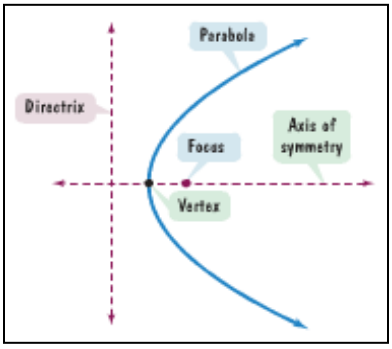
Section 9.3 (The Parabola)

Parabolas are explored in Pre-Calculus Algebra (having the form $y = a(x - h)^2 + k$ or $y = ax^2 + bx + c$), so we will look at a couple different attributes in this class

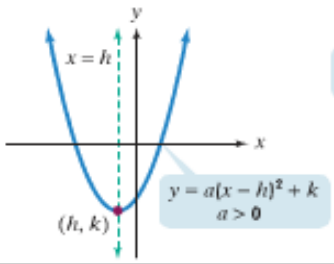
A parabola is the set of all points in a plane that are equidistant from a fixed line (directrix) and a fixed point (focus) not on the line

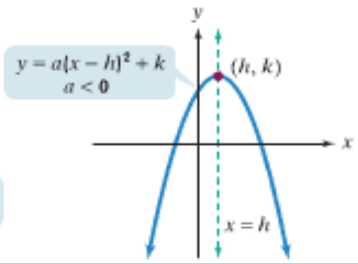


Here is a summary of what you should already know about graphing parabolas.

Graphing $y = a(x - h)^2 + k$ and $y = ax^2 + bx + c$

1. If $a > 0$, the graph opens upward. If $a < 0$, the graph opens downward.
2. The vertex of $y = a(x - h)^2 + k$ is (h, k).
3. The x-coordinate of the vertex of $y = ax^2 + bx + c$ is $x = -\frac{b}{2a}$.





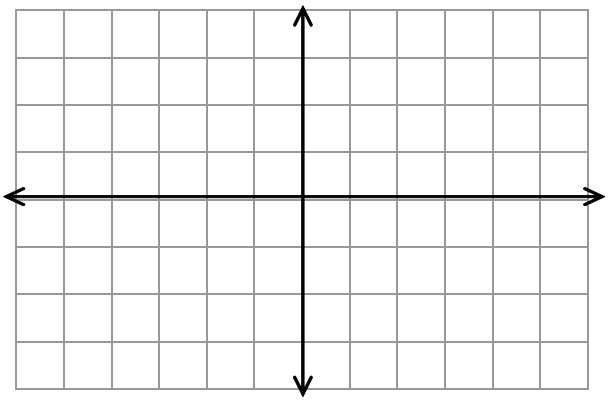
Measuring the distances to a point on a parabola from the focus (p,0) and directrix (-p,y) as $d_1 = d_2$, we can use distance formulas to derive another form for parabolas with a vertex at the origin (see derivation on pgs. 901-902) as **$y^2 = 4px$** (opens right/left with focus on x-axis of symmetry) or **$x^2 = 4py$** (opens up/down with focus on y-axis)

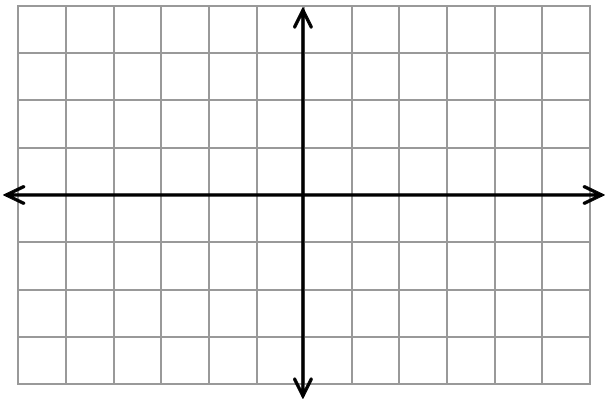
Example: Find the focus and directrix of the parabola given by the following equations and graph using points above/below or left/right of the focus (notice that these points are +/- 2p from the focus)

$y^2 = 8x$

$x^2 = -12y$

4p = _____ …





Example: Find the standard form of the equation of a parabola with focus **(8,0)** and directrix **x = –8**

Again, not all parabolas are centered at the origin and may be translated (techniques remain the same, but vertices, foci, directrix are now in relation to the new center point) – see figures in book…

Equation	Vertex	Axis of Symmetry	Focus	Directrix	Description
$(y-k)^2 = 4p(x-h)$	(h, k)	Horizontal	$(h+p, k)$	$x = h - p$	If $p > 0$, opens to the right. If $p < 0$, opens to the left.
$(x-h)^2 = 4p(y-k)$	(h, k)	Vertical	$(h, k+p)$	$y = k - p$	If $p > 0$, opens upward. If $p < 0$, opens downward.

Example: Find the vertex, focus, and directrix of the following (and graph if time)

$(x-2)^2 = 4(y+1)$ **$y^2 + 2y + 4x - 7 = 0$**

There are many applications of parabolas including arches/cables for bridges, solar cookers, reflectors for lights (flashlights), satellite dishes, etc.

Example: Cookie Monster is making an effort to go green, so he has decided to make a solar cooker to help him bake cookies (satellite dish basically) with a diameter of 6 feet and a depth of 1 foot. Where should he put the cooker (focus) to get the maximum reflected sun rays to bake the cookies?

Review online HW in class with time