

**Standard Equation of a Parabola with Vertex at the Origin**

The standard form of the equation of a parabola with vertex at  $(0, 0)$  is as follows:

Equation	Focus	Directrix	Axis of Symmetry
$x^2 = 4py$	$(0, p)$	$y = -p$	Vertical ( $x = 0$ )
$y^2 = 4px$	$(p, 0)$	$x = -p$	Horizontal ( $y = 0$ )

**EXAMPLE 1** Graph an equation of a parabola

Graph  $x = -\frac{1}{8}y^2$ . Identify the focus, directrix, and axis of symmetry.

**Solution**

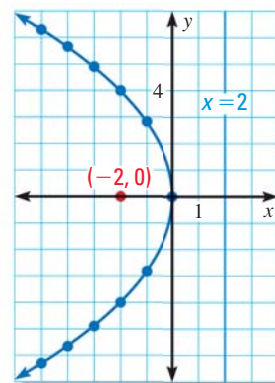
**STEP 1** Rewrite the equation in standard form.

$$x = -\frac{1}{8}y^2 \quad \text{Write original equation.}$$

$$-8x = y^2 \quad \text{Multiply each side by } -8.$$

**STEP 2** Identify the focus, directrix, and axis of symmetry. The equation has the form  $y^2 = 4px$  where  $p = -2$ . The focus is  $(p, 0)$ , or  $(-2, 0)$ . The directrix is  $x = -p$ , or  $x = 2$ . Because  $y$  is squared, the axis of symmetry is the  $x$ -axis.

**STEP 3** Draw the parabola by making a table of values and plotting points. Because  $p < 0$ , the parabola opens to the left. So, use only negative  $x$ -values.



<b>x</b>	-1	-2	-3	-4	-5
<b>y</b>	$\pm 2.83$	$\pm 4$	$\pm 4.90$	$\pm 5.66$	$\pm 6.32$

**SOLVE FOR Y**

To fill in the table, note that because  $-8x = y^2$ ,  $y = \pm\sqrt{-8x}$ . The value of  $y$  will be a real number only when  $x \leq 0$ .

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**EXAMPLE 2** Write an equation of a parabola

Write an equation of the parabola shown.

**Solution**

The graph shows that the vertex is  $(0, 0)$  and the directrix is  $y = -p = -\frac{3}{2}$ . Substitute  $\frac{3}{2}$  for  $p$  in the standard form of the equation of a parabola.

$$x^2 = 4py \quad \text{Standard form, vertical axis of symmetry}$$

$$x^2 = 4\left(\frac{3}{2}\right)y \quad \text{Substitute } \frac{3}{2} \text{ for } p.$$

$$x^2 = 6y \quad \text{Simplify.}$$

