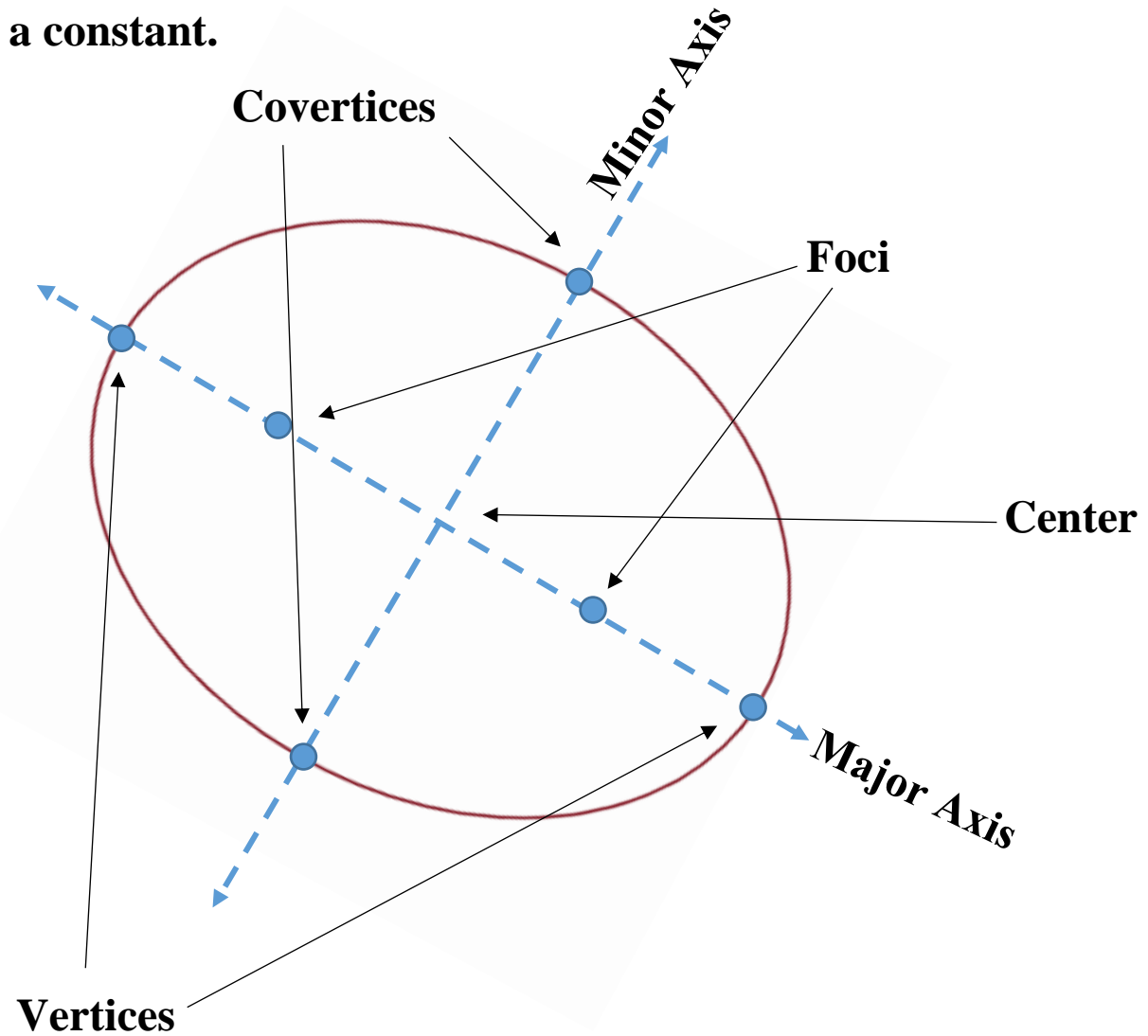**Ellipse:** The set of points in the plane the sum of whose distances to two fixed points, called foci, is a constant.
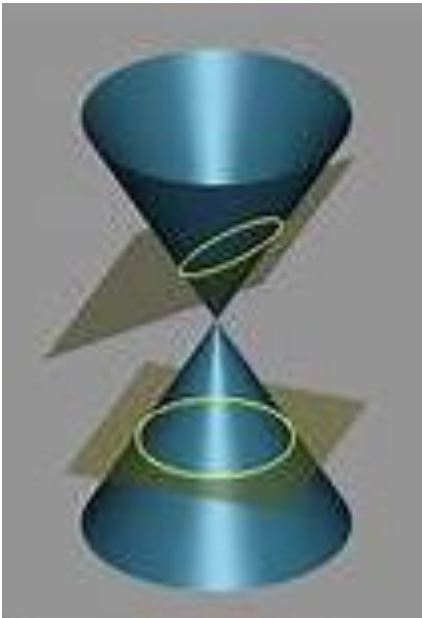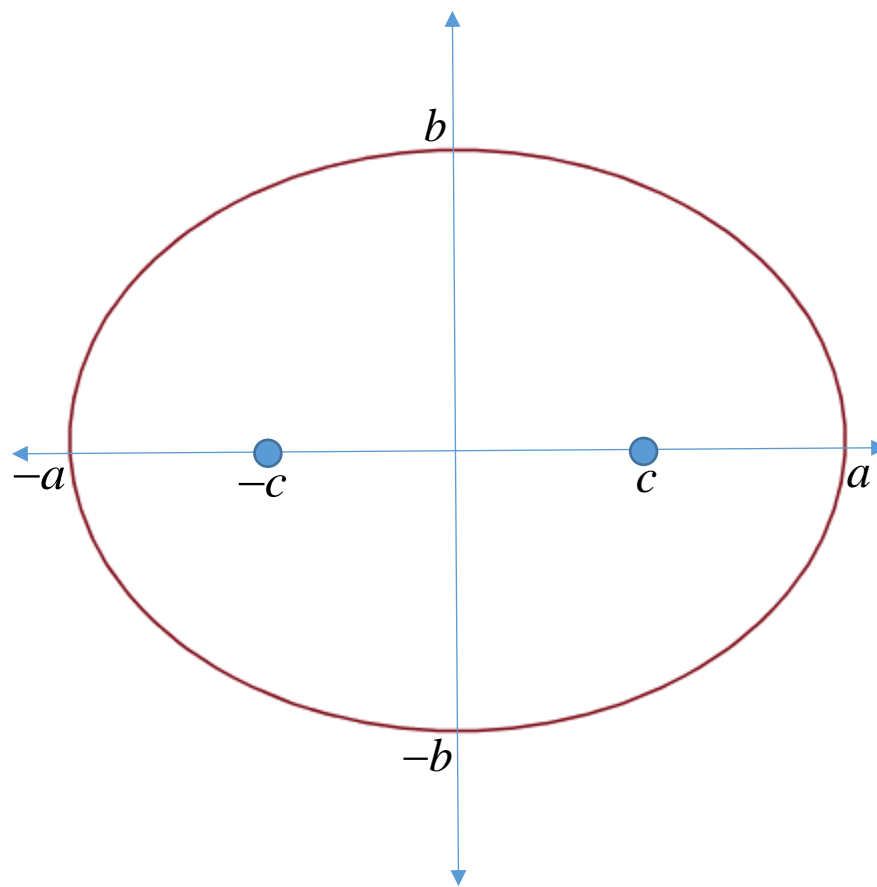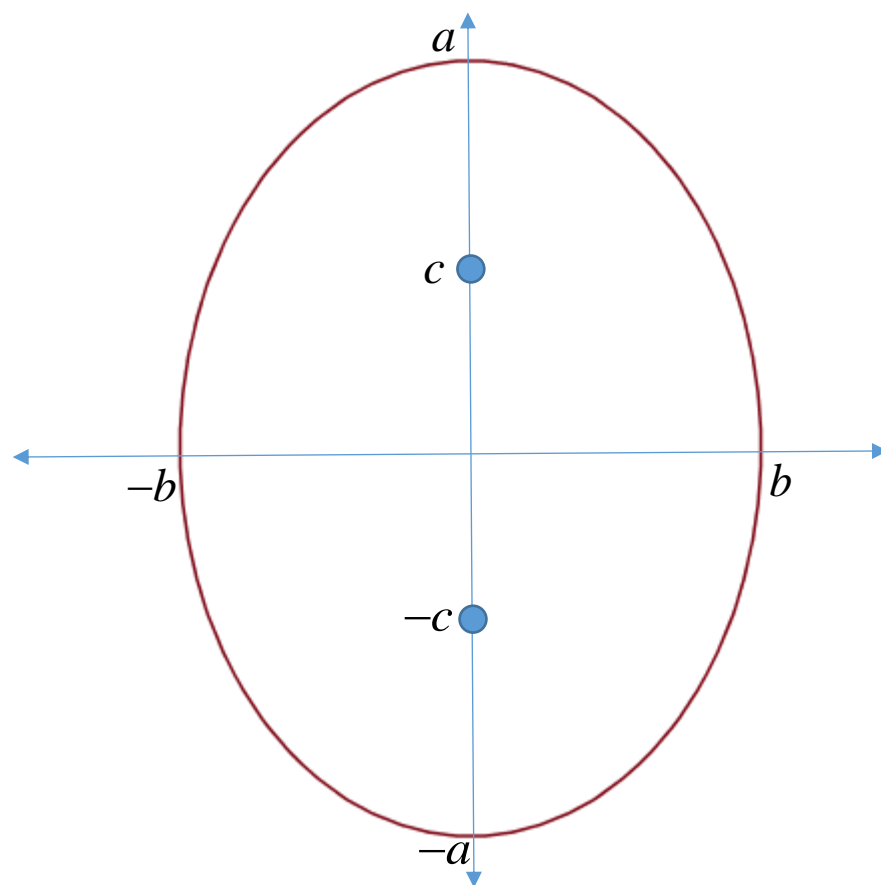
Covertices

Minor Axis

Foci

Center

Major Axis

Vertices

Ellipses centered at the origin with major and minor axes of the x and y axes.
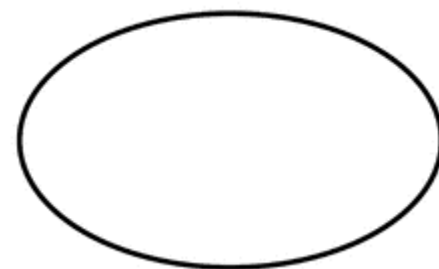

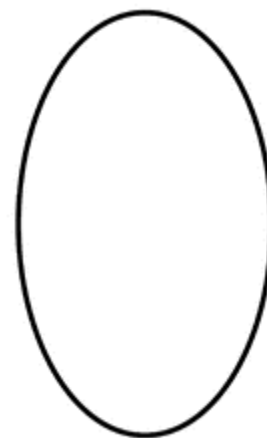$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \; c^2 = a^2 - b^2, a \geq b$$

$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1, \; c^2 = a^2 - b^2, a \geq b$$

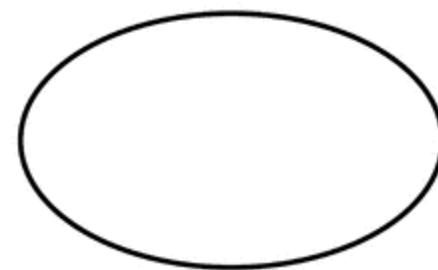**Examples: Graph the ellipses with the following equations.**
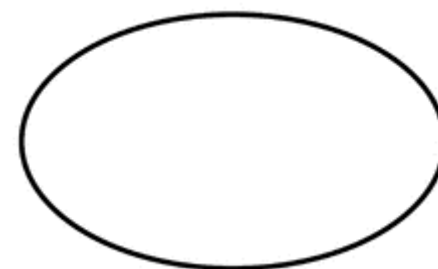
1. $\dfrac{x^2}{9} + \dfrac{y^2}{4} = 1$

2. $x^2 + \dfrac{y^2}{16} = 1$

3. $x^2 + 9y^2 = 36$

4. $4y^2 + x^2 = 8$
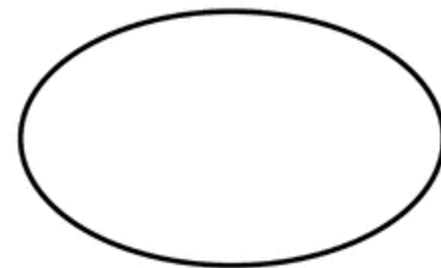
Not necessarily centered at $(0,0)$:

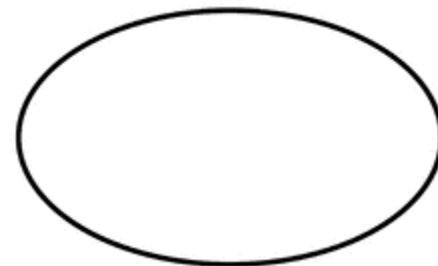$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

Or

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

Graph:

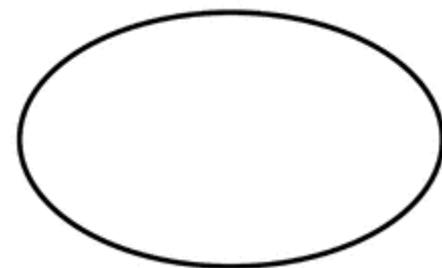**1.** $\dfrac{(x-4)^2}{9} + \dfrac{(y+2)^2}{4} = 1$
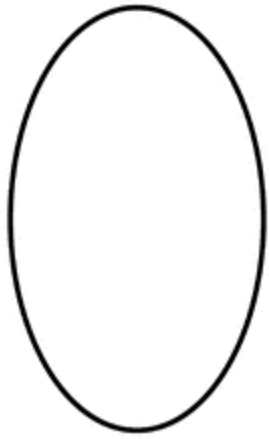
2. $x^2 + 4x + 4y^2 - 8y + 4 = 0$

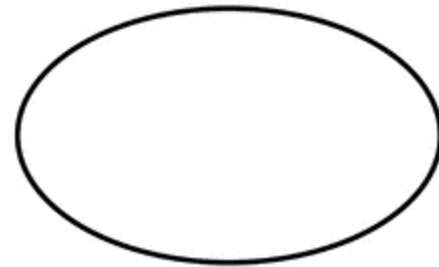Find an equation for the ellipse that is described.

1. Center at $(0,0)$, focus at $(-1,0)$, and vertex at $(3,0)$.

2. Foci at $(0,\pm2)$, and the length of the major axis is 8.

3. Center at $(2,-2)$, focus at $(4,-2)$, and vertex at $(7,-2)$.

4. Center at $(1,2)$**, focus at** $(1,4)$**, and passes through** $(2,2)$**.**