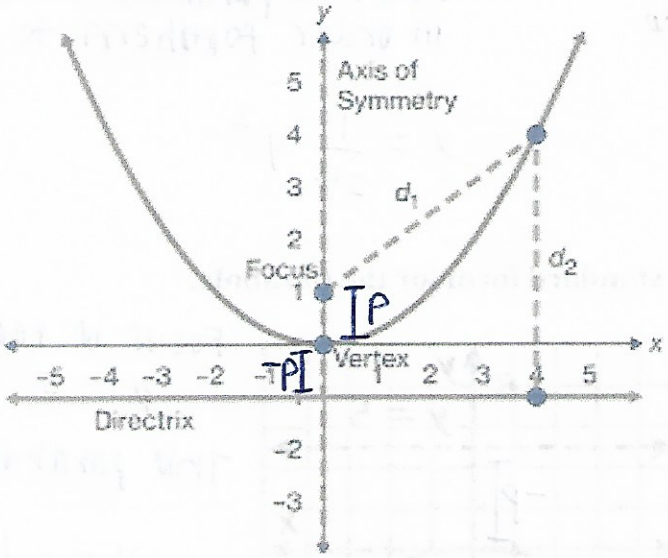
Section 10.5

Parabolas

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

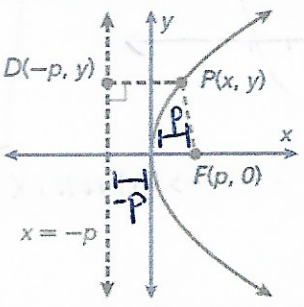
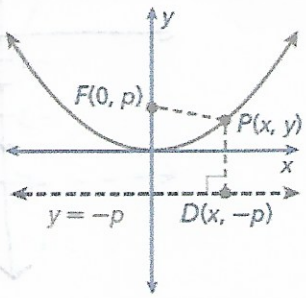


- A parabola has an **axis of symmetry** perpendicular to its directrix and that passes through its vertex.
- The **vertex** of a parabola is the midpoint of the perpendicular segment connecting the focus and the directrix.
- "p" is the distance from the vertex to the focus.
- "-p" is the distance/direction from the vertex to the directrix.

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

Always goes through the vertex of the parabola.

Always write as an equation!

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		

★ Notice how parabola and directrix never intersect!

Example #1: Write the equation of the parabola given the following information:
vertex (0, 0), directrix $x = -6$

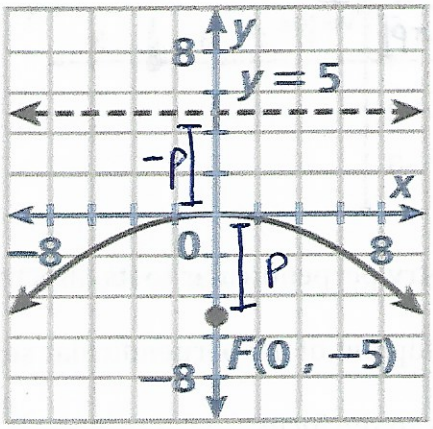
Directrix is $-p$ and is a vertical line, so parabola must be horizontal in order for them to not intersect.

$-p = -6$

$p = 6$

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

Example #2:
Write the equation in standard form for the parabola.



Focus is regular p.

$p = -5$

This parabola is vertical.

$$y = -\frac{1}{20} x^2$$

When the center moves:

AXIS OF SYMMETRY	HORIZONTAL $y = k$	VERTICAL $x = h$
Equation	$x - h = \frac{1}{4p}(y - k)^2$	$y - k = \frac{1}{4p}(x - h)^2$
Directrix	$x = h - p$	$y = k - p$

(h, k) are coordinates of vertex.

★ move p units away from vertex

Example #3: **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.** ★ vertical since x is squared

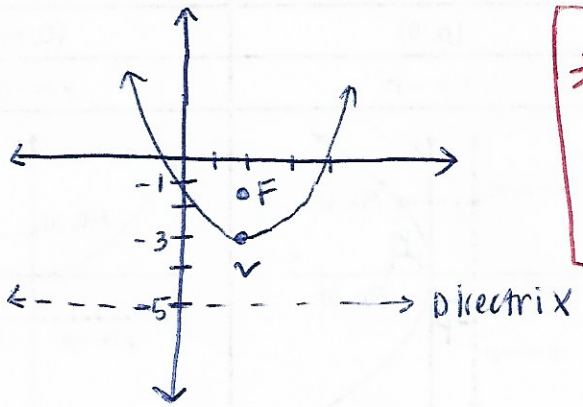
Vertex: (2, -3)

$p = 2$

AOS: $x = 2$

Focus: (2, -1)

Directrix: $y = -5$



★ This is not drawn perfectly, but shows relationship between vertex, focus, and directrix

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

Vertex: (1, 3) $p = 3$ Focus: (4, 3)

★ opens right Directrix: $x = -2$