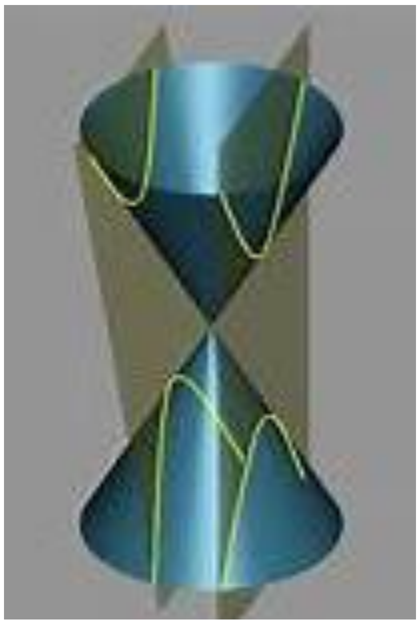
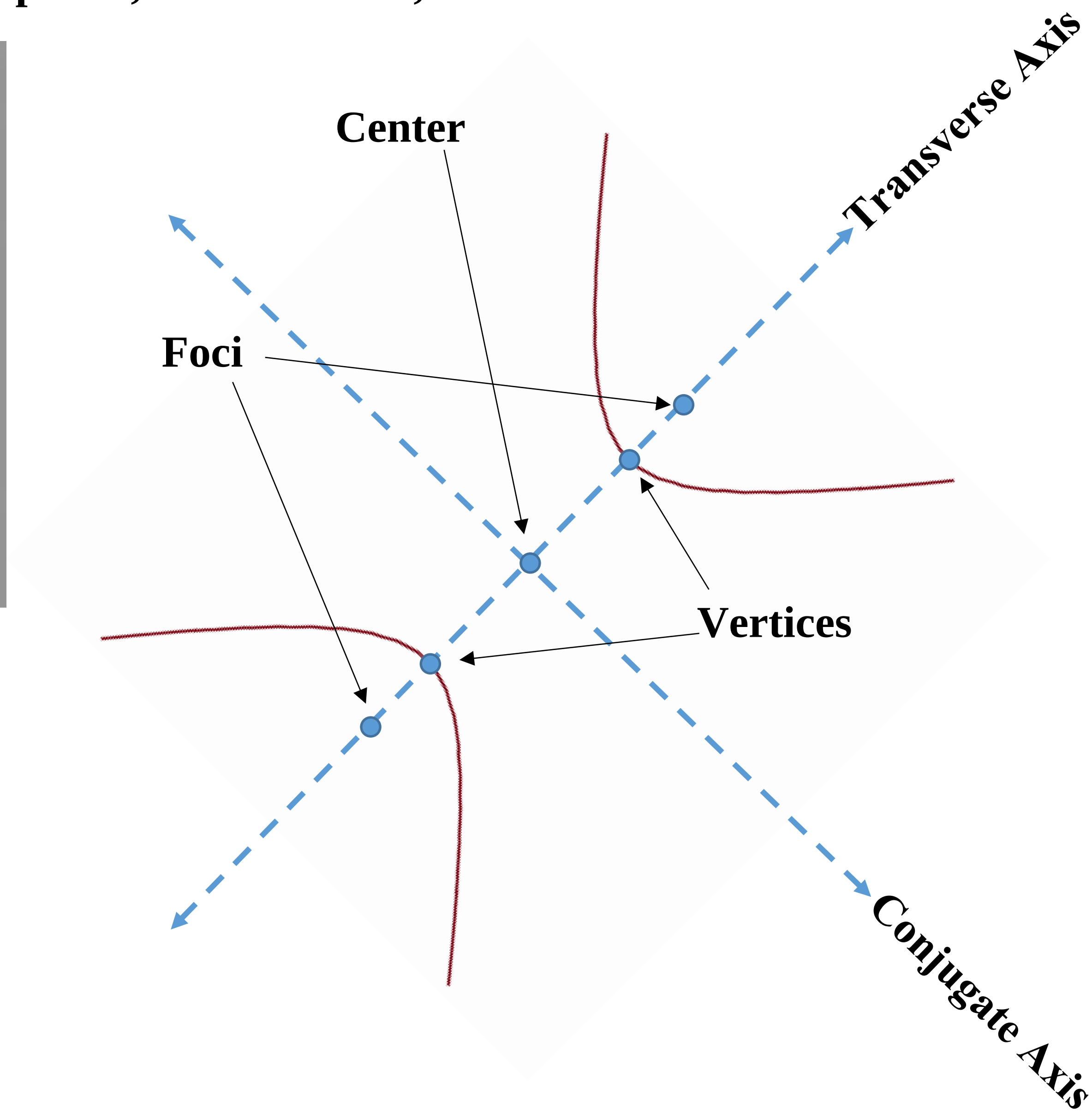
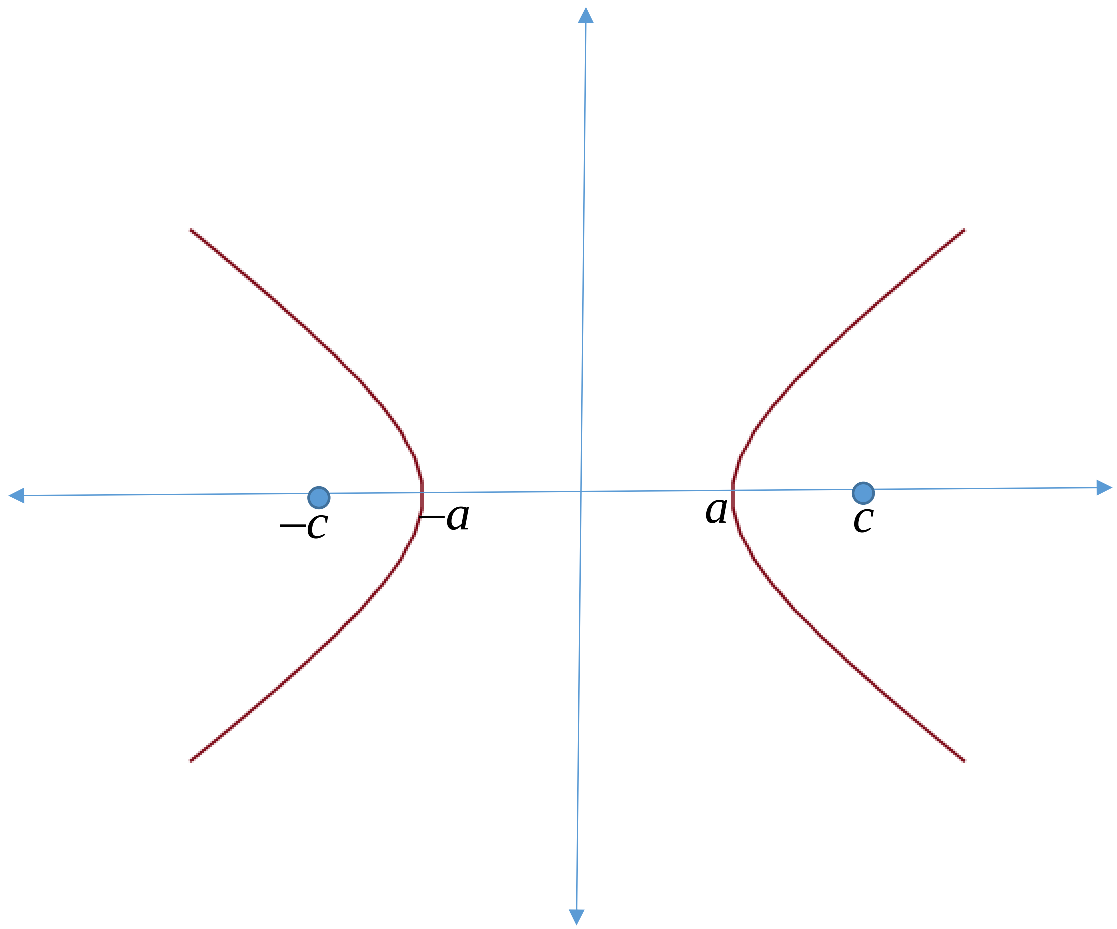
<u>Hyperbola:</u> The set of points in the plane the difference of whose distances to two fixed points, called the foci, is a constant.

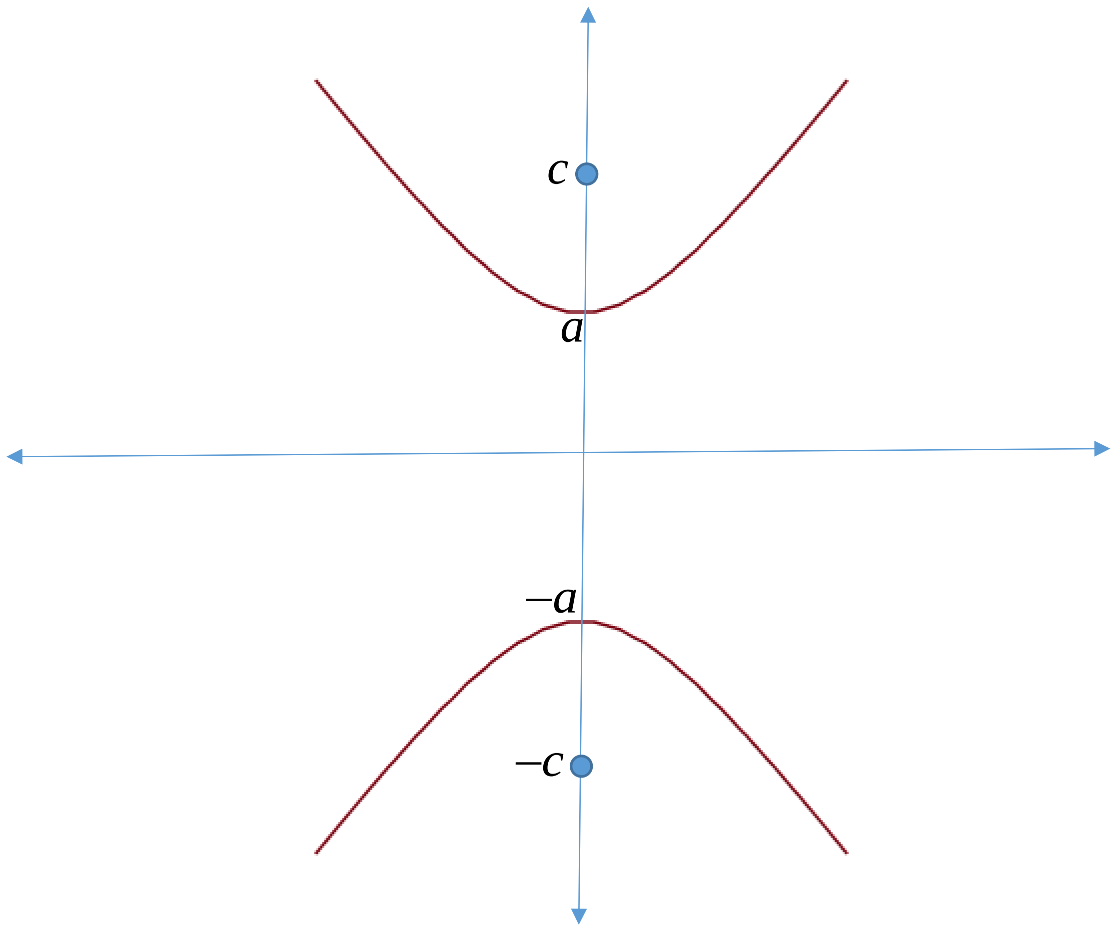




Hyperbolas centered at the origin with transverse and conjugate axes of the *x* and *y* axes.



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



$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1, \; c^2 = a^2 + b^2$$

Where is *b* on the graph?

<u>Asymptotes:</u> Hyperbolas have a pair of asymptotes.

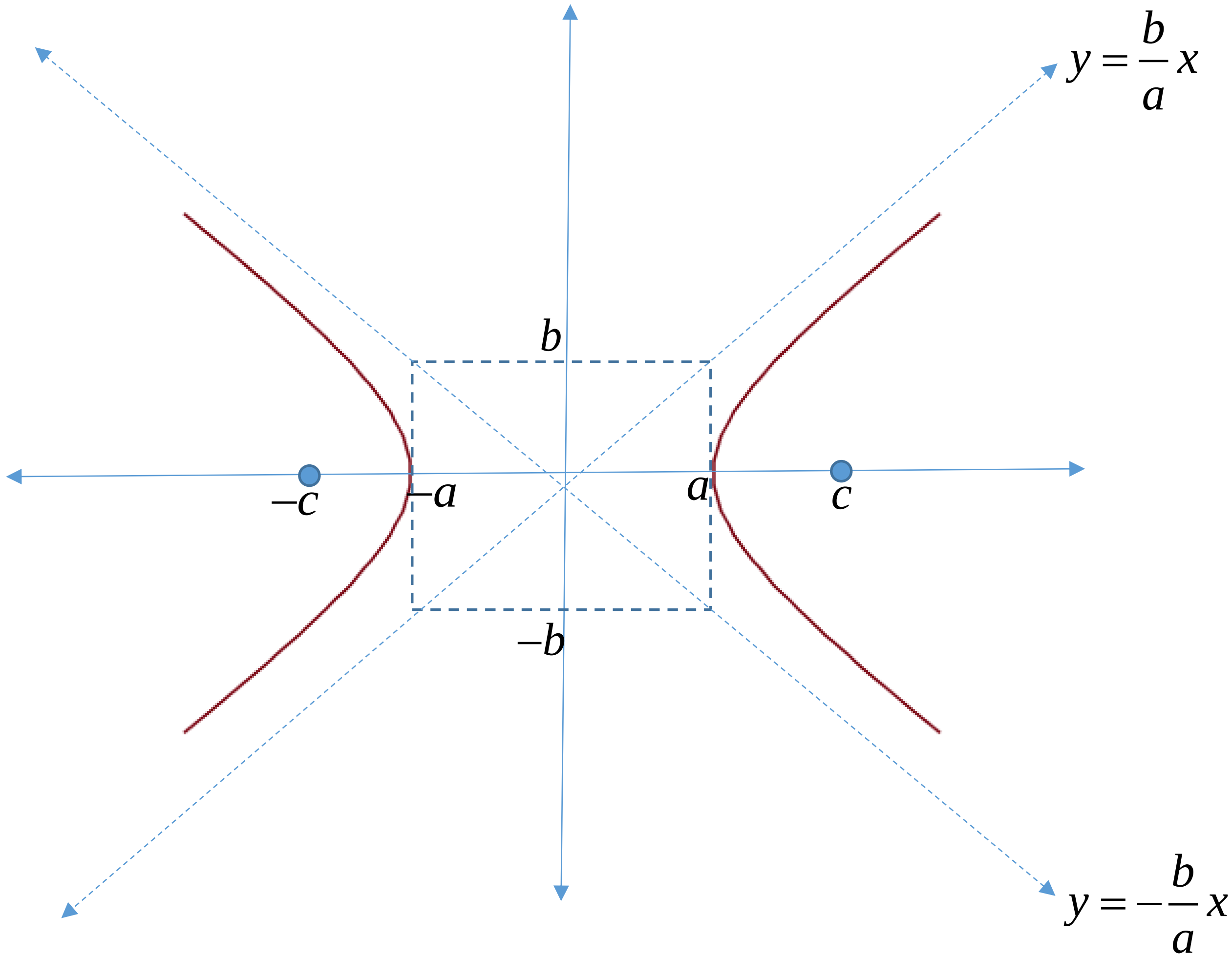
$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

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

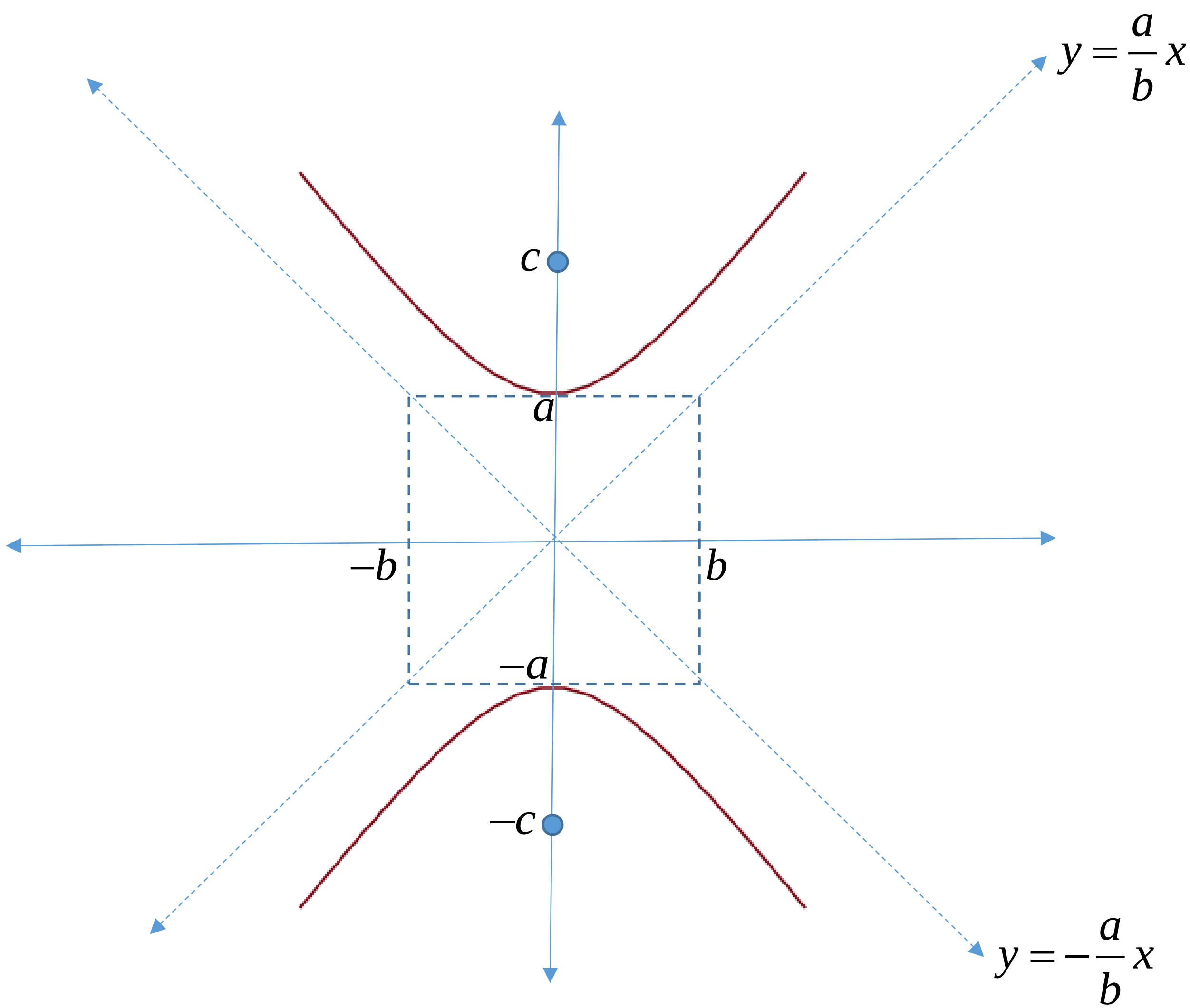
$$y^2 = \frac{b^2 x^2}{a^2} - b^2$$

$$y^2 = x^2\left[\frac{b^2}{a^2} - \frac{b^2}{x^2}\right]$$

So for x^2 large, $y^2 \approx \frac{b^2}{a^2}x^2$, so the asymptotes are $y = \pm\frac{b}{a}x$.

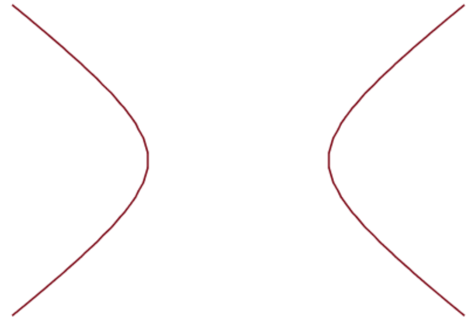


The extensions of the diagonals of the rectangle form the asymptotes.

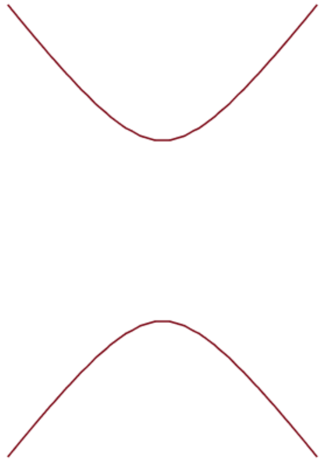


The extensions of the diagonals of the rectangle form the asymptotes.

Sketch the graphs of the following hyperbolas.

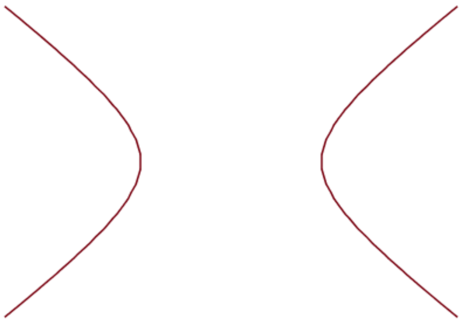


1. $\frac{x^2}{25} - \frac{y^2}{9} = 1$



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

3. $4x^2 - y^2 = 16$



Not necessarily centered at the origin

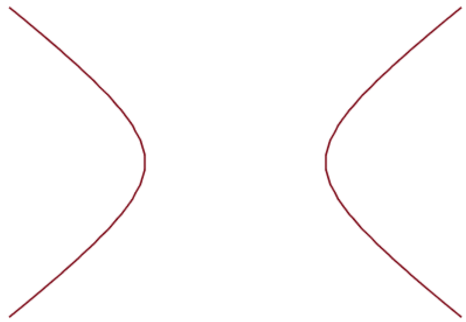
$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

Or

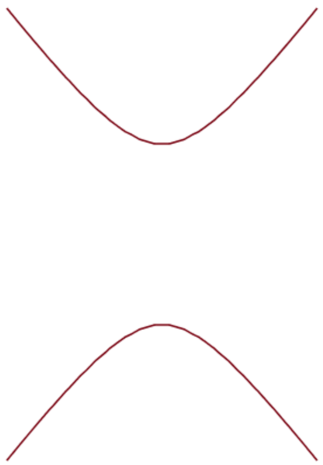
$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

Sketch the following hyperbolas.

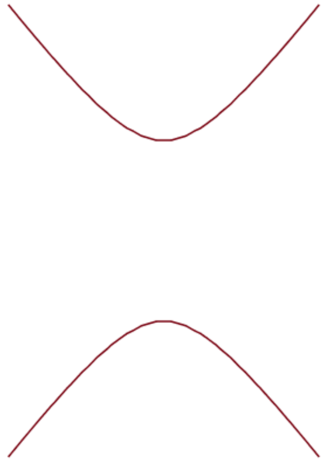
1. $\frac{(x-2)^2}{4} - \frac{(y+3)^2}{9} = 1$



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

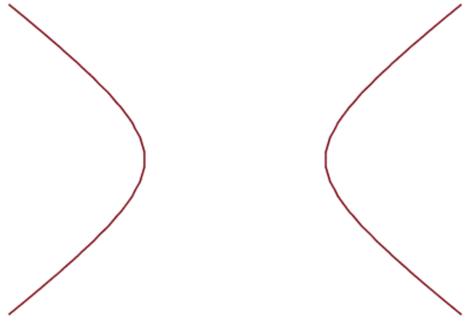


3. $y^2 - x^2 - 4y + 4x - 1 = 0$

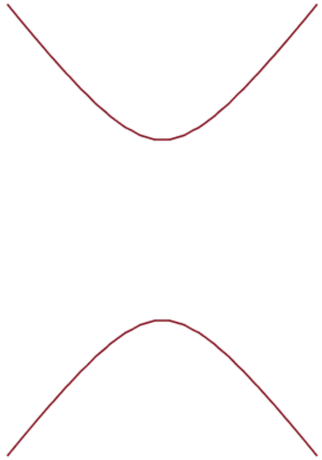


Find an equation for the hyperbola being described.

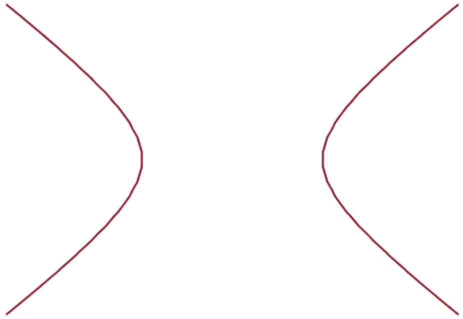
1. Center at $(0,0)$, focus at $(3,0)$, and vertex at $(1,0)$.



2. Focus at $(0,6)$ and vertices at $(0,\pm 2)$.



3. Center at $(4,-1)$, focus at $(7,-1)$, and vertex at $(6,-1)$.



4. Focus at $(-4,0)$ **and vertices at** $(-4,4)$ **and** $(-4,2)$**.**