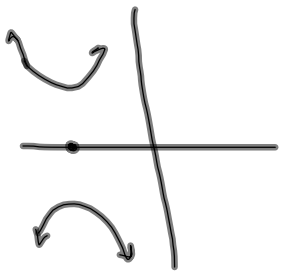
Warm Up:

Find the vertices, co-vertices, and asymptotes of $\frac{y^2}{25} - \frac{(x+6)^2}{144} = 1$, then graph.

Ver.

(-6, 0)



10-5 Parabolas

Objectives

Write the standard equation of a parabola and its axis of symmetry.

Graph a parabola and identify its focus, directrix, and axis of symmetry.

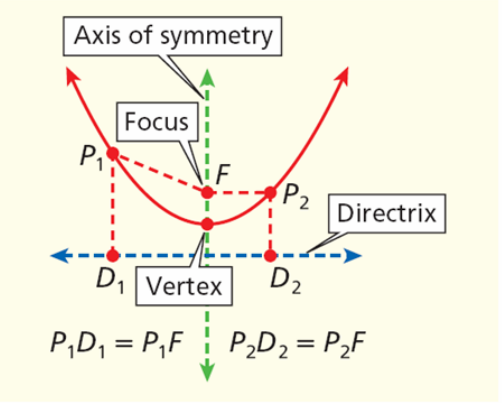
10-5 Parabolas

Vocabulary

focus of a parabola
directrix

10-5 Parabolas

A parabola is the set of all points $P(x, y)$ in a plane that are an equal distance from both a fixed point, the **focus**, and a fixed line, the **directrix**. A parabola has a axis of symmetry perpendicular to its directrix and that passes through its vertex. The vertex of a parabola is the midpoint of the perpendicular segment connecting the focus and the directrix.



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Since the distance from a point to the directrix and focus are the same we can use the equation PD=PF, with each side being a distance formula, use that to find equations of a parabola.

Use the Distance Formula to find the equation of a parabola with focus $F(2, 4)$ and directrix $y = -4$.

Point (x, y)

$PD = PF$

$\sqrt{(x-x)^2+(y+4)^2}^2 = \sqrt{(x-2)^2+(y-4)^2}^2$

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

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

$-y^2 \quad -16 \quad -y^2 \quad -16$

$8y=(x-2)^2-8y$

$+8y \quad +8y$

$16y=(x-2)^2$

$y=\frac{(x-2)^2}{16}$

$=\frac{1}{16}(x-2)^2$

Use the Distance Formula to find the equation of a parabola with focus $F(0, 4)$ and directrix $y = -4$.

Point (x, y)

$PD = PF$

$\sqrt{(x-x)^2+(y+4)^2} = \sqrt{(x-0)^2+(y-4)^2}$

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

$y^2+8y+16 = x^2+y^2-8y+16$

$16y = x^2$

$y = \frac{1}{16}x^2$

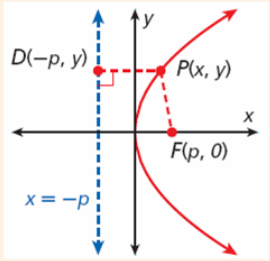
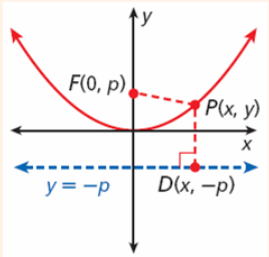
10-5 Parabolas

Previously, you have graphed parabolas with vertical axes of symmetry that open upward or downward. Parabolas may also have horizontal axes of symmetry and may open to the left or right.

The equations of parabolas use the parameter p. The $|p|$ gives the distance from the vertex to both the focus and the directrix.

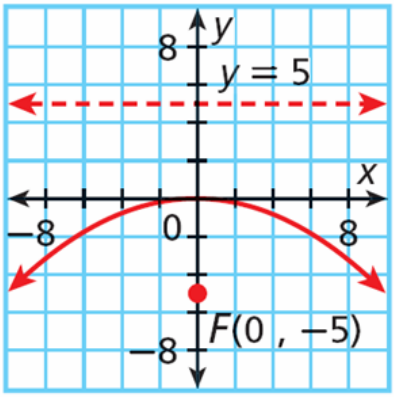
10-5 Parabolas

Standard Form for the Equation of a Parabola — Vertex at (0, 0)

AXIS OF SYMMETRY	HORIZONTAL $y = 0$	VERTICAL $x = 0$
Equation	$x = \frac{1}{4p}y^2$	$y = \frac{1}{4p}x^2$
Direction	Opens right if $p > 0$ Opens left if $p < 0$	Opens upward if $p > 0$ Opens downward if $p < 0$
Focus	$(p, 0)$	$(0, p)$
Directrix	$x = -p$	$y = -p$
Graph		

Like before, find all your values, in this case we are looking to find p. Once we have that we can find the equation of the parabola.

Write the equation in standard form for the parabola.

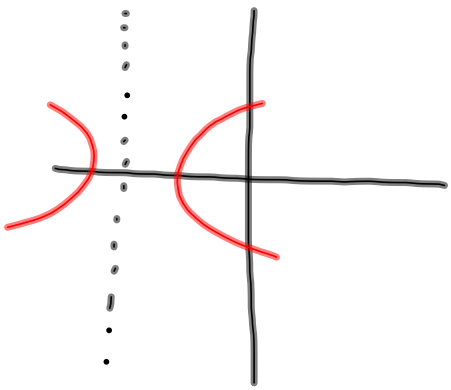


Write the equation in standard form for the parabola.

$x = -p$

vertex (0, 0), directrix $x = -6$

$p = 6$



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

$x = \frac{1}{24} y^2$

Write the equation in standard form for the parabola.

$x = -p$

vertex (0, 0), directrix $x = 1.25$

$p = -1.25$ $\quad x = \frac{1}{4p}y^2$

$x = \frac{1}{-5}y^2$

Write the equation in standard form for each parabola.

$(0, p)$

vertex (0, 0), focus (0, –7)

$p = -7$ $\quad y = \frac{1}{4p}x^2$

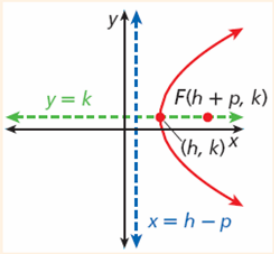
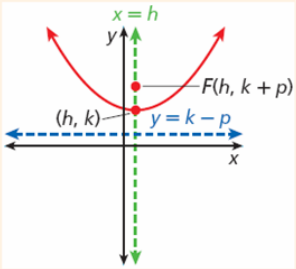
$y = \frac{1}{-28}x^2$

10-5 Parabolas

The vertex of a parabola may not always be the origin. Adding or subtracting a value from x or y translates the graph of a parabola. Also notice that the values of p stretch or compress the graph.

10-5 Parabolas

Standard Form for the Equation of a Parabola — Vertex at (h, k)

AXIS OF SYMMETRY	HORIZONTAL $y = k$	VERTICAL $x = h$
Equation	$x - h = \frac{1}{4p}(y - k)^2$	$y - k = \frac{1}{4p}(x - h)^2$
Direction	Opens right if $p > 0$ Opens left if $p < 0$	Opens upward if $p > 0$ Opens downward if $p < 0$
Focus	$(h + p, k)$	$(h, k + p)$
Directrix	$x = h - p$	$y = k - p$
Graph		

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Find the vertex, value of *p*, axis of symmetry, focus, and directrix of the parabola $y + 3 = \frac{1}{8}(x - 2)^2$. Then graph.

$h = 2$

$k = -3$

$p = 2$

$\frac{1}{4p} = \frac{1}{8}$ $4p = 8$ $p = 2$

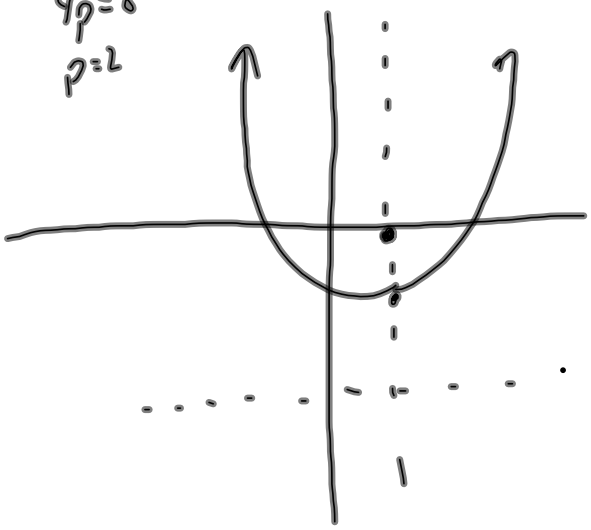
Vertex $(2, -3)$

$p = 2$

Sym: $x = 2$

focus: $(2, -1)$

directrix: $y = -5$



Find the vertex, value of *p*, axis of symmetry, focus, and directrix of the parabola. Then graph.

$h = 1$

$k = 3$

$p = 3$

$$x - 1 = \frac{1}{12}(y - 3)^2$$

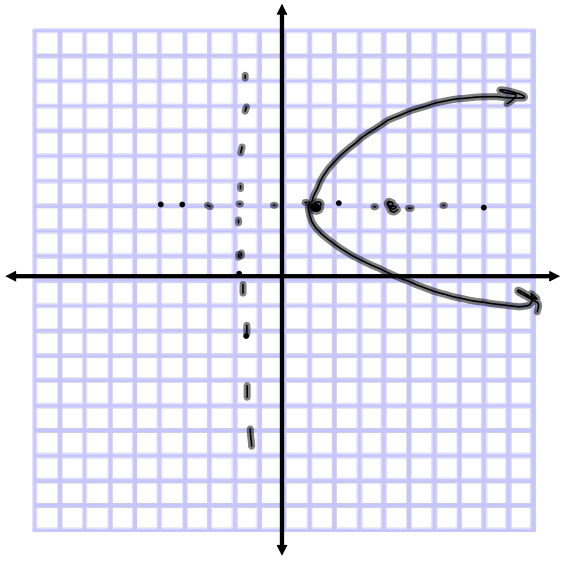
Vertex $(1, 3)$

$p = 3$

Sym: $y = 3$

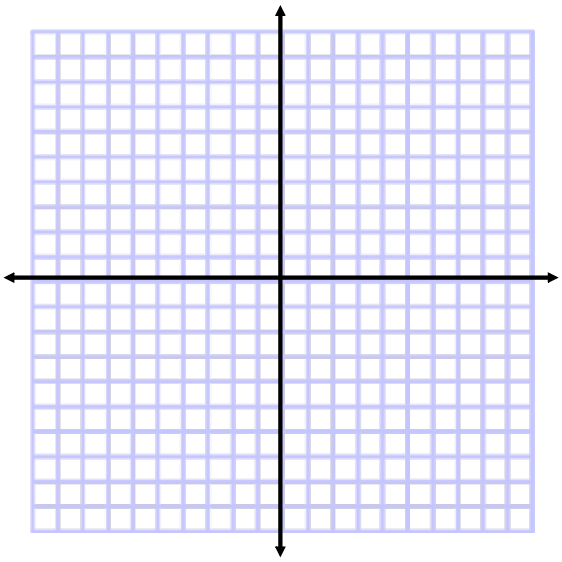
Focus: $(4, 3)$

Directrix: $x = -2$



Find the vertex, value of *p* axis of symmetry, focus, and directrix of the parabola. Then graph.

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



Homework:

p. 755 #14-22, 24, 29-34, 44-47