Always draw a little sketchy picture to know where the conic parts are located!

Algebra 2
Lesson 10.2: Parabolas
Mrs. Snow, Instructor

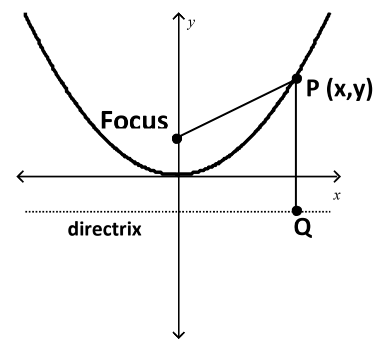
There are numerous applications using parabolas – solar collectors, TV satellite dishes, flashlight and car headlight design, artillery and shell trajectory, tsunami wave speed calculations, to name a few.

A **parabola** is a set of points in a plane that are the same distance from a fixed line, called **directrix,** and a fixed point, called a **focus** not on the line. *In other words:*

The distance from the $\boldsymbol{focus}$ *to* $\mathbf{p}$ *equals the distance from* $\mathbf{p}$ *to the* $\boldsymbol{directrix}$

$\therefore \quad FP = PQ$

The shape of a parabola is known as a **parabolic** shape.



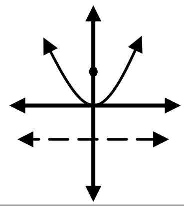
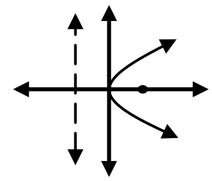
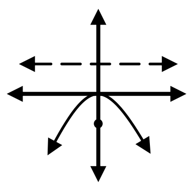
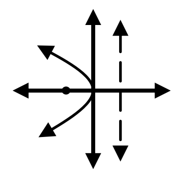
In chapter 5 we looked at functions in the form of $y = ax^2$. Here we will look at both the parabola as a function and not as a function. Note the equations and the relationship between x and y.

Write an equation using the definition of a parabola and the distance formula:

Using the definition of a parabola, write an equation for a graph that is the set of all points in the plane that are equidistant from the point $F\ (0,2)$ and the line $y = -2$,

$\mathrm{FP} = \mathrm{PQ}$ a little sketchy picture:

Standard form:

$\boldsymbol{y = a(x-h)^2 + k}$**, vertex at** $\boldsymbol{(h,k)}$ **focus:** $\boldsymbol{(h, k \pm c)}$	$\boldsymbol{x = a(y-k)^2 + h}$**, vertex at** $\boldsymbol{(h,k)}$ **focus:** $\boldsymbol{(h \pm c, k)}$
centered about the origin: $\boldsymbol{y = ax^2}$ 	**centered about the origin:** $\boldsymbol{x = ay^2}$ 
Opens upward The focus will be at $(0, c)$ Directrix is the line $y = -c$	Opens to the right The focus will be at $(c, 0)$ Directrix is the line $x = -c$
$\boldsymbol{y = -ax^2}$ 	$x = -\boldsymbol{ay^2}$ 
Opens downward The focus will be at $(0, -c)$ The directrix is the line $y = c$	Opens to the left The focus will be at $(-c, 0)$ Directrix is the line $x = c$

- Vertices are located at the origin in the above examples.
- Parabolas may be translated with the vertex at (h, k); *more at the end of lesson.*

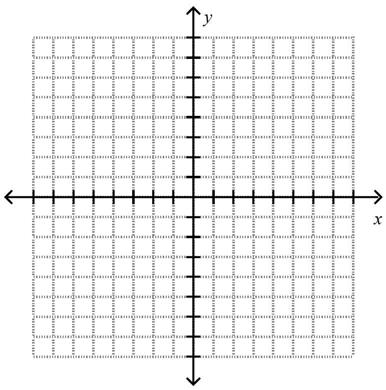
Leading Coefficient "a" and the focus/directrix "c":

The focal distance is a very important aspect of parabolas. This distance, c, measured from the vertex to the focus, is used to precisely place bulbs in car headlights, flashlights, search lights, etc. for maximum illumination. The relationship between the leading coefficient and the focus allows us to calculate one variable if we know the other.

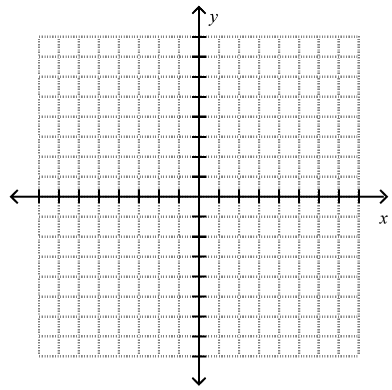
$$|\boldsymbol{a}| = \frac{\boldsymbol{1}}{\boldsymbol{4c}}$$

Write the equation of a parabola with a vertex at the origin and sketch graph labeling directrix and focus:

Focus $(-5, 0)$

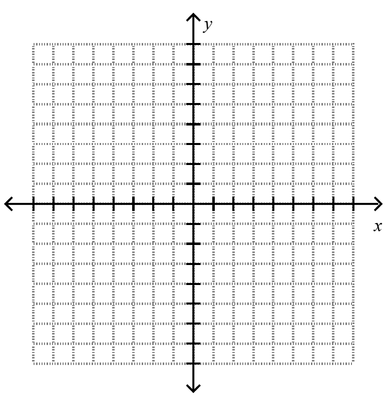


Directrix $y = -\frac{1}{4}$

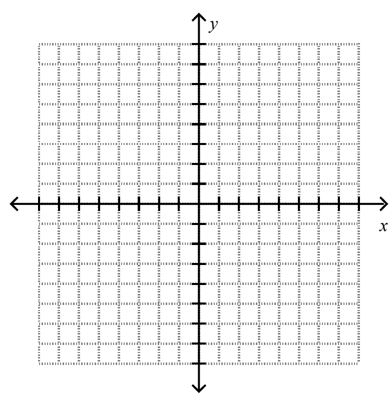


Identify the vertex, focus, and directrix of a parabola and graph:

$x^2 = 4y$



$-8x = y^2$



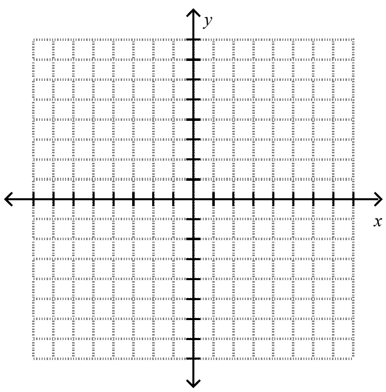
10.6

We have seen plenty of parabolas that are not centered at the origin.

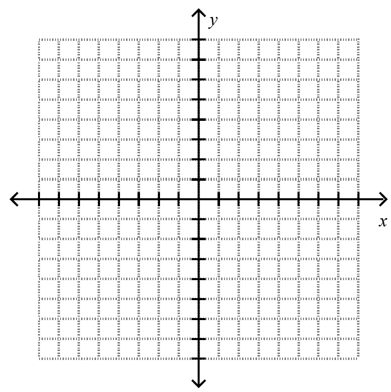
Vertex $(\boldsymbol{h},\boldsymbol{k})$	**Foci:**
$\boldsymbol{y=a(x-h)^2+k}$ $\boldsymbol{x=a(y-k)^2+h}$	$(\boldsymbol{h},\boldsymbol{k\pm c})$ $(\boldsymbol{h\pm c},\boldsymbol{k})$

Identify the vertex, focus, and directrix of a parabola and graph:

$16(y-3)=(x-2)^2$



$(y+2)^2=-20(x+4)$



Example: Write an equation for a parabola with a vertex of $(2,-3)$ and a foci of $(2,5)$

Write the parabola in standard form,. What is the vertex?

$$x^2+6x+3y+12=0$$