

**Aim: Introduction to the Hyperbola**

**I. Do Now:**

1. Convert to standard form:

$$4x^2 + 9y^2 - 48x + 72y + 144 = 0$$

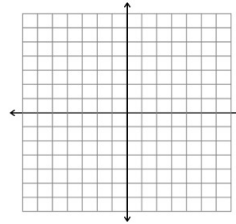
Vertices: \_\_\_\_\_

Foci: \_\_\_\_\_

Eccentricity: \_\_\_\_\_

Length of Major Axis: \_\_\_\_\_

Length of Minor Axis: \_\_\_\_\_



2. Identify the conic section by its equation.

(a)  $\frac{x^2}{3} + \frac{y^2}{5} = 1$  \_\_\_\_\_

(b)  $3x^2 + 3y^2 = 27$  \_\_\_\_\_

(c)  $\frac{x^2}{3} - \frac{y^2}{5} = 1$  \_\_\_\_\_

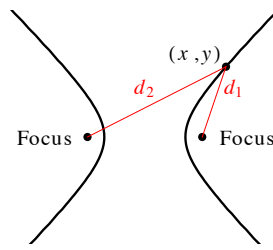
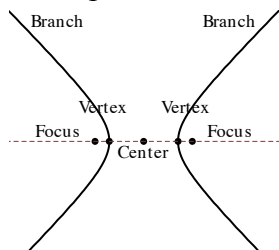
(d)  $y = x^2 - 3$  \_\_\_\_\_

**II. Definitions:**

*Ellipse:* the set of all points whose **sum** of distances from two fixed points called the foci is constant.

*Hyperbola:* the set of all points whose \_\_\_\_\_ of distances from two fixed points called the foci is constant.

**III. Development:**



- Each hyperbola has two distinct *branches*.
- The line passing through the two *foci* intersects the hyperbola at its *vertices*.
- The segment connecting the vertices is called the *transverse axis*; the midpoint of the transverse axis is the hyperbola's *center*.
- The axis perpendicular to the transverse axis passing through the center is called the *conjugate axis*.

*Standard Form of Equations of Hyperbolas*

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1 \quad \text{Horizontal Transverse Axis}$$

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1 \quad \text{Vertical Transverse Axis}$$

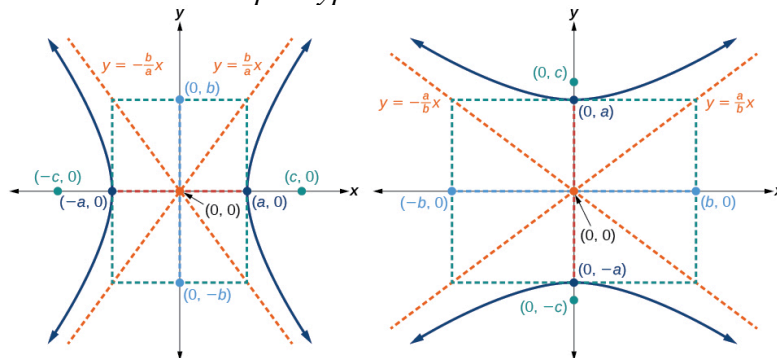
If the center is (0, 0), these equations are:

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

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

For hyperbolas, the relationship between  $a$ ,  $b$ , and  $c$  is  $c^2 = a^2 + b^2$ .

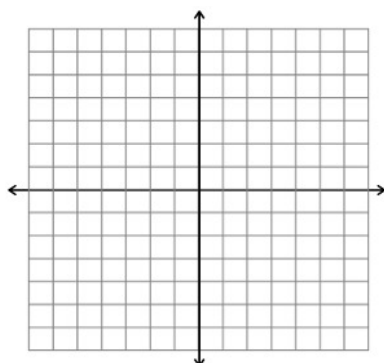
*The Box Method to Graph Hyperbolas*



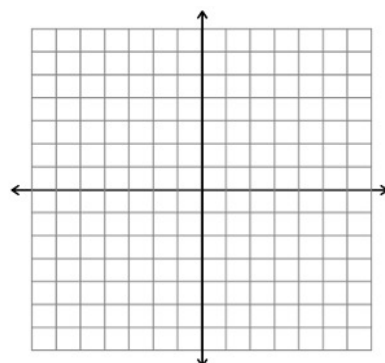
The eccentricity of a hyperbola is  $e = c/a$  (same as for the ellipse).  
 Since  $c > a$ ,  $e > 1$ .  
 As  $e$  approaches 1, the hyperbola becomes flatter.  
 As  $e$  increases, the hyperbola becomes rounder at its vertices.

**IV. Examples**

3. Graph the hyperbola  $4x^2 - y^2 = 16$ .



4. Graph the hyperbola  $4y^2 - x^2 = 16$ .



**HW48**  
 • Read pages 772 – 776.  
 • p. 779: 1 – 4, 5, 8  
 • p. 825: 10, 23, 27