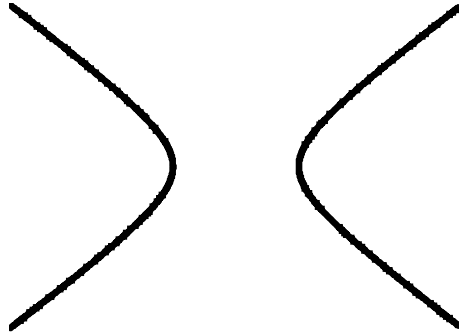
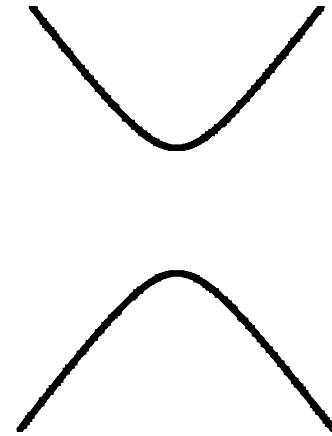


Write your questions  
and thoughts here!**Horizontal Hyperbola**

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

**Vertical Hyperbola**

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

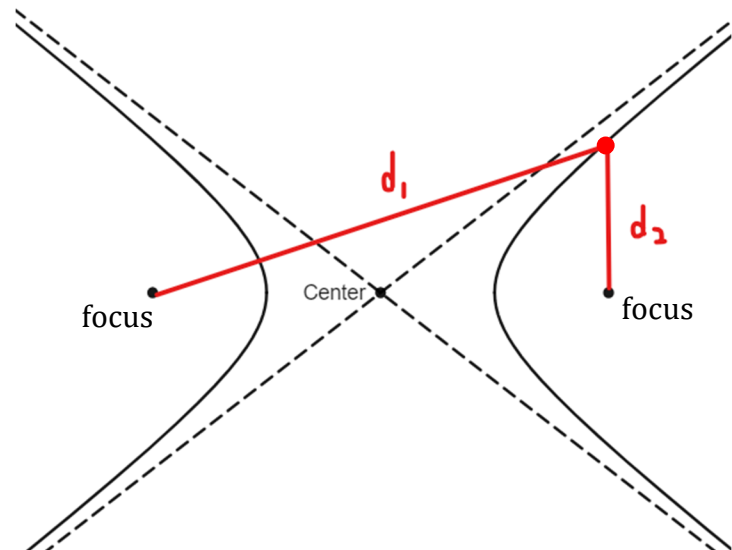


**Ask yourself:** Which squared “term” is positive?  $x$  term positive = horizontal.  $y$  term positive = vertical. There are no restrictions on whether  $a^2$  or  $b^2$  is larger, smaller or equal. This is different than an ellipse.

**Definition of a Hyperbola**

A hyperbola is the set of all points  $(x, y)$  in the plane where the **absolute value of the difference** of the distances from a point on the hyperbola to each focus is a fixed constant.

$$|d_1 - d_2| = \text{constant}$$

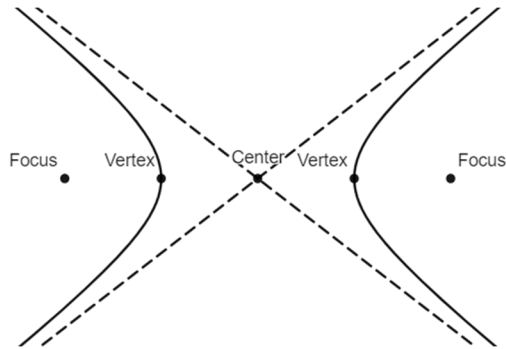


Write your questions and thoughts here!

### Horizontal Hyperbola

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

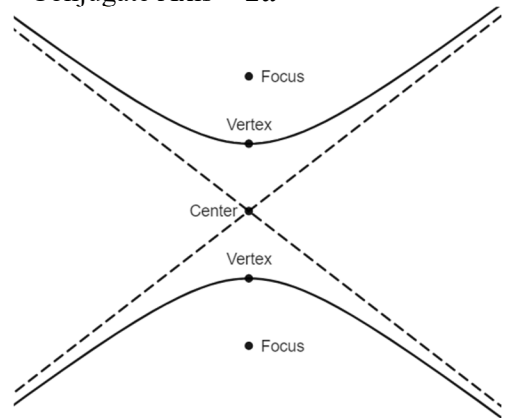
- Center  $(h, k)$
- Foci  $(h \pm c, k)$  where  $c^2 = a^2 + b^2$
- Vertices  $(h \pm a, k)$
- Asymptotes:  $y - k = \pm \frac{b}{a}(x - h)$
- Transverse Axis =  $2a$
- Conjugate Axis =  $2b$



### Vertical Hyperbola

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

- Center  $(h, k)$
- Foci  $(h, k \pm c)$  where  $c^2 = a^2 + b^2$
- Vertices  $(h, k \pm b)$
- Asymptotes:  $y - k = \pm \frac{b}{a}(x - h)$
- Transverse Axis =  $2b$
- Conjugate Axis =  $2a$



1. Sketch the graph of  $\frac{(y+1)^2}{25} - \frac{(x-2)^2}{9} = 1$ .

a. center

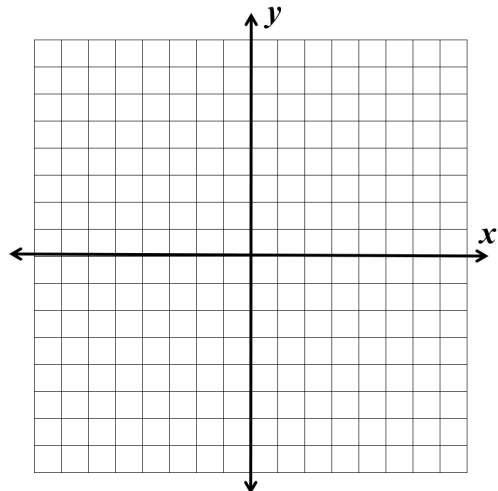
b. horizontal/vertical

c. Find the length of the transverse axis.

d. Find the length of the conjugate axis.

e. foci

g. sketch the graph



Write your questions  
and thoughts here!

2. Sketch the graph of  $x^2 - 4(y - 3)^2 = 16$ .

a. center

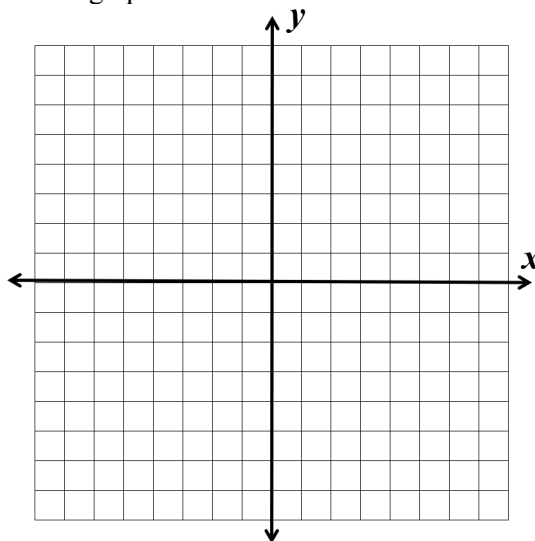
b. horizontal/vertical

c. Find the length of  
the transverse axis.

d. Find the length of  
the conjugate axis.

e. foci

g. sketch the graph



3. Given that the foci of a hyperbola are located at  $(0, -4)$  and  $(0, 2)$  and the transverse axis has a length of 4, find the equation of the hyperbola in standard form.

4. Put the following equation into standard form and identify the center and orientation.

$$x^2 - 9y^2 + 2x - 36y - 71 = 0$$

### 4.6C Conic Sections: Hyperbolas

### 4.6C Practice

AP Precalculus

1. Use the equation  $\frac{(x+1)^2}{25} - \frac{(y-3)^2}{16} = 1$  to find the following.

a. center

b. horizontal/vertical

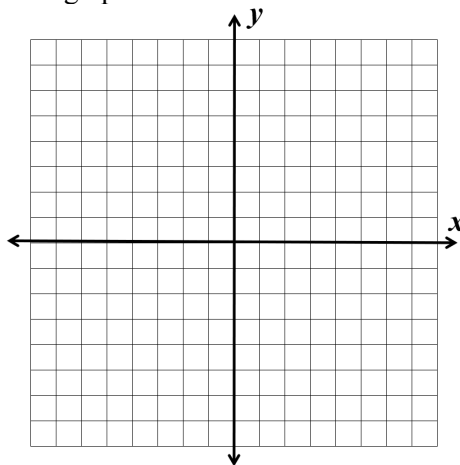
c. Find the length of the transverse axis.

d. Find the length of the conjugate axis.

e. vertices

f. foci

g. sketch the graph



2. Use the equation  $\frac{(y+1)^2}{16} - \frac{x^2}{49} = 1$  to find the following.

a. center

b. horizontal/vertical

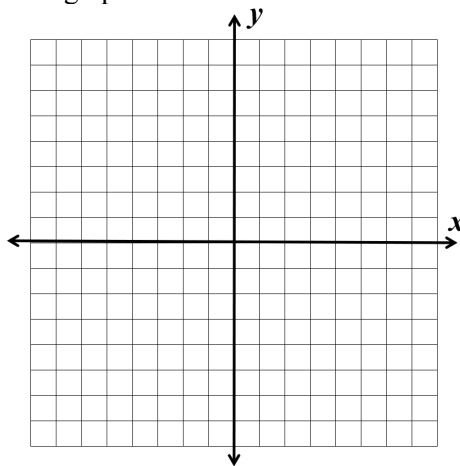
c. Find the length of the transverse axis.

d. Find the length of the conjugate axis.

e. vertices

f. foci

g. sketch the graph

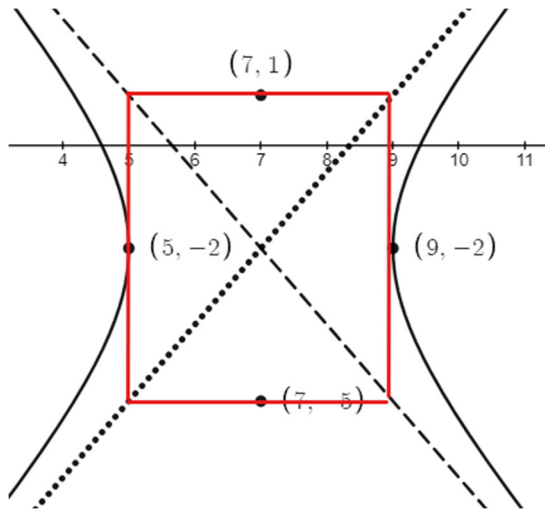


3. Find the equation of a hyperbola, in standard form, with a vertical orientation, center at  $(0,4)$ , transverse axis length of 22 and conjugate axis length of 14.

4. Find the equation of a hyperbola, in standard form, with a horizontal orientation, center at  $(-2, 3)$ , transverse axis length of 4 and conjugate axis length of 16.

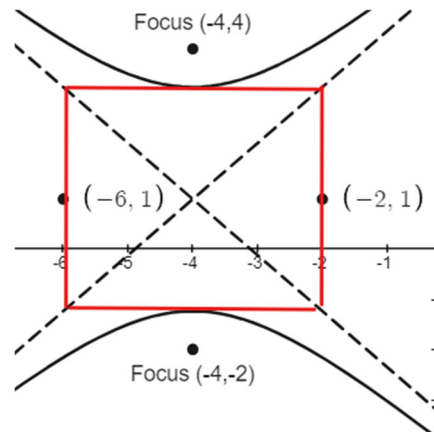
Match the graph with its equation.

5.



- (A)  $\frac{(x+7)^2}{9} - \frac{(y-2)^2}{4} = 1$   
 (B)  $\frac{(x+7)^2}{4} - \frac{(y-2)^2}{9} = 1$   
 (C)  $\frac{(x-7)^2}{4} - \frac{(y+2)^2}{9} = 1$   
 (D)  $\frac{(x-7)^2}{9} - \frac{(y+2)^2}{4} = 1$

6.



- (A)  $\frac{(y+1)^2}{4} - \frac{(x-4)^2}{5} = 1$   
 (B)  $\frac{(y+1)^2}{5} - \frac{(x-4)^2}{4} = 1$   
 (C)  $\frac{(y-1)^2}{4} - \frac{(x+4)^2}{5} = 1$   
 (D)  $\frac{(y-1)^2}{5} - \frac{(x+4)^2}{4} = 1$

**Put the given equation of a hyperbola into standard form. Then identify the center, foci, and vertices.**

7.  $x^2 - 3y^2 + 6x - 12y + 6 = 0$

8.  $3x^2 - y^2 - 18x - 6 = 0$

9. Use the equation  $3(x + 9)^2 - 2(y + 2)^2 = -18$  to find the center, foci and vertices of the hyperbola.

10. Given the foci of a hyperbola are located at  $(2, 5)$  and  $(2, 17)$  and the conjugate axis length is 10, find the equation of the hyperbola in standard form.