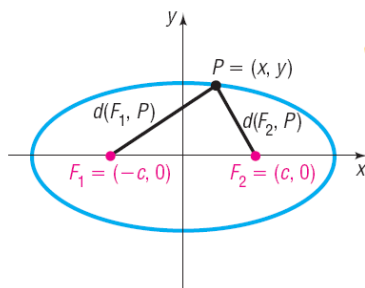
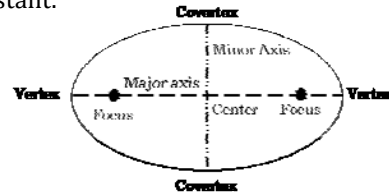


## Section 11.3

### The Ellipse

## THE ELLIPSE

An **ellipse** is the collection of all points in the plane the sum of whose distances from two fixed points (**foci**) is a positive constant.



$$d(F_1, P) + d(F_2, P) = 2a$$

## AN ELLIPSE WITH CENTER AT THE ORIGIN

Using the distance formula and algebra, we can show that the equation for an ellipse whose center is the origin is:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad (a > b) \quad \text{if the major axis is horizontal.}$$

$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1 \quad (a > b) \quad \text{if the major axis is vertical.}$$

## ELLIPSES WITH CENTER AT $(h, k)$

Using shifts (Section 3.5), we can find the standard form of an equation of an ellipse with center at  $(h, k)$ .

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1 \quad (a > b) \quad \text{if the major axis is horizontal.}$$

$$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1 \quad (a > b) \quad \text{if the major axis is vertical.}$$

## ELLIPSE FACTS

- **center:**  $(h, k)$
- **vertices:**  $a$  units from center in both directions
- **covertices:**  $b$  units from center in both directions
- **foci:**  $c$  units from center in both directions where  $c^2 = a^2 - b^2$ .
- **eccentricity:**  $e = \frac{c}{a}$ . The eccentricity measures how far an ellipse is from a circle.

