

Unit 1

Number and Operations: Rational and Real Numbers

Focus

Use appropriate operations to solve problems and justify solutions.

CHAPTER 1

Algebra: Integers

BIG Idea Express quantitative relationships by using algebraic terminology, expressions, equations, inequalities, and graphs.

BIG Idea Use exponents, powers, and roots and use exponents in working with fractions.

CHAPTER 2

Algebra: Rational Numbers

BIG Idea Know the properties of, and compute with, rational numbers expressed in a variety of forms.

BIG Idea Choose appropriate units of measure and use ratios to convert within and between measurement systems to solve problems.

CHAPTER 3

Real Numbers and the Pythagorean Theorem

BIG Idea Know the Pythagorean theorem and understand plane and solid geometric shapes by constructing figures that meet given conditions and by identifying attributes of figures.

Cross-Curricular Project

Math and Geography

Bon Voyage! All aboard! We're setting sail on an adventure that will take us to exotic vacation destinations. Along the way, you'll act as a travel agent for one of three different families, working to meet their vacation needs while still staying within their budget. You will also plan their itinerary and offer choices of activities for them to participate in at their destinations. We'll be departing shortly, so pack your problem-solving tool kit and hop on board.



Log on to ca.gr7math.com to begin.



CHAPTER

1

Algebra: Integers

BIG Ideas

- **Standard 7AF1.0** Express quantitative relationships by using algebraic terminology, expressions, equations, inequalities, and graphs
- **Standard 7NS2.0** Use exponents, powers, and roots and use exponents in working with fractions.

Key Vocabulary

algebraic expression (p. 29)

equation (p. 57)

integer (p. 35)

variable (p. 29)

Real-World Link

Submarines Integers can be used to describe the depth of a submarine. You can also add and subtract integers to determine a change in depth.

FOLDABLES

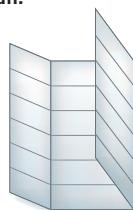
Study Organizer

Algebra: Integers Make this Foldable to help you organize your notes. Begin with a piece of $11'' \times 17''$ paper.

- 1** Fold the paper in sixths lengthwise.



- 2** Open and fold a 4'' tab along the short side. Then fold the rest in half.



- 3** Draw lines along the folds and label as shown.

	Words	Example(s)
A Plan for Problem Solving		
+ & - of Integers		
$\times$ & $\div$ of Integers		
Solving + & - Equations		
Solving $\times$ & $\div$ Equations		

GET READY for Chapter 1

Diagnose Readiness You have two options for checking Prerequisite Skills.

Option 2



Take the Online Readiness Quiz at ca.gr7math.com.

Option 1

Take the Quick Check below. Refer to the Quick Review for help.

QUICK Check

Add. (Prior Grade)

1. $64 + 13$
2. $10.32 + 4.7$
3. $2.5 + 77$
4. $38 + 156$
5. **SHOPPING** Mrs. Wilson spent \$80.20, \$72.10, \$68.50, and \$60.70 on school clothes for her children. Find the total amount she spent.
(Prior Grade)

Subtract. (Prior Grade)

6. $200 - 48$
7. $59 - 26$
8. $3.3 - 0.7$
9. $73.5 - 0.87$

Multiply. (Prior Grade)

10. $3 \times 5 \times 2$
11. 2.8×5
12. 12.7×6
13. $4 \times 9 \times 3$
14. **TRAVEL** The Perez family drove for 5.75 hours at 55 miles per hour. How far did they drive.
(Prior Grade)

Divide. (Prior Grade)

15. $244 \div 0.2$
16. $72 \div 9$
17. $96 \div 3$
18. $100 \div 0.5$
19. $2 \div 5$
20. $0.36 \div 0.3$
21. **BAGELS** A bag of 8 assorted bagels sells for \$6.32. What is the price per bagel? (Prior Grade)

QUICK Review

Example 1 Find $14.63 + 2.9$.

$$\begin{array}{r} 14.63 \\ + 2.90 \\ \hline 17.53 \end{array}$$

Line up the decimal points.
Annex a zero.

Example 2 Find $82 - 14.61$.

$$\begin{array}{r} 82.00 \\ - 14.61 \\ \hline 67.39 \end{array}$$

Annex two zeroes.

Example 3 Find 8.7×6 .

$$\begin{array}{r} 8.7 \\ \times 6 \\ \hline 52.2 \end{array}$$

← 1 decimal place
← + 0 decimal places
← 1 decimal place

Example 4 Find $4.77 \div 0.9$.

$$0.9 \overline{)4.77} \rightarrow 09 \overline{)47.7}$$

Multiply both numbers by the same power of 10.

$$\begin{array}{r} 5.3 \\ 9 \overline{)47.7} \\ -45 \\ \hline 27 \\ -27 \\ \hline 0 \end{array}$$

Place the decimal point and divide as with whole numbers.

Main IDEA

Solve problems by using the four-step plan.

**Standard 7MR1.1**

Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.

Reinforcement of Standard 6AF2.3 Solve problems involving rates, average speed, distance, and time.

MINI Lab

Suppose you are designing rectangular gardens that are bordered by white tiles. The three smallest gardens you can design are shown below.



Garden 1



Garden 2



Garden 3

1. How many white tiles does it take to border each of these three gardens?
2. Predict how many white tiles it will take to border the next-longest garden. Check your answer by modeling the garden.
3. How many white tiles will it take to border a garden that is 6 tiles long? Explain your reasoning.

Some problems, like the one above, can be solved by using one or more problem-solving strategies.

No matter which strategy you use, you can always use the four-step plan to solve a problem.

NEW Vocabulary

conjecture

1. **Explore**
 - Determine what information is given in the problem and what you need to find.
 - Do you have all the information you need?
 - Is there too much information?
2. **Plan**
 - Visualize the problem and select a strategy for solving it. There may be several strategies that you can use.
 - Estimate what you think the answer should be.
 - Make an educated guess or a **conjecture**.
3. **Solve**
 - Solve the problem by carrying out your plan.
 - If your plan doesn't work, try another.
4. **Check**
 - Examine your answer carefully.
 - See if your answer fits the facts given in the problem.
 - Compare your answer to your estimate.
 - You may also want to check your answer by solving the problem again in a different way.
 - If the answer is not reasonable, make a new plan and start again.

STUDY TIP**Problem-Solving Strategies**

- Make a model.
- Solve a simpler problem.
- Make an organized list.
- Make a table.
- Find a pattern.
- Work backward.
- Draw a graph.
- Guess and check.



Real-World EXAMPLE

1 GARDENING Refer to the Mini Lab on page 24. The table shows how the number of blue tiles it takes to represent each garden is related to the number of white tiles needed to border the garden. How many white tiles will it take to border a garden that is 10 blue tiles long?



Blue Tiles	1	2	3	4	5	6
White Tiles	8	10	12	14	16	18

Explore You know the number of white tiles it takes to border gardens up to 6 tiles long. You need to determine how many white tiles it will take to border a garden 10 tiles long.

Plan You might make the conjecture that there is a pattern to the number of white tiles used. One method of solving this problem is to look for a pattern.

Solve First, look for the pattern. Then, extend the pattern.

Blue Tiles	1	2	3	4	5	6	7	8	9	10
White Tiles	8	10	12	14	16	18	20	22	24	26

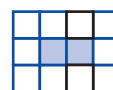
+2 +2 +2 +2 +2 +2 +2 +2 +2

It would take 26 white tiles to border a garden that was 10 blue tiles long.

Check It takes 8 white tiles to border a garden that is 1 blue tile wide. Each additional blue tile needs 2 white tiles to border it, one above and one below.



Garden 1



Garden 2

So, to border a garden 10 blue tiles long, it would take 8 white tiles for the first blue tile and 9×2 or 18 for the 9 additional tiles. Since $8 + 18 = 26$, the answer is correct.

STUDY TIP

Reasonableness

Always check to be sure your answer is reasonable. If the answer seems unreasonable, solve the problem again.

CHECK Your Progress

- a. **INTERNET** The table shows the number of visitors, rounded to the nearest thousand, to a new Web site on each of the first five days after the owners place an ad in a newspaper. If this pattern continues, about how many visitors should the Web site receive on day 8?

Day	Visitors
1	15,000
2	30,000
3	60,000
4	120,000
5	240,000



Some problems can be solved by a combination of operations.

READING Math

Word Problems It is important to read a problem more than once before attempting to solve it. You may discover important details that you overlooked when you read the problem the first time.

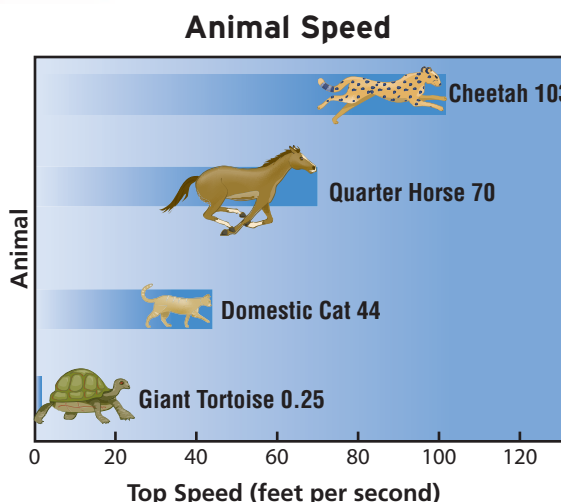


Real-World EXAMPLE

Use the Four-Step Plan

2

ANIMALS Refer to the graphic. If a cheetah and a giant tortoise travel at their top speed for 1 minute, how much farther does the cheetah travel?



Explore *What do you know?*

You know the top speeds for a cheetah and a giant tortoise in feet per second.

What are you trying to find?

You need to find the difference in the distances traveled by a cheetah and a giant tortoise in 1 minute.

Plan

Begin by determining the distance each animal traveled in 1 minute. Since 1 minute is 60 seconds, multiply each top speed by 60. Then, subtract to find the difference of the distances traveled by the two animals.

Estimate $100 \times 60 = 6,000$ and $0.25 \times 60 = 15$
 $6,000 - 15 = 5,985$

Solve

$103 \times 60 = 6,180$	Distance cheetah travels in 1 minute
$0.25 \times 60 = 15$	Distance giant tortoise travels in 1 minute
$6,180 - 15 = 6,165$	Difference in distances traveled

A cheetah will travel 6,165 feet farther than a giant tortoise in 1 minute.

Check

Is your answer reasonable? The answer is close to the estimate, so the answer is reasonable.



CHECK Your Progress

- b. **FOOD** Almost 90 million jars of a popular brand of peanut butter are sold annually. Use the four-step plan to determine the approximate number of jars sold every second.



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CHECK Your Understanding

Example 1
(p. 25)

1. **CRAFTS** A quilt is made using different-sized groups of square patches as shown below. Use the four-step plan to determine how many square patches it will take to create the 10th figure in this pattern.



Figure 1



Figure 2



Figure 3



Figure 4

Example 2
(p. 26)

ART For Exercises 2 and 3, use the following information.

The number of paintings an artist produced during her first four years as a professional is shown in the table at the right.

Year	Paintings Produced
1	59
2	34
3	91
4	20

2. About how many more paintings did she produce in the last two years than in the first two years?
3. Estimate the total number of paintings the artist has produced.

Exercises

HOMEWORK HELP

For Exercises	See Examples
4–5	1
6–7	2

Use the four-step plan to solve each problem.

4. **TRAVEL** The table shows a portion of the bus schedule for the bus stop at the corner of Second Street and Elm Street. What is the earliest time that Tyler can catch the bus if he cannot make it to the bus stop before 9:30 A.M.?
5. **HOBBIES** Owen fills his bird feeder with 4 pounds of sunflower seeds on Sunday morning. On Thursday morning, the bird feeder was empty, so he filled it again. The following Saturday, the seeds were half gone. If this feeding pattern continues, on what day will Owen need to fill his feeder?
6. **FIELD TRIP** Two 8th-grade teams, the Tigers and the Waves, are going to Washington, D.C. There are 123 students and 4 teachers on the Tigers team and 115 students and 4 teachers on the Waves team. If one bus holds 64 people, how many buses are needed for the trip?
7. **HISTORY** In 1803, the United States acquired the Louisiana Purchase from France for \$15 million. The area of this purchase was 828,000 square miles. If one square mile is equal to 640 acres, about how much did the United States pay for the Louisiana Purchase per acre?

Second and Elm Bus Schedule

6:40 A.M.
6:58 A.M.
7:16 A.M.
7:34 A.M.
7:52 A.M.
8:10 A.M.





Use the four-step plan to solve each problem.

8. **SCHOOL SUPPLIES** A bookstore sells pens for \$0.45 and writing tablets for \$0.85. How many pens and tablets could you buy for exactly \$2.15?
9. **JOBS** John stocks the vending machines at Rose Hill Elementary every 9 school days and Nassaux Intermediate every 6 school days. In September, he stocked both schools on the 27th. How many school days earlier had he stocked the vending machines at both schools on the same day?

EXTRAPRACTICE

See pages 676, 708.

Math Online

Self-Check Quiz at
ca.gr7math.com

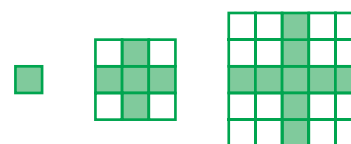
GEOMETRY For Exercises 10 and 11, draw the next two figures in each pattern.

10. 11.

H.O.T. Problems

12. **OPEN ENDED** Refer to the Mini Lab at the beginning of the lesson. Describe another method you could use to find the number of white tiles it takes to border a garden 12 green tiles long.

13. **CHALLENGE** Draw the next figure in the pattern at the right. How many white tiles are needed when 21 green tiles are used? Explain.



14. **SELECT A TECHNIQUE** Handy Crafts will paint a custom design on the back of a cell phone for \$3.25. Which of the following techniques should one use to determine the fewest number of phones that will need to be painted in order to earn \$58.29 for the painting supplies? Justify your selection(s). Then use the technique(s) to solve the problem.

mental math

estimation

paper/pencil

15. **WRITING IN MATH** Summarize the four-step problem-solving plan.



STANDARDS PRACTICE

16. Mrs. Acosta wants to buy 2 flag pins for each of the 168 band members for the Fourth of July Parade. Pins cost \$0.09 each. Which is the best estimate of the cost of the pins?

A \$8 C \$30
B \$20 D \$50

17. The next figure in the pattern will have what fraction of its area shaded?



F $\frac{3}{8}$
G $\frac{1}{2}$

H $\frac{5}{8}$
J $\frac{3}{4}$

GET READY for the Next Lesson

PREREQUISITE SKILL Add, subtract, multiply, or divide.

18. $15 + 45$

19. $1,287 - 978$

20. 4×3.6

21. $280 \div 0.4$

1-2

Variables, Expressions, and Properties

Main IDEA

Evaluate expressions and identify properties.



Standard 7AF1.2

Use the correct order of operations to evaluate algebraic expressions such as $3(2x + 5)^2$.

Standard 7AF1.3

Simplify numerical expressions by applying properties of rational numbers (e.g. identity, inverse, distributive, associative, commutative) and justify the process used.

Standard 7AF1.4

Use algebraic terminology (e.g. variable, equation, term, coefficient, inequality, expression, constant) correctly.

MINI Lab

The figures below are formed using toothpicks. If each toothpick is a unit, the perimeter of the first figure is 4 units.



Figure 1

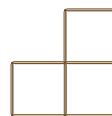


Figure 2

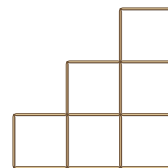


Figure 3

- Copy and complete the table. What is the relationship between the figure number and the perimeter of the figure?

Figure Number	1	2	3	4	5	6
Perimeter	4	8				

- What would be the perimeter of Figure 10?

A **variable** is a symbol, usually a letter, used to represent a number. You can use the variable n to represent the figure number in the Mini Lab above.

figure number

$$4 \times n$$

expression for perimeter of figure

NEW Vocabulary

variable
algebra
algebraic expression
evaluate
numerical expression
order of operations
powers
property
counterexample

The branch of mathematics that involves expressions with variables is called **algebra**. The expression $4 \times n$ is called an **algebraic expression** because it contains a variable, a number, and at least one operation.

To **evaluate** or find the value of an algebraic expression, first replace the variable or variables with the known values to produce a **numerical expression**, one with only numbers and operations. Then find the value of the expression using the **order of operations**.

READING in the Content Area

For strategies in reading this lesson, visit ca.gr7math.com.

KEY CONCEPT

Order of Operations

- Perform all operations within grouping symbols first; start with the innermost grouping symbols.
- Evaluate all powers before other operations.
- Multiply and divide in order from left to right.
- Add and subtract in order from left to right.



Algebra uses special ways of showing multiplication. Since the multiplication symbol $\times$ can be confused with the variable x , 4 times n is usually written as $4 \cdot n$, $4(n)$, or $4n$.

Expressions such as 7^2 and x^3 are called **powers** and represent repeated multiplication.

7 squared or $7 \cdot 7$

$\rightarrow 7^2$

$x^3 \leftarrow$

x cubed or $x \cdot x \cdot x$

STUDY TIP

Parentheses

Parentheses around a single number do not necessarily mean that multiplication should be performed first. Remember to multiply or divide in order from left to right.

$20 \div 4(2) = 5(2)$
or 10

EXAMPLES

Evaluate Algebraic Expressions

- 1** Evaluate $6(x - y)^2$ if $x = 7$ and $y = 4$.

$$6(x - y)^2 = 6(7 - 4)^2 \quad \text{Replace } x \text{ with } 7 \text{ and } y \text{ with } 4.$$

$$= 6(3)^2 \quad \text{Perform operations in the parentheses first.}$$

$$= 6 \cdot 9 \text{ or } 54 \quad \text{Evaluate the power. Then multiply.}$$

- 2** Evaluate $g^2 - 2g - 4$ if $g = 5$.

$$g^2 - 2g - 4 = (5)^2 - 2(5) - 4 \quad \text{Replace } g \text{ with } 5.$$

$$= 25 - 2(5) - 4 \quad \text{Evaluate powers before other operations.}$$

$$= 25 - 10 - 4 \quad \text{Multiply 2 and 5.}$$

$$= 15 - 4 \text{ or } 11 \quad \text{Subtract from left to right.}$$

CHECK Your Progress

Evaluate each expression if $c = 3$ and $d = 7$.

a. $6c + 4 - 3d$

b. $4(d - c)^2 + 1$

c. $d^2 + 5d - 6$

The fraction bar is another grouping symbol. Evaluate the expressions in the numerator and denominator separately before dividing.

EXAMPLE

Evaluate Algebraic Fractions

- 3** Evaluate $\frac{4 + 6m}{2n - 8}$ if $m = 9$ and $n = 5$.

$$\frac{4 + 6m}{2n - 8} = \frac{4 + 6(9)}{2(5) - 8} \quad \text{Replace } m \text{ with } 9 \text{ and } n \text{ with } 5.$$

$$= \frac{58}{2(5) - 8} \quad \text{Evaluate the numerator.}$$

$$= \frac{58}{2} \text{ or } 29 \quad \text{Evaluate the denominator. Then divide.}$$

CHECK Your Progress

Evaluate each expression if $p = 5$ and $q = 12$.

d. $\frac{3p - 6}{8 - p}$

e. $\frac{4q}{q + 2(p + 1)}$

f. $\frac{q^2}{4p - 2}$



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A **property** is a feature of an object or a rule that is always true. The following properties are true for any number.

Property	Algebra	Arithmetic
Commutative	$a + b = b + a$ $a \cdot b = b \cdot a$	$6 + 1 = 1 + 6$ $7 \cdot 3 = 3 \cdot 7$
Associative	$a + (b + c) = (a + b) + c$ $a \cdot (b \cdot c) = (a \cdot b) \cdot c$	$2 + (3 + 8) = (2 + 3) + 8$ $3 \cdot (4 \cdot 5) = (3 \cdot 4) \cdot 5$
Distributive	$a(b + c) = ab + ac$ $a(b - c) = ab - ac$	$4(6 + 2) = 4 \cdot 6 + 4 \cdot 2$ $3(7 - 5) = 3 \cdot 7 - 3 \cdot 5$
Identity	$a + 0 = a$ $a \cdot 1 = a$	$9 + 0 = 9$ $5 \cdot 1 = 5$

Concepts in Motion
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EXAMPLE

Identify Properties

- 4** Name the property shown by the statement $2 \cdot (5 \cdot n) = (2 \cdot 5) \cdot n$.

The order of the numbers and variables did not change but their grouping did. This is the Associative Property of Multiplication.



CHECK Your Progress

Name the property shown by each statement.

g. $42 + x + y = 42 + y + x$

h. $3x + 0 = 3x$



You may wonder whether any of the properties applies to subtraction or division. If you can find a **counterexample**, an example that shows that a conjecture is false, the property does not apply.

EXAMPLE

Find a Counterexample

- 5** State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.

Division of whole numbers is commutative.

Write two division expressions using the Commutative Property.

$15 \div 3 \stackrel{?}{=} 3 \div 15$ **State the conjecture.**

$5 \neq \frac{1}{5}$ **Divide.**

We found a counterexample. That is, $15 \div 3 \neq 3 \div 15$. So, division is *not* commutative. The conjecture is false.



CHECK Your Progress

- i. State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.

The difference of two different whole numbers is always less than either of the two numbers.

Vocabulary Link
Conjecture
Everyday Use a guess
Math Use an informed guess based on known information.





CHECK Your Understanding

Examples 1–3
(p. 30)

Evaluate each expression if $a = 2$, $b = 7$, and $c = 4$.

1. $(a + b)^2$
2. $4(a + b - c)^2$
3. $c^2 - 2c + 5$
4. $b^2 - 2a + 10$
5. $\frac{bc}{2}$
6. $\frac{c^2}{b - 5}$

Example 3
(p. 30)

7. **INSECTS** The expression $\frac{c}{4} + 37$ gives the approximate temperature of the air in degrees Fahrenheit, given the number of chirps c per minute made by a cricket. If Brandon estimates that a cricket has chirped 140 times in the past minute, what is the approximate temperature of the air in degrees Fahrenheit?

Example 4
(p. 31)

Name the property shown by each statement.

8. $3(m + n) = 3m + 3n$
9. $6(5 \cdot y) = (6 \cdot 5)y$

Example 5
(p. 31)

10. State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.

Subtraction of whole numbers is associative.

Exercises

HOMEWORK HELP

For Exercises	See Examples
11–22	1–3
23, 24	3
25–32	4
33–36	5

Evaluate each expression if $w = 2$, $x = 6$, $y = 4$, and $z = 5$.

11. $2x + y$
12. $3z - 2w$
13. $9 + 7x - y$
14. $12 + z - x$
15. wx^2
16. $(wx)^2$
17. $\frac{x^2 - 3}{2z + 1}$
18. $\frac{wz^2}{y + 6}$

Evaluate each expression if $a = 4$, $b = 3$, and $c = 6$.

19. $3(c - b)^2 - a$
20. $2(ab - 9)^2 \div c$
21. $3b^2 + 2b - 7$
22. $2c^2 - 4c + 5$

23. **MEASUREMENT** When a temperature in degrees Fahrenheit F is known, the expression $\frac{5F - 160}{9}$ can be used to find the temperature in degrees Celsius C . If a thermometer shows that the temperature is 50°F , what is the temperature in degrees Celsius?

24. **TRAVEL** The cost of renting a car from EZ Rent-A-Car for a day is given by the expression $\frac{270 + m}{10}$, where m is the number of miles driven. How much would it cost to rent a car for one day and drive 50 miles?

Name the property shown by each statement.

25. $1(12 \cdot 4) = 12 \cdot 4$
26. $14(16 \cdot 32) = (14 \cdot 16)32$
27. $a + (b + 12) = (b + 12) + a$
28. $(5 + x) + 0 = 5 + x$
29. $15(3 + 6) = 15(3) + 15(6)$
30. $16 + (c + 17) = (16 + c) + 17$
31. $9(ab) = (9a)b$
32. $y \cdot 7 = 7y$

**Real-World Link . . .**

The average dog visits its veterinarian almost twice as many times as the average cat or horse.

Source: The American Veterinary Medical Association

State whether each conjecture is *true* or *false*. If *false*, provide a counterexample.

33. The sum of two even numbers is always even.
34. The sum of two odd numbers is always odd.
35. Division of whole numbers is associative.
36. Subtraction of whole numbers is commutative.

••PETS For Exercises 37 and 38, use the information below.

You can estimate the number of a certain type of pet in a community with a population of c people by evaluating the expression $\frac{c}{n} \cdot p$. The variable n is the number of people per household, and p is the percent of households owning that pet.

National Percent of Households Owning Pets	
Dogs	0.316
Cats	0.273
Birds	0.046
Horses	0.015

Source: U.S. Pet Ownership & Demographics Sourcebook

37. According to the 2000 U.S. Census, there are approximately 2.62 people per household. Estimate the number of dog-owning households for a community with a population of 50,000.
38. Estimate the number of bird-owning households in this community.
39. **PHYSICAL SCIENCE** The distance in feet an object falls t seconds after it is released is given by the expression $\frac{gt^2}{2}$, where g is the force of gravity. How many feet will a stone fall 3 seconds after it is released from the top of a cliff? Assume a force of gravity of 16 feet per second squared.

Write each verbal statement as an algebraic expression.

40. the square of x minus the sum of four times x and 6
41. three times n cubed increased by four times n
42. the product of 3 and r decreased by the quotient of r squared divided by 6

RECREATION For Exercises 43–45, use the following information.

A group is planning to go to an amusement park. There are two parks in the area, Fun World and Coaster City. The cost in dollars for n admission tickets to Fun World is $37n$. If the group has 15 or more people, the cost at Coaster City is $30n + 75$. If the group has fewer than 15 people, the cost at Coaster City is $40n$. As few as 10 people or as many as 25 people might go.

43. Find the cost for each possible group size if they go to Fun World.
44. Find the cost for each possible group size if they go to Coaster City.
45. Write a recommendation that details which park they should go to based on the number of people they expect to attend. Justify your answer.
46. **OPEN ENDED** Write an equation that illustrates the Commutative Property of Multiplication.

CHALLENGE Decide whether each equation is *true* or *false*. If *false*, copy the equation and insert parentheses to make it true.

47. $8 \cdot 4 - 3 \cdot 2 = 26$
48. $8 + 2^3 \div 4 = 4$
49. $6 + 7 \cdot 2 + 5 = 55$

EXTRAPRACTICE

See pages 676, 708.

Math online

Self-Check Quiz at ca.gr7math.com

H.O.T. Problems



50. **FIND THE ERROR** Regina and Camila are evaluating $10 \div 2 \times 5$. Who is correct? Explain.



Regina

$$10 \div 2 \times 5 = 10 \div 10 = 1$$



Camila

$$10 \div 2 \times 5 = 5 \times 5 = 25$$

51. **WRITING IN MATH** Compare the everyday meaning of the term variable with its mathematical definition.

STANDARDS PRACTICE

52. The expression $6s^2$ can be used to find the surface area of a cube, where s is the length of an edge of the cube. What is the surface area of the cube shown below?



- A 144 cm^2
- B 432 cm^2
- C 864 cm^2
- D $5,184 \text{ cm}^2$

53. Which equation is an example of the Associative Property?

- F $4 \cdot a = a \cdot 4$
- G $5 + (x + y) = (x + y) + 5$
- H $w + (3 + 2) = w + (2 + 3)$
- J $d(9 \cdot f) = (d \cdot 9)f$

54. If $r = 4$ and $t = 3$, then $rt - 2r =$

- A 4
- B 6
- C 19
- D 40

Spiral Review

Use the four-step plan to solve each problem.

55. **DINING** Kyung had \$17. His lunch cost \$5.62, and he gave the cashier a \$10 bill. How much change should he receive from the cashier? (Lesson 1-1)
56. **BABY-SITTING** Kayla earned \$30 baby-sitting last weekend. She wants to buy 3 CDs that cost \$7.89, \$12.25, and \$11.95. Does she have enough money to purchase the CDs? Explain your reasoning. (Lesson 1-1)

GET READY for the Next Lesson

PREREQUISITE SKILL Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence.

57. $4 \bullet 9$

58. $7 \bullet 7$

59. $8 \bullet 5$

60. $3 \bullet 2$

1-3

Integers and Absolute Value

Main IDEA

Compare and order integers and find absolute value.



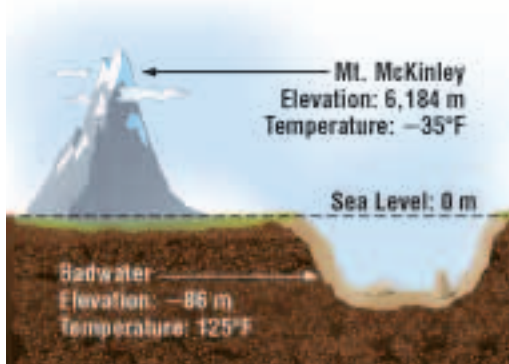
Standard

7NS2.5 Understand the meaning of the absolute value of a number; interpret the absolute value as the distance of the number from zero on a number line; and determine the absolute value of real numbers.

GET READY for the Lesson

GEOGRAPHY Badwater, in Death Valley, California, is the lowest point in North America, while Mt. McKinley in Alaska is the highest point.

1. What does an elevation of -86 meters represent?
2. What does a temperature of -35° represent?

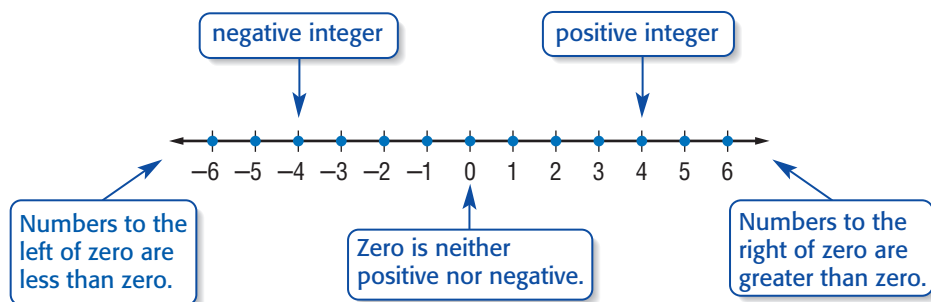


NEW Vocabulary

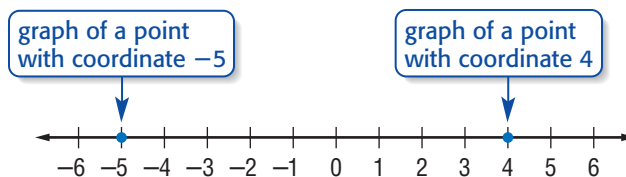
negative number
positive number
integer
coordinate
inequality
absolute value

With sea level as the starting point 0, you can express 86 meters below sea level as negative 86 or -86 . A **negative number** is a number less than zero. A **positive number** like 125 is a number greater than zero.

Numbers like -86 and 125 are called integers. An **integer** is any number from the set $\{\dots, -4, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$ where $\dots$ means *continues without end*.



To graph an integer, locate the point corresponding to the integer on a number line. The number that corresponds to a point is called its **coordinate**.



Notice that -5 is to the left of 4 on the number line. This means that -5 is less than 4. A sentence that compares two different quantities is called an **inequality**. Inequalities contain symbols like $<$ and $>$.

READING Math

Inequality Symbols

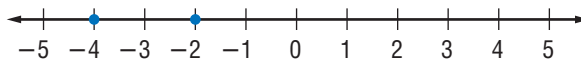
$<$ is less than
 $>$ is greater than

-5 is less than 4. $\rightarrow -5 < 4$ $4 > -5 \leftarrow$ 4 is greater than -5 .

EXAMPLE Compare Integers

- 1 Replace the $\bullet$ with $<$ or $>$ to make $-2 \bullet -4$ a true sentence.

Graph each integer on a number line.



Since -2 is to the right of -4 , $-2 > -4$.

CHECK Your Progress

Replace each $\bullet$ with $<$ or $>$ to make a true sentence.

a. $-3 \bullet 2$

b. $-5 \bullet -6$

c. $-1 \bullet 1$

The distance between a number and 0 on a number line is called its **absolute value**. On the number line below, notice that -4 and 4 are each 4 units from 0, even though they are on opposite sides of 0. They have the same absolute value, 4.



The symbol for absolute value is two vertical bars on either side of the number.

STUDY TIP

Absolute Value

Since distance cannot be negative, the absolute value of a number is always positive or zero.

The absolute value of 4 is 4.

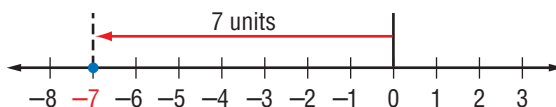
$$|4| = 4$$

$$|-4| = 4$$

The absolute value of -4 is 4.

EXAMPLES Expressions with Absolute Value

- 2 Evaluate $|-7|$.



The graph of -7 is 7 units to the left of 0 on the number line.

$$|-7| = 7$$

- 3 Evaluate $|5| + |-6|$.

$$|5| + |-6| = 5 + |-6|$$

$$= 5 + 6$$

$$= 11$$

The absolute value of 5 is 5.

The absolute value of -6 is 6.

Simplify.

- 4 Evaluate $|5 - 3| + |8 - 10|$.

$$|5 - 3| + |8 - 10| = |2| + |-2|$$

$$= 2 + |-2|$$

$$= 2 + 2$$

$$= 4$$

Simplify the absolute value expressions.

The absolute value of 2 is 2.

The absolute value of -2 is 2.

Simplify.

5 Evaluate $8 + |n|$ if $n = -12$.

$$\begin{aligned} 8 + |n| &= 8 + |-12| && \text{Replace } n \text{ with } -12. \\ &= 8 + 12 \text{ or } 20 && |-12| = 12 \end{aligned}$$

CHECK Your Progress Evaluate each expression.

- d. $|14|$ e. $|-8| - |-2|$
f. $|7 - 4| + |12 - 15|$ g. $|a| - 2$, if $a = -5$.

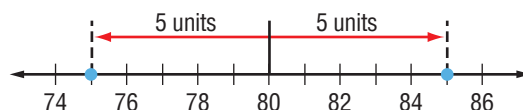


You can also use an absolute value expression to find the distance between a number and zero on a number line.

Real-World EXAMPLE

6 SNAKES A tank used to keep a pet snake should be kept at a temperature of 80°F , give or take 5° . Graph the equation $|x - 80| = 5$ to determine the least and the greatest temperatures.

$|x - 80| = 5$ means that the distance between x and 80 is 5 units. Start at 80 and move 5 units in either direction to find the value of x .



The distance from 80 to 75 is 5 units.

The distance from 80 to 85 is 5 units.

The solution set is $\{75, 85\}$.

Real-World Link

Snakes are cold-blooded, which means that they cannot regulate their body temperature. Their body temperature will reflect the temperature of their surroundings, and these animals cannot survive temperature extremes.

Source: trailquest.net



CHECK Your Progress

- h. The average lifespan of an elephant in the wild is 65 years, give or take 6 years. Graph the equation $|y - 65| = 6$ on a number line to determine the least and greatest average age of an elephant.

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CHECK Your Understanding

Example 1 (p. 36) Replace each $\bullet$ with $<$ or $>$ to make a true sentence.

1. $1 \bullet -5$ 2. $-1 \bullet -2$ 3. $-4 \bullet 3$ 4. $-7 \bullet -3$

Examples 2-4 (p. 36) Evaluate each expression.

5. $|5|$ 6. $|-9|$ 7. $|6 - 3| - |2 - 4|$ 8. $|-8| - |-2|$

Example 5 (p. 37) Evaluate each expression if $x = -10$ and $y = 6$.

9. $3 + |x|$ 10. $|y| + 12$ 11. $|x| - y$

Example 6 (p. 37) **12. PROFIT** In order to ensure a profit, the average cost of a CD must be \$16, give or take \$3. Graph the equation $|c - 16| = 3$ to determine the least and greatest cost of a CD.

Exercises

HOMEWORK HELP

For Exercises	See Examples
13–24	1
25–30	2–4
31–34	5
35–38	6

Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence.

13. $0 \bullet -1$ 14. $5 \bullet -6$ 15. $-9 \bullet -7$ 16. $-6 \bullet -1$
 17. $-7 \bullet -2$ 18. $0 \bullet 12$ 19. $-9 \bullet -10$ 20. $4 \bullet -11$
 21. $-3 \bullet 0$ 22. $-15 \bullet 14$ 23. $-8 \bullet -8$ 24. $-13 \bullet -13$

Evaluate each expression.

25. $|-14|$ 26. $|25|$
 27. $|0| + |-18|$ 28. $|2| - |-13|$
 29. $|6 - 8| + |9 - 5|$ 30. $|14 - 7| - |5 - 8|$

Evaluate each expression if $a = 5$, $b = -8$, $c = -3$, and $d = 9$.

31. $|b| + 7$ 32. $a - |c|$
 33. $d + |b|$ 34. $6|b| + d$

Graph the equation to determine the solutions.

35. $|x - 15| = 10$ 36. $|a - 7| = 4$

37. **SOCCER** A professional soccer player is in his prime at age 26 plus or minus 7 years. This range can be modeled by the equation $|x - 26| = 7$. Graph the equation on a number line to determine the least and the greatest ages.

38. **MONEY** The Perez family spends an average of \$435 per month on groceries give or take \$22. This range can be modeled by the equation $|y - 435| = 22$. Graph the equation on a number line to determine the least and the greatest money spent.

CHEMISTRY For Exercises 39–42, use the table at the right.

Gas	Freezing Point ($^{\circ}\text{F}$) at Sea Level
hydrogen	-435°
krypton	-251°
oxygen	-369°
helium	-458°
argon	-309°

39. Which of these gases freezes at the coldest temperature?
 40. Which of these gases freezes at the warmest temperature?
 41. The freezing point for xenon at sea level is about 200 degrees warmer than the freezing point for oxygen. What is the approximate freezing point of xenon? Justify your answer using a number line.
 42. How many degrees lower is the freezing point for oxygen at sea level than the freezing point for argon? Justify your answer using a number line.

EXTRA PRACTICE

See pages 676, 708.

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**H.O.T. Problems**

CHALLENGE Determine whether each statement is *always*, *sometimes*, or *never* true. Explain your reasoning.

43. The absolute value of a positive integer is a negative integer.
 44. If a and b are integers and $a > b$, then $|a| > |b|$.
 45. If a and b are integers, $a - |b| \leq a + b$.
 46. **Which One Doesn't Belong?** Identify the phrase that cannot be described by the same integer as the other three. Explain your reasoning.

5° below
normal

5 miles above
sea level

a loss of
5 pounds

giving
away \$5

47. **WRITING IN MATH** Explain why the absolute value of a number is never negative.

**STANDARDS PRACTICE**

48. The table shows the number of laps selected race cars finished behind the winner of a race.

Car Number	Laps Behind Winner
3	-1
8	-12
15	-3
24	0
48	-8

Which list shows the finishing order of the cars from highest to lowest?

- A 8, 48, 15, 3, 24 C 24, 3, 15, 48, 8
 B 3, 8, 15, 24, 48 D 48, 24, 15, 8, 3

49. If $a = -3$ and $b = 3$, then which of the following statements is false?

- F $|a| > 2$
 G $|a| = |b|$
 H $|b| < 2$
 J $|a| = b$

50. Which expression has the *greatest* value?

- A $|-25|$
 B $|-16|$
 C $|18|$
 D $|22|$

Spiral Review

ALGEBRA Evaluate each expression if $m = 3$, $n = 2$, $p = 10$, and $r = 15$. (Lesson 1-2)

51. $r - 4n$

52. $2m^2 - p + 3$

53. $\frac{3p + m}{r - 2n}$

54. **CHARITY WALK** Krystal knows that she can walk about 1.5 meters per second. If she can maintain that pace, about how long should it take her to complete a 10-kilometer charity walk? (Lesson 1-1)

GET READY for the Next Lesson

PREREQUISITE SKILL Add or subtract.

55. $9 + 14$

56. $100 - 57$

57. $47 - 19$

58. $18 + 34 + 13$

Extend 1-3

Algebra Lab Graphing Data

Main IDEA

Graph and interpret data.



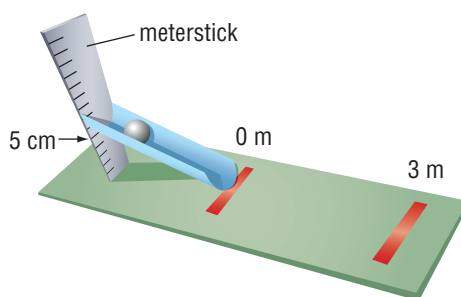
Standard 7AF1.5

Represent quantitative relationships graphically and interpret the meaning of a specific part of a graph in the situation represented by the graph.

Standard 7MR2.3 Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.

ACTIVITY

- STEP 1** Make a meter-long chute for the ball out of cardboard. Reinforce the chute by taping it to one of the metersticks.
- STEP 2** Use the tape measure to mark off a distance of 3 meters on the floor. Make a 0-meter mark and a 3-meter mark using tape.
- STEP 3** Place the end of your chute at the edge of the 0-meter mark. Raise the back of the chute to a height of 5 centimeters.
- STEP 4** Let a tennis ball roll down the chute. When the ball stops, measure how far it is from the 3-meter mark.
- STEP 5** Copy the table shown and record your results. If the ball stops short of the 3-meter mark, record the distance as a negative number. If the ball passes the 3-meter mark, record the distance as a positive number.
- STEP 6** Raise the chute by 5 centimeters and repeat the experiment. Continue until the chute is 40 centimeters high.



Height h of Chute (cm)	Distance d from 3-meter Mark (cm)
5	
10	
15	

ANALYZE THE RESULTS

1. Graph the ordered pairs (h, d) on a coordinate grid.
2. Describe how the points appear on your graph.
3. Describe how raising the chute affects the distance the ball travels.
4. **MAKE A PREDICTION** Use your graph to predict how far the ball will roll when the chute is raised to the 50-centimeter mark. Then check your prediction.

1-4

Adding Integers

Main IDEA

Add integers.



Standard

7NS1.2 Add,

subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.



Standard 7AF1.3

Simplify numerical expressions by applying properties of rational numbers (e.g. identity, inverse, distributive, associative, commutative) and justify the process used.

GET READY for the Lesson



1. Write an integer that describes the game show host's statement.
2. Write an addition sentence that describes this situation.

The equation $-3,200 + (-7,400) + (-2,600) = -13,200$ is an example of adding integers with the same sign. Notice that the sign of the sum is the same as the sign of each addend.

NEW Vocabulary

opposites

additive inverse

REVIEW Vocabulary

addends numbers that are added together

sum the result when two or more numbers are added together

EXAMPLE

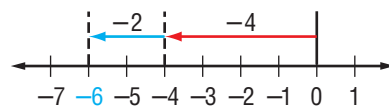
Add Integers with the Same Sign

- 1 Find $-4 + (-2)$.

Use a number line.

- Start at zero.
- Move 4 units left.
- From there, move 2 units left.

So, $-4 + (-2) = -6$.



CHECK Your Progress

Add. Use a number line if necessary.

a. $-3 + (-2)$

b. $1 + 5$

c. $-5 + (-4)$

These examples suggest a rule for adding integers with the same sign.

KEY CONCEPT

Add Integers with the Same Sign

Words

To add integers with the same sign, add their absolute values. The sum has the same sign as the integers.

Examples

$-7 + (-3) = -10$

$5 + 4 = 9$



A number line can also help you add integers with different signs.

STUDY TIP

Adding Integers on a Number Line

Always start at zero. Move right to model a positive integer and left to model a negative integer.

EXAMPLES

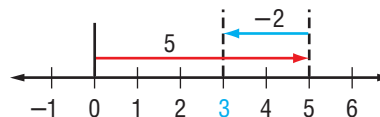
Add Integers with Different Signs

2 Find $5 + (-2)$.

Use a number line.

- Start at zero.
- Move 5 units right.
- From there, move 2 units left.

$$5 + (-2) = 3$$

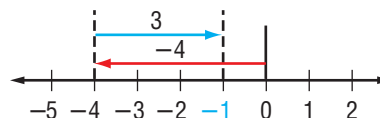


3 Find $-4 + 3$.

Use a number line.

- Start at zero.
- Move 4 units left.
- From there, move 3 units right.

$$-4 + 3 = -1$$



CHECK Your Progress

Add. Use a number line if necessary.

d. $7 + (-5)$

e. $-6 + 4$

f. $-1 + 8$



These examples suggest a rule for adding integers with different signs.

KEY CONCEPT

Add Integers with Different Signs

Words

To add integers with different signs, subtract their absolute values. The sum has the same sign as the integer with the greater absolute value.

Examples

$$8 + (-3) = 5$$

$$-8 + 3 = -5$$

EXAMPLE

Add Integers with Different Signs

4 Find $-14 + 9$.

$$-14 + 9 = -5$$

To find $-14 + 9$, subtract $|9|$ from $|-14|$.

The sum is negative because $|-14| > |9|$.

CHECK Your Progress

Add.

g. $-20 + 4$

h. $17 + (-6)$

i. $-8 + 27$



Two numbers with the same absolute value but different signs are called **opposites**. For example, -2 and 2 are opposites. An integer and its opposite are also called **additive inverses**.

KEY CONCEPT

Additive Inverse Property

Words The sum of any number and its additive inverse is zero.

Examples

Numbers

$$7 + (-7) = 0$$

Algebra

$$x + (-x) = 0$$

The Commutative, Associative, and Identity Properties, along with the Additive Inverse Property, can help you add three or more integers.

EXAMPLE Add Three or More Integers

5 Find $-4 + (-12) + 4$.

$$\begin{aligned} -4 + (-12) + 4 &= -4 + 4 + (-12) \\ &= 0 + (-12) \\ &= -12 \end{aligned}$$

Commutative Property

Additive Inverse Property

Identity Property of Addition

CHECK Your Progress

Add.

j. $33 + 16 + (-33)$

k. $3 + (-2) + (-10) + 6$

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Real-World EXAMPLE

6 MONEY The starting balance in a checking account is \$75. What is the balance after checks for \$12 and \$20 are written?

Writing a check *decreases* your account balance, so integers for this situation are -12 and -20 . Add these integers to the starting balance to find the new balance.

$$\begin{aligned} 75 + (-12) + (-20) &= 75 + [-12 + (-20)] && \text{Associative Property} \\ &= 75 + (-32) && -12 + (-20) = -32 \\ &= 43 && \text{Simplify.} \end{aligned}$$

The balance is now \$43.

CHECK Your Progress

l. **BANKING** A checking account has a starting balance of \$130. What is the balance after writing checks for \$58 and \$62, then making a deposit of \$150?



Real-World Link

One out of every five Americans does not have a checking account.

Source: harpers.org





CHECK Your Understanding

Add.

Examples 1–4
(pp. 41–42)

1. $-4 + (-5)$

2. $-18 + (-8)$

3. $-3 + (-12)$

4. $10 + (-6)$

5. $7 + (-18)$

6. $-9 + 16$

Example 5
(p. 43)

7. $11 + 9 + (-3)$

8. $8 + (-6) + 5$

9. $3 + (-15) + 1$

Example 6
(p. 43)

10. **GOLF** Suppose a player shot -5 , $+2$, -3 , and -2 in four rounds of a tournament. What was the player's final score?

Exercises

HOMEWORK HELP

For Exercises	See Examples
11–16	1
17–22	2–4
23–28	5
29, 30	6

Add.

11. $14 + 8$

12. $12 + 17$

13. $-14 + (-6)$

14. $-21 + (-13)$

15. $-5 + (-31)$

16. $-7 + (-24)$

17. $20 + (-5)$

18. $45 + (-4)$

19. $-15 + 8$

20. $-19 + 2$

21. $-10 + 34$

22. $-17 + 28$

23. $5 + 18 + (-22)$

24. $8 + 13 + (-14)$

25. $-17 + (-4) + 10$

26. $-26 + (-8) + 2$

27. $-12 + 9 + (-15)$

28. $-34 + 19 + (-16)$

ANALYZE TABLES For Exercises 29 and 30, use the table below that shows the change in music sales to the nearest percent from 2001 to 2003.

29. What is the percent of music sold in 2003 for each of these musical categories?
30. What was the total percent change in the sale of these types of music?

Style of Music	Percent of Music Sold in 2001	Percent Change as of 2003
Rock	24	+1
Rap/Hip Hop	11	+2
Pop	11	-2
Country	11	-1

Source: Recording Industry Association of America

Write an addition expression to describe each situation. Then find each sum and explain its meaning.

31. **FOOTBALL** Your team gains 8 yards on its first play. On the next play, your team loses 5 yards.
32. **SCUBA DIVING** A scuba diver dives 125 feet below the water's surface. Later, she rises 46 feet.
33. **WEATHER** The temperature outside is -2°F . The temperature drops by 9° .

EXTRA PRACTICE

See pages 677, 708.

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Add.

34. $-47 + (-41) + (-33)$

35. $-51 + (-38) + (-44)$

36. $-31 + (-26) + (-60)$

37. $-13 + 6 + (-8) + 13$

38. $9 + (-4) + 12 + (-9)$

39. $-14 + 2 + (-15) + 7$

**H.O.T. Problems**

40. **OPEN ENDED** Give an example of a positive and a negative integer with a negative sum. Then find their sum.
41. **CHALLENGE** Determine whether the following statement is *always*, *sometimes*, or *never* true. Give examples to justify your answer.
If x and y are integers, then $|x + y| = |x| + |y|$.
42. **WRITING IN MATH** Find the sum of -8 , 25 , and -2 mentally by applying the properties of numbers. Justify the process.

**STANDARDS PRACTICE**

43. A stock's opening value on Monday morning was \$52. What was the stock worth at the end of the day on Friday?

Day	Change
Monday	-\$2
Tuesday	+\$1
Wednesday	+\$3
Thursday	-\$1
Friday	-\$4

- A \$41 C \$57
 B \$49 D \$63

44. Marcus started the month with a balance of \$75 in his checking account. He made a deposit of \$12.50 and wrote three checks in the amounts of \$25, \$58.75, and \$32. What is the balance of his checking account?

- F \$3.75
 G \$0
 H -\$18.75
 J -\$28.25

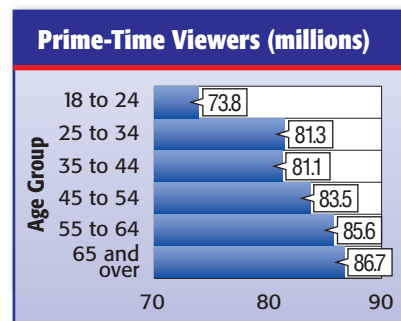
Spiral Review

Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence. (Lesson 1-3)

45. $-6 \bullet -11$ 46. $5 \bullet -5$ 47. $5 \bullet |8|$ 48. $|-7| \bullet -7$

49. **WEATHER** The time s in seconds between seeing lightning and hearing thunder can be used to estimate a storm's distance in miles. Use the expression $\frac{s}{5}$ to determine how far away a storm is if this time is 15 seconds. (Lesson 1-2)

50. **STATISTICS** The graph shows the number of prime-time television viewers in millions for different age groups. Estimate the total number of viewers for all the age groups given. (Lesson 1-1)

**GET READY for the Next Lesson**

PREREQUISITE SKILL Evaluate each expression if $x = 3$, $y = 9$, and $z = 5$. (Lesson 1-2)

51. $x + 14$ 52. $z - 2$ 53. $y - z$ 54. $x + y - z$

1-5

Subtracting Integers

Main IDEA

Subtract integers.

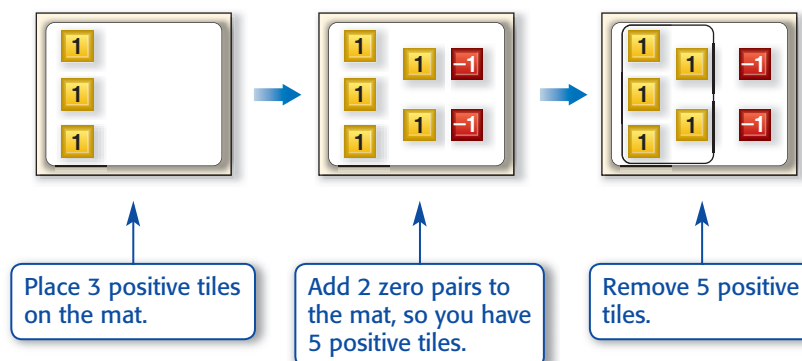


Standard

7NS1.2 Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.

MINI Lab

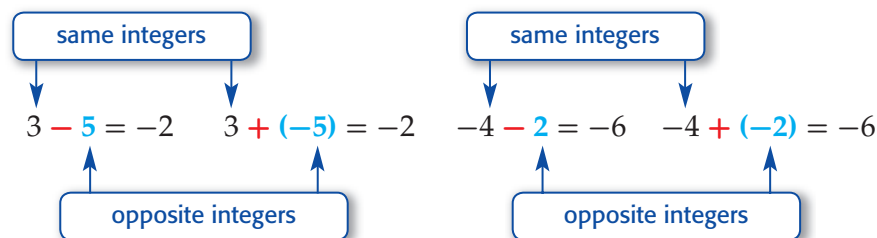
You can use algebra tiles to model the subtraction of two integers. Follow these steps to model $3 - 5$. Remember that *subtract* means *take away* or *remove*.



Since 2 negative tiles remain, $3 - 5 = -2$.

- How does this result compare with the result of $3 + (-5)$?
- Use algebra tiles to find $-4 - 2$.
- How does this result compare to $-4 + (-2)$?
- Use algebra tiles to find each difference and sum. Compare the results in each group.
 - $1 - 5$; $1 + (-5)$
 - $-6 - 4$; $-6 + (-4)$

When you subtract 5, as shown in the Mini Lab, the result is the same as adding -5 . When you subtract 2, the result is the same as adding -2 .



These and other examples suggest a method for subtracting integers.

KEY CONCEPT

Subtract Integers

Words To subtract an integer, add its opposite or additive inverse.

Examples

Numbers

$$4 - 7 = 4 + (-7) \text{ or } -3$$

Algebra

$$a - b = a + (-b)$$

EXAMPLES**Subtract a Positive Integer****1** Find $9 - 12$.

$$9 - 12 = 9 + (-12)$$

$$= -3$$

To subtract 12, add -12 .
Add.

2 Find $-6 - 8$.

$$-6 - 8 = -6 + (-8)$$

$$= -14$$

To subtract 8, add -8 .
Add.

**CHECK Your Progress**

Subtract.

a. $3 - 8$

b. $-5 - 4$

c. $10 - 7$

EXAMPLES**Subtract a Negative Integer****3** Find $7 - (-15)$.

$$7 - (-15) = 7 + 15 \text{ or } 22$$

To subtract -15 , add 15.

4 CHEMISTRY The melting point of mercury is about -39°C and the melting point of aluminum is about 660°C . Find the difference between these temperatures.

$$660 - (-39) = 660 + 39 \text{ or } 699$$

To subtract -39 , add 39.The difference between the temperatures is about 699°C .**CHECK Your Progress**

Subtract.

d. $6 - (-7)$

e. $-5 - (-19)$

f. $-14 - (-2)$

Personal Tutor at ca.gr7math.com**STUDY TIP****Common Error**

In Example 5, a common error is to replace b with 8 instead of its correct value of -8 . Prevent this error by inserting a set of parentheses before replacing b with its value.

$$14 - b = 14 - ()$$

$$= 14 - (-8)$$

EXAMPLES**Evaluate Algebraic Expressions**Evaluate each expression if $a = 9$, $b = -8$, and $c = -2$.**5** $14 - b$

$$14 - b = 14 - (-8)$$

$$= 14 + 8 \text{ or } 22$$

Replace b with -8 .To subtract -8 , add 8.**6** $c - a^2$

$$c - a^2 = -2 - 9^2$$

$$= -2 - 81$$

$$= -2 + (-81) \text{ or } -83$$

Replace c with -2 and a with 9.Simplify 9^2 .To subtract 81, add -81 .**CHECK Your Progress**Evaluate each expression if $x = -5$ and $y = 7$.

g. $x - (-8)$

h. $-3 - y$

i. $y^2 - x + 3$



CHECK Your Understanding

Examples 1–4
(p. 47)

Subtract.

1. $8 - 13$
2. $5 - 24$
3. $-4 - 10$
4. $-6 - 3$
5. $7 - (-3)$
6. $2 - (-8)$
7. $-2 - (-6)$
8. $-18 - (-7)$

Example 3
(p. 47)

9. **SPACE** On Mercury, the temperatures range from 805°F during the day to -275°F at night. Find the change in temperature from day to night.

Examples 5, 6
(p. 47)

Evaluate each expression if $n = 10$, $m = -4$, and $p = -12$.

10. $n - 17$
11. $m - p$
12. $p + n - m$

Exercises

HOMEWORK HELP

For Exercises	See Examples
13–16	1
17–20	2
21–24	3
25–28	4
29–30	1–4
31–38	5, 6

Subtract.

13. $14 - 8$
14. $17 - 12$
15. $5 - 9$
16. $1 - 8$
17. $-16 - 4$
18. $-15 - 12$
19. $-3 - 14$
20. $-6 - 13$
21. $9 - (-5)$
22. $10 - (-2)$
23. $5 - (-11)$
24. $17 - (-14)$
25. $-5 - (-4)$
26. $-18 - (-7)$
27. $-3 - (-6)$
28. $-9 - (-20)$

GEOGRAPHY For Exercises 29 and 30, use the table at the right.

Great Lakes	Deepest Point (m)	Surface Elevation (m)
Erie	-64	174
Huron	-229	176
Michigan	-281	176
Ontario	-244	75
Superior	-406	183

29. How far below the surface elevation is the deepest part of Lake Huron?
30. Find the difference between the deepest part of Lake Erie and the deepest part of Lake Superior.

Source: National Ocean Service

Evaluate each expression if $a = -3$, $b = 14$, and $c = -8$.

31. $b - 20$
32. $c - 15$
33. $a - c$
34. $a - b$
35. $b - a$
36. $c - b$
37. $(b - a)^2 + c$
38. $a - c - b^2$

ANALYZE TABLES For Exercises 39 and 40, use the table.

39. The wind makes the air outside feel colder than the actual air temperature. How much colder does a temperature of 0°F with a 30-mile-per-hour wind feel than the same temperature with a 10-mile-per-hour wind?
40. How much warmer does 20°F feel than -10°F , both with a 30-mile-per-hour wind?

Wind Chill Temperature				
Wind (miles per hour)				
Temperature ($^{\circ}\text{F}$)	Calm	10	20	30
	20	9	4	1
	10	-4	-9	-12
	0	-16	-22	-26
	-10	-28	-35	-39

Source: National Weather Service

Simplify.

41. $31 - (-3) - (-18)$
42. $-20 - [6 + (-28)]$
43. $(-3 + 8) - (-21 - 10)$

EXTRA PRACTICE

See pages 677, 708.

Math online

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H.O.T. Problems

44. **OPEN ENDED** Write an expression involving the subtraction of a negative integer. Then write an equivalent addition expression.
45. **FIND THE ERROR** Anna and David are finding $-5 - (-8)$. Who is correct? Explain your reasoning.



Anna

$$\begin{aligned} -5 - (-8) &= 5 + 8 \\ &= 13 \end{aligned}$$



David

$$\begin{aligned} -5 - (-8) &= -5 + 8 \\ &= 3 \end{aligned}$$

CHALLENGE For Exercises 46 and 47, determine whether the statement is *true* or *false*. If *false*, give a counterexample.

46. If x and y are positive integers, then $x - y$ is a positive integer.
47. Subtraction of integers is commutative.
48. **WRITING IN MATH** Write a problem about a real-world situation involving subtraction of integers for which the answer is -4 .



STANDARDS PRACTICE

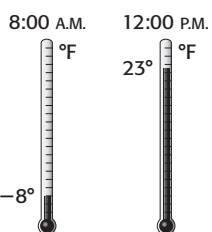
49. Use the thermometers to determine how much the temperature increased between 8:00 A.M. and 12:00 P.M.

A 14°F

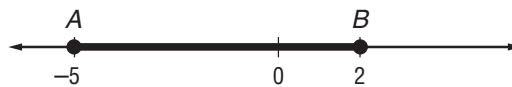
C 30°F

B 15°F

D 31°F



50. Find the distance between A and B on the number line.



F -7 units

H 3 units

G -3 units

J 7 units

Spiral Review

51. **BASEBALL** The table shows the income of several baseball teams in a recent year. What was the total income of all of these teams? (*Hint*: A gain is positive income, and a loss is negative income.) (Lesson 1-4)

Team	Income (thousands)
Atlanta Braves	$-\$14,360$
Chicago Cubs	$\$4,797$
Florida Marlins	$-\$27,741$
New York Yankees	$\$40,359$

Source: mlb.com

Evaluate each expression. (Lesson 1-3)

52. $|-14| + |3|$

53. $|20| - |-5|$

54. $|13 - (-7)|$

55. $|-12 + (-25)|$



GET READY for the Next Lesson

PREREQUISITE SKILL Find the mean for each set of data.

56. 1, 2, 3, 6, 8

57. 12, 13, 14, 16, 17, 18

58. 40, 45, 55, 60, 75, 85

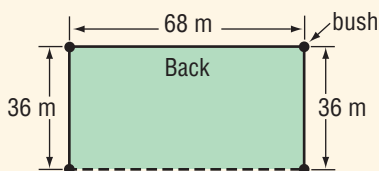
Mid-Chapter Quiz

Lessons 1-1 through 1-5

1. **TRAVEL** A cruise ship has 148 rooms, with fifty on each of the two upper decks and the rest on the two lower decks. An upper deck room costs \$1,000, and a lower deck room costs \$900. Use the four-step plan to find the greatest possible room sales on one trip.

(Lesson 1-1)

2.  **STANDARDS PRACTICE** A landscaper plants bushes in a row across the back and down two sides of a yard. A bush is planted at each of the four corners and at every 4 meters. Which expression would give the number of bushes that are planted? (Lesson 1-1)



- A $2 \times (36 \div 4) + (68 \div 4)$
 B $2 + 2 \times (36 \div 4) + (64 \div 4)$
 C $4 + 2 \times (36 \div 4) + (68 \div 4)$
 D $2 \times (36 \div 4) + 2 \times (68 \div 4)$

Evaluate each expression if $x = 3$, $y = 6$, and $z = 2$. (Lesson 1-2)

3. $x^2 + y^2 + z^2$ 4. $\frac{xy}{z} - 4z$

5. **MEASUREMENT** The expression $2\ell + 2w$ gives the perimeter of a rectangle with length ℓ and width w . What amount of fencing would Mr. Nakagawa need in order to fence his tomato garden that is 12 feet long and 9 feet wide? (Lesson 1-2)

Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence. (Lesson 1-3)

6. $-3 \bullet 2$ 7. $|-4| \bullet |4|$

8.  **STANDARDS PRACTICE** The table gives several of the highest and lowest elevations, in meters, on Earth's land surface.

Name	Location	Elevation
Mt. Everest	Nepal	8,850
Lake Assal	Djibouti	-156
Mt. McKinley	Alaska	6,194
Death Valley	California	-86
Dead Sea	Israel	-400

Choose the group of elevations that is listed in order from least to greatest. (Lesson 1-3)

- F $-86, -156, -400, 6,194, 8,850$
 G $8,850, 6,194, -400, -156, -86$
 H $-400, -156, -86, 6,194, 8,850$
 J $-156, -86, -400, 6,194, 8,850$

Add or subtract. (Lessons 1-4, 1-5)

9. $-7 + 2 + (-1)$ 10. $-3 - (-4)$
 11. $2 - 6$ 12. $-5 + (-8)$
 13. $-5 + 9$ 14. $-11 + 15 + 11 + (-6)$
 15. $12 + (-4) - 7$ 16. $-7 + 14 + (-1) + 13$
 17. $-4 + -7$ 18. $(-1) + (-5) + 18 - 3$

19.  **STANDARDS PRACTICE** If $|y| = 5$, what is the value of y ?

- A -25 or 25
 B 0 or 5
 C -5 or 5
 D -5 or 0

20. **ELEVATORS** In one hour, an elevator traveled up 5 floors, down 2 floors, up 8 floors, down 6 floors, up 11 floors, and down 14 floors. If the elevator started on the seventh floor, on which floor is it now? (Lessons 1-4, 1-5)

1-6

Multiplying and Dividing Integers

Main IDEA

Multiply and divide integers.



Standard 7NS1.2 Add, subtract, multiply, and divide

rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.

Standard 7AF1.3 Simplify numerical expressions by applying properties of rational numbers (e.g. identity, inverse, distributive, associative, commutative) and justify the process used.

GET READY for the Lesson

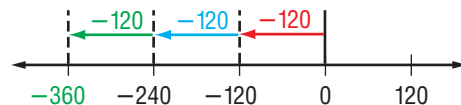
OCEANOGRAPHY A deep-sea submersible descends 120 feet each minute to reach the bottom of Challenger Deep, a trench in the Pacific Ocean. The table shows the submersible's depth at different times.

Time (min)	Depth (ft)
1	-120
2	-240
⋮	⋮

- Write two different addition sentences that could be used to find the submersible's depth after 3 minutes. Then find their sums.
- Write a multiplication sentence that could be used to find this same depth. Explain your reasoning.
- Write a multiplication sentence that could be used to find the submersible's depth after 10 minutes. Then find the product.

Multiplication is repeated addition. So, $3(-120)$ means that -120 is used as an addend 3 times.

$$3(-120) = -120 + (-120) + (-120) = -360$$



REVIEW Vocabulary

product the result when two or more numbers are multiplied together

By the Commutative Property of Multiplication, $3(-120) = -120(3)$. This example suggests the following rule.

KEY CONCEPT

Multiply Integers with Different Signs

Words The product of two integers with different signs is negative.

Examples $2(-5) = -10$ $-5(2) = -10$

REVIEW Vocabulary

factors numbers that are multiplied together

EXAMPLES

Multiply Integers with Different Signs

1 Find $6(-8)$.

$$6(-8) = -48$$

The factors have different signs. The product is negative.

2 Find $-9(2)$.

$$-9(2) = -18$$

The factors have different signs. The product is negative.



CHECK Your Progress

Multiply.

a. $5(-3)$

b. $-8(6)$

c. $-2(4)$



The product of two positive integers is positive. What is the sign of the product of two negative integers? Look for a pattern below.

	Factor • Factor = Product	
Negative • Positive = Negative	$-3 \cdot 2 = -6$	+3
	$-3 \cdot 1 = -3$	+3
	$-3 \cdot 0 = 0$	+3
Negative • Negative = Positive	$-3 \cdot (-1) = 3$	+3
	$-3 \cdot (-2) = 6$	

KEY CONCEPT

Multiply Integers with the Same Sign

Words The product of two integers with the same sign is positive.

Examples $2(5) = 10$ $-2(-5) = 10$

EXAMPLE

Multiply Integers with the Same Sign

3 Find $-4(-3)$.

$-4(-3) = 12$ The factors have the same sign. The product is positive.



CHECK Your Progress

Multiply.

d. $-3(-7)$

e. $6(4)$

f. $(-5)^2$



To multiply more than two integers, use the Commutative and Associative Properties of Multiplication.

EXAMPLE

Multiply More than Two Integers

4 Find $-2(13)(-5)$.

METHOD 1 Use the Associative Property.

$$\begin{aligned} -2(13)(-5) &= [-2(13)](-5) && \text{Associative Property} \\ &= -26(-5) && -2(13) = -26 \\ &= 130 && -26(-5) = 130 \end{aligned}$$

METHOD 2 Use the Commutative Property.

$$\begin{aligned} -2(13)(-5) &= -2(-5)(13) && \text{Commutative Property} \\ &= 10(13) && -2(-5) = 10 \\ &= 130 && 10(13) = 130 \end{aligned}$$



CHOOSE Your Method

Multiply.

g. $4(-2)(-5)$

h. $-1(-3)(-8)$

i. $(-2)^3$

STUDY TIP

Mental Math

Look for products that are multiples of ten to make the multiplication simpler.



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READING Math

Division In a division sentence like $12 \div 3 = 4$, the number you are dividing, 12, is called the *dividend*. The number you are dividing by, 3, is called the *divisor*. The result is called the *quotient*.

Examine the following multiplication sentences and their related division sentences.

Multiplication Sentence	Related Division Sentences	
$4(3) = 12$	$12 \div 3 = 4$	$12 \div 4 = 3$
$-4(3) = -12$	$-12 \div 3 = -4$	$-12 \div -4 = 3$
$4(-3) = -12$	$-12 \div (-3) = 4$	$-12 \div 4 = -3$
$-4(-3) = 12$	$12 \div (-3) = -4$	$12 \div (-4) = -3$

These examples suggest that the rules for dividing integers are similar to the rules for multiplying integers.

KEY CONCEPT

Divide Integers

Words The quotient of two integers with different signs is negative.
The quotient of two integers with the same sign is positive.

Examples $16 \div (-8) = -2$ $-16 \div (-8) = 2$

EXAMPLES

Divide Integers

5 Find $-24 \div 3$. The dividend and the divisor have different signs.

$-24 \div 3 = -8$ The quotient is negative.

6 Find $\frac{-30}{-15}$. The signs are the same.

$\frac{-30}{-15} = 2$ The quotient is positive.

CHECK Your Progress Divide.

j. $-28 \div (-7)$

k. $\frac{36}{-2}$

l. $\frac{-40}{8}$



You can use all of the rules you have learned for adding, subtracting, multiplying, and dividing integers to evaluate algebraic expressions.

EXAMPLE

Evaluate Algebraic Expressions

7 Evaluate $-2a - b$ if $a = -3$ and $b = -5$.

$-2a - b = -2(-3) - (-5)$ Replace a with -3 and b with -5 .
 $= 6 - (-5)$ The product of -2 and -3 is positive.
 $= 6 + 5$ To subtract -5 , add 5.
 $= 11$ Add.

CHECK Your Progress

Evaluate each expression if $a = -4$, $b = 5$, and $c = -6$.

m. $c + 3a$

n. $\frac{-10}{a + b}$

o. $ab + c^2$



Real-World EXAMPLE

- 8 GAMES** In each round of a game, you can gain or lose points. Atepa's change in score for each of five rounds is shown. Find Atepa's mean (average) point gain or loss per round.

Atepa
-10
-30
-20
10
20

To find the mean of a set of numbers, find the sum of the numbers. Then divide the sum by how many numbers there are in the set.

$$\frac{-10 + (-30) + (-20) + 10 + 20}{5} = \frac{-30}{5} \quad \begin{array}{l} \text{Find the sum of the set of numbers.} \\ \text{Divide by the number in the set.} \end{array}$$

$$= -6 \quad \text{Simplify.}$$

Atepa lost an average of 6 points per round.



CHECK Your Progress

- p. **TEMPERATURE** On six consecutive days, the low temperature in Montreal was -6°C , -5°C , 6°C , 3°C , -2°C , and -8°C . What was the average low temperature for the six days?

CONCEPT Summary

Multiplying and Dividing Integers

- The product or quotient of two integers with the same sign is positive.
- The product or quotient of two integers with different signs is negative.



CHECK Your Understanding

Examples 1–4
(pp. 51–52)

Multiply.

- $4(-5)$
- $3(-6)$
- $-3(7)$
- $-7(-2)$
- $(-3)^2$
- $-4(5)(-7)$

Examples 5, 6
(p. 53)

Divide.

- $-16 \div 4$
- $21 \div (-3)$
- $-72 \div (-8)$
- $\frac{22}{11}$
- $\frac{-25}{-5}$
- $\frac{-96}{12}$

Example 7
(p. 53)

Evaluate each expression if $a = -5$, $b = 8$, and $c = -12$.

- $4a + 9$
- $\frac{b - c}{a}$
- $3b - a^2$

Example 8
(p. 54)

- 16. FOOTBALL** During a scoring drive, a football team gained or lost yards on each play as shown. What was the average number of yards per play?

Yards Gained or Lost					
+6	-2	+8	0	+23	-4
+5	+12	-4	-3	+18	+1

Exercises

HOMEWORK HELP

For Exercises	See Examples
17–22, 29, 30	1, 2
23–26	3
27, 28	4
31–40	5, 6
41–44	7
45–48	8

Multiply.

17. $7(-8)$ 18. $8(-9)$ 19. $-5 \cdot 8$ 20. $-12 \cdot 7$
 21. $-4(9)$ 22. $-6(8)$ 23. $-4(-6)$ 24. $-14(-2)$
 25. $(-4)^2$ 26. $(-7)^2$ 27. $-6(-2)(-7)$ 28. $-3(-3)(-4)$

29. **HIKING** For every 1-kilometer increase in altitude, the temperature drops 7°C . Find the temperature change for a 5-kilometer increase in altitude.

30. **LIFE SCIENCE** Most people lose 100 to 200 hairs per day. If you were to lose 150 hairs per day for 10 days, what would be the change in the number of hairs you have?

Divide.

31. $50 \div (-5)$ 32. $-60 \div 3$ 33. $45 \div 9$ 34. $-34 \div (-2)$
 35. $\frac{-84}{4}$ 36. $\frac{28}{-7}$ 37. $\frac{-72}{-6}$ 38. $\frac{64}{8}$

39. **FARMING** During a seven-day period, the level of a pond receded 28 centimeters. Find the average daily change in the level of the pond.

40. **WEATHER** The outside temperature is changing at a rate of -8° per hour. At that rate, how long will it take for the temperature change to be -24° ?

ALGEBRA Evaluate each expression if $w = -2$, $x = 3$, $y = -4$, and $z = -5$.

41. $x + 6y$ 42. $9 - wz$ 43. $\frac{w - x}{z}$ 44. $\frac{8y}{x^2 - 5}$

STATISTICS Find the mean of each set of integers.

45. $-4, 6, -10, -3, -8, 1$ 46. $12, -14, -15, 18, -19, -17, -21$
 47. $-2, -7, -6, 5, -10$ 48. $-14, -17, -20, -16, -13$

49. **AVIATION** An atmospheric research aircraft began descending from an altitude of 36,000 feet above its base, at a rate of 125 feet per minute. How long did it take for the aircraft to land at its base?

Multiply or divide.

50. $(2)^2 \cdot (-6)^2$ 51. $(-4)^3$ 52. $-2(4)(-3)(-10)$

ALGEBRA Evaluate each expression if $a = 12$, $b = -4$, and $c = -8$.

53. $\frac{6c}{a} - b$ 54. $\frac{-9b}{b - a} + c$ 55. $-c^2 - 25$ 56. $(3b + 2)^2 \div (-4)$

EXTRAPRACTICE

See pages 677, 708.

Math  online

Self-Check Quiz at
ca.gr7math.com

57. **MOVIES** Predict the number of theater admissions in 2010 if the average change per year following 2004 remains the same as the average change per year from 2002 to 2004. Justify your answer.

U.S. Theater Admissions	
Year	Number of Admissions (millions)
2002	1,630
2004	1,530

Source: National Association of Theater Owners

**H.O.T. Problems**

58. **OPEN ENDED** Name two integers that have a quotient of -7 .

NUMBER SENSE Find the sign of each of the following if n is a negative number. Explain your reasoning.

59. n^2

60. n^3

61. n^4

62. n^5

CHALLENGE The sum of any two whole numbers is always a whole number. So, the set of whole numbers $(0, 1, 2, 3, \dots)$ is said to be *closed* under addition. This is an example of the *Closure Property*. State whether each statement is *true* or *false*. If *false*, give a counterexample.

63. The set of whole numbers is closed under subtraction.

64. The set of integers is closed under multiplication.

65. **WRITING IN MATH** Determine the sign of the product of -2 , -3 , and -4 . Explain your reasoning.

**STANDARDS PRACTICE**

66. A glacier receded at a rate of 350 feet per day for two consecutive weeks. How much did the glacier's position change in all?

- A -336 ft C -700 ft
B -348 ft D $-4,900$ ft

67. The temperature at 6:00 P.M. was 10°F . Between 6:00 P.M. and midnight, the temperature dropped 4° three different times. What was the temperature at midnight?

- F -12° H 0°
G -2° J 2°

Spiral Review

Subtract. (Lesson 1-5)

68. $12 - 18$

69. $-5 - (-14)$

70. $-3 - 20$

71. $7 - (-15)$

Add. (Lesson 1-4)

72. $-9 + 2 + (-8)$

73. $-24 + (-11) + 24$

74. $-21 + 5 + (-14)$

75. $-7 + (-3) + 6$

76. **SHOPPING** Gabriel went to the store to buy DVDs. Each DVD costs \$20. If he buys four DVDs, he can get a fifth DVD free. How much will he save per DVD if he buys four? (Lesson 1-1)

GET READY for the Next Lesson

PREREQUISITE SKILL Give an example of a word or phrase that could indicate each operation.

Example: addition $\rightarrow$ the sum of

77. subtraction

78. multiplication

79. division

1-7

Writing Equations

Main IDEA

Write algebraic equations from verbal sentences and problem situations.



Standard 7AF1.1

Use variables and appropriate operations to write an expression, an equation, an inequality, or a system of equations or inequalities that represents a verbal description (e.g. three less than a number, half as large as area A.)

Standard 7AF1.4 Use algebraic terminology (e.g. variable, equation, term, coefficient, inequality, expression, constant) correctly.

NEW Vocabulary

equation

define a variable

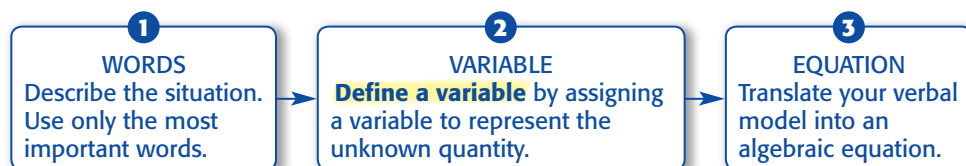
GET READY for the Lesson

PARTY PLANNING It costs \$8 per guest to hold a birthday party at a skating rink.

1. What is the relationship between the number of guests and the cost?
2. Write an expression representing the cost of a party with g guests.
3. What does the equation $g \cdot 8 = 120$ represent in this situation?

BIRTHDAY PARTY	
Number of Guests	Party Cost (\$)
5	$5 \cdot 8$ or 40
7	$7 \cdot 8$ or 56
10	$10 \cdot 8$ or 80
12	$12 \cdot 8$ or 96
g	?

An **equation** is a mathematical sentence containing an equals sign ($=$). An important skill in algebra is modeling situations using equations.



To translate your verbal model, look for common words or phrases that suggest one of the four operations.

EXAMPLE Write an Algebraic Equation

- 1 **GAMES** Eduardo had a score of -150 points in the first round of a game. His final score after two rounds was 75 points. Write an equation to find his second round score.

Words	1st round score	plus	2nd round score	was	final score.
Variable	Let s represent the 2nd round score.				
Equation	$-150 + s = 75$				

The equation is $-150 + s = 75$.

CHECK Your Progress Write an equation to model each situation.

- a. The winning time of 27 seconds was 2 seconds shorter than Tina's.
- b. A drop of 4°F per hour for the last several hours results in a total temperature change of -24°F .

STUDY TIP

Defining a Variable

Any letter can be used as a variable, but it is often helpful to select letters that can be easily connected to the quantity they represent.

Example: score $\rightarrow s$



Real-World Link . . .



Yosemite Falls in Yosemite National Park is the fifth highest falls in the world at a height of 740 meters.

Source: U.S. National Park Service

Test-Taking Tip

Reading Choices

Read all answer choices carefully before deciding on the correct answer. Often two choices will look very similar.



Real-World EXAMPLE

- 2 FALLS** The height of Yosemite Falls is 239 meters less than the height of Angel Falls in Venezuela. Use the information at the left to write an equation that could be used to find the height of Angel Falls.

Words	Yosemite's height	is	239 meters less than	Angel's height.
Variable	Let a represent the height of Angel Falls.			
Equation	$740 = a - 239$			



CHECK Your Progress

- c. **DANCE** The change in attendance from last year's spring dance was -45 students. The attendance this year was 128 students. Write an equation that could be used to find the attendance last year.

You can also write an equation with two variables to express the relationship between two unknown quantities.



STANDARDS EXAMPLE

- 3** The number of pounds of insects a bat can eat is 2.5 times its own bodyweight. Given b , a bat's bodyweight in pounds, which equation can be used to find p , the pounds of insects it can eat?

A $b = 2.5 \cdot p$

C $b = 2.5 + p$

B $p = b + 2.5$

D $p = 2.5 \cdot b$

Read the Item

The phrase *2.5 times its own bodyweight* indicates multiplication. So, you can eliminate B and C.

Solve the Item

$$\underbrace{\text{Pounds of insects eaten}}_p \text{ is } \underbrace{2.5 \text{ times}}_{= 2.5 \cdot} \underbrace{\text{bodyweight}}_b$$

The solution is D.



CHECK Your Progress

- d. A state's number of electoral votes is 2 more than its number of Representatives. Given r , a state's number of Representatives, which equation can be used to find e , the state's number of electoral votes?

F $e = 2r$

G $e = r \div 2$

H $e = r + 2$

J $e = 2 - r$



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CHECK Your Understanding

Example 1 (p. 57) Define a variable. Then write an equation to model each situation.

- Kevin's score of 20 points was four times Corey's score.
- The total was \$28 after a \$4 tip was added to the bill.

Example 2 (p. 58) Define a variable. Then write an equation that could be used to solve each problem.

- SUBMARINES** A submarine dived 75 feet below its original depth. If the submarine's new depth is -600 feet, what was its original depth?
- TESTING** The total time given to take a state test is equally divided among the 3 subjects tested. If the time given for each subject test is 45 minutes, how many minutes long is the entire test?

Example 3 (p. 58)

-  **STANDARDS PRACTICE** Javier is 4 years younger than his sister Rita. Given j , Javier's age, which equation can be used to find r , Rita's age?
 A $j = r \div 4$ B $j = r + 4$ C $j = r - 4$ D $j = 4r$

Exercises

HOMEWORK HELP

For Exercises	See Examples
6–11	1
12–15	2
16–19	3

Define a variable. Then write an equation to model each situation.

- After dropping 12°C , the temperature outside was -5°C .
- Jamal's score of 82 was 5 points less than the class average.
- At 30 meters per second, a cheetah's top speed is three times that of the top speed of the fastest recorded human.
- A site is excavated to a level of -75 centimeters over several days for an average dirt removal of 15 centimeters each day.
- A class of 24 students separated into equal-sized teams results in 6 students per team.
- When the money was divided among the four grade levels, each grade received \$235.

Define a variable. Then write an equation that could be used to solve each problem.

- PETS** Nikki's cat is 5 pounds heavier than her sister's cat. If Nikki's cat weighs 9 pounds, how much does her sister's cat weigh?
- MEASUREMENT** A triangle's base is one-fourth its height. If the base is 15 meters long, what is the height of the triangle?
- CREDIT** For charging the cost of 4 equally priced shirts, Antonio's father's credit card statement shows an entry of $-\$74$. What would the statement have shown for a charge of just one shirt?



Real-World Link . . .

The earliest year a musical group can be inducted into the Rock and Roll Hall of Fame is 25 years after the year its first album debuted.

Source: rockhall.com

15. **GOLF** The graphic shows some of the top 20 leaders in a golf tournament after the first round. If the 6th place participant is 5 strokes behind the leader, what was the leader's score after the first round?

6.	Poole	-3
7.	Shaw	-2
8.	Kendrick	-2
9.	Rodriguez	1

Write an equation that could be used to express the relationship between the two quantities.

16. **HEALTH** Your heart rate r in beats per minute is the number of times your heart beats h in 15 seconds multiplied by 4. Given h , write an equation to find r .

17. **CARS** Ashley's car travels 24 miles per gallon of gas. Given d , the distance the car travels, write an equation to find g , the gallons of gas used.

18. **FRAMING** A mat for a picture frame should be cut so that its width is $\frac{1}{8}$ inch less than the frame's opening. Given p , the width of the frame's opening, write an equation to find m , the width of the mat.

19. **MEASUREMENT** A seam allowance indicates that the total length of fabric needed is $\frac{1}{2}$ inch more than that measured. Given t , the total length of fabric needed, write an equation to find m , the length measured.

20. **MUSIC** Refer to the information at the left. If an artist was inducted in 2005, write an equation that could be used to find the latest year the artist's first album could have debuted.

Write an equation to model the relationship between the quantities in each table.

21.

Yards, y	Feet, f
1	3
2	6
3	9
4	12
y	f

22.

Centimeters, c	Meters, m
200	2
300	3
400	4
500	5
c	m

EXTRA PRACTICE

See pages 678, 708.

Math online

Self-Check Quiz at ca.gr7math.com

23. **MAPS** The scale on a map indicates that 1 inch on the map represents an actual distance of 20 miles. Create a table of values showing the number of miles represented by 1, 2, 3, 4, and m inches on the map. Given m , a distance on the map, write an equation to find a , the actual distance.

H.O.T. Problems

CHALLENGE For Exercises 24–26, consider the sequence 2, 4, 6, 8,

24. Express the relationship between a number in this sequence and its position using words. For example, 6 is the third number in this sequence.
25. Define two variables and write an equation to express this relationship.
26. Describe how this relationship would change, using words and a new equation, if the sequence were changed to 0, 2, 4, 6, 8,

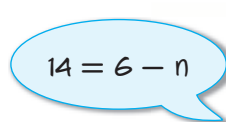


27. **FIND THE ERROR** Zoe and Toshi are translating the verbal sentence *14 is 6 less than a number* into an algebraic equation. Who is correct? Explain.



Zoe

$$14 = n - 6$$



Toshi

$$14 = 6 - n$$

28. **WRITING IN MATH** Analyze the meaning of the equations $\ell = 2w$ and $w = 2\ell$ if ℓ represents the length of a rectangle and w its width. Then draw a rectangle that demonstrates each relationship.

STANDARDS PRACTICE

29. The length of an actual car is 87 times its corresponding length of a model of the car. Given a , an actual length of the car, which equation can be used to find m , the corresponding model length?
- A $a = 87 + m$
 B $a = 87 - m$
 C $a = 87 \cdot m$
 D $a = 87 \div m$
30. The sides of each triangle are 1 unit long. Which equation can be used to represent the perimeter of the figure that contains x triangles?



Figure 1



Figure 2



Figure 3

F $P = 3x$

H $P = x + 2$

G $P = 3x - 2$

J $P = x - 2$

Spiral Review

Multiply or divide. (Lesson 1-6)

31. $-9(10)$

32. $-5(-14)$

33. $34 \div (-17)$

34. $\frac{-105}{-5}$

35. **BUSINESS** During January, a small business had an income I of \$18,600 and expenses E of \$20,400. Use the formula $P = I - E$ to find the business's profit P for the month of January. (Lesson 1-5)

GET READY for the Next Lesson

36. **PREREQUISITE SKILL** When Jason joined the football team, he had 8 plays memorized. By the end of the 1st week, he had 10 memorized. By the end of the 2nd week, he had 14 memorized. By the end of the 3rd week, he had 20 memorized. If he continues to learn at this pace, how many plays will he have memorized after 8 weeks? (Lesson 1-1)

Problem-Solving Investigation

MAIN IDEA: Solve problems by working backward.



Standard 7MR1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns. **Standard 7NS1.2** Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.

P.S.I. TEAM +

e-Mail: WORK BACKWARD

YOUR MISSION: Work backward to solve the problem.

THE PROBLEM: What time will Trent need to start camp activities?

TRENT: The closing day activities at camp must be over by 2:45 P.M. I need $1\frac{1}{2}$ hours to hold the field competitions, 45 minutes for the awards ceremony, and an hour and 15 minutes for the cookout. Then, everyone will need an hour to pack and check out.



EXPLORE	You know the time that the campers must leave. You know the time it takes for each activity. You need to determine the time the day's activities should begin.	
PLAN	Start with the ending time and work backward.	
SOLVE	The day is over at 2:45 p.m. Go back 1 hour for checkout. >>>>>>>>>>>>>>>>>> Go back 1 hour and 15 minutes for the cookout. >>>>>>>>>>>>>>>>>> Go back 45 minutes for the awards ceremony. >>>>>>>>>>>>>>>>>> Go back $1\frac{1}{2}$ hours for the field competitions. >>>>>>>>>>>>>>>>>> So, the day's activities should start no later than 10:15 A.M.	2:45 P.M. 1:45 P.M. 12:30 P.M. 11:45 A.M. 10:15 A.M.
CHECK	Assume that the day starts at 10:15 A.M. Work forward, adding the time for each activity.	

Analyze The Strategy

1. Tell why the *work backward* strategy is the best way to solve this problem.
2. Explain how you can check a solution when you solve by working backward.
3. **WRITING IN MATH** Write a problem that can be solved by working backward. Then write the steps you would take to find the solution to your problem.

Mixed Problem Solving

For Exercises 4–6, solve using the *work backward* strategy.

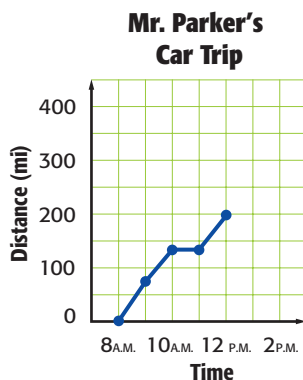
4. **FAMILY** Mikal's great-grandmother was 6 years old when her family came to the United States. That was 73 years ago. If the year is now 2006, in what year was Mikal's great-grandmother born?
5. **GRADES** Amelia's test scores are 94, 88, 93, 85, and 91. What is the minimum score she can make on her next test to maintain a test average of at least 90?
6. **SHOPPING** Janelle has \$75 to spend on a dress. She buys a dress that is on sale for half price and then applies an in-store coupon for \$10 off. After paying an additional sales tax of \$1.80, she receives \$37.20 in change. What was the original price of the dress?

Use any strategy to solve Exercises 7–9. Some strategies are shown below.

PROBLEM-SOLVING STRATEGIES

- Use the four-step plan.
- Work backward.

7. **ANALYZE GRAPHS** Examine the graph below.



Mr. Parker's total trip will cover 355 miles. If he maintains the speed that he set between 11 A.M. and noon, about what time should he reach his destination?

8. **ANALYZE TABLES** The table gives the average television viewing time, in hours:minutes, for teens and children.

Group	Nightly 8–11 P.M.	Total per Week
Teens (ages 12–17)	5:38	19:19
Children (ages 2–11)	4:58	21:00

Source: Nielsen Media Research

How many more minutes each week do children spend watching television at times other than 8–11 P.M. than teens do?

9. **FURNITURE** Ms. Calzada makes an initial down payment of \$150 when purchasing a sofa. She pays the remaining cost of the sofa over 12 months, at no additional charge. If her monthly payment is \$37.50, what was the original price of the sofa?

Select the Operation

For Exercises 10 and 11, select the appropriate operation(s) to solve the problem. Justify your selection(s) and solve the problem.

10. **ANALYZE TABLES** The table gives information about two different airplanes.

Airplane	Top Speed (mph)	Flight Length (mi)	Operating Cost per Hour
B747-400	534	3,960	\$8,443
B727-200	430	644	\$4,075

Source: *The World Almanac*

How much greater is the operating cost of a B747-400 than a B727-200 if each plane flies at its top speed for its maximum length of flight?

11. **PEACE PRIZE** Mother Teresa of Calcutta, India, received the Nobel Peace Prize in 1979. If she died in 1997 at the age of 87, how old was she when she received the Nobel Prize?





READING Word Problems

Simplify the Problem

Have you ever tried to solve a long word problem and didn't know where to start? Always start by reading the problem carefully.

Step 1

Look for key words like *more* or *less* to understand how the numbers are related.

It is estimated that 12.4 million pounds of potato chips were consumed during a recent Super Bowl. **This** was 3.1 million pounds **more than** the number of pounds of tortilla chips consumed. How many pounds of tortilla chips were consumed?

The potato chips were 3.1 million **more than** the tortilla chips.

The word **this** refers to the number of pounds of potato chips.



Standard 7MR1.3

Determine when and how to break a problem into simpler parts.

Standard 7AF1.4 Use algebraic terminology (e.g. variable, equation, term, coefficient, inequality, expression, constant) correctly.

Step 2

Now, try to write the important information in only one sentence.

The **number of pounds of potato chips** was 3.1 million pounds **more than** the number of pounds of tortilla chips.

Step 3

Replace any phrases with numbers that you know.

12.4 million was 3.1 million **more than** the number of pounds of tortilla chips.

Before you write an equation, use the three steps described above to simplify the problem.

PRACTICE

Refer to page 59. For each exercise below, simplify the problem by writing the important information in only one sentence. Replace any phrases with numbers that you know. Do not write an equation.

1. Exercise 3
2. Exercise 12
3. Exercise 13

1-9

Solving Addition and Subtraction Equations

Main IDEA

Solve equations using the Subtraction and Addition Properties of Equality.



Reinforcement of Standard 6AF1.1

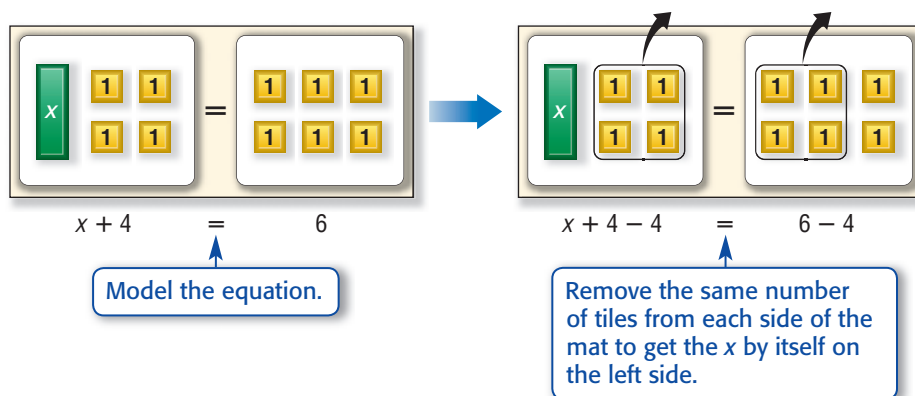
Write and solve one-step linear equations in one variable.

NEW Vocabulary

solve
solution
inverse operations

MINI Lab

When you **solve** an equation, you are finding the values of the variable that make the equation true. These values are called the **solutions** of the equation. You can use algebra tiles and an equation mat to solve $x + 4 = 6$.



The number of tiles remaining on the right side of the mat represents the value of x . So, 2 is the solution of the equation $x + 4 = 6$.

Solve each equation using algebra tiles.

1. $x + 1 = 4$
2. $x + 3 = 7$
3. $x + (-4) = -5$
4. Explain how you would find a value of x that makes $x + (-3) = -8$ true without using algebra tiles.

In the Mini Lab, you solved the equation $x + 4 = 6$ by *removing*, or subtracting, the same number of positive counters from each side of the mat. This suggests the **Subtraction Property of Equality**, which can be used to solve addition equations like $x + 4 = 6$.

KEY CONCEPT

Subtraction Property of Equality

Words If you subtract the same number from each side of an equation, the two sides remain equal.

Examples

Numbers

$$\begin{aligned} 7 &= 7 \\ 7 - 3 &= 7 - 3 \\ 4 &= 4 \end{aligned}$$

Algebra

$$\begin{aligned} x + 4 &= 6 \\ x + 4 - 4 &= 6 - 4 \\ x &= 2 \end{aligned}$$



STUDY TIP

Isolating the Variable

When trying to decide which value to subtract from each side of an addition equation, remember that your goal is to get the variable by itself on one side of the equation. This is called *isolating the variable*.

You can use this property to solve any addition equation. Remember to check your solution by substituting it back into the original equation.

EXAMPLE Solve an Addition Equation

1 Solve $x + 5 = 3$. Check your solution.

METHOD 1 Use the vertical method.

$$x + 5 = 3$$

Write the equation.

$$x + 5 = 3$$

$$\underline{-5 = -5}$$

Subtract 5 from each side.

$$x = -2$$

METHOD 2 Use the horizontal method.

$$x + 5 = 3$$

Write the equation.

$$x + 5 - 5 = 3 - 5$$

Subtract 5 from each side.

$$x = -2$$

The solution is -2 .

Check $x + 5 = 3$

Write the original equation.

$$-2 + 5 \stackrel{?}{=} 3$$

Replace x with -2 . Is this sentence true?

$$3 = 3$$

The sentence is true.

CHOOSE Your Method

Solve each equation. Check your solution.

a. $a + 6 = 2$

b. $y + 3 = -8$

c. $5 = n + 4$



Addition and subtraction are called **inverse operations** because they “undo” each other. For this reason, you can use the **Addition Property of Equality** to solve subtraction equations like $x - 7 = -5$.

KEY CONCEPT

Addition Property of Equality

Words

If you add the same number to each side of an equation, the two sides remain equal.

Examples

Numbers

$$7 = 7$$

$$7 + 3 = 7 + 3$$

$$10 = 10$$

Algebra

$$x - 5 = 6$$

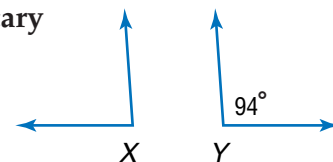
$$x - 5 + 5 = 6 + 5$$

$$x = 11$$



EXAMPLE Solve an Addition Equation

- 2 MEASUREMENT** Two angles are supplementary if the sum of their measures is 180° . The two angles shown are supplementary. Write and solve an equation to find the measure of angle X.



Words	The sum of the measures is 180° .
Variable	Let x represent the measure of angle X.
Equation	$x + 94 = 180$

$$\begin{array}{ll}
 x + 94 = 180 & \text{Write the equation.} \\
 x + 94 - 94 = 180 - 94 & \text{Subtract 94 from each side.} \\
 x = 86 & \text{Simplify.}
 \end{array}$$

The measure of angle X is 86° .

CHECK Your Progress

- d. **READING** A novel is ranked 7th on a best-seller list. This is a change of -8 from its position last week. Write and solve an equation to determine the novel's ranking last week.



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EXAMPLE Solve a Subtraction Equation

- 3** Solve $-6 = y - 7$.

METHOD 1 Use the vertical method.

$$\begin{array}{ll}
 -6 = y - 7 & \text{Write the equation.} \\
 -6 = y - 7 & \\
 +7 = +7 & \text{Add 7 to each side.} \\
 1 = y & -6 + 7 = 1 \text{ and } -7 + 7 = 0.
 \end{array}$$

METHOD 2 Use the horizontal method.

$$\begin{array}{ll}
 -6 = y - 7 & \text{Write the equation.} \\
 -6 + 7 = y - 7 + 7 & \text{Add 7 to each side.} \\
 1 = y & -6 + 7 = 1 \text{ and } -7 + 7 = 0.
 \end{array}$$

The solution is 1. Check the solution.

CHOOSE Your Method Solve each equation.

- e. $x - 8 = -3$ f. $b - 4 = -10$ g. $7 = p - 12$

STUDY TIP

Position of the Variable

You could also begin solving Example 3 by rewriting the equation so that the variable is to the left side of the equation.

$$\begin{array}{l}
 -6 = y - 7 \\
 \downarrow \\
 y - 7 = -6
 \end{array}$$

CHECK Your Understanding

Example 1 Solve each equation. Check your solution.

(p. 66)

1. $a + 4 = 10$

2. $2 = z + 7$

3. $x + 9 = -3$

Example 2

(p. 67)

4. **RUGS** The length of a rectangular rug is 12 inches shorter than its width. If the length is 30 inches, write and solve an equation to find the width.

Example 3

(p. 67)

Solve each equation. Check your solution.

5. $y - 2 = 5$

6. $n - 5 = -6$

7. $-8 = d - 11$

Exercises

HOMEWORK HELP

For Exercises	See Examples
8–13	1
14–19	3
20–23	2

Solve each equation. Check your solution.

8. $x + 5 = 18$

9. $n + 3 = 20$

10. $9 = p + 11$

11. $1 = a + 7$

12. $y + 12 = -3$

13. $w + 8 = -6$

14. $m - 15 = 3$

15. $b - 9 = -8$

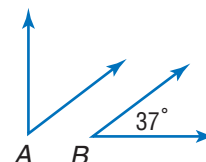
16. $g - 2 = -13$

17. $-16 = t - 6$

18. $-4 = r - 20$

19. $k - 14 = -7$

20. **MEASUREMENT** Two angles are complementary if the sum of their measures is 90° . The two angles shown are complementary. Write and solve an equation to find the measure of angle A.



21. **BANKING** After you withdraw \$50 from your savings account, the balance is \$124. Write and solve an equation to find your starting balance.

22. **TEMPERATURE** On one day in Fairfield, Montana, the temperature dropped 84°F from noon to midnight. If the temperature at midnight was -21°F , write and solve an equation to determine the noon temperature that day.

23. **TREES** Before planting a tree, Manuel digs a hole with a floor 18 inches below ground level. Once planted, the top of the tree is 54 inches above ground. Write and solve an equation to find the height of the tree Manuel planted.

ANALYZE TABLES For Exercises 24 and 25, use the table.

24. Lauren Jackson averaged 0.5 point per game more than Tina Thompson. Write and solve an equation to find Thompson's average points scored per game.

25. Sheryl Swoopes averaged 5.2 fewer points per game than Tina Thompson. Write and solve an equation to find how many points Swoopes averaged per game.

2004 WNBA Regular Season Points Leaders	
Player	AVG
Lauren Jackson	20.5
Tina Thompson	a
Lisa Leslie	17.6
Diana Taurasi	17.0

Source: wnba.com

**EXTRAPRACTICE**

See pages 678, 708.

Math onlineSelf-Check Quiz at
ca.gr7math.com**H.O.T. Problems**

26. **STOCK MARKET** The changes in the price of a certain stock each day from Monday to Thursday of one week were $-\$2.25$, $+\$0.50$, $+\$1.50$, and $+\$0.75$. If the overall change in the stock price for the week was $-\$0.50$, write an equation that can be used to find the change in the price on Friday and explain two methods of solving this equation. Then solve the equation and explain its meaning in the context of the situation.

27. **OPEN ENDED** Write one addition equation and one subtraction equation that each have -3 as a solution.
28. **Which One Doesn't Belong?** Identify the equation that does not belong with the other three. Explain your reasoning.

$4 + g = 2$

$a + 5 = -3$

$m + 6 = 4$

$1 + x = -1$

29. **CHALLENGE** Solve $|x| + 5 = 7$. Explain your reasoning.
30. **WRITING IN MATH** Write a problem about a real-world situation that can be answered by solving the equation $x + 60 = 20$. Then solve the equation and explain the meaning of its solution in the context of your problem.

**STANDARDS PRACTICE**

31. Dante paid $\$42$ for a jacket, which included $\$2.52$ in sales tax. Which equation could be used to find the price of the jacket before tax?
- A $x - 2.52 = 42$ C $x - 42 = 2.52$
 B $x + 2.52 = 42$ D $x + 42 = 2.52$
32. The record low temperature for Virginia is 7°F warmer than the record low for West Virginia. If the record low for Virginia is -30°F , what is West Virginia's record low?
- F -37°F H 23°F
 G -23°F J 37°F

Spiral Review

33. **TRAVEL** James needs to drive an average of 575 miles a day for three days in order to make it to his vacation destination on time. If he drove 630 miles the first day and 480 miles the second day, how many miles does he need to drive on the third day to meet his goal? (Lesson 1-8)

ALGEBRA Write an equation to model each situation. (Lesson 1-7)

34. Lindsay, 59 inches tall, is 5 inches shorter than her sister.
35. After cutting the recipe in half, Ricardo needed 3 cups of flour.

**GET READY for the Next Lesson****PREREQUISITE SKILL** Multiply. (Lesson 1-6)

36. $3(9)$

37. $-2(18)$

38. $-5(-11)$

39. $4(-15)$

Solving Multiplication and Division Equations

Main IDEA

Solve equations by using the Division and Multiplication Properties of Equality.



Reinforcement of Standard 6AF1.1

Write and solve one-step linear equations in one variable.

GET READY for the Lesson

PLANTS Some species of a bamboo can grow 35 inches per day. That is as many inches as the average child grows in the first 10 years of his or her life!

- If d represents the number of days the bamboo has been growing, write a multiplication equation you could use to find how long it would take for the bamboo to reach a height of 210 inches.

Bamboo Growth

Day	Height (in.)
1	$35(1) = 35$
2	$35(2) = 70$
3	$35(3) = 105$
$\vdots$	$\vdots$
d	

The equation $35d = 210$ models the relationship described above. To undo the multiplication of 35, divide each side of the equation by 35.

EXAMPLE Solve a Multiplication Equation

- Solve $35d = 210$.

$$35d = 210$$

Write the equation.

$$\frac{35d}{35} = \frac{210}{35}$$

Divide each side of the equation by 35.

$$1d = 6$$

$$35 \div 35 = 1 \text{ and } 210 \div 35 = 6$$

$$d = 6$$

Identity Property; $1d = d$

CHECK Your Progress

Solve each equation. Check your solution.

a. $8x = 72$

b. $-4n = 28$

c. $-12 = -6k$

STUDY TIP

Solving Equations

When you solve a simple equation like $8x = 72$, you can mentally divide each side by 8.

In Example 1, you used the **Division Property of Equality** to solve a multiplication equation.

KEY CONCEPT

Division Property of Equality

Words If you divide each side of an equation by the same nonzero number, the two sides remain equal.

Examples

Numbers

$$12 = 12$$

$$\frac{12}{4} = \frac{12}{4}$$

$$3 = 3$$

Algebra

$$5x = -60$$

$$\frac{5x}{5} = \frac{-60}{5}$$

$$x = -12$$

READING Math

Division Expressions

Remember, $\frac{a}{-3}$ means a divided by -3 .

You can use the **Multiplication Property of Equality** to solve equations.

KEY CONCEPT

Multiplication Property of Equality

Words If you multiply each side of an equation by the same number, the two sides remain equal.

Examples

Numbers

$$\begin{aligned}5 &= 5 \\5(-4) &= 5(-4) \\-20 &= -20\end{aligned}$$

Algebra

$$\begin{aligned}\frac{x}{2} &= 8 \\\frac{x}{2}(2) &= 8(2) \\x &= 16\end{aligned}$$

EXAMPLE

Solve a Division Equation

2 Solve $\frac{a}{-3} = -7$.

$$\frac{a}{-3} = -7$$

Write the equation.

$$\frac{a}{-3}(-3) = -7(-3)$$

Multiply each side by -3 .

$$a = 21$$

$$-7 \cdot (-3) = 21$$



CHECK Your Progress

Solve each equation.

d. $\frac{y}{-4} = -8$

e. $\frac{m}{5} = -9$

f. $30 = \frac{b}{-2}$



Real-World EXAMPLE

- 3 REPTILES** A Nile crocodile grows to be 4,000 times as heavy as the egg from which it hatched. If an adult crocodile weighs 2,000 pounds, how much does a crocodile egg weigh?

Words

Adult weight is 4,000 times egg weight.

Variable

Let g represent the weight of the crocodile egg.

Equation

$$2,000 = 4,000 \cdot g$$

$$2,000 = 4,000g$$

Write the equation.

$$\frac{2,000}{4,000} = \frac{4,000g}{4,000}$$

Divide each side by 4,000.

$$0.5 = g$$

$$2,000 \div 4,000 = 0.5$$

A crocodile egg weighs 0.5 pound.



CHECK Your Progress

- g. An adult lizard is about five times longer than a hatchling. If an adult lizard is 11 centimeters long, about how long is a hatchling?



Real-World Career . . .

How Does a Zoologist Use Math?

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CHECK Your Understanding

Examples 1, 2
(pp. 70, 71)

Solve each equation. Check your solution.

1. $5b = 40$

2. $-7k = 14$

3. $-18 = -3n$

4. $\frac{p}{9} = 9$

5. $\frac{a}{12} = -3$

6. $22 = \frac{m}{-2}$

Example 3
(p. 71)

7. **LAWN SERVICE** Josh charges \$15 to mow an average size lawn in his neighborhood. Write and solve a multiplication equation to find how many of these lawns he needs to mow to earn \$600.

Exercises

HOMEWORK HELP

For Exercises	See Examples
8–13	1
14–19	2
20, 21	3

Solve each equation. Check your solution.

8. $4c = 44$

9. $9b = 72$

10. $34 = -2x$

11. $36 = -18y$

12. $-32 = 8d$

13. $-35 = 5n$

14. $\frac{m}{7} = 10$

15. $\frac{u}{9} = 6$

16. $\frac{h}{-3} = 33$

17. $20 = \frac{q}{-5}$

18. $-8 = \frac{c}{12}$

19. $\frac{r}{24} = -3$

20. **ANIMALS** An African elephant can eat 500 pounds of vegetation per day. If a zookeeper has 3,000 pounds of vegetation on hand for one elephant, write and solve a multiplication equation to find how many days this supply will last.

21. **SCHOOL ACTIVITIES** The drama club sold 1,200 tickets for the school musical. If the total ticket sales were \$6,000, write and solve a multiplication equation to find the cost per ticket.

MEASUREMENT For Exercises 22–26, refer to the table. Write and solve an equation to find each quantity.

22. the number of yards in 18 feet

23. the number of feet in 288 inches

24. the number of yards in 540 inches

25. the number of miles in 26,400 feet

26. the number of miles in 7,040 yards

Customary System Conversions (length)

1 foot = 12 inches

1 yard = 3 feet

1 yard = 36 inches

1 mile = 5,280 feet

1 mile = 1,760 yards

Solve each equation.

27. $7 = \frac{-56}{z}$

28. $\frac{10}{x} = -5$

29. $\frac{-126}{a} = -21$

30. $-17 = \frac{136}{g}$

31. **PHYSICAL SCIENCE** The amount of work, measured in foot-pounds, is equal to the amount of force applied, measured in pounds, times the distance, in feet, the object moved. How far do you have to lift a 45-pound object to produce 180 foot-pounds of work?

EXTRA PRACTICE

See pages 679, 708.

Math  online

Self-Check Quiz at
ca.gr7math.com

**H.O.T. Problems**

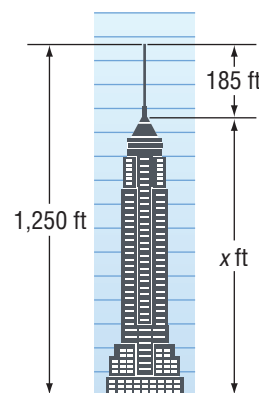
32. **OPEN ENDED** Describe a real-world situation in which you would use a division equation to solve a problem. Then write your equation.
33. **NUMBER SENSE** Without solving the equation, tell what you know about the value of x in the equation $\frac{x}{25} = 300$.
34. **CHALLENGE** If an object is traveling at a rate of speed r , then the distance d the object travels after a time t is given by the equation $d = rt$. Rewrite this equation so that it expresses the value of r in terms of t and d .
35. **WRITING IN MATH** Explain how to solve $-4a = 84$. Be sure to state which property you use and why you used it.

**STANDARDS PRACTICE**

36. Grace paid \$2.24 for 4 granola bars. All 4 granola bars were the same price. How much did each granola bar cost?
- A \$0.52
B \$0.56
C \$1.24
D \$1.56
37. Luis ran 2.5 times the distance that Mark ran. If Mark ran 3 miles, which equation can be used to find the distance d in miles that Luis ran?
- F $d = 2.5 + 3$
G $d + 2.5 = 3$
H $d = 2.5(3)$
J $2.5d = 3$

Spiral Review

38. **ARCHITECTURE** When the Empire State Building was built, its 185-foot spire was built inside the building and then hoisted to the top of the building upon its completion. Write and solve an equation to find the height of the Empire State Building without its spire. (Lesson 1-9)



ALGEBRA Write an equation to model each situation. (Lesson 1-7)

39. Eight feet longer than she jumped is 15 feet.
40. The temperature fell 28°F from 6 A.M. to 17°F at 11 A.M.
41. Three friends shared a \$9 parking fee equally.

Find each product or quotient. (Lesson 1-6)

- | | | | |
|--------------------|----------------------|----------------------|-----------------------------|
| 42. $-23(-12)$ | 43. $-25(7)$ | 44. $22 \cdot (-20)$ | 45. $4 \cdot 8 \cdot (-14)$ |
| 46. $-180 \div 15$ | 47. $147 \div (-21)$ | 48. $-162 \div 9$ | 49. $-208 \div (-16)$ |

Write an integer for each situation. (Lesson 1-3)

- | | |
|-----------------------------|--------------------------------------|
| 50. a gain of 4 ounces | 51. earning \$45 |
| 52. 2 miles below sea level | 53. a decrease of 5 miles per gallon |

Study Guide and Review



Download Vocabulary
Review from ca.gr7math.com

FOLDABLES

Study Organizer

GET READY to Study

Be sure the following
Key Concepts are noted
in your Foldable.

	Words	Example(s)
A Plan for Problem Solving		
+ & - of Integers		
x & ÷ of Integers		
Solving + & - Equations		
Solving x & ÷ Equations		

Key Concepts

Order of Operations (Lesson 1-2)

1. Do all operations within grouping symbols first.
2. Evaluate all powers before other operations.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

Operations With Integers (Lessons 1-4 to 1-6)

- To add integers with the same sign, add their absolute values. The sum has the same sign as the integers.
- To add integers with different signs, subtract their absolute values. The sum has the sign of the integer with the greater absolute value.
- To subtract an integer, add its opposite or additive inverse.
- The product or quotient of two integers with the same sign is positive.
- The product or quotient of two integers with different signs is negative.

Solving Equations (Lessons 1-9, 1-10)

- If you add or subtract the same number to/from each side of an equation, the two sides remain equal.
- If you multiply or divide each side of an equation by the same nonzero number, the two sides remain equal.

Key Vocabulary

absolute value (p. 36)	integer (p. 35)
additive inverse (p. 43)	inverse operations (p. 66)
algebra (p. 29)	negative number (p. 35)
algebraic expression (p. 29)	numerical expression (p. 29)
coordinate (p. 35)	opposites (p. 43)
counterexample (p. 31)	order of operations (p. 29)
define a variable (p. 57)	powers (p. 30)
equation (p. 57)	solution (p. 65)
evaluate (p. 29)	solve (p. 65)
inequality (p. 35)	variable (p. 29)

Vocabulary Check

State whether each sentence is *true* or *false*.
If *false*, replace the underlined word or
number to make a true sentence.

1. Operations that “undo” each other are called order of operations.
2. The symbol for absolute value is $| \quad |$.
3. A mathematical sentence that contains an equals sign is an inequality.
4. An integer is a number less than zero.
5. A property is an example that shows that a conjecture is false.
6. The value of the variable that makes the equation true is called the solution.
7. The number that corresponds to a point is called its coordinate.
8. A power is a symbol, usually a letter, used to represent the number.
9. An equation that contains a variable is an algebraic expression.

Lesson-by-Lesson Review

1-1 A Plan for Problem Solving (pp. 24–28)

Use the four-step plan to solve each problem.

10. **SCIENCE** A chemist pours table salt into a beaker. If the beaker plus the salt has a mass of 84.7 grams and the beaker itself has a mass of 63.3 grams, what was the mass of the salt?
11. **SPORTS** In a basketball game, the Sliders scored five 3-point shots, seven 2-point shots, and fifteen 1-point shots. Find the total points scored.
12. **SHOPPING** Miguel went to the store to buy jeans. Each pair costs \$24. If he buys two pairs, he can get the second pair for half price. How much will he save per pair if he buys two pairs?

Example 1 At Smart's Car Rental, it costs \$57 per day plus \$0.10 per mile to rent a certain car. How much will it cost to rent the car for 1 day and drive 180 miles?

Explore You know the rental cost per day and per mile. You need to find the cost for a 1-day rental for 180 miles.

Plan Multiply the number of miles by the cost per mile. Then add the daily cost.

Estimate $\$0.10 \times 200 = \20 and $\$60 + \$20 = \$80$

Solve $\$0.10 \times 180 = \18
 $\$18 + \$57 = \$75$

The cost is \$75.

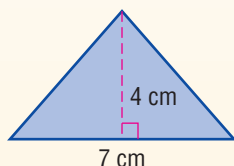
Check The answer of \$75 is close to the estimate of \$80, so the answer is reasonable.

1-2 Variables, Expressions, and Properties (pp. 29–34)

Evaluate each expression if $a = 6$, $b = 2$, and $c = 1$.

13. $a(b + 4)$
14. $3b^2$
15. $3a + 2b + c$
16. $\frac{(a + 2)^2}{bc}$

17. **MEASUREMENT** The area A of a triangle can be found using the formula $A = \frac{1}{2}bh$, where b is the base of the triangle and h is the height. Find the area of the triangle.



Example 2 Evaluate $x^2 + yx - z^2$ if $x = 4$, $y = 2$, and $z = 1$.

$x^2 + yx - z^2$ Write the expression.
 $= 4^2 + (2)(4) - (1)^2$ $x = 4$, $y = 2$, and $z = 1$
 $= 16 + (2)(4) - 1$ Evaluate powers first.
 $= 16 + 8 - 1$ Multiply.
 $= 23$ Add and subtract.

Study Guide and Review

1-3

Integers and Absolute Value (pp. 35–39)

Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence.

18. $-8 \bullet 7$

19. $-2 \bullet -6$

20. **BASKETBALL** On average, the varsity team wins games by a margin of 13 points, give or take 5 points. This range can be modeled by the equation $|p - 13| = 5$. Graph this equation on a number line to determine the least and the greatest margin of points.

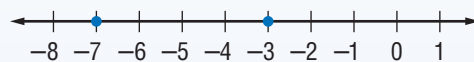
Evaluate each expression.

21. $|-5|$

22. $|-12| - |4|$

Example 3 Replace the $\bullet$ in $-3 \bullet -7$ with $<$, $>$, or $=$ to make a true sentence.

Graph the integers on a number line.



Since -3 is to the right of -7 , $-3 > -7$.

Example 4 Evaluate $|-3|$.

Since the graph of -3 is 3 units from 0 on the number line, the absolute value of -3 is 3.

1-4

Adding Integers (pp. 41–45)

Add.

23. $-54 + 21$

24. $100 + (-75)$

25. $-14 + (-20)$

26. $38 + (-46)$

27. $-14 + 37 + (-20) + 2$

28. **WEATHER** At 8:00 A.M., it was -5°F . By noon, it had risen 34° . Write an addition statement to describe this situation. Then find the sum.

Example 5 Find $-16 + (-11)$.

$$\begin{aligned} -16 + (-11) \\ = -27 \end{aligned}$$

Add $|-16|$ and $|-11|$. Both numbers are negative, so the sum is negative.

Example 6 Find $-7 + 20$.

$$\begin{aligned} -7 + 20 \\ = 13 \end{aligned}$$

Subtract $|-7|$ from $|20|$. The sum is positive because $|20| > |-7|$.

1-5

Subtracting Integers (pp. 46–49)

Subtract.

29. $-2 - (-5)$

30. $11 - 15$

31. **GEOGRAPHY** At an elevation of -52 feet, Lake Eyre is the lowest point in Australia. How much lower than Lake Eyre is the Valdes Peninsula in South America, which has an elevation of -131 ft?

Example 7 Find $-27 - (-6)$.

$$\begin{aligned} -27 - (-6) &= -27 + 6 \\ &= -21 \end{aligned}$$

To subtract -6 , add 6.

1-6 Multiplying and Dividing Integers (pp. 51–56)

Multiply or divide.

32. $-4(-25)$ 33. $-7(3)$
34. $-15(-4)(-1)$ 35. $180 \div (-15)$
36. $-170 \div (-5)$ 37. $-88 \div 8$
38. **GAMES** José's score in each of 6 rounds of a game was -2 . What was his overall score for these six rounds?

Example 8 Find $3(-20)$.

$$3(-20) = -60$$

The factors have different signs. The product is negative.

Example 9 Find $-48 \div (-12)$.

$$-48 \div (-12) = 4$$

The dividend and the divisor have the same sign. The quotient is positive.

1-7 Writing Equations (pp. 57–61)

39. **SPORTS** An athlete's long jump attempt measured 670 centimeters. This was 5 centimeters less than her best jump. Define a variable. Then write an equation that could be used to find the measure of her best jump.
40. **ALGEBRA** Lauren uses a copier to reduce the length of an image so it is $\frac{1}{4}$ of its original size. Given ℓ , the length of the image, write an equation to find the length n of the new image.

Example 10 Tennessee became a state 4 years after Kentucky. If Tennessee became a state in 1796, write an equation that could be used to find the year Kentucky became a state.

Words Tennessee's year is 4 years after Kentucky year.

Variable Let y represent Kentucky's year.

Equation $1796 = y + 4$

1-8 PSI: Work Backward (pp. 62–63)Solve. Use the *work backward* strategy.

41. **TRAVEL** Alonzo's flight to Phoenix departs at 7:15 P.M. It takes 30 minutes to drive to the airport from his home, and it is recommended that he arrive at the airport 2 hours prior to departure. What time should Alonzo leave his house?
42. **TICKETS** After Candace purchased tickets to the play for herself and her two brothers, ticket sales totaled \$147. If tickets were \$5.25 each, how many tickets were sold before her purchase?

Example 11 Fourteen years ago, Samuel's parents had their oldest child, Isabel. Six years later, Julia was born. If Samuel was born last year, how many years older than Samuel is Julia?

Since Samuel was born last year, he must be one year old. Since Isabel was born fourteen years ago, she must be fourteen years old. Since Julia was born six years after Isabel, she must be eight years old. This means that Julia is seven years older than Samuel.

Study Guide and Review

1-9

Solving Addition and Subtraction Equations (pp. 65–69)

Solve each equation. Check your solution.

43. $n + 40 = 90$

44. $x - 3 = 10$

45. $c - 30 = -18$

46. $9 = a + 31$

47. $d + 14 = -1$

48. $27 = y - 12$

49. **CANDY** There are 75 candies in a bowl after you remove 37. Write and solve a subtraction equation to find how many candies were originally in the bowl.

50. **WEATHER** On August 15, the monthly rainfall for a city was 2 inches below average. On August 31, the monthly total was 1 inch above average. Write and solve an addition equation to determine the amount of rainfall between August 15 and August 31.

Example 12 Solve $5 + k = 18$.

$5 + k = 18$

Write the equation.

$5 - 5 + k = 18 - 5$ Subtract 5 from each side.

$k = 13$

$18 - 5 = 13$

Example 13 Solve $n - 13 = -62$.

$n - 13 = -62$

Write the equation.

$n - 13 + 13 = -62 + 13$ Add 13 to each side.

$n = -49$

$-62 + 13 = -49$

1-10

Solving Multiplication and Division Equations (pp. 70–73)

Solve each equation. Check your solution.

51. $15x = -75$

52. $-4x = 52$

53. $\frac{s}{7} = 42$

54. $\frac{y}{-10} = -15$

55. **MONEY** Toni borrowed \$168 from her father to buy clothes. She plans to pay \$28 a month toward this debt. Write and solve an equation to find how many months it will take to repay her father.

56. **CARS** Mr. Mitchell bought 12 quarts of motor oil for \$36. Write and solve an equation to find the cost of each quart of motor oil.

Example 14 Solve $60 = 5t$.

$60 = 5t$

Write the equation.

$\frac{60}{5} = \frac{5t}{5}$

Divide each side by 5.

$12 = t$

Simplify.

Example 15 Solve $\frac{m}{-2} = 8$.

$\frac{m}{-2} = 8$

Write the equation.

$\left(\frac{m}{-2}\right)(-2) = 8(-2)$

Multiply each side by -2 .

$m = -16$

Simplify.

Practice Test

1. **ANALYZE TABLES** The table gives the annual number of hours worked by citizens in four countries in a recent year.

Country	Annual Hours Worked
United States	1,877
Japan	1,840
Canada	1,801
United Kingdom	1,708

On average, how many more hours per week did a person in the United States work that year than a person in the United Kingdom?

Evaluate each expression if $a = 3$, $b = 2$, and $c = -5$.

2. $(2c + b) \div b - 3$

3. $4a^2 - 5a - 12$

4. **CELL PHONES** The monthly charge in dollars for a specific cell phone company is given by the expression $40 + \frac{x - 500}{2}$ where x is the number of minutes of phone usage. Find the charge if a person uses 622 minutes.

Replace each $\bullet$ with $<$, $>$, or $=$ to make a true sentence.

5. $-8 \bullet -11$

6. $|13| \bullet -13$

7.  **STANDARDS PRACTICE** Evaluate the following expression:

$$|12 - 7| - |3 - 6|$$

A -8

B -2

C 2

D 8

8. Find the value of $|y| - |x|$ if $x = -4$ and $y = -9$.

Add, subtract, multiply, or divide.

9. $-27 + 8$

10. $-105 \div 15$

11. $\frac{-70}{-5}$

12. $-4 - (-35)$

13. $7(-10)(-4)$

14. $-9 + (-11)$

15. $8(-9)$

16. $13 - 61$

17.  **STANDARDS PRACTICE** What is the absolute value of -7 ?

F -7

G $-\frac{1}{7}$

H $\frac{1}{7}$

J 7

18. **MEASUREMENT** A circle's radius is half its diameter. Given d , the diameter, write an equation that could be used to find r , the radius.

19. **JEANS** A store tripled the price it paid for a pair of jeans. After a month, the jeans were marked down by \$5. Two weeks later, the price was divided in half. Finally, the price was reduced by \$3, down to \$14.99. How much did the store pay for the jeans?

Solve each equation. Check your solution.

20. $x + 15 = -3$

21. $-7 = a - 11$

22. $\frac{n}{-2} = 16$

23. $-96 = 8y$

24. **TRANSPORTATION** An airplane flies over a submarine cruising at a depth of -326 feet. The distance between the two is $1,176$ feet. Write and solve an equation to find the airplane's altitude.

25. **GAMES** After Round 2 in a game, Eneas' score was -40 . After Round 3, her score was 5 . Write and solve an equation to find the number of points scored in Round 3.

California Standards Practice

Chapter 1



Read each question. Then fill in the correct answer on the answer document provided by your teacher or on a sheet of paper.

- 1 Kristy, Megan, and Heather sold a total of 48 magazines this weekend. Megan sold 3 more magazines than Heather, and Kristy sold twice as many magazines as Heather. Which is a reasonable conclusion about the number of magazines sold by the students?
 - A Megan sold the least number of magazines.
 - B Kristy and Megan sold the same number of magazines.
 - C Heather sold exactly half of the total number of magazines.
 - D Kristy sold the most magazines.
- 2 Two siblings agreed to split the cost of a television and a DVD player evenly. They spent a total of \$335.00 on the television and \$95.00 on the DVD player. Find the amount that each sibling paid.

F \$430.00	H \$215.00
G \$265.00	J \$210.00
- 3 Which of the following numerical expressions results in a positive number?

A $(-4) + (-7)$	C $(-4) + (7)$
B $(4) + (-7)$	D $(-4) + (7) + (-4)$
- 4 An electrician received d dollars for a job. She had to pay \$75 for supplies. On her next job, she received $3m$ dollars. Which expression represents the amount of money she has now?

F $d - 75 - 3m$	H $d + 75 - 3m$
G $d + 75 + 3m$	J $d - 75 + 3m$

- 5 If $|r| = 2$, what is the value of r ?

A -2 or 0	C 0 or 2
B -2 or 2	D -4 or 4

TEST-TAKING TIP

Question 5 In some instances, the quickest and easiest way to answer the question is to simply try each choice to see which one works.

- 6 Tony received some money from his grandmother for his birthday. He spent \$12.75 each for 3 CDs. Then he spent \$5.20 for lunch. Later he bought a T-shirt for \$8.90. If he had \$7.65 left over, which of the following expressions can be used to find how much money Tony received for his birthday?
 - F $3(12.75) + 5.20 + 8.90 + 7.65$
 - G $3(12.75) + 5.20 + 8.90 - 7.65$
 - H $3(12.75 + 5.20 + 8.90 + 7.65)$
 - J $3(12.75 + 5.20 + 8.90 - 7.65)$
- 7 Abigail evaluated the expression $|-27 + 3| - |-3 - 5|$ by performing the following steps.

$ \begin{aligned} -27 + 3 - -3 - 5 &= -24 - -8 \\ &= 24 + 8 \\ &= 32 \end{aligned} $
--

What did Abigail do incorrectly in evaluating the expression?

- A She evaluated $|-24|$ as 24 when she should have evaluated $|-24|$ as -24 .
- B She added 24 and 8 when she should have subtracted 8 from 24.
- C She evaluated $|-3 - 5|$ as $|-8|$ when she should have evaluated $|-3 - 5|$ as $|-2|$.
- D She added 24 and 8 when she should have subtracted -8 from -24 .

- 8** Add six to the quotient of a number and three. The answer is 14. Which of the following equations matches these statements?

F $14 = \frac{x}{3} + 6$

G $6 = 14 + \frac{x}{3}$

H $14 = \frac{x+6}{3}$

J $6 = \frac{x+14}{3}$

- 9** The table below shows the train travel times from Cleveland (CLE) to Chicago (CHI).

Depart CLE	Arrive CHI
2:30 A.M.	8:45 A.M.
7:45 A.M.	1:45 P.M.
8:20 P.M.	2:25 A.M.
2:00 P.M.	8:20 P.M.

Which of the following statements about the travel times is true?

- A** The train leaving at 2:30 A.M. has the least travel time.
- B** The train leaving at 7:45 A.M. has the greatest travel time.
- C** The train leaving at 8:20 P.M. has the least travel time.
- D** The train leaving at 2:00 P.M. has the greatest travel time.
- 10** If $x = 5$ and $y = \frac{1}{4}$, then $y(13 - x) =$
- F** 2 **H** 4
- G** 3 **J** 6

- 11** Mandy wants to buy a new couch that costs \$1,299. For the next 8 months, she plans to save an equal amount of money each month to pay for the couch. About how much will she need to save each month?

A \$162.50

B \$158.50

C \$165.75

D \$185.00

- 12** The high temperature on Monday was -8°F . On Tuesday, the high temperature was 11°F . How much warmer was it on Tuesday than Monday?

F 19°F

G 3°F

H -3°F

J -19°F

Pre-AP

**Record your answers on a sheet of paper.
Show your work.**

- 13** Below, n , p , r , and t each represent a different integer. If $n = -4$ and $t \neq 1$, find each of the following values. Explain your reasoning using the properties of integers.

$$\begin{aligned} n \times p &= n \\ t \times r &= r \\ n + t &= r \end{aligned}$$

a. p

b. r

c. t

NEED EXTRA HELP?													
If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13
Go to Lesson...	1-1	1-6	1-4	1-7	1-3	1-1	1-3	1-7	1-1	1-2	1-1	1-5	1-3
For Help with Standard...	MR1.1	NS1.2	NS1.2	AF1.1	NS2.5	MR1.1	NS2.5	AF1.1	MR1.2	AF1.2	MR2.1	NS1.2	NS2.5