

Distance in the Coordinate Plane

Check Skills You'll Need

1. **Vocabulary Review**
In the Pythagorean equation $a^2 + b^2 = c^2$, what do the variables a , b , and c represent?

Solve each equation for c by finding the positive square root of each side. If necessary, round to the nearest tenth.

- $c^2 = 64$
- $c^2 = 36$
- $c^2 = 28$
- $c^2 = 40$

GO for Help
Lesson 1-4

What You'll Learn

To graph points and to use the Pythagorean Theorem to find distances in the coordinate plane

New Vocabulary coordinate plane, y -axis, x -axis, quadrants, origin, ordered pair, x -coordinate, y -coordinate

Why Learn This?

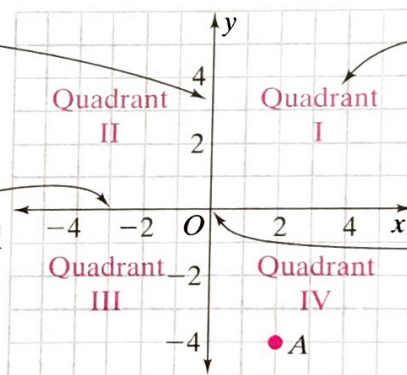
Mapmakers use a coordinate grid system for maps. The coordinate plane is another type of grid system.

A **coordinate plane** is a grid formed by the intersection of two number lines. You can use a coordinate plane to locate and name points.



The **y -axis** is a vertical number line.

The **x -axis** is a horizontal number line.



The axes divide the plane into four **quadrants**.

O indicates the **origin**, where the axes intersect.

An **ordered pair** (x, y) gives the coordinates of the location of a point. In the graph above, point A has coordinates $(2, -4)$.

The **x -coordinate** tells the number of horizontal units a point is from the origin.

The **y -coordinate** tells the number of vertical units a point is from the origin.

You can graph a point when you know its coordinates.

You can use the Pythagorean Theorem to find distances in the coordinate plane.

EXAMPLES

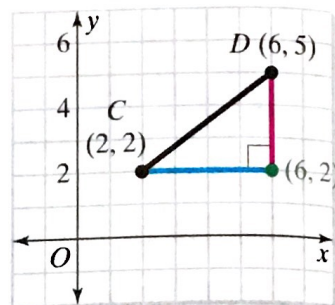
Finding Distance on a Coordinate Plane

Vocabulary Tip

A *vertical segment* runs up-down. A *horizontal segment* runs left-right.

- 1 Find the distance between $C(2, 2)$ and $D(6, 5)$.

Graph C and D on a coordinate plane. Notice you can draw a right triangle by drawing a **vertical segment** down from D and a **horizontal segment** over from C . The point of intersection is $(6, 2)$.



horizontal leg: $6 - 2 = 4$
vertical leg: $5 - 2 = 3$

Subtract the x -coordinates to find the length of the horizontal leg. Subtract the y -coordinates to find the length of the vertical leg.

Use the Pythagorean Theorem to find the distance between C and D .

$$\begin{aligned} a^2 + b^2 &= c^2 && \leftarrow \text{Pythagorean Theorem.} \\ 4^2 + 3^2 &= c^2 && \leftarrow \text{Substitute.} \\ 16 + 9 &= c^2 && \leftarrow \text{Simplify.} \\ 25 &= c^2 && \leftarrow \text{Add.} \\ \sqrt{25} &= \sqrt{c^2} && \leftarrow \text{Find the positive square root of each side.} \\ 5 &= c \end{aligned}$$

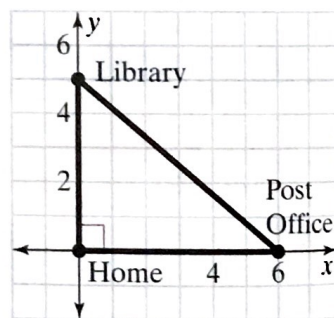
The distance between $C(2, 2)$ and $D(6, 5)$ is 5 units.

- 2 **Multiple Choice** The library is 5 miles north of your house. The post office is 6 miles east of your house. To the nearest mile, how far is the library from the post office?

(A) 7 mi (B) 8 mi (C) 9 mi (D) 10 mi

Graph the three locations. Place your home at the origin. Draw a right triangle.

$$\begin{aligned} a^2 + b^2 &= c^2 && \leftarrow \text{Pythagorean Theorem.} \\ 5^2 + 6^2 &= c^2 && \leftarrow \text{Substitute.} \\ 25 + 36 &= c^2 && \leftarrow \text{Simplify.} \\ 61 &= c^2 && \leftarrow \text{Add.} \\ \sqrt{61} &= \sqrt{c^2} && \leftarrow \text{Find the positive square root of each side.} \end{aligned}$$



$$\begin{aligned} \sqrt{61} &\approx 7.810249676 && \leftarrow \text{Use a calculator.} \\ c &\approx 8 \end{aligned}$$

The answer is B.

Quick Check

- Find the distance between $(2, 1)$ and $(7, 9)$. Round to the nearest tenth.
- Your school is 3 miles south of your house. The park is 5 miles east of your school. To the nearest mile, how far is your house from the park?



Test Prep Tip

Be careful to follow the order of operations when solving for a variable in the Pythagorean Theorem.

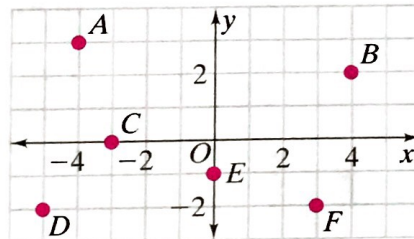
Check Your Understanding

Vocabulary Match each ordered pair with the appropriate quadrant.

- | | |
|---------------|-----------------|
| 1. $(-4, 2)$ | A. Quadrant I |
| 2. $(3, 5)$ | B. Quadrant II |
| 3. $(12, -6)$ | C. Quadrant III |
| 4. $(-7, -1)$ | D. Quadrant IV |

Find the lengths of the horizontal and vertical legs of a right triangle that can be formed with the given segment as its hypotenuse.

5. \overline{AE} 6. \overline{CF} 7. \overline{ED}



Homework Exercises

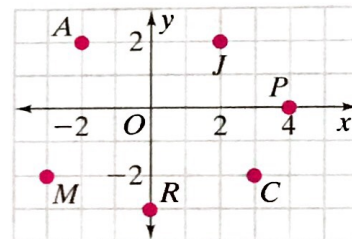
For more exercises, see Extra Skills and Word Problems.

GO for Help

For Exercises	See Examples
8–11	1
12	2

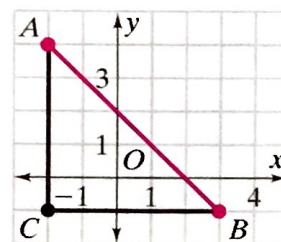
Find the distance between each pair of points. If necessary, round to the nearest tenth.

- $(3, -2)$ and $(0, -3)$
- $(-3, -2)$ and $(4, 0)$
- $(4, 0)$ and $(-2, 2)$
- $(3, -2)$ and $(-2, 2)$
- Softball** A softball diamond has the shape of a square. The distance from home plate to second base is about 85 ft. Find the distance a player would run going from first base to second base.



GPS

- Guided Problem Solving** Find the length of the hypotenuse to the nearest tenth.
 - The length of \overline{AC} is \blacksquare units.
 - The length of \overline{BC} is \blacksquare units.
 - Using the Pythagorean Theorem, the length of \overline{AB} is the square root of $\blacksquare^2 + \blacksquare^2$.



- Graph each of these points on a coordinate plane:
 $(-2, -2)$, $(-5, 3)$, $(-3, 3)$, $(-1, 0)$, $(1, 3)$, $(3, 3)$, $(0, -2)$,
 $(0, -7)$, $(-2, -7)$, $(-2, -2)$.
 - Connect the points in order and describe the figure formed.

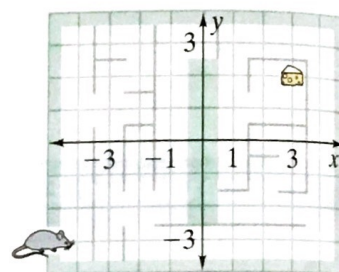
15. On a graph, the points $(4, -2)$, $(7, -2)$, $(9, -5)$, and $(2, -5)$ are connected in order to form a trapezoid. To the nearest tenth, what is its perimeter?
16. **Geography** Degrees of longitude and latitude indicate locations on a map. The longitude of Chicago is about 88° W, and the latitude is about 42° N. Estimate the longitude and latitude of St. Paul and Lincoln.



In which quadrant is each point located?

17. (x, y) if $x > 0$ and $y < 0$ 18. (x, y) if $x > 0$ and $y > 0$

19. **Writing in Math** Use coordinates to write directions that will get the mouse to the cheese in the maze at the right.



20. **Challenge** Graph and connect the points $(3, 2)$, $(-2, 2)$, $(-2, 7)$, $(3, 7)$, and $(3, 2)$ in order. Then graph and connect the points $(3, -2)$, $(-2, -2)$, $(-2, -7)$, $(3, -7)$, and $(3, -2)$ in order. How are these two figures related?

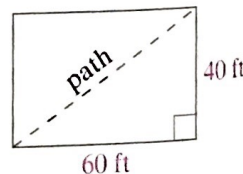


Test Prep and Mixed Review

Practice

Multiple Choice

21. The route of a cycling race is in the shape of a right triangle with vertices formed by the towns of Springfield, Jackson, and Troy. Springfield is 8 miles south of Jackson. Troy is 10 miles west of Springfield. To the nearest mile, what is the total length of the route?
 (A) 13 mi (B) 18 mi (C) 30 mi (D) 31 mi
22. Which set of lengths could NOT be the side lengths of a right triangle?
 (F) 12 in., 16 in., 20 in. (H) 30 m, 16 m, 34 m
 (G) 9 yd, 40 yd, 41 yd (J) 10 mi, 24 mi, 25 mi
23. Sarah walks across a rectangular field as shown. Which is the closest to the distance she walks?
 (A) 100 ft (C) 70 ft
 (B) 90 ft (D) 50 ft



Find each square root. If necessary, round to the nearest tenth.

24. $\sqrt{50}$ 25. $-\sqrt{\frac{1}{6}}$ 26. $\sqrt{7}$ 27. $\sqrt{0.18}$

GO for Help

For Exercises	See Lesson
24-27	1-2