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7.7 Circles in the Coordinate Plane

For use with Exploration 7.7

Essential Question What is the equation of a circle with center (h, k) and radius r in the coordinate plane?

1 EXPLORATION: The Equation of a Circle with Center at the Origin

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use dynamic geometry software to construct and determine the equations of circles centered at $(0, 0)$ in the coordinate plane, as described below.

a. Complete the first two rows of the table for circles with the given radii. Complete the other rows for circles with radii of your choice.

b. Write an equation of a circle with center $(0, 0)$ and radius r.

Radius	Equation of circle
1	
2	

2 EXPLORATION: The Equation of a Circle with Center (h, k)

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use dynamic geometry software to construct and determine the equations of circles of radius 2 in the coordinate plane, as described below.

a. Complete the first two rows of the table for circles with the given centers. Complete the other rows for circles with centers of your choice.

b. Write an equation of a circle with center (h, k) and radius 2.

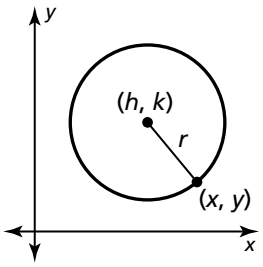
c. Write an equation of a circle with center (h, k) and radius r.

Center	Equation of circle
$(0, 0)$	
$(2, 0)$	

3 EXPLORATION: Deriving the Standard Equation of a Circle

Work with a partner. Consider a circle with radius r and center (h, k).

Write the Distance Formula to represent the distance d between a point (x, y) on the circle and the center (h, k) of the circle. Then square each side of the Distance Formula equation.



How does your result compare with the equation you wrote in part (c) of Exploration 2?

Communicate Your Answer

4. What is the equation of a circle with center (h, k) and radius r in the coordinate plane?

5. Write an equation of the circle with center $(4, -1)$ and radius 3.

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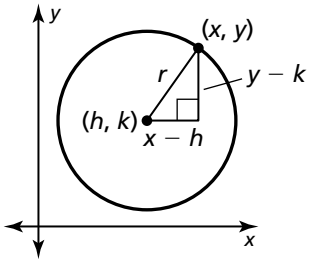
7.7 Practice
For use after Lesson 7.7

Core Concepts

Standard Equation of a Circle

Let (x, y) represent any point on a circle with center (h, k) and radius r. By the Pythagorean Theorem (Theorem 9.1),

$$(x - h)^2 + (y - k)^2 = r^2.$$



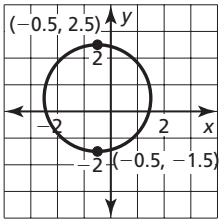
This is the **standard equation of a circle** with center (h, k) and radius r.

Notes:

Worked-Out Examples

Example #1

Find the center and radius of the circle.



By the Ruler Postulate, the distance between $(-0.5, 2.5)$ and $(-0.5, -1.5)$ is $|2.5 - (-1.5)| = |2.5 + 1.5| = |4| = 4$. So, the radius is $r = \frac{4}{2} = 2$. The y-value of the center is $-1.5 + 2 = 0.5$. So, the center is at $(-0.5, 0.5)$.

Example #2

Write the standard equation of the circle.

a circle with center $(3, -5)$ and radius 7.

The center is $(3, -5)$, and the radius is 7.

$$(x - h)^2 + (y - k)^2 = r^2$$
$$(x - 3)^2 + (y - (-5))^2 = 7^2$$
$$(x - 3)^2 + (y + 5)^2 = 49$$

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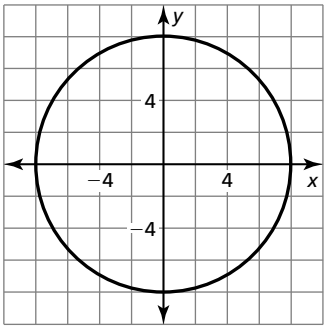
7.7 Practice (continued)

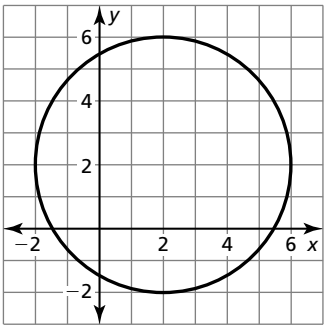
Practice A

In Exercises 1–4, write the standard equation of the circle.

1.



2.



3. a circle with center $(0, 0)$ and radius $\frac{1}{3}$

4. a circle with center $(-3, -5)$ and radius 8

In Exercises 5 and 6, use the given information to write the standard equation of the circle.

5. The center is $(0, 0)$, and a point on the circle is $(4, -3)$.

6. The center is $(4, 5)$, and a point on the circle is $(0, 8)$.

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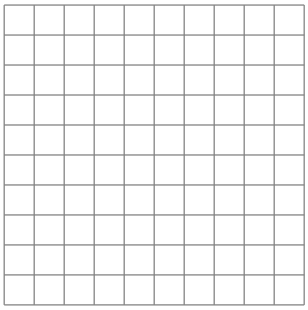
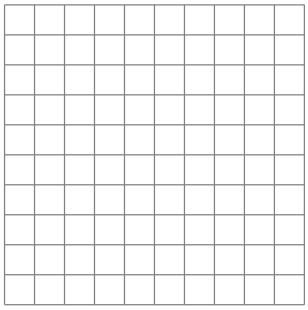
7.7 Practice (continued)

In Exercises 7–10, find the center and radius of the circle. Then graph the circle.

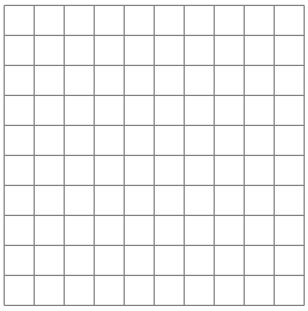
7. $x^2 + y^2 = 225$



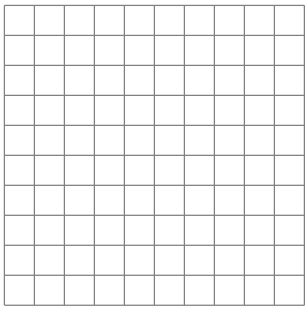
8. $(x - 3)^2 + (y + 2)^2 = 16$



9. $x^2 + y^2 + 2x + 2y = 2$



10. $x^2 + y^2 - 3x + y = \frac{5}{2}$



In Exercises 11 and 12, prove or disprove the statement.

11. The point $(-4, 4)$ lies on the circle centered at the origin with radius 6.

12. The point $(-1, 2)$ lies on the circle centered at $(-4, -1)$ with radius $3\sqrt{2}$.

13. Solve the system.

$x^2 + y^2 = 16$

$y = -x - 4$

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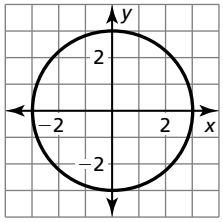
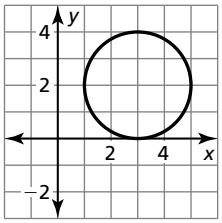
Practice B

In Exercises 1–4, write the standard equation of the circle.

1.



2.



3. a circle with center $(4, -7)$ and radius 4

4. a circle with center $(-3, 0)$ and radius 5

In Exercises 5–7, use the given information to write the standard equation of the circle.

5. The center is $(0, 0)$, and a point on the circle is $(1, 0)$.

6. The center is $(4, -1)$, and a point on the circle is $(-1, -1)$.

7. The center is $(2, 4)$, and a point on the circle is $(-3, 16)$.

In Exercises 8–11, find the center and radius of the circle. Then graph the circle.

8. $x^2 + y^2 = 100$

9. $(x - 2)^2 + (y - 9)^2 = 4$

10. $x^2 + y^2 + 4y + 4 = 36$

11. $x^2 - 2x + 5 + y^2 = 8$

In Exercises 12 and 13, prove or disprove the statement.

12. The point $(-3, 4)$ lies on the circle centered at the origin with radius 5.

13. The point $(2, \sqrt{3})$ lies on the circle centered at the origin and containing the point $(-3, 0)$.

14. After an earthquake, you are given seismograph readings from three locations where the coordinates are miles.

The epicenter is 5 miles away from $A(2, 1)$.

The epicenter is 6 miles away from $B(-2, -2)$.

The epicenter is 4 miles away from $(-6, 4)$.

a. Graph three circles in one coordinate plane to represent the possible epicenter locations determined by each of the seismograph readings.

b. What are the coordinates of the epicenter?

c. People could feel the earthquake up to 9 miles from the epicenter. Could a person at $(4, -5)$ feel it? Explain.

15. Solve the system $x^2 + y^2 = 14, y = 4$.