

9.3 Hyperbolas

Key Characteristics

- Center **A**
- Vertices **B, C**
- Foci **E, D**
- Transverse Axis \overline{CB} connects vertices
- Conjugate Axis \overline{XY}
- Asymptotes

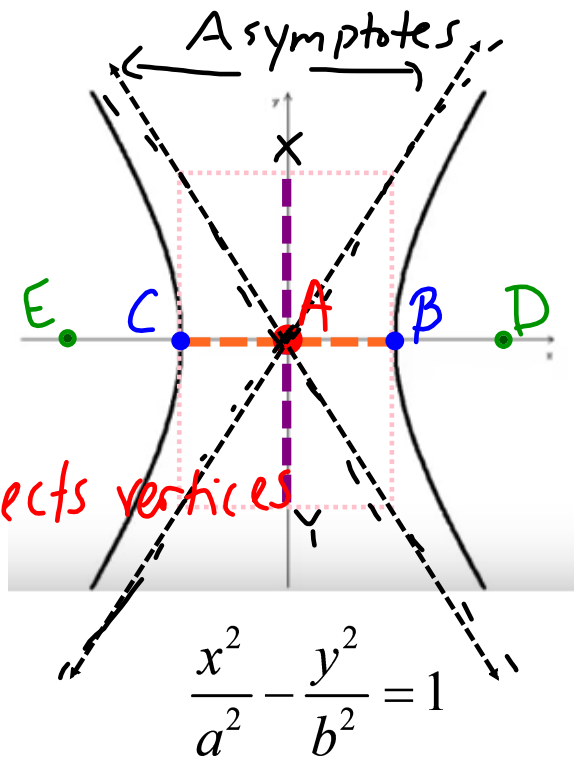


Table 9.2 Standard Forms of Equations of Hyperbolas Centered at (h, k)

Equation	Center	Transverse Axis	Vertices	Graph
$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ <p>Vertices are a units right and a units left of center.</p> <p>Foci are c units right and c units left of center, where $c^2 = a^2 + b^2$.</p>	(h, k)	Parallel to the x -axis; horizontal	$(h - a, k)$ $(h + a, k)$	
$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$ <p>Vertices are a units above and a units below the center.</p> <p>Foci are c units above and c units below the center, where $c^2 = a^2 + b^2$.</p>	(h, k)	Parallel to the y -axis; vertical	$(h, k - a)$ $(h, k + a)$	

Equations of asymptotes:

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

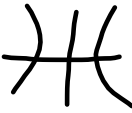
Asymptotes

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

Standard Equation of a Hyperbola

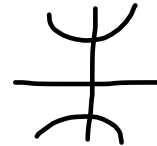
"Horizontal" Hyperbola:

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



"Vertical" Hyperbola:

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



Center: (h, k)

Foci are c units away from the center along the transverse axis.

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

1.) Graph: $\frac{y^2}{9} - \frac{x^2}{16} = 1$

vert. movement $a=3$ $b=4$ hor. movement

Center: $(0, 0)$

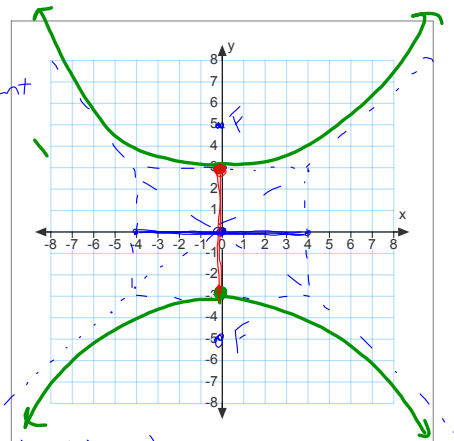
Lines Containing Axes:
 transverse: $X=0$
 conjugate: $Y=0$

Vertices:
 $(0, 3), (0, -3)$

Foci: $c^2 = a^2 + b^2$
 $c^2 = 9 + 16 = 25$ $(c=5)$
 $(0, 5), (0, -5)$

Equations of Asymptotes:

$$y = \pm \frac{3}{4}x$$



2.) Graph: $\frac{(x-2)^2}{16} - \frac{(y-3)^2}{9} = 1$
 $a=4$ $b=3$

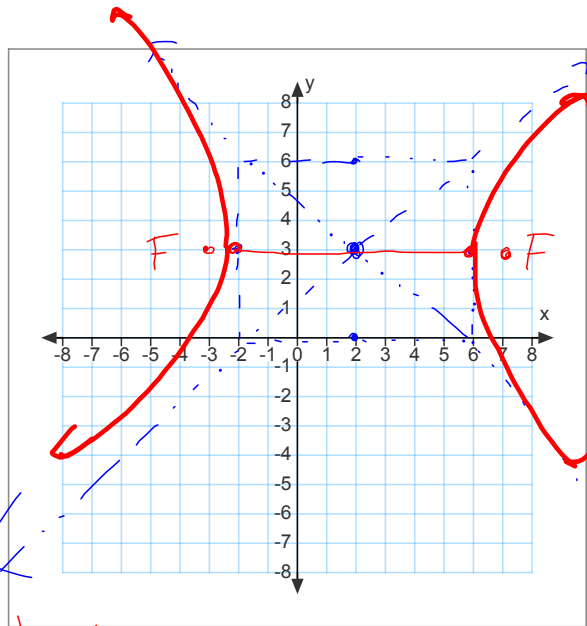
Center: $(2, 3)$

Lines Containing Axes:
 transverse: $y=3$
 conjugate: $x=2$

Vertices: $(6, 3), (-2, 3)$

Foci: $c^2 = 16 + 9 = 25$ $c=5$
 $(-3, 3), (7, 3)$

Equations of Aysmptotes: $y = k \pm \frac{b}{a}(x-h)$
 $y = 3 \pm \frac{3}{4}(x-2)$



Write the standard form of the equation, find the indicated values and graph:

3.) $4x^2 - 24x - 25y^2 + 250y - 489 = 0$

$4(x^2 - 6x + 9) - 25(y^2 - 10y + 25) = 489$
 $+36$
 -625

$\frac{4(x-3)^2}{-100} - \frac{25(y-5)^2}{-100} = \frac{-100}{-100}$

Center: $\frac{-(x-3)^2}{25} + \frac{(y-5)^2}{4} = 1$ $\frac{(y-5)^2}{4} - \frac{(x-3)^2}{25} = 1$

Lines Containing Axes:

Vertices:

Foci:

Equations of Aysmptotes:

