

# 1-8

## Introduction to Functions

### Objectives

Graph ordered pairs in the coordinate plane.

Graph functions from ordered pairs.

### Vocabulary

coordinate plane

axes

origin

x-axis

y-axis

ordered pair

x-coordinate

y-coordinate

quadrant

input

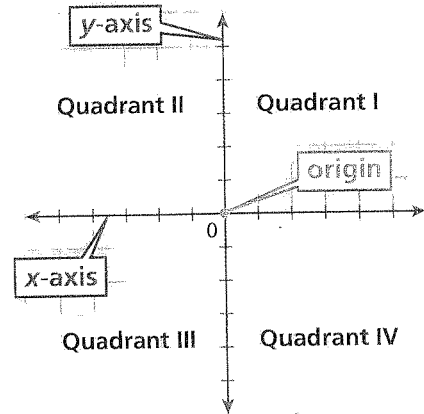
output

### Why learn this?

You can use functions to determine how the cost of a caricature is affected by the number of people in the picture. (See Example 3.)

The **coordinate plane** is formed by the intersection of two perpendicular number lines called **axes**. The point of intersection, called the **origin**, is at 0 on each number line. The horizontal number line is called the **x-axis**, and the vertical number line is called the **y-axis**.

Points on the coordinate plane are described using ordered pairs. An **ordered pair** consists of an **x-coordinate** and a **y-coordinate** and is written  $(x, y)$ . Points are often named by a capital letter.



### EXAMPLE 1 Graphing Points in the Coordinate Plane

#### Reading Math

The x-coordinate tells how many units to move left or right from the origin. The y-coordinate tells how many units to move up or down.

Graph each point.

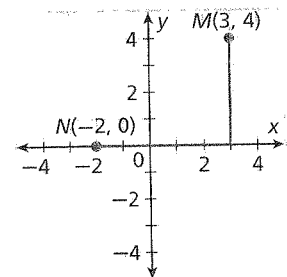
**A**  $M(3, 4)$

Start at the origin.

Move 3 units right and 4 units up.

**B**  $N(-2, 0)$

Start at the origin. Move 2 units left.



Graph each point.

1a.  $R(2, -3)$

1b.  $S(0, 2)$

1c.  $T(-2, 6)$

Look at the graph at the top of this lesson. The axes divide the coordinate plane into four **quadrants**. Points that lie on an axis are not in any quadrant.

### EXAMPLE 2 Locating Points in the Coordinate Plane

Name the quadrant in which each point lies.

**A**  $P$

Quadrant III

**B**  $Q$

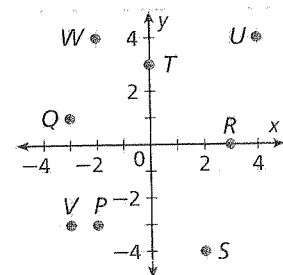
Quadrant II

**C**  $R$

no quadrant (x-axis)

**D**  $S$

Quadrant IV



Name the quadrant in which each point lies.

2a.  $T$

2b.  $U$

2c.  $V$

2d.  $W$

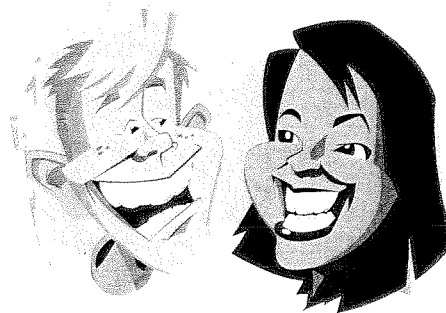
An equation that contains two variables can be used as a rule to generate ordered pairs. When you substitute a value for  $x$ , you generate a value for  $y$ . The value substituted for  $x$  is called the **input**, and the value generated for  $y$  is called the **output**.

Output      Input  
↓            ↓  
 $y = 10x + 5$

In a *function*, the value of  $y$  (the output) is determined by the value of  $x$  (the input). All of the equations in this lesson represent functions.

### EXAMPLE 3 Art Application

A caricature artist charges his clients a \$5 setup fee plus \$10 for every person in a picture. Write a rule for the artist's fee. Write ordered pairs for the artist's fee when there are 1, 2, 3, and 4 people in the picture.



Let  $y$  represent the artist's fee and  $x$  represent the number of people in a picture.

Artist's fee is \$5 plus \$10 for each person.

$$y = 5 + 10 \cdot x$$

$$y = 5 + 10x$$

Number of People in Picture	Rule	Fee	Ordered Pair
$x$ (input)	$y = 5 + 10x$	$y$ (output)	$(x, y)$
1	$y = 5 + 10(1)$	15	(1, 15)
2	$y = 5 + 10(2)$	25	(2, 25)
3	$y = 5 + 10(3)$	35	(3, 35)
4	$y = 5 + 10(4)$	45	(4, 45)

#### Writing Math

The artist's fee is determined by the number of people in the picture, so the number of people is the input and the artist's fee is the output.



**3. What if...?** The artist increased his fees to a \$10 setup fee plus \$20 for every person. Write a rule for the new fee. Write ordered pairs for the fee when there are 1, 2, 3, and 4 people.

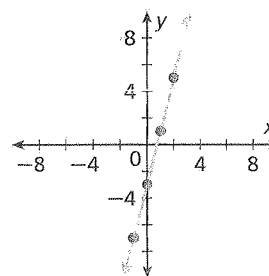
When you graph ordered pairs generated by a function, they may create a pattern.

### EXAMPLE 4 Generating and Graphing Ordered Pairs

Generate ordered pairs for each function using the given values for  $x$ . Graph the ordered pairs and describe the pattern.

**A**  $y = 4x - 3$ ;  $x = -1, 0, 1, 2$

Input	Output	Ordered Pair
$x$	$y$	$(x, y)$
-1	$4(-1) - 3 = -7$	$(-1, -7)$
0	$4(0) - 3 = -3$	$(0, -3)$
1	$4(1) - 3 = 1$	$(1, 1)$
2	$4(2) - 3 = 5$	$(2, 5)$

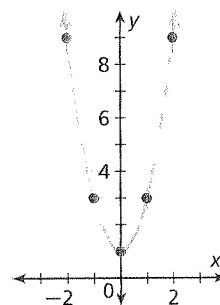


The points form a straight line.

Generate ordered pairs for each function using the given values for  $x$ . Graph the ordered pairs and describe the pattern.

**B**  $y = 2x^2 + 1; x = -2, -1, 0, 1, 2$

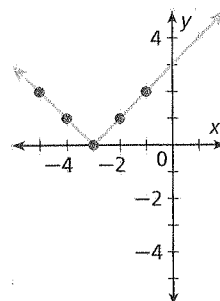
Input	Output	Ordered Pair
$x$	$y$	$(x, y)$
-2	$2(-2)^2 + 1 = 9$	$(-2, 9)$
-1	$2(-1)^2 + 1 = 3$	$(-1, 3)$
0	$2(0)^2 + 1 = 1$	$(0, 1)$
1	$2(1)^2 + 1 = 3$	$(1, 3)$
2	$2(2)^2 + 1 = 9$	$(2, 9)$



The points form a U shape.

**C**  $y = |x + 3|; x = -5, -4, -3, -2, -1$

Input	Output	Ordered Pair
$x$	$y$	$(x, y)$
-5	$ -5 + 3  =  -2  = 2$	$(-5, 2)$
-4	$ -4 + 3  =  -1  = 1$	$(-4, 1)$
-3	$ -3 + 3  =  0  = 0$	$(-3, 0)$
-2	$ -2 + 3  =  1  = 1$	$(-2, 1)$
-1	$ -1 + 3  =  2  = 2$	$(-1, 2)$



The points form a V shape.



Generate ordered pairs for each function using the given values for  $x$ . Graph the ordered pairs and describe the pattern.

4a.  $y = \frac{1}{2}x - 4; x = -4, -2, 0, 2, 4$

4b.  $y = 3x^2 + 3; x = -3, -1, 0, 1, 3$

4c.  $y = |x - 2|; x = 0, 1, 2, 3, 4$

In Chapter 4, you will learn more about functions. You will study the relationship between the shape of a graph and the rule that generates the ordered pairs.

## THINK AND DISCUSS

- Describe how to graph the ordered pair  $(-3, 6)$ .
- Give an example of a point that lies on the  $y$ -axis.

Know It!

Note

- GET ORGANIZED** Copy and complete the graphic organizer. In each blank, write "positive" or "negative."

Quadrant II	Quadrant I
$x$ is <u>  </u> .	$x$ is <u>  </u> .
$y$ is <u>  </u> .	$y$ is <u>  </u> .
$x$ is <u>  </u> .	$x$ is <u>  </u> .
$y$ is <u>  </u> .	$y$ is <u>  </u> .
Quadrant III	Quadrant IV

The  
Coordinate  
Plane



## GUIDED PRACTICE

1. **Vocabulary** Explain why the order in an *ordered pair* is important.

SEE EXAMPLE

1

Graph each point.

p. 54

L

2.  $J(4, 5)$

3.  $K(-3, 2)$

4.  $L(6, 0)$

5.  $M(1, -7)$

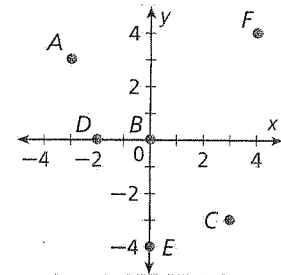
SEE EXAMPLE

2

Name the quadrant in which each point lies.

p. 54

L

6.  $A$ 7.  $B$ 8.  $C$ 9.  $D$ 10.  $E$ 11.  $F$ 

SEE EXAMPLE

3

12. **Multi-Step** The number of counselors at a summer camp must be equal to  $\frac{1}{4}$  the number of campers. Write a rule for the number of counselors that must be at the camp. Write ordered pairs for the number of counselors when there are 76, 100, 120, and 168 campers.

p. 55

L

SEE EXAMPLE

4

Generate ordered pairs for each function for  $x = -2, -1, 0, 1,$  and  $2$ . Graph the ordered pairs and describe the pattern.

p. 55

L

13.  $y = x + 2$

14.  $y = -x$

15.  $y = -2|x|$

16.  $y = \frac{1}{2}x^2$

## PRACTICE AND PROBLEM SOLVING

Graph each point.

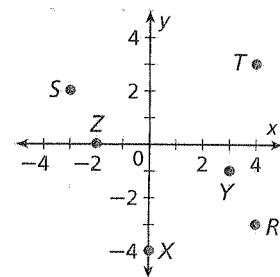
17.  $D(2, 8)$

18.  $E(-2, -7)$

19.  $F(0, -5)$

20.  $G(4, -4)$

Name the quadrant in which each point lies.

21.  $X$ 22.  $Y$ 23.  $Z$ 24.  $R$ 25.  $S$ 26.  $T$ 

27. **Multi-Step** Jeremy's wages include a \$500 base salary plus  $\frac{1}{10}$  of his sales. Write a rule for the total amount of Jeremy's paycheck. Write ordered pairs for the amount of Jeremy's paycheck when his sales are \$500, \$3000, \$5000, and \$7500.

Generate ordered pairs for each function for  $x = -2, -1, 0, 1,$  and  $2$ . Graph the ordered pairs and describe the pattern.

28.  $y = 6 - 2x$

29.  $y = -(x^2)$

30.  $y = 3|x|$

31.  $y = x^2 + 3$



**Geometry** Graph each point and connect them in the order they are listed.

Connect the last point to the first. Describe the figure drawn.

32.  $(-1, 1), (4, 1), (4, -4), (-1, -4)$

33.  $(-6, 3), (2, -2), (-7, -3)$

34.  $(4, 4), (6, 2), (5, -1), (3, -1), (2, 2)$

35.  $(-6, 5), (4, 5), (4, 7), (-6, 7)$

36. **Multi-Step** The salary at Beth's company is \$32,000 for someone with no experience and increases by \$2700 per year of experience. Write a rule for the salary at Beth's company. Write ordered pairs for the salaries for employees with 0, 2, 5, and 7 years of experience.

## Independent Practice

For Exercises 17–20, see Example 1.

For Exercises 21–26, see Example 2.

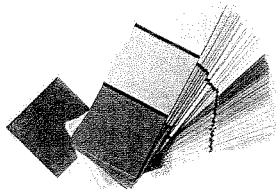
For Exercises 27–31, see Example 3.

For Exercises 32–35, see Example 4.

## Extra Practice

Practice p. S5  
Application Practice p. S28

## MULTI-STEP TEST PREP



37. This problem will prepare you for the Multi-Step Test Prep on page 60.
- A room decorator wants to purchase fabric. Each yard of fabric costs \$2.90. Write a rule for the cost of the fabric. Let  $c$  equal the total cost and  $f$  equal the number of yards of fabric.
  - Which variable is the input and which variable is the output?
  - Make a table showing the cost of 1, 2, 3, 4, and 5 yards of fabric.
  - How many whole yards can the decorator purchase if she has \$21.00?

Write an equation for each rule. Use the given values for  $x$  to generate ordered pairs. Graph the ordered pairs and describe the pattern.

- $y$  is equal to 3 more than the absolute value of  $x$ ;  $x = -2, -1, 0, 1, \text{ and } 2$ .
- $y$  is equal to the sum of one half of  $x$  and  $-3$ ;  $x = -4, -2, 0, 2, \text{ and } 4$ .
- $y$  is equal to the sum of  $x$  squared and 1;  $x = -5, -3, -1, 1, 3, \text{ and } 5$ .
- Business** An events planner is preparing for a 5K race. She will buy enough water bottles for 50 volunteers, plus  $1\frac{1}{2}$  times the number of runners who preregister for the race.
  - Write an equation for the number of water bottles the planner should buy.
  - Generate ordered pairs for the number of water bottles the event planner will buy for the following numbers of preregistered runners: 100, 150, 200, 250, and 300.

## LINK

### Math History

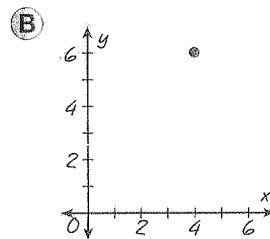
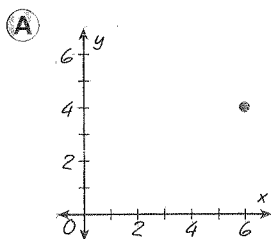


RENÉ DESCARTES

The coordinate plane is also called the Cartesian plane. This name comes from the mathematician René Descartes (1596–1650), who is credited with developing the coordinate system.

Give the coordinates of three points that fit the given description. Graph the points and describe the pattern.

- The  $x$ -coordinate is 1 less than the  $y$ -coordinate.
- The sum of the  $x$ -coordinate and  $y$ -coordinate is 5.
- The  $x$ -coordinate is 2 times the  $y$ -coordinate.
- The quotient of the  $x$ -coordinate and  $y$ -coordinate is 3.
- Critical Thinking** Lance wrote five ordered pairs for which the  $y$ -coordinate was the opposite of the  $x$ -coordinate. Then he graphed the ordered pairs. What pattern did the points make?
- Write About It** Graph the point  $(4, 2)$ .
  - How is graphing the point  $(4, 2)$  different from graphing the point  $(2, 4)$ ?
  - How is graphing the point  $(4, 2)$  different from graphing the point  $(-4, -2)$ ?
- ERROR ANALYSIS** Two students graphed the point  $(4, 6)$ . Which is incorrect? Explain the error.



- Generate ordered pairs for  $y = x$ , graph the points, and connect them to make a line. Do the same for  $y = x + 2$  using the same values for  $x$ . How is the line for  $y = x + 2$  different from the line for  $y = x$ ?

50. Which equation could be used to generate the ordered pairs (2, 7) and (6, 9)?

- (A)  $y = 9 - x$       (B)  $y = \frac{3}{2}x^2 + 1$       (C)  $y = \frac{1}{2}x + 6$       (D)  $y = x + 5$

51. Which table of ordered pairs is generated when the values 1, 2, 3, and 4 are substituted for  $x$  in the equation  $y = 2x - 4$ ?

**(F)**

$x$	$y$
1	-3
2	-2
3	-1
4	0

**(G)**

$x$	$y$
1	-2
2	0
3	2
4	4

**(H)**

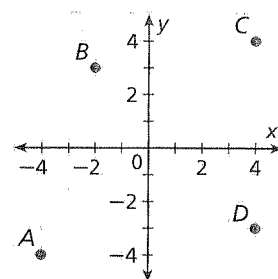
$x$	$y$
1	-2
2	0
3	1
4	2

**(J)**

$x$	$y$
1	-3
2	-1
3	2
4	4

52. For which point on the graph is  $x > \frac{7}{2}$  and  $y < \frac{8}{3}$ ?

- (A) A      (C) C  
(B) B      (D) D



53. Which ordered pair describes the point (2, 5) shifted 3 units right and 2 units down?

- (F) (0, 8)      (H) (5, 3)  
(G) (2, 3)      (J) (5, 5)

## CHALLENGE AND EXTEND

Graph each point.

54.  $W(x + 4, y - 8)$  for  $x = 5$  and  $y = 2$       55.  $X(5 - x, y^2)$  for  $x = -1$  and  $y = 3$   
56.  $Y(x + y, y - x)$  for  $x = 6$  and  $y = 3$       57.  $Z(xy, x^2y)$  for  $x = -1$  and  $y = 4$   
58. Graph several ordered pairs that have an  $x$ -coordinate of 3. Describe the pattern.  
59. Graph several ordered pairs that have a  $y$ -coordinate of 6. Describe the pattern.  
60. Find the perimeter of a rectangle whose vertices have the coordinates  $A(3, 6)$ ,  $B(3, -2)$ ,  $C(-1, -2)$ , and  $D(-1, 6)$ .  
61. **Multi-Step** The coordinates of three vertices of a rectangle are  $J(-4, -2)$ ,  $K(2, -2)$ , and  $L(2, 5)$ . Find the coordinates of the fourth vertex. What is the area of the rectangle?

## SPIRAL REVIEW

Give the name of each figure. (Previous course)

62.       63.       64.       65. 

Write all classifications that apply to each real number. (Lesson 1-5)

66.  $\sqrt{36}$       67.  $\sqrt{6}$       68.  $\frac{1}{9}$       69.  $-32$

Simplify each expression. (Lesson 1-7)

70.  $\frac{1}{5} \cdot 18 \cdot 25$       71.  $x^2 + 3x$       72.  $2a - b + a + 4b$

## MULTI-STEP TEST PREP

## The Tools of Algebra

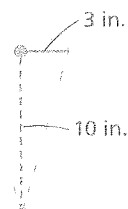
**Design Time** Lori's family and Marie's family are redecorating a room in each other's home. They have three days for the decorating project, which will be filmed for a local TV show.

1. Lori decides to paint Marie's room a shade of blue. She measures the height and width of each wall in the rectangular room. She finds that two walls have a width of 12 feet and the other two have a width of 14 feet. The ceiling is 9 feet high. Find the area of each wall. Find the total area of all four walls plus the ceiling.
2. One gallon of paint covers 400 square feet. How many gallons are needed if Lori wants to apply 2 coats of paint to all the walls and the ceiling?
3. Lori decided to build a bedside table in the shape of a cylinder and cover all of its surfaces except the bottom with yellow fabric. The fabric costs \$2.50 per square yard. The table has a radius of 1 foot and a height of 2 feet. What is the cost to cover the table? Use 3.14 for  $\pi$ .
4. Lori will fill a vase with multicolored beads and place it on the bedside table. The vase is in the approximate shape of a cone. The height of the vase is 10 inches, and the radius of the vase at the top is 3 inches. Find the volume of the vase. Use 3.14 for  $\pi$ . (*Hint: The formula for the volume of a cone is  $V = \frac{1}{3}\pi r^2 h$ , where  $r$  is the radius of the cone and  $h$  is the height of the cone.*)
5. Lori wants to create a border around the room using stickers. She can purchase a package of 5 stickers for \$6.00. Make a table to show the cost of 1, 2, 3, 4, and 5 packages of stickers. Make another table to show the cost based on the number of stickers (not the number of packages). How many stickers can Lori purchase if she has \$32 left in her budget?



1 ft

2 ft



## Quiz for Lessons 1-6 Through 1-8

### 1-6 Order of Operations

Simplify each expression.

1.  $-6 + 12 \div (-3)$

2.  $30 - 9 + 4$

3.  $(6 - 8) \cdot (7 - 5)$

4.  $8 \cdot [8 - (4 - 2)]$

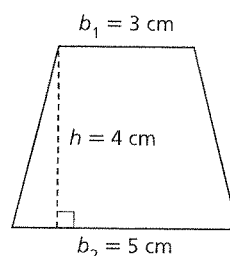
5.  $\frac{23 - 3 \cdot 5}{4}$

6.  $|3 - 9| \div 2 + 5$

Translate each word phrase into a numerical expression.

 7. the quotient of 16 and the difference of 9 and  $-7$ 

8. the product of 5 and the sum of 6 and 4

 9. The area of a trapezoid can be found using the expression  $\frac{1}{2}(b_1 + b_2)h$ . Find the area of the trapezoid shown.


### 1-7 Simplifying Expressions

Simplify each expression.

10.  $75 + 32 + 25$

11.  $5 \cdot 18 \cdot 20$

12.  $\frac{1}{4} \cdot 19 \cdot 8$

Write each product using the Distributive Property. Then simplify.

13.  $7(67)$

14.  $9(29)$

15.  $17(18)$

16.  $8(106)$

Simplify each expression by combining like terms.

17.  $4k + 15k$

18.  $x^2 + 22x^2$

19.  $-2g + 5g$

Simplify each expression. Justify each step with an operation or property.

20.  $3(x + 2) - 3x$

21.  $x - 6x^2 + 3x + 4x^2$

22.  $-2(3x + 2y + 4x + 5y)$

### 1-8 Introduction to Functions

Graph each point.

23.  $A(0, -3)$

24.  $B(-2, -3)$

25.  $C(1, 4)$

Name the quadrant in which each point lies.

26.  $A$

27.  $B$

28.  $C$

29.  $D$

30.  $E$

31.  $F$

Generate ordered pairs for each function for  $x = -2, -1, 0, 1,$  and  $2$ . Graph the ordered pairs and describe the pattern.

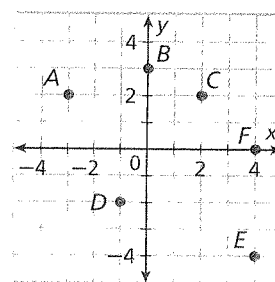
32.  $y = x^2 + 1$

33.  $y = x - 1$

34.  $y = -|x|$

35.  $y = 3x + 3$

36. A swimming pool contains 30,000 gallons of water. The pool is drained at a rate of 100 gallons per minute. Write a rule for the amount of water in the pool when  $x$  minutes have gone by. Write ordered pairs for the amount of water in the pool when 30, 60, 90, and 120 minutes have gone by.





## Vocabulary

absolute value . . . . .	14	like terms . . . . .	47	real numbers . . . . .	33
additive inverse . . . . .	15	multiplicative inverse . . . . .	21	reciprocal . . . . .	21
algebraic expression . . . . .	6	natural numbers . . . . .	33	repeating decimal . . . . .	34
axes . . . . .	54	numerical expression . . . . .	6	square root . . . . .	32
base . . . . .	26	opposites . . . . .	15	term . . . . .	47
coefficient . . . . .	48	order of operations . . . . .	40	terminating decimal . . . . .	33
constant . . . . .	6	ordered pair . . . . .	54	variable . . . . .	6
coordinate plane . . . . .	54	origin . . . . .	54	whole numbers . . . . .	33
cube root . . . . .	32	output . . . . .	55	$x$ -axis . . . . .	54
evaluate . . . . .	7	perfect square . . . . .	32	$x$ -coordinate . . . . .	54
exponent . . . . .	26	power . . . . .	26	$y$ -axis . . . . .	54
input . . . . .	55	principal square root . . . . .	32	$y$ -coordinate . . . . .	54
integers . . . . .	33	quadrant . . . . .	54		
irrational numbers . . . . .	33	rational numbers . . . . .	34		

Complete the sentences below with vocabulary words from the list above.

1. A(n) constant is a value that does not change.
2. The natural numbers include the natural numbers and zero.
3. A(n) coefficient is the numerical factor of a term that contains a variable.
4. The origin is the point where the axes of a coordinate plane intersect.

## 1-1 Variables and Expressions (pp. 6–11)

## EXAMPLES

- Barbara has saved  $d$  dollars for a \$65 sweater. Write an expression for the amount of money she still needs to buy the sweater.

$$65 - d \quad \text{The amount of money she still needs is the difference of 65 and } d.$$

- Evaluate  $b - a$  for  $a = 7$  and  $b = 15$ .

$$b - a = 15 - 7 \quad \text{Substitute } b = 15 \text{ and } a = 7.$$

$$= 8 \quad \text{Simplify.}$$

5. Grapes cost \$1.99 per pound. Write an expression for the cost of  $g$  pounds of grapes.
6. Today's temperature is 3 degrees warmer than yesterday's temperature  $t$ . Write an expression for today's temperature.

Evaluate each expression for  $p = 5$  and  $q = 1$ .

$$7. qp \qquad 8. p \div q \qquad 9. q + p$$

10. Each member of the art club will make the same number of posters to advertise their club. They will make 150 posters total. Write an expression for how many posters each member will make if there are  $m$  members. Find how many posters each member will make if there are 5, 6, and 10 members.

## I-2 Adding and Subtracting Real Numbers (pp. 14–19)

### EXAMPLES

Add or subtract.

$$-4 + (-9)$$

$$-4 + (-9) \quad \text{The signs are the same.}$$

$$(4 + 9 = 13) \quad \text{Add the absolute values and use the sign of the numbers.}$$

$$-13$$

$$-8 - (-3)$$

$$-8 + 3 \quad \text{To subtract } -3, \text{ add } 3.$$

$$-5$$

### EXERCISES

Add or subtract.

$$11. -2 + (-12) \quad 12. -6 + 1.4 \quad 13. 9\frac{1}{4} + \left(-4\frac{3}{4}\right)$$

$$14. \frac{1}{2} - \frac{3}{2} \quad 15. -8 - 16 \quad 16. 6.7 - (-7.6)$$

17. A trail starts at an elevation of 2278 feet. It descends 47 feet to a campsite. What is the elevation of the campsite?

## I-3 Multiplying and Dividing Real Numbers (pp. 20–25)

### EXAMPLES

Multiply or divide.

$$-12(9)$$

$$\blacksquare -\frac{5}{6} \div \left(-\frac{3}{4}\right)$$

$$-12(9) = -108$$

$$-\frac{5}{6} \div \left(-\frac{3}{4}\right) = -\frac{5}{6} \left(-\frac{4}{3}\right)$$

$$= \frac{(-5)(-4)}{6(3)}$$

$$= \frac{20}{18} = \frac{10}{9}$$

### EXERCISES

Multiply or divide if possible.

$$18. -5(-18) \quad 19. 0 \cdot 10 \quad 20. -4(3.8)$$

$$21. -56 \div 7 \quad 22. 0 \div 0.75 \quad 23. 9 \div 0$$

Divide.

$$24. 4 \div \frac{4}{9} \quad 25. -\frac{1}{2} \div \frac{3}{4} \quad 26. \frac{6}{7} \div \frac{2}{5}$$

27. An exercise program recommends that a person walk at least 10,000 steps every day. At this rate, how many steps would the person walk in 1 year?

## I-4 Powers and Exponents (pp. 26–31)

### EXAMPLES

Simplify  $-3^4$ .

$$-3^4 = -1 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \quad \text{Find the product of } -1 \text{ and four } 3\text{'s.}$$

$$= -81$$

Write  $-216$  as a power of  $-6$ .

$$-216 = (-6)(-6)(-6) \quad \text{The product of three } -6\text{'s is } -216.$$

$$= (-6)^3$$

### EXERCISES

Write each expression as repeated multiplication. Then simplify the expression.

$$28. 4^3 \quad 29. (-3)^3 \quad 30. (-3)^4$$

$$31. -5^2 \quad 32. \left(\frac{2}{3}\right)^3 \quad 33. \left(-\frac{4}{5}\right)^2$$

Write each number as a power of the given base.

$$34. 16; \text{ base } 2 \quad 35. -1000; \text{ base } -10$$

$$36. 64; \text{ base } -8 \quad 37. 12; \text{ base } 12$$

38. The interior of a safe is shaped like a cube with edges 9 inches long. What is the volume of the interior of the safe?

## 1-5 Roots and Real Numbers (pp. 32–37)

### EXAMPLES

Find each root.

$$-\sqrt{64}$$

$$8^2 = 64$$

$$-\sqrt{64} = -8$$

$$\text{or } \sqrt{\frac{16}{81}}$$

$$\left(\frac{4}{9}\right)^2 = \frac{4}{9} \cdot \frac{4}{9} = \frac{16}{81}$$

$$\sqrt{\frac{16}{81}} = \frac{4}{9}$$

Write all classifications that apply to  $-7$ .

$$-7 = \frac{-7}{1} = -7.0$$

rational number, terminating decimal, integer

Find each root.

$$39. \sqrt{36}$$

$$40. \sqrt[3]{64}$$

$$41. -\sqrt{49}$$

$$42. -\sqrt{144}$$

$$43. \sqrt{\frac{25}{36}}$$

$$44. \sqrt[3]{\frac{1}{27}}$$

Write all the classifications that apply to each real number.

$$45. 21$$

$$46. 0$$

$$47. -13$$

$$48. 0.8$$

$$49. \sqrt{3}$$

$$50. \frac{5}{6}$$

51. A tabletop is shaped like a square with an area of 13 square feet. Find the length of one side of the table to the nearest tenth of a foot.

## 1-6 Order of Operations (pp. 40–45)

### EXAMPLES

**a** Simplify  $18 - 3\left(\frac{15 - 7}{4}\right)^2$ .

$$18 - 3\left(\frac{15 - 7}{4}\right)^2$$

$$18 - 3\left(\frac{8}{4}\right)^2$$

$$18 - 3\left(\frac{2}{1}\right)^2$$

$$18 - 3 \cdot 4$$

$$18 - 12$$

$$6$$

**b** Evaluate  $-5\sqrt{40 - x} + 12$  for  $x = 4$ .

$$-5\sqrt{40 - 4} + 12$$

$$-5\sqrt{36} + 12$$

$$-5(6) + 12$$

$$-30 + 12$$

$$-18$$

Simplify each expression.

$$52. 5 \cdot 4 + 3$$

$$53. 17 + 3(-3)$$

$$54. [8 + (2 - 6)^2] \div 4$$

$$55. \frac{4^2 - 11}{10}$$

$$56. |12 - 3 \cdot 7| \cdot (-2)$$

$$57. \sqrt{4 \cdot 5 + 5} - 5$$

Evaluate each expression for the given value of  $x$ .

$$58. 48 - x + 29 \text{ for } x = 15$$

$$59. x + 4 \cdot 6 - 10 \text{ for } x = -4$$

$$60. 8(x - 8)^3 \text{ for } x = 9$$

$$61. [(3 - x)^2 + 4] \div 2 \text{ for } x = 7$$

Translate each word phrase into a numerical or algebraic expression.

62. the sum of 8 and the product of 7 and  $-2$

63. the quotient of 12 and the sum of 8 and 3

64. 4 times the square root of  $x$  less than 20

65. The expression  $16t^2 + vt$  can be used to find the distance in feet traveled by a falling object. The initial speed is  $v$  (ft/s), and time is  $t$  (s). Find the distance traveled in 3 s by a falling object with an initial speed of 8 ft/s.

## 7 Simplifying Expressions (pp. 46–51)

### EXAMPLES

Simplify each expression.

$$-6f^2 - 8f + 3f^2$$

$$-6f^2 + 3f^2 - 8f$$

$$-3f^2 - 8f$$

Commutative Property  
Combine like terms.

$$3x - 4y$$

$$3x - 4y$$

There are no like terms.  
It cannot be simplified.

$$3x^2 - 3(x - 2) - x$$

$$3x^2 - 3x - 3(-2) - x$$

$$3x^2 - 3x + 6 - x$$

$$3x^2 - 3x - x + 6$$

$$3x^2 - 4x + 6$$

Distributive Property  
Multiply.

Commutative Property  
Combine like terms.

### EXERCISES

Simplify each expression.

$$66. 18 + 26 - 8 + 4$$

$$67. 60 \cdot 27 \cdot \frac{1}{6}$$

Write each product using the Distributive Property.  
Then simplify.

$$68. 13(103)$$

$$69. 18(99)$$

Simplify each expression.

$$70. 20x - 16x$$

$$71. 2y^2 + 5y^2$$

$$72. 6(x + 4) - 2x$$

$$73. -2(x^2 - 1) + 4x^2$$

$$74. -2y + 3y^2 - 3y + y$$

$$75. 7y + 3y - a - 2y$$

76. Rita bought a sandwich, 2 bottles of water, and an apple for lunch. The sandwich cost \$4.99, the bottles of water cost \$1.48 each, and the apple cost \$0.89. About how much did Rita spend on lunch?

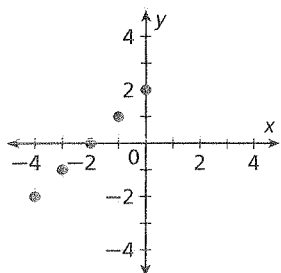
## 8 Introduction to Functions (pp. 54–59)

### EXAMPLES

Generate ordered pairs for the function using the given values for  $x$ . Graph the ordered pairs and describe the pattern.

$$y = x + 2; x = -4, -3, -2, -1, 0$$

Input	Output	Ordered Pair
$x$	$y$	$(x, y)$
-4	$-4 + 2 = -2$	$(-4, -2)$
-3	$-3 + 2 = -1$	$(-3, -1)$
-2	$-2 + 2 = 0$	$(-2, 0)$
-1	$-1 + 2 = 1$	$(-1, 1)$
0	$0 + 2 = 2$	$(0, 2)$



The points form a straight line.

### EXERCISES

Graph each point.

$$77. A(2, 3)$$

$$78. B(-1, 4)$$

$$79. C(0, 8)$$

$$80. D(5, -3)$$

Name the quadrant in which each point lies.

$$81. R$$

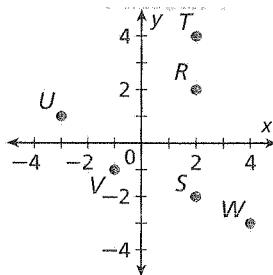
$$82. S$$

$$83. T$$

$$84. U$$

$$85. V$$

$$86. W$$



87. The price of an item with tax is equal to the price of the item plus  $\frac{1}{20}$  of the price. Write a rule for the price with tax. Write ordered pairs for the price with tax of items that cost \$2, \$15, \$30, and \$40.

88. Generate ordered pairs for the function  $y = \frac{1}{4}x^2$  for  $x = -4, -1, 0, 1,$  and  $4$ . Graph the ordered pairs and describe the pattern.

## CHAPTER TEST

Evaluate each expression for  $a = 2$ ,  $b = 3$ , and  $c = 6$ .

1.  $c - a$

2.  $ab$

3.  $c \div a$

4.  $\frac{c}{b}$

5.  $b - a$

6. Give two ways to write  $n - 5$  in words.

7. Nate runs 8 miles each week. Write an expression for the number of miles he runs in  $n$  weeks. Find the number of miles Nate runs in 5 weeks.

Add or subtract.

8.  $-5 + 8$

9.  $-3 - 4$

10.  $4 + (-7)$

11.  $7 - (-2)$

The table shows the lowest temperatures recorded in four states.

12. How much greater is the lowest temperature in Hawaii than the lowest temperature in Alaska?

13. How much greater is the lowest temperature in Texas than the lowest temperature in Nebraska?

Lowest Temperatures in Four States	
Location	Temperature ( $^{\circ}\text{F}$ )
Prospect Creek, Alaska	-80
Camp Clarke, Nebraska	-47
Mauna Kea, Hawaii	12
Seminole, Texas	-23

Multiply or divide if possible.

14.  $(-3)(-6)$

15.  $-\frac{1}{2} \div \frac{1}{4}$

16.  $12 \div (-3)$

17.  $0 \div (-4)$

Simplify each expression.

18.  $5^4$

19.  $\left(-\frac{4}{5}\right)^3$

20.  $2^5$

21.  $-6^2$

Write all classifications that apply to each real number.

22. 30

23.  $\sqrt{6}$

24. -12

25.  $\frac{1}{2}$

Evaluate each expression for the given value of  $x$ .

26.  $\frac{-2 - 6}{x^2}$  for  $x = 2$

27.  $8(x - 1)^2$  for  $x = 11$

28.  $22 + [-2(19 - x)]$  for  $x = 7$

29. Does the phrase "2 times the sum of a number and 5" represent the same expression as the phrase "the sum of 2 times a number and 5"? Explain why or why not.

Simplify each expression.

30.  $5\frac{1}{4} + 7 + 2\frac{3}{4}$

31.  $-2(x + 5) + 4x$

32.  $3x + 2x^2 - x$

Graph each point.

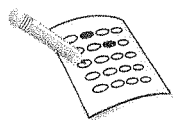
33.  $W(1, -3)$

34.  $X(-3, 0)$

35.  $Y(5, 3)$

36.  $Z(0, -2)$

37. Generate ordered pairs for  $y = 2x - 1$  for  $x = -2, -1, 0, 1, 2$ . Graph the ordered pairs and describe the pattern.



# COLLEGE ENTRANCE EXAM PRACTICE

CHAPTER

1

## FOCUS ON SAT\*

The SAT is often used to predict academic success at the college level. SAT scores are used to compare the math and verbal reasoning skills of students from all over the world.

You may want to time yourself as you take this practice test. It should take you about 8 minutes to complete.



In each section of SAT questions, the easier questions are at the beginning of the section and harder questions come later. Answer as many of the easy questions as you can first, and then move on to the more challenging questions.

The number 0 is NOT an example of which of the following?

- (A) Real numbers
- (B) Rational numbers
- (C) Whole numbers
- (D) Integers
- (E) Natural numbers

A clothing store opens with 75 pairs of jeans on a sale table. By noon, 10 pairs have been sold. As of 2:00, another 8 pairs have been sold. A clerk then restocks with 12 pairs. Receipts show that 18 pairs of jeans were sold after 2:00. How many pairs of jeans are left at the end of the day?

- (A) 23
- (B) 27
- (C) 36
- (D) 51
- (E) 123

If Jack is three times as old as his sister Judy, which of the following expressions represents Jack's age if Judy is  $j$  years old?

- (A)  $3 \div j$
- (B)  $3j$
- (C)  $j + 3$
- (D)  $3 - j$
- (E)  $\frac{1}{3}j$

4. Which of the following is equal to  $-3^4$ ?

- (A) 81
- (B) 12
- (C)  $-12$
- (D)  $-64$
- (E)  $-81$

5. What is the result after applying the following sequence of operations to a number  $n$  in the given order?

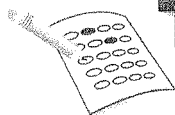
- 1. Subtract 2.
- 2. Divide by 3.
- 3. Add 7.
- 4. Multiply by  $-1$ .

- (A)  $\frac{n-2}{3} + 7(-1)$
- (B)  $\frac{(-n-2) + 7}{3}$
- (C)  $-(-\frac{2}{3} + 7)n$
- (D)  $-\left(\frac{n-2}{3} + 7\right)$
- (E)  $n - \frac{2}{3} + 7(-1)$

6. Which expression is equivalent to  $8(6 + x)$ ?

- (A)  $48x$
- (B)  $8x + 14$
- (C)  $8x + 48$
- (D)  $x + 14$
- (E)  $x + 48$

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# TEST TACKLER

## Standardized Test Strategies

When responding to a test item that requires you to place your answer in a grid, you must fill out the grid on your answer sheet correctly, or the item will be marked as incorrect.

## 1

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

$$\begin{array}{r} 12^2 - 3(10 + 4) \\ 12^2 - 3(14) \\ 144 - 3(14) \\ 144 - 42 \\ 102 \end{array}$$

- Write your answer in the answer boxes at the top of the grid.
- Put only one digit in each box. Do not leave a blank box in the middle of an answer.
- Shade the bubble for each digit in the same column as the digit in the answer box.

## 2

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

$$\begin{aligned} & ba \div c \\ (2)(-7) \div (-6) \\ & -14 \div (-6) \\ & \frac{7}{3} = 2\frac{1}{3} = 2.\overline{3} \end{aligned}$$

- Mixed numbers and repeating decimals cannot be gridded, so you must grid the answer as  $\frac{7}{3}$ .
- Write your answer in the answer boxes at the top of the grid.
- Put only one digit or symbol in each box. On some grids, the fraction bar and the decimal point have a designated box. Do not leave a blank box in the middle of an answer.
- Shade the bubble for each digit or symbol in the same column as the digit in the answer box.



On many grids you cannot grid a negative number because the grid does not include the negative sign. If you get a negative answer to a test item, you may need to recalculate the problem.

Read each sample and then answer the questions that follow.

**Sample A**  
A student correctly evaluated an expression and got  $\frac{8}{15}$  as a result. Then the student filled in the grid as shown.

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

What error did the student make when filling in the grid?  
Explain how to fill in the answer correctly.

**Sample B**  
The square root of 6.25 is 2.5. This answer is displayed in the grid.

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

What error did the student make when filling in the grid?  
Explain how to fill in the answer correctly.

**Sample C**  
A student correctly simplified the expression  $2\frac{1}{8} + 3\frac{5}{8} + \frac{7}{8}$ . Then the student filled in the grid as shown.

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

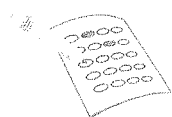
- What answer does the grid show?
- Explain why you cannot fill in a mixed number.
- Write the answer  $6\frac{5}{8}$  in two forms that could be entered in the grid correctly.

**Sample D**  
A student added  $-10$  and  $25$  and got an answer of  $15$ . Then the student filled in the grid as shown.

-	1	5
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

- What error does the grid show?
- Another student got an answer of  $-15$ . Explain why the student knew this answer was wrong.





# STANDARDIZED TEST PREP



## CUMULATIVE ASSESSMENT, CHAPTERS 1

### Multiple Choice

1. Eric is collecting gifts for a charity event. He needs 150 gifts. So far he has collected  $x$  gifts. Which expression represents how many gifts Eric still needs to collect?

(A)  $150 + x$                       (C)  $x - 150$   
(B)  $150 - x$                       (D)  $150 \div x$

2. An online store sells birdhouses for \$34.95 each. For each order, there is a one-time shipping and handling fee of \$7.50. Which expression can be used to represent the cost of ordering  $x$  birdhouses?

(F)  $x + 34.95 + 7.50$   
(G)  $(34.95 + 7.50)x$   
(H)  $7.50x + 34.95$   
(J)  $34.95x + 7.50$

3. Which equation could have generated the table?

$x$	$y$
-2	5
-1	2
0	1
1	2
2	5

(A)  $y = -2x + 1$   
(B)  $y = x + 1$   
(C)  $y = |2x| + 1$   
(D)  $y = x^2 + 1$

4. The equation  $C = \frac{5}{9}(F - 32)$  relates the Celsius temperature  $C$  to the Fahrenheit temperature  $F$ . What is the Celsius temperature if the Fahrenheit temperature is  $-13$  degrees?

(F)  $-45^\circ\text{C}$                       (H)  $-25^\circ\text{C}$   
(G)  $-39.2^\circ\text{C}$                       (J)  $-10.6^\circ\text{C}$

5. Which equation is NOT true?

(A)  $55 + 27 + 45 = 100 + 27$   
(B)  $5 \cdot 7 \cdot \frac{2}{5} = 2 \cdot 7$   
(C)  $14(126) = 14(100) + 14(26)$   
(D)  $31(152) = 30(150) + 1(2)$

6. The volume of a sphere with radius  $r$  is  $\frac{4\pi r^3}{3}$ . The radius of a ball is 4 inches. What is the volume of the ball in cubic inches?

(F)  $16\pi \text{ in}^3$   
(G)  $\frac{64\pi}{3} \text{ in}^3$   
(H)  $\frac{256\pi}{3} \text{ in}^3$   
(J)  $\frac{4096\pi}{3} \text{ in}^3$

7. Which of the following real numbers is a terminating decimal?

(A)  $\pi$   
(B)  $\frac{3}{2}$   
(C)  $\frac{4}{9}$   
(D)  $\frac{1}{3}$

8. At one time, a U.S. dollar had the same value as 11.32 Mexican pesos. To the nearest hundredth, how many Mexican pesos were equal to 16 U.S. dollars at that time?

(F) 1.41 pesos  
(G) 4.68 pesos  
(H) 27.32 pesos  
(J) 181.12 pesos

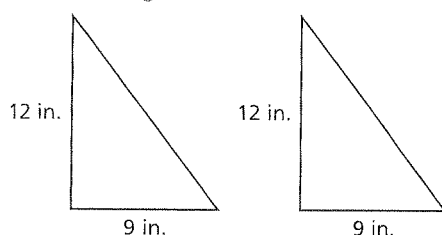


Read each question carefully. Be sure you understand what the question is asking before looking at the answer choices or beginning your calculations.

Tickets to a festival cost \$5.00 each, and lunch costs \$8.50 per person. Renting a bus to and from the festival costs \$47.00. Which expression gives the cost of  $x$  people going to the festival?

- (A)  $5.00 + 8.50 + 47.00$
- (B)  $5.00x + 8.50 + 47.00$
- (C)  $5.00 + 8.50x + 47.00$
- (D)  $5.00x + 8.50x + 47.00$

Tariq cut a rectangular piece of paper in half to make two triangles, as shown.



What was the area of the rectangle?

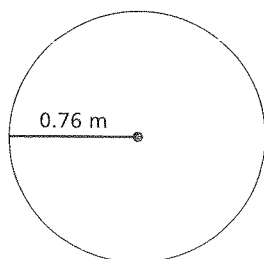
- (F) 42 inches
- (G) 54 square inches
- (H) 72 inches
- (J) 108 square inches

### Added Response

A scientist prepares 4 beakers of an acid solution. Each beaker contains 70.9 milliliters of the solution. How many milliliters of acid solution did the scientist prepare in all?

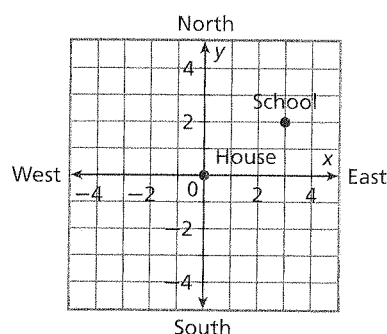
At an accident scene, an insurance inspector finds a skid mark 60 feet long. The inspector can determine how fast the car was going in miles per hour when the driver applied the breaks by using the expression  $\sqrt{21d}$ , where  $d$  is the length of the skid mark in feet. To the nearest tenth, what was the speed of the car that left the skid mark?

The area of a circle with radius  $r$  is  $\pi r^2$ . What is the area in square meters of the robot sumo-wrestling ring shown below? Use 3.14 for  $\pi$ . Round to the nearest tenth.



### Short Response

14. Dee is using a coordinate plane to make a map of her town. Each square on the grid represents 1 square mile. She plots her house at the origin. Her school is 3 miles east and 2 miles north of her house.



- a. Write an ordered pair to show where Dee plotted the point for her school.
  - b. The post office is 4 miles east of Dee's house. Write an ordered pair to show where Dee should plot a point for the post office.
  - c. The bank is 3 miles north and 3 miles west of the school. Which is closer to Dee's house, the post office or the bank? Explain your answer.
15. As part of a challenge problem, a math teacher writes the following expression on the board:
- $$-(-x).$$
- a. If  $x$  is 12, what is the value of the expression?
  - b. If  $x$  is a negative number, is the value of the expression positive or negative? Explain how you found your answer.
  - c. Simplify the expression.

### Extended Response

16. Fatima enrolled in a traveler rewards program. She begins with 10,000 bonus points. For every trip she takes, she collects 3000 bonus points.
- a. Write a rule for the number of bonus points Fatima has after  $x$  trips.
  - b. Make a table showing the number of bonus points Fatima has after 0, 1, 2, 3, 4, and 5 trips.
  - c. Graph the ordered pairs from the table. Describe the pattern formed by the points.
  - d. When Fatima has collected 20,000 bonus points, she gets a free vacation. How many trips does Fatima need to take to get a free vacation?