

1.4 The Coordinate Plane

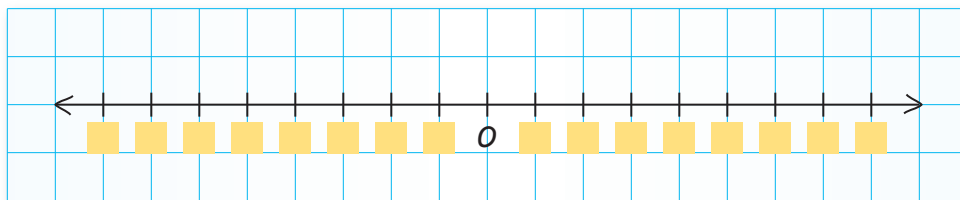
Essential Question How can you graph and locate points in a coordinate plane?

In Activity 1, you will form the coordinate plane.

1 ACTIVITY: Forming the Entire Coordinate Plane

Work with a partner.

- In the middle of a sheet of grid paper, construct a horizontal number line as shown. Label the tick marks. On a different sheet of grid paper, construct and label a similar vertical number line.



- Cut out the vertical number line and tape it on top of the horizontal number line so that the zeros overlap. Make sure the number lines are perpendicular to one another. How many regions did you form by doing this?
- REASONING** What ordered pair represents the point where the number lines intersect? Why do you think this point is called the *origin*? Explain.

2 ACTIVITY: Describing Points in the Coordinate Plane

Work with a partner. Use your perpendicular number lines from Activity 1.

- Plot and label $(3, 2)$ on your coordinate plane. Shade this region in your coordinate plane. What do you notice about the integers along the number lines that surround $(3, 2)$?
- Can you plot a point in your coordinate plane so that it is surrounded by negative numbers on the axes? If so, where is this point? Use a different color to shade this region in your coordinate plane.
- What do you notice about the integers along the number lines for points in the regions that are not shaded?
- STRUCTURE** Describe how you would plot $(-3, -2)$. How is plotting this point similar to plotting $(3, 2)$? Plot $(-3, -2)$ in your coordinate plane.
- REASONING** Where in your coordinate plane do you plot $(2, -4)$? Where do you plot $(-2, 4)$? Explain your reasoning.

Coordinate Plane

In this lesson, you will

- describe the locations of points in the coordinate plane.
- plot points in the coordinate plane given ordered pairs.
- find distances between points in the coordinate plane.

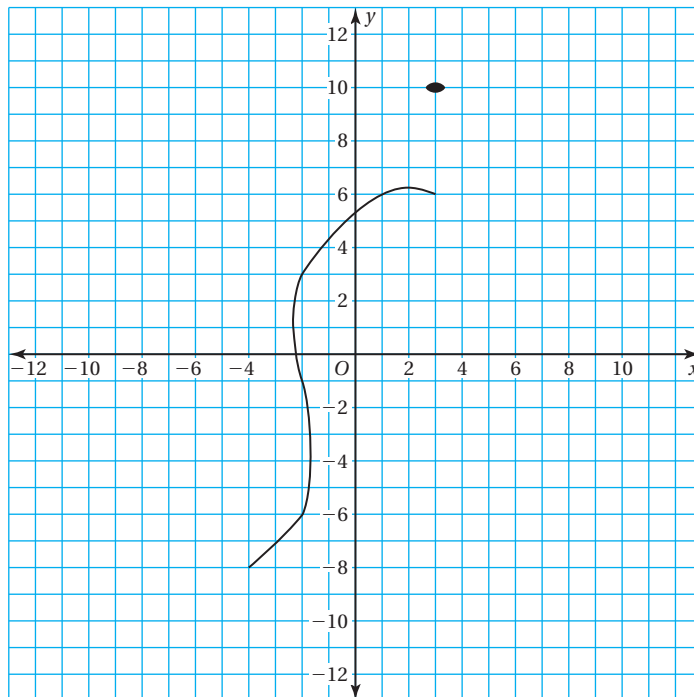
3

ACTIVITY: Plotting Points in a Coordinate Plane**Math
Process****Check Progress**

How can you check your progress to make sure you are accurately drawing the picture?

Work with a partner. Plot and connect the points to make a picture. Describe and color the picture when you are done.

- | | | | | |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| 1 (6, 9) | 2 (4, 11) | 3 (2, 12) | 4 (0, 11) | 5 (-2, 9) |
| 6 (-6, 2) | 7 (-9, 1) | 8 (-11, -3) | 9 (-7, 0) | 10 (-5, -1) |
| 11 (-5, -5) | 12 (-4, -8) | 13 (-6, -10) | 14 (-3, -9) | 15 (-3, -10) |
| 16 (-4, -11) | 17 (-4, -12) | 18 (-3, -11) | 19 (-2, -12) | 20 (-2, -11) |
| 21 (-1, -12) | 22 (-1, -11) | 23 (-2, -10) | 24 (-2, -9) | 25 (1, -9) |
| 26 (2, -8) | 27 (2, -10) | 28 (1, -11) | 29 (1, -12) | 30 (2, -11) |
| 31 (3, -12) | 32 (3, -11) | 33 (4, -12) | 34 (4, -11) | 35 (3, -10) |
| 36 (3, -8) | 37 (4, -6) | 38 (6, 0) | 39 (9, -3) | 40 (9, -1) |
| 41 (8, 1) | 42 (5, 3) | 43 (3, 6) | 44 (3, 7) | 45 (4, 8) |

**What Is Your Answer?**

- IN YOUR OWN WORDS** How can you graph and locate points in a coordinate plane?
- Make up your own “dot-to-dot” picture. Use at least 20 points. Your picture should have at least two points in each region of the coordinate plane.

Practice

Use what you learned about the coordinate plane to complete Exercise 4 on page 25.

Key Vocabulary

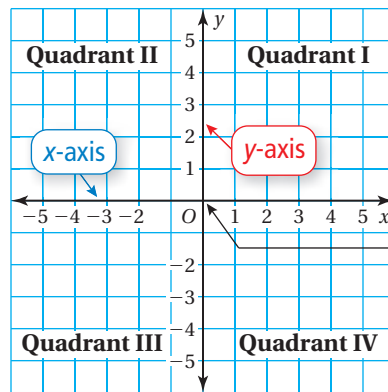
coordinate plane,
p. 22
origin, p. 22
quadrants, p. 22

In this lesson, you will plot points with positive and negative coordinates.

Key Idea

The Coordinate Plane

A **coordinate plane** is formed by the intersection of a horizontal number line and a vertical number line. The number lines intersect at the **origin** and separate the coordinate plane into four regions called **quadrants**.



The origin is at (0, 0).

An *ordered pair* is used to locate a point in a coordinate plane.

ordered pair: (4, -2)

x-coordinate

y-coordinate

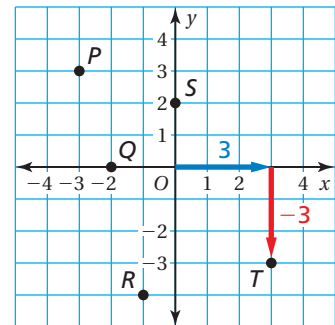
EXAMPLE 1 Identifying an Ordered Pair

Which ordered pair corresponds to point *T*?

- (A) (-3, -3) (B) (-3, 3)
(C) (3, -3) (D) (3, 3)

Point *T* is 3 units to the **right** of the origin and 3 units **down**. So, the *x*-coordinate is 3 and the *y*-coordinate is -3.

∴ The ordered pair (3, -3) corresponds to point *T*. The correct answer is (C).



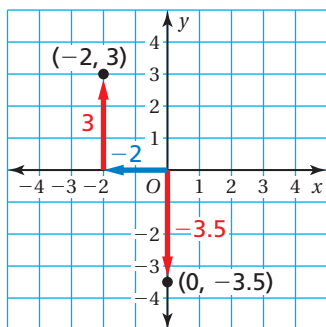
On Your Own

Use the graph in Example 1 to write an ordered pair corresponding to the point.

- Point *P*
- Point *Q*
- Point *R*
- Point *S*

Now You're Ready
Exercises 5–14

EXAMPLE 2 Plotting Ordered Pairs



Plot (a) $(-2, 3)$ and (b) $(0, -3.5)$ in a coordinate plane. Describe the location of each point.

- Start at the origin. Move 2 units left and 3 units up. Then plot the point.
 - ∴ The point is in Quadrant II.
- Start at the origin. Move 3.5 units down. Then plot the point.
 - ∴ The point is on the y -axis.

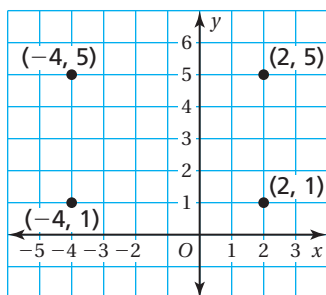
On Your Own

Now You're Ready
Exercises 15–22

Plot the ordered pair in a coordinate plane. Describe the location of the point.

5. $(3, -1)$ 6. $(-5, 0)$ 7. $(-2.5, -1)$ 8. $(-1\frac{1}{2}, \frac{1}{2})$

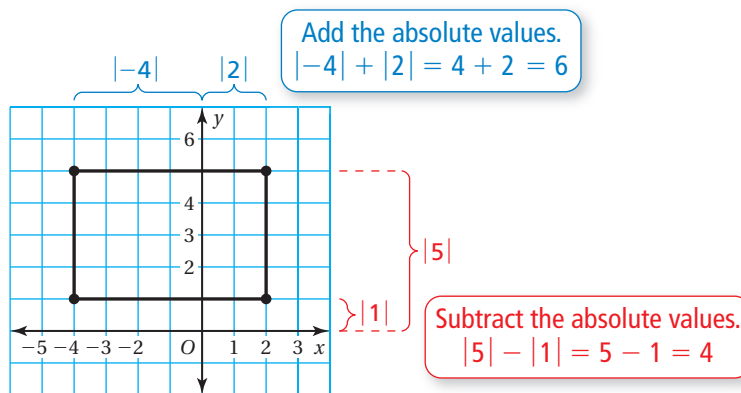
EXAMPLE 3 Finding Distances in the Coordinate Plane



An archaeologist divides an area using a coordinate plane in which each unit represents 1 meter. The corners of a secret chamber are shown in the graph. What are the dimensions of the secret chamber?

The length of the chamber is the distance between $(-4, 5)$ and $(2, 5)$.
The width of the chamber is the distance between $(2, 5)$ and $(2, 1)$.

You can use absolute values to find the distances between the points.



- ∴ The secret chamber is 6 meters long and 4 meters wide.

On Your Own

Now You're Ready
Exercises 25–30

9. In Example 3, the archaeologist finds a gold coin at $(-1, 4)$, a silver coin at $(-4, 2)$, and pottery at $(-4, 4)$. How much closer is the pottery to the silver coin than to the gold coin?

You can use line graphs to display data that is collected over a period of time. Graphing and connecting the ordered pairs can show patterns or trends in the data. This type of line graph is also called a *time series graph*.

EXAMPLE 4 Real-Life Application



A blizzard hits a town at midnight. The table shows the hourly temperatures from midnight to 8:00 A.M.

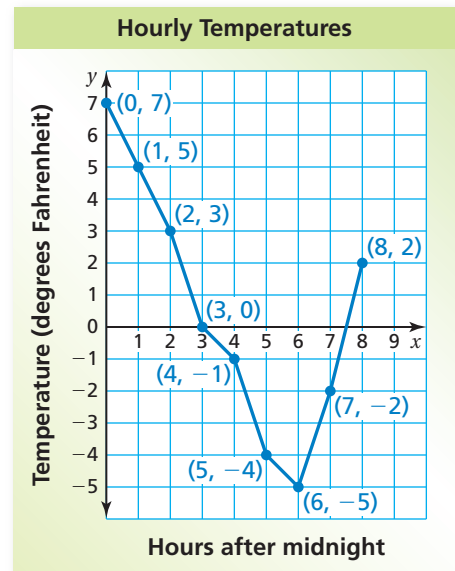
Hours after Midnight, x	0	1	2	3	4	5	6	7	8
Temperature, y	7°F	5°F	3°F	0°F	-1°F	-4°F	-5°F	-2°F	2°F

a. Display the data in a line graph.

Write the ordered pairs.

(0, 7) (1, 5) (2, 3)
 (3, 0) (4, -1) (5, -4)
 (6, -5) (7, -2) (8, 2)

Plot and label the ordered pairs. Then connect the ordered pairs with line segments.



b. Make three observations from the graph.

Three possible observations follow:

- The hourly temperatures decrease from midnight to 6:00 A.M.
- The hourly temperatures increase from 6:00 A.M. to 8:00 A.M.
- The greatest decrease in hourly temperatures from one hour to the next is 3°F. This happens twice: from 2:00 A.M. to 3:00 A.M. and from 4:00 A.M. to 5:00 A.M.

Study Tip

The observations given in Example 4(b) are sample answers. You can make many other correct observations.

On Your Own

10. In Example 4, the blizzard hits another town at noon. The table shows the hourly temperatures from noon to 6:00 P.M.

Hours after Noon	0	1	2	3	4	5	6
Temperature	6°F	7°F	5°F	1°F	1°F	0°F	-3°F

- Display the data in a line graph.
- Make three observations from the graph.

1.4 Exercises

Vocabulary and Concept Check

- VOCABULARY** How many quadrants are in a coordinate plane?
- VOCABULARY** Is the point $(0, -7)$ on the x -axis or the y -axis?
- WHICH ONE DOESN'T BELONG?** Which point does *not* belong with the other three? Explain your reasoning.

$(-2, 1)$

$(-4, 5)$

$(2, -3)$

$(-1, 3)$

Practice and Problem Solving

- Plot and connect the points to make a picture.

1 $(5, 0)$

2 $(2, -3)$

3 $(2, -2)$

4 $(0, -2)$

5 $(-3, -2)$

6 $(-3, 0)$

7 $(-3, 2)$

8 $(0, 2)$

9 $(2, 2)$

10 $(2, 3)$

Write an ordered pair corresponding to the point.

1 5. Point A

6. Point B

7. Point C

8. Point D

9. Point E

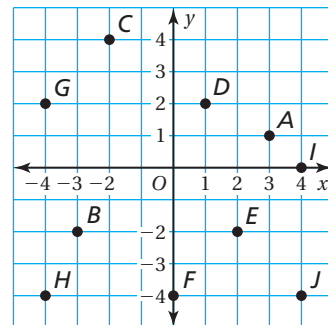
10. Point F

11. Point G

12. Point H

13. Point I

14. Point J



Plot the ordered pair in a coordinate plane. Describe the location of the point.

2 15. $K(4, 3)$

16. $L(-1, 2)$

17. $M(0, -6)$

18. $N(3.5, -1.5)$

19. $P(2, -4)$

20. $R(-4, 1)$

21. $S\left(2\frac{1}{2}, 0\right)$

22. $T(-4, -5)$

ERROR ANALYSIS Describe and correct the error in the solution.

23.



To plot $(4, 5)$, start at $(0, 0)$ and move 5 units right and 4 units up.

24.



To plot $(-6, 3)$, start at $(0, 0)$ and move 6 units right and 3 units down.

Plot the points and find the distance between the points.

3 25. $(2, -3), (6, -3)$

26. $(4, 2), (4, -1)$

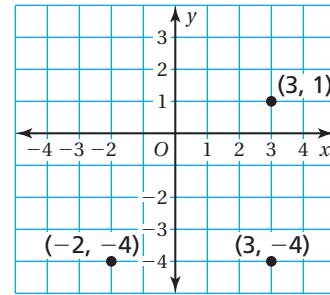
27. $(-1, 1), (-1, 7)$

28. $(-5, -2), (4, -2)$

29. $(-3, 4), (5, 4)$

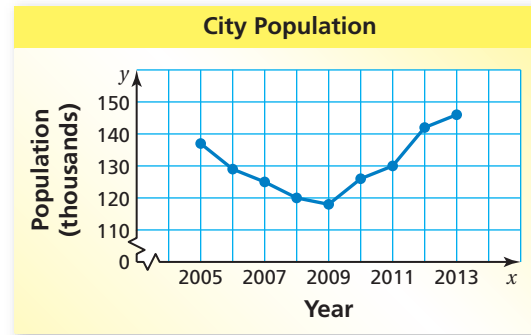
30. $(-2, -4), (-2, 1)$

31. **REASONING** The coordinates of three vertices of a square are shown in the figure. What are the coordinates of the fourth vertex?



Draw the figure with the given vertices in a coordinate plane. Find the perimeter and the area of the figure.

32. $D(1, 1), E(1, -2), F(-2, -2), G(-2, 1)$
 33. $P(-2, 3), Q(5, 3), R(5, -1), S(-2, -1)$
 34. $W(-3, 2), X(2, 2), Y(2, -7), Z(-3, -7)$
 35. **POPULATION** The line graph shows the population of a city from 2005 to 2013.



- a. Estimate the population of the city in 2012.
 b. Between which two years did the population increase the most?
 c. Estimate the total change in population from 2005 to 2013.

36. **MODELING** The table shows the total miles run through 18 weeks for a marathon training program.

Week	1	2	3	4	5	6	7	8	9
Total Miles	22	46	72	96	124	151	181	211	244
Week	10	11	12	13	14	15	16	17	18
Total Miles	279	317	357	397	437	473	506	530	544

- a. Create a table for the distance run during each week of training.
 b. Display the data from part (a) in a line graph.
 c. Make three observations from the graph.
 d. Explain the pattern shown in the graph.
37. **PROFITS** The table shows the profits of a company from 2007 to 2013.

Years since 2000, x	7	8	9	10	11	12	13
Profit (millions of dollars), y	0.6	-0.2	-1.2	1.2	0.8	1	-0.6

- a. Display the data in a line graph.
 b. Make three observations from the graph.
 c. How could you include profits from the years 1990 to 2006 on your graph? Explain.

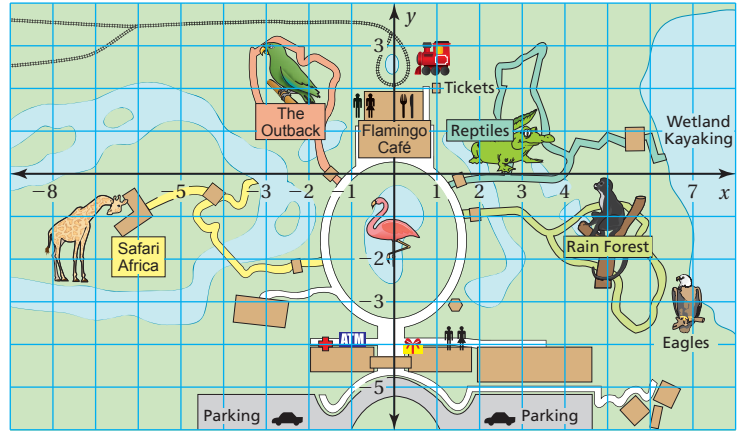
Describe the possible location(s) of the point (x, y) .

38. $x > 0, y > 0$ 39. $x < 0, y < 0$ 40. $x > 0, y < 0$
 41. $x > 0$ 42. $y < 0$ 43. $x = 0, y = 0$

Tell whether the statement is *sometimes*, *always*, or *never* true. Explain your reasoning.

44. The x -coordinate of a point on the x -axis is zero.
45. The y -coordinates of points in Quadrant III are positive.
46. The x -coordinate of a point in Quadrant II has the same sign as the y -coordinate of a point in Quadrant IV.

Z00 In Exercises 47–51, use the map of the zoo.



47. Which exhibit is located at $(2, 1)$?
48. Name an attraction on the positive y -axis.
49. Is parking available in Quadrant II? If not, name a quadrant in which you can park.
50. Write two different ordered pairs that represent the location of the Rain Forest.
51. Which exhibit is closest to $(-8, -3)$?
52. **NUMBER SENSE** Name the ordered pair that is 5 units right and 2 units down from $(-3, 4)$.
53. **OPEN-ENDED** The vertices of triangle ABC are $A(-6, -3)$ and $B(2, -3)$. List four possible coordinates of the third vertex so that the triangle has an area of 24 square units.
54. **Reasoning** Your school is located at $(2, -1)$, which is 2 blocks east and 1 block south of the center of town. To get from your house to the school, you walk 5 blocks west and 2 blocks north.
 - a. What ordered pair corresponds to the location of your house?
 - b. Is your house or your school closer to the center of town? Explain.
 - c. You can only walk along streets that are north and south or streets that are east and west. You are at the center of town and decide to take the shortest path home that passes by the school. When you are at the school, what percent of the walk home remains?



Fair Game Review what you learned in previous grades & lessons

Evaluate the expression.

55. $7 + 3 \times 9$
56. $24 - 14 \div 2$
57. $30 \div (4 + 2)$
58. $4 \times (10 - 3)$
59. **MULTIPLE CHOICE** What is the perimeter of the rectangle?

- (A) 10 ft (B) 11.5 ft
 (C) 20 ft (D) 21 ft

