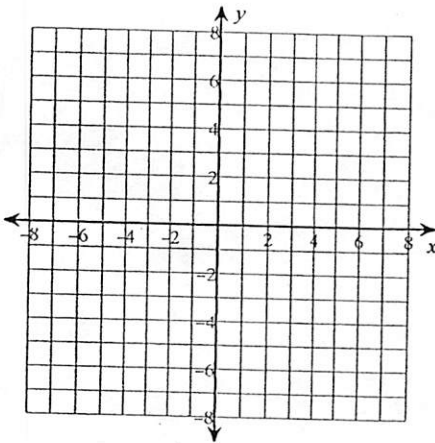


## Hyperbola Notes

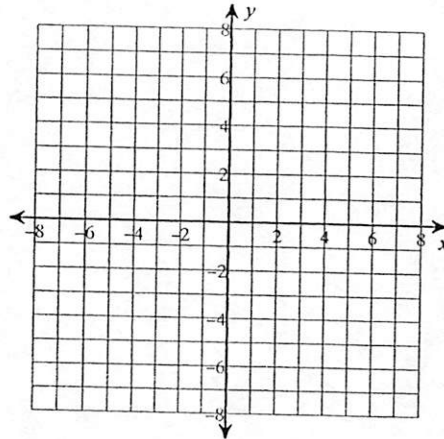
- ✓ I know the differences and similarities of an equation of a hyperbola and an ellipse.
- ✓ I can write the general form of an equation to standard form of a hyperbola
- ✓ I know how to find the asymptotes of a hyperbola
- ✓ I can graph a hyperbola by using the vertices, transverse axis (horizontal & vertical), asymptotes & foci.
- ✓ I can find the equation of a hyperbola given key features.

Identify the center, vertices, foci, eccentricity, equation of the asymptotes, and direction of opening. Then sketch the graph.

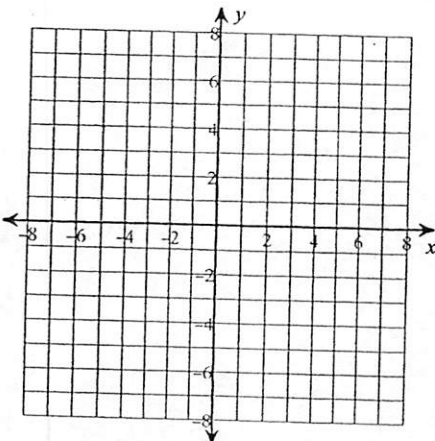
1)  $\frac{y^2}{4} - \frac{x^2}{25} = 1$



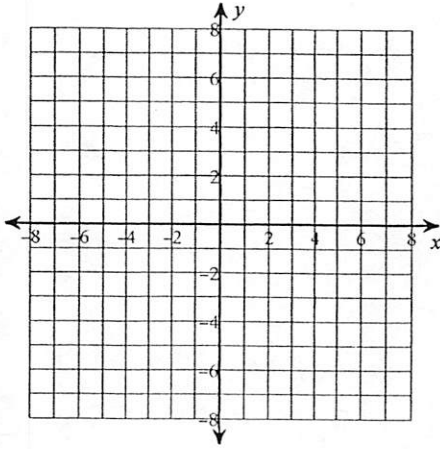
2)  $25x^2 - 4y^2 - 100 = 0$



3)  $\frac{(y-1)^2}{9} - \frac{(x+1)^2}{16} = 1$



$$4) 9x^2 - 4y^2 - 18x + 16y - 43 = 0$$



Use the information provided to write the standard form equation of each hyperbola.

5) Vertices:  $(-1, 9)$ ,  $(-15, 9)$   
 Endpoints of Conjugate Axis:  $(-8, 18)$   
 $(-8, 0)$

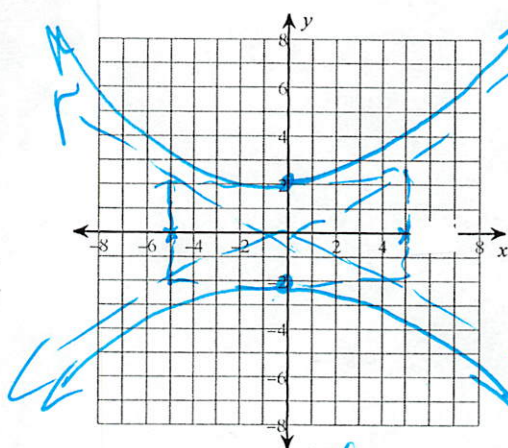
6) Vertices:  $(3, 17)$ ,  $(3, -3)$   
 Asymptotes:  $y = \frac{5}{3}x + 2$   
 $y = -\frac{5}{3}x + 12$

# Hyperbola Notes

- ✓ I know the differences and similarities of an equation of a hyperbola and an ellipse.
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1)  $\frac{y^2}{4} - \frac{x^2}{25} = 1$

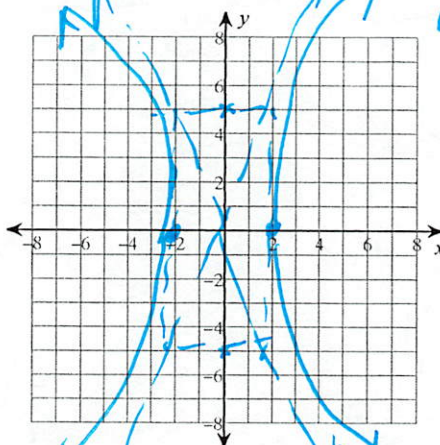


asy:  $y = \pm \frac{2}{5}x$

$c^2 = 4 + 25$   
 $c = \sqrt{29}$

Opens: up & down  
center: (0,0)  
vertices: (0, ±2)  
foci: (0, ±√29)

2)  $25x^2 - 4y^2 - 100 = 0$

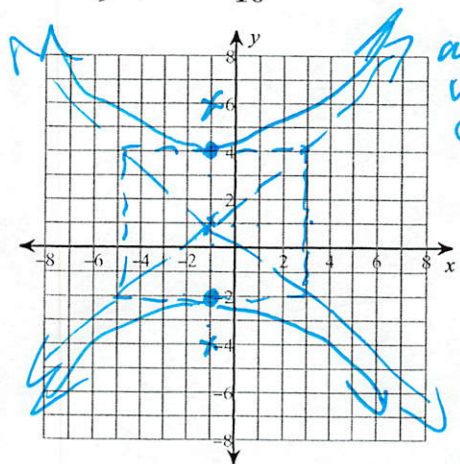


asy:  $y = \pm \frac{5}{2}x$

vert: (±2, 0)  
foci: (±√29, 0)  
opens left & right

$25x^2 - 4y^2 = 100$   
 $\frac{x^2}{4} - \frac{y^2}{25} = 1$

3)  $\frac{(y-1)^2}{9} - \frac{(x+1)^2}{16} = 1$



Center (-1, 1)

asy:  $y = \pm \frac{3}{4}(x+1) + 1$

$c^2 = 9 + 16$   
 $c = 5$

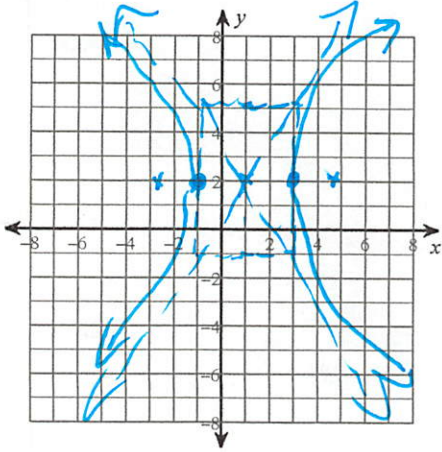
vertices (-1, 4)  
(-1, -2)

foci (-1, 6)  
(-1, -4)

opens up & down

$e = \frac{5}{3}$

4)  $9x^2 - 4y^2 - 18x + 16y - 43 = 0$



$$9x^2 - 18x - 4y^2 + 16y = 43$$

$$9(x^2 - 2x + 1) - 4(y^2 - 4y + 4) = 43$$

$$+9 - 16$$

$$9(x-1)^2 - 4(y-2)^2 = 36$$

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

$$c^2 = 4 + 9$$

$$c = \sqrt{13}$$

Center (1, 2)

Vertices (-1, 2) (3, 2)

Foci  $(1 \pm \sqrt{13}, 2)$

Asy:  $y = \pm \frac{3}{2}(x-1) + 2$

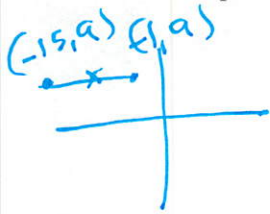
opens left and right

$$e = \frac{\sqrt{13}}{2}$$

Use the information provided to write the standard form equation of each hyperbola.

5) Vertices: (-1, 9), (-15, 9)

Endpoints of Conjugate Axis: (-8, 18), (-8, 0)



$h, k (-8, 9)$   
 $2a = 14$   
 $a = 7$

Conjugate axis  
 $2b = 18$   
 $b = 9$

opens left/right

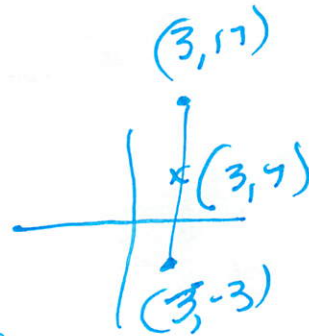
$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$\boxed{\frac{(x+8)^2}{49} - \frac{(y-9)^2}{81} = 1}$$

6) Vertices: (3, 17), (3, -3)

Asymptotes:  $y = \frac{5}{3}x + 2$

$$y = -\frac{5}{3}x + 12$$



opens up/down

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

$$2a = 20$$

$$a = 10$$

$$(h, k) = 3, 7$$

$$y = \frac{5}{3}x + 2$$

$$\frac{5}{3} = \frac{a}{b} = \frac{10}{b}$$

$$b = 6$$

$$\frac{(y-7)^2}{100} - \frac{(x-3)^2}{36} = 1$$

## Hyperbolas

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### Hyperbolas with Center (0, 0)

Equation	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$
Graph		
Direction of Opening		
Vertices		
Foci		
Asymptotes		
Transverse Axis		
Conjugate Axis		
Eccentricity		

## Hyperbolas with Center (0, 0)

Equation	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$
Graph		
Direction of Opening	(H)	(V)
Vertices	$(\pm a, 0)$	$(0, \pm a)$
Foci	$(\pm c, 0)$ $c^2 = a^2 + b^2$	$(0, \pm c)$ $c^2 = a^2 + b^2$
Asymptotes	$y = \pm \frac{b}{a}x$	$y = \pm \frac{a}{b}x$
Transverse Axis	<i>Length of 2a</i>	<i>Length of 2a</i>
Conjugate Axis	<i>Length of 2b</i>	<i>Length of 2b</i>
Eccentricity	$e = \frac{c}{a}$	$e = \frac{c}{a}$

### Hyperbolas with Center (h, k)

Equation	$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$
Graph		
Direction of Opening		
Vertices		
Foci		
Asymptotes		
Transverse Axis		
Conjugate Axis		
Eccentricity		

### Hyperbolas with Center (h, k)

Equation	$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$
Graph		
Direction of Opening	(H) $y = k$	(V) $x = h$
Vertices	$(h \pm a, k)$	$(h, k \pm a)$
Foci	$(h \pm c, k)$	$(h, k \pm c)$
Asymptotes	$y = \pm \frac{b}{a}(x-h) + k$	$y = \pm \frac{a}{b}(x-h) + k$
Transverse Axis	<i>Length of 2a</i>	<i>Length of 2a</i>
Conjugate Axis	<i>Length of 2b</i>	<i>Length of 2b</i>
Eccentricity	$e = \frac{c}{a}$	$e = \frac{c}{a}$