

$$\textcircled{6} \text{ b) } (x+2)^2 + y^2 = 49$$

$$\text{Center: } (-2, 0)$$

$$r^2 = 49$$

$$r = 7$$

$$\textcircled{7} \text{ a) } C = (-11, 6) \quad r = \sqrt{7}$$

$$h = -11$$

$$k = 6$$

$$(x-h)^2 + (y-k)^2 = r^2$$

$$(x+11)^2 + (y-6)^2 = (\sqrt{7})^2$$

$$(x+11)^2 + (y-6)^2 = 7$$

$$\textcircled{8} \text{ a) } \text{Center: } (2, -2)$$

$$h = 2$$

$$k = -2$$

passes through  $(8, 4)$

$$x = 8$$

$$y = 4$$

$$(x-h)^2 + (y-k)^2 = r^2$$

$$(8-2)^2 + (4+2)^2 = r^2$$

$$(6)^2 + (6)^2 = r^2$$

$$36 + 36 = r^2$$

$$72 = r^2$$

$$\boxed{(x-2)^2 + (y+2)^2 = 72}$$

$$\textcircled{9} \quad d) \quad \frac{2x^2}{2} + \frac{2y^2}{2} + \frac{16x}{2} - \frac{8y}{2} + \frac{19}{2} = 0$$

$$x^2 + y^2 + 8x - 4y + \frac{19}{2} = 0$$

$$\textcircled{1} \quad x^2 + 8x + 16 + y^2 - 4y + 4 = \frac{-19}{2} + 16 + 4$$

$$(x+4)^2 + (y-2)^2 = \frac{-19}{2} + \frac{20}{1}$$

$$(x+4)^2 + (y-2)^2 = \frac{-19}{2} + \frac{40}{2}$$

$$\boxed{(x+4)^2 + (y-2)^2 = \frac{21}{2}}$$

$$\text{Center: } (-4, 2)$$

$$r^2 = \frac{21}{2}$$

$$r = \sqrt{\frac{21}{2}} = \frac{\sqrt{21}}{\sqrt{2}}$$

SOLUTIONS  $\Rightarrow$  EQUATIONS OF CIRCLES/ELLIPSES  
REVIEW

1  $\{x^2 + y^2 = r^2\}$

a)  $r = 6$

$\hookrightarrow x^2 + y^2 = (6)^2$   
 $x^2 + y^2 = 36$

b)  $r = \sqrt{5}$

$\hookrightarrow x^2 + y^2 = (\sqrt{5})^2$   
 $x^2 + y^2 = 5$

c)  $r = 4\sqrt{7}$

$\hookrightarrow x^2 + y^2 = (4\sqrt{7})^2$   
 $x^2 + y^2 = (16)(7)$   
 $x^2 + y^2 = 112$

d)  $r = 3\sqrt{2}$

$x^2 + y^2 = (3\sqrt{2})^2$   
 $x^2 + y^2 = (9)(2)$   
 $x^2 + y^2 = 18$

2. A:  $x^2 + y^2 = 81$

a) radius

$$\hookrightarrow r^2 = 81$$

$$r = \sqrt{81}$$

$$r = 9 \text{ units}$$

b) x-intercepts

$$\hookrightarrow -9 \text{ and } +9$$

c) y-intercepts

$$\hookrightarrow -9 \text{ and } 9$$

d) domain

e) range

$$\{x \mid -9 \leq x \leq 9, x \in \mathbb{R}\}$$

$$\{y \mid -9 \leq \mathbf{y} \leq 9, y \in \mathbb{R}\}$$

2. B:  $x^2 + y^2 = 48$

a) radius

$$\hookrightarrow r^2 = 48$$

$$r = \sqrt{48}$$

$$r = \sqrt{16 \times 3}$$

$$r = 4\sqrt{3} \text{ units}$$

b) x-intercepts

$$\hookrightarrow -4\sqrt{3} \text{ and } 4\sqrt{3}$$

c) y-intercepts

$$\hookrightarrow -4\sqrt{3} \text{ and } 4\sqrt{3}$$

d) domain

$$\{x \mid -4\sqrt{3} \leq x \leq 4\sqrt{3}, x \in \mathbb{R}\}$$

e) range

$$\{y \mid -4\sqrt{3} \leq y \leq 4\sqrt{3}, y \in \mathbb{R}\}$$

$$3. x^2 + y^2 = 25$$

$$a) (-4, ?)$$

$$\text{If } x = -4:$$

$$(-4)^2 + y^2 = 25$$

$$16 + y^2 = 25$$

$$y^2 = 25 - 16$$

$$y^2 = 9$$

$$y = \pm\sqrt{9} \quad y = \pm 3$$

$$\text{Coordinate} \Rightarrow (-4, -3)$$

$$\text{or} \\ (-4, 3)$$

b)  $x^2 + y^2 = 25$

$(?, 3)$

If  $y = 3$ :

$$x^2 + (3)^2 = 25$$

$$x^2 + 9 = 25$$

$$x^2 = 25 - 9$$

$$x^2 = 16$$

$$x = \pm \sqrt{16}$$

$$x = \pm 4$$

Coordinate:  $(-4, 3)$   
or  
 $(4, 3)$

c) (5, ?)

If  $x=5$ :

$$(5)^2 + y^2 = 25$$

$$25 + y^2 = 25$$

$$y^2 = 25 - 25$$

$$y^2 = 0$$

$$y = \pm\sqrt{0}$$

$$y = 0$$

Coordinate: (5, 0)



d)  $(2\sqrt{3}, ?)$

If  $x = 2\sqrt{3}$ :

$$\begin{aligned} (2\sqrt{3})^2 + y^2 &= 25 \\ (4)(3) + y^2 &= 25 \\ 12 + y^2 &= 25 \\ y^2 &= 25 - 12 \\ y^2 &= 13 \\ y &= \sqrt{13} \end{aligned}$$

Coordinate:  $(2\sqrt{3}, \sqrt{13})$

4.

EQUATION	CENTER	DOMAIN	RANGE	X-INTERCEPTS	Y-INTERCEPTS
$x^2 + y^2 = 9$	$(0, 0)$	$\{x   -3 \leq x \leq 3, x \in \mathbb{R}\}$	$\{y   -3 \leq y \leq 3, y \in \mathbb{R}\}$	-3 and 3	-3 and 3
$x^2 + y^2 = 36$	$(0, 0)$	$\{x   -6 \leq x \leq 6, x \in \mathbb{R}\}$	$\{y   -6 \leq y \leq 6, y \in \mathbb{R}\}$	-6 and 6	-6 and 6
$x^2 + y^2 = 121$	$(0, 0)$	$\{x   -11 \leq x \leq 11, x \in \mathbb{R}\}$	$\{y   -11 \leq y \leq 11, y \in \mathbb{R}\}$	-11 and 11	-11 and 11

5. a) passing through (2, -4)

↳ If  $x=2$  and  $y=-4$ :

$$\begin{aligned}x^2 + y^2 &= r^2 \\(2)^2 + (-4)^2 &= r^2 \\4 + 16 &= r^2 \\20 &= r^2\end{aligned}$$

↳ Therefore, the equation would be:

$$\begin{aligned}x^2 + y^2 &= r^2 \\x^2 + y^2 &= 20\end{aligned}$$

b) passing through  $(4\sqrt{5}, \sqrt{2})$

↳ If  $x = 4\sqrt{5}$  and  $y = \sqrt{2}$  :

$$\begin{aligned}x^2 + y^2 &= r^2 \\(4\sqrt{5})^2 + (\sqrt{2})^2 &= r^2 \\(16)(5) + 2 &= r^2 \\80 + 2 &= r^2 \\82 &= r^2\end{aligned}$$

↳ Therefore, the equation would be :

$$\begin{aligned}x^2 + y^2 &= r^2 \\x^2 + y^2 &= 82\end{aligned}$$

c) With an  $x$ -intercept of  $-12$ °  
↳ Point  $(-12, 0)$

If  $x = -12$  and  $y = 0$ °

$$\begin{aligned}x^2 + y^2 &= r^2 \\(-12)^2 + (0)^2 &= r^2 \\144 + 0 &= r^2 \\144 &= r^2\end{aligned}$$

↳ Therefore, the equation would be °

$$\begin{aligned}x^2 + y^2 &= r^2 \\x^2 + y^2 &= 144.\end{aligned}$$

6. a)  $x^2 + (y-4)^2 = 64$   
 $(x-0)^2 + (y-4)^2 = 64$

Center  $(0, 4)$

Radius:  $r^2 = 64$   
 $r = \sqrt{64}$   
 $r = 8$  units

b)  $(x+2)^2 + y^2 = 49$   
 $(x+2)^2 + (y+0)^2 = 49$

Center  $(-2, 0)$

Radius:  $r^2 = 49$   
 $r = \sqrt{49}$   
 $r = 7$  units

$$c) (x+1)^2 + (y-11)^2 = 100$$

Center  $(-1, 11)$

Radius:  $r^2 = 100$   
 $r = \sqrt{100}$   
 $r = 10$  units

$$d) (x-16)^2 + (y-3)^2 = 144$$

Center  $(16, 3)$

Radius:  $r^2 = 144$   
 $r = \sqrt{144}$   
 $r = 12$  units

7  
a)  $C(-11, 6); r = \sqrt{7}$

$$\begin{aligned}(x-h)^2 + (y-k)^2 &= r^2 \\ (x-(-11))^2 + (y-6)^2 &= (\sqrt{7})^2 \\ (x+11)^2 + (y-6)^2 &= 7\end{aligned}$$

b)  $C(0, 3); r = 5$

$$\begin{aligned}(x-h)^2 + (y-k)^2 &= r^2 \\ (x-0)^2 + (y-3)^2 &= (5)^2 \\ x^2 + (y-3)^2 &= 25\end{aligned}$$

c)  $C(4, -4); r = 13$

$$\begin{aligned}(x-h)^2 + (y-k)^2 &= r^2 \\ (x-4)^2 + (y-(-4))^2 &= (13)^2 \\ (x-4)^2 + (y+4)^2 &= 169\end{aligned}$$

$$d) C(-9, 14); r=2$$

$$(x-h)^2 + (y-k)^2 = r^2$$

$$(x-9)^2 + (y-14)^2 = (2)^2$$

$$(x+9)^2 + (y-14)^2 = 4$$



8.a) C(2,-2) and passing through J(8,4)

Method 1:

$$\begin{aligned} D &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(8 - 2)^2 + (4 - (-2))^2} \\ &= \sqrt{(6)^2 + (6)^2} \\ &= \sqrt{36 + 36} \\ &= \sqrt{72} \\ &= \sqrt{36 \times 2} \\ &= 6\sqrt{2} \end{aligned}$$

$$r = 6\sqrt{2} ; C(2, -2)$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (x-2)^2 + (y-(-2))^2 &= (6\sqrt{2})^2 \\ (x-2)^2 + (y+2)^2 &= (36)(2) \\ (x-2)^2 + (y+2)^2 &= 72 \end{aligned}$$

Method 2:

$$\begin{array}{cc} C(2, -2) & J(8, 4) \\ h \quad k & x \quad y \end{array}$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (8-2)^2 + (4-(-2))^2 &= r^2 \\ (6)^2 + (6)^2 &= r^2 \\ 36 + 36 &= r^2 \\ 72 &= r^2 \end{aligned}$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (x-2)^2 + (y-(-2))^2 &= 72 \\ (x-2)^2 + (y+2)^2 &= 72 \end{aligned}$$

b) C(10,0) and passing through K(1,-3)

Method 1:

$$\begin{aligned} D &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\ &= \sqrt{(1 - 10)^2 + (-3 - 0)^2} \\ &= \sqrt{(-9)^2 + (-3)^2} \\ &= \sqrt{81 + 9} \\ &= \sqrt{90} \\ &= \sqrt{9 \times 10} \\ &= 3\sqrt{10} \end{aligned}$$

$$r = 3\sqrt{10}; C(10,0)$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (x-10)^2 + (y-0)^2 &= (3\sqrt{10})^2 \\ (x-10)^2 + y^2 &= (9)(10) \\ (x-10)^2 + y^2 &= 90 \end{aligned}$$

Method 2:

$$\begin{array}{cc} C(10,0) & K(1,-3) \\ h & k \quad x \quad y \end{array}$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (1-10)^2 + (-3-0)^2 &= r^2 \\ (-9)^2 + (-3)^2 &= r^2 \\ 81 + 9 &= r^2 \\ 90 &= r^2 \end{aligned}$$

$$\begin{aligned} (x-h)^2 + (y-k)^2 &= r^2 \\ (x-10)^2 + (y-0)^2 &= 90 \\ (x-10)^2 + y^2 &= 90 \end{aligned}$$

$$9a) x^2 + y^2 - 12y - 5 = 0$$

$$\text{Step 1: } x^2 + y^2 - 12y = 5$$

$$\text{Step 2: } x^2 + y^2 - 12y + 36 = 5 + 36$$

$$\text{Step 3: } (x-0)^2 + (y-6)^2 = 41$$

Center  $(0, 6)$  ;  $r = \sqrt{41}$  units

$$b) x^2 + y^2 - 4x - 1 = 0$$

$$\text{Step 1: } x^2 - 4x + y^2 = 1$$

$$\text{Step 2: } x^2 - 4x + 4 + y^2 = 1 + 4$$

$$\text{Step 3: } (x-2)^2 + (y-0)^2 = 5$$

Center  $(2, 0)$  ;  $r = \sqrt{5}$  units

$$c) x^2 + y^2 - 6x - 8y - 1 = 0$$

$$\text{Step 1: } x^2 - 6x + y^2 - 8y = 1$$

$$\text{Step 2: } x^2 - 6x + 9 + y^2 - 8y + 16 = 1 + 9 + 16$$

$$\text{Step 3: } (x-3)^2 + (y-4)^2 = 26$$

Center  $(3, 4)$  ;  $r = \sqrt{26}$  units

$$d) 2x^2 + 2y^2 + 16x - 8y + 19 = 0$$

Extra Step: Divide each term by 2

$$x^2 + y^2 + 8x - 4y + \frac{19}{2} = 0$$

$$\text{Step 1: } x^2 + 8x + y^2 - 4y = -\frac{19}{2}$$

$$\text{Step 2: } x^2 + 8x + 16 + y^2 - 4y + 4 = -\frac{19}{2} + 16 + 4$$

$$\text{Step 3: } (x+4)^2 + (y-2)^2 = \frac{-19}{2} + \frac{20}{1}$$

$$(x+4)^2 + (y-2)^2 = \frac{-19}{2} + \frac{40}{2}$$

$$(x+4)^2 + (y-2)^2 = \frac{21}{2}$$

$$\text{Center } (-4, 2); r^2 = \frac{21}{2}$$

$$r = \sqrt{\frac{21}{2}} \text{ units}$$

$$e) 3x^2 + 3y^2 - 36x + 48y + 100 = 0$$

Extra Step: Divide each term by 3.

$$x^2 + y^2 - 12x + 16y + \frac{100}{3} = 0$$

$$\text{Step 1: } x^2 - 12x + y^2 + 16y = -\frac{100}{3}$$

$$\text{Step 2: } x^2 - 12x + 36 + y^2 + 16y + 64 = -\frac{100}{3} + 36 + 64$$

$$\text{Step 3: } (x-6)^2 + (y+8)^2 = -\frac{100}{3} + \frac{100}{1}$$

$$(x-6)^2 + (y+8)^2 = -\frac{100}{3} + \frac{300}{3}$$

$$(x-6)^2 + (y+8)^2 = \frac{200}{3}$$

$$\text{Center } (6, -8); r^2 = \frac{200}{3}$$

$$r = \sqrt{\frac{200}{3}}$$

$$r = \frac{\sqrt{100 \times 2}}{\sqrt{3}}$$

$$r = \frac{10\sqrt{2}}{\sqrt{3}} \text{ units}$$

10.  $x^2 + y^2 - 6x - 8y - 39 = 0$

Step 1:  $x^2 - 6x + y^2 - 8y = 39$

Step 2:  $x^2 - 6x + 9 + y^2 - 8y + 16 = 39 + 9 + 16$

Step 3:  $(x-3)^2 + (y-4)^2 = 64$

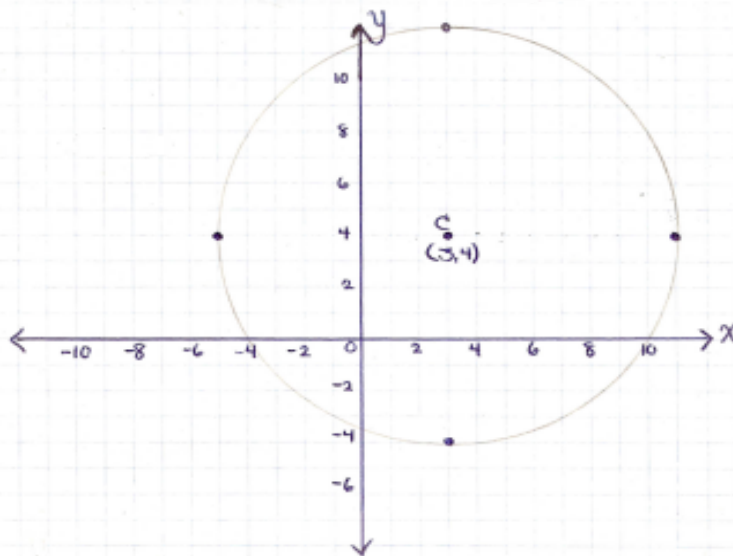
a) Center  $(3, 4)$

d) Domain:  $\{x \mid -5 \leq x \leq 11, x \in \mathbb{R}\}$

b) radius:  $r^2 = 64$   
 $r = \sqrt{64}$   
 $r = 8$  units

e) Range:  $\{y \mid -4 \leq y \leq 12, y \in \mathbb{R}\}$

c)



$$11. a) \frac{x^2}{36} + \frac{y^2}{1} = 1$$

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

↳ Horizontal Ellipse

$$a=6$$

$$b=1$$

$$i) \text{Major Axis} = 2a$$

$$= 2(6)$$

$$= 12 \text{ units}$$

$$\text{Minor Axis} = 2b$$

$$= 2(1)$$

$$= 2 \text{ units}$$

$$ii) \text{vertices.}$$

$$(-6, 0) \text{ and } (6, 0)$$

$$iii) x\text{-ints} \Rightarrow -6 \text{ and } 6$$

$$y\text{-ints} \Rightarrow -1 \text{ and } 1$$

$$b) \frac{x^2}{16} + \frac{y^2}{49} = 1$$

$$\frac{x^2}{(4)^2} + \frac{y^2}{(7)^2} = 1$$

↳ Vertical Ellipse

$$a=7$$

$$b=4$$

$$i) \text{Major Axis} = 2a$$

$$= 2(7)$$

$$= 14 \text{ units}$$

$$\text{Minor Axis} = 2b$$

$$= 2(4)$$

$$= 8 \text{ units}$$

$$ii) \text{vertices.}$$

$$(0, -7) \text{ and } (0, 7)$$

$$iii) x\text{-ints} \Rightarrow -4 \text{ and } 4$$

$$y\text{-ints} \Rightarrow -7 \text{ and } 7$$

$$c) \frac{x^2}{4} + \frac{y^2}{9} = 1$$

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

↳ Vertical Ellipse.

$$a=3$$

$$b=2$$

$$\begin{aligned} \text{i) Major Axis} &= 2a \\ &= 2(3) \\ &= 6 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Minor Axis} &= 2b \\ &= 2(2) \\ &= 4 \text{ units} \end{aligned}$$

ii) vertices.

$$(0, -3) \text{ and } (0, 3)$$

iii) x-ints  $\Rightarrow -2$  and  $2$ ,  
y-ints  $\Rightarrow -3$  and  $3$



12.

$$\text{a) Major Axis is } 12 \Rightarrow 2a = 12 \\ a = 6$$

$$\text{Minor Axis is } 5 \Rightarrow 2b = 5 \\ b = \frac{5}{2}$$

\* Vertical.

$$\text{Equation: } \frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$$

$$\frac{x^2}{(\frac{5}{2})^2} + \frac{y^2}{(6)^2} = 1$$

$$\frac{x^2}{\frac{25}{4}} + \frac{y^2}{36} = 1$$

$$\hookrightarrow \frac{4x^2}{25} + \frac{y^2}{36} = 1$$

b)  $\rightarrow$  x-ints  $\Rightarrow \pm 7$

$\rightarrow$  y-ints  $\Rightarrow \pm 9$ .

$$\text{Equation: } \frac{x^2}{(7)^2} + \frac{y^2}{(9)^2} = 1$$
$$\frac{x^2}{49} + \frac{y^2}{81} = 1$$

c)  $\rightarrow$  One vertex  $\Rightarrow (10, 0)$

$\hookrightarrow$  Remaining vertex must be  $(-10, 0)$

\* Therefore the major axis is 20 units

$$\hookrightarrow 2a = 20$$
$$a = 10.$$

$\rightarrow$  Minor Axis = 6

$$\hookrightarrow 2b = 6$$
$$b = 3$$

$$\text{Equation: } \frac{x^2}{(10)^2} + \frac{y^2}{(3)^2} = 1$$
$$\frac{x^2}{100} + \frac{y^2}{9} = 1$$

$$13a) 16(x-1)^2 + 12(y+3)^2 = 48$$

$$\frac{16(x-1)^2}{48} + \frac{12(y+3)^2}{48} = \frac{48}{48}$$
$$\frac{(x-1)^2}{3} + \frac{(y+3)^2}{4} = 1$$

Center  $(1, -3)$

Since this ellipse is vertical, it is parallel to the  $y$ -axis.

$$b) 3(x+4)^2 + 9(y-2)^2 = 27$$

$$\frac{3(x+4)^2}{27} + \frac{9(y-2)^2}{27} = \frac{27}{27}$$
$$\frac{(x+4)^2}{9} + \frac{(y-2)^2}{3} = 1$$

Center  $(-4, 2)$

Since this ellipse is horizontal, it is parallel to the  $x$ -axis.

$$\textcircled{14} \text{ a) } 9x^2 + 25y^2 - 36x - 100y - 89 = 0$$

$$9x^2 - 36x + 25y^2 - 100y = 89$$

$$9(x^2 - 4x + 4) + 25(y^2 - 4y + 4) = 89 + 36 + 100$$

$$\frac{9(x-2)^2}{25} + \frac{25(y-2)^2}{25} = \frac{225}{25}$$

$$\boxed{\frac{(x-2)^2}{25} + \frac{(y-2)^2}{9} = 1}$$

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

Horizontal  
 $a=5$   $b=3$

$$14. a) 9x^2 + 25y^2 - 36x - 100y - 89 = 0 \quad x\text{-axis.}$$

$$\text{Step 1: } 9x^2 - 36x + 25y^2 - 100y = 89$$

$$\text{Extra Step: } 9(x^2 - 4x) + 25(y^2 - 4y) = 89$$

$$\text{Step 2: } 9(x^2 - 4x + 4) + 25(y^2 - 4y + 4) = 89 + 36 + 100$$

$$\text{Step 3: } 9(x-2)^2 + 25(y-2)^2 = 225$$

$$\frac{9(x-2)^2}{225} + \frac{25(y-2)^2}{225} = \frac{225}{225}$$

$$\frac{(x-2)^2}{25} + \frac{(y-2)^2}{9} = 1$$

$$b) 2x^2 + 5y^2 + 20x - 30y + 75 = 0$$

$$\text{Step 1: } 2x^2 + 20x + 5y^2 - 30y = -75$$

$$\text{Extra Step: } 2(x^2 + 10x) + 5(y^2 - 6y) = -75$$

$$\text{Step 2: } 2(x^2 + 10x + 25) + 5(y^2 - 6y + 9) = -75 + 50 + 45$$

$$\text{Step 3: } 2(x+5)^2 + 5(y-3)^2 = 20$$

$$\frac{2(x+5)^2}{20} + \frac{5(y-3)^2}{20} = \frac{20}{20}$$
$$\frac{(x+5)^2}{10} + \frac{(y-3)^2}{4} = 1$$

$$15. 25x^2 + 16y^2 + 150x + 32y - 159 = 0$$

$$\text{Step 1: } 25x^2 + 150x + 16y^2 + 32y = 159$$

$$\text{Extra Step: } 25(x^2 + 6x) + 16(y^2 + 2y) = 159$$

$$\text{Step 2: } 25(x^2 + 6x + 9) + 16(y^2 + 2y + 1) = 159 + 225 + 16$$

$$\text{Step 3: } 25(x+3)^2 + 16(y+1)^2 = 400$$

$$\frac{25(x+3)^2}{400} + \frac{16(y+1)^2}{400} = \frac{400}{400}$$
$$\frac{(x+3)^2}{16} + \frac{(y+1)^2}{25} = 1$$

a) Center  $(-3, -1)$

$$b) \frac{(x+3)^2}{(4)^2} + \frac{(y+1)^2}{(5)^2} = 1 \quad C(-3, -1)$$

vertices

$$(-3, -1-5) \text{ and } (-3, -1+5)$$

$$(-3, -6) \text{ and } (-3, 4)$$

$$c) \begin{array}{ll} \text{Major Axis} = 2a & \text{Minor Axis} = 2b \\ = 2(5) & = 2(4) \\ = 10 \text{ units} & = 8 \text{ units} \end{array}$$



$$16. 4x^2 + 9y^2 - 8x - 54y + 49 = 0$$

$$\text{Step 1: } 4x^2 - 8x + 9y^2 - 54y = -49$$

$$\text{Extra Step: } 4(x^2 - 2x) + 9(y^2 - 6y) = -49$$

$$\text{Step 2: } 4(x^2 - 2x + 1) + 9(y^2 - 6y + 9) = -49 + 4 + 81$$

$$\text{Step 3: } 4(x-1)^2 + 9(y-3)^2 = 36$$

$$\frac{4(x-1)^2}{36} + \frac{9(y-3)^2}{36} = \frac{36}{36}$$
$$\frac{(x-1)^2}{9} + \frac{(y-3)^2}{4} = 1$$

a) Center  $(1, 3)$

b)  $\frac{(x-1)^2}{(3)^2} + \frac{(y-3)^2}{(2)^2} = 1$

vertices  $(1-3, 3)$  and  $(1+3, 3)$   
 $(-2, 3)$  and  $(4, 3)$

d) Major Axis =  $2a$   
=  $2(3)$   
= 6 units

Minor Axis =  $2b$   
=  $2(2)$   
= 4 units