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Reteach

Parabolas

A **parabola** is the set of all points in the plane that are the same distance from a fixed point, called the focus, and from a fixed line, called the directrix.

Use $|p|$ to represent this distance.

To write the equation of a parabola with vertex (0, 0), substitute the value of p into the equation for the standard form.

- Use $x = \frac{1}{4p}y^2$ if the axis of symmetry is the x-axis.
- Use $y = \frac{1}{4p}x^2$ if the axis of symmetry is the y-axis.
- $p > 0$ if the parabola opens to the right or upward.
- $p < 0$ if the parabola opens to the left or downward.

From the graph of the parabola:

The x-axis is the axis of symmetry.

Use $x = \frac{1}{4p}y^2$ to write the equation.

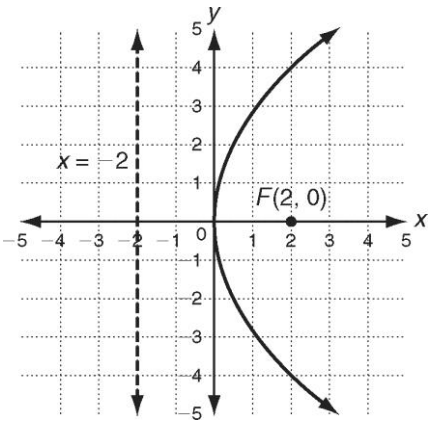
The parabola opens to the right, so p is positive.

The focus is (2, 0). It is 2 units away from the vertex (0, 0).

The directrix, $x = -2$, is also 2 units away from the vertex. So, $p = 2$.

Substituting $p = 2$,

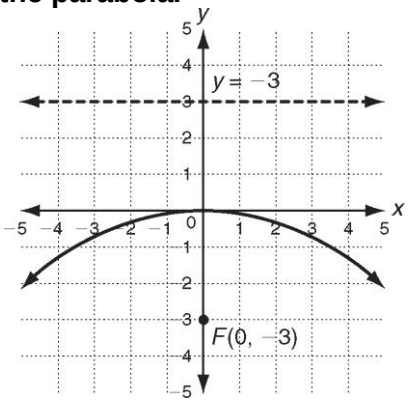
$$x = \frac{1}{4p}y^2 \rightarrow x = \frac{1}{4(2)}y^2 \rightarrow x = \frac{1}{8}y^2$$



Note that the focus and the directrix are the same distance from the vertex of the parabola.

Complete to write the equation in standard form for the parabola.

1. Axis of symmetry: _____
2. Equation form: _____
3. Sign of p: _____
4. Focus: _____
5. Value of p: _____
6. Equation: _____



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Parabolas (continued)

The equations of a parabola in standard form with vertex (h, k) are

Horizontal Opening	Vertical Opening
$x - h = \frac{1}{4p}(y - k)^2$	$y - k = \frac{1}{4p}(x - h)^2$
Axis of symmetry: $y = k$	Axis of symmetry: $x = h$
Focus: $(h + p, k)$	Focus: $(h, k + p)$
Directrix: $x = h - p$	Directrix: $y = k - p$

Use the information from the table to graph a parabola.

Graph $x + 1 = -\frac{1}{12}(y - 1)^2$.

Think:

$x - (-1) = -\frac{1}{12}(y - 1)^2$

Identify the vertex: $h = -1$ and $k = 1$. So, vertex (h, k) is $(-1, 1)$.

Find the axis of symmetry: $y = k \rightarrow y = 1$

To find p, solve $\frac{1}{4p} = -\frac{1}{12}$.

Since p is negative, the parabola opens left.

$4p = -12$

$p = -3$

Use p to find the focus and directrix.

Focus: $(h + p, k)$

$(-1 + (-3), 1)$

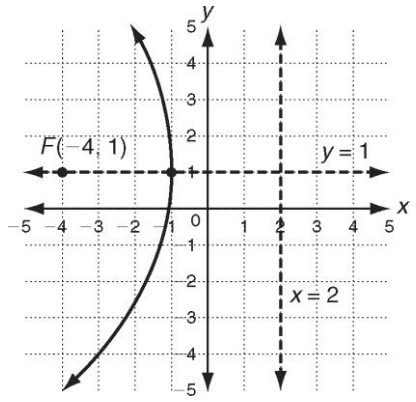
$(-4, 1)$

Substitute $h = -1$, $k = 1$, and $p = -3$.

Directrix: $x = h - p$

$x = -1 - (-3)$ or $x = 2$

Graph the parabola. Include the vertex, axis of symmetry, focus, and directrix.



Graph the parabola.

7. $y - 2 = -\frac{1}{8}(x - 1)^2$

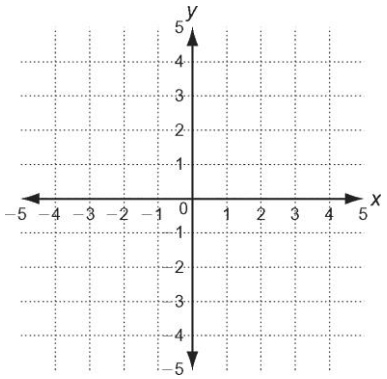
a. Vertex: _____

b. Axis of symmetry: _____

c. p = _____

d. Focus: _____

e. Directrix: _____



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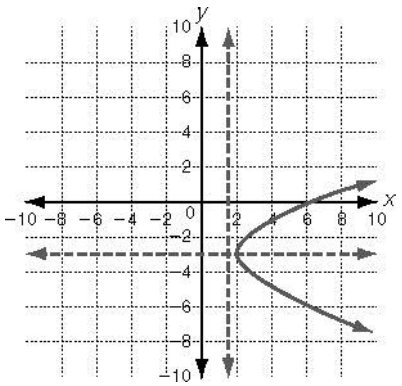
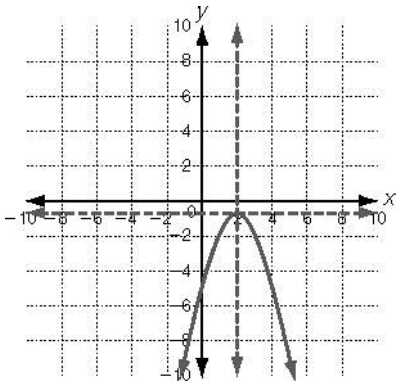
7. Vertex (2, -3); $p = \frac{1}{2}$; axis of symmetry y = -3; focus $\left(2\frac{1}{2}, -3\right)$; directrix $x = 1\frac{1}{2}$



8. Vertex (2, -1); $p = -\frac{1}{4}$; axis of symmetry $x = 2$; focus $\left(2, -1\frac{1}{4}\right)$; directrix $y = -\frac{3}{4}$



9. a. $y = \frac{1}{60}x^2$

   b. 21.6 cm

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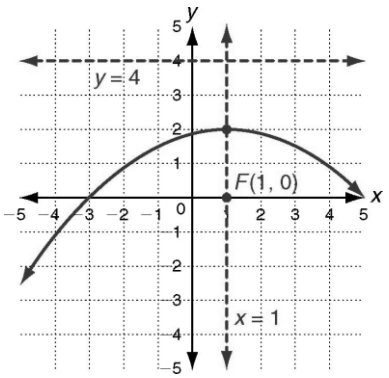
1. y-axis
2. $y = \frac{1}{4p}x^2$
3. Negative
4. $(0, -3)$
5. $p = -3$
6. $y = -\frac{1}{12}x^2$
7. a. (1, 2)
   b. $x = 1$
   c. $p = -2$
   d. (1, 0)
   e. $y = 4$

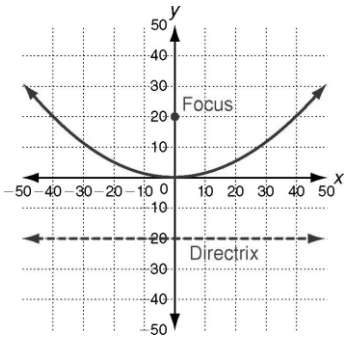


Challenge

4. $y = \frac{1}{2}x^2$

Problem Solving

1. a. (0, 0)
   b. $4p = 80$, $p = 20$
   c. $x = 0$
   d. (0, 20)
   e. $y = -20$
   f.



2. a. Possible answer: A parabola is the set of points in a plane that are equidistant from the focus and the directrix.
   b. $y = \frac{1}{20}x^2$
3. A
4. J

Reading Strategies

1. a. Possible answer: From the equation, $\frac{1}{4p} = \frac{1}{32}$, so $p = 8$. Because p is positive, the parabola opens upward.
   b. (0, 8)
   c. $y = -8$
2. a. $p = -12$