

Warm-up
4.30.17
10.4 Hyperbolas

Sketch the lines.

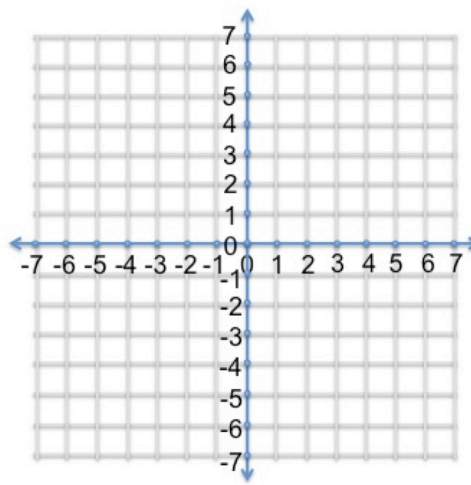
1) $y = \frac{2}{3}x$

2) $y = -\frac{4}{3}x$

Where is the center?

3) $(x - 2)^2 + (y - 5)^2 = 4$

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



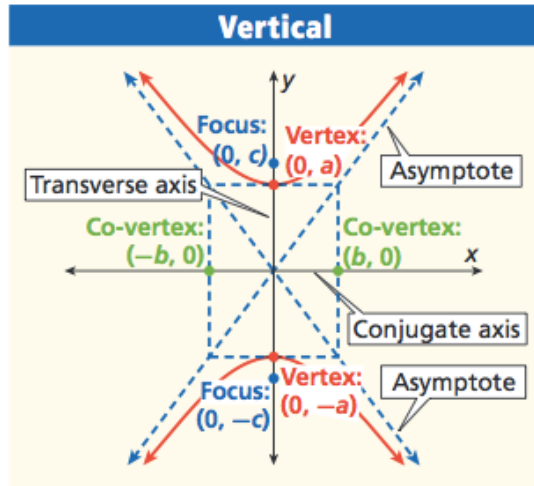
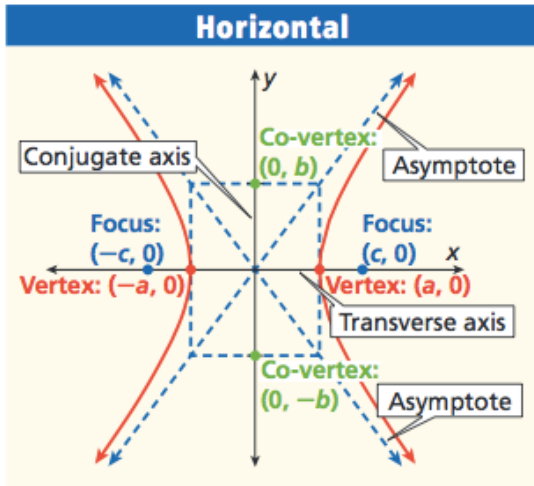
Hyperbolas

10.4



- A **hyperbola** is the set of points P in a plane such that the difference of the distances from P to the foci is constant.

- A hyperbola is made up of two **branches**.
- The **transverse axis** of symmetry contains the *vertices and foci*.
- The **conjugate axis** of symmetry separates the two branches of the hyperbola and contains the *co-vertices*.



Standard Form for the Equation of a Hyperbola Center at (0, 0)

TRANSVERSE AXIS	HORIZONTAL	VERTICAL
Equation	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$
Vertices	$(a, 0), (-a, 0)$	$(0, a), (0, -a)$
Foci	$(c, 0), (-c, 0)$	$(0, c), (0, -c)$
Co-vertices	$(0, b), (0, -b)$	$(b, 0), (-b, 0)$
Asymptotes	$y = \pm \frac{b}{a}x$	$y = \pm \frac{a}{b}x$

Pg. 745

Question!

For ellipses, are $\frac{y^2}{a^2} + \frac{x^2}{b^2} = 1$ and $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$ the same?

What about for hyperbolas?

Are $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$ and $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ the same?

What do you remember about the “a” for ellipses

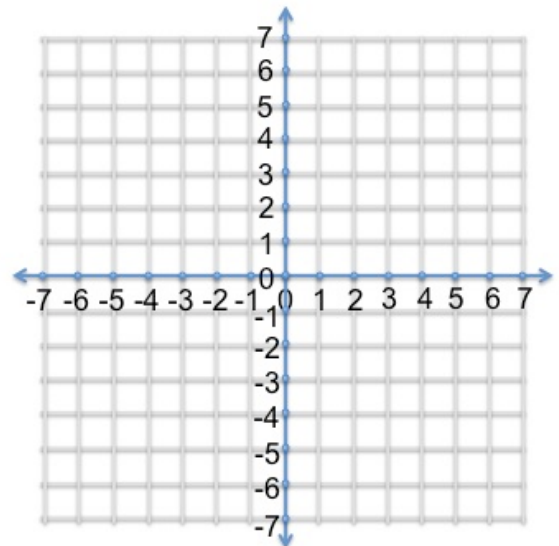
A is always first!

I do.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	Vertical
Identify “a” and “b”	$a^2 = 4, \quad a = 2$ $b^2 = 9, \quad b = 3$
Identify the Center, vertices, and co-vertices	Center: (0,0) Vertices: (0,2),(0,-2) Co-Vertices:(3,0),(-3,0)
Identify the Asymptotes:	$y = \pm \frac{2}{3}x$
Vertical $y = \pm \frac{a}{b}x$ Horizontal $y = \pm \frac{b}{a}x$	

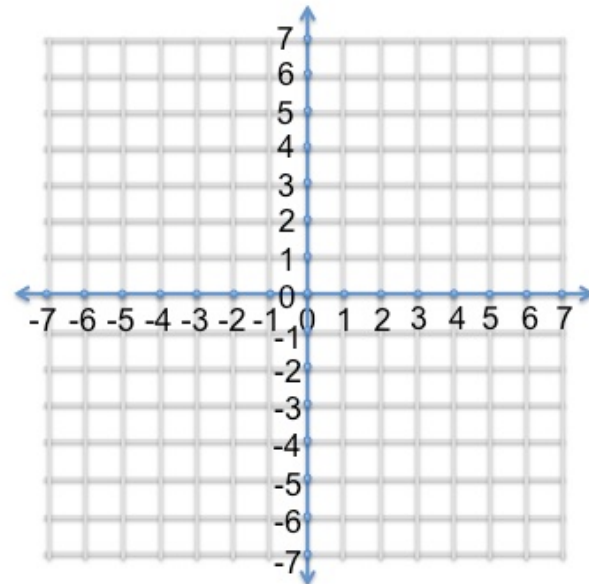


We do.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify the Center, vertices, and co-vertices	Center: Vertices: Co-Vertices:
Identify a and b	a= b=
Identify the Asymptotes	

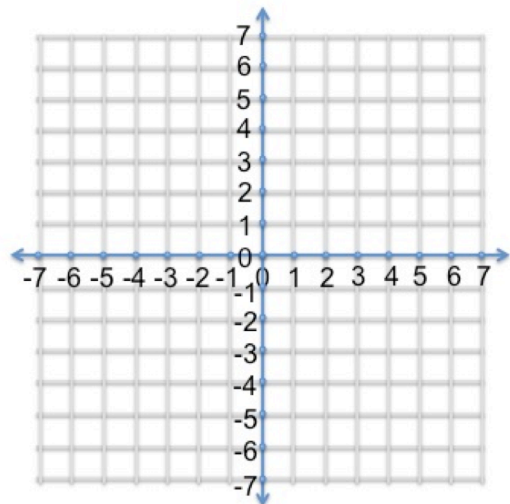


We do.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify the Center, vertices, and co-vertices	Center: Vertices: Co-Vertices:
Identify a and b	a= b=
Identify the Asymptotes	



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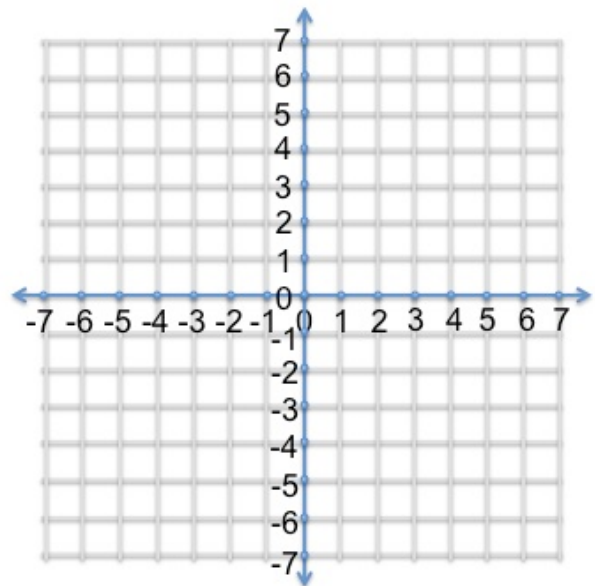
You do with a partner in your notes.

Odd rows talk, Even rows write.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify the Center, vertices, and co-vertices	Center: V: CV:
Identify a and b	a= b=
Identify the Asymptotes Vertical $y = \pm \frac{a}{b}x$ Horizontal $y = \pm \frac{b}{a}x$	



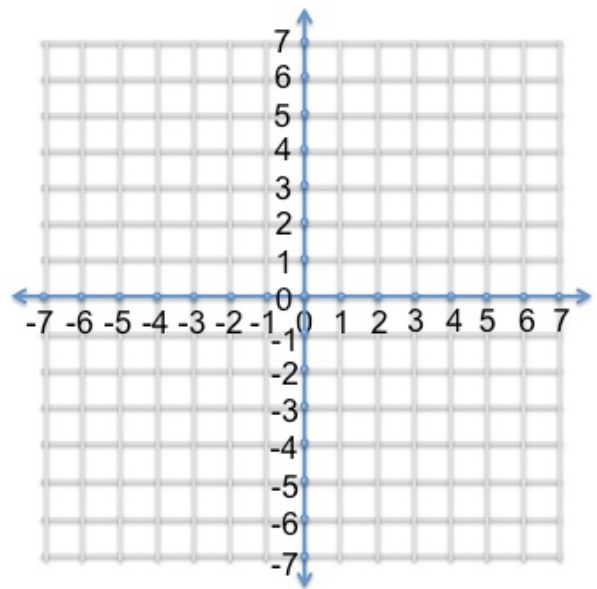
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Even rows talk, Odd rows write.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify the Center, vertices, and co-vertices	C: V: CV:
Identify a and b	a= b=
Identify the Asymptotes Vertical $y = \pm \frac{a}{b}x$ Horizontal $y = \pm \frac{b}{a}x$	



Adding in H and K

What does H and K do again?

Compare and contrast

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

and

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

Standard Form for the Equation of a Hyperbola Center at (h, k)

TRANSVERSE AXIS	HORIZONTAL	VERTICAL
Equation	$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$	$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$
Vertices	$(h+a, k), (h-a, k)$	$(h, k+a), (h, k-a)$
Foci	$(h+c, k), (h-c, k)$	$(h, k+c), (h, k-c)$
Co-vertices	$(h, k+b), (h, k-b)$	$(h+b, k), (h-b, k)$
Asymptotes	$y - k = \pm \frac{b}{a}(x - h)$	$y - k = \pm \frac{a}{b}(x - h)$

Pg. 746

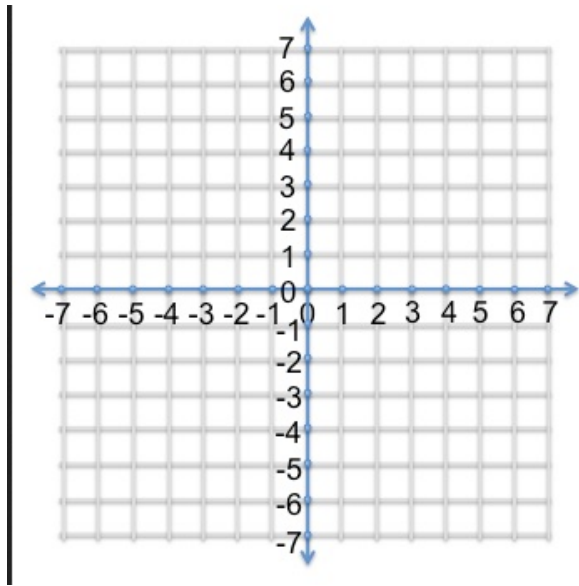
Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	Horizontal
Identify a and b	$a^2 = 4, \quad a = 2$ $b^2 = 9, \quad b = 3$
Identify the center, vertices, co-vertices.	Center: $(2, -1)$ Vertices $(2+2, -1), (2-2, -1)$ $(4, -1), (0, -1)$ Co-Vertices: $(2, -1+3), (2, -1-3)$ $(2, 2), (2, -4)$
Identify the Asymptotes Vertical:	

$y - k = \pm \frac{a}{b} (x - h)$ Horizontal: $y - k = \pm \frac{b}{a} (x - h)$	$y + 1 = \pm \frac{3}{2} (x - 2)$
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$$\frac{(x - 2)^2}{4} - \frac{(y + 1)^2}{9} = 1$$

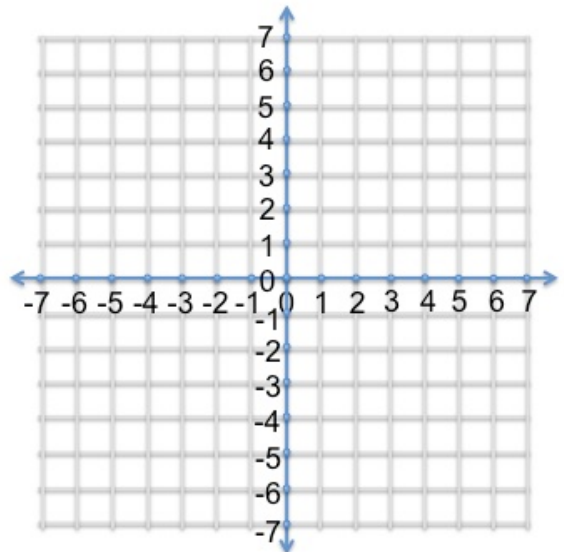


We do.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify a and b	a= b=
Identify the center, vertices, co-vertices.	Center: Vertices: Co-vertices:
Identify the Asymptotes Vertical: $y - k = \pm \frac{a}{b} (x - h)$ Horizontal: $y - k = \pm \frac{b}{a} (x - h)$	

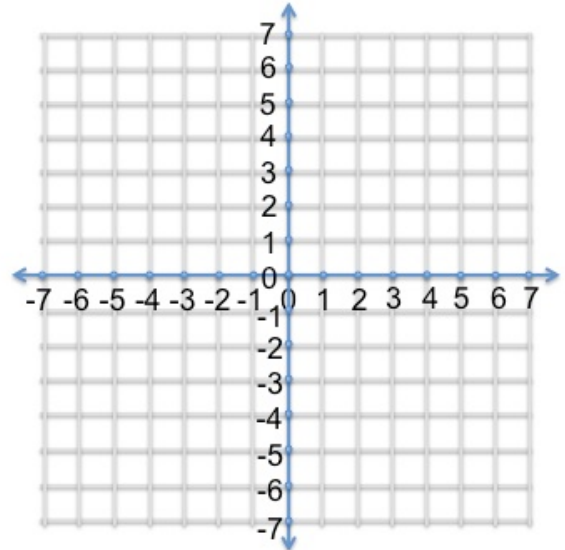


We do.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify a and b	a= b=
Identify the center, vertices, co-vertices.	Center: V: CV:
Identify the Asymptotes Vertical: $y - k = \pm \frac{a}{b} (x - h)$ Horizontal: $y - k = \pm \frac{b}{a} (x - h)$	

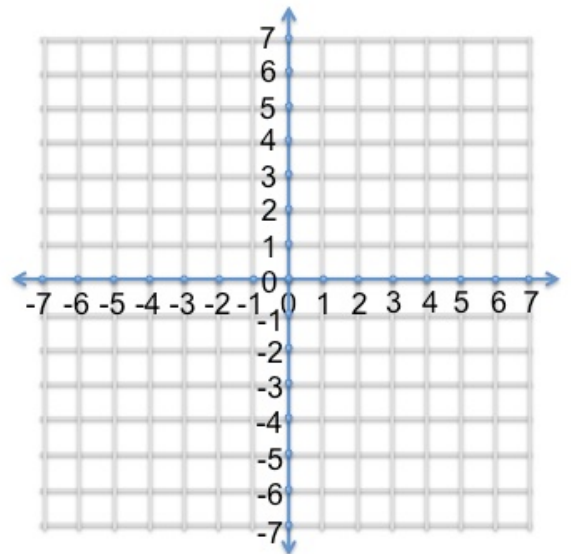


You do with your partners in your notes. Even rows talk, odd rows write.

Find the vertices, co-vertices, and asymptotes of each hyperbola, and then graph.

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

Identify form of the equation	
Identify a and b	a= b=
Identify the center, vertices, co-vertices.	Center: Vertices: Co-vertices:
Identify the Asymptotes Vertical: $y - k = \pm \frac{a}{b} (x - h)$ Horizontal: $y - k = \pm \frac{b}{a} (x - h)$	



Closure:

Compare and Contrast the differences between a Hyperbola and an Ellipse equation and graph. Write at least 3 aspects that are similar and 3 that are different. Be ready to share with the class

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

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

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

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

I try:

Example #1:

Write an equation in standard form for each hyperbola with center (0, 0) and focus at (-9, 0); vertex at $(3\sqrt{5}, 0)$

Identify givens	Center: (0,0) Vertex: $(3\sqrt{5}, 0)$ Focus: $(-9, 0)$
Identify Major axis	
Solve to find Co-vertex or vertex using $c^2 = a^2 + b^2$	Missing: Co-vertex A= $3\sqrt{5}$ C=-9
Plug parts into standard equation.	

We Try:

Example #2:

Write an equation in standard form for each hyperbola with center (0, 0) and Co-Vertex at (10, 0) and focus at (0,24).

Identify givens	
Identify Major axis	
Solve to find Co-vertex or Vertex using $c^2 = a^2 + b^2$	
Plug parts into standard equation.	

Write an equation in standard form for each hyperbola with center $(0, 0)$ and Co-Vertex at $(0, 3)$ and vertex at $(-4, 0)$.

Identify givens	
Identify Major axis	
Solve to find Co-vertex or Vertex using $c^2 = a^2 + b^2$	
Plug parts into standard equation.	

You Try in your notebooks with your partners:

Write an equation in standard form for each ellipse with center (0,0).

**1) Co-vertex (-8,0),
focus (0,6)**

**2) Vertex (6,0),
focus (0, 10)**

True or false?

Discuss with your partner about the statements. Are they true or false? Provide reasons for your answer.

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

This is an equation for an ellipse.

This is horizontal.

$a = 3$.

$b = 4$.

The center is $(-2,3)$.