

I. Hyperbola

Hyperbola - the collection (locus) of all points in the plane, the difference of whose distances from two fixed points, called the foci, is a constant.

A. Equation of a Hyperbola centered at (0, 0) with Transverse Axis along the x-axis

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

center at (0, 0)

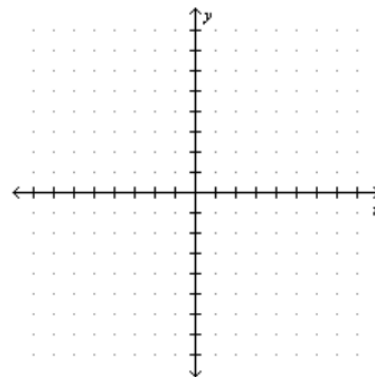
foci at $(\pm c, 0)$

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

vertices at $(\pm a, 0)$

oblique asymptotes at $y = \pm \frac{b}{a}x$

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



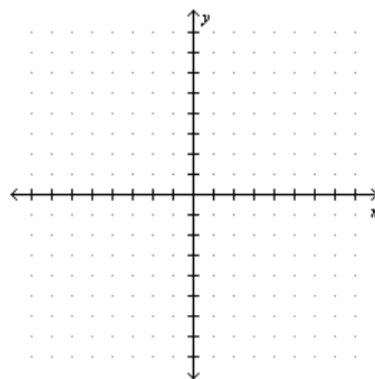
2. Analyze and graph. $\frac{x^2}{16} - \frac{y^2}{4} = 1$

center:

vertices:

transverse axis:

foci:



B. Equation of a Hyperbola centered at (0, 0) with Transverse Axis along the y-axis

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

center at (0, 0)

foci at $(0, \pm c)$

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

vertices at $(0, \pm a)$

oblique asymptotes at $y = \pm \frac{a}{b}x$

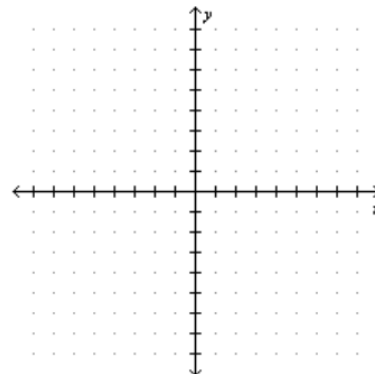
3. Analyze and graph. $y^2 - 4x^2 = 4$

center:

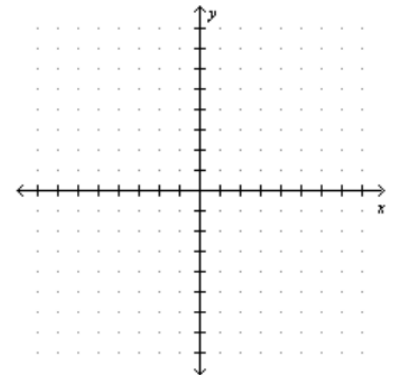
vertices:

transverse axis:

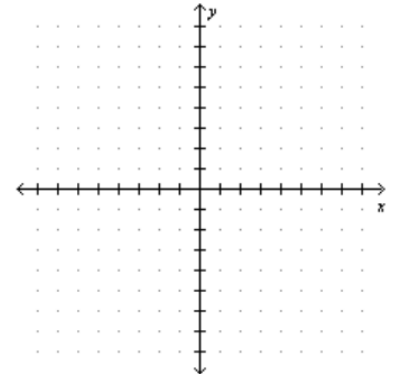
foci:



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



5. Analyze and graph. $9x^2 - 4y^2 = 36$



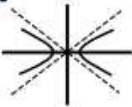

center:

vertices:

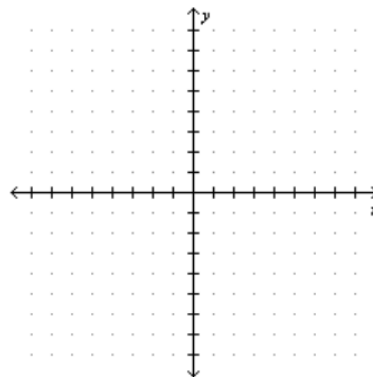
transverse axis:

foci:

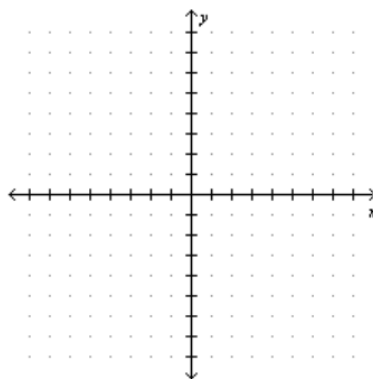
C. Hyperbolas centered at (h, k) with Transverse Axis parallel to a Coordinate Axis

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	$y - k = \pm \frac{b}{a}(x - h)^*$	$y - k = \pm \frac{a}{b}(x - h)^*$
Foci	$(h + c, k), (h - c, k)$	$(h, k + c), (h, k - c)$

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



7. Analyze and graph. $-x^2 + 4y^2 - 2x - 16y + 11 = 0$



center:

vertices:

transverse axis:

foci: