Precalculus
Lesson 10.4: The Hyperbola
Mrs. Snow, Instructor

A **hyperbola** is the collection (locus) of all points In the plane, the difference of whose distances from two fixed points, called the foci, is a constant.

Equation of a Hyperbola Centered about the origin with Transverse Axis along the x-axis

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

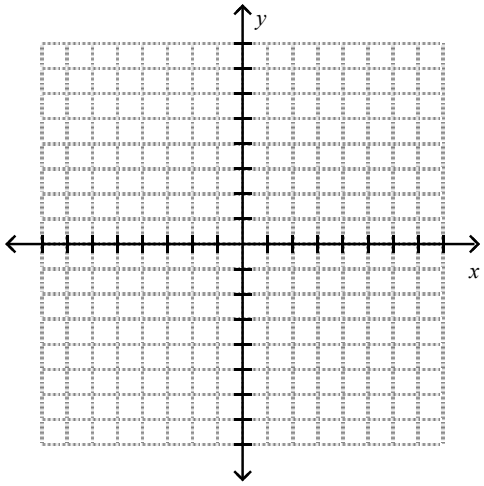
where

$$b^2 = c^2 - a^2$$

center at $(0, 0)$; foci at $(\pm c, 0)$; and vertices at $(\pm a, 0)$

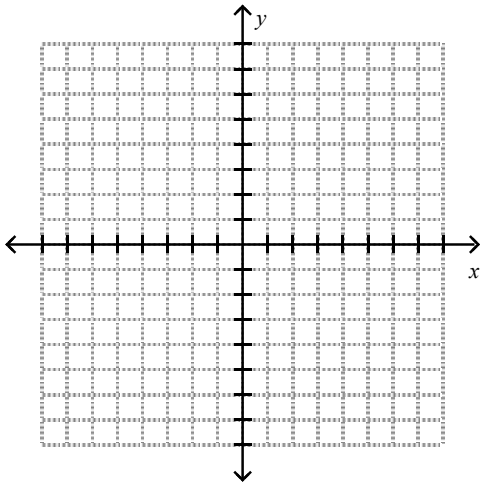
$$\textit{two oblique asymptotes}: \quad y = \pm\frac{b}{a}x$$

Find an equation of the hyperbola with center at the origin, one focus at $(3, 0)$ and one vertex at $(-2, 0)$. Graph



Analyze the equation; find the center, transverse axis, vertices, and foci. Graph.

$\frac{x^2}{16} - \frac{y^2}{4} = 1$



Equation of a Hyperbola; Center at (0, 0); Transverse Axis along the y-axis

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

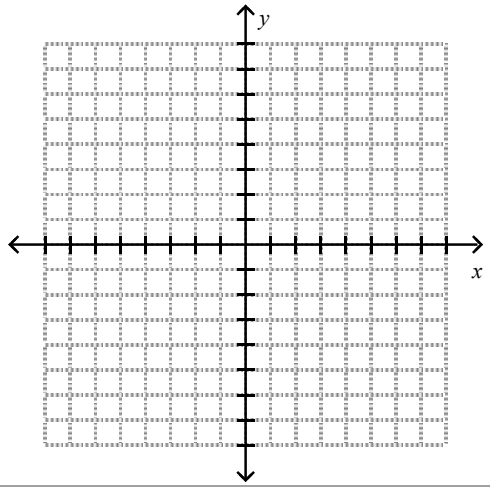
$$b^2 = c^2 - a^2$$

center at $(0, 0)$; foci at $(0, \pm c)$; and vertices at $(0, \pm a)$

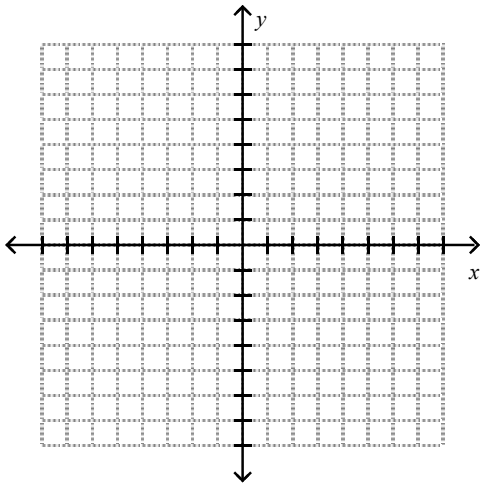
$$\textit{two oblique asymptotes}: \; y = \pm \frac{a}{b} x$$

Analyze the equation, find the center, transverse axis, vertices, and foci and graph:

$$y^2 - 4x^2 = 4$$

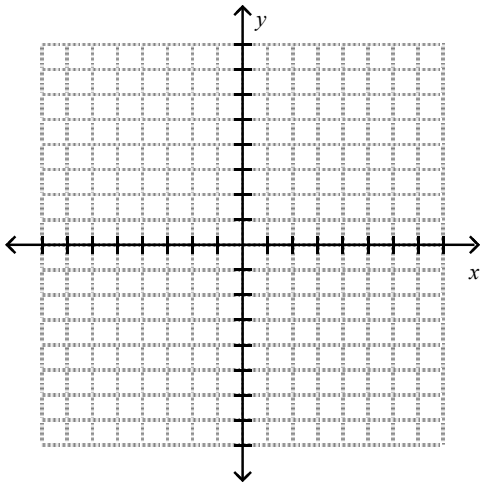


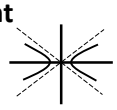
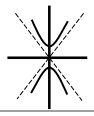
Find an equation of the hyperbola having one vertex at $(0,2)$ and foci at $(0,-3)\ and\ (0,3)$. Graph.



Analyze the equation, find the center, transverse axis , vertices, foci, and asymptotes and graph:

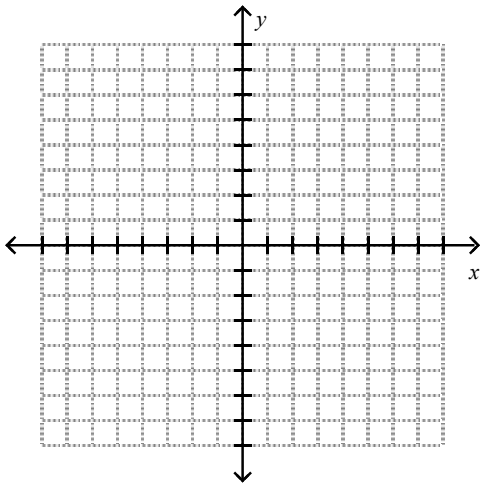
$$9x^2 - 4y^2 = 36$$



Hyperbolas at a center of (h, k) Transverse Axis Parallel to a Coordinate Axis $b^2 = c^2 - a^2$		
Opens	**Opens left and right** **Transverse axis** **x-axis** 	**Opens up and down** **Transverse axis** **y-axis** 
Form:	$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$
Center:	(h, k)	(h, k)
Vertices	$(h+a, k) and\ (h-a, k)$	$(h, k+a) and\ (h, k-a)$
Slope of Asymptotes	$\pm\frac{b}{a}$	$\pm\frac{a}{b}$
Equation of Asymptotes	$\boldsymbol{y-k=\pm\frac{b}{a}(x-h)}$*	$\boldsymbol{y-k=\pm\frac{a}{b}(x-h)}$*
Foci	$(h+c, k)\ , (h-c, k))$	$(h\ , k+c)\ , (h\ , k-c)$

**The homework will ask for the equation of the asymptote. For the quiz and test, <u>all you will be expected to answer is the slope of the asymptote line.</u>*

Find an equation for the hyperbola with center at $(1, -2)$, one focus at $(4, -2)$, and one vertex at $(3, -2)$. Graph the equation by hand.



Analyze the equation, find the center, transverse axis , vertices, foci, and asymptotes and graph:

$-x^2 + 4y^2 - 2x - 16y + 11 = 0$