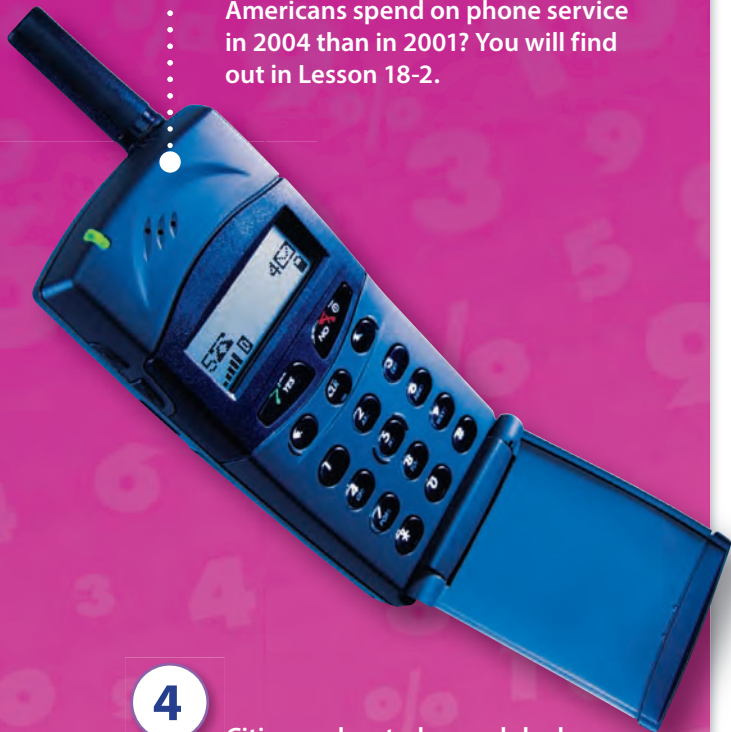**3** Americans spend hundreds of dollars every year on telephone service. How many more dollars did Americans spend on phone service in 2004 than in 2001? You will find out in Lesson 18-2.

4 Cities are located on a globe by using ordered pairs of latitude and longitude. What is city located at the coordinates (30, 30)? You will find out in Lesson 18-2

Review What You Know!

Vocabulary

Choose the best term from the box.

- axes
- x-coordinate
- ordered pair
- y-coordinate

1. (2, 5) is an example of a(n) _?_.

2. If you name a point (4, 6), 4 is the _?_ and 6 is the _?_.

3. A coordinate plane is made up of two intersecting _?_.

Basic Facts

Find each sum, difference, or product.

4. 4×5 **5.** 7×8 **6.** 3×6

7. $8 + 6$ **8.** $3 + 9$ **9.** $5 + 7$

10. $16 - 9$ **11.** $8 - 6$ **12.** $12 - 8$

Algebra

13. Evaluate $4x + 8$ for $x = 7$

14. Evaluate $51 \div y - 2$ for $y = 3$

Graphing Ordered Pairs

Writing to Explain Write an answer for the question.

15. Explain the steps you would follow to graph Point A (2, 3) on a coordinate grid.

Lesson
18-1

AF 1.4 ⚬━━ Identify
and graph ordered pairs
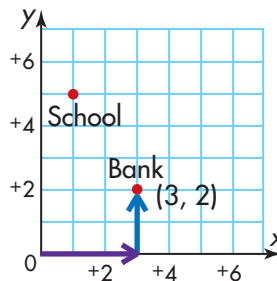in the four quadrants of
the coordinate plane.
Also **SDAP 1.0, 1.5**
⚬━━

Ordered Pairs

How can you locate points on a coordinate grid?

Hands-On
grid paper

A coordinate grid makes it easy to locate a point on a map. Start at 0. Go 3 blocks east and then 2 blocks north. You will be at the bank. An ordered pair names a point on a coordinate grid. The bank is at (3, 2).

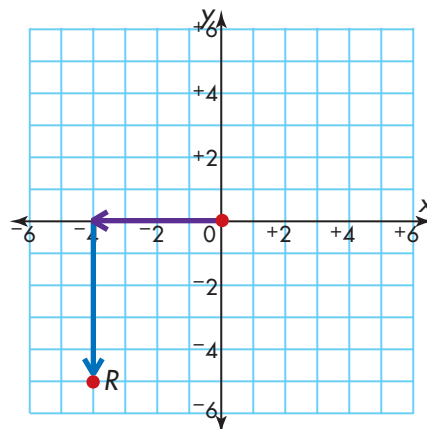**Another Example** **How do you graph a point on a coordinate plane?**

You know that graphs represent data. Now you will see how ordered pairs of numbers can represent points on a coordinate plane.

Graph Point *R* at (⁻4, ⁻5)

Step 1 Draw and label the *x*-axis and *y*-axis on grid paper.

**Step 2** Move 4 units to the left of the origin. Then, move 5 units down.

Step 3 Mark a point and label it *R*.

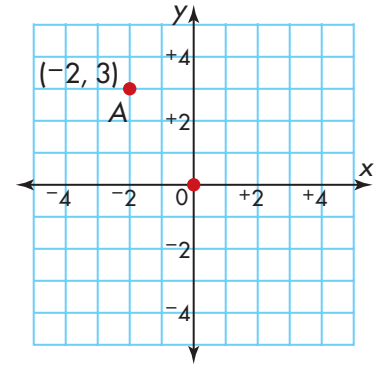### Explain It

1. How would you locate the point (⁺4, ⁻5) on a coordinate grid?

2. If the location of point R above were changed to (⁻4, ⁺5), would the point be above or below its current position?

3. Suppose you want to graph the point (0, ⁺5) on graph paper. When you start from the origin, do you move right 0 units or move up 0 units?

A **coordinate plane** extends to include both positive and negative numbers. It has a horizontal *x*-axis and a vertical **y-axis**. The point at which the *x*-axis and *y*-axis intersect is called the **origin**.
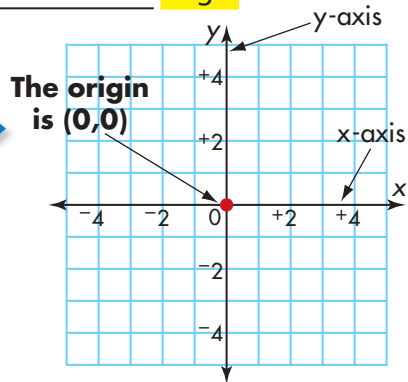
The origin is (0,0)

The first number in an ordered pair, the **x-coordinate**, names the distance to the right or left from the origin along the *x*-axis. The second number, the **y-coordinate**, names the distance up or down from the origin along the *y*-axis.
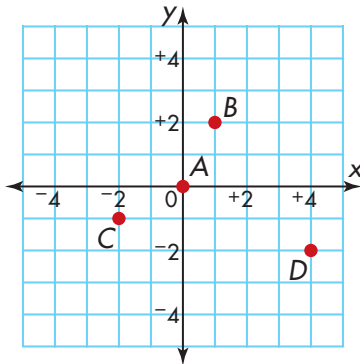
The ordered pair for Point *A* is (⁻2, 3).

Guided Practice*

Do you know HOW?

In **1** through **4**, write the ordered pair for each point. Use the grid at the right.

1. *A*

2. *B*

3. *C*

4. *D*

Do you UNDERSTAND?

5. Writing to Explain Describe how to plot the ordered pair (⁻3, ⁺4).

6. What ordered pair names the origin of any coordinate plane?

7. In the example above, name the ordered pair for a point that is 3 units directly above Point *A*.

Independent Practice

In **8** through **13**, write the ordered pair for each point. Use the grid at the right.

8. *M*

9. *N*

10. *P*

11. *R*

12. *S*

13. *T*

In **14** through **19**, graph and label each point on a grid.

14. *H* (2, ⁺1)

15. *J* (⁺5, ⁺1)

16. *K* (0, ⁺5)

17. *E* (⁺1, ⁻3)

18. *F* (⁺4, ⁻5)

19. *G* (⁻3, ⁻4)
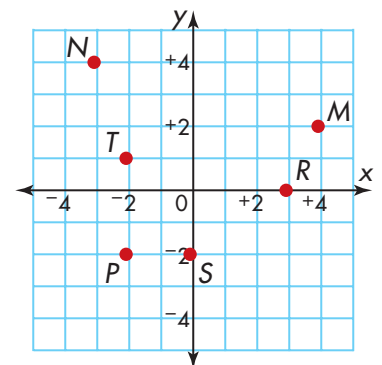
DIGITAL

Geometry For **20** through **24**, complete the table by listing the ordered pair for each vertex of the pentagon at the right.

	Label	Ordered Pair
20.	A	
21.	C	
22.	E	
23.	G	
24.	I	
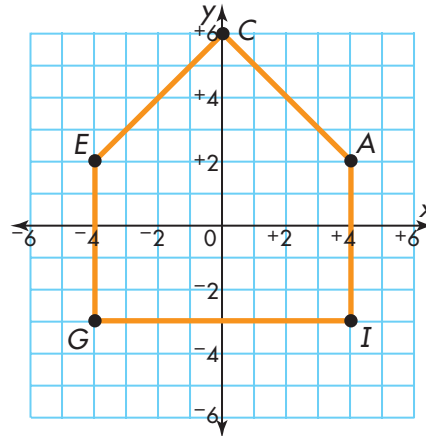
25. Algebra Which equation shows the relationship of the values in the table?

x	y
+9	+6
−2	−5
+5	+2
0	−3
+10	+7

A $y = x + 3$

B $x = y - 3$

C $y = x - 3$

D $y = x$

26. A chessboard is similar to a coordinate grid. The pieces that look like horses are called knights. What letter-number combinations name the locations of the white knights?

27. Writing to Explain The streets in many cities in the United States are laid out in a coordinate grid. How is this helpful when finding locations in cities such as Los Angeles, California?
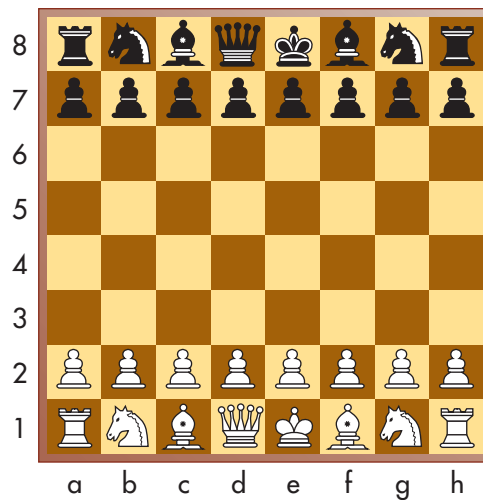
28. In a class of 25 students, 15 are girls. Which does NOT show the part of the class that are girls?

A $\frac{3}{5}$

B 0.6

C 60%

D 0.3

Find each difference.

1. $6.7 - 0.921$ **2.** $219.2 - 61.3$ **3.** $2.5 - 1.054$

4. $88.7 - 17.62$ **5.** $1.17 - 0.362$ **6.** $1.1 - 0.033$

In **7** through **13**, solve each equation for c.

7. $\frac{c}{8} = 9$ **8.** $\frac{c}{16} = 2$ **9.** $\frac{c}{17} = 5$

10. $\frac{c}{2} = 2$ **11.** $\frac{c}{30} = 3$ **12.** $\frac{c}{10} = 13$ **13.** $\frac{c}{7} = 6$

Find each difference. Estimate to check if the answer is reasonable.

14. $3\overline{)316}$ **15.** $734 \div 6$ **16.** $5\overline{)98}$ **17.** $723 \div 9$

18. $10,648 \div 39$ **19.** $20\overline{)2,084}$ **20.** $55\overline{)17,932}$ **21.** $6,203 \div 43$

Error Search Find each sum or difference that is not correct. Write it correctly and explain the error.

22.
$$\begin{array}{r} 52.03 \\ +\ 21.67 \\ \hline 73.70 \end{array}$$

23.
$$\begin{array}{r} 13.7 \\ \times\ \ 0.95 \\ \hline 130.15 \end{array}$$

24.
$$\begin{array}{r} 23,061 \\ +\ 48,205 \\ \hline 71,266 \end{array}$$

25.
$$\begin{array}{r} 22,114 \\ -\ \ \ \ \ \ 36 \\ \hline 22,082 \end{array}$$

26.
$$\begin{array}{r} 0.116 \\ +\ 0.93 \\ \hline 2.09 \end{array}$$

Number Sense

Estimating and Reasoning Write whether each statement is true or false. Explain your reasoning.

27. The sum of $^-8$ and $^+12$ equals $^-4$.

28. The quotient of $5,763 \div 8$ is between 700 and 800.

29. The difference of $25,980 - 15,980$ is less than 10,000.

30. The product of 8 and 5.943 is closer to 48 than 40.

31. The sum of $5\frac{7}{10}$ and $3\frac{3}{4}$ is greater than 9.

32. The k in the equation $13k = 39$ is equal to 3.

Line Graphs

How can data be represented?
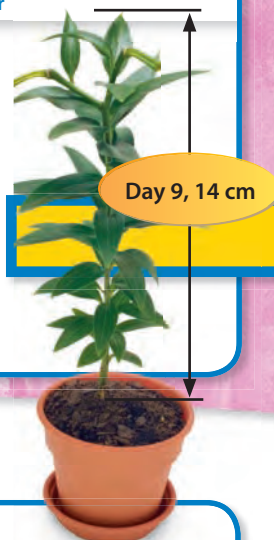
Data is collected information. A line graph is used to show how data changes over time. It shows a trend, a general direction in data.

This table shows the growth of a plant over a period of several days. The data can be displayed in a line graph.

Hands-On
metric ruler
grid paper

Plant Growth	
Day	**Height (cm)**
1	4
3	8
5	10
7	11
9	14

Day 9, 14 cm

Another Example **How can you read data from line graphs?**

To use data from a graph, locate a point on the graph, and read the values on both axes. To estimate a value not on a graph, interpret the data to determine a trend. The graph below shows Sasha's reading log.

Reading Log — line graph, Number of Pages (y-axis) vs Number of Hours (x-axis)
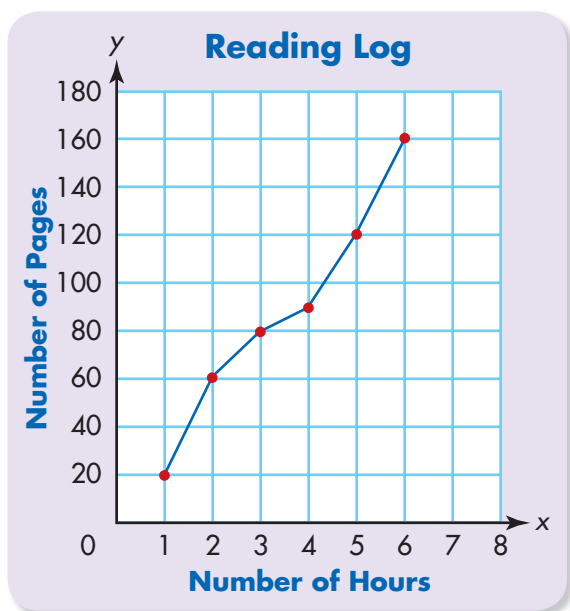
| Reading Log	
Hours	**Pages Read**
1	20
2	60
3	80
4	90
5	120
6	160

Explain It

1. Based on the data, how many pages had Sasha read after 2 hours? After 4 hours?

2. If the trend continues, about how many hours will Sasha take to finish a 190-page book?

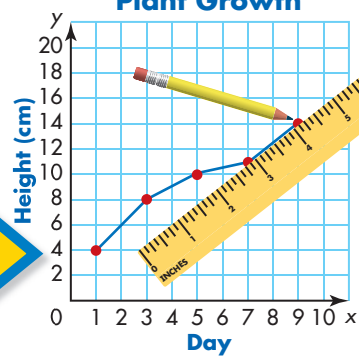3. Using the graph, between what two hours was Sasha reading page 140?

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Step 1

Plant Growth
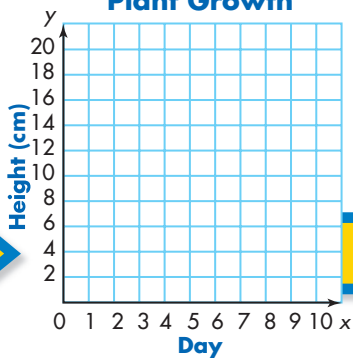
Draw a coordinate grid, use an appropriate scale, and label each axis. Title the graph.

Step 2

Plant Growth
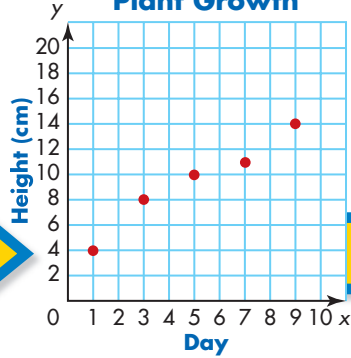
Plot each ordered pair from the table.

Step 3

Plant Growth

Use a ruler to connect the points.

Guided Practice*

Do you know HOW?

1. Use grid paper to make a line graph. Plot the ordered pairs from the table of values. Use an interval of 2 for each axis. Connect each point with a ruler.

Sam's Reading Log	
Minutes	**Pages**
2	4
4	6
6	10
8	10

Do you UNDERSTAND?

2. In the problem above, between which two days was the plant growth the greatest?

3. If the line connecting the points for several days in a row is horizontal, how much taller did the plant grow during those days?

4. **Writing to Explain** How can you determine information from a line graph for a point that is not plotted?

Independent Practice

For **5** through **7**, use the information from the line graph at the right.

5. When were the most DVDs sold?

6. How many more DVDs were sold during Week 3 than Week 5?

7. Based on the trend, estimate the number of DVDs sold during Week 7.

DVD Sales
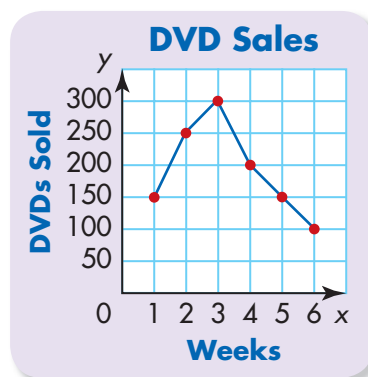
*For another example, see Set B on page 416.

8. Use the table at the right. On a globe, latitude is the *x*-coordinate. Longitude is the *y*-coordinate. What city is located at (30°, 30°)? Where is Milan, Italy, located?

| City	Approx. Degrees Latitude	Approx. Degrees Longitude
Cairo, Egypt	30	30
London, U.K.	50	0
Bordeaux, France	45	30
Milan, Italy	45	10

For **9** and **10**, use the line graph at the right.

9. Look for a trend. How many inches do you predict the plant will have grown by the end of Week 5?

10. How many more inches did the plant grow from the end of Week 2 to the end of Week 4?

Plant Growth — Height (in in.) vs Weeks Passed
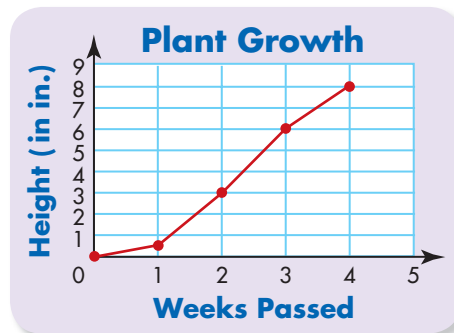
11. Use the table below. How much more did Americans spend on telephone service in 2004 than in 2001?

Annual Household Expenditures for Telephone Service					
Year	2000	2001	2002	2003	2004
Amount	$877	$914	$957	$956	$984

12. **Think About the Process** If a line graph shows an upward trend in population growth for the past five years, what do you know about the population size during that time?

A The population decreased.

B The population inceased and then decreased.

C The population stayed the same.

D The population increased.

For **13** and **14**, use the table at the right. The table shows how far a group of hikers hiked for 4 days.
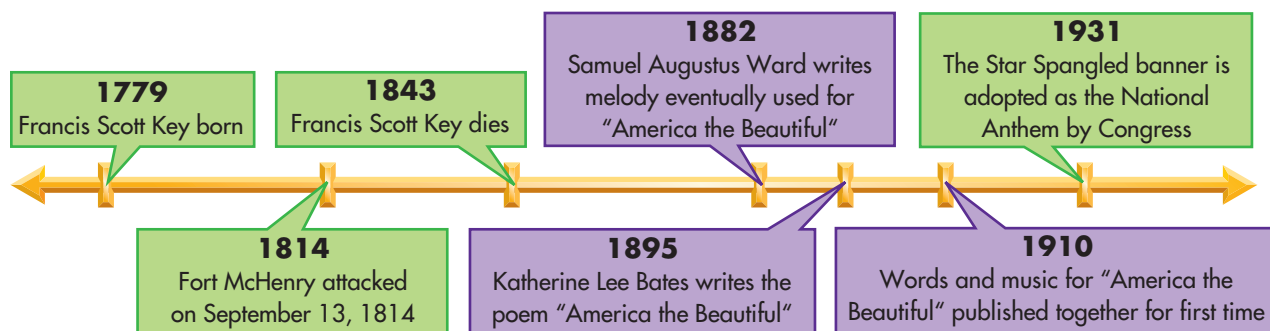
13. Make a line graph of the data. Use a scale from 0 to 12 and an interval of 2 for the miles hiked. Write a sentence about the trends represented on the graph.

14. During which day did the hikers hike the greatest distance?

Four-day Hike				
By End of Day	1	2	3	4
Total Miles Hiked	2	6	8	11

Mixed Problem Solving

The Star Spangled Banner was written by poet Francis Scott Key. Francis Scott Key wrote this poem during the British attack of Fort McHenry in 1814.

1. Francis Scott Key was born in 1779 and lived until 1843. During his life, he worked as a lawyer in Washington, D.C., for many famous politicians. How old was Francis Scott Key when he wrote the Star Spangled Banner?

   A 30   **B** 32   **C** 35   **D** 40

2. The Star Spangled Banner was adopted as the National Anthem of the United States by Congress in 1931. How many years after it was written was Francis Scott Key's poem made the National Anthem?

3. America the Beautiful was written and composed by two different people. Katherine Lee Bates is the author of the poem, *"America the Beautiful."* The poem was published in 1895. Samuel Augustus Ward wrote the melody in 1882. The words and music were first published together in 1910. How many years passed between the publication of the poem and the publication of the words and music?

| 1779 Francis Scott Key born | 1843 Francis Scott Key dies | 1882 Samuel Augustus Ward writes melody eventually used for "America the Beautiful" | 1931 The Star Spangled banner is adopted as the National Anthem by Congress |

| 1814 Fort McHenry attacked on September 13, 1814 | 1895 Katherine Lee Bates writes the poem "America the Beautiful" | 1910 Words and music for "America the Beautiful" published together for first time |

4. How many years after the Star Spangled Banner was written was the poem America the Beautiful written?

5. How many years after Samuel Augustus Ward wrote the melody for *"America the Beautiful"* did Katherine Lee Bates write the poem?

6. **Strategy Focus** Solve using the strategy Work Backward.

   Elisa has to be at ballet practice at 5:30 P.M. She has 30 minutes of homework to do and then has to eat dinner, which will take 25 minutes. If it takes 20 minutes to get to the ballet studio, at what time should she start her homework?

Graphing Equations

How do you graph an equation on a coordinate grid?

Hands-On
grid paper

Each day at 7:00 A.M., Tim listed the temperature on his outdoor thermometer and from the radio weather report.

Write an equation to show the relationship between the temperatures and then graph that relationship.

7:00 A.M. Temperature (°F)

	Tim's House	Weather Report
Mon.	2°	0°
Tues.	5°	3°
Wed.	0°	−2°
Thurs.	−2°	−4°
Fri.	4°	2°

Guided Practice*

Do you know HOW?

In **1** and **2**, complete the table of values and graph the equation.

1. $y = x + {}^+3$

x	y
+2	▪
+1	▪
0	▪

2. $y = x - {}^+4$

x	y
+5	▪
+4	▪
0	▪

Do you UNDERSTAND?

3. For the problem above, suppose the temperature given in the weather report was 2° F higher than the temperature at Tim's house. Write an equation, make a table of values, and graph the equation.

4. On your graph for Problem 1, what is the *y*-coordinate at the point where the line would cross the *x*-axis?

Independent Practice

In **5** through **7**, write an equation to describe each table.

5.

x	−2	−1	0	+1	+2
y	+4	+5	+6	+7	+8

6.

x	−2	−1	0	+1	+2
y	−9	−8	−7	−6	−5

7.

x	−2	−1	0	+1	+2
y	−2	−1	0	+1	+2

In **8** through **10**, complete each table of values and graph each equation.

8. $y = x + 1$

x	+4	+2	0	−4
y	▪	▪	▪	▪

9. $y = x - 3$

x	+5	+1	0	−2
y	▪	▪	▪	▪

10. $y = 4 + x$

x	+1	0	−1	−2
y	▪	▪	▪	▪

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For another example, see Set C on page 417.

Write an equation.

Let x = temperature at Tim's house

Let y = temperature given by the weather report
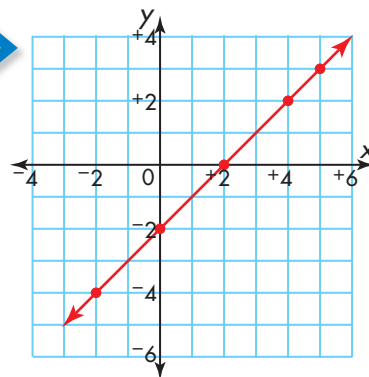
Each day the temperature was reported as 2° lower.

$y = x - 2$

Use Tim's list to make a table of values.

x	y
$^+5$	$^+3$
$^+4$	$^+2$
$^+2$	0
0	$^-2$
$^-2$	$^-4$

A table of values shows how x and y are related and lists values that satisfy the equation.
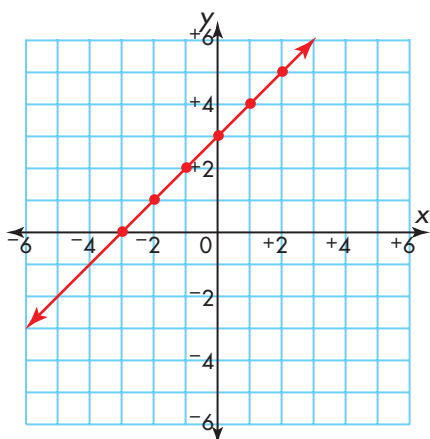
Use the table of values to graph the equation.

An equation whose graph is a straight line is called a linear equation.

Problem Solving

11. Reasoning If the points $(^+1, ^+7)$, $(^+1, ^+3)$, $(^+1, ^-5)$, and $(^+1, ^-9)$ were graphed, they would form a vertical line. Do you think the equation for this line would be $x = ^+1$ or $y = ^+1$? Explain.

12. The Clothes Closet was having a year-end sale. Julie bought 2 pairs of jeans. The jeans cost $28 each. Her state charges 7% sales tax. What was the total cost of the jeans?

13. Which ordered pair will be included on the graph for $y = ^+9 + x$?

A $(^+6, ^+3)$ **C** $(^+3, ^-6)$

B $(^-3, ^+6)$ **D** $(^+6, ^-3)$

14. If you were to walk on Mars, the air near your toes may have a temperature of $^+18°C$, but the air at your head may be 27°C colder. What would be the temperature near your head?

For **15** and **16**, use the graph below.

15. Make a table of values for the graph.

16. Use the table of values to write an equation for the graph.

17. Justin bought a hat for $8.50 and socks for $5.75. He had a coupon for $2 off one item. How much change did he receive if he paid with a $20 bill?

18. Writing to Explain Aaron's graph included the points $(^+6, ^+2)$, $(^+3, ^-1)$, and $(^-3, ^-7)$. Bob's graph included the points $(^+7, ^+3)$, $(^+2, ^-2)$, and $(^-2, ^-6)$. Would all six points be included on the same graph? Why or why not?

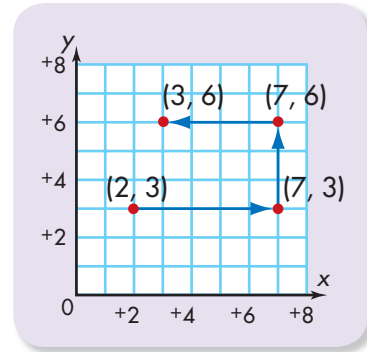**19.** If two pencils cost $0.25, how much would 12 pencils cost?

Problem Solving

Work Backward

Symbols can show movement of points on a coordinate plane.

Symbols	
move right	→
move left	←
move up	↑
move down	↓

Starting Position (2, 3)

5 units	→	(7, 3)
3 units	↑	(7, 6)
4 units	←	(3, 6) **Ending Position**

Guided Practice*

Do you know HOW?

1. Work backward to find the starting position.

Starting (x, y)

3 units	→	(6, 14)
5 units	↓	(6, 9)
2 units	→	(8, 9) **Ending**

Do you UNDERSTAND?

2. How can you check the starting position in the answer from the example at the top?

3. **Write a Problem** Write a problem involving movement of points on a coordinate plane that can be solved by working backward.

Independent Practice

In **4** and **5**, work backward to find each starting position.

4. **Starting** (x, y)

4 units	←	
6 units	↑	
2 units	↓	
3 units	→	(3, 9) **Ending**

TIP *Right and left: x coordinate*
Up and down: y coordinate

5. **Starting** (x, y)

2 units	↓	
7 units	→	
2 units	↑	
14 units	→	(21, 2) **Ending**

Stuck? Try this....

- What do I know?
- What am I asked to find?
- What diagram can I use to help understand the problem?
- Can I use addition, subtraction, multiplication, or division?
- Is all of my work correct?
- Did I answer the right question?
- Is my answer reasonable?

For another example, see Set D on page 417.

What is the starting position?

If you know the ending position and the motions used, you can work backward to find the starting position.

Starting (x, y)

5 units	→	(7, 3)
3 units	↑	(7, 6)
4 units	←	(3, 6) **Ending**

Begin at the ending position. Do the opposite motions and work backward.

Ending (3, 6)

4 units	→	(7, 6)
3 units	↓	(7, 3)
5 units	←	(2, 3) **Starting**

The starting position is (2, 3).

Solve.

6. Pat decided to bake one evening. First, she used a certain amount of flour to make biscuits. Then, Pat used $3\frac{3}{4}$ cups of flour to make bread and $1\frac{1}{4}$ cups of flour to make pretzels. If Pat used a total of $7\frac{1}{4}$ cups of flour for all of her baking, how much flour did she use to make biscuits?

7. The Tigers scored 20 points during a basketball game. The team scored 6 points during the fourth quarter, 4 points during the third quarter, and the same number of points in both the second and first quarters. How many points did the Tigers score in the first quarter of the game? The second quarter?

8. Heather is thinking of a solid that is made up of a couple of shapes. The solid has 5 faces. One of the faces is a shape that has sides of equal length. The other 4 faces are shapes that have three sides. What is the name of the solid Heather is thinking of?

9. Steve, Derrin, Sid, Spencer, and Naji are waiting in line to buy tickets to a movie. Derrin is in front of Spencer and behind Sid. Steve is between Sid and Derrin. Naji is behind Spencer. Who is first in line?

10. Julie kept track of the number of miles she drove over a three-day period. On the first day, she drove 17.25 miles. On the second day, she drove 5.25 miles. On the third day, she drove 24 miles. At the end of the third day, the odometer on Julie's car read 52,607.5 miles. What was the mileage number on Julie's odometer when she began keeping track of her mileage?

11. Philip wants to take the quickest trip to Chicago. Some trains make more stops than others. Which train should he take?

Train Schedule

Train	Leave from Elgin	Arrive in Chicago
A	8:45 A.M.	9:55 A.M.
B	2:35 P.M.	3:50 P.M.
C	3:55 P.M.	5:00 P.M.

Data

1. The map shows the approximate placement of some of the Smithsonian museums located on the National Mall. Which museum is located at $(0, ^-1)$? (18-1)
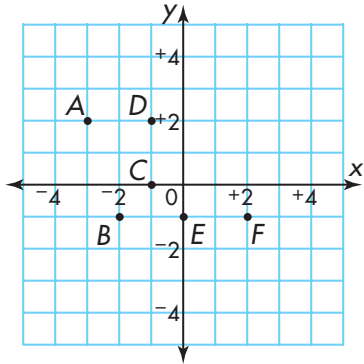
A = American History Museum
B = Freer
C = Smithsonian Castle
D = Natural History Museum
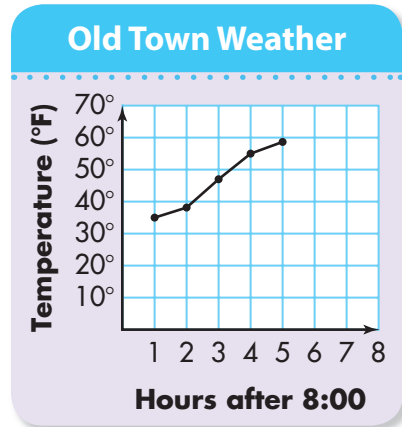E = Hirshhorn Museum
F = Air and Space Museum

A Hirshhorn Museum

B Freer

C Smithsonian Castle

D Air and Space Museum

2. Complete the table of ordered pairs for $y = x - 5$. (18-3)

A $^-9$

B $^-2$

C $^-1$

D $^+9$

x	y
0	−5
$^+2$	−3
$^+4$	▨
$^+6$	$^+1$

**3.** The graph shows the Fahrenheit temperature in Old Town taken every hour after 8:00 A.M. What was the temperature at noon? (18-2)

A 58°F

**B** 54°F

C 47°F

D 45°F

4. Which ordered pair is a point on the line $y = x + 3$? (18-3)

A $(^+1, ^+3)$

B $(^+2, ^+4)$

C $(^+1, ^+2)$

D $(^-1, ^+2)$

5. On a map, Todd's school has coordinates $(^+6, ^+7)$. From a starting point, Todd walks east (right) 3 blocks, north (up) 5 blocks and ends up at school. What are the coordinates for where Todd started? (18-4)

A $(^+9, ^+2)$

B $(^+3, ^+12)$

C $(^+11, ^+4)$

D $(^+3, ^+2)$

6. Which ordered pair is located on the line for the equation $x = 2$? (18-3)
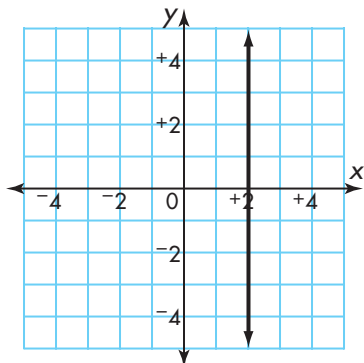
A ($^+2$, $^+3$)

B ($^-2$, $^+2$)

C ($^+1$, $^+2$)

D ($^+3$, $^+2$)

**7.** Martina drew the graph shown. Which equation did she graph? (18-3)
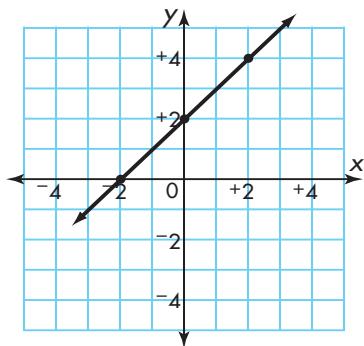
A $y = x + 2$

B $y = x + 1$

C $y = x - 2$

D $y = x - 1$

8. The graph shows the average miles per gallon for vehicles in the United States. Based on the trend, what would be a reasonable estimate of the average miles per gallon for U.S. vehicles in 2010? (18-2)

U.S. Gas Mileage
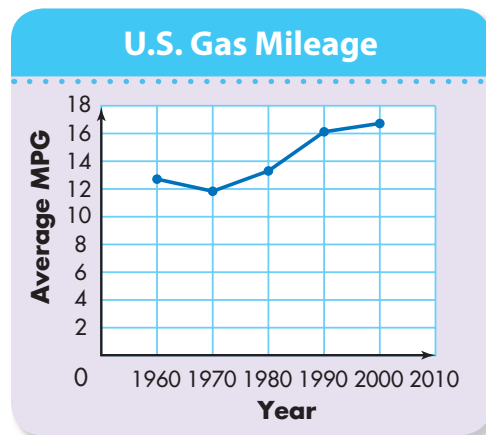
A 11

B 13

C 18

D 25

9. What is the ordered pair for Point X on the graph? (18-1)

A ($^+2$, $^-4$)

B ($^-4$, $^+2$)

C ($^+4$, $^-2$)

D ($^-2$, $^+4$)
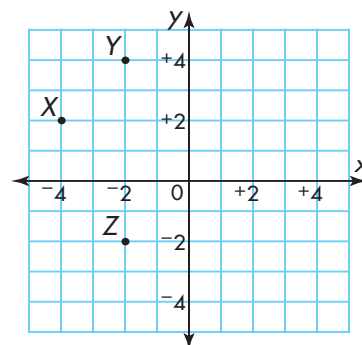
Set A, pages 402–404

What ordered pair names Point *A*?
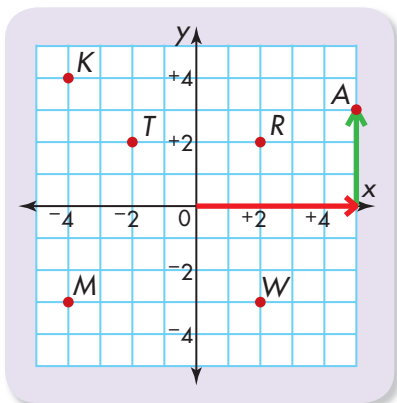
Start at the origin. The *x*-coordinate is the distance to the right or left along the *x*-axis. The *y*-coordinate is the distance up or down along the *y*-axis. Point *A* is at ($^+$5, $^+$3).

Remember to name a point on a coordinate grid, first find the *x*-coordinate. Then find the *y*-coordinate. Write the coordinates in (*x*, *y*) order.

1. Which point is located at ($^-$4, $^-$3)?

2. Which point is located at ($^+$2, $^+$2)?

3. Which point is located at ($^-$4, $^+$4)?

4. What ordered pair names Point *T*?

5. What ordered pair names Point *W*?

6. What is the new ordered pair if Point *A* is moved to the left 5 spaces?

Set B, pages 406–408

Make a line graph for the data.

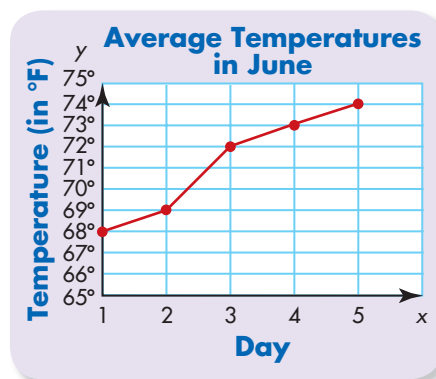| Day	Newspapers sold
1	6
2	8
3	9
4	10
5	12
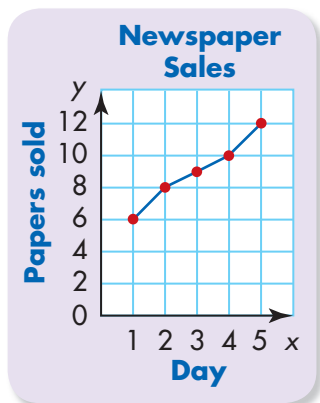
Use grid paper to draw a coordinate grid.

Label the axes.

Number each axis with a consistent scale.

Plot the ordered pairs and connect the points.

Remember that line graphs show data that change over time.

1. Make a line graph for the data.

Week	CDs sold
1	10
2	5
3	20
4	15

2. Describe the trend.

Set C, pages 410–411

Graph the equation $y = x + 2$.

Choose values for x and find the values for y.

x	y
⁻2	0
0	⁺2
⁺3	⁺5

$y = x + 2$

$0 = ⁻2 + 2$

$2 = 0 + 2$

$5 = 3 + 2$

Use grid paper to draw a coordinate grid.

Label and number the axes.

Plot the ordered pairs and connect the points.
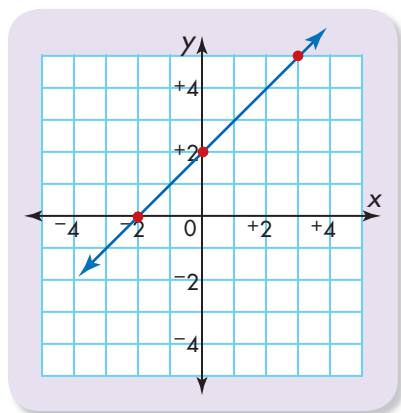
Remember to choose at least three values for x. The values for x and y must satisfy the equation.

Make a table of values for each equation. Then graph the equations on a coordinate grid.

1. $y = x - 4$

x	y
0	▪
⁻1	▪
⁺2	▪

2. $y = 3x$

x	y
0	▪
⁺1	▪
⁺2	▪

3. $y = x + 5$

x	y
0	▪
⁻3	▪
⁺1	▪

4. $y = x$

x	y
0	▪
⁻2	▪
⁺4	▪

Set D, pages 412–413

Franco worked on his science fair project for 35 minutes. Then he spent 20 minutes working on math homework. After that, Franco spent 45 minutes on the computer. If he logged off the computer at 8:10 P.M., what time did Franco begin working on his science fair project?

You can draw a picture to help you work backward. Use an inverse operation for each change.

Franco began his science project at 6:30 P.M.

Remember that addition and subtraction have an inverse relationship.

1. Barb has $3\frac{1}{4}$ ft of ribbon left over. She used $2\frac{1}{4}$ ft to wrap a gift and $\frac{3}{4}$ ft to decorate a picture frame. She then used $1\frac{3}{4}$ ft for hair ribbons. How many feet of ribbon did Barb start with?