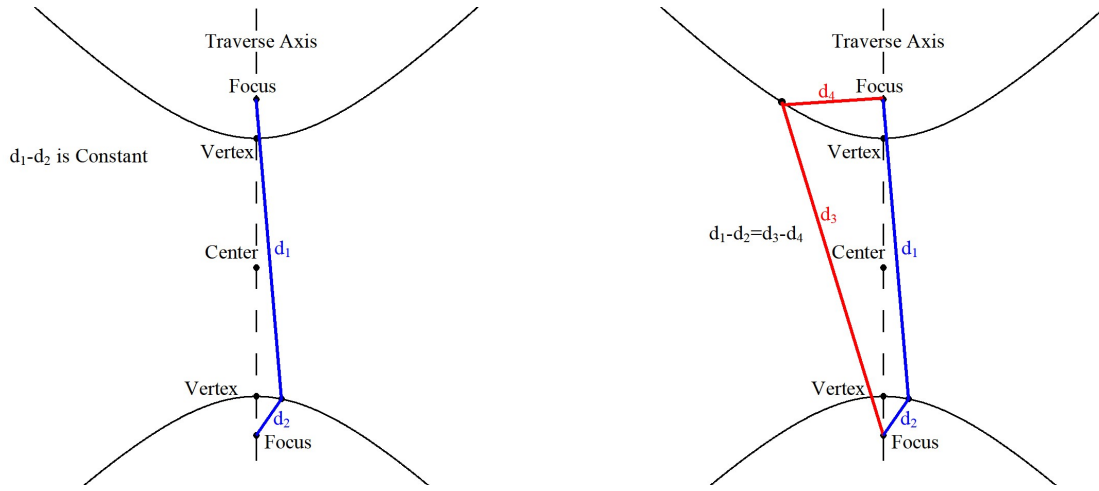


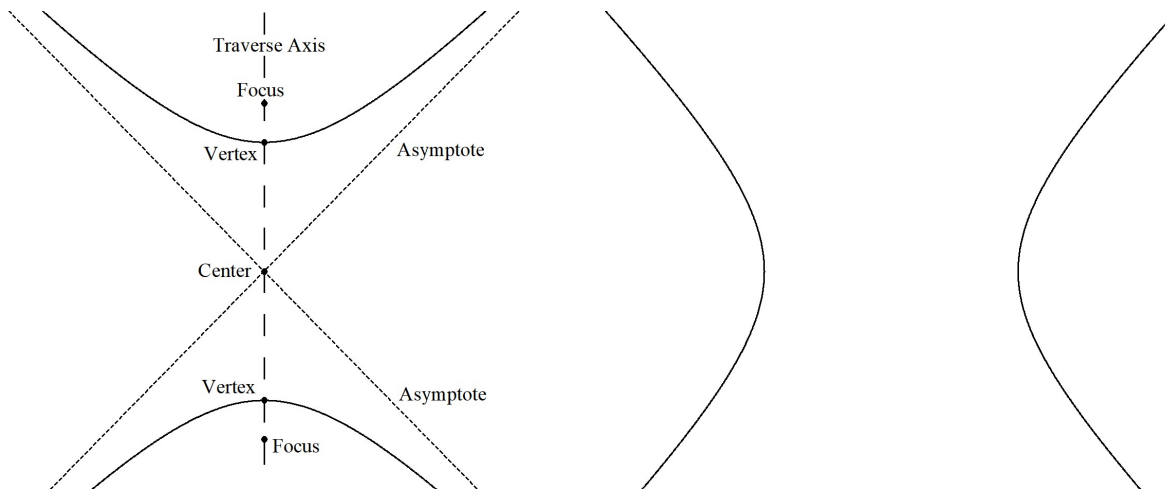
# 7.4 The Hyperbola

## ▼ Geometric Definition of a Hyperbola

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



## ▼ Vocabulary of a Hyperbola



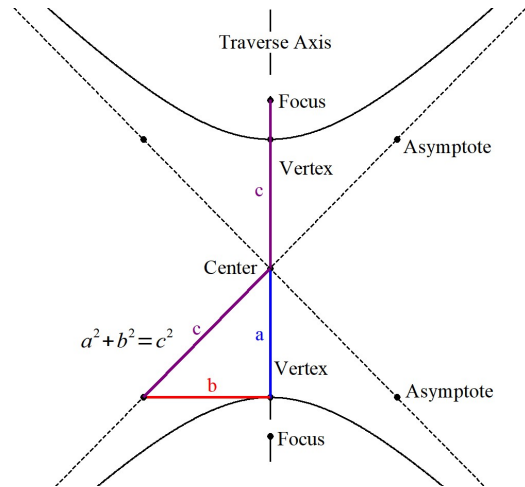
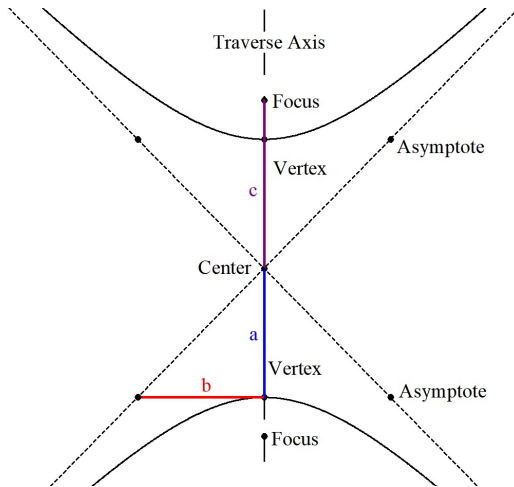
▼ Important Components of the Equations

$a$  : distance from center to vertex

$b$  : helps define slope of the asymptotes

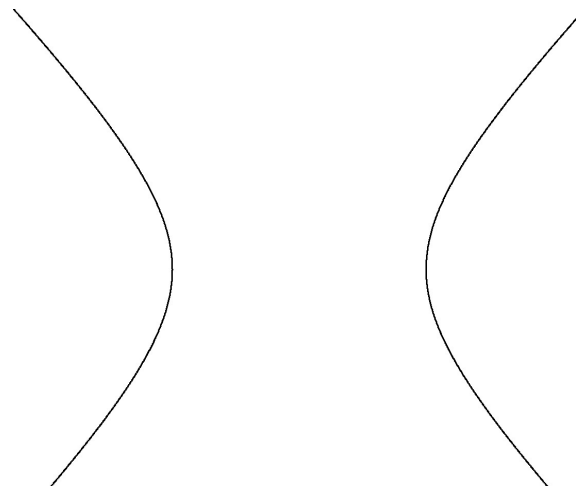
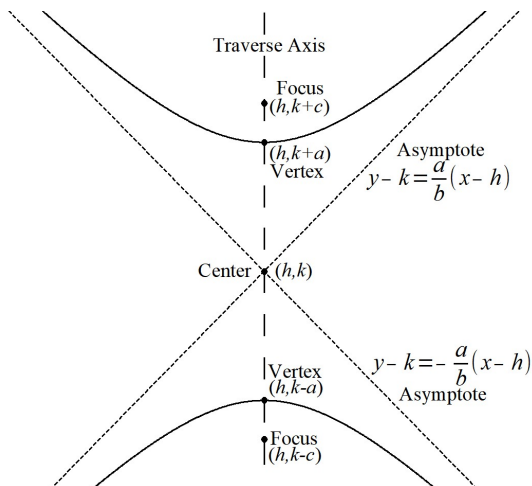
$c$  : distance from center to focus

Related by Pythagorean theorem



▼ Labeling the Ordered Pairs and Equations

When you know the center,  $a$ ,  $b$ , and  $c$  you can find all of the significant features of the hyperbola



▼ Equations of a hyperbola with center at the origin  $(0, 0)$ .

**Horizontal Traverse Axis ( $y = 0$ )**

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

Asymptotes:  $y = \pm \frac{b}{a}x$

$$a^2 + b^2 = c^2$$

**Vertical Traverse Axis ( $x = 0$ )**

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

Asymptotes:  $y = \pm \frac{a}{b}x$

$$a^2 + b^2 = c^2$$

▼ Equations of a hyperbola with center at  $(h, k)$ .

**Horizontal Traverse Axis ( $y = k$ )**

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

Asym:  $y - k = \pm \frac{b}{a}(x - h)$

$$a^2 + b^2 = c^2$$

**Vertical Traverse Axis ( $x = h$ )**

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

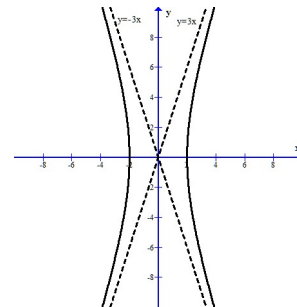
Asym:  $y - k = \pm \frac{a}{b}(x - h)$

$$a^2 + b^2 = c^2$$

▼ Examples: Given the graph find the features and equation

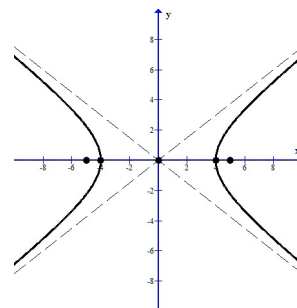
▼ Example 1:

Find the equation of the hyperbola, the center, vertices, foci, traverse axis, asymptotes



▼ Example 2:

Find the equation of the hyperbola, the center, vertices, foci, traverse axis, asymptotes

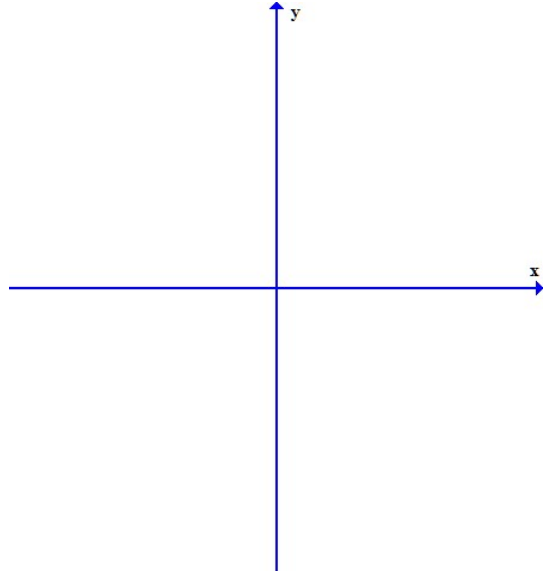


▼ Examples: Given the features find the equation and the graph

▼ Example 1:

Find the orientation, center, vertices, foci, and write the equation of the hyperbola.

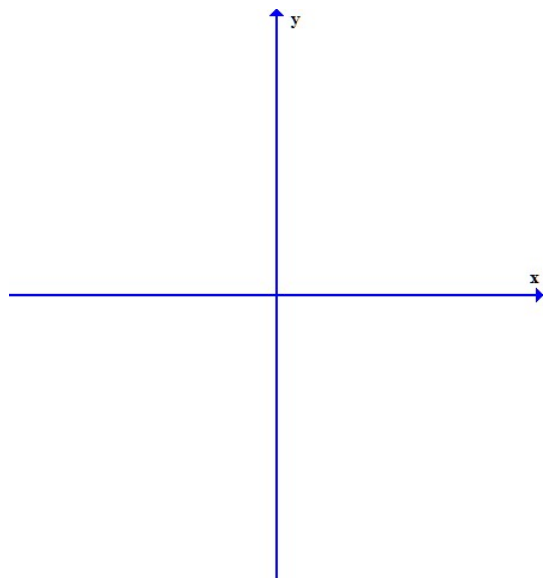
The foci is  $(0, \pm 2)$  and the length of the major axis is 8.



▼ Example 2:

Find the orientation, center, vertices, and write the equation of the hyperbola.

The center is at  $(2, 1)$ ; One vertex is at  $(7, 1)$ ; One focus is at  $(-1, 1)$ .

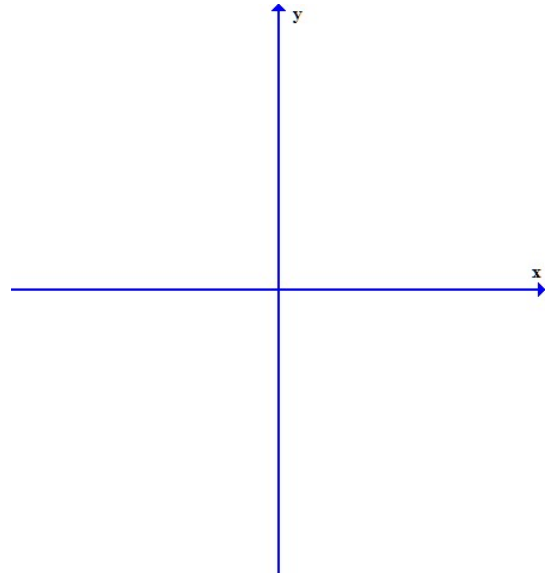


▼ Examples: Given the equations find the features and graph

▼ Example 1:

Find the orientation, center, vertices, and graph of the hyperbola.

$$\frac{(x - 3)^2}{16} - \frac{(y + 4)^2}{79} = 1$$



▼ Example 2:

Rewrite using completing the square. Find the orientation, center, vertices, and graph of the hyperbola.

$$x^2 - 2x + 16y^2 + 32y + 1 = 0$$

