

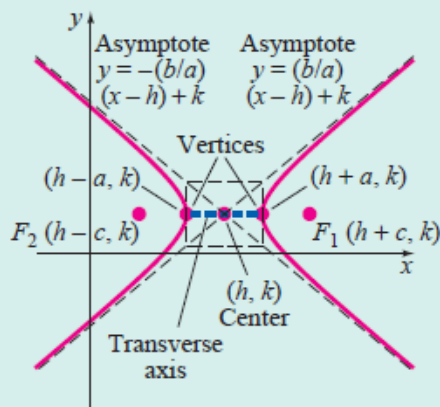
Hyperbolas with Center at the Origin

	Horizontal Transverse Axis	Vertical Transverse Axis
Graph	<p>Figure 9.3.3</p>	<p>Figure 9.3.4</p>
Equation	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, a, b > 0$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1, a, b > 0$
Center	$(0, 0)$	$(0, 0)$
Foci	$(-c, 0), (c, 0), c = \sqrt{a^2 + b^2}$	$(0, -c), (0, c), c = \sqrt{a^2 + b^2}$
Vertices	$(-a, 0), (a, 0)$	$(0, -a), (0, a)$
Transverse axis	Segment of x -axis from $(-a, 0)$ to $(a, 0)$	Segment of y -axis from $(0, -a)$ to $(0, a)$
Asymptotes	The lines $y = \frac{b}{a}x$ and $y = -\frac{b}{a}x$	The lines $y = \frac{a}{b}x$ and $y = -\frac{a}{b}x$

Hyperbolas with Center at (h, k)

Horizontal Transverse Axis

Figure 9.3.9



$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1, a, b > 0$$

Equation

Center

$$(h, k)$$

Foci

$$(h-c, k), (h+c, k), c = \sqrt{a^2 + b^2}$$

Vertices

$$(h-a, k), (h+a, k)$$

Transverse axis

Segment of the line $y = k$
from $(h-a, k)$ to $(h+a, k)$

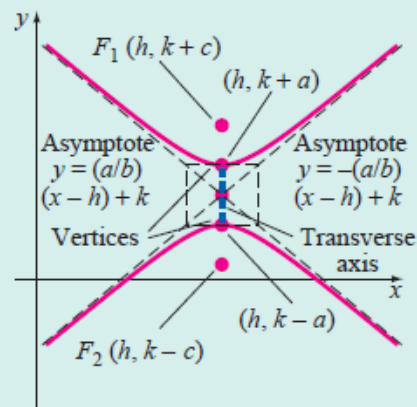
Asymptotes

The lines $y = \frac{b}{a}(x-h) + k$

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

Vertical Transverse Axis

Figure 9.3.10



$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1, a, b > 0$$

Center

(h, k)

Foci

$$(h, k-c), (h, k+c), c = \sqrt{a^2 + b^2}$$

Vertices

$$(h, k-a), (h, k+a)$$

Transverse axis

Segment of the line $x = h$
from $(h, k-a)$ to $(h, k+a)$

Asymptotes

The lines $y = \frac{a}{b}(x-h) + k$

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

► Hyperbola with a horizontal transverse axis:

Equation	$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1, a, b > 0$
Center	(h, k)
Foci	$(h - c, k), (h + c, k), c = \sqrt{a^2 + b^2}$
Vertices	$(h - a, k), (h + a, k)$
Transverse axis	Parallel to the x -axis between $(h - a, k)$ and $(h + a, k)$
Asymptotes	$y = \frac{b}{a}(x - h) + k$ and $y = -\frac{b}{a}(x - h) + k$

► Hyperbola with a vertical transverse axis:

Equation	$\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1, a, b > 0$
Center	(h, k)
Foci	$(h, k - c), (h, k + c), c = \sqrt{a^2 + b^2}$
Vertices	$(h, k - a), (h, k + a)$
Transverse axis	Parallel to the y -axis between $(h, k - a)$ and $(h, k + a)$
Asymptotes	$y = \frac{a}{b}(x - h) + k$ and $y = -\frac{a}{b}(x - h) + k$