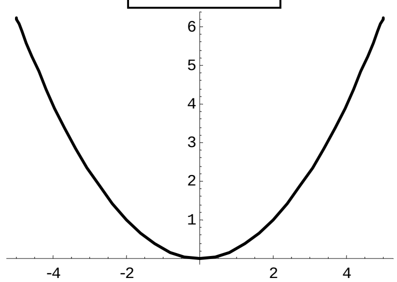
Conic Sections

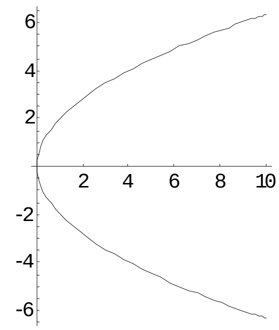
Parabola

Equation	$(x-h)^2 = 4p(y-k)$		$(y-k)^2 = 4p(x-h)$
Vertex	(h, k)		(h, k)
Focus	$(h, p+k)$		$(p+h, k)$
Directrix	$y = -p+k$		$x = -p+h$
Focal Diameter	$\lvert 4p \rvert$		$\lvert 4p \rvert$
If $p > 0$	Opens UP		Opens RIGHT
If $p < 0$	Opens DOWN		Opens LEFT

In the examples below, $p = 1$ and h and k are both 0. (So the vertex is at the origin.)

$x^2 = 4y$





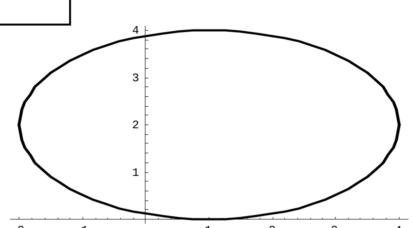
$y^2 = 4x$

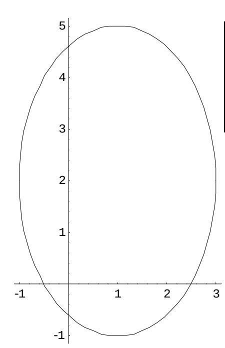
Ellipse

Equation	$\dfrac{(x-h)^2}{a^2} + \dfrac{(y-k)^2}{b^2} = 1$		$\dfrac{(x-h)^2}{b^2} + \dfrac{(y-k)^2}{a^2} = 1$
	$a > b > 0$		$a > b > 0$
Center	(h, k)		(h, k)
Vertices	$(h \pm a, k)$		$(h, k \pm a)$
Foci $c^2 = a^2 - b^2$	$(h \pm c, k)$		$(h, k \pm c)$
Major Axis	Horizontal, length 2a		Vertical, length 2a
Minor Axis	Vertical, Length 2b		Horizontal, Length 2b
Eccentricity	*e = c/a*		*e = c/a*

In the examples below, $h = 1$ and $k = 2$, so the center is at (1, 2). Also, $a = 3$ and $b = 2$.

$$\frac{(x-1)^2}{9} + \frac{(y-2)^2}{4} = 1$$





$$\frac{(x-1)^2}{4} + \frac{(y-2)^2}{9} = 1$$

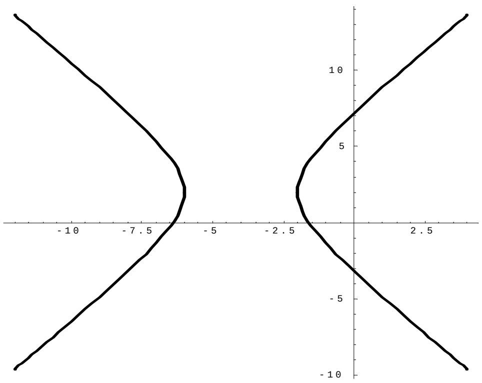
Conic Sections

Hyperbola

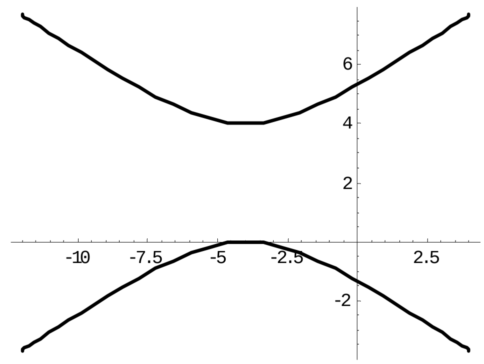
Equation	$\dfrac{(x-h)^2}{a^2}-\dfrac{(y-k)^2}{b^2}=1$		$\dfrac{(y-k)^2}{a^2}-\dfrac{(x-h)^2}{b^2}=1$
	$a>0,\ b>0$		$a>0,\ b>0$
Center	(h, k)		(h, k)
Vertices	$(h \pm a, k)$		$(h, k \pm a)$
Foci $c^2 = a^2 + b^2$	$(h \pm c, k)$		$(h, k \pm c)$
Transverse Axis	Horizontal, length 2a		Vertical, length 2a
Minor Axis	Vertical, Length 2b		Horizontal, Length 2b
Asymptotes	$y-k=\pm\dfrac{b}{a}(x-h)$		$y-k=\pm\dfrac{a}{b}(x-h)$

In both examples below, h = - 4 and k = 2, so the center is at (- 4, 2). Also, a = 2 and b = 3.

$$\frac{(x+4)^2}{4}-\frac{(y-2)^2}{9}=1$$



$$\frac{(y-2)^2}{4}-\frac{(x+4)^2}{9}=1$$



The hyperbola on the right above is plotted again with the asymptotes (dashed lines) $y-2=\pm\dfrac{2}{3}(x+4)$,

center (-4, 2),

vertices (-4, 0) and (-4, 4), and

foci $(-4, 2\pm\sqrt{13}\,)$.