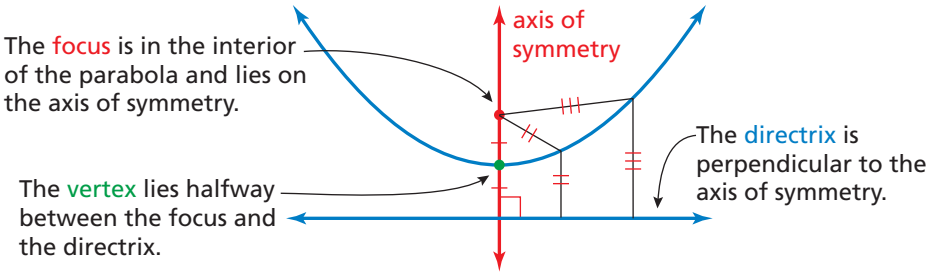
Name _____ Date _____

Focus of a Parabola

A parabola can be defined as the set of all points (x, y) in a plane that are equidistant from a fixed point called the **focus** and a fixed line called the **directrix**.



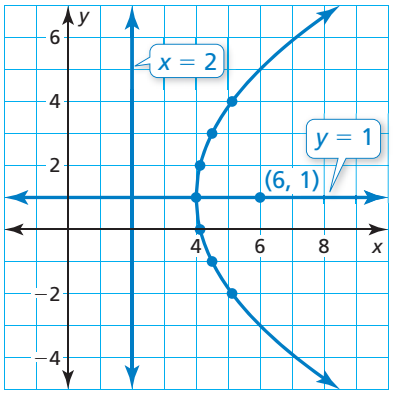
The standard form of the equation of a parabola with vertex at (h, k) is as follows.

Equation	Focus	Directrix	Axis of Symmetry	Behavior
$y = \frac{1}{4p}(x - h)^2 + k$	$(h, k + p)$	$y = k - p$	Vertical $x = h$	Opens up when $p > 0$ Opens down when $p < 0$
$x = \frac{1}{4p}(y - k)^2 + h$	$(h + p, k)$	$x = h - p$	Horizontal $y = k$	Opens right when $p > 0$ Opens left when $p < 0$

Example 1 **Identify the vertex, focus, directrix, and axis of symmetry of $x = \frac{1}{8}(y - 1)^2 + 4$. Then graph the equation.**

The equation has the form $x = \frac{1}{4p}(y - k)^2 + h$, where $p = 2$, $h = 4$, and $k = 1$. The vertex is (h, k), or (4, 1). The focus is $(h + p, k)$, or (6, 1). The directrix is $x = h - p$, or $x = 2$. The axis of symmetry is $y = k$, or $y = 1$. Use a table of values to graph the equation. Notice that it is easier to substitute y-values and solve for x.

y	−2	−1	0	1	2	3	4
x	5.125	4.5	4.125	4	4.125	4.5	5.125

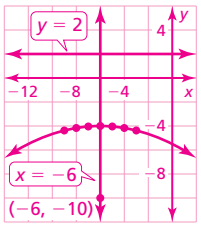


Practice

Check your answers at BigIdeasMath.com.

Identify the vertex, focus, directrix, and axis of symmetry of the parabola. Then graph the equation.

1. $y = -\frac{1}{24}(x + 6)^2 - 4$
   vertex: $(-6, -4)$, focus: $(-6, -10)$,
   directrix: $y = 2$, axis of symmetry: $x = -6$;
2. $x = -\frac{1}{4}(y + 5)^2 - 1$
   vertex: $(-1, -5)$, focus: $(-2, -5)$,
   directrix: $x = 0$, axis of symmetry: $y = -5$;
3. $y = \frac{1}{6}x^2 - 3$
   vertex: $(0, -3)$, focus: $(0, -1.5)$,
   directrix: $y = -4.5$, axis of symmetry: $x = 0$;
4. $x = \frac{1}{4}(y - 2)^2 + 2$
   vertex: $(2, 2)$, focus: $(3, 2)$,
   directrix: $x = 1$, axis of symmetry: $y = 2$;

1.


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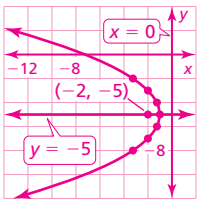

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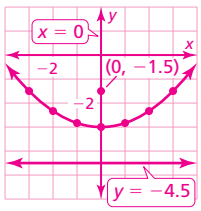

4.