

Polynomials

Whales, sharks, and dolphins have shapes that minimize water resistance. The ideal shape for minimum water resistance is a torpedo shape, with a width that is one-quarter the length. The equations below show how the widths of a blue whale, a shark, and a dolphin are related to their lengths.

Blue Whale $w = 0.21l$

Shark $w = 0.26l$

Dolphin $w = 0.25l$

About how wide is a shark that is 18 m long?

The blue whale is the world's largest mammal. Is a 30-m long blue whale wider than your classroom?

What objects made by humans have torpedo shapes? Explain why they are made in this shape.



Activity 1 Like Tiles I

1. a) What is the name of each type of algebra tile shown?



b) How many are there of each type?

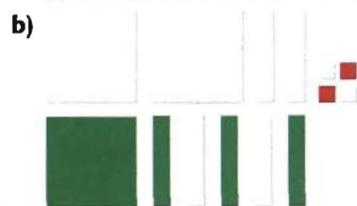
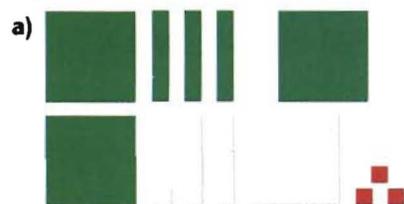
2. a) Group the same types of tiles together.

b) Write the simplified algebraic expression represented by your group of tiles.

c) Evaluate the expression for $x = -3$.

Activity 2 Like Tiles II

1. In each set, group the same types of tiles together.



2. Simplify each set of tiles and explain your reasoning.

3. a) Write an algebraic expression represented by each simplified set of tiles.

b) Evaluate each expression for $x = 2$.

Mental Math

Calculate.

- | | |
|-----------------|-----------------|
| 1. $101 - 765$ | 2. $432 + 333$ |
| 3. $723 + 145$ | 4. $-824 + 134$ |
| 5. $666 + 121$ | 6. $545 + 232$ |
| 7. $-616 + 303$ | 8. $876 + 123$ |

Calculate.

- | | |
|------------------|------------------|
| 9. $555 - 121$ | 10. $-656 - 234$ |
| 11. $875 - 662$ | 12. $285 - 164$ |
| 13. $-742 - 141$ | 14. $637 - 237$ |
| 15. $567 - 456$ | 16. $973 - 663$ |

Calculate.

- | | |
|--------------------|--------------------|
| 17. $7 + 8 - 3$ | 18. $11 - 6 + 7$ |
| 19. $13 + 2 - 9$ | 20. $17 + 8 - 20$ |
| 21. $21 - 6 + 8$ | 22. $55 - 15 + 11$ |
| 23. $44 - 22 - 11$ | 24. $21 + 21 - 20$ |

Calculate.

- | | |
|------------------------|----------------------|
| 25. 102×3 | 26. 111×7 |
| 27. $2002 \times (-4)$ | 28. -1010×6 |
| 29. -3434×2 | 30. 1212×4 |
| 31. $3003 \times (-3)$ | 32. 44×4 |

Calculate.

- | | |
|--------------------|---------------------|
| 33. $5555 \div 5$ | 34. $606 \div 3$ |
| 35. $-8080 \div 4$ | 36. $963 \div (-3)$ |
| 37. $8642 \div 2$ | 38. $147 \div 7$ |
| 39. $-515 \div 5$ | 40. $246 \div (-6)$ |

Calculate.

- | | |
|-----------------------------|-------------------------------|
| 41. $5 \times 6 \div 2$ | 42. $3 \times 4 \times 5$ |
| 43. $-3 \div 3 \times 4$ | 44. $8 \div (-2) \times (-2)$ |
| 45. $6 \times 0 \div 2$ | 46. $6 \times 5 \div 2$ |
| 47. $14 \div 4 \times (-2)$ | 48. $8 \times (-1) \times 9$ |

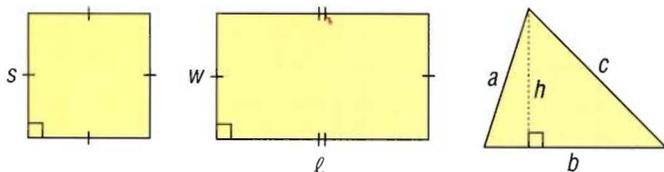
4.1 Polynomials

The Olympic biathlon consists of 2 events. The events are cross-country skiing and shooting. At one winter Olympics, Canada's Miriam Bedard won two gold medals in the biathlon.

Just like combination Olympic events, algebraic expressions have special names. A monomial is a number or variable or the product of numbers and variables. A **polynomial** is a monomial or the sum of monomials. A polynomial with 2 terms is called a **binomial**. A polynomial with 3 terms is called a **trinomial**.

Activity: Use the Diagrams

Copy the diagrams into your notebook.



Inquire

1. Write the formulas for the perimeter and area of each figure. Combine like terms where possible.
2. Which expressions are monomials?
3. Which expression is a binomial?
4. Which expression is a trinomial?
5. Explain why it is appropriate to call expressions with 1, 2, and 3 terms monomials, binomials, and trinomials.

Example 1

Classify each of the following as a monomial, binomial, or trinomial.

- a) $a - 2b$ b) $x^2 + y^2 + z^2$ c) 10

Solution

- a) The expression $a - 2b$ is a binomial because it contains 2 terms.
- b) The expression $x^2 + y^2 + z^2$ is a trinomial because it contains 3 terms.
- c) The number 10 is a monomial because it contains 1 term.



The **degree of a monomial** is the sum of the exponents of its variables.

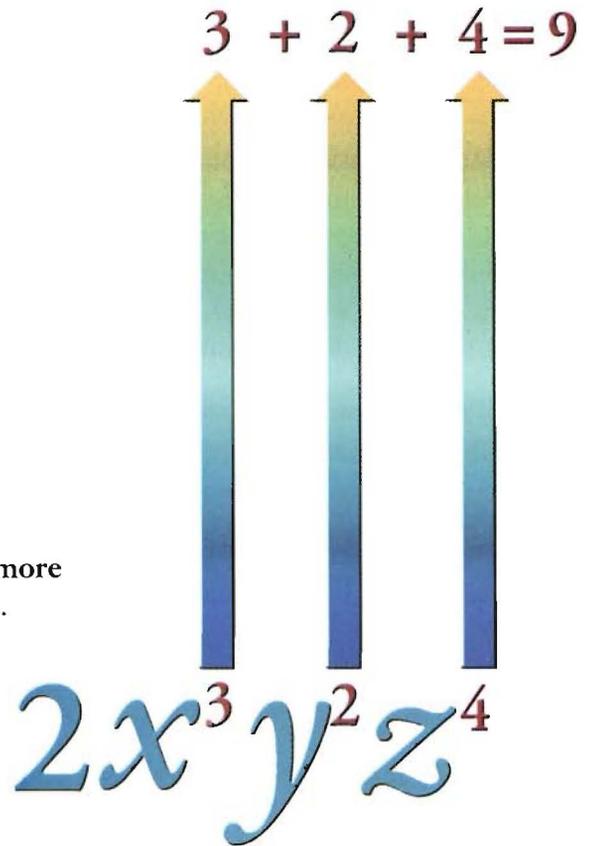
Monomial	Degree
$4x^3$	3
$5a^2b^3c$	$2 + 3 + 1 = 6$

The **degree of a polynomial in one variable** is the highest power of the variable in any one term.

Polynomials	Degree
$6x^2 + 3x$	2
$x^5 + 7x^2 - 3$	5

The **degree of a polynomial in two variables or more** is the largest sum of the exponents in any one term.

Polynomials	Degree
$x^2y^3 + xy^4 + xy^5$	6
$3x^3y^4 + 7xy^3 - 2xy$	7



Example 2

Classify each polynomial and state its degree.

- a)** $3abc$ **b)** $2x^2 + x$ **c)** $3xy + 5x^2y^2 - 3$

Solution

a) $3abc$ is a monomial. The sum of the exponents is $1 + 1 + 1 = 3$. It is a third-degree polynomial.

b) $2x^2 + x$ is a binomial. The highest power, 2, is contained in the term $2x^2$. It is a second-degree polynomial.

c) $3xy + 5x^2y^2 - 3$ is a trinomial. The largest exponent sum is contained in the term $5x^2y^2$. It is a fourth-degree polynomial.

The terms of a polynomial are usually arranged so that the powers of one variable are in either ascending order or descending order.

Descending Order

$$x^3 + 2x^2 - 5x + 7$$

(in x) $5x^2 + 7xy + 3y^2$

Ascending Order

$$7 - 5x + 2x^2 + x^3$$

(in x) $3y^2 + 7xy + 5x^2$

Practice

Identify as a monomial, binomial, or trinomial.

1. $5xyz$ 2. $x + 2y$ 3. $a - 2b + 3c$
 4. $x^2 + y^2$ 5. 23 6. $x - y + 2$

State the degree of each monomial.

7. $25x$ 8. $25x^2y^2$ 9. 17
 10. $2x^2y^3$ 11. $-5x^3y^4$ 12. $-6xy^4z$

State the degree of each polynomial.

13. $5x^2y^2 + 3xy^3$
 14. $3x + 2y - 5z$
 15. $x^4 + 2x^3 + 3x^2 + 4$
 16. $4x^4y^2 + 2x^3y^5 - 23$
 17. $3x - 2y + z^2$
 18. $25m^3n + 36m^3n^3$
 19. $-5x^4y^2z + 2x^2y^2z^2$

Arrange the terms in each polynomial in descending powers of x .

20. $1 + x^3 + x^2 + x^5$
 21. $5 - 3x^3 + 2x$
 22. $5y^2 + 2xy - x^2$
 23. $25xy^2 - 5x^2y + 3x^3y^3 - 4x^4$
 24. $5ax + 7b^2x^4 - 3x^3 + 4abx^2$

Arrange the terms in each polynomial in ascending powers of x .

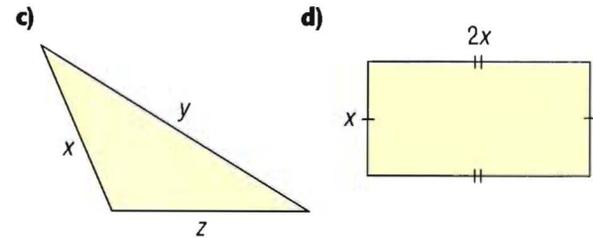
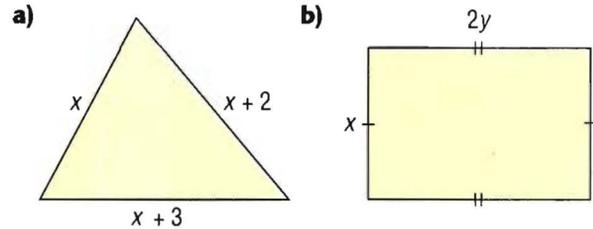
25. $3x^2 - 2x^3 + 5x^5 + x - 2$
 26. $4x^4 + x^2 - 3x^3 + 5 - x$
 27. $4xy^2 - 2x^2y^2 - 3x^4 + 2x^3y$
 28. $5x^2yz^2 + 2xy^4z + 3x^3y^4z^2 - 3$
 29. $z - xy + x^2$
 30. $x^2 - 2xy - 3x^3 + 16$
 31. $2x^3y + 3xy - x^5$
 32. $3x^3y^2 + x^4y + xy - 1$

Problems and Applications

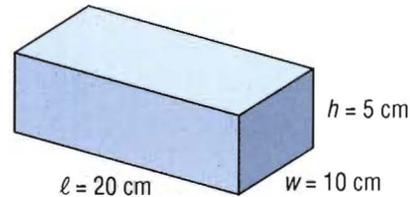
33. Identify each type of polynomial.

- a) $\frac{4\pi r^3}{3}$ b) $\pi r^2 + 2\pi rh$ c) $4\pi r$

34. What type of polynomial is represented by the perimeter of each of these figures?



35. a) Calculate the area of each face of this box.



b) What is the total area of the box?

c) Write a polynomial that can be used to calculate the answer you gave in part b).

36. The formula for the volume of a rectangular jewellery box is lwh . Its dimensions are 25 cm \times 18 cm \times 17 cm. It has 2 cm thick walls. What is the volume of the box's interior to the nearest cubic centimetre?

 37. Write a problem that can be solved with a polynomial. Have a classmate solve your problem.

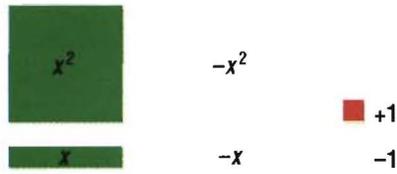
4.2 Adding Polynomials

A sports car has 4 wheels, 2 seats, and 1 engine.
To build 2 sports cars, we need

4 + 4 or 8 wheels,
2 + 2 or 4 seats,
and 1 + 1 or 2 engines.

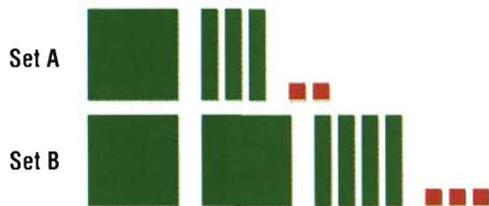
We have added the like parts of the 2 cars.
Algebra tiles model the addition of like parts
of 2 polynomials.

To model polynomials, we can use x^2 -tiles,
 x -tiles, and 1-tiles. When the x^2 or x -tile is
green side up, it means x^2 or x . When the
 x^2 or x -tile is white side up, it means $-x^2$ or
 $-x$. When the 1-tile is red side up, it means $+1$.
When the 1-tile is white side up it means -1 .



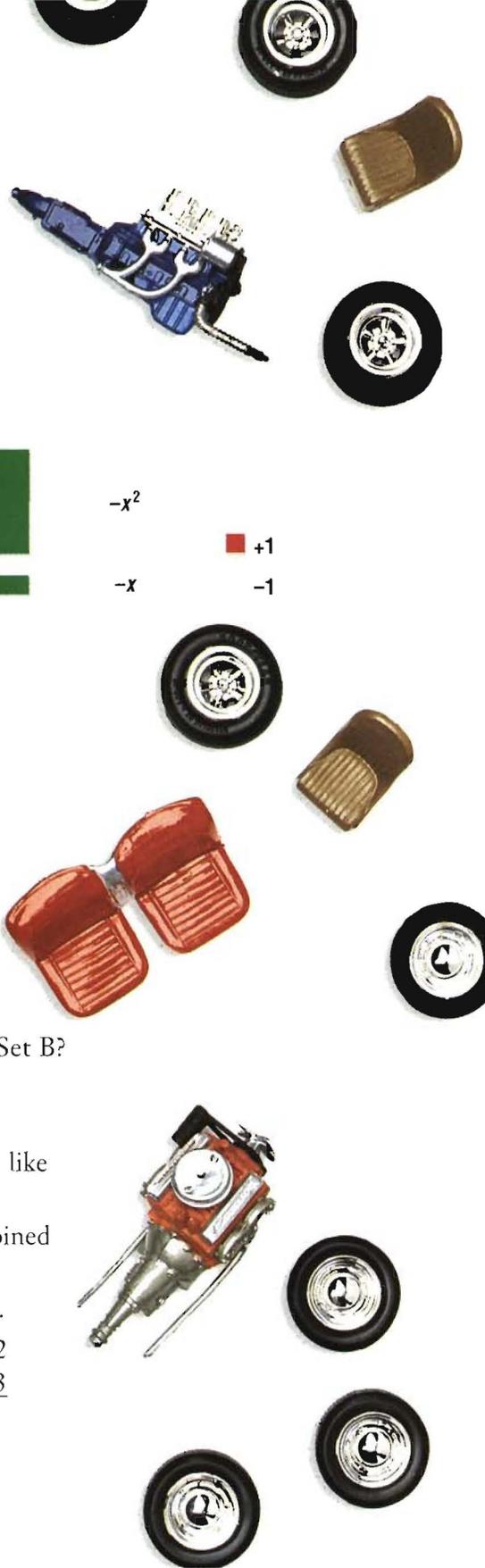
Activity: Use Algebra Tiles

Use x^2 -tiles, x -tiles, and 1-tiles to duplicate
the algebraic expressions in Set A and Set B.



Inquire

- How many x^2 -tiles, x -tiles, and 1-tiles are in Set A? in Set B?
- Write an algebraic expression to represent
 - Set A
 - Set B
- Combine the tiles in Set A and Set B into 1 set, so that like tiles are placed together.
- Write the algebraic expression that represents the combined set in 3.
- Use tiles to represent the following pairs of expressions.
 - $x^2 + 2x + 3$
 - $x^2 - 2x + 6$
 - $3x^2 + 4x - 2$
 - $2x^2 + 3x + 2$
 - $3x^2 + 5x - 2$
 - $5x^2 - 2x + 3$
- Combine each pair in 5 and write its algebraic sum.
- Write a rule for adding polynomials.



Example 1

Add $(x^2 + 4x + 3) + (2x^2 + 5x + 1)$.

Solution

Remove the brackets, collect like terms, and add.

$$\begin{aligned}(x^2 + 4x + 3) + (2x^2 + 5x + 1) &= x^2 + 4x + 3 + 2x^2 + 5x + 1 \\ &= x^2 + 2x^2 + 4x + 5x + 3 + 1 \\ &= 3x^2 + 9x + 4\end{aligned}$$

Note that the answer to Example 1, $3x^2 + 9x + 4$, is in **simplest form**. A polynomial is in simplest form when it contains no like terms.

Example 2

Use column form to add these polynomials.

- a) $(5x^2 - 3x + 5) + (2x^2 - 7x - 10)$
b) $(3y^3 - 3y + 2y^2 + 8) + (-5 - 6y^2 + 2y)$

Solution

a) Write the like terms of the polynomials in columns, then add.

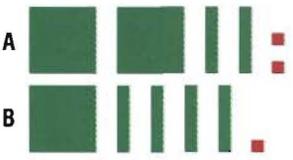
$$\begin{array}{r} 5x^2 - 3x + 5 \\ + 2x^2 - 7x - 10 \\ \hline 7x^2 - 10x - 5 \end{array}$$

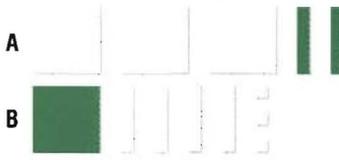
b) Rewrite the terms in descending powers of y before arranging them in columns and adding.

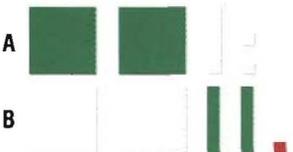
$$\begin{array}{r} 3y^3 - 3y + 2y^2 + 8 \longrightarrow 3y^3 + 2y^2 - 3y + 8 \\ - 5 - 6y^2 + 2y \longrightarrow \quad - 6y^2 + 2y - 5 \\ \hline 3y^3 - 4y^2 - y + 3 \end{array}$$

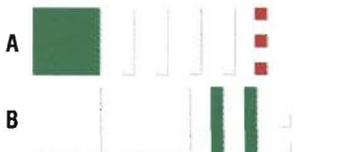
Practice

Find the sums of the expressions, A and B , represented by the algebra tiles.

1. 

2. 

3. 

4. 

Identify the like terms in each expression.

5. $2x + 3y - 4xy + 5x - 2y + 6xy$

6. $2a + 5a - 6b + 8b - 2c + 3c$

7. $3s^2 + 5s - 2 + 7s^2 + s - 3$

Add.

8. $(3x + 1) + (4x - 2)$

9. $(3x^2 + 5x - 4) + (x^2 - 7x + 2)$

10. $(-y^2 + 7y - 5) + (2y^2 + 7y - 4)$

11. $(2y^3 - 3y^2 - 1) + (-5y^2 - 4y^3 + 3)$

Add.

12. $\begin{array}{r} x + 7 \\ +5x + 2 \\ \hline \end{array}$

13. $\begin{array}{r} 3y^2 + 2y + 8 \\ +4y^2 + 7y + 11 \\ \hline \end{array}$

14. $\begin{array}{r} 5x - 2y + 6 \\ +3x - 6y + 9 \\ \hline \end{array}$

15. $\begin{array}{r} 5x^2 - 3x + 7 \\ +2x^2 - 5x - 12 \\ \hline \end{array}$

16. $\begin{array}{r} 5x^2 + 7x - 9 \\ +4x^2 - 8x + 11 \\ \hline \end{array}$

17. $\begin{array}{r} 3y^2 - 8y + 3 \\ +2y^2 + 8y - 9 \\ \hline \end{array}$

Simplify.

18. $(5z + 6 - 3z^2) + (4 - 7z + 2z^2)$

19. $(3x^2 + 2y^2 - 5) + (4x^2 + 3y^2 - 11)$

20. $(2x^4 + 7x - 5x^2 + 3) + (2x^3 - 7)$

Add.

21. $(5x^2 + 7x - 7) + (4x^2 - 8x + 12)$

22. $(3y^2 - 8y + 3) + (2y^2 + 8y - 9)$

23. $(m^3 + 5m^2 + 3) + (4m^2 + 7)$

24. $(x^2 + x + 3) + (x^2 - 6) + (x^2 - 2x - 3)$

Simplify.

25. $(4x^2 + 3xy - 2y^2) + (-x^2 - 5xy + 7y^2)$

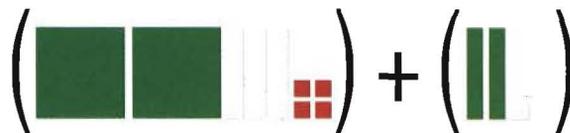
26. $(5y^2 + 3y - 7) + (-2y^2 - 5y + 8)$

27. $(3x^2y - 2xy + 4y^2) + (x^2y + y^2)$

Problems and Applications

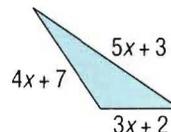


28. Explain how these algebra tiles can be used to model a solution to $(2x^2 - 3x + 4) + (2x - 3)$.



29. a) Write an

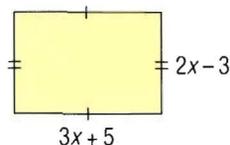
expression in simplest form for the perimeter of the figure.



b) If $x = 4$ cm, what is the perimeter?

30. a) Write an

expression in simplest form for the perimeter of the figure.



b) If $x = 7$ cm, what is the perimeter?

31. a) The perimeter of historic Fort York is expressed by the following polynomial.

$$x + (x + 171) + (x + 156)$$

What geometric shape is the perimeter of Fort York?

b) If $x = 153$ m, what is the perimeter?

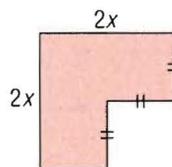


32. Add $(3x^2 + x - 1) + (x^2 - 3x - 2)$. How can you use $x = 1$ to check your solution?

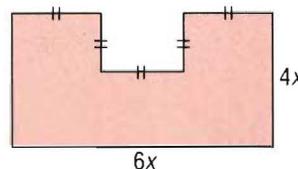


33. Work with a partner to write a monomial that describes the perimeter of each figure.

a)



b)



Budgets from a Spreadsheet

A spreadsheet is a useful tool for keeping track of expenses and the amount of money that remains in a budget.

Activity 1

1. Work with a partner. Use magazines, catalogues, and newspapers to choose 5 prizes of different values. They will be 1st, 2nd, 3rd, 4th, and 5th prizes for the students who raise the most in a fund-raising project. Keep the total cost below \$500.00.
2. Copy the following spreadsheet into your notebook. Calculate and record the entries.

You will need to enter the rate of provincial tax for your province. You may need to correct the rate of the GST.

	B	C	D	E	F
1	Prize	Price	Provincial Tax	GST	Item Cost
2	1st		+C2*	+C2*.07	+C2+D2+E2
3	2nd				
4	3rd				
5	4th				
6	5th				
7				Total Cost	@SUM(F2..F6)

3. Is the calculation method shown in the spreadsheet correct for all provinces? Explain.

Activity 2

1. Set up the spreadsheet from Activity 1 on a computer and have the computer calculate the total cost.
2. Adjust your prizes until you have spent no more than \$350.00 and no less than \$300.00.
3. Challenge another group of students to come closer to \$350.00 than your total cost does.

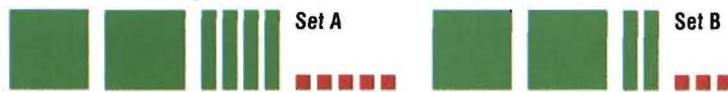
Activity 3

1. Redo the spreadsheet to allow for 8 prizes, but leave the total cost at no more than \$350.00.
2. Challenge another group of students to come closer to \$350.00 than your total cost does.

4.3 Subtracting Polynomials

Activity: Use Algebra Tiles

Use tiles to duplicate Set A and Set B.



Inquire

- Write the algebraic expression represented by each group of tiles.
- How many x^2 -tiles, x -tiles, and 1-tiles are there in each set?
- If the x^2 -tiles, x -tiles, and 1-tiles in Set B are subtracted from those in Set A, how many of each type of tile are left?
- Turn Set B over to make its opposite or **additive inverse**. Write the sum of Set A and the opposite of Set B. Compare with your answer in 3.
- Use algebra tiles to represent each pair of expressions.

a) $x^2 + 5x - 7$	b) $3x^2 - 4x + 3$	c) $-2x^2 + 4x - 5$
$\quad - 2x + 3$	$\quad x^2 + 3x - 5$	$\quad -x^2 + x - 3$
- In each pair, add the opposite or additive inverse of the second polynomial to the first polynomial.
- Write a rule for subtracting polynomials.

Example 1

Use column form to subtract $2x^2 + 2x + 5$ from $5x^2 - 7x + 4$.

Solution

When we subtract 1 polynomial from another, we add the opposite of the polynomial that is being subtracted.

The opposite of $2x^2 + 2x + 5$ is $-2x^2 - 2x - 5$.

$$\begin{array}{r} 5x^2 - 7x + 4 \\ -2x^2 - 2x - 5 \\ \hline 3x^2 - 9x - 1 \end{array}$$



How can you check your answer by addition?

Example 2

Simplify $(4x^2 - 5x + 7) - (3x^2 + 2x - 5)$.

Solution

Write the opposite of $3x^2 + 2x - 5$ and add.

$$\begin{aligned} & (4x^2 - 5x + 7) - (3x^2 + 2x - 5) \\ &= (4x^2 - 5x + 7) + (-3x^2 - 2x + 5) \\ &= 4x^2 - 5x + 7 - 3x^2 - 2x + 5 \\ &= 4x^2 - 3x^2 - 5x - 2x + 7 + 5 \\ &= x^2 - 7x + 12 \end{aligned}$$

Practice

Write the additive inverse.

1. $x^2 + 4x + 1$ 2. $x^2 - 2x - 3$
 3. $2x^2 + x - 5$ 4. $-3x^2 - 7x + 2$

Subtract.

5. $(3x - 5) - (x + 2)$ 6. $(x + 5) - (3x - 1)$
 7. $(x + 4) - (-x - 3)$ 8. $(3x - 5) - (x + 4)$

Subtract.

9. $\frac{5x^2 + 3x - 5}{2x^2 - 5x - 4}$ 10. $\frac{-3x^2 + 5x - 7}{2x^2 + 3x - 3}$
 11. $\frac{-4x^2 - 4x + 3}{-3x^2 + 4x - 8}$ 12. $\frac{x^2 - 5x + 1}{x^2 - 5x + 6}$
 13. $\frac{x^2 + 7x - 1}{x^2 + 4x + 1}$ 14. $\frac{12x^3 + 3x^2 - 5x}{9x^3 + 4x^2 - 4x}$

Subtract.

15. $(2y^2 + 3y - 5) - (2y^2 + 4y + 6)$
 16. $(4s^2 + s - 2) - (-3s^2 + s - 5)$
 17. $(y^2 - 5y + 3) - (-2y^2 + 7y + 5)$

Subtract.

18. $3x^2 + 7x - 3$ from $2x^2 - 2x + 3$
 19. $5y^2 + 7y - 5$ from $-2y^2 + 3y - 2$
 20. $-t^2 + 5t - 1$ from $2t^2 + 3t + 6$

Simplify.

21. $(-5n^2 - n - 8) - (-2n^2 + 7n - 3)$
 22. $(4 + 2x - x^2) - (3 - 7x^2 + 5x)$
 23. $(-t^2 + 4t - 7) - (3t^2 + 4t - 2)$
 24. $(x^2 + 5x + 3) - (-x^2 - 7x + 11)$
 25. $(3m^2 + 7m - 8) - (-m^2 + m - 1)$
 26. $(-5y^2 + 7y - 12) - (-3y^2 + 4y - 2)$

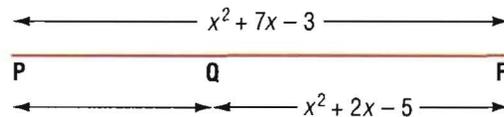
Problems and Applications



27. Explain how these algebra tiles can be used to model a solution to $(2x^2 - 2x + 1) - (2 + x - 2x^2)$.

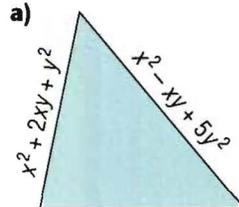


28. Find the length of PQ .



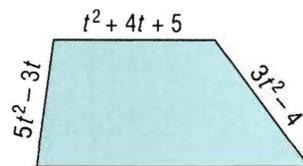
29. Given the perimeter, P , of a figure and 2 or 3 sides, find the missing length.

a)



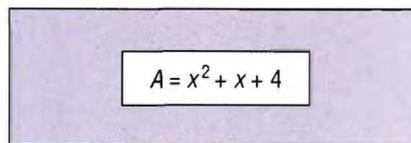
$$P = 5x^2 + xy + 5y^2$$

b)



$$P = 11t^2 + 6t + 9$$

30. The area of the large rectangle is $3x^2 + 2x + 1$. What is the area of the shaded region?



31. What is the result of adding a polynomial and its additive inverse? Explain why.

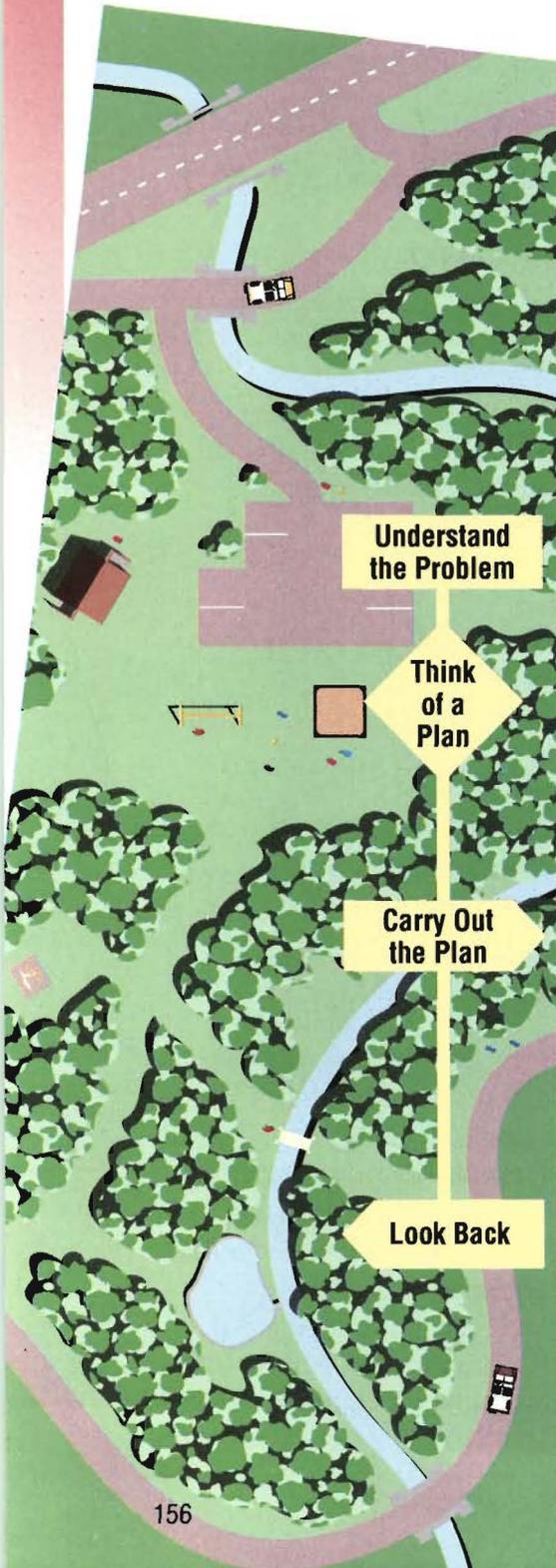


32. a) If you add 2 polynomials, A and B , does it matter if you add $A + B$ or $B + A$? Explain and give an example.



b) If you subtract 2 polynomials, A and B , does it matter if you subtract $A - B$ or $B - A$? Explain and give an example.

4.4 Use a Diagram



Understand the Problem

Think of a Plan

Carry Out the Plan

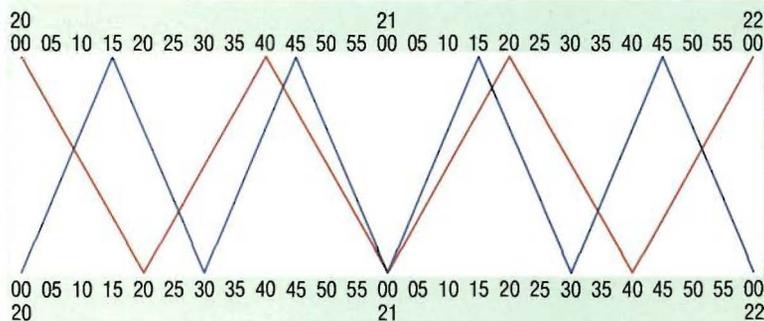
Look Back

You can simplify many problems by drawing a diagram. Architects and interior designers use diagrams to solve design problems. The director of a play uses a diagram to block out where the actors should be.

Tom and Margarita are park rangers. They patrol the park by driving around the outside in jeeps. They start on opposite sides and drive at different speeds. Margarita takes 15 min to drive halfway around the park. Tom takes 20 min. They start their patrols at 20:00 and travel in opposite directions. If they stay on schedule, what are the approximate times at which they pass each other between 20:00 and 22:00?

1. What information are you given?
2. What are you asked to find?
3. Do you need an exact or approximate answer?

Draw a diagram to show the time taken to drive around the park. Show Tom in red. Show Margarita in blue. Use the diagram to find when they pass each other.



They pass each other 7 times, at about 20:09, 20:26, 20:43, 21:00, 21:17, 21:34, and 21:51.

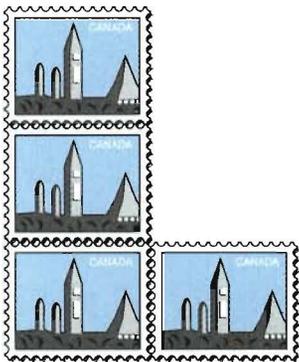
Does the answer seem reasonable?

Use a Diagram

1. Draw a diagram to represent the situation.
2. Use the diagram to solve the problem.
3. Check that the answer is reasonable.

Problems and Applications

1. How many different-sized rectangles have a perimeter of 16 m and side lengths that are whole numbers?
2. In a scalene triangle, no 2 sides are equal. How many scalene triangles have a perimeter of 12 cm or less, if the side lengths are whole numbers?
3. Roberto bought 4 stamps attached as shown.



In how many different ways can 4 stamps be attached to each other?

4. Lenore wants to fence a rectangular yard that measures 15 m by 9 m. She wants posts at the corners and every 3 m. How many posts does she need?
5. Yoshiko and Carla are water polo players. Part of their training program is to swim widths of the pool. Carla swims a width in 15 s. Yoshiko swims a width in 12 s. They start swimming widths at the same time from opposite sides of the pool. How many times do they pass each other in 2 min? What assumptions have you made?
6. Terry, Rocky, Indu, and Lennox went out for dinner. They sat at a square table. They decided to use a math problem to see who would leave the tip. The problem was: "In how many different ways can 4 people sit at a square table if there must be 1 person on each side?"

7. Ships at sea use flags to send signals. Different orders of the same flags mean different messages. How many different messages could you send by using 3 flags?



8. You can cut a round pie into 4 pieces with 2 straight cuts. If you do not care about the sizes of the pieces, you can cut a round pie into 7 pieces using 3 straight cuts. What is the greatest number of pieces you can get using 5 straight cuts?



9. A farmer must get a wolf, a goat, and some cabbages across a river. The boat will hold the farmer and one of the wolf, the goat, or the cabbages. Only the farmer can row the boat. The farmer cannot leave the goat alone with the cabbages, because the goat will eat them. The farmer cannot leave the wolf alone with the goat, because the wolf will chase the goat away. How does the farmer get the goat, wolf, and cabbages safely across the river?
10. A photography expedition planned an 8-day crossing of a desert. Each person could carry, at most, a 5-day supply of water. What is the smallest number of people needed to start the trip so that one person can cross the desert and the others can return to the starting point?

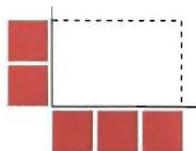


11. Write a problem that can be solved with a diagram. Have a classmate solve your problem.

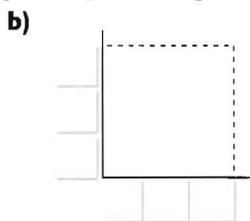
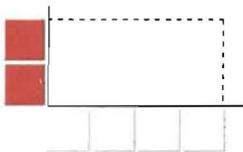
Multiplication with Algebra Tiles

Activity 1 Multiplication with 1-tiles

- a) Draw a frame with a square corner.
- b) Place three 1-tiles along the horizontal frame line and two 1-tiles along the vertical frame line, as shown.

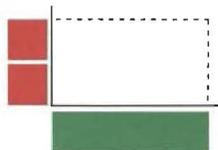


- a) Fill the outlined rectangular space with 1-tiles.
 - b) Count the number of 1-tiles to find the product.
 - c) What two numbers are multiplied together to give this product?
- Draw a frame. Then, use 1-tiles to model these products.
 - 6×2
 - 4×3
 - 5×2
 - What type and number of tiles should be used to fill each rectangular space? Explain.

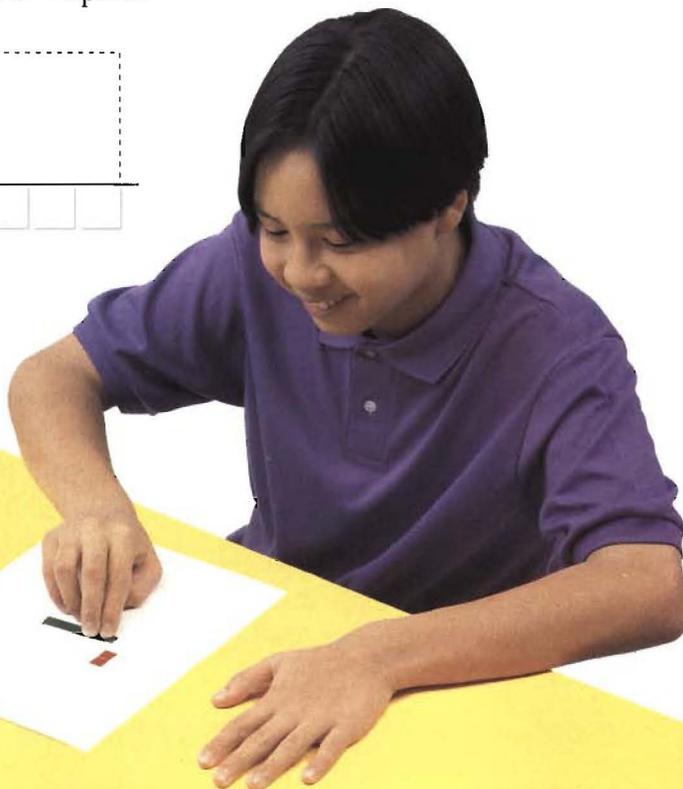


Activity 2 Multiplication with x-tiles and 1-tiles

- Draw a frame and use algebra tiles to model the situation shown.

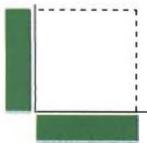


- Can 1-tiles be used to exactly fill the rectangular space? Explain.
 - Can x -tiles be used to exactly fill it? Explain.
- Count the number of tiles that exactly fill the space to find the product.
 - What number and variable are multiplied together to give this product?
- Use algebra tiles to model and find these products.
 - $x \times 3$
 - $x \times 1$
 - $2x \times 2$



Activity ③ Multiplication with x -tiles

1. Use algebra tiles to model the situation shown.



2. a) State the length and the width of the shape.

b) What is the geometric name for this shape?

 3. a) Can the space be exactly filled with x -tiles? Explain.

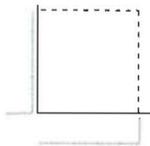
b) Can the space be exactly filled with x^2 -tiles?

4. a) What is the product?

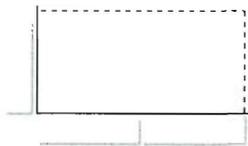
b) What two algebraic expressions are multiplied together to give this product?

5. What type and number of tile represent each product?

a)



b)



Activity ④ Multiplication with x^2 -tiles

1. Count x^2 -tiles to find the product.



2. Write the two algebraic expressions, each including x , that have been multiplied together to create this product.

3. Use algebra tiles to model and find these products.

a) $x \times 2x$

b) $2x \times 2x$

c) $2x \times 3x$

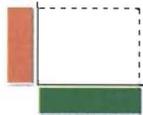
Activity ⑤ Multiplication with x -tiles and y -tiles

1. Compare a green x -tile and an orange y -tile.

a) Do an x -tile and a y -tile have the same width?

b) Which of the 2 tiles is longer?

2. a) Use algebra tiles to model this product.



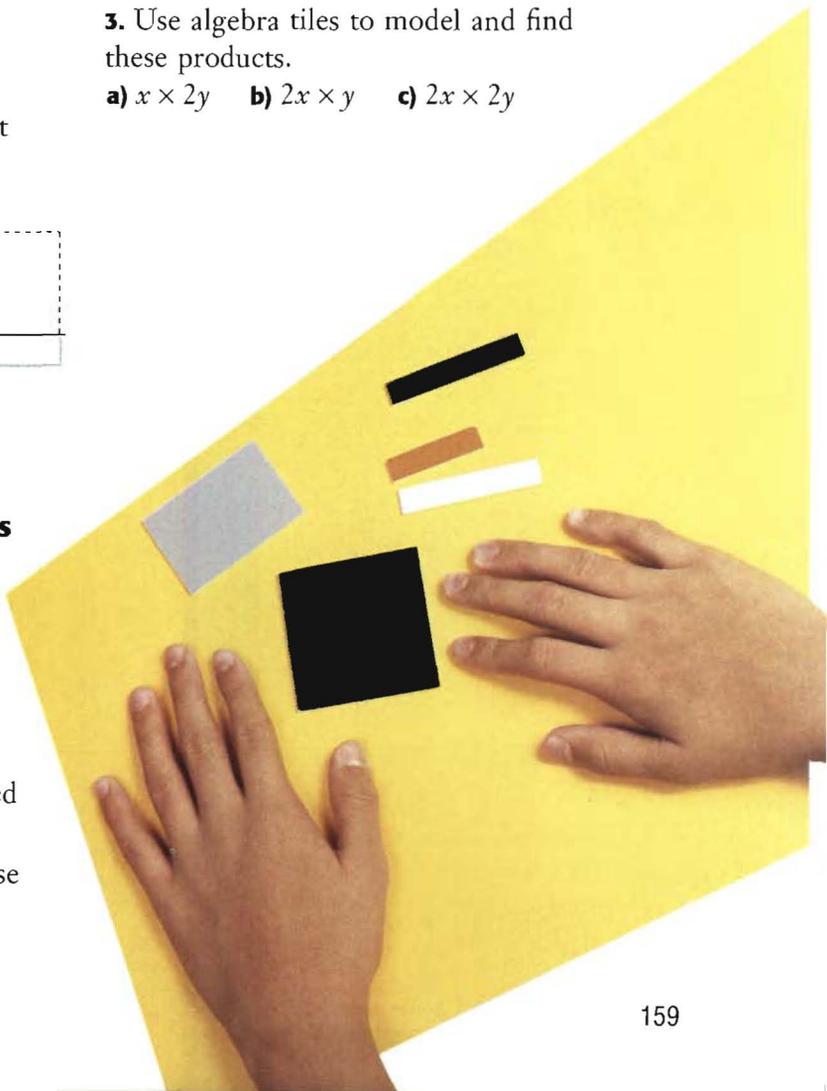
 b) Can the space be exactly filled with x -tiles or y -tiles? Explain.

c) Can the space be exactly filled with grey xy -tiles?

d) What is the product?

3. Use algebra tiles to model and find these products.

a) $x \times 2y$ b) $2x \times y$ c) $2x \times 2y$

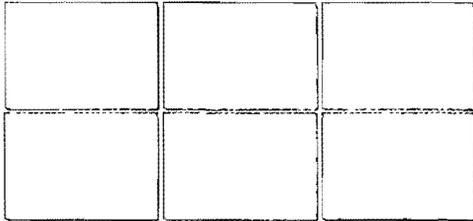


4.5 Multiplying Monomials by Monomials

The first male killer whale born in captivity in North America was born at Marineland in Niagara Falls. The volume of the tank in which *Splash* lives can be expressed as the product of 3 monomials, $l \times w \times h$, where l is the length, w is the width, and h is the height of the tank.

Activity: Use Algebra Tiles

Arrange six xy -tiles to form a rectangle as shown.



Inquire

1. What is the area of the rectangle?
2. What is the length of the rectangle?
3. What is the width of the rectangle?
4. Write the area of the rectangle as a product of its dimensions.
5. Use xy -tiles to model these products. State the product in each case.

a) $2x \times 3y$ b) $x \times 3y$ c) $3x \times y$

-  6. Write a rule for multiplying a monomial by a monomial.

Example

Find the product.

a) $(30x)(4y)$

b) $-5x^2(-3yz)$

Solution

a) $(30x)(4y)$
 $= 30 \times x \times 4 \times y$
 $= 30 \times 4 \times x \times y$
 $= 120xy$

b) $-5x^2(-3yz)$
 $= -5 \times x^2 \times (-3) \times y \times z$
 $= -5 \times (-3) \times x^2 \times y \times z$
 $= 15x^2yz$



Practice

Multiply.

1. $5x \times 3y$ 2. $2m \times 3n$ 3. $5s \times 7t$
 4. $4a \times 6b$ 5. $3x^2 \times 2y$ 6. $4a \times 5b^2$
 7. $4b \times 3c$ 8. $3a \times 2b^2$ 9. $6s \times 3t$

Multiply.

10. $(3x)(2y)$ 11. $(3a)(4b)$ 12. $(5x^2)(2y^2)$
 13. $(5ab)(3c)$ 14. $(4x)(3y)$ 15. $(6xy)(5z)$
 16. $(2a^2)(3b^2)$ 17. $(3a)(3b)$ 18. $(7a)(5b)$

Multiply.

19. $(3x^2)(-5y^2)$ 20. $-2t^3(-4a)$
 21. $(6ab)(-2c^2)$ 22. $-8a^2(3y^2)$
 23. $(5x)(5yz)$ 24. $-12x^2(4y^2)$

Multiply.

25. $(-2xy)(-7xy)$ 26. $-5m^2(-2mn)$
 27. $4s^2t^3(-3st)$ 28. $-3abx(-2a^2b^4y)$
 29. $-2s^2t^3(-5s^4t^2)$ 30. $-5x^2y^2(4c^2x^3y^8)$

Multiply.

31. $-3x^2yz(5yz)$ 32. $-2x^2(-3cy^2z^3)$
 33. $-2x^2(-2y^2)(z)$ 34. $-5x^2(-7y)(-2z)$
 35. $-5x(-7y)(-2z)$ 36. $-6xy(-5z^2)(3t^2)$

Multiply.

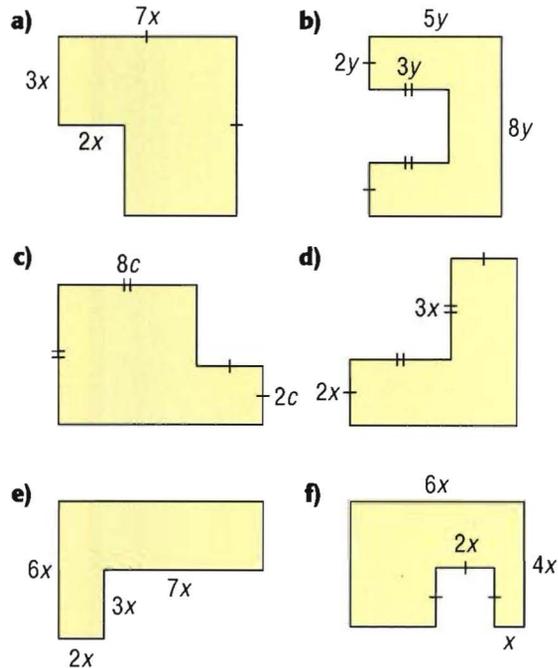
37. $(4a^2x^3z)(-2x^3y^2z^2)$
 38. $(2b^2xy^4z^2)(-3xyz)$
 39. $-5a^2b^3(-2a^2b^2)$

Multiply.

40. $(3abc)(-4abc)(2abc)$
 41. $(-x^2yz)(2xy^2z)(-2xyz^2)$
 42. $(-2jkl)(-3jkl)(-4jkl)$

Problems and Applications

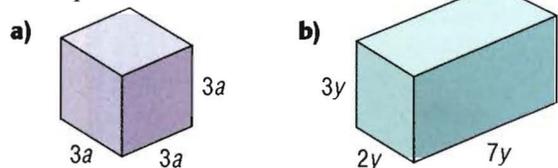
43. Find the area of each figure.



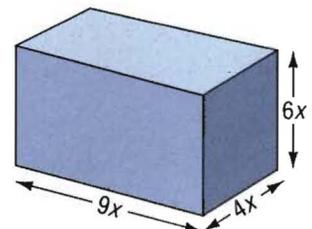
44. a) If x is the time needed in minutes to make a hat, and y is the cost of production in dollars per minute, what does the expression $24xy$ mean?

b) Use $x = 3$ and $y = 0.5$ to evaluate your expression in part a).

45. Write an expression for the volume of each prism.



46. What is the length of the side of a cube that has the same volume as this rectangular solid?



4.6 Solve a Simpler Problem

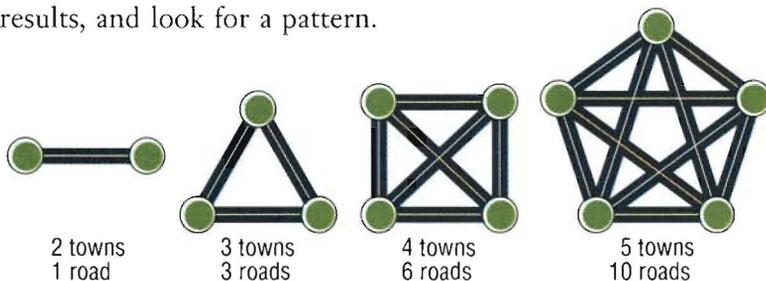


A problem that appears to be difficult because of large numbers can often be simplified if you use smaller numbers. You may need to solve a series of simpler problems, with the numbers getting larger, until you see a pattern. This pattern will help you solve the original problem.

There are 9 towns in the county. Each town is connected directly to each of the others by a road. How many roads are there?

1. What information are you given?
2. What are you asked to find?
3. Do you need an exact or approximate answer?

Find out how many roads connect 2 towns, 3 towns, 4 towns, and so on. Draw diagrams, make a table of the results, and look for a pattern.



Number of Towns	Number of Roads
2	1
3	3 or 1 + 2
4	6 or 1 + 2 + 3
5	10 or 1 + 2 + 3 + 4

For 3 towns, add the first 2 non-zero whole numbers.
 For 4 towns, add the first 3 non-zero whole numbers.
 For 5 towns, add the first 4 non-zero whole numbers.
 For 9 towns, add the first 8 non-zero whole numbers.

$$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 = 36$$

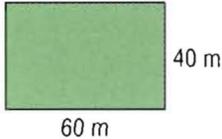
So, there are 36 roads.

How could you check the answer?

- Solve a Simpler Problem**
1. Break the problem into smaller problems.
 2. Solve the problem.
 3. Check that your answer is reasonable.

Problems and Applications

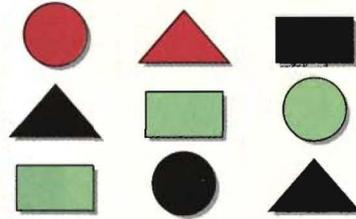
1. How would you estimate the number of listings in the white pages of a telephone book?
2. How would you estimate the thickness of 1 page of this textbook?
3. How would you estimate how long it would take you to read a 250-page novel?
4. Caroline owns a rectangular field of length 60 m and width 40 m. She wants to put a fence around the field. The fence posts are to be 2 m apart and there must be a post in each corner. How many posts will she need?
5. Find the sum of the first 100 odd numbers.
 $1 + 3 + 5 + 7 + 9 + \dots$
6. Find the sum of the first 100 even numbers.
 $2 + 4 + 6 + 8 + 10 + \dots$
7. Calculate the following.
 $80 - 79 + 78 - 77 \dots + 2 - 1$
8. Sixteen teams play in a basketball tournament. Each team plays until it loses 1 game. There are no ties. How many games are played?
9. For the final game of an international hockey tournament, each team had 18 players. Before the game, each player shook hands with every player on the opposing team. How many handshakes were exchanged?
10. Each of the 10 provinces sent 1 student to Ottawa for the opening of Parliament. Each student gave each of the other students a provincial pin. How many pins were exchanged?
11. About how many breaths do you take in 1 year?



12. If 1 bacterium divides into 2 bacteria in 1 min, how many bacteria come from 1 bacterium in 12 min? What assumptions have you made?
13. Write a problem that can be solved by means of a simpler problem. Have a classmate solve your problem.

LOGIC POWER

The Riddler has invited you to a party at his apartment. The elevator buttons are shown below. They are lettered from A to I, but the letters are hidden. You must press the buttons in order from A to I to get to the party. Use the clues to find the button letters.



1. The D button is green.
2. The G button is red.
3. The F button is directly below a triangle.
4. The I button is in the left column.
5. The B button is not round.
6. The E button is in the middle row.
7. The H button is in the top row.
8. The F button is lower than the C button.
9. The C button is directly to the left of a round button.

4.7 Dividing Monomials by Monomials

When Patricia Hy became Canadian Women's Tennis Champion, she played on a regulation court. If we know the area of the court and its length or width, we can calculate the other dimension. Dividing the area, A , by the length, l , or width, w , involves the division of a monomial by a monomial.

Recall that for the multiplication statement $3 \times 2 = 6$, there are 2 division statements.

$$6 \div 2 = 3 \qquad 6 \div 3 = 2$$

Activity: Discover the Relationship

Copy and complete.

a) $2a \times 3b$ b) $3x \times 5x$ c) $4x^2 \times 2x$

Inquire

1. Write 2 division statements for each multiplication statement above.

2. Write 2 division statements for each of the following.

a) $3g \times 4b = 12gb$ b) $5y \times 2y^2 = 10y^3$
 c) $2x \times 3y = 6xy$ d) $x^2 \times 2y^3 = 2x^2y^3$



3. Write a rule for dividing monomials by monomials.

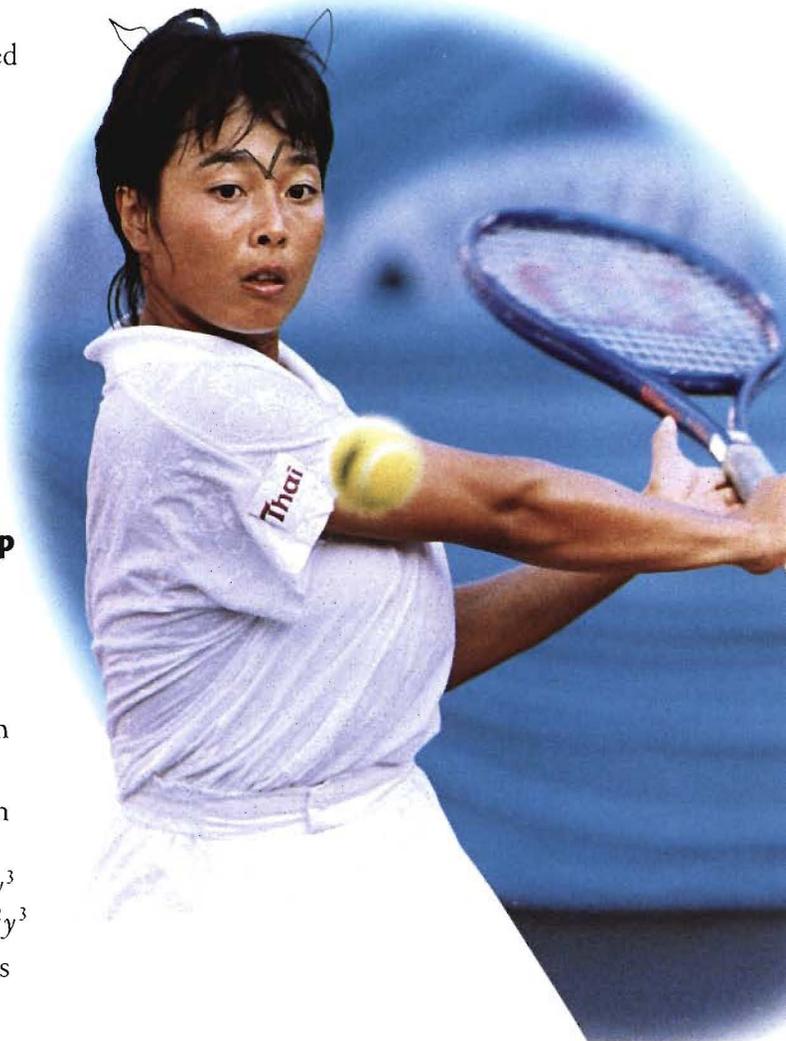
Example

Divide. Express each answer with positive exponents.

a) $10x^3y^4 \div 2y^3$ b) $\frac{-8x^6y^7}{4x^5y^5}$ c) $\frac{60a^2b^2c^2}{30a^4b^3c^2}$

Solution

a) $10x^3y^4 \div 2y^3$ b) $\frac{-8x^6y^7}{4x^5y^5}$ c) $\frac{60a^2b^2c^2}{30a^4b^3c^2}$
 $= \frac{10x^3y^4}{2y^3}$ $= \left(\frac{-8}{4}\right)\left(\frac{x^6}{x^5}\right)\left(\frac{y^7}{y^5}\right)$ $= \left(\frac{60}{30}\right)\left(\frac{a^2}{a^4}\right)\left(\frac{b^2}{b^3}\right)\left(\frac{c^2}{c^2}\right)$
 $= (102)\left(\frac{x^3}{1}\right)\left(\frac{y^4}{y^3}\right)$ $= -2xy^2$ $= 2a^{-2}b^{-1}$
 $= 5x^3y$ $= \frac{2}{a^2b}$



Practice

Divide.

- | | | |
|-----------------------|-----------------------|-----------------------|
| 1. $\frac{6x}{3}$ | 2. $\frac{-15a}{5}$ | 3. $\frac{24y}{8}$ |
| 4. $\frac{36m}{9}$ | 5. $\frac{-30x}{6}$ | 6. $\frac{-25y}{5}$ |
| 7. $\frac{12x}{4x}$ | 8. $\frac{-18y}{3y}$ | 9. $\frac{24a}{1a}$ |
| 10. $\frac{-32b}{-b}$ | 11. $\frac{-40x}{40}$ | 12. $\frac{-32m}{-8}$ |

Divide.

- | | | |
|-------------------------|------------------------|--------------------------|
| 13. $\frac{15xyz}{5xy}$ | 14. $\frac{-18ab}{6a}$ | 15. $\frac{12pqr}{4pqr}$ |
| 16. $\frac{36abc}{-4a}$ | 17. $\frac{28xy}{7y}$ | 18. $\frac{-15rst}{3rt}$ |

Divide.

- | | |
|------------------------|-----------------------|
| 19. $25xy \div 5xy$ | 20. $22ab \div 11ab$ |
| 21. $21xyz \div 3xyz$ | 22. $9amn \div amn$ |
| 23. $36rst \div 3rs$ | 24. $39jkl \div 13kl$ |
| 25. $52pqrs \div 13ps$ | 26. $51defg \div 3eg$ |

Simplify.

- | | |
|-----------------------------|------------------------------------|
| 27. $5x^4y^2 \div x^3y^1$ | 28. $-3a^3b^4 \div ab$ |
| 29. $18j^7k^7 \div (-9j^4)$ | 30. $\frac{-20x^5y^{15}}{4x^2y^4}$ |
| 31. $7a^3b^2c \div (-7ab)$ | 32. $-8x^2y^9 \div (-2xy^8)$ |

Simplify.

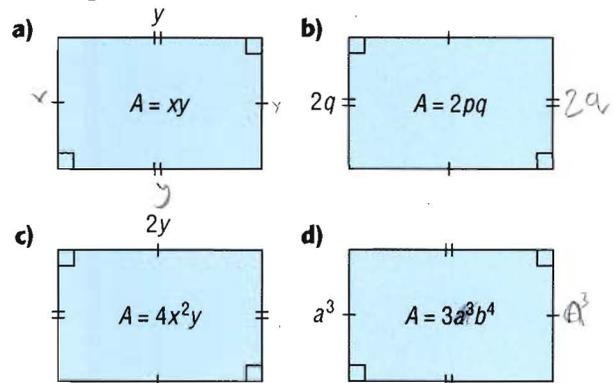
- | | | |
|-----------------------------------|-----------------------------------|----------------------------------|
| 33. $\frac{10a^6b^3}{5a^4b^2}$ | 34. $\frac{-15x^6y^8}{-5x^5y^7}$ | 35. $\frac{-12m^6n^2}{4m^3n^2}$ |
| 36. $\frac{22x^2y^4z^3}{11xy^3z}$ | 37. $\frac{20a^4b^6c}{15a^4b^6c}$ | 38. $\frac{-18x^5y^8}{12x^3y^6}$ |

Simplify. Express each answer with positive exponents.

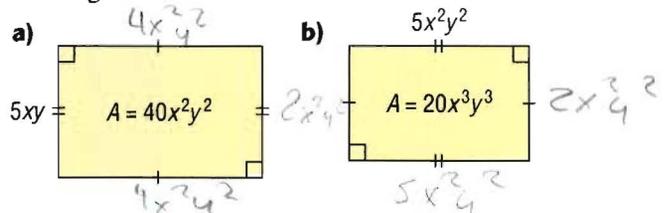
- | | | |
|------------------------------------|-----------------------------------------|------------------------------------|
| 39. $\frac{10x^3y}{5x^5y^3}$ | 40. $\frac{-12a^4b^{-3}}{3a^2b^{-5}}$ | 41. $\frac{-16m^7n^3}{4m^8n^6}$ |
| 42. $\frac{-9x^3y^3}{-3x^{-5}y^2}$ | 43. $\frac{-24x^{-6}y^{-3}}{18x^{-7}y}$ | 44. $\frac{9p^5q^{15}}{p^2q^3r^2}$ |

Problems and Applications

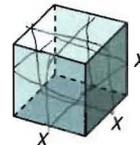
45. Find the missing dimension in each rectangle.



46. What are the dimensions of each rectangle if each area is 160 cm^2 ?



47. Find the quotient of the volume of this box divided by its area.



48. A and B represent monomials. When you multiply $A \times B$, the result is A . When you divide $A \div B$, the result is A . What is the monomial B?



49. Write a problem similar to problem 46. Have a classmate solve your problem.

PATTERN POWER

There are x cars in a bumper-to-bumper lineup. The cars' bumpers are touching. How many bumpers are touching?

4.8 Sequence the Operations

The solutions to some problems have several steps, which must be performed in the proper sequence.

Bob Robertson is a gold miner in the Klondike. He has 400 claims and pays the Canadian government \$10 per year to operate each one. Bob employs 14 people during the “season,” which runs from April to freeze-up in October. Each employee works 12 h a day for \$19.75/h. One year, 9 people worked 143 days, and the other 5 worked 131 days. If gold was worth \$15 000/kg, how many kilograms of gold did Bob’s claims have to produce to cover the salaries and government costs? Write your answer to the nearest kilogram.

Understand
the Problem

Think
of a
Plan

Carry Out
the Plan

Look Back

1. What information are you given?
2. What are you asked to find?
3. What is the proper sequence of steps?

Calculate the wages of the 14 employees. Add the amount paid to the government. Divide the total expenses by \$15 000 to find out how many kilograms were needed. Use a calculator to find the exact answer.

$$\begin{aligned} \text{Wages of 9 employees} \\ &= 9 \times 143 \times 12 \times \$19.75 \\ &= \$305\,019 \end{aligned}$$

$$\begin{aligned} \text{EST} \quad &10 \times 140 \times 10 \times 20 \\ &= 280\,000 \end{aligned}$$

$$\begin{aligned} \text{Wages of 5 employees} \\ &= 5 \times 131 \times 12 \times \$19.75 \\ &= \$155\,235 \end{aligned}$$

$$\begin{aligned} \text{EST} \quad &5 \times 100 \times 10 \times 20 \\ &= 100\,000 \end{aligned}$$

$$\begin{aligned} \text{Payment to government} \\ &= 400 \times \$10 \\ &= \$4000 \end{aligned}$$

$$\begin{aligned} \text{Total expenses} \\ &= \$305\,019 + \$155\,235 + \$4000 \\ &= \$464\,254 \end{aligned}$$

$$\begin{aligned} \text{EST} \quad &300\,000 + 160\,000 + 4000 \\ &= 464\,000 \end{aligned}$$

$$\begin{aligned} \text{Kilograms of gold needed} \\ &= \frac{\$464\,254}{\$15\,000} \\ &= 30.950\,266\,67 \end{aligned}$$

$$\begin{aligned} \text{EST} \quad &450\,000 \div 15\,000 \\ &= 30 \end{aligned}$$

Bob’s claims had to produce 31 kg of gold to cover salaries and government costs.

How can you work backward to check your answer?

**Sequence
the
Operations**

1. List the given facts.
2. Decide on the proper solution sequence.
3. Complete the calculation.
4. Check that your answer is reasonable.

Problems and Applications

1. At ages 3, 4, and 5, a child learns about 3 new words each day. About how many words does a child learn in these 3 years?
2. The average person normally speaks about 125 words/min. How many words can the average person speak in 2.5 h?
3. The sports arena has 17 624 seats. Tickets for the track meet cost \$22.50 each. If 1057 tickets remain unsold, what is the value of the tickets sold?
4. Tamar and Ken left the highway service centre at the same time and travelled in the same direction. Tamar drove at 90 km/h, and Ken drove at 70 km/h.
 - a) How far did Tamar drive in 3.5 h?
 - b) How far did Ken drive in 4 h?
 - c) How far apart were they after 4.5 h?
5. The parking garage charges \$5.50 for the first hour or part of an hour. The charge is \$2.00 for each additional half hour or part of a half hour. Eileen arrived at 08:17 and left at 11:45. How much was she charged?
6. Mohammed works on a highway survey crew during the summer. He earns \$11.70/h for up to 35 h/week. He earns time-and-a-half for hours over 35 h/week. If he works 41 h in one week, how much does he earn?
7. Light travels through space at a speed of 298 000 km/s. A **light year** is the distance light travels through space in one year. How far is a light year?
8. What time will it be 213 000 h from now?

9. Twenty-four students are planning a trip to a theatre festival. The total cost is \$10 466. The school will pay \$1100 towards the total cost. The students will equally share the rest of the cost. Each student will pay in 5 equal monthly instalments. How much is each instalment?

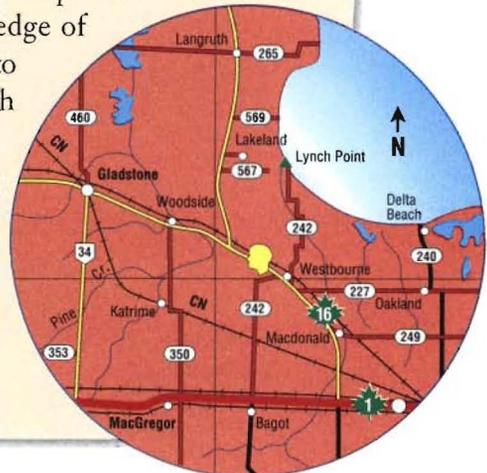
10. The passenger pigeon was a North American migratory bird. At one time, there were huge numbers of these pigeons, but they became extinct in 1914. A flock of passenger pigeons was once described as follows.

“The column was 500 m wide and flew overhead at 500 m/min. It took three hours to fly by. Each square metre was occupied by ten pigeons.”

How many pigeons were in the flock?

LOGIC POWER

Examine the map. Use your knowledge of geography to decide which province this area is in. Then find this area on a complete map.



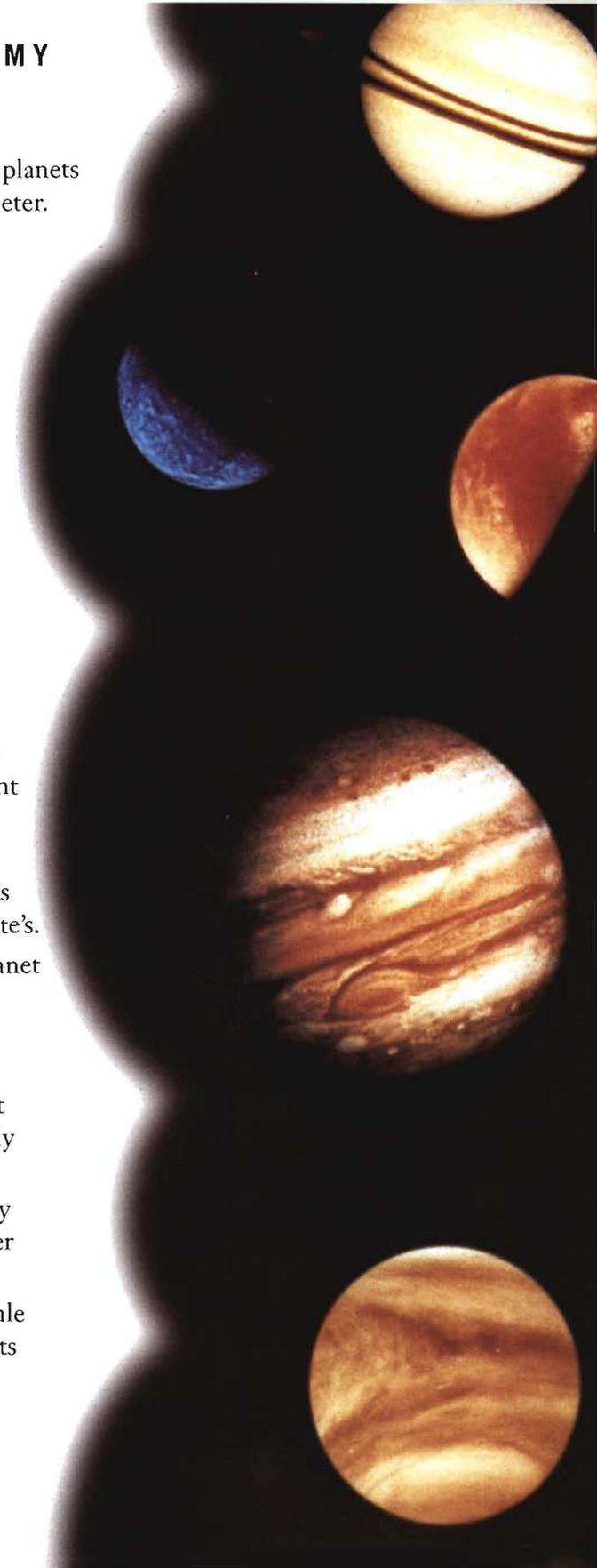
The Solar System

The table shows the diameters of the star and planets in the solar system relative to the Earth's diameter.

Planet or Star	Diameter (Earth = 1)
Sun	109
Mercury	0.38
Venus	0.95
Earth	1.00
Mars	0.53
Jupiter	11.2
Saturn	9.4
Uranus	4.0
Neptune	3.8
Pluto	0.2

Activity 1 Diameters in the Solar System

1. Work with a partner to explain what is meant by the heading “Earth = 1” in the diameter column of the table.
2. How were the diameters of the other planets calculated? Compare your answer to a classmate's.
3. a) Estimate how many times the smallest planet could fit across the diameter of the sun.
b) Use your calculator to check your estimate. How close was your estimate?
4. Prepare some arguments that would support the statement, “Some planets are approximately the same size.”
5. If the diameter of the Earth is approximately 12 756 km, what are the diameters of the other planets?
6. Use circles, or parts of circles, to make a scale drawing that shows how the sizes of the planets and the sun compare.
7. Write three English words that are derived from *sol*, the Latin word for sun.



Activity 2 Distances in the Solar System

This table shows how far from the sun each planet is relative to the Earth.

Planet	Average Distance from Sun (Earth = 1)
Mercury	0.39
Venus	0.72
Earth	1.00
Mars	1.52
Jupiter	5.2
Saturn	9.5
Uranus	19.2
Neptune	30.1
Pluto	39.6

1. Work with a partner to explain why the numbers are increasing from the beginning to the end of this table.

2. Compare the meaning of the heading “Earth = 1” in this table to its meaning in the previous table.

3. If the average distance of the Earth from the sun is 149.6 million kilometres, calculate the average distance from the sun for the rest of the planets.

4. What sort of orbit does Pluto make as it revolves around the sun?

5. Make a scale drawing to show how the distances of the planets from the sun compare.



Activity 3 Researching a Space Probe

1. Research the latest space probe. Then, write a press release to describe what was supposed to happen.

2. List 3 points supporting the view that the money spent on all the space probes to date is well worth it.

3. List 3 points supporting the view that the money spent on all the space probes to date is not worth it.

4. a) Work with a classmate to compare the lists that each of you prepared in questions 2 and 3 of this activity.

b) On the basis of your lists, discuss whether space probes should continue.

5. Divide the class into small groups to prepare a debate on this topic.

6. Choose a side, elect a speaker for each side of the argument, and hold the debate.



Review

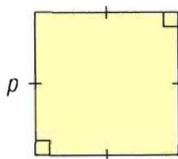
Identify each polynomial type and state its degree.

- | | |
|------------------------|-----------------------------|
| 1. xyz | 2. $3x^2y^3$ |
| 3. $5xy^2 - 5xy$ | 4. $x^2 + y$ |
| 5. $ab^3 + b^2 + 1$ | 6. $3m^2n^3 + 5mn$ |
| 7. $x^2 + 2x^4 + 5x^2$ | 8. $3x^3 - 5x + 3$ |
| 9. $x^2yz + 2yz$ | 10. $b^2x^3 - 2x^3 - 4xy^2$ |

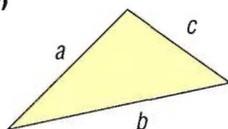
Arrange each polynomial with its powers in descending order.

- $x^2 + 3x - 5x^3$
- $5 + 2y^2 - 3y + y^4$
- $2m + 6 - 3m^2 - m^4 + 6m^3$
- $3 + x + x^2 + x^3 + x^4$
- $y^5 - 2y^7 + 3y - 4y^2 + 5y^6$
- What type of polynomial is represented by the perimeter of each figure?

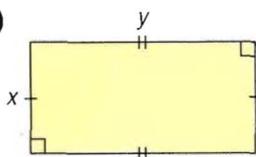
a)



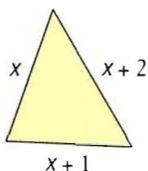
b)



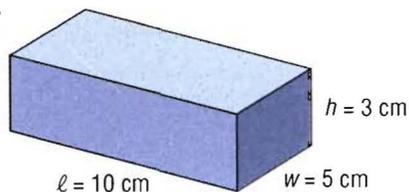
c)



d)



17. a) Calculate the area of each face of this box.



- What is the total area of the box?
- Write a polynomial that can be used to calculate the answer you gave in part b).

Add.

- $(m^2 + 3m - 5) + (2m^2 - 5m + 7)$
- $(5a + 3a^2 - 2) + (a^2 + 3a + 4)$
- $(b + 5 - 2b^2) + (1 - 2b + b^2)$

Add.

- | | |
|------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 21. $\begin{array}{r} 2x^3 - 3x^2 + 5x \\ - x^2 + 3x \\ \hline \end{array}$ | 22. $\begin{array}{r} 3x^2 - 7x + 5 \\ -x^2 - x - 3 \\ \hline \end{array}$ |
| 23. $\begin{array}{r} -5a^2 - 2a - 7 \\ 6a^2 + 4a + 3 \\ \hline \end{array}$ | 24. $\begin{array}{r} 7t^2 + 8t - 9 \\ 2t^2 - 10t - 5 \\ \hline \end{array}$ |

Subtract.

- $(5a^2 - 3a + 6) - (2a^2 + 3a + 7)$
- $(3m^2 + 5m + 1) - (5m^2 + 2m - 1)$
- $(3x^2 + 2x - 5) - (x^2 + x + 1)$

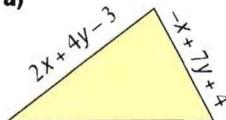
Subtract.

- | | |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 28. $\begin{array}{r} 5x^2 - 3x + 2 \\ -x^2 - 2x + 4 \\ \hline \end{array}$ | 29. $\begin{array}{r} 4x^2 - 7x + 5 \\ 7x^2 - 9x + 3 \\ \hline \end{array}$ |
| 30. $\begin{array}{r} 2x^2 + 8x - 4 \\ -3x^2 + 13x - 11 \\ \hline \end{array}$ | 31. $\begin{array}{r} 8x^2 - 2x - 1 \\ 3x^2 + x + 7 \\ \hline \end{array}$ |

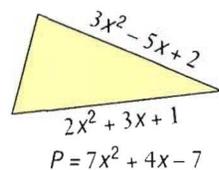
Simplify.

- $(-3n^2 - n - 7) - (-2n^2 + 8n - 4)$
- $(5 + 3x - 2x^2) - (4 - 8x^2 + 6x)$
- $(-p^2 + 5p - 8) - (2p^2 + 3p - 1)$
- $(4x^2 + 6x + 4) - (-x^2 - 8x + 12)$
- $(2m^2 + 8m - 9) - (-m^2 + 2m - 3)$
- $(-4y^2 + 5y - 14) - (-5y^2 + 3y - 1)$
- Given the perimeter, P , of a figure and 2 or 3 sides, find the missing length.

a)



b)



Multiply.

39. $(10x)(4y)$

40. $(-30y)(5xy)$

41. $(3ax)(4bx)$

42. $(-2ap)(-5ab)$

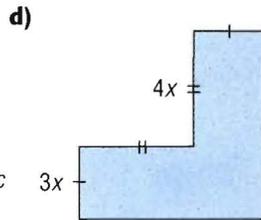
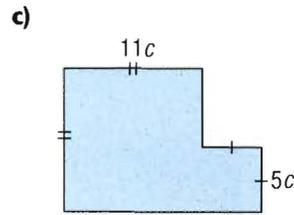
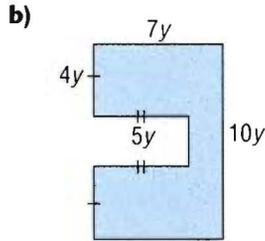
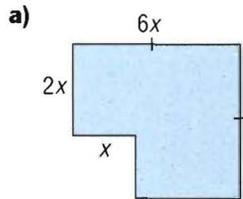
43. $(3xy)(-5xy)$

44. $-4a^2(-ab)$

45. $4x^2(-2xy^2z)$

46. $-s^2t^2(3s^3t^3)$

47. Find the area of each figure.



Divide. Express each answer with positive exponents.

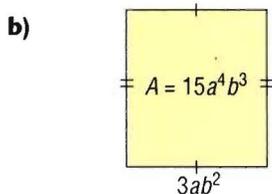
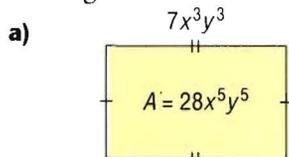
48. $\frac{20x^5y^3}{5x^4y^6}$

49. $\frac{36x^2y^4}{4x^3y^8}$

50. $\frac{45a^3b^3}{9ab^4}$

51. $\frac{-20a^4b^{-5}}{10a^3b^{-3}c^2}$

52. Find the missing dimension in each rectangle.



Group Decision Making Researching Computer Careers

1. Brainstorm the computer careers that you would like to investigate. They could include careers such as programming, systems design, sales, marketing, and hardware technician. As a class, select six careers to research. Number the careers from 1 to 6.

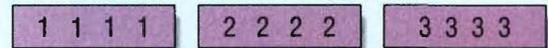
2. Go to home groups. As a group, decide which career each group member will research.



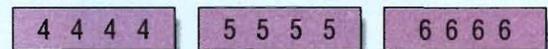
Home Groups



3. Form an expert group with students who have the same career to research. In your expert group, decide what questions you want to answer about the career. Then, research the answers.



Expert Groups



4. Return to your home group and tell the others in the group what you learned in your expert group.

5. In your home group, prepare a report on the 6 careers. As a group, decide what form the report will take. It could be written, acted out, presented as a video, displayed on a poster, or presented in any other appropriate form.

6. In your home group, evaluate the process and your presentation.

Chapter Check

Classify each polynomial and state its degree.

1. $x^2 + 3x + 7$ 2. $3x^3 + x^2$
 3. $3x^2y$ 4. 200

Arrange each of the following in descending powers of x .

5. $1 + x^3 + x^5 + x^4$
 6. $5x^3 + 2xy - yx^4$
 7. $x^3y - 3x^4 - 2x^2y + 10xy^2$
 8. $3ax - 5b^2x^3 - 1 + 5abx^2$

Simplify.

9. $(5a^2 - x + 9) + (a^2 + x - 13)$
 10. $(b^3 + b^2 - 2y + 7) + (3y - 8 - 2b^2)$

Simplify.

11. $(6y^2 - 6x + 3) - (y^2 + 6x - 3)$
 12. $(-8t^2 + 4t - 1) - (4 - 7t^2 + 5t)$

Simplify.

13. $(10x^2 - 3x + 8) + (-11x^2 - 4x - 2)$
 14. $(8y^2 + 6y - 1) - (3y^2 - 8y - 2)$

Add.

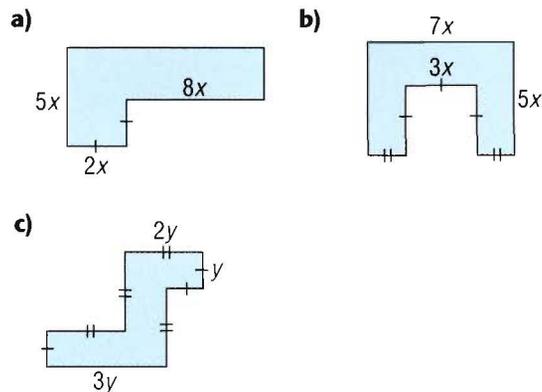
15. $3x^2 + 2x - 7$ 16. $10x^2 + 4x - 5$
 $+5x^2 - 11x - 5$ $-12x^2 + 6x + 6$

Subtract.

17. $7x^2 - 5x + 4$ 18. $5x^2 - 8x + 6$
 $-3x^2 - 3x + 8$ $9x^2 - 11x + 5$
 19. $x^2 + 7x - 5$ 20. $10x^2 - 3x - 2$
 $-2x^2 + 15x - 13$ $2x^2 - x + 9$

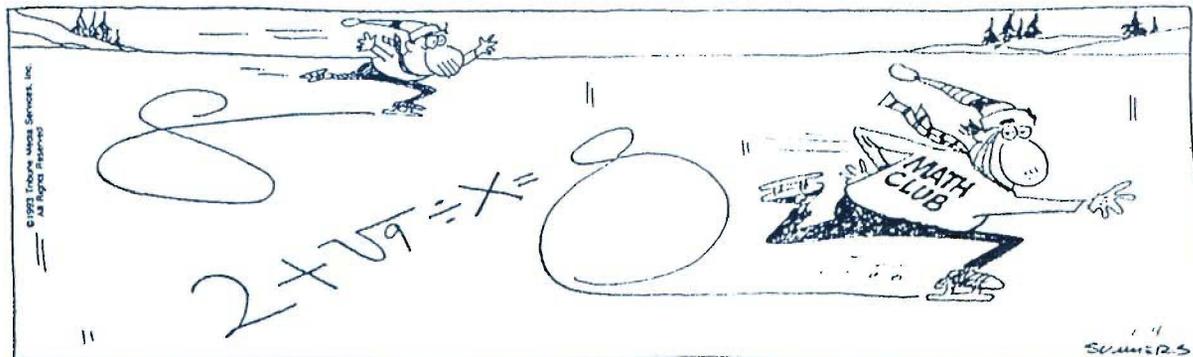
Multiply.

21. $-10x(5y)$ 22. $(15x^2y)(-3xy^2)$
 23. $-2x^5(3b^2yz)$ 24. $3x^3yz(-5xyz^2)$
 25. Find the area of each figure.



Divide. Express each answer with positive exponents.

26. $\frac{-6a^5b^3}{3a^8b^5}$ 27. $\frac{-39j^5k^4l^5}{-13j^2k^5l^3}$

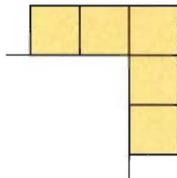


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Using the Strategies

- How many hours are in 1000 s?
- What is the largest 2-digit number that is a perfect square?
 - What is the largest 3-digit number that is a perfect square?
- Find 3 consecutive numbers that have a sum of 111.
- There are 4 boys, Barry, Bob, Hans, and Joe and 5 girls, Marie, Sue, Paola, Natasha, and Oba, who wish to enter a badminton mixed doubles tournament. How many different 2 player teams can these nine players make?

- A picture 20 cm by 20 cm is to be bordered by 1-cm squares. How many squares are needed for the border?



- The sides of a triangular field are 40 m, 44 m, and 52 m. A fence is to be built around the field with a post in each corner and the posts 4 m apart. How many fence posts are needed?
- Sue is 4 years older than Alex. In four years, the sum of their ages will be 36. How old are they today?
- A restaurant offers a choice of how to pay for a class lunch.

Plan A:	\$8 per person
Plan B:	\$20 service charge plus \$7 per person

 - For what number of students is Plan A better?
 - For what number of students is Plan B better?
 - For what number of students are the 2 plans the same?

- In a bean toss game, each person throws 2 bags.

Scoring A and B gives 18 points.
 Scoring A and C gives 15 points.
 Scoring B and C gives 13 points.

What will you score if you toss both bags in B?

- Two grade 6 students and two grade 9 students want to cross a river in a canoe. The canoe is big enough to hold the two grade 6 students or one grade 6 student and one grade 9 student. How many times must the canoe cross the river to get all the students to the other side?

- Find the 4-digit perfect square that is a pair of 2-digit perfect squares written side by side.

- Chicken pieces come in boxes of 6, 9, and 20. You can buy 21 pieces by buying 2 boxes of 6 pieces and 1 box of 9 pieces.

$$6 + 6 + 9 = 21$$

- How can you buy 44 pieces?
- How can you buy 41 pieces?
- How can you buy 42 pieces?
- Can you buy 43 pieces?

DATA BANK

- You leave Halifax at 09:00 on a Friday and drive to Vancouver. You average 80 km/h and drive for 9 h/day, starting at 09:00. On what day and at about what time will you arrive in Vancouver?
- The Canadian city with the greatest elevation is 561 m higher than Saskatoon. What is the elevation of Saskatoon?

Chapter 3

Solve.

1. The sides of a triangle are 3 consecutive numbers. Its perimeter is 54 cm. How long is each side?

2. a) Copy and complete the table for the areas of 4 triangles, each with a fixed height of 10 cm.

Base (cm)	4	6	8	10
Area (cm) ²				

b) Write a formula for the areas of the triangles with a fixed height of 10 cm.

c) Use the formula to find the area of a triangle with a height of 10 cm and a base of 15 cm.

3. One painter paints a room in 1 h. A second paints it in 2 h. How long will they take to paint a room together?

4. An aircraft flew at 400 km/h to its destination and returned at 500 km/h. If the total trip took 9 h, how far did the aircraft fly?

5. The sum of 2 numbers is 26. Four times the first number plus twice the second is 70. What are the numbers?

Solve each inequality and graph the solution on a number line.

6. $7x - 3 \geq 5x - 1$ 7. $3x - 2 < 2x - 4$

8. $3x - 1 > 5x - 3$ 9. $6x - 4 \leq 9x + 5$

10. A swinging pendulum is often used to keep time. The period of a pendulum is defined as the time it takes for a complete swing to and fro. At sea level on the surface of the Earth, the period, T seconds, is given by the formula

$$T = 2.01\sqrt{l}$$

where l is the length of the pendulum in metres. What is the period of a pendulum of length 1 m? 2 m? 3 m? Write each answer to the nearest hundredth of a second.

Chapter 4

Simplify.

1. $(3x^2 + 2x - 3) + (x^2 + x + 1)$

2. $(2y^2 - 3y + 1) + (3y^2 - y - 1)$

3. $(x^2 + x - 7) - (2x^2 + 3x + 2)$

4. $(2x^2 - x - 1) - (3x^2 - x + 2)$

Simplify.

5. $(3x)(5y)$

6. $(-6s)(2t)$

Add.

7. $3x^2 - 5x + 2$
 $+ x^2 + 2x + 1$

8. $4x^2 + x - 2$
 $+ 3x^2 - 4x + 4$

9. $-6x^2 + 7x + 5$
 $2x^2 - 5x - 14$

10. $-2x^2 + 3x - 4$
 $- x^2 - 8x - 5$

Subtract.

11. $10x^2 - 5x + 1$
 $- 2x^2 - 3x + 6$

12. $6x^2 - 4x + 9$
 $7x^2 - 10x + 3$

13. $-7x^2 + 11x - 3$
 $2x^2 + 13x - 7$

14. $-3x^2 - 5x - 2$
 $- 2x^2 + x + 15$

Multiply.

15. $(4ax)(5bx)$

16. $(-2pw)(-6pb)$

17. $(5xy)(-7xy)$

18. $-5b^2(-5ab)$

19. $3x^2(-4x^2yz^2)$

20. $-p^2q^3(2p^4q)$

Divide. Express each answer with positive exponents.

21. $\frac{15x^4y}{5x^7y^2}$

22. $\frac{-21a^5b^{-4}}{3a^3b^{-4}}$

23. $\frac{-16p^3q^5}{8p^4q^9}$

24. $\frac{-18x^5y^5}{-3x^{-6}y^{-2}}$

25. $\frac{-48x^{-8}y^{-6}}{-32x^{-7}y^{-1}}$

26. $\frac{15s^2t^7}{-21rs^5t^2}$

Find the area of each figure.

