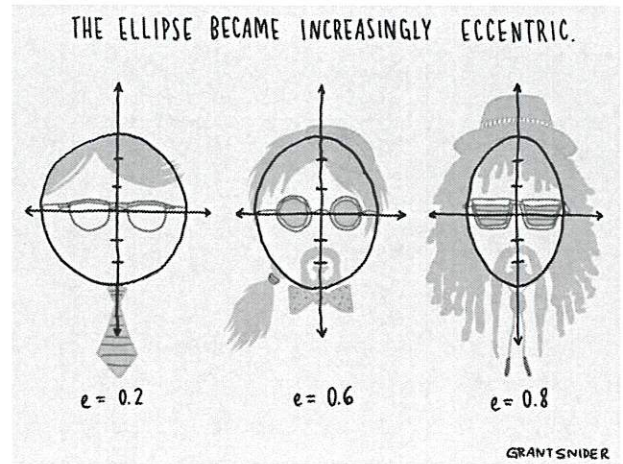


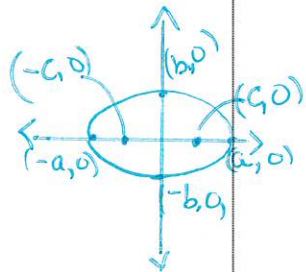
Precalculus  
 Lesson 10.3: The Ellipse  
 Mrs. Snow, Instructor

*I will:* I will be able to graph an ellipse with the center at the origin and solve real world problems involving ellipses

*We will:* Analyze ellipses with center at the origin and solve real world problems involving ellipses



**Ellipse:** the collection, or locus, of all points in the plane, the sum of whose distances from two fixed points, called the foci, is constant.



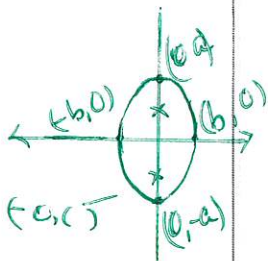
**Major axis it's the x-axis:**  
**Equation of an Ellipse: Center at (0, 0); Major Axis along the x-Axis**

An equation of the ellipse with center at (0, 0), foci at (-c, 0) and (c, 0), and vertices at (-a, 0) and (a, 0) is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \quad \text{where } a > b > 0 \text{ and } b^2 = a^2 - c^2 \quad (2)$$

*a - biggest number ⇒ x is major axis*

*Relationship between axes and foci*



**Major axis is the y-axis:**

**Equation of an Ellipse; Center at (0, 0); Major Axis along the y-Axis**

An equation of the ellipse with center at (0, 0), foci at (0, -c) and (0, c), and vertices at (0, -a) and (0, a) is

$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1 \quad \text{where } a > b > 0 \text{ and } b^2 = a^2 - c^2 \quad (3)$$

*a - biggest number ⇒ y is major axis*

- \* Center: (0, 0)
- \* 2 foci points:  $(\pm c, 0) \rightarrow c$  units from origin  
 $(0, \pm c) \rightarrow c$  units from origin
- \* variable with biggest value in the denominator is the major axis

### Finding an equation of an Ellipse

Find an equation of an ellipse with center at the origin, one focus at  $(3, 0)$ , and a vertex at  $(-4, 0)$ . Graph.

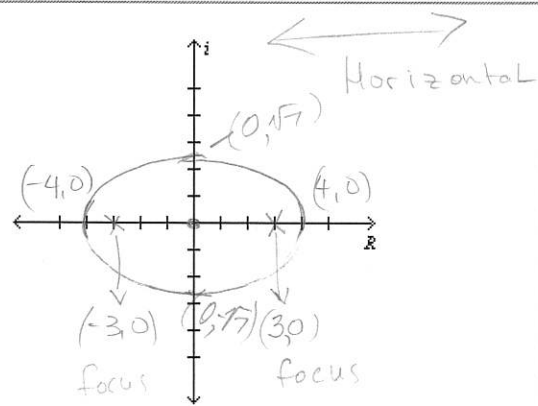
Use information to build an equation.

$$a=4, c=3 \quad b^2 = a^2 - c^2$$

horizontal orientation:  $b^2 = 16 - 9$   
 $b^2 = 7$

$$\frac{x^2}{16} + \frac{y^2}{7} = 1 \quad b = \pm \sqrt{7}$$

↑ between 2 & 3



### Analyze the Equation of an Ellipse

Analyze (find the center foci and vertices)

Identify parts of graph  
 $\frac{x^2}{25} + \frac{y^2}{9} = 1$  Minor axis - y  
 longest Major axis x

$$a^2 = 25 \quad b^2 = 9$$

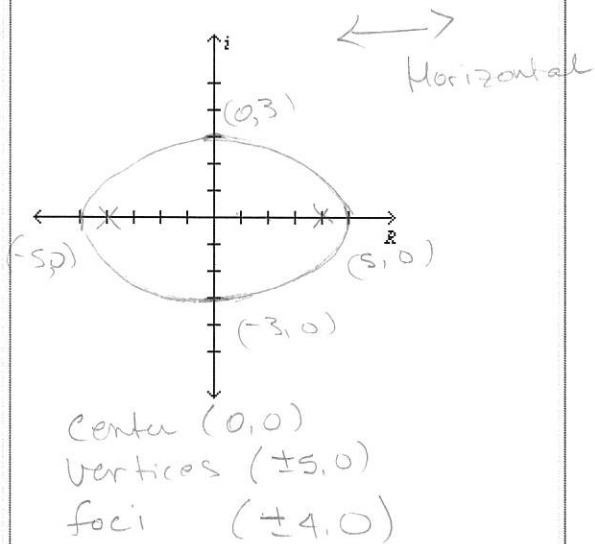
$$a = 5 \quad b = 3$$

$$b^2 = a^2 - c^2$$

$$9 = 25 - c^2$$

$$c^2 = 25 - 9 = 16$$

$$c = \pm 4$$



Ellipse form:  $\frac{9x^2}{9} + \frac{y^2}{9} = \frac{9}{9}$

$\frac{x^2}{1} + \frac{y^2}{9} = 1$   
 x-axis minor  
 longest major axis y

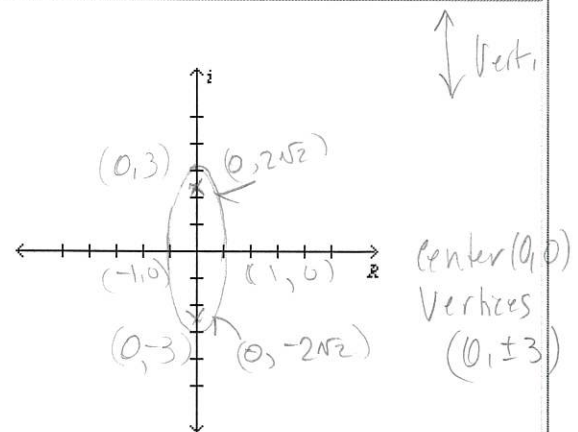
$$b^2 = a^2 - c^2$$

$$1 = 9 - c^2$$

$$c^2 = 9 - 1 = 8$$

$$c = \pm \sqrt{8} = \pm 2\sqrt{2}$$

c is between 2 & 3

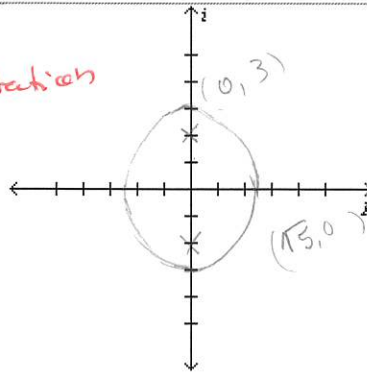


Find an equation of the ellipse having one focus at  $(0, 2)$  and vertices at  $(0, -3)$  and  $(0, 3)$ . Graph.

$$b^2 = a^2 - c^2$$

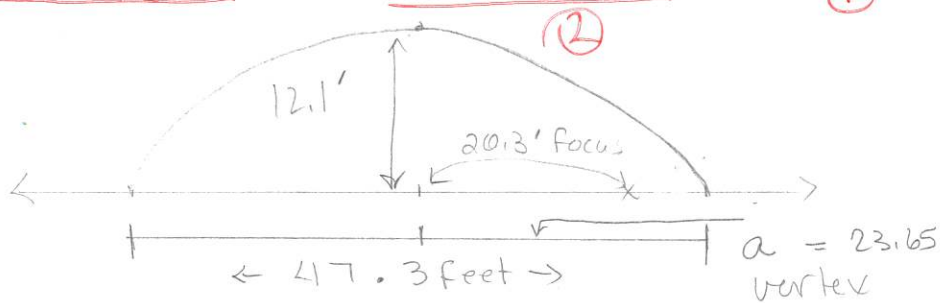
$$b^2 = 9 - 4 = 5 \quad b = \pm\sqrt{5}$$

$$\frac{x^2}{5} + \frac{y^2}{9} = 1$$



Vertical

The whispering gallery in the Museum of Science and Industry in Chicago is 47.3 feet long. The distance from the center of the room to the foci is 20.3 feet. Find an equation that describes the shape of the room. How high is the room at its center? ①



$$b^2 = 23.65^2 - 20.3^2$$

$$b^2 = 147.2325$$

$$b \approx 12.1 \text{ ft}$$

②

Equation ①

$$\frac{x^2}{23.65^2} + \frac{y^2}{12.1^2} = 1$$