10-5

Study Guide

Parabolas

The standard form of the equation of the **parabola** is $(y - k)^2 = 4p(x - h)$ when the parabola opens to the right. When p is negative, the parabola opens to the left. The standard form is $(x - h)^2 = 4p(y - k)$ when the parabola opens upward. When p is negative, the parabola opens downward.

Example 1 **Given the equation $x^2 = 12y + 60$, find the coordinates of the focus and the vertex and the equations of the directrix and the axis of symmetry. Then graph the equation of the parabola.**

First write the equation in the form $(x - h)^2 = 4p(y - k)$.

$x^2 = 12y + 60$

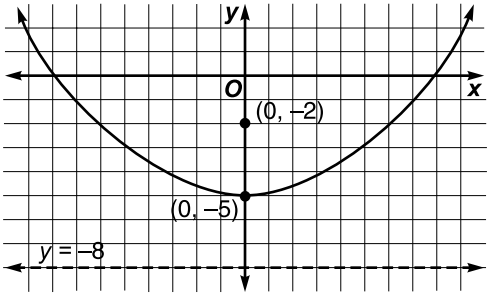
$x^2 = 12(y + 5)$ *Factor.*

$(x - 0)^2 = 4(3)(y + 5)$ *$4p = 12$, so $p = 3$.*

In this form, we can see that $h = 0$, $k = -5$, and $p = 3$.

Vertex: $(0, -5)$	(h, k)	Focus: $(0, -2)$	$(h, k + p)$
Directrix: $y = -8$	$y = k - p$	Axis of Symmetry: $x = 0$	$x = h$

The axis of symmetry is the y-axis. Since p is positive, the parabola opens upward. Graph the directrix, the vertex, and the focus. To determine the shape of the parabola, graph several other ordered pairs that satisfy the equation and connect them with a smooth curve.



Example 2 **Write the equation $y^2 + 6y + 8x + 25 = 0$ in standard form. Find the coordinates of the focus and the vertex, and the equations of the directrix and the axis of symmetry. Then graph the parabola.**

$y^2 + 6y + 8x + 25 = 0$

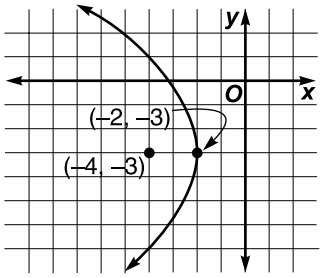
$y^2 + 6y = -8x - 25$ *Isolate the x terms and the y terms.*

$y^2 + 6y + ? = -8x - 25 + ?$

$y^2 + 6y + 9 = -8x - 25 + 9$ *Complete the square.*

$(y + 3)^2 = -8(x + 2)$ *Simplify and factor.*

From the standard form, we can see that $h = -2$ and $k = -3$. Since $4p = -8$, $p = -2$. Since y is squared, the directrix is parallel to the y-axis. The axis of symmetry is the x-axis. Since p is negative, the parabola opens to the left.



Vertex: $(-2, -3)$	(h, k)
Focus: $(-4, -3)$	$(h + p, k)$
Directrix: $x = 0$	$x = h - p$
Axis of Symmetry: $y = -3$	$y = k$