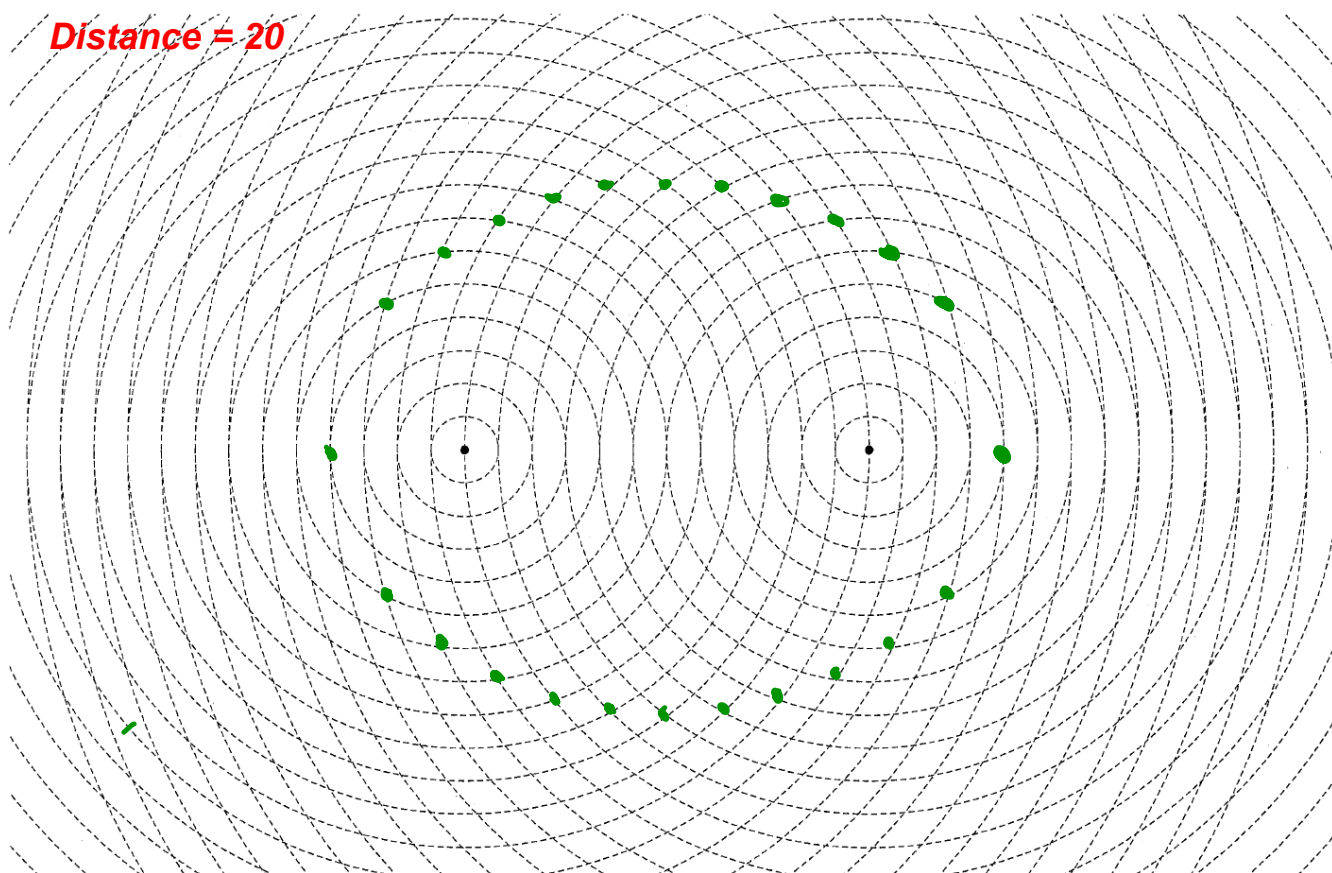### *Section 9.4 Exploration*

Mark all of the points where the total distance from the two points is the same.

Distance = 20

Section 9.4 Exploration

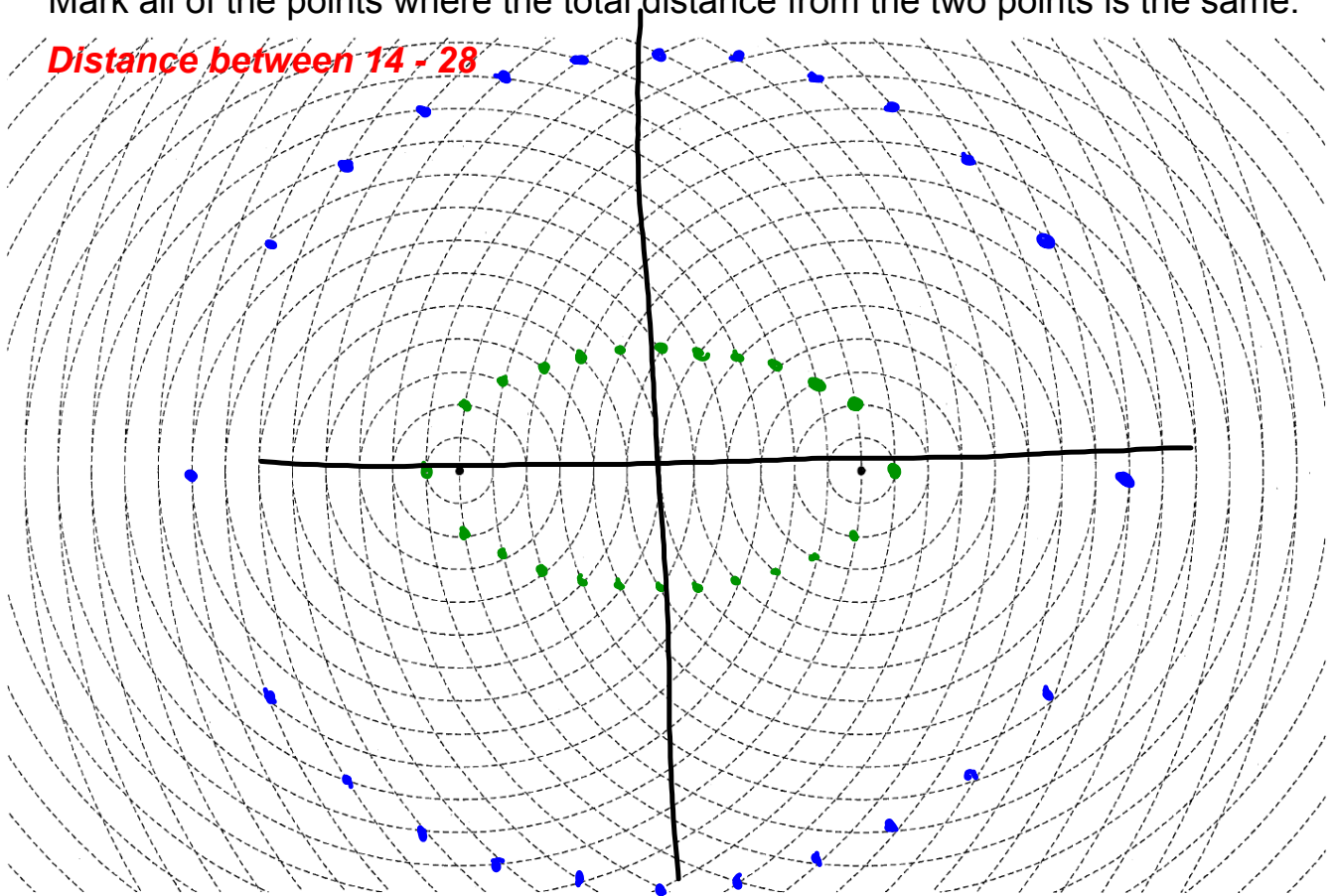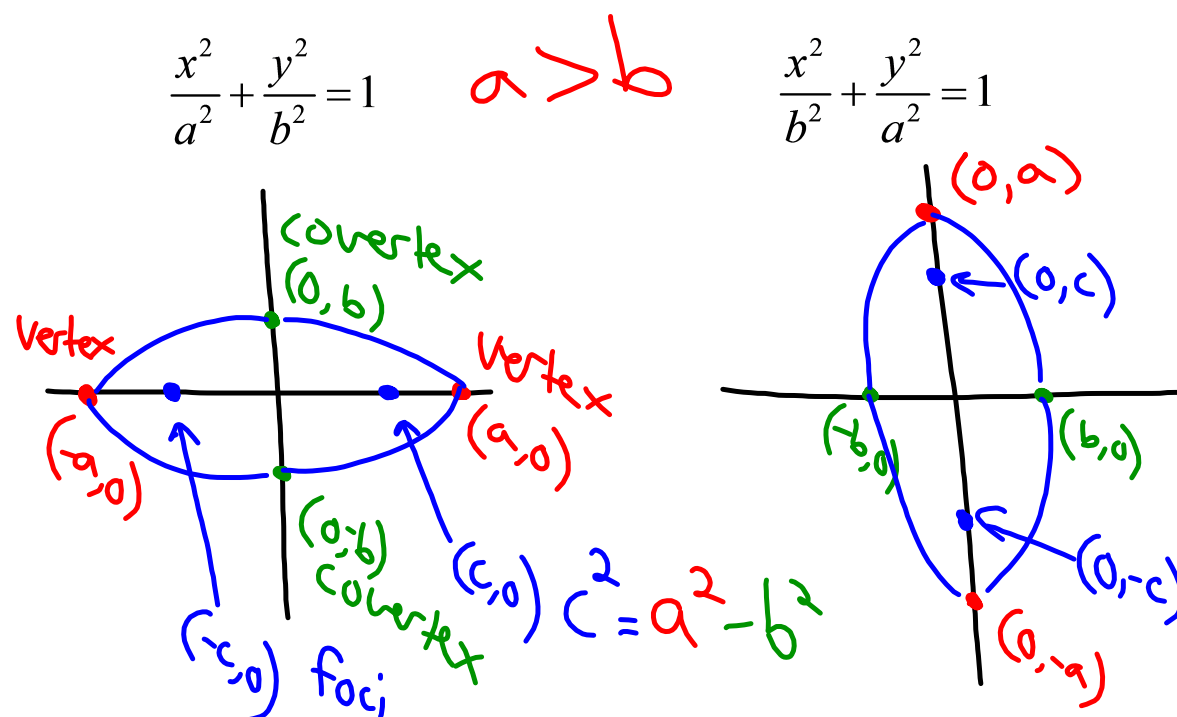Mark all of the points where the total distance from the two points is the same.

Distance between 14 - 28

9.4 Graph and Write Equations of Ellipses

Standard Form:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \qquad a > b \qquad \frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$$

Covertex
(0,b)

Vertex

(a,0)

Vertex
(a,0)

(-c,0) foci

(0,-b)
Covertex

(c,0)

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

(0,a)

(0,c)

(-b,0)

(b,0)

(0,-c)

(0,-a)

EXAMPLE 1 **Graph an equation of an ellipse**

Graph the equation $4x^2 + 25y^2 = 100$. Identify the vertices, co-vertices, and foci of the ellipse.

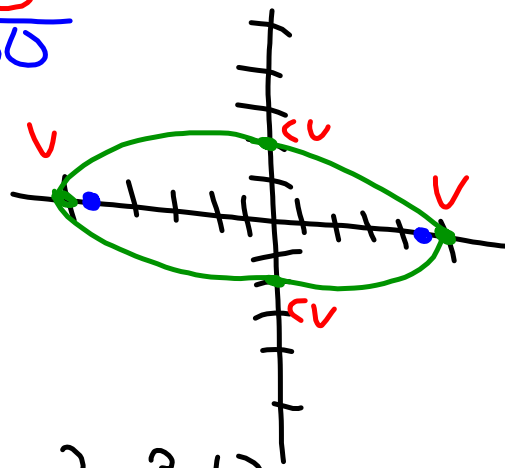$$\frac{4x^2}{100} + \frac{25y^2}{100} = \frac{100}{100}$$

$$\frac{x^2}{25} + \frac{y^2}{4} = 1$$

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

$a = 5 \qquad b = 2$

Vertices: $(\pm 5, 0)$
co-vertices: $(0, \pm 2)$
foci: $(\pm \sqrt{21}, 0)$

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

$c^2 = 25 - 4$

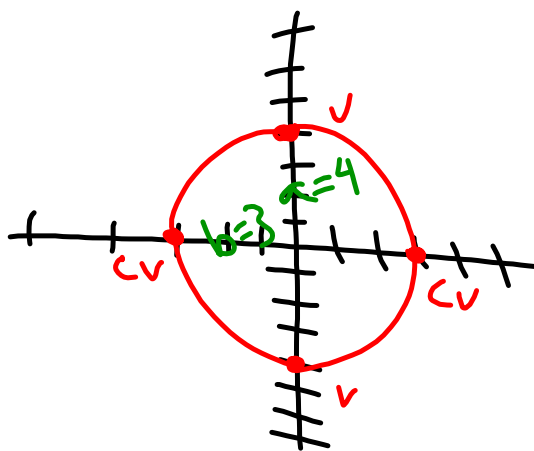$\sqrt{c^2} = \sqrt{21}$

$c = \pm\sqrt{21}$

EXAMPLE 2   **Write an equation given a vertex and a co-vertex**

Write an equation of the ellipse that has a vertex at $(0, 4)$, a co-vertex at $(-3, 0)$, and center at $(0, 0)$.

$$\frac{x^2}{6^2} + \frac{y^2}{9^2} = 1$$

$$\frac{x^2}{3^2} + \frac{y^2}{4^2} = 1$$

$$\boxed{\frac{x^2}{9} + \frac{y^2}{16} = 1}$$

EXAMPLE 4 **Write an equation given a vertex and a focus**

Write an equation of the ellipse that has a vertex at $(-8, 0)$, a focus at $(4, 0)$, and center at $(0, 0)$.

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

$$4^2 = 8^2 - b^2$$

$$16 = 64 - b^2$$
$$-64 \quad -64$$

$$\frac{-48}{-1} = \frac{-b^2}{-1}$$

$$b^2 = 48$$

$$\frac{x^2}{8^2} + \frac{y^2}{48} =$$

$$\frac{x^2}{64} + \frac{y^2}{48} = 1$$

$c = 4$ $c = 4$

V f f V

$a = 8$ $a = 8$