a tree casts a shadow that is 21 feet in length. What is the height of the tree?

10. At 6 P.M., a signpost casts a shadow that is 4 feet in length. At the same time, a street lamp casts a shadow that is 16 feet in length. If the signpost is 6 feet tall, what is the height of the street lamp?

Refer to the information and figure below to answer Questions 11 and 12.

A 42-foot tower has a diagonal brace. To reduce the effects of the wind, an engineer wants to add a vertical support 20 feet from the tower and shown by the dotted line in the drawing.



11. What is the value of $\angle y$?
12. What will be the height of the new support?

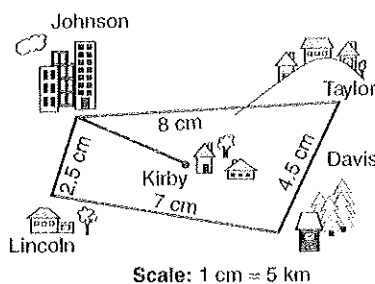
Answers start on page 442.

GED STRATEGY Solving Word Problems

Using Proportion in Geometry

Many measurement and geometry problems involve **indirect measurement**. Instead of making actual measurements, use proportions and knowledge of corresponding parts to find the answer. Finding a missing measurement when working with similar triangles is an example of indirect measurement. There are two other common measurement situations that can be solved using indirect measurement.

A **scale drawing** is a sketch of an object with all distances proportional to corresponding distances on the actual object. The **scale** gives the ratio of the sketch measurements to the actual measurements. A map is an example of a scale drawing.



Example 1 The distance on the map between Taylor and Davis is 4.5 cm. What is the actual distance between the two towns?

Step 1 Read the map scale. According to the scale 1 centimeter on the map equals 5 kilometers of actual distance.

Step 2 Write a proportion.

$$\frac{\text{map distance}}{\text{actual distance}} = \frac{1 \text{ cm}}{5 \text{ km}} = \frac{4.5 \text{ cm}}{x \text{ km}}$$

Step 3 Solve.

$$x = 5(4.5) = 22.5 \text{ km}$$

The actual distance is **22.5 kilometers**.



With real-life situations, use experience to decide whether your answers make sense. Is it reasonable that a living room would measure 12 ft by 18 ft? Yes, it is.

A **floor plan** is another example of indirect measurement. A floor plan is a map showing the layout of the rooms in a building. A floor plan usually shows the placement of doors and windows. It may also use symbols to show the placement of furniture.

Example 2 In a floor plan of the Martin's house, the rectangular living room measures 3 inches by $4\frac{1}{2}$ inches. Every 2 inches on the floor plan represents 8 actual feet. How many square feet of carpet are needed to cover the living room floor?

Step 1 Read the scale. The scale is given in the problem.
2 inches = 8 feet

Step 2 Write the proportions. You need to write two proportions to find the actual length and width of the room.

$$\frac{2 \text{ inches}}{8 \text{ feet}} = \frac{4.5 \text{ inches}}{l \text{ feet}} \quad \frac{2 \text{ inches}}{8 \text{ feet}} = \frac{3 \text{ inches}}{w \text{ feet}}$$

Step 3 Solve.

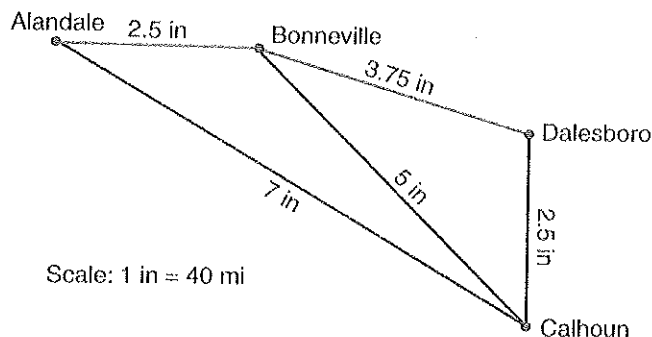
$$\begin{aligned} 2l &= 8(4.5) & 2w &= 8(3) \\ 2l &= 36 & 2w &= 24 \\ l &= 18 \text{ feet} & w &= 12 \text{ feet} \end{aligned}$$

Step 4 Find the area. $A = l \times w = 12 \times 18 = 216$ square feet

The living room floor will require **216 square feet** of carpet.

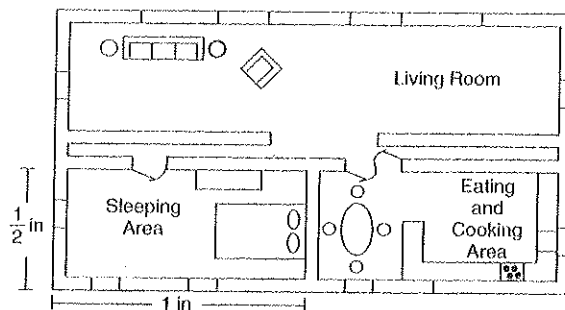
Directions: Choose the one best answer to each question.

Questions 1 and 2 refer to the following drawing.



- The map distances between cities are shown on the map. What is the actual distance in miles between Bonneville and Dalesboro?
 - 120
 - 150
 - 160
 - 180
 - 200
- Susan drove from Calhoun to Alandale, then from Alandale to Bonneville, and back to Calhoun. How many miles did she drive?
 - 460
 - 480
 - 540
 - 580
 - 620
- Hillsboro is 50 miles from Merville. On a map these towns are 2.5 inches apart. What is the scale of this map?
 - 1 in = $\frac{1}{5}$ mi
 - 1 in = 2 mi
 - 1 in = 2.5 mi
 - 1 in = 20 mi
 - 1 in = 25 mi

- In this floor plan, the scale is $\frac{3}{4}$ in = 15 ft. What are the dimensions of the actual sleeping area?
 - 10 feet by 20 feet
 - 12 feet by 24 feet
 - 15 feet by 30 feet
 - 20 feet by 40 feet
 - 25 feet by 50 feet



- A floor plan is drawn to a scale of 1 in = 8 ft. On the plan, one wall is $1\frac{3}{4}$ inches long. Will a 14-foot wall unit fit on this wall?
 - No, the wall unit is about 2 feet too long.
 - No, the wall unit is about 1 foot too long.
 - Yes, the wall unit fits exactly.
 - Yes, the wall unit fits with about 1 foot of extra space remaining.
 - Yes, the wall unit fits with about 2 feet of extra space remaining.
- A map scale is 1 in = 1.8 mi. How far is the actual distance in miles between two points that are 3.5 inches apart on the map?
 - 0.5
 - 1.9
 - 3.5
 - 6.3
 - 35.0

Answers start on page 443.

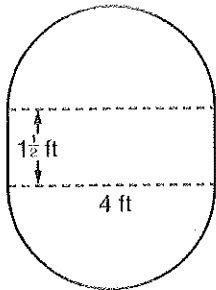
Lesson 26

GED SKILL Irregular Figures

Area and Volume

A figure may be made up of several shapes. To find the area or volume of a combined figure, find the area or volume of each of the parts and add the results.

Example 1 Marcus is stripping a table for refinishing. He needs to know the area of the tabletop in order to know how much wood stripper he will need. What is the area of the tabletop to the nearest square foot?



Step 1 Divide the figure into simple shapes. Think of each end as a half-circle attached to a rectangle.

Step 2 Find the area of each part. The two half-circles can be combined to make one whole circle.

Find the area of the circle.

$$A = \pi \times \text{radius}^2 = \pi r^2$$

Remember: $r = \frac{d}{2}$.

$$r = 4 \div 2 = 2$$

$$A = \pi r^2$$

$$= 3.14(2^2)$$

$$= 3.14(4) = 12.56 \text{ square feet}$$

Find the area of the rectangle.

$$A = lw$$

$$= 4\left(1\frac{1}{2}\right) = 6 \text{ square feet}$$

$$12.56 + 6 = 18.56,$$

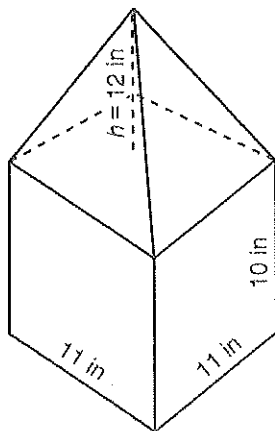
which rounds to 19 square feet

Step 3 Add the areas.

The area of the tabletop is about **19 square feet**.

Irregular figures can also be made up of common solid shapes.

Example 2 Find the volume of the object shown at left.



Step 1 Divide the figure into simple figures. This figure is made up of a pyramid and a rectangular solid.

Step 2 Find the volume of each part.

Find the volume of the pyramid.

$$V = \frac{1}{3} \times A \times h$$

Since the base is a square, $A = s^2$, where s = base edge.

$$V = \frac{1}{3} \times (\text{base edge})^2 \times \text{height}$$

$$= \frac{1}{3}(11^2)(12) = \frac{1}{3}(121)(12) = 484 \text{ cubic inches}$$

Find the volume of the rectangular solid.

$$V = l \times w \times h$$

$$= 11 \times 11 \times 10 = 1210 \text{ cubic inches}$$

Step 3 Add to find the total volume.

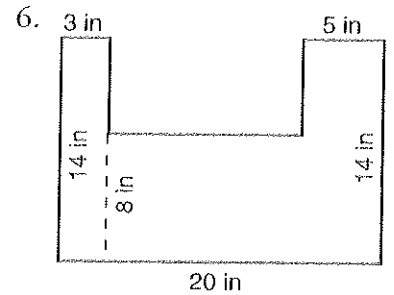
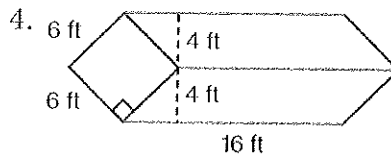
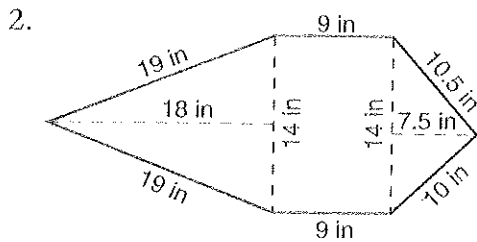
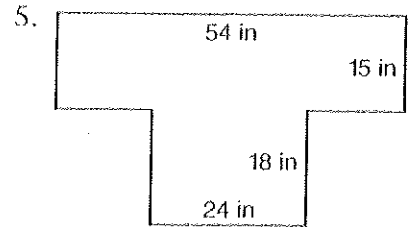
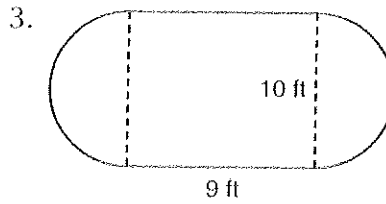
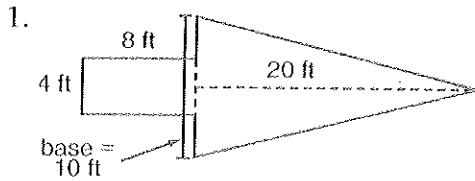
$$484 + 1210 = 1694 \text{ cubic inches}$$

The volume of the object is **1694 cubic inches**.

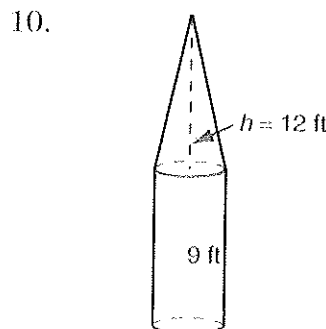
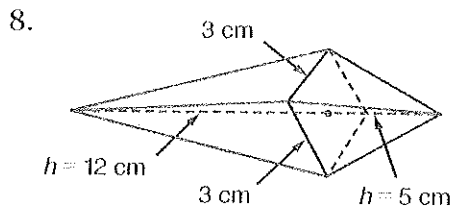
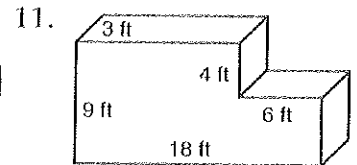
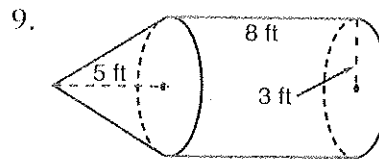
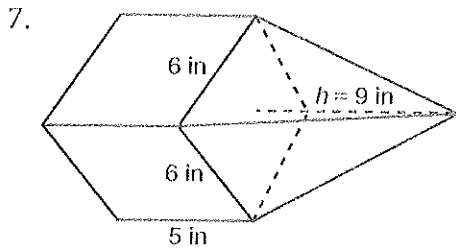
GED SKILL FOCUS



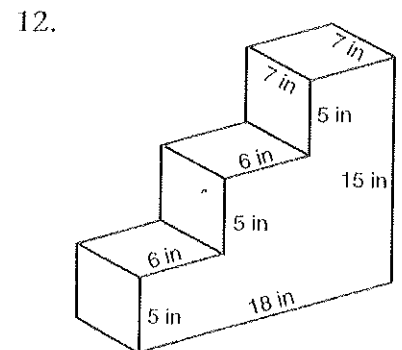
A. Find the area of each figure. You may use a calculator.



B. Each object is made of two or more solid shapes combined into one. Name the shapes and find the volume of each object. You may use a calculator.



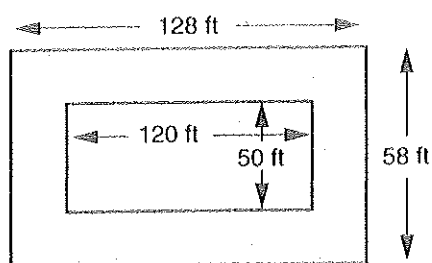
Area of base = 6.5 sq ft



Use logic to find missing measurements. Often the base of one figure is also the base of another figure in a combined figure.

Answers start on page 443.

Approaching Multi-Step Problems



Note: Figure is not drawn to scale.

Some problems involving irregular figures test your ability to use logical reasoning to find the solution. In these problems, you need to figure out how to use the information you have been given to find the area or volume of an unusual shape.

Example

An apartment complex has a central recreation area as shown in the diagram. The tenants vote to pave a 4-foot walkway around the lawn. What is the area of the walkway?

Addition method:

Sections 2 & 4:

$$A = lw = 128(4) = 512$$

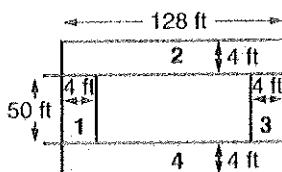
Sections 1 & 3:

$$A = lw = 50(4) = 200$$

$$\text{Sections } 1 + 2 + 3 + 4 =$$

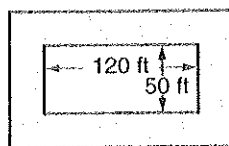
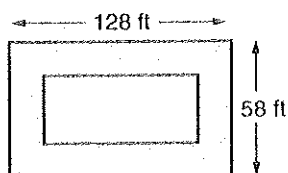
$$200 + 512 + 200 + 512 =$$

$$1424 \text{ sq ft}$$



Addition Method: One way to solve the problem is to divide the walkway into four rectangles, find the area of each rectangle, and add to find the total area.

Subtraction Method: The total area equals the area of the walkway plus the area of the lawn. Find the total area and then subtract the area of the lawn. The difference is equal to the area of the walkway.



Step 1 Find the area of the larger (outer) rectangle. $A = lw$
 $= 128(58)$
 The outer rectangle measures 128 by 58 feet. $= 7424 \text{ sq ft}$

Step 2 Find the area of the smaller rectangle. $A = lw$
 $= 120(50)$
 The smaller rectangle measures 120 by 50 feet. $= 6000 \text{ sq ft}$

Step 3 Find the difference. $7424 - 6000 = 1424 \text{ sq ft}$



Another method involves the use of the memory keys on your calculator. Use this key sequence on the GED calculator.

AC **SHIFT** **MR**

To clear the memory.

128 **×** 58 **=** 7424. **M+**

M+ means "add to memory."

120 **×** 50 **=** 6000. **SHIFT** **M+**

SHIFT M+ = M− means "subtract from memory."

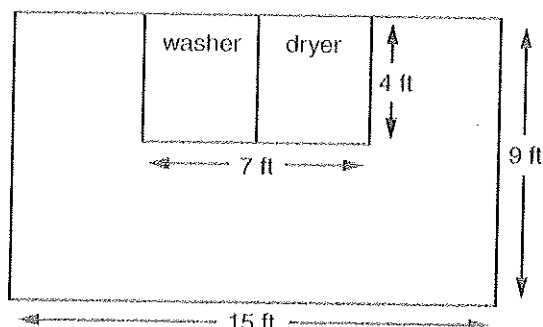
MR 1424.

MR means "memory recall."

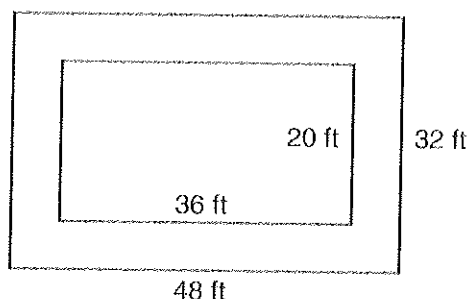
The area of the walkway is **1424 square feet**.

Solve.

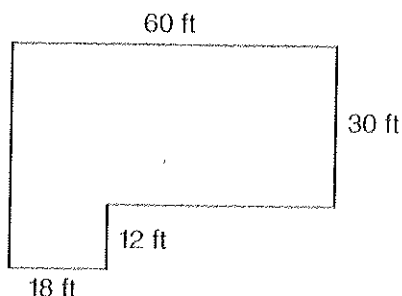
1. Emily plans to tile her laundry room floor, except for the space underneath the washer and dryer. Each tile covers 1 square foot of space. How many tiles will Emily need to do the job?



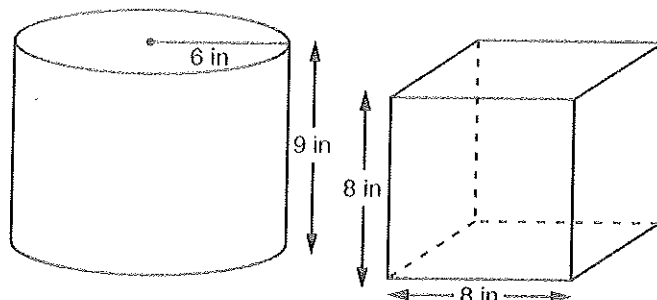
2. In the following figure, the shaded part shows the walkway around a garden. The garden measures 36 feet by 20 feet. How many square feet is the surface of the walkway?



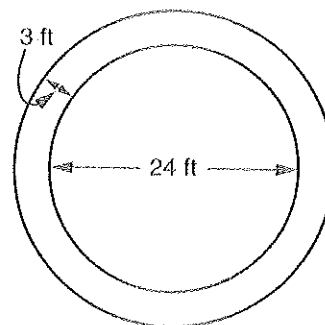
3. Construction workers will line the outside edge of a pool with tile strips, each 6 inches in length. How many strips are needed to go completely around the edge of the pool shown below?



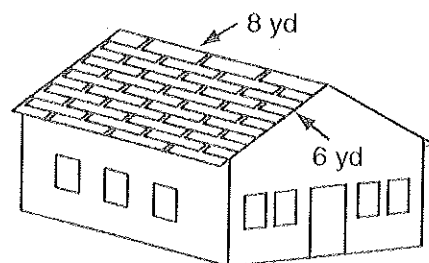
4. A toy maker is using a cylindrical container, shown below, to package a new toy. The toy is in the shape of a cube, 8 inches on a side. The remaining space inside the cylinder will be filled with protective filler. How many cubic inches of filler will be needed per package?



5. A circular fountain is 24 feet in diameter and has a three-foot wide gravel walkway around it. What is the area of the walkway in square feet?

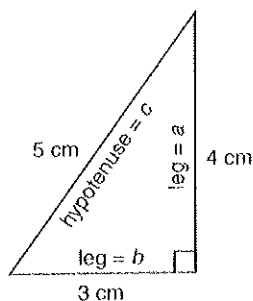


6. Jerry is ordering shingles for the roof of the storage building shown below. A bundle of shingles covers 3 square yards of roof. How many bundles of shingles should Jerry order?



Answers start on page 444.

The Pythagorean Relationship



The ancient Egyptians discovered a special property of triangles whose sides measure 3, 4, and 5 units. They learned that the angle opposite the longest side is always a right angle. The ancient Greeks learned why this relationship exists and named it the **Pythagorean Relationship** after the Greek mathematician Pythagoras.

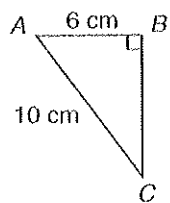
The Pythagorean Relationship explains the special relationship between the **legs** (the two shorter sides) and the **hypotenuse** (the longest side) of a right triangle. It states that in a right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse. Note that a 3-4-5 triangle is always a right triangle, but a right triangle is not always a 3-4-5 triangle.



Watch for 3-4-5 right triangles in problems on the GED Math Test. Multiples are also commonly used: 6-8-10, 9-12-15, and 1.5-2-2.5.

Pythagorean Relationship $a^2 + b^2 = c^2$, where a and b are the legs and c is the hypotenuse of a right triangle

You can use the Pythagorean Relationship to find a missing length of a right triangle.



Example 1 What is the length of side BC of the triangle shown to the left?

Step 1 Identify the legs and the hypotenuse. Sides AB and BC are the legs. Side AC is the hypotenuse. The hypotenuse is always opposite the right angle.

Step 2 Assign a variable. Let b represent the measure of side BC , a leg, the missing measure.

Step 3 Use the Pythagorean Relationship.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 6^2 + b^2 &= 10^2 \\ 36 + b^2 &= 100 \\ b^2 &= 64 \\ b &= \sqrt{64} \\ b &= 8 \end{aligned}$$



To find the length of a side b using a calculator, rewrite the Pythagorean Relationship as $c^2 - a^2 = b^2$. Then input as follows:

10 $\times^2$ $\pm$ 6 $\times^2$ $=$ SHIFT $\times^2$ 8.

The length of the missing side is **8 centimeters**.

Given the lengths of the sides of a triangle, you can use the Pythagorean Relationship to determine whether or not the triangle is a right triangle.

Example 2 The lengths of the sides of a triangle are 5, 6, and 9 inches. Is the triangle a right triangle?

If the triangle is a right triangle, the longest side, 9 inches, must be the hypotenuse. Substitute the other measures for a and b . Let $a = 5$ and $b = 6$. Then solve for c . If the solution is 9, the triangle is a right triangle.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 5^2 + 6^2 &= c^2 \\ 25 + 36 &= c^2 \\ 61 &= c^2 \\ \sqrt{61} &= c \approx 7.8 \end{aligned}$$

Use your calculator on the final step, or work backwards. If the hypotenuse, c , is 9, then $c^2 = 81$.

The triangle in the example is **not** a right triangle.

GED SKILL FOCUS

A. Each question gives the lengths of the three sides of a triangle. Write **Yes** if the triangle is right triangle. Write **No** if it is not.

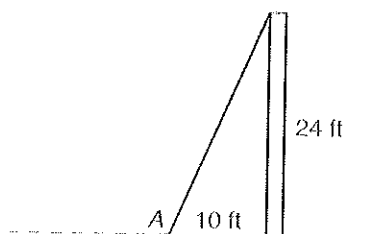
	a	b	c
1.	2	3	4
2.	2	6	7
3.	2	2	3
4.	3	3	5

	a	b	c
5.	11	60	61
6.	5	12	13
7.	18	24	30
8.	1	$1\frac{1}{3}$	$1\frac{2}{3}$

	a	b	c
9.	7	24	25
10.	25	60	65
11.	6.5	42	42.5
12.	8	50	51

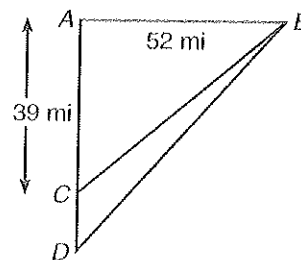
B. Solve as directed.

Refer to the diagram to answer Questions 13 and 14.



- The pole is perpendicular to the ground. How many feet of wire are needed to reach from the top of the pole to point A?
- If point A is moved 8 feet farther from the pole, how much more wire will be needed?

Refer to the diagram to answer Questions 15 and 16.

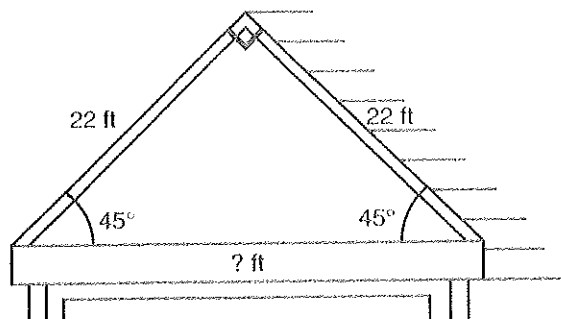


- How far is it from point C to point B?
- Point D is 11 miles from point C. To the nearest whole mile, how far is it from point D to point B?

Answers start on page 444.

Recognizing Applications of the Pythagorean Relationship

Many practical problems can be solved using the Pythagorean Relationship. Since diagonal bracing is often used to make structures stronger, construction situations often involve right triangles.



Example 1 A beam across the front of a garage needs to be replaced. Using the diagram at the left, what is the length of the beam to the nearest foot?

- (1) 26
- (2) 31
- (3) 44
- (4) 968
- (5) Not enough information is given.



Don't assume that a triangle is a right triangle. Always look for evidence that the triangle must be a right triangle before applying the Pythagorean Relationship.

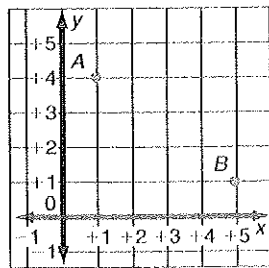
Did you realize that the front of the garage is a right triangle? The right angle is at the peak of the roof. The other angles each measure 45° . Remember that the sum of the angles in a triangle equals 180° . Even without the right angle symbol, you can prove that the peak of the roof is a right angle because $180^\circ - 45^\circ - 45^\circ = 90^\circ$. The beam across the front is the hypotenuse.

Use the Pythagorean Relationship.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 22^2 + 22^2 &= c^2 \\ 484 + 484 &= c^2 \\ 968 &= c^2 \\ \sqrt{968} = c &\approx 31.1 \end{aligned}$$

The wooden beam is about 31 feet in length. **Option 2 is correct.**

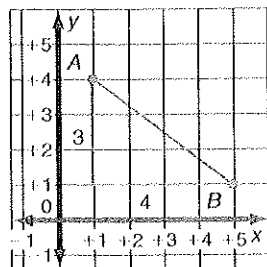
You know the distance formula for finding the distance between points on a coordinate grid. Using the Pythagorean Relationship may be easier.



Example 2 Find the distance between points A and B on the graph shown at right.

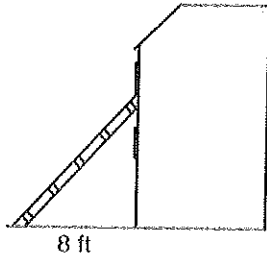
- Step 1** Let the distance between the points be the hypotenuse of a right triangle. Draw in the legs of the triangle so that they form a right angle.
- Step 2** Count units to find the lengths of the legs.
- Step 3** You can solve for the length of the hypotenuse using the Pythagorean Relationship; however, this triangle is the common 3-4-5 triangle. Since the legs measure 3 and 4 units, the hypotenuse is 5.

The distance between points A and B is **5 units**.



Directions: Choose the one best answer to each question.

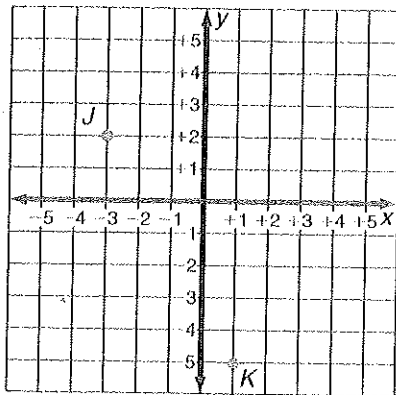
Question 1 refers to the following diagram.



1. The bottom of a ladder is placed 8 feet from the wall of a house. The wall and the ground form a right angle. If the ladder is 15 feet in length, how far up the wall does it reach (to the nearest foot)?

- (1) 12
- (2) 13
- (3) 17
- (4) 23
- (5) 161

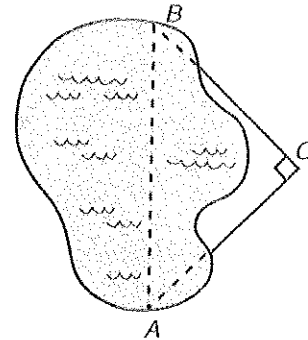
Question 2 refers to the following diagram.



2. What is the distance between points J and K to the nearest tenth unit?

- (1) 6.5
- (2) 7.7
- (3) 8.1
- (4) 8.6
- (5) 11.0

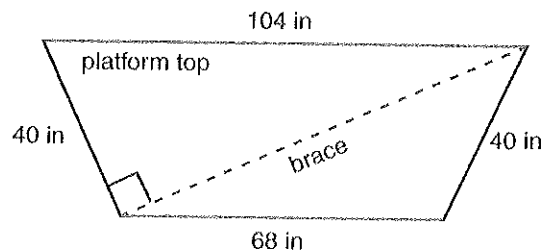
Question 3 refers to the following diagram.



3. Bill wants to find the width of the pond. He places stakes at A and B and then finds C so that C is a right angle. This makes $\triangle ABC$ a right triangle. If $AC = 60$ feet and $BC = 80$ feet, about how far is it from A to B ?

- (1) less than 85 ft
- (2) from 85 to 95 ft
- (3) from 95 to 105 ft
- (4) from 105 to 115 ft
- (5) more than 115 ft

Question 4 refers to the following diagram.



4. Jan builds a platform with a top in the shape of a trapezoid. The plans call for a diagonal brace to be added. What is the length of the brace to the nearest inch?

- (1) 64
- (2) 88
- (3) 96
- (4) 111
- (5) Not enough information is given.

Answers start on page 446.

Organizing Information

When solving problems, it is often helpful to organize a large amount of information into a chart or list. Information is often easier to understand when it is organized.

Example 1 Jane is considering joining a music club. If she joins Club A, she will receive eight free CDs, but she has to purchase four more CDs during the year at \$18.95 each. Club B offers six free CDs, but Jane would have to buy six more at the club price of \$14.90 each. If she joins Club C, she gets two free CDs, and she would have to buy ten more during the year for \$9.50 each. Which of the three options is the best buy if she only belongs to the club for one year?



Making a table can help you save time whenever several questions are based on the same paragraph of information.

- Step 1** The paragraph contains a great deal of information. As you read, find what the three clubs have in common. All three clubs offer free CDs, and all require Jane to buy more CDs at a certain price.
- Step 2** Create a table with columns.

Club	Free CDs	Number to Buy	Price Per CD
A	8	4	\$18.95
B	6	6	\$14.90
C	2	10	\$9.50

- Step 3** Compare the offers. You can see that Jane would end up with 12 CDs at the end of one year, no matter which club she joins. You can find the amount she would pay at each club by multiplying the number she is required to purchase by the price per CD.

$$\text{Club A: } \$18.95 \times 4 = \$75.80$$

$$\text{Club B: } \$14.90 \times 6 = \$89.40$$

$$\text{Club C: } \$9.50 \times 10 = \$95.00$$

Even though the price per CD is greater, **Club A is the best offer** if Jane belongs to the club for only one year.

Example 2 Rita is shopping for a new car. She wants an automatic transmission, which costs \$800, and an air conditioner for \$1100. The base price is \$15,789 and the transportation and handling is \$979. Rita also wants an anti-theft alarm for \$250. How much more will the car's total price be with the optional features added?

- Step 1** Make a chart with these categories: mandatory and optional.

<u>Mandatory</u>		<u>Optional</u>	
Base price	\$15,789	Air conditioner	\$1100
Transportation/handling	979	Auto transmission	800
		Anti-theft alarm	250

- Step 2** Once the prices are listed, add each column. The price of Rita's car without options is \$16,768. The options will add \$2,150 to the price of the car.

GED SKILL FOCUS



A. Solve. You may use your calculator. Refer to the following information to answer **Questions 1 through 4.**

Sheila and Paul are looking at apartments. Here are the results of what they have found.

- Apartment A rents for \$545 per month. Sheila and Paul would have to pay a full month's rent as a deposit and \$40 for keys.
- Apartment B requires a \$1000 deposit. The rent is \$525 per month. There is also a one-time \$25 fee per parking space needed.
- Apartment C is \$600 per month, but it requires a \$450 deposit plus 10% of one month's rent for a lease fee.
- Apartment D rents for \$565 per month. There is also a one-time \$30 parking fee, a \$580 deposit, and a \$50 fee for a credit check.

1. If Sheila and Paul choose Apartment B, how much rent will they pay in one year?

2. How much would it cost to rent Apartment D for a year, including initial fees?

3. How much more would the most expensive apartment cost in rent per year than the least expensive?

4. a. The move-in cost for an apartment includes one month's rent and any deposits or fees. How much is the move-in cost for Apartment A?

b. How much is the move-in cost for Apartment C?

B. Solve. Refer to the following information to answer **Questions 5 through 7.**

Tri-Towers Office Complex has several offices for lease. Tower 1 has three available offices that face east and four that face south. Five of the offices in Tower 2 face north and three face west. In Tower 3, six offices face east, two face north, and four face south.

5. Gordon wants to lease office space that faces east or south. What are his choices?

6. How many more offices are available in Tower 3 than in Tower 1?

7. How many more available offices face north or south than east or west?

Answers start on page 446.

Function Applications

As you may remember, a function is a rule that shows a special relationship from one set of numbers to another. We use functions in business and everyday life all the time. For example, total cost is a function of the number of items you buy. We express the function as a formula:

$$\text{total cost} = (\text{number of units}) \times (\text{price per unit}).$$

Example 1 At Selton Industries, workers are paid \$150 per day plus \$18 per each product assembled. At Wilshire Products, workers are paid \$42 per assembly. At both companies, daily pay (P) is a function of the number of products (n) assembled. The functions are shown below:

$$\text{Selton Industries: } P = \$150 + \$18n$$

$$\text{Wilshire Products: } P = \$42n$$

Jesse can complete five products in one day. How much more money would he earn per day working for Selton Industries than he would working for Wilshire Products?

Step 1 Find Jesse's pay at Selton Industries. $150 + 18(5) = 240$

Step 2 Find his pay at Wilshire Products. $42(5) = 210$

Step 3 Find the difference.
 $\$240 - \$210 = \$30$

Jesse would earn **\$30 more** per day at Selton Industries.



Use your calculator to find the difference.

$$240 - 210 = 30$$

Selton Industries pays Jesse \$30 more a day.

Example 2 The function $w = \frac{11(h-40)}{2}$ shows a person's recommended weight (w) in pounds as a function of his or her height (h) in inches.

Renata is 5 feet 8 inches tall. Based on the function, what is her recommended weight?

Step 1 Convert Renata's height into inches.

$$5 \text{ feet } 8 \text{ inches} = 68 \text{ inches}$$

Step 2 Plug Renata's height into the function.

$$w = \frac{11(h-40)}{2}$$

$$w = \frac{11(68-40)}{2}$$

$$w = \frac{11(28)}{2}$$

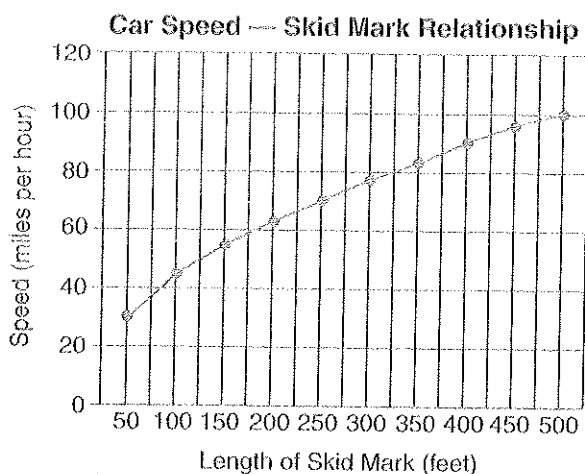
$$w = \frac{308}{2}$$

$$w = 154 \text{ --- Renata's recommended weight is 154 lbs.}$$



Directions: Choose the one best answer for each question. You MAY use your calculator.

1. How many feet a car skids when the driver steps hard on the brakes is a function of the speed of the car in miles per hour. The graph below shows this function.



After an accident, a police officer measures a skid mark of 310 feet. About how fast (in miles per hour) was the car traveling when the driver hit the brakes?

- (1) between 55 and 70 mph
 - (2) between 70 and 85 mph
 - (3) between 85 and 100 mph
 - (4) between 100 and 115 mph
 - (5) Not enough information is given.
2. The salespeople at Weston Shoes earn \$5.50 per hour (h) plus an 8% commission on their total sales (s). Which of the following formulas could be used to find the pay (P) for a salesperson at the shoe store?
- (1) $P = \$5.50 \times 0.08 \times h \times s$
 - (2) $P = \$5.50 + (0.08)s$
 - (3) $P = \$5.50 + 0.08(s + h)$
 - (4) $P = \$5.50s + 0.08h$
 - (5) $P = \$5.50h + 0.08s$

Question 3 refers to the following information.

Details of Long Distance Calling Plans

Plan	Monthly Fee	Charge per Minute
A	\$6.95	\$0.07
B	None	\$0.09
C	\$6.50	\$0.06
D	\$4.95	\$0.07
E	\$8.50	\$0.06

The following formula can be used to find the total monthly bill under any plan: $B = (c \times m) + f$, where B equals the total monthly bill, c equals the charge per minute, m equals the number of minutes of long distance calls, and f equals the monthly fee.

3. Based on prior bills, Melinda estimates that she makes about 300 minutes of long distance calls each month. Which of the calling plans would be best for her?
- (1) Plan A
 - (2) Plan B
 - (3) Plan C
 - (4) Plan D
 - (5) Plan E
4. To convert Celsius to Fahrenheit, use the following function: $F = \frac{9}{5}C + 32$ where C equals Celsius and F equals Fahrenheit. Yesterday in London, England it was 15°C . What was the temperature in Fahrenheit?
- (1) 32.12°F
 - (2) 33.4°F
 - (3) 59°F
 - (4) 71°F
 - (5) 84.6°F

Answers start on page 446.

GED Mini-Test • Lessons 25–27

Directions: This is a thirty-minute practice test. After thirty minutes, mark the last question you finished. Then complete the test and check your answers. If most of your answers are correct, but you didn't finish, try to work faster next time.



Part 1

Directions: Choose the one best answer to each question. You MAY use your calculator.

1. On a map with a scale of $1.5 \text{ cm} = 60 \text{ km}$, 4.7 cm on the map represents how many actual kilometers?

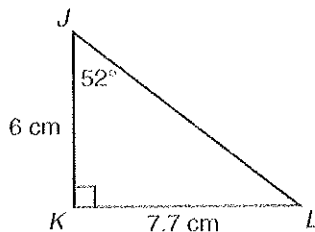
- (1) 40
- (2) 117
- (3) 188
- (4) 282
- (5) 423

4. Which of the following is a right triangle?

- (1) a triangle with sides of 4, 5, and 6
- (2) a triangle with sides of 5, 7, and 9
- (3) a triangle with sides of 6, 8, and 11
- (4) a triangle with sides of 7, 9, and 12
- (5) a triangle with sides of 7, 24, and 25

5. To the nearest foot, how long will the ladder need to be to reach a third floor window?

Questions 2 and 3 refer to the following diagram.

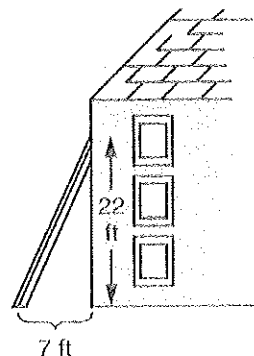


2. If $\triangle JKL$ is a right triangle, what is the measure of $\angle L$?

- (1) 26°
- (2) 38°
- (3) 52°
- (4) 90°
- (5) 128°

3. Which of the following expressions can be used to find the measure of side JL ?

- (1) $6 + 7.7$
- (2) $(6)^2 + (7.7)^2$
- (3) 6×7.7
- (4) $\sqrt{6 + 7.7}$
- (5) $\sqrt{(6)^2 + (7.7)^2}$

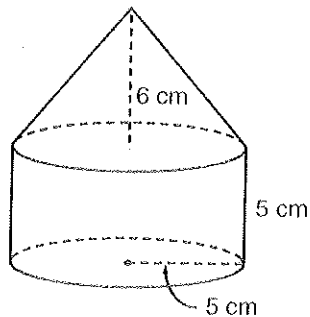


- (1) 18
- (2) 20
- (3) 22
- (4) 23
- (5) 25

6. A circular pool, 20 feet in diameter, has a 2-foot wide gravel walk around it. What is the approximate area of the walk in square feet?

- (1) 100
- (2) 138
- (3) 144
- (4) 314
- (5) 452

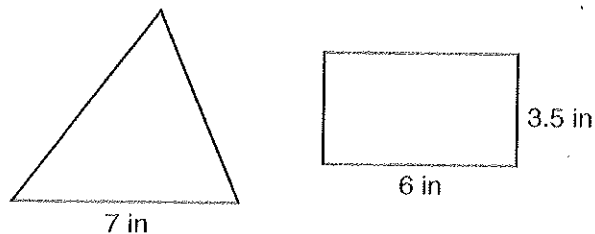
Question 7 refers to the following figure.



7. What is the volume to the nearest cubic centimeter of the object shown above?

- (1) 79
- (2) 157
- (3) 393
- (4) 471
- (5) 550

Question 8 refers to the following figures.



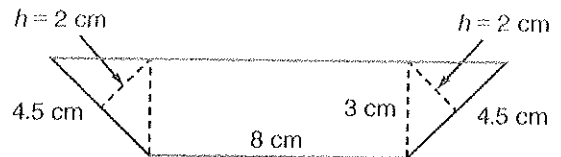
8. A rectangle and triangle have the same area. What is the height of the triangle in inches?

- (1) 3
- (2) 3.5
- (3) 6
- (4) 12
- (5) 21

9. A 3-foot post casts a $4\frac{1}{2}$ -foot shadow at the same time that a telephone pole casts a shadow of 33 feet. What is the length in feet of the telephone pole?

- (1) 18
- (2) 22
- (3) 28
- (4) 33
- (5) 99

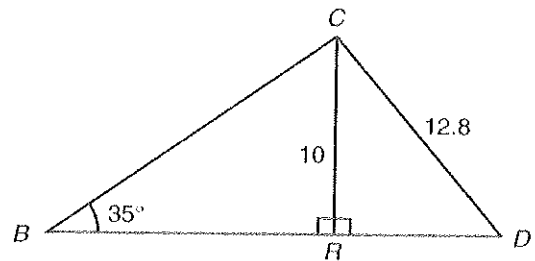
Question 10 refers to the following figure.



10. What is the area in square centimeters of the figure shown?

- (1) 27
- (2) 28.5
- (3) 33
- (4) 37.5
- (5) 42

Questions 11 and 12 refer to the following figure.



11. To the nearest unit, what is the measure of side RD ?

- (1) 3
- (2) 5
- (3) 7
- (4) 8
- (5) 16

12. In $\triangle BRC$, what is the measure of $\angle BCR$?

- (1) 35°
- (2) 45°
- (3) 55°
- (4) 90°
- (5) 135°

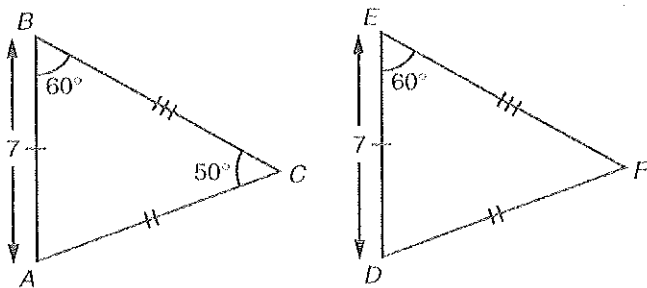
Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

13. A four-sided figure has sides, in order, of 6, 10, 6, and 10. There are no right angles. What is the figure?

- (1) triangle
- (2) square
- (3) trapezoid
- (4) rhombus
- (5) parallelogram

Question 14 refers to the following figure.



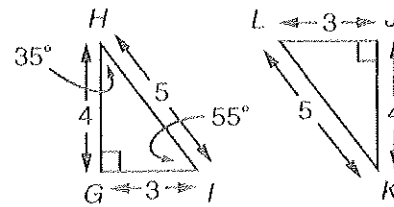
14. The two triangles are congruent. What is the measure of $\angle D$?

- (1) 50°
- (2) 70°
- (3) 110°
- (4) 180°
- (5) Not enough information is given.

15. The three sides of triangle ABC measure 12 feet, 16 feet, and 20 feet. Triangle DEF is similar to $\triangle ABC$. The shortest side of $\triangle DEF$ measures 15 feet. What are the lengths in feet of the other two sides of $\triangle DEF$?

- (1) 18 and 23
- (2) 18 and 25
- (3) 19 and 23
- (4) 20 and 24
- (5) 20 and 25

16. What is the measure of $\angle L$?

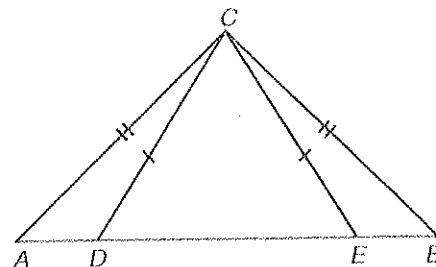


- (1) 35°
- (2) 45°
- (3) 55°
- (4) 90°
- (5) Not enough information is given.

17. Sides AB and BC of $\triangle ABC$ each measure 10 inches. If $m\angle A = 60^\circ$ and $m\angle B = 60^\circ$, what is the length in inches of side AC ?

- (1) 5
- (2) 6
- (3) 10
- (4) 14
- (5) Not enough information is given.

18. In order to prove that $\triangle ACE \cong \triangle BCD$ by SSS, it is necessary to know which of the following?



- (1) $\overline{AD} \cong \overline{BC}$
- (2) $\overline{AE} \cong \overline{BD}$
- (3) $\angle DAC \cong \angle EBC$
- (4) $\angle CDE \cong \angle CED$
- (5) $\overline{DE} \cong \overline{EB}$

19. A wooden rectangular frame is 6 feet by 8 feet. A diagonal brace will be added to the back of the frame. What is the length in feet of the brace?

(1) 5
(2) 7
(3) 8
(4) 10
(5) 13

20. A circle has a radius of 7 inches. Which of the following is the best estimate of the circumference of the circle in inches?

(1) 15
(2) 25
(3) 40
(4) 50
(5) 150

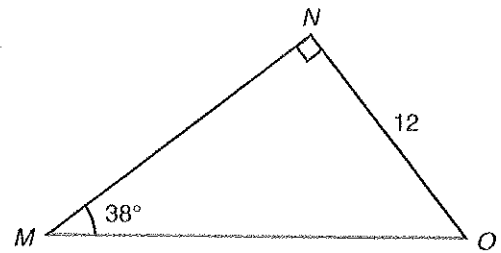
21. Triangle ABC has sides measuring 2.9, 4.6, and 4.9 cm. Its angle measures are 78° , 36° , and 66° . Triangle ABC can be classified as which of the following two kinds of triangles?

(1) equilateral and acute
(2) isosceles and acute
(3) isosceles and obtuse
(4) scalene and acute
(5) scalene and obtuse

22. In a right triangle, the measure of one acute angle is five times larger than the measure of the other acute angle. Which of the following equations can be used to find the measure of the smaller angle?

(1) $x + 5x + 90^\circ = 180^\circ$
(2) $x + (5 + x) + 90^\circ = 180^\circ$
(3) $x + 5x = 180^\circ$
(4) $90x + 5x = 180^\circ$
(5) $180^\circ - 90^\circ = 5x$

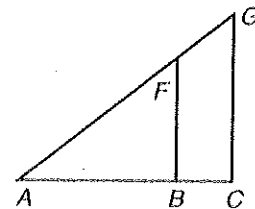
Question 23 refers to the following figure.



23. Which of the following expressions could be used to find angle O ?

(1) $38^\circ + 90^\circ$
(2) $180^\circ - 90^\circ + 38^\circ$
(3) $180^\circ - (90^\circ + 38^\circ)$
(4) $\sqrt{38^2 + 90^2}$
(5) Not enough information is given.

Question 24 refers to the following figure.



24. If $\triangle ABF \sim \triangle ACG$, then which of the following is a true proportion?

(1) $\frac{AF}{AB} = \frac{AB}{AC}$
(2) $\frac{AB}{AC} = \frac{FB}{GC}$
(3) $\frac{AF}{AC} = \frac{AC}{AB}$
(4) $\frac{AB}{GC} = \frac{AC}{FB}$
(5) $\frac{AG}{AC} = \frac{AB}{AF}$

Answers start on page 447.

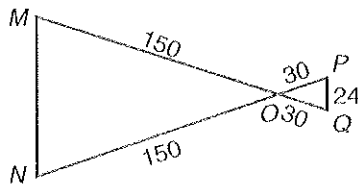
Unit 4 Cumulative Review Geometry



Part 1

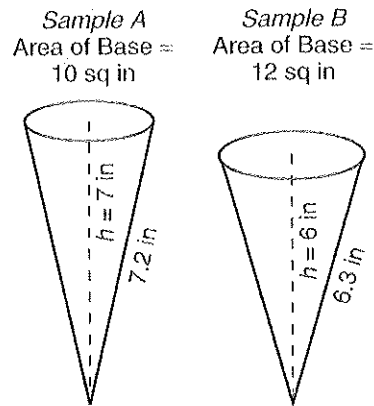
Directions: Choose the one best answer to each question. You MAY use your calculator.

Question 1 refers to the following figure.



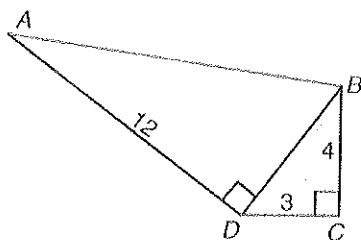
- If $\overline{PQ}$ and $\overline{MN}$ are parallel, what is the length of $\overline{MN}$?
 - 48
 - 60
 - 90
 - 120
 - 150
- What is the approximate area in square feet of a circular pool with a diameter of 8 feet?
 - 50
 - 48
 - 40
 - 20
 - 16
- The scale on a house plan is 1 inch = 2 feet. The drawing of the kitchen is 5 inches by 7 inches. What is the area of the actual kitchen in square feet?
 - 12
 - 24
 - 35
 - 70
 - 140

Question 4 refers to the following information.



- How many more cubic inches does Sample B hold than Sample A?
 - $\frac{2}{3}$
 - 3
 - 5
 - $6\frac{2}{3}$
 - 9
- To the nearest tenth meter, what is the circumference of a circle with a radius of 3 meters?
 - 4.7
 - 7.1
 - 9.4
 - 18.8
 - 28.2
- The inside volume of a refrigerator is 19.5 cubic feet. If the interior is 5.2 feet high and 1.5 feet deep, what is its width in feet?
 - 2.5
 - 2.9
 - 3.75
 - 13
 - 15.2

Question 7 refers to the following figure.



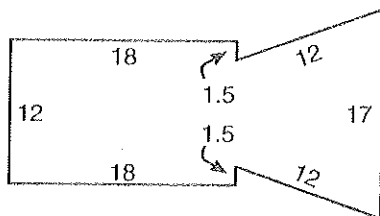
7. If $\angle ADB$ and $\angle C$ are right angles, what is the length of $\overline{AB}$?

- (1) 5
- (2) 10
- (3) 13
- (4) 16
- (5) 17

8. The perimeter of a rectangle is 5 feet. The length is 6 inches longer than the width. What is the width in inches?

- (1) 4
- (2) 8
- (3) 10
- (4) 12
- (5) 15

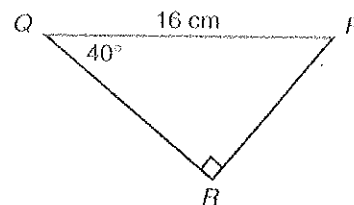
Question 9 refers to the following figure.



9. What is the perimeter of the figure?

- (1) 72
- (2) 75
- (3) 90
- (4) 92
- (5) 101

Questions 10 and 11 refer to the following figure.



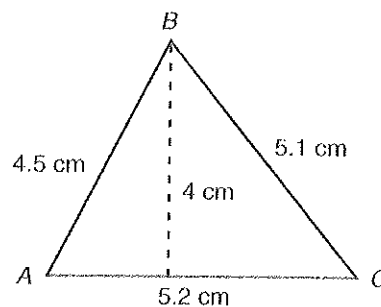
10. What is the measure of $\angle RPQ$?

- (1) 40°
- (2) 50°
- (3) 60°
- (4) 90°
- (5) 140°

11. Which of the following statements is true about $\triangle PQR$?

- (1) The lengths of $\overline{QR}$ and $\overline{PR}$ are equal.
- (2) The length of $\overline{QP}$ is the shortest.
- (3) The length of $\overline{PR}$ is longer than the length of $\overline{QR}$.
- (4) The length of $\overline{QR}$ is longer than the length of $\overline{PR}$.
- (5) The lengths of $\overline{QR}$, $\overline{PR}$, and $\overline{QP}$ are equal.

Question 12 refers to the following figure.



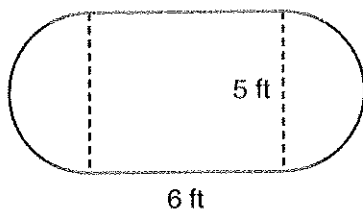
12. What is the area to the nearest square centimeter of $\triangle ABC$?

- (1) 10
- (2) 14
- (3) 17
- (4) 19
- (5) 21

13. In a right triangle, the measure of one acute angle is 5 times the measure of the other acute angle. What is the measure of the smaller acute angle?

- (1) 10°
- (2) 15°
- (3) 20°
- (4) 25°
- (5) 30°

Question 14 refers to the following figure.



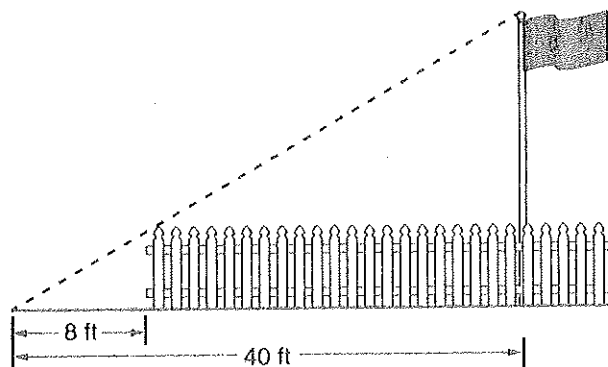
14. A tabletop has the measurements shown in the figure. If the ends of the table are half-circles, what is the approximate area of the tabletop in square feet?

- (1) 110
- (2) 80
- (3) 50
- (4) 40
- (5) 25

15. A cylinder-shaped candle mold has a base area of 12 square inches. The mold is 5 inches high. How many cubic inches of candle wax are needed to make 200 candles?

- (1) 452,160
- (2) 113,040
- (3) 37,680
- (4) 12,000
- (5) 3,400

Question 16 refers to the following figure.



16. The shadows cast by a fence post and a flagpole are measured at the same time of day. If the fence post is 5 feet in height, what is the height in feet of the flagpole?

- (1) 22
- (2) 25
- (3) 40
- (4) 320
- (5) Not enough information is given.

17. The scale on a map is 1 inch = 1.5 miles. The actual distance from Ivey to Garrett is 4 miles. How far apart in inches are these two cities on the map?

- (1) less than 2
- (2) $2\frac{1}{3}$
- (3) $2\frac{2}{3}$
- (4) 3
- (5) 6

18. Angles M and N are complementary angles. If $\angle M$ measures 26° , what is the measure of $\angle N$?

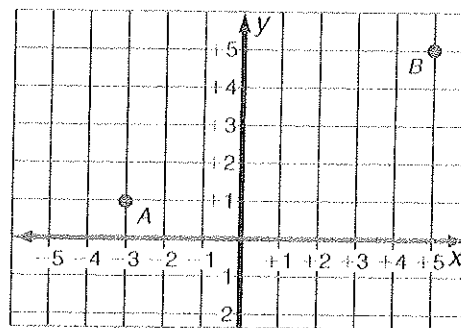
- (1) 26°
- (2) 64°
- (3) 90°
- (4) 154°
- (5) Not enough information is given.

Directions: Solve the following questions and enter your answers on the grids provided.

19. A parallelogram has a base of 32 yards and a height of 8 yards. How many yards is the side of a square with the same area as the parallelogram?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

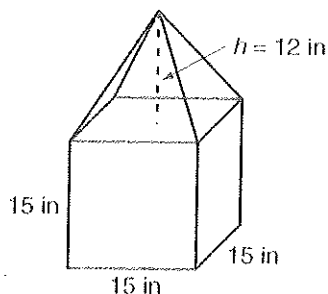
Question 21 refers to the following graph.



21. To the nearest whole unit, what is the distance between points A and B?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Question 20 refers to the following figure.



20. What is the volume of the figure in cubic inches?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

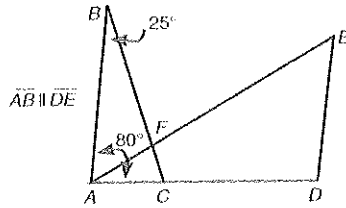
22. In a right triangle, the short leg is 9 and the hypotenuse is 15. What is the measure of the other leg?

/	/	/		
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Part 2

Directions: Choose the one best answer to each question. You may NOT use your calculator.

Questions 23 and 24 refer to the following figure.



23. Which of the following is a true statement regarding the measure of $\angle D$?

- (1) $m\angle D = m\angle BAC$
- (2) $m\angle D = m\angle BCD$
- (3) $m\angle D = m\angle B + m\angle BAC$
- (4) $m\angle D + m\angle BAC = 180^\circ$
- (5) $m\angle D + m\angle B = 90^\circ$

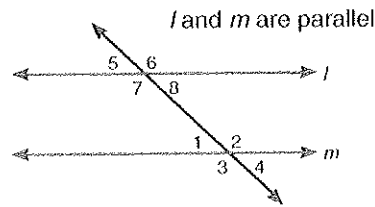
24. What is the degree measure of $\angle BCD$?

- (1) 105°
- (2) 110°
- (3) 120°
- (4) 125°
- (5) 130°

25. If C equals circumference, d = diameter, and r = radius, which of the following formulas is not valid?

- (1) $d = 2r$
- (2) $C = \pi d$
- (3) $C = 2\pi r$
- (4) $\frac{C}{d} = \pi$
- (5) $\pi = \frac{C}{r}$

Question 26 refers to the following figure.

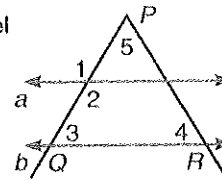


26. If $\angle 8$ measures 50° , which two angles measure 130° ?

- (1) $\angle 1$ and $\angle 7$
- (2) $\angle 2$ and $\angle 6$
- (3) $\angle 4$ and $\angle 6$
- (4) $\angle 4$ and $\angle 7$
- (5) $\angle 5$ and $\angle 7$

Questions 27 and 28 refer to the following figure.

Line a is parallel to line b .
 $m\angle 3 = m\angle 4$



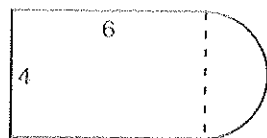
27. Which equation is true?

- (1) $m\angle 2 = 180^\circ - m\angle 1$
- (2) $m\angle 2 = m\angle 4$
- (3) $m\angle 2 = 180^\circ - m\angle 3$
- (4) $m\angle 2 = 90^\circ - m\angle 4$
- (5) $m\angle 2 = m\angle 3$

28. Which statement is true if $m\angle 3 = 60^\circ$?

- (1) $m\angle 5 = 45^\circ$
- (2) $m\angle 4 = 120^\circ$
- (3) $m\angle 2 = 60^\circ$
- (4) $m\angle 5 = 60^\circ$
- (5) $m\angle 1 = 135^\circ$

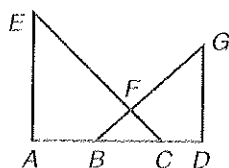
Question 29 refers to the following figure.



29. The figure shows a rectangle attached to a half-circle. Which of the following expressions represents the perimeter of the figure?

- (1) $16 + 2\pi$
- (2) $10 + 2\pi$
- (3) $10 + 4\pi$
- (4) $16 + 4\pi$
- (5) $24 + 4\pi$

Question 30 refers to the following figure.



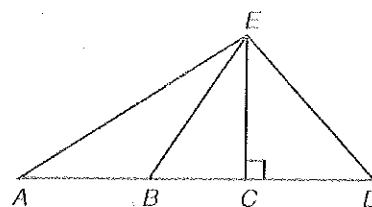
30. $\triangle AEC$ and $\triangle BDG$ are isosceles. What conclusion can be drawn?

- (1) $\overline{AB} \cong \overline{BC} \cong \overline{CD}$
- (2) $\overline{AC} \cong \overline{AE}$
- (3) $\overline{AE} \cong \overline{DG}$
- (4) $\angle E \cong \angle D$
- (5) $\overline{BF} \cong \overline{FC}$

31. The hypotenuse of a right triangle measures 12 inches. If one leg measures 7 inches, which of the following expressions could be used to find the length of the other leg?

- (1) $12^2 + 7^2$
- (2) $\sqrt{12^2 + 7^2}$
- (3) $12^2 - 7^2$
- (4) $\sqrt{12^2 - 7^2}$
- (5) $(12 + 7)^2$

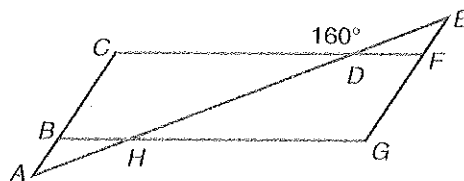
Question 32 refers to the following figure.



32. Triangle ECD is a right triangle. Which of the following must be an obtuse angle?

- (1) $\angle ABE$
- (2) $\angle ACE$
- (3) $\angle BCE$
- (4) $\angle DAE$
- (5) Not enough information is given.

Question 33 refers to the following figure.



33. The measure of $\angle CDE$ is 160° . If $\overline{CF} \parallel \overline{BG}$, which other angle is congruent to $\angle CDE$?

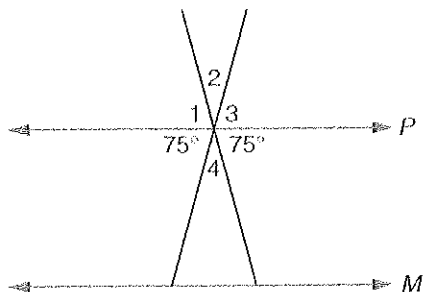
- (1) $\angle BCD$
- (2) $\angle EGH$
- (3) $\angle AHG$
- (4) $\angle ABH$
- (5) $\angle DFE$

34. The Grahams' rectangular yard measures 50 by 30 feet. They plan to plant a small square vegetable garden, measuring 12 feet per side, in one corner of the yard. The remaining area will be grass. What is the area in square feet of the grass portion of the yard?

- (1) 900
- (2) 1140
- (3) 1356
- (4) 1500
- (5) 1644

Directions: Solve the following questions and enter your answers on the grids provided.

Question 35 refers to the following figure.



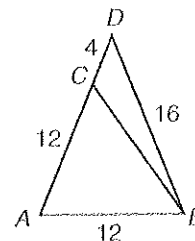
35. Lines p and m are parallel, and $\angle 2$ and $\angle 4$ are vertical angles. What is the measure of $\angle 4$ in degrees?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

36. The height of a triangle is 40 inches. If the area of the triangle is 200 square inches, what is the length of the base in inches?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Question 37 refers to the following figure.



37. The measure of $\angle DAB$ is 70° . What is the measure of $\angle D$ in degrees?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

38. A sign 4 meters tall casts a shadow 5 meters long. At the same time, a tree casts a shadow 30 meters long. What is the height of the tree in meters?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

Answers start on page 448.