Name _____ Date _____

2.3 Focus of a Parabola

For use with Exploration 2.3

Essential Question What is the focus of a parabola?

1 EXPLORATION: Analyzing Satellite Dishes

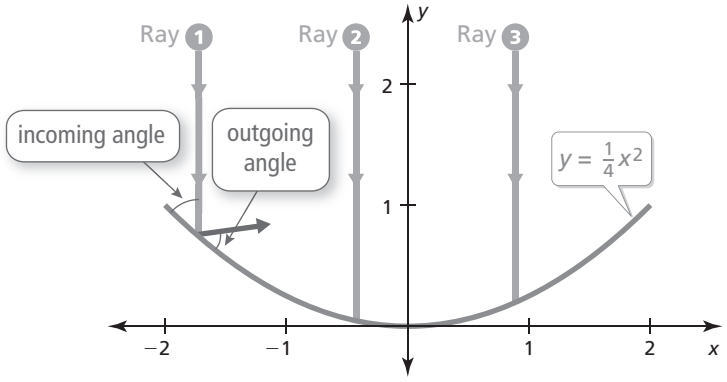
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Vertical rays enter a satellite dish whose cross section is a parabola. When the rays hit the parabola, they reflect at the same angle at which they entered. (See Ray 1 in the figure.)

a. Draw the reflected rays so that they intersect the y-axis.

b. What do the reflected rays have in common?

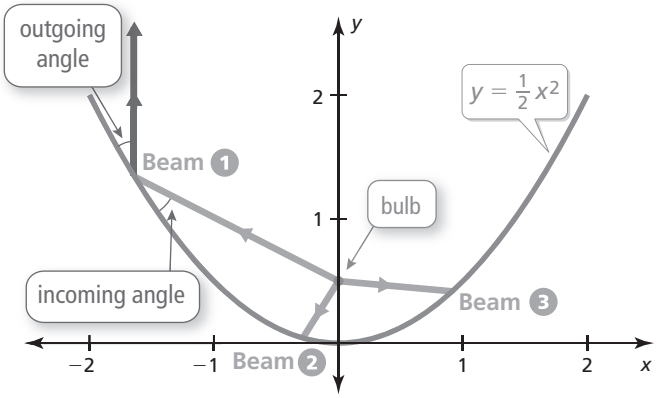
c. The optimal location for the receiver of the satellite dish is at a point called the *focus* of the parabola. Determine the location of the focus. Explain why this makes sense in this situation.



2 EXPLORATION: Analyzing Spotlights

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

Work with a partner. Beams of light are coming from the bulb in a spotlight, located at the focus of the parabola. When the beams hit the parabola, they reflect at the same angle at which they hit. (See Beam 1 in the figure.) Draw the reflected beams. What do they have in common? Would you consider this to be the optimal result? Explain.



Communicate Your Answer

3. What is the focus of a parabola?

4. Describe some of the properties of the focus of a parabola.

Name _____ Date _____

2.3 Notetaking with Vocabulary

For use after Lesson 2.3

In your own words, write the meaning of each vocabulary term.

focus

directrix

Core Concepts

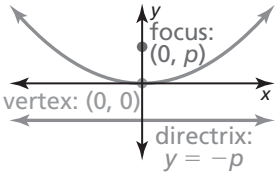
Standard Equations of a Parabola with Vertex at the Origin

Vertical axis of symmetry $(x = 0)$

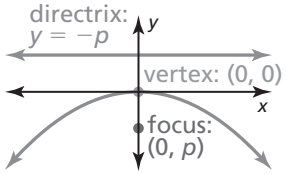
Equation: $y = \frac{1}{4p}x^2$

Focus: $(0, p)$

Directrix: $y = -p$



$p > 0$



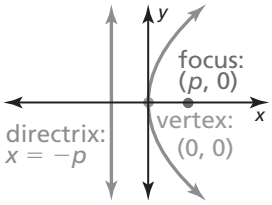
$p < 0$

Horizontal axis of symmetry $(y = 0)$

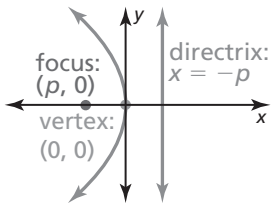
Equation: $x = \frac{1}{4p}y^2$

Focus: $(p, 0)$

Directrix: $x = -p$



$p > 0$



$p < 0$

Notes:

Name_____ Date _____

2.3 Notetaking with Vocabulary (continued)

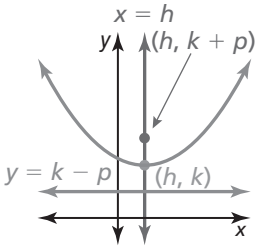
Standard Equations of a Parabola with Vertex at (h, k)

Vertical axis of symmetry $(x = h)$

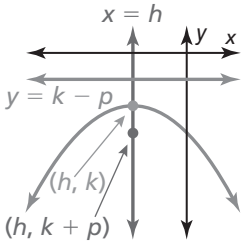
Equation: $y = \frac{1}{4p}(x - h)^2 + k$

Focus: $(h, k + p)$

Directrix: $y = k - p$



$p > 0$



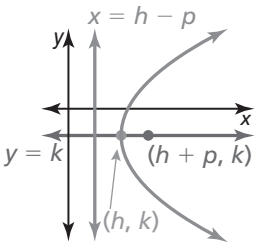
$p < 0$

Horizontal axis of symmetry $(y = k)$

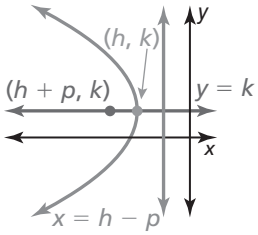
Equation: $x = \frac{1}{4p}(y - k)^2 + h$

Focus: $(h + p, k)$

Directrix: $x = h - p$



$p > 0$



$p < 0$

Notes:

Extra Practice

In Exercises 1 and 2, use the Distance Formula to write an equation of the parabola.

1. focus: $(0, -8)$ directrix: $y = 8$

2. vertex: $(0, 0)$ focus: $(0, 1)$

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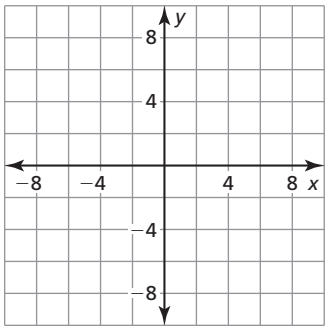
2.3 Notetaking with Vocabulary (continued)

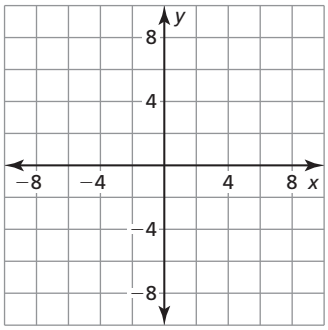
In Exercises 3–5, identify the focus, directrix, and axis of symmetry of the parabola. Graph the equation.

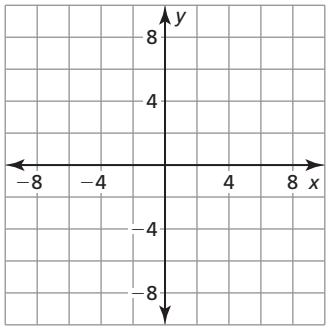
3. $x^2 = -2y$

4. $-5x + \frac{1}{3}y^2 = 0$

5. $y = -2(x + 1)^2 - 3$

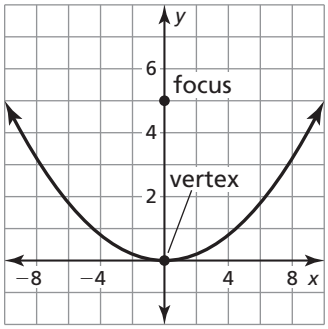




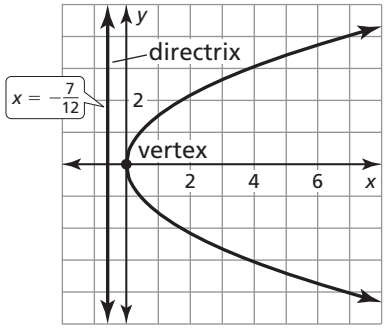


In Exercises 6–8, write an equation of the parabola shown.

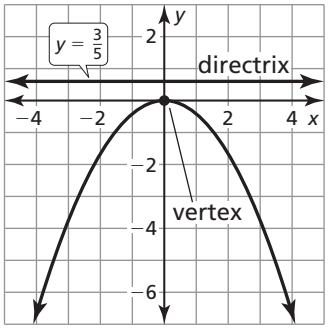
6.



7.



8.



9. The cross section of a parabolic sound reflector at the Olympics has a diameter of 20 inches and is 25 inches deep. Write an equation that represents the cross section of the reflector with its vertex at $(0, 0)$ and its focus to the left of the vertex.