

CHAPTER 10

Think & Discuss (p. 587)

1. a parabola

$$2. y = \frac{x^2}{1040} = \frac{(32.5)^2}{1040} = \frac{1056.25}{1040} = 1.015 \approx 1.02 \text{ cm}$$

Substitute the radius (32.5 cm) for x in the equation and solve for y .

Skill Review (p. 588)

1. $(0, 4), m = 2$

$$y - 4 = 2(x - 0)$$

$$y - 4 = 2x$$

$$y = 2x + 4$$

2. $(2, -2), m = \frac{1}{3}$

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

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

$$y = \frac{1}{3}x - \frac{8}{3}$$

3. $(-4, 1), m = -\frac{3}{4}$

$$y - 1 = -\frac{3}{4}(x + 4)$$

$$y - 1 = -\frac{3}{4}x - 3$$

$$y = -\frac{3}{4}x - 2$$

4. $x + 2y = 8$

$$3x - y = 3$$

$$x + 2y = 8$$

$$\underline{6x - 2y = 6}$$

$$7x = 14$$

$$x = 2$$

$$x + 2y = 8$$

$$2 + 2y = 8$$

$$2y = 6$$

$$y = 3$$

$$(2, 3)$$

5. $2x + y = 3$

$$3x + y = 2$$

$$-2x - y = -3$$

$$\underline{3x + y = 2}$$

$$x = -1$$

$$2x + y = 3$$

$$2(-1) + y = 3$$

$$-2 + y = 3$$

$$y = 5$$

$$(-1, 5)$$

6. $4x - y = 7$

$$5x - 2y = 2$$

$$-8x + 2y = -14$$

$$\underline{5x - 2y = 2}$$

$$-3x = -12$$

$$x = 4$$

$$4x - y = 7$$

$$4(4) - y = 7$$

$$16 - y = 7$$

$$-y = -9$$

$$y = 9$$

$$(4, 9)$$

7. $y = x^2 + 4$

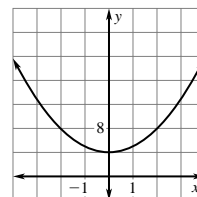
x	0	1	-1	2	-2
y	4	5	5	8	8

$$\frac{-b}{2a} = \frac{0}{1} = 0$$

$$y = 1(0)^2 + 4 = 4$$

$$\text{vertex} = (0, 4)$$

$$\text{axis of symmetry } x = 0$$



8. $y = -3x^2$

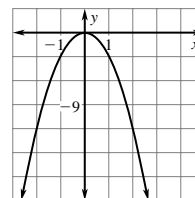
x	0	1	-1	2	-2
y	0	-3	-3	-12	-12

$$\frac{-b}{2a} = \frac{0}{2(-3)} = \frac{0}{-6} = 0$$

$$y = -3(0)^2 = 0$$

$$\text{vertex} = (0, 0)$$

$$\text{axis of symmetry } x = 0$$



9. $y = 2(x - 3)^2 - 1$

$$= 2[(x - 3)(x - 3)] - 1$$

$$= 2[x^2 - 6x + 9] - 1$$

$$= 2x^2 - 12x + 18 - 1$$

$$= 2x^2 - 12x + 17$$

x	3	2	4	1	5
y	-1	1	1	7	7

$$\frac{-b}{2a} = \frac{12}{2(2)} = \frac{12}{4} = 3$$

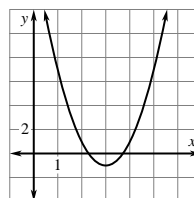
$$y = 2(3)^2 - 12(3) + 17$$

$$= 18 - 36 + 17$$

$$= -1$$

$$\text{vertex} (3, -1)$$

$$\text{axis of symmetry } x = 3$$



Chapter 10 continued

$$10. \quad x^2 + 8x + 14 = 0$$

$$x^2 + 8x = -14$$

$$x^2 + 8x + (4)^2 = -14 + 16$$

$$(x + 4)^2 = 2$$

$$x + 4 = \sqrt{2}$$

$$x = -4 \pm \sqrt{2}$$

$$11. \quad 5x^2 + 15x = -25$$

$$x^2 + 3x = -5$$

$$x^2 + 3x + \left(\frac{3}{2}\right)^2 = -5 + \frac{9}{4}$$

$$\left(x + \frac{3}{2}\right)^2 = -\frac{11}{4}$$

$$x + \frac{3}{2} = \pm \frac{i\sqrt{11}}{2}$$

$$x = -\frac{3}{2} \pm \frac{i\sqrt{11}}{2}$$

$$12. \quad x^2 - 2x = -8x + 14$$

$$x^2 + 6x = 14$$

$$x^2 + 6x + (3)^2 = 14 + 9$$

$$(x + 3)^2 = 23$$

$$x + 3 = \pm \sqrt{23}$$

$$x = -3 \pm \sqrt{23}$$

Lesson 10.1

10.1 Guided Practice (pp. 592–594)

1. distance formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$;

midpoint formula: $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

2. let $(x_1, y_1) = (3, -1)$ and $(x_2, y_2) = (-2, 5)$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(-2 - 3)^2 + [5 - (-1)]^2}$$

$$= \sqrt{(-5)^2 + (6)^2}$$

$$= \sqrt{25 + 36}$$

$$= \sqrt{61} \approx 7.81$$

$d = \sqrt{61}$ for each. The differences are opposite the first pair of differences. Since they are squared, the answer is the same.

3. a. $d = \sqrt{(x - 0)^2 + (y - 0)^2}$

$$d = \sqrt{x^2 + y^2}$$

b. $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = \left(\frac{0 + x}{2}, \frac{0 + y}{2}\right) = \left(\frac{x}{2}, \frac{y}{2}\right)$

4. $(2, -1), (2, 3)$

$$d = \sqrt{(2 - 2)^2 + [3 - (-1)]^2} = \sqrt{4^2} = 4$$

5. $(-5, -2), (0, -2)$

$$d = \sqrt{[0 - (-5)]^2 + [-2 - (-2)]^2} = \sqrt{5^2} = 5$$

6. $(0, 6), (4, 9)$

$$d = \sqrt{(4 - 0)^2 + (9 - 6)^2} = \sqrt{16 + 9}$$

$$= \sqrt{25} = 5$$

7. $(10, -2), (7, 4)$

$$d = \sqrt{(7 - 10)^2 + [(4 - (-2))]^2} = \sqrt{9 + 36}$$

$$= \sqrt{45} = 3\sqrt{5} \approx 6.71$$

8. $(-3, 8), (5, 6)$

$$d = \sqrt{[5 - (-3)]^2 + (6 - 8)^2} = \sqrt{64 + 4}$$

$$= \sqrt{68} = 2\sqrt{17} \approx 8.25$$

9. $(6, -1), (-9, 8)$

$$d = \sqrt{(-9 - 6)^2 + [8 - (-1)]^2} = \sqrt{225 + 81}$$

$$= \sqrt{306} = 3\sqrt{34} \approx 17.49$$

10. $(0, 0), (-8, 14)$

$$\left(\frac{0 - 8}{2}, \frac{0 + 14}{2}\right) = \left(\frac{-8}{2}, \frac{14}{2}\right) = (-4, 7)$$

11. $(0, 3), (4, 9)$

$$\left(\frac{0 + 4}{2}, \frac{3 + 9}{2}\right) = \left(\frac{4}{2}, \frac{12}{2}\right) = (2, 6)$$

12. $(1, -2), (1, 6)$

$$\left(\frac{1 + 1}{2}, \frac{-2 + 6}{2}\right) = \left(\frac{2}{2}, \frac{4}{2}\right) = (1, 2)$$

13. $(1, 3), (3, 11)$

$$\left(\frac{1 + 3}{2}, \frac{3 + 11}{2}\right) = \left(\frac{4}{2}, \frac{14}{2}\right) = (2, 7)$$

14. $(-5, 4), (2, -4)$

$$\left(\frac{-5 + 2}{2}, \frac{4 - 4}{2}\right) = \left(\frac{-3}{2}, \frac{0}{2}\right) = \left(-\frac{3}{2}, 0\right)$$

15. $(-1, 5), (-8, -6)$

$$\left(\frac{-1 - 8}{2}, \frac{5 - 6}{2}\right) = \left(\frac{-9}{2}, \frac{-1}{2}\right) = \left(-\frac{9}{2}, -\frac{1}{2}\right)$$

16.

a.

$(-3, 2), (2, 6)$

$$\left(\frac{-3 + 2}{2}, \frac{2 + 6}{2}\right) = \left(\frac{-1}{2}, \frac{8}{2}\right) = \left(-\frac{1}{2}, 4\right)$$

b.

$$d = \sqrt{[0 - (-3)]^2 + (0 - 2)^2} = \sqrt{9 + 4} = \sqrt{13}$$

$$d = \sqrt{[-3 - (-0.5)]^2 + (2 - 4)^2} = \sqrt{6.25 + 4} = \sqrt{10.25}$$

day 1 = $\sqrt{13} + \sqrt{10.25} \approx 6.81$ mi

$$d = \sqrt{[2 - (-0.5)]^2 + (6 - 4)^2} = \sqrt{6.25 + 4} = \sqrt{10.25}$$

$$d = \sqrt{[(2 - 0)]^2 + (6 - 0)^2} = \sqrt{4 + 36} = \sqrt{40}$$

day 2 = $\sqrt{10.25} + \sqrt{40} \approx 9.53$ mi

Chapter 10 continued

—CONTINUED—

10.1 Practice and Applications (pp. 592–594)

17. $(0, 0), (3, 4)$

$$d = \sqrt{(3 - 0)^2 + (4 - 0)^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

$$\left(\frac{0 + 3}{2}, \frac{0 + 4}{2}\right) = \left(\frac{3}{2}, 2\right)$$

18. $(0, 0), (4, 12)$

$$d = \sqrt{(4 - 0)^2 + (12 - 0)^2} = \sqrt{16 + 144} = \sqrt{160}$$

$$= 4\sqrt{10} \approx 12.65$$

$$\left(\frac{0 + 4}{2}, \frac{0 + 12}{2}\right) = (2, 6)$$

19. $(0, 4), (8, -3)$

$$d = \sqrt{(8 - 0)^2 + (-3 - 4)^2}$$

$$= \sqrt{64 + 49}$$

$$= \sqrt{113} \approx 10.63$$

$$\left(\frac{0 + 8}{2}, \frac{4 - 3}{2}\right) = \left(4, \frac{1}{2}\right)$$

20. $(-2, 8), (6, 0)$

$$d = \sqrt{(6 + 2)^2 + (0 - 8)^2}$$

$$= \sqrt{64 + 64}$$

$$= \sqrt{128} = 8\sqrt{2} \approx 11.31$$

$$\left(\frac{-2 + 6}{2}, \frac{8 + 0}{2}\right) = (2, 4)$$

21. $(-3, -1), (7, 4)$

$$d = \sqrt{(7 + 3)^2 + (4 + 1)^2}$$

$$= \sqrt{100 + 25}$$

$$= \sqrt{125} = 5\sqrt{5} \approx 11.18$$

$$\left(\frac{-3 + 7}{2}, \frac{-1 + 4}{2}\right) = \left(2, \frac{3}{2}\right)$$

22. $(9, -2), (3, 6)$

$$d = \sqrt{(3 - 9)^2 + (6 + 2)^2}$$

$$= \sqrt{36 + 64}$$

$$= \sqrt{100} = 10$$

$$\left(\frac{9 + 3}{2}, \frac{-2 + 6}{2}\right) = (6, 2)$$

23. $(-5, -8), (1, 6)$

$$d = \sqrt{(1 + 5)^2 + (6 + 8)^2}$$

$$= \sqrt{36 + 196}$$

$$= \sqrt{232} = 2\sqrt{58} \approx 15.23$$

$$\left(\frac{-5 + 1}{2}, \frac{-8 + 6}{2}\right) = (-2, -1)$$

24. $(-2, 10), (10, -2)$

$$d = \sqrt{(10 + 2)^2 + (-2 - 10)^2}$$

$$= \sqrt{144 + 144}$$

$$= \sqrt{288} = 12\sqrt{2} \approx 16.97$$

$$\left(\frac{-2 + 10}{2}, \frac{10 - 2}{2}\right) = (4, 4)$$

25. $(8, 3), (2, -1)$

$$d = \sqrt{(2 - 8)^2 + (-1 - 3)^2}$$

$$= \sqrt{36 + 16}$$

$$= \sqrt{52} = 2\sqrt{13} \approx 7.21$$

$$\left(\frac{8 + 2}{2}, \frac{3 - 1}{2}\right) = (5, 1)$$

26. $(-10, -15), (12, 18)$

$$d = \sqrt{(12 + 10)^2 + (18 + 15)^2}$$

$$= \sqrt{(22)^2 + (33)^2}$$

$$= \sqrt{484 + 1089}$$

$$= \sqrt{1573}$$

$$= 11\sqrt{13} \approx 39.66$$

$$\left(\frac{-10 + 12}{2}, \frac{-15 + 18}{2}\right) = \left(1, \frac{3}{2}\right)$$

27. $(-3.5, 1.2), (6, -3.8)$

$$d = \sqrt{6 + 3.5)^2 + (-3.8 - 1.2)^2}$$

$$= \sqrt{(9.5)^2 + (-5.0)^2}$$

$$= \sqrt{90.25 + 25}$$

$$= \sqrt{115.25} \approx 10.74$$

$$\left(\frac{-3.5 + 6}{2}, \frac{1.2 - 3.8}{2}\right) = \left(\frac{2.5}{2}, \frac{-2.6}{2}\right) = (1.25, -1.3)$$

28. $(6.3, -9), (1.3, -8.5)$

$$d = \sqrt{(1.3 - 6.3)^2 + (-8.5 + 9)^2}$$

$$= \sqrt{(5)^2 + (0.5)^2}$$

$$= \sqrt{25 + 0.25} = \sqrt{25.25} \approx 5.02$$

$$\left(\frac{6.3 + 1.3}{2}, \frac{-9 - 8.5}{2}\right) = \left(\frac{7.6}{2}, \frac{-17.5}{2}\right) = (3.8, -8.75)$$

Chapter 10 continued

29. $(-7, 2), \left(-\frac{11}{2}, 4\right)$

$$\begin{aligned} d &= \sqrt{\left(-\frac{11}{2} + 7\right)^2 + (4 - 2)^2} \\ &= \sqrt{\left(\frac{3}{2}\right)^2 + (2)^2} \\ &= \sqrt{\frac{9}{4} + \frac{16}{4}} \\ &= \frac{\sqrt{25}}{\sqrt{4}} = \frac{5}{2} = 2.5 \end{aligned}$$

$$\left(\frac{-7 - \frac{11}{2}}{2}, \frac{2 + 4}{2}\right) = \left(\frac{-\frac{25}{2}}{2}, \frac{6}{2}\right) = \left(\frac{-25}{4}, 3\right) = (-6.25, 3)$$

30. $\left(\frac{2}{3}, -\frac{11}{4}\right), \left(-\frac{7}{2}, -\frac{11}{2}\right)$

$$\begin{aligned} d &= \sqrt{\left(-\frac{7}{2} - \frac{2}{3}\right)^2 + \left(-\frac{11}{2} + \frac{11}{4}\right)^2} \\ &= \sqrt{\left(-\frac{21}{6} - \frac{4}{6}\right)^2 + \left(-\frac{22}{4} + \frac{11}{4}\right)^2} \\ &= \sqrt{\left(-\frac{25}{6}\right)^2 + \left(-\frac{11}{4}\right)^2} = \sqrt{\frac{625}{36} + \frac{121}{16}} \\ &= \sqrt{\frac{2500}{144} + \frac{1089}{144}} = \sqrt{\frac{3589}{144}} \approx 4.99 \end{aligned}$$

$$\begin{aligned} &\left(\frac{\frac{2}{3} - \frac{7}{2} - \frac{11}{4} - \frac{11}{2}}{2}, \frac{-\frac{11}{4} - \frac{11}{2}}{2}\right) \\ &= \left(\frac{\frac{4}{6} - \frac{21}{6} - \frac{11}{4} - \frac{22}{4}}{2}, \frac{-\frac{11}{4} - \frac{22}{4}}{2}\right) \\ &= \left[\frac{-17}{6}\left(\frac{1}{2}\right), \frac{-33}{4}\left(\frac{1}{2}\right)\right] = \left(-\frac{17}{12}, -\frac{33}{8}\right) \end{aligned}$$

31. $\left(-\frac{3}{4}, 2\right), \left(5, -\frac{7}{4}\right)$

$$\begin{aligned} d &= \sqrt{\left(5 + \frac{3}{4}\right)^2 + \left(-\frac{7}{4} - 2\right)^2} \\ &= \sqrt{\left(\frac{20}{4} + \frac{3}{4}\right)^2 + \left[-\frac{7}{4} + \left(-\frac{8}{4}\right)\right]^2} \\ &= \sqrt{\left(\frac{23}{4}\right)^2 + \left(\frac{-15}{4}\right)^2} \\ &= \sqrt{\frac{529}{16} + \frac{225}{16}} \\ &= \sqrt{\frac{754}{16}} \\ &= \frac{\sqrt{754}}{4} \approx 6.86 \end{aligned}$$

$$\begin{aligned} &\left(\frac{-\frac{3}{4} + 5}{2}, \frac{2 - \frac{7}{4}}{2}\right) \\ &= \left(\frac{-\frac{3}{4} + \frac{20}{4}}{2}, \frac{\frac{8}{4} - \frac{7}{4}}{2}\right) = \left[\frac{17}{4}\left(\frac{1}{2}\right), \frac{1}{4}\left(\frac{1}{2}\right)\right] = \left(\frac{17}{8}, \frac{1}{8}\right) \end{aligned}$$

32. $(2, 0), (0, 8), (-2, 0)$

$$\begin{aligned} d_1 &= \sqrt{(0 - 2)^2 + (8 - 0)^2} = \sqrt{4 + 64} = \sqrt{68} \\ &= 2\sqrt{17} \approx 8.25 \end{aligned}$$

$$\begin{aligned} d_2 &= \sqrt{(-2 - 0)^2 + (0 - 8)^2} = \sqrt{4 + 64} = \sqrt{68} \\ &= 2\sqrt{17} \approx 8.25 \end{aligned}$$

$$d_3 = \sqrt{(-2 - 2)^2 + (0 - 0)^2} = \sqrt{16 + 0} = \sqrt{16} = 4$$

$d_1 = d_2$, isosceles

33. $(4, 1), (1, -2), (6, -4)$

$$\begin{aligned} d_1 &= \sqrt{(1 - 4)^2 + (-2 - 1)^2} = \sqrt{9 + 9} \\ &= \sqrt{18} \approx 4.243 \end{aligned}$$

$$\begin{aligned} d_2 &= \sqrt{(6 - 1)^2 + (-4 + 2)^2} = \sqrt{25 + 4} \\ &= \sqrt{29} \approx 5.385 \end{aligned}$$

$$\begin{aligned} d_3 &= \sqrt{(6 - 4)^2 + (-4 - 1)^2} = \sqrt{4 + 25} \\ &= \sqrt{29} \approx 5.385 \end{aligned}$$

$d_2 = d_3$, isosceles

34. $(1, 9), (-4, 2), (4, 2)$

$$\begin{aligned} d_1 &= \sqrt{(-4 - 1)^2 + (2 - 9)^2} = \sqrt{25 + 49} \\ &= \sqrt{74} \approx 8.602 \end{aligned}$$

$$d_2 = \sqrt{(4 + 4)^2 + (2 - 2)^2} = \sqrt{64} = 8$$

$$\begin{aligned} d_3 &= \sqrt{(4 - 1)^2 + (2 - 9)^2} = \sqrt{9 + 49} \\ &= \sqrt{58} \approx 7.616 \end{aligned}$$

$d_1 \neq d_2 \neq d_3$, scalene

35. $(2, 5), (8, 2), (4, -1)$

$$\begin{aligned} d_1 &= \sqrt{(8 - 2)^2 + (2 - 5)^2} = \sqrt{36 + 9} \\ &= \sqrt{45} \approx 6.708 \end{aligned}$$

$$\begin{aligned} d_2 &= \sqrt{(4 - 8)^2 + (-1 - 2)^2} = \sqrt{16 + 9} \\ &= \sqrt{25} = 5 \end{aligned}$$

$$\begin{aligned} d_3 &= \sqrt{(4 - 2)^2 + (-1 - 5)^2} = \sqrt{4 + 36} \\ &= \sqrt{40} \approx 6.325 \end{aligned}$$

$d_1 \neq d_2 \neq d_3$, scalene

36. $(5, -1), (-4, 0), (3, 5)$

$$\begin{aligned} d_1 &= \sqrt{(-4 - 5)^2 + (0 + 1)^2} = \sqrt{81 + 1} \\ &= \sqrt{82} \approx 9.055 \end{aligned}$$

$$\begin{aligned} d_2 &= \sqrt{(3 + 4)^2 + (5 - 0)^2} = \sqrt{49 + 25} \\ &= \sqrt{74} \approx 8.602 \end{aligned}$$

$$\begin{aligned} d_3 &= \sqrt{(3 - 5)^2 + (5 + 1)^2} = \sqrt{4 + 36} \\ &= \sqrt{40} \approx 6.325 \end{aligned}$$

$d_1 \neq d_2 \neq d_3$, scalene

Chapter 10 continued

37. (4, 4), (8, 1), (6, -5)

$$d_1 = \sqrt{(8-4)^2 + (1-4)^2} = \sqrt{16+9}$$

$$= \sqrt{25} = 5$$

$$d_2 = \sqrt{(6-8)^2 + (-5-1)^2} = \sqrt{4+36}$$

$$= \sqrt{40} \approx 6.325$$

$$d_3 = \sqrt{(6-4)^2 + (-5-4)^2} = \sqrt{4+81}$$

$$= \sqrt{85} \approx 9.220$$

$d_1 \neq d_2 \neq d_3$, scalene

38. (0, -3), (3, 5), (-5, 2)

$$d_1 = \sqrt{(3-0)^2 + (5+3)^2} = \sqrt{9+64}$$

$$= \sqrt{73} \approx 8.544$$

$$d_2 = \sqrt{(-5-3)^2 + (2-5)^2} = \sqrt{64+9}$$

$$= \sqrt{73} \approx 8.544$$

$$d_3 = \sqrt{(-5-0)^2 + (2+3)^2} = \sqrt{25+25}$$

$$= \sqrt{50} \approx 7.071$$

$d_1 = d_2$, isosceles

39. (1, 1), (-4, 0), (-2, 5)

$$d_1 = \sqrt{(-4-1)^2 + (0-1)^2} = \sqrt{25+1}$$

$$= \sqrt{26} \approx 5.099$$

$$d_2 = \sqrt{(-2+4)^2 + (5-0)^2} = \sqrt{4+25}$$

$$= \sqrt{29} \approx 5.385$$

$$d_3 = \sqrt{(-2-1)^2 + (5-1)^2} = \sqrt{9+16}$$

$$= \sqrt{25} = 5$$

$d_1 \neq d_2 \neq d_3$, scalene

40. (2, 4), (3, -2), (-1, 1)

$$d_1 = \sqrt{(3-2)^2 + (-2-4)^2} = \sqrt{1+36}$$

$$= \sqrt{37} \approx 6.083$$

$$d_2 = \sqrt{(-1-3)^2 + (1+2)^2} = \sqrt{16+9}$$

$$= \sqrt{25} = 5$$

$$d_3 = \sqrt{(-1-2)^2 + (1-4)^2} = \sqrt{9+9}$$

$$= \sqrt{18} \approx 4.243$$

$d_1 \neq d_2 \neq d_3$, scalene

41. (2, 2), (6, 14)

$$\left(\frac{2+6}{2}, \frac{2+14}{2}\right) = (4, 8)$$

$$m = \frac{14-2}{6-2} = \frac{12}{4} = 3$$

$$\text{slope} = -\frac{1}{3}$$

$$y - 8 = -\frac{1}{3}(x - 4)$$

$$y - 8 = -\frac{1}{3}x + \frac{4}{3}$$

$$y = -\frac{1}{3}x + \frac{28}{3}$$

42. (0, 0), (-8, -10)

$$\left(\frac{0-8}{2}, \frac{0-10}{2}\right) = (-4, -5)$$

$$m = \frac{-10-0}{-8-0} = \frac{5}{4}$$

$$\text{slope} = -\frac{4}{5}$$

$$y + 5 = -\frac{4}{5}(x + 4)$$

$$y + 5 = -\frac{4}{5}x - \frac{16}{5}$$

$$y = -\frac{4}{5}x - \frac{41}{5}$$

43. (0, -6), (-4, 9)

$$\left(\frac{0-4}{2}, \frac{-6+9}{2}\right) = \left(-2, \frac{3}{2}\right)$$

$$m = \frac{9+6}{-4-0} = -\frac{15}{4}$$

$$\text{slope} = \frac{4}{15}$$

$$y - \frac{3}{2} = \frac{4}{15}(x + 2)$$

$$y - \frac{3}{2} = \frac{4}{15}x + \frac{8}{15}$$

$$y = \frac{4}{15}x + \frac{61}{30}$$

44. (3, -7), (-3, 1)

$$\left(\frac{3-3}{2}, \frac{-7+1}{2}\right) = (0, -3)$$

$$m = \frac{1+7}{-3-3} = -\frac{8}{6} = -\frac{4}{3}$$

$$\text{slope} = \frac{3}{4}$$

$$y + 3 = \frac{3}{4}(x - 0)$$

$$y + 3 = \frac{3}{4}x$$

$$y = \frac{3}{4}x - 3$$

45. (-3, -7.2), (-4.2, 1.8)

$$\left(\frac{-3-4.2}{2}, \frac{-7.2+1.8}{2}\right) = \left(\frac{-7.2}{2}, \frac{-5.4}{2}\right)$$

$$= (-3.6, -2.7)$$

$$m = \frac{1.8+7.2}{-4.2+3} = -\frac{9}{1.2}$$

$$\text{slope} = \frac{1.2}{9} = \frac{12}{90} = \frac{2}{15}$$

$$y + 2.7 = \frac{2}{15}(x + 3.6)$$

$$y + 2.7 = \frac{2}{15}x + 0.48$$

$$y = \frac{2}{15}x - 2.22$$

Chapter 10 continued

46. $\left(\frac{3}{2}, -6\right), (-3, 1)$

$$\left[\frac{\frac{3}{2} + (-3)}{2}, \frac{-6 + 1}{2}\right] = \left(-\frac{3}{4}, -\frac{5}{2}\right)$$

$$m = \frac{1 + 6}{-3 - \frac{3}{2}} = \frac{7}{-\frac{6}{2} - \frac{3}{2}} = \frac{7}{-\frac{9}{2}} = \frac{7}{1} \cdot \left(-\frac{2}{9}\right) = -\frac{14}{9}$$

$$\text{slope} = \frac{9}{14}$$

$$y + \frac{5}{2} = \frac{9}{14}\left(x + \frac{3}{4}\right)$$

$$y + \frac{5}{2} = \frac{9}{14}x + \frac{27}{56}$$

$$y = \frac{9}{14}x - \frac{113}{56}$$

47. $(0, 1), (x, 4); d = \sqrt{34}$

$$\sqrt{34} = \sqrt{(x-0)^2 + (4-1)^2}$$

$$\sqrt{34} = \sqrt{(x)^2 + 9}$$

$$(\sqrt{34})^2 = (\sqrt{(x)^2 + 9})^2$$

$$34 = x^2 + 9$$

$$x^2 = 34 - 9 = 25$$

$$x = \pm 5$$

48. $(1, 3), (-6, x); d = \sqrt{74}$

$$\sqrt{74} = \sqrt{(-6-1)^2 + (x-3)^2}$$

$$\sqrt{74} = \sqrt{49 + (x-3)^2}$$

$$(\sqrt{74})^2 = [\sqrt{49 + (x-3)^2}]^2$$

$$74 = 49 + (x-3)^2$$

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

$$x^2 - 6x - 16 = 0$$

$$(x-8)(x+2) = 0$$

$$x-8 = 0 \quad x+2 = 0$$

$$x = 8 \quad x = -2$$

49. $(x, -10), (-8, 4); d = 7\sqrt{5}$

$$7\sqrt{5} = \sqrt{(-8-x)^2 + (4+10)^2}$$

$$7\sqrt{5} = \sqrt{(-8-x)^2 + 196}$$

$$(7\sqrt{5})^2 = [\sqrt{(-8-x)^2 + 196}]^2$$

$$49(5) = (-8-x)^2 + 196$$

$$245 = (-8-x)^2 + 196$$

$$49 = 64 + 16x + x^2$$

$$x^2 + 16x + 15 = 0$$

$$(x+15)(x+1) = 0$$

$$x+15 = 0 \quad x+1 = 0$$

$$x = -15 \quad x = -1$$

50. $(0.5, x), (7, 2); d = 8.5$

$$8.5 = \sqrt{(7-0.5)^2 + (2-x)^2}$$

$$8.5 = \sqrt{42.25 + (2-x)^2}$$

$$(8.5)^2 = [\sqrt{42.25 + (2-x)^2}]^2$$

$$72.25 = 42.25 + (2-x)^2$$

$$30 = 4 - 4x + x^2$$

$$x^2 - 4x - 26 = 0$$

$$x^2 - 4x + 4 = 26 + 4$$

$$(x-2)^2 = 30$$

$$x-2 = \pm\sqrt{30}$$

$$x = 2 \pm \sqrt{30}$$

51. $(0, 0), (25, 35)$

$$\left(\frac{0+25}{2}, \frac{0+35}{2}\right) = \left(\frac{25}{2}, \frac{35}{2}\right)$$

$$(50, 0), (25, 35)$$

$$\left(\frac{50+25}{2}, \frac{0+35}{2}\right) = \left(\frac{75}{2}, \frac{35}{2}\right)$$

$$\left(\frac{25}{2}, \frac{35}{2}\right); \left(\frac{75}{2}, \frac{35}{2}\right)$$

52. $d = \sqrt{\left(\frac{75}{2} - \frac{25}{2}\right)^2 + \left(\frac{35}{2} - \frac{35}{2}\right)^2}$

$$= \sqrt{\left(\frac{50}{2}\right)^2} = \sqrt{625} = 25$$

53. $(1, 0), (19, 6)$

$$d = \sqrt{(19-1)^2 + (6-0)^2} = \sqrt{(18)^2 + (6)^2}$$

$$= \sqrt{324 + 36} = \sqrt{360} \approx 18.97 \text{ miles}$$

54. $(1, 0), (6, -9)$

$$d = \sqrt{(6-1)^2 + (-9-0)^2} = \sqrt{25 + 81}$$

$$= \sqrt{106} \approx 10.30 \text{ miles}$$

55. $(1, 0), (-6, -9)$

$$d = \sqrt{(-6-1)^2 + (-9-0)^2} = \sqrt{49 + 81}$$

$$d = \sqrt{130} \approx 11.40 \text{ miles}$$

56. $(1, 0), (-14, 1)$

$$d = \sqrt{(-14-1)^2 + (1-0)^2} = \sqrt{225 + 1}$$

$$= \sqrt{226} \approx 15.03 \text{ miles}$$

Chapter 10 continued

57. $(-10, 1), (0, 0)$

$$\left(\frac{-10+0}{2}, \frac{1+0}{2}\right) = \left(-5, \frac{1}{2}\right)$$

$$m = \frac{0-1}{0+10} = -\frac{1}{10}$$

$$\text{slope} = 10$$

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

$$y - \frac{1}{2} = 10x + 50$$

$$y = 10x + 50.5$$

$$(16, 2), (0, 0)$$

$$\left(\frac{16+0}{2}, \frac{2+0}{2}\right) = (8, 1)$$

$$m = \frac{0-2}{0-16} = \frac{1}{8}$$

$$\text{slope} = -8$$

$$y - 1 = -8(x - 8)$$

$$y - 1 = -8x + 64$$

$$y = -8x + 65$$

$$-8x + 65 = 10x + 50.5$$

$$14.5 = 18x$$

$$0.806 = x$$

$$y = 10(0.806) + 50.5$$

$$= 58.56$$

$$C(0.806, 58.56)$$

$$r = \sqrt{(0.806 - 0)^2 + (58.56 - 0)^2} = \sqrt{0.65 + 3429.27}$$

$$= \sqrt{3429.92} \approx 58.57 \text{ m}$$

$$v = \sqrt{ar} = \sqrt{6.86(58.57)} = \sqrt{401.79}$$

$$\approx 20 \text{ meters per second}$$

58. $(1, 127), (2, 120)$

$$d = \sqrt{(2-1)^2 + (120-127)^2}$$

$$= \sqrt{1+49} = \sqrt{50} \approx 7.07$$

$$(1, 127), (5, 127)$$

$$d = \sqrt{(5-1)^2 + (127-127)^2}$$

$$= \sqrt{16+0} = \sqrt{16} = 4$$

$$(1, 127), (1, 140)$$

$$d = \sqrt{(1-1)^2 + (140-127)^2}$$

$$= \sqrt{(13)^2} = 13$$

—CONTINUED—

58. —CONTINUED—

$$(1, 127), (7, 115)$$

$$d = \sqrt{(7-1)^2 + (115-127)^2}$$

$$= \sqrt{36+144} = \sqrt{180} \approx 13.42$$

$$(1, 127), (3, 112)$$

$$d = \sqrt{(3-1)^2 + (112-127)^2}$$

$$= \sqrt{4+225} = \sqrt{229} \approx 15.13$$

$$(1, 127), (4, 125)$$

$$d = \sqrt{(4-1)^2 + (125-127)^2}$$

$$= \sqrt{9+4} = \sqrt{13} \approx 3.61$$

$$(1, 127), (1, 130)$$

$$d = \sqrt{(1-1)^2 + (130-127)^2} = \sqrt{0+9} = \sqrt{9} = 3$$

59. $(0, 7), (1, -1)$

$$d = \sqrt{(1-0)^2 + (-1-7)^2}$$

$$= \sqrt{1+64} = \sqrt{65} \approx 8.06$$

$$(9, 2), (3, 8)$$

$$d = \sqrt{(3-9)^2 + (8-2)^2}$$

$$= \sqrt{36+36} = \sqrt{72} \approx 8.49$$

$$8.06 < 8.49 \text{ B}$$

60. $(-5, -2), (5, 2)$

$$d = \sqrt{(5+5)^2 + (2+2)^2}$$

$$= \sqrt{100+16} = \sqrt{116} \approx 10.77$$

$$(-5, 5), (2, -2)$$

$$d = \sqrt{(2+5)^2 + (-2-5)^2}$$

$$= \sqrt{49+49} = \sqrt{98} \approx 9.9$$

$$10.77 > 9.9 \text{ A}$$

61. $(-3, 0), (2, -4)$

$$d = \sqrt{(2+3)^2 + (-4-0)^2}$$

$$= \sqrt{25+16} = \sqrt{41} \approx 6.4$$

$$(7, 6), (1, 5)$$

$$d = \sqrt{(1-7)^2 + (5-6)^2}$$

$$= \sqrt{36+1} = \sqrt{37} \approx 6.08$$

$$6.4 > 6.08 \text{ A}$$

62. $(2, -5), (1, 6)$

$$d = \sqrt{(1-2)^2 + (6+5)^2}$$

$$= \sqrt{1+121} = \sqrt{122} \approx 11.05$$

$$(0, 8), (6, 0)$$

$$d = \sqrt{(6-0)^2 + (0-8)^2}$$

$$= \sqrt{36+64} = \sqrt{100} = 10$$

$$11.05 > 10 \text{ A}$$

Chapter 10 continued

63. a. $y = k$ horizontal line $(x, y) \rightarrow (x, k), (x, y)$

$$d = \sqrt{(x-x)^2 + (y-k)^2} = \sqrt{0 + (y-k)^2}$$

$$= \sqrt{(y-k)^2} = |y-k|$$

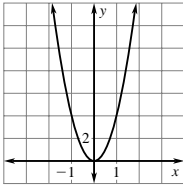
b. $x = h$ vertical line $(x, y) \rightarrow (h, y), (x, y)$

$$d = \sqrt{(x-h)^2 + (y-y)^2} = \sqrt{(x-h)^2} = |x-h|$$

10.1 Mixed Review (p. 594)

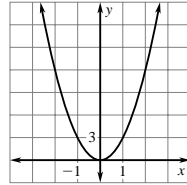
64. $y = 4x^2$

x	y
0	0
1	4
-1	4



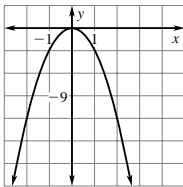
65. $y = 3x^2$

x	y
0	0
1	3
-1	3



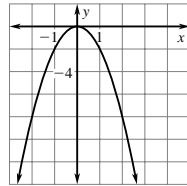
66. $y = -3x^2$

x	y
0	0
1	-3
-1	-3



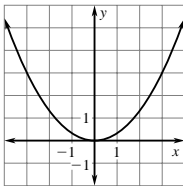
67. $y = -2x^2$

x	y
0	0
1	-2
-1	-2



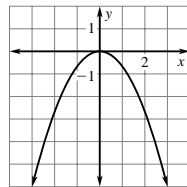
68. $y = \frac{1}{3}x^2$

x	y
0	0
1	$\frac{1}{3}$
-1	$\frac{1}{3}$



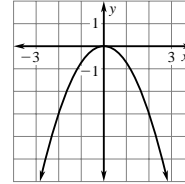
69. $y = -\frac{2}{3}x^2$

x	y
0	0
1	$-\frac{2}{3}$
-1	$-\frac{2}{3}$



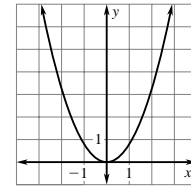
70. $y = -\frac{3}{4}x^2$

x	y
0	0
1	$-\frac{3}{4}$
-1	$-\frac{3}{4}$



71. $y = \frac{5}{6}x^2$

x	y
0	0
1	$\frac{5}{6}$
-1	$\frac{5}{6}$



72. $x^{2/3} + 13 = 17$

$$x^{2/3} = 4$$

$$\sqrt[3]{x^2} = 4$$

$$(\sqrt[3]{x^2})^3 = (4)^3$$

$$x^2 = 64$$

$$x = \pm 8$$

73. $\sqrt{x+100} = 25$

$$(\sqrt{x+100})^2 = (25)^2$$

$$x+100 = 625$$

$$x = 625 - 100$$

$$x = 525$$

74.

$$\sqrt{2x} = x - 4$$

$$(\sqrt{2x})^2 = (x-4)^2$$

$$2x = x^2 - 8x + 16$$

$$x^2 - 10x + 16 = 0$$

$$(x-8)(x-2) = 0$$

$$x-8 = 0 \quad x-2 = 0$$

$$x = 8 \quad x = 2$$

$x = 2$ is extraneous

75. $\sqrt{x+2} = \sqrt{3x}$

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

$$x+2 = 3x$$

$$2 = 2x$$

$$1 = x$$

76. $2\sqrt[3]{3x} = 6$

$$(2\sqrt[3]{3x})^3 = (6)^3$$

$$8(3x) = 216$$

$$24x = 216$$

$$x = 9$$

77. $-2x^{3/2} = -8$

$$x^{3/2} = 4$$

$$(x^{3/2})^{2/3} = 4^{2/3}$$

$$x \approx 2.52$$

78. $\frac{2}{x+1} - \frac{x}{x^2-1} = \frac{2}{x+1} - \frac{x}{(x+1)(x-1)}$

$$= \frac{2(x-1) - x}{(x+1)(x-1)}$$

$$= \frac{2x-2-x}{(x+1)(x-1)}$$

$$= \frac{x-2}{(x+1)(x-1)}$$

$$= \frac{x-2}{x^2-1}$$

Chapter 10 continued

$$79. \frac{4}{2x^2} + \frac{1}{3x} = \frac{4}{2x^2} \left(\frac{3}{3}\right) + \frac{1}{3x} \left(\frac{2x}{2x}\right)$$

$$= \frac{12 + 2x}{6x^2}$$

$$= \frac{6 + x}{3x^2}$$

$$= \frac{x + 6}{3x^2}$$

$$80. \frac{11}{4(x-5)} - \frac{x+1}{4x} = \frac{11x}{4(x-5)x} - \frac{(x+1)(x-5)}{4x(x-5)}$$

$$= \frac{11x - [x^2 - 4x - 5]}{4x^2 - 20x}$$

$$= \frac{11x - x^2 + 4x + 5}{4x^2 - 20x}$$

$$= \frac{-x^2 + 15x + 5}{4x^2 - 20x}$$

$$81. \frac{3x}{x^2} - \frac{x-1}{x+3} = \frac{3x(x+3) - x^2(x-1)}{x^3 + 3x^2}$$

$$= \frac{3x^2 + 9x - x^3 + x^2}{x^3 + 3x^2}$$

$$= \frac{-x^3 + 4x^2 + 9x}{x^3 + 3x^2}$$

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

$$= \frac{-x^2 + 4x + 9}{x^2 + 3x}$$

$$82. \frac{2}{3x+2} + \frac{5x^2}{x-4} = \frac{2}{3x+2} \left(\frac{x-4}{x-4}\right) + \frac{5x^2}{x-4} \left(\frac{3x+2}{3x+2}\right)$$

$$= \frac{2x - 8 + 15x^3 + 10x^2}{(3x+2)(x-4)}$$

$$= \frac{15x^3 + 10x^2 + 2x - 8}{(3x+2)(x-4)}$$

$$83. \frac{1-3x}{x-6} + \frac{2}{2x+1} = \frac{1-3x}{x-6} \left(\frac{2x+1}{2x+1}\right) + \frac{2}{2x+1} \left(\frac{x-6}{x-6}\right)$$

$$= \frac{2x+1-6x^2-3x+2x-12}{(x-6)(2x+1)}$$

$$= \frac{-6x^2+x-11}{(x-6)(2x+1)}$$

Lesson 10.2

10.2 Guided Practice (p. 598)

- focus; directrix
- The graph of $y = ax^2$ rotated 90° clockwise is the graph of $x = ay^2$.

$$3. y = ax^2$$

$$x^2 = \frac{1}{a}y$$

$$4p = \frac{1}{a}$$

$$p = \frac{1}{4a}$$

$$\text{focus: } \left(0, \frac{1}{4a}\right)$$

$$\text{directrix: } y = -\frac{1}{4a}$$

$$4. x^2 = 4y$$

$$4p = 4$$

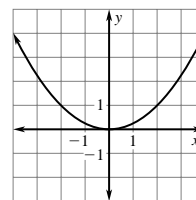
$$p = 1$$

$$\text{focus: } (0, 1)$$

$$\text{directrix: } y = -1$$

$p > 1$ parabola opens up only positive y values

x	± 2	± 2.83	± 3.46
y	1	2	3



$$5. y = -5x^2$$

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

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

$$4p = -\frac{1}{5}$$

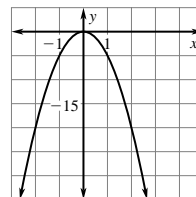
$$p = -\frac{1}{20}$$

$$\text{focus: } \left(0, -\frac{1}{20}\right)$$

$$\text{directrix: } y = \frac{1}{20}$$

$p < 0$ parabola opens down, only negative y-values

x	-1	-2	-3	4
y	± 0.45	± 0.63	± 0.77	± 0.89



$$6. -12x = y^2$$

$$4p = -12$$

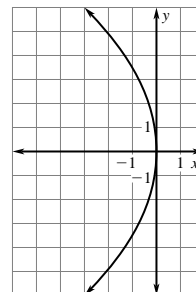
$$p = -\frac{12}{4} = -3$$

$$\text{focus: } (-3, 0)$$

$$\text{directrix is } x = 3$$

$p < 0$ parabola opens left, only negative x-values

x	-1	-2	-3	-4
y	± 3.46	± 4.90	± 6	± 6.93



Chapter 10 continued

7. $8y^2 = x$

$$y^2 = \frac{1}{8}x$$

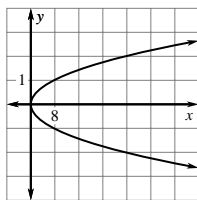
$$4p = \frac{1}{8}$$

$$p = \frac{1}{32}$$

focus: $(\frac{1}{32}, 0)$

directrix: $x = -\frac{1}{32}$

$p > 0$ parabola opens right, only positive x-values



x	1	2	3	4	5
y	± 0.35	± 0.5	± 0.61	± 0.71	± 0.79

8. $-6x = y^2$

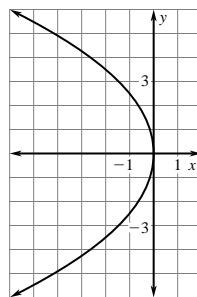
$$4p = -6$$

$$p = -\frac{3}{2}$$

focus: $(-\frac{3}{2}, 0)$

directrix: $x = \frac{3}{2}$

$p < 0$ parabola opens left, only negative x-values



x	-1	-2	-3	-4	-5
y	± 2.45	± 3.46	± 4.24	± 4.90	± 5.48

9. $x^2 = 2y$

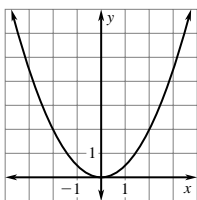
$$4p = 2$$

$$p = \frac{1}{2}$$

focus: $(0, \frac{1}{2})$

directrix: $y = -\frac{1}{2}$

$p > 0$ parabola opens up, only positive y-values



x	1	2	3	4	5
y	± 1.41	± 2	± 2.45	± 2.83	± 3.16

10. focus: $(0, 3)$

focus: $(0, p); x^2, p = 3$

directrix: $y = -p = -3$

$$x^2 = 4py$$

$$x^2 = 4(3)y$$

$$x^2 = 12y$$

12. focus: $(-6, 0)$

focus: $(p, 0); y^2, p = -6$

directrix: $x = -p = 6$

$$y^2 = 4px$$

$$y^2 = 4(-6)x$$

$$y^2 = -24x$$

11. focus: $(5, 0)$

focus: $(p, 0); y^2, p = 5$

directrix: $x = -p = -5$

$$y^2 = 4px$$

$$y^2 = 4(5)x$$

$$y^2 = 20x$$

13. directrix: $x = 4,$

$x = -p,$

$p = -4$

focus: $(4, 0)$

$$y^2 = 4px$$

$$y^2 = 4(-4)x$$

$$y^2 = -16x$$

14. directrix: $x = -1,$

$x = -p, p = 1$

focus: $(1, 0)$

$$y^2 = 4px$$

$$y^2 = 4(1)x$$

$$y^2 = 4x$$

15. directrix: $y = 8,$

$y = -p, p = -8$

focus: $(0, -8)$

$$x^2 = 4py$$

$$x^2 = 4(-8)y$$

$$x^2 = -32y$$

10.2 Practice and Applications (pp. 598–600)

16. $y^2 = 4x$ D 17. $x^2 = -4y$ B 18. $x^2 = 4y$ A

19. $y^2 = -4x$ E 20. $y^2 = \frac{1}{4}x$ F 21. $x^2 = \frac{1}{4}y$ C

22. $y = -3x^2$

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

$$-\frac{1}{3} = 4p$$

$$-\frac{1}{12} = p$$

$p < 0$ parabola opens down

23. $-9x^2 = 2y$

$$x^2 = -\frac{2}{9}y$$

$$4p = -\frac{2}{9}$$

$$p = -\frac{2}{9}(\frac{1}{4})$$

$$= -\frac{2}{36} = -\frac{1}{18}$$

$p < 0$ parabola opens down

24. $2y^2 = -6x$

$$y^2 = -3x$$

$$4p = -3$$

$$p = -\frac{3}{4}$$

$p < 0$ parabola opens left

25. $x = 7y^2$

$$\frac{1}{7}x = y^2$$

$$\frac{1}{7} = 4p$$

$$\frac{1}{28} = p$$

$p > 0$ parabola opens right

26. $x^2 = 16y$

$$4p = 16$$

$$p = 4$$

$p > 0$ parabola opens up

27. $-3y^2 = 8x$

$$y^2 = -\frac{8}{3}x$$

$$4p = -\frac{8}{3}$$

$$p = -\frac{8}{12} = -\frac{2}{3}$$

$p < 0$ parabola opens left

28. $-5x = -y^2$

$$5x = y^2$$

$$5 = 4p$$

$$\frac{5}{4} = p$$

$p > 0$ parabola opens right

29. $x^2 = \frac{4}{3}y$

$$4p = \frac{4}{3}$$

$$p = \frac{4}{12} = \frac{1}{4}$$

$p > 0$ parabola opens up

30. $3x^2 = -y$

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

$$4p = -\frac{1}{3}$$

$$p = -\frac{1}{12}$$

focus: $(0, -\frac{1}{12})$

directrix: $y = \frac{1}{12}$

31. $2y^2 = x$

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

$$4p = \frac{1}{2}$$

$$p = \frac{1}{8}$$

focus: $(\frac{1}{8}, 0)$

directrix: $x = -\frac{1}{8}$

Chapter 10 continued

32. $x^2 = 8y$

$4p = 8$

$p = 2$

focus: $(0, 2)$

directrix: $y = -2$

34. $y^2 = -16x$

$4p = -16$

$p = -4$

focus: $(-4, 0)$

directrix: $x = 4$

36. $-4x + 9y^2 = 0$

$9y^2 = 4x$

$y^2 = \frac{4}{9}x$

$4p = \frac{4}{9}$

$p = \frac{4}{36} = \frac{1}{9}$

focus: $(\frac{1}{9}, 0)$

directrix: $x = -\frac{1}{9}$

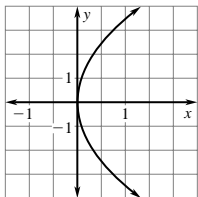
38. $y^2 = 12x$

$4p = 12$

$p = 3$

focus: $(3, 0)$

directrix: $x = -3$



$p > 0$ parabola opens right, only positive x-values

x	1	2	3	4
y	± 3.46	± 4.90	± 6	± 6.9

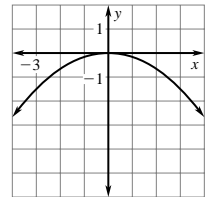
39. $x^2 = -6y$

$4p = -6$

$p = -\frac{3}{2}$

focus: $(0, -\frac{3}{2})$

directrix: $y = \frac{3}{2}$



$p < 0$ parabola opens down, only negative y-values

x	-1	-2	-3	-4	-5
y	± 2.45	± 3.46	± 4.24	± 4.9	± 5.48

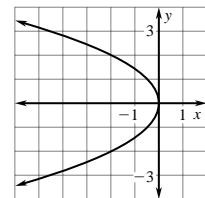
40. $y^2 = -2x$

$4p = -2$

$p = -\frac{1}{2}$

focus: $(-\frac{1}{2}, 0)$

directrix: $x = \frac{1}{2}$



$p < 0$ parabola opens left, only negative x-values

x	-1	-2	-3	-4	-5
y	± 1.41	2	± 2.45	± 2.83	± 3.16

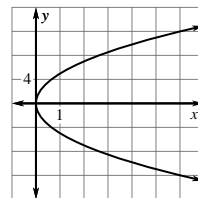
41. $y^2 = 24x$

$4p = 24$

$p = 6$

focus: $(6, 0)$

directrix: $x = -6$



$p > 0$ parabola opens right, only positive x-values

x	1	2	3	4
y	± 4.90	± 6.93	± 8.49	± 9.80

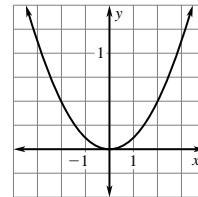
42. $x^2 = 8y$

$4p = 8$

$p = 2$

focus: $(0, 2)$

directrix: $y = -2$



$p > 0$ parabola opens up, only positive y-values

x	1	2	3
y	± 2.83	± 4	± 4.90

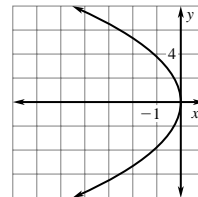
43. $y^2 = -14x$

$4p = -14$

$p = -\frac{14}{4} = -\frac{7}{2}$

focus: $(-\frac{7}{2}, 0)$

directrix: $x = \frac{7}{2}$



$p < 0$ parabola opens left, only negative x-values

x	-1	-2	-3
y	± 3.74	± 5.29	± 6.48

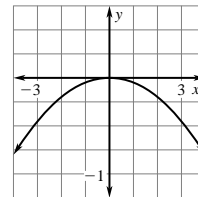
44. $x^2 = -20y$

$4p = -20$

$p = -5$

focus: $(0, -5)$

directrix: $y = 5$



$p < 0$ parabola opens down, only y-values

x	-1	-2	-3	-4	-5
y	± 4.47	± 6.32	± 7.75	± 8.94	± 10

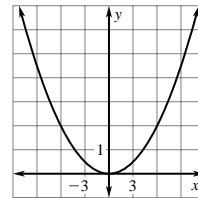
45. $x^2 = 18y$

$4p = 18$

$p = \frac{18}{4} = \frac{9}{2}$

focus: $(0, \frac{9}{2})$

directrix: $y = -\frac{9}{2}$



$p > 0$ parabola opens up, only y-values

x	1	2	3	4	5
y	± 4.24	± 6	± 7.35	± 8.49	± 9.49

Chapter 10 continued

46. $x^2 = -4y$

$4p = -4$

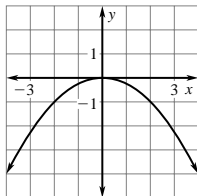
$p = -1$

focus: $(0, -1)$

directrix: $y = 1$

$p < 0$ parabola opens down, only negative y-values

x	1	2	3
y	± 2	± 2.83	± 3.46



47. $x^2 = 16y$

$4p = 16$

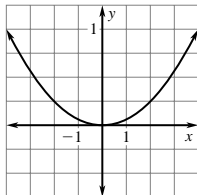
$p = 4$

focus: $(0, 4)$

directrix: $y = -4$

$p > 0$ parabola opens up, only positive y-values

x	1	2	3	4
y	± 4	± 5.66	± 6.93	± 8



48. $y^2 = 9x$

$4p = 9$

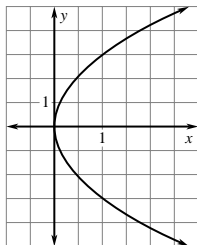
$p = \frac{9}{4}$

focus: $(\frac{9}{4}, 0)$

directrix: $x = -\frac{9}{4}$

$p > 0$ parabola opens right, only positive x-values

x	1	2	3
y	± 3	± 4.24	± 5.20



49. $y^2 = -3x$

$4p = -3$

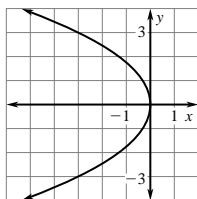
$p = -\frac{3}{4}$

focus: $(-\frac{3}{4}, 0)$

directrix: $x = \frac{3}{4}$

$p < 0$ parabola opens left, only negative x-values

x	-1	-2	-3
y	± 1.73	± 2.45	± 3



50. $x^2 - 40y = 0$

$x^2 = 40y$

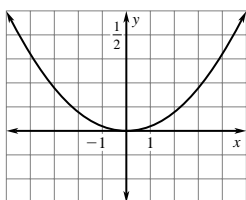
$4p = 40$

$p = 10$

focus: $(0, 10)$

directrix: $y = -10$

$p > 0$ parabola opens up, only positive y values



x	10	20	30	40	50
y	± 20	± 28.28	± 34.64	± 40	± 44.72

51. $x + \frac{1}{20}y^2 = 0$

$\frac{1}{20}y^2 = -x$

$y^2 = -20x$

$4p = -20$

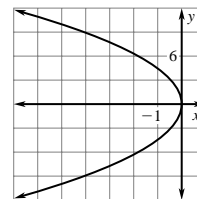
$p = -5$

focus: $(-5, 0)$

directrix: $x = 5$

$p < 0$ parabola opens left, only negative x-values

x	-1	-2	-3	4
y	± 4.47	± 6.32	± 7.75	± 8.94



52. $3x^2 = 4y$

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

$4p = \frac{4}{3}$

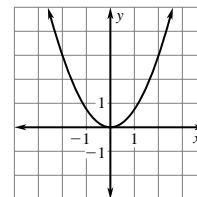
$p = \frac{4}{12} = \frac{1}{3}$

focus: $(0, \frac{1}{3})$

directrix: $y = -\frac{1}{3}$

$p > 0$ parabola opens up, only positive y-values

x	1	2	3
y	$\pm \frac{4}{3}$	$\pm \frac{8}{3}$	$\pm \frac{12}{3} = 4$



53. $x - \frac{1}{8}y^2 = 0$

$-\frac{1}{8}y^2 = -x$

$y^2 = 8x$

$4p = 8$

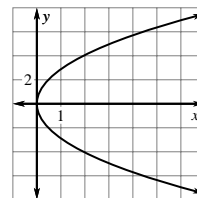
$p = 2$

focus: $(2, 0)$

directrix: $x = -2$

$p > 0$, parabola opens to the right, only positive x-values

x	1	2	3
y	± 2.83	4	± 4.90



54. $(4, 0) p = 4$

$y^2 = 4px$

$y^2 = 4(4)x$

$y^2 = 16x$

56. $(-3, 0) p = -3$

$y^2 = 4px$

$y^2 = 4(-3)x$

$y^2 = -12x$

55. $(-2, 0) p = -2$

$y^2 = 4px$

$y^2 = 4(-2)x$

$y^2 = -8x$

57. $(0, 1) p = 1$

$x^2 = 4py$

$x^2 = 4(1)y$

$x^2 = 4y$

Chapter 10 *continued*

58. $(0, 4) p = 4$

$$x^2 = 4py$$

$$x^2 = 4(4)y$$

$$x^2 = 16y$$

60. $(0, -4) p = -4$

$$x^2 = 4py$$

$$x^2 = 4(-4)y$$

$$x^2 = -16y$$

62. $(-\frac{1}{4}, 0) p = -\frac{1}{4}$

$$y^2 = 4px$$

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

$$y^2 = -x$$

64. $(0, \frac{1}{2}) p = \frac{1}{2}$

$$x^2 = 4py$$

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

$$x^2 = 2y$$

66. $y = 2 p = -2$

$$x^2 = 4py$$

$$x^2 = 4(-2)y$$

$$x^2 = -8y$$

68. $x = -4 p = 4$

$$y^2 = 4px$$

$$y^2 = 4(4)x$$

$$y^2 = 16x$$

70. $x = -5 p = 5$

$$y^2 = 4px$$

$$y^2 = 4(5)x$$

$$y^2 = 20x$$

72. $x = 2 p = -2$

$$y^2 = 4px$$

$$y^2 = 4(-2)x$$

$$y^2 = -8x$$

74. $x = -\frac{1}{2} p = \frac{1}{2}$

$$y^2 = 4px$$

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

$$y^2 = 2x$$

76. $y = \frac{5}{8} p = -\frac{5}{8}$

$$x^2 = 4py$$

$$x^2 = 4(-\frac{5}{8})y$$

$$x^2 = -\frac{5}{2}y$$

59. $(0, -3) p = -3$

$$x^2 = 4py$$

$$x^2 = 4(-3)y$$

$$x^2 = -12y$$

61. $(-5, 0) p = -5$

$$y^2 = 4px$$

$$y^2 = 4(-5)x$$

$$y^2 = -20x$$

63. $(0, -\frac{3}{8}) p = -\frac{3}{8}$

$$x^2 = 4py$$

$$x^2 = 4(-\frac{3}{8})y$$

$$x^2 = -\frac{12}{8}y = -\frac{3}{2}y$$

65. $(\frac{5}{12}, 0) p = \frac{5}{12}$

$$y^2 = 4px$$

$$y^2 = 4(\frac{5}{12})x$$

$$y^2 = \frac{20}{12}x = \frac{5}{3}x$$

67. $y = -3 p = 3$

$$x^2 = 4py$$

$$x^2 = 4(3)y$$

$$x^2 = 12y$$

69. $x = 6 p = -6$

$$y^2 = 4px$$

$$y^2 = 4(-6)x$$

$$y^2 = -24x$$

71. $y = -1 p = 1$

$$x^2 = 4py$$

$$x^2 = 4(1)y$$

$$x^2 = 4y$$

73. $y = 4 p = -4$

$$x^2 = 4py$$

$$x^2 = 4(-4)y$$

$$x^2 = -16y$$

75. $x = \frac{3}{4} p = -\frac{3}{4}$

$$y^2 = 4px$$

$$y^2 = 4(-\frac{3}{4})x$$

$$y^2 = -3x$$

77. $y = -\frac{1}{12} p = \frac{1}{12}$

$$x^2 = 4py$$

$$x^2 = 4(\frac{1}{12})y$$

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

78. $y = -4 p = 4$

$$x^2 = 4py$$

$$x^2 = 4(4)y$$

$$x^2 = 16y$$

$$(4)^2 = 16y$$

$$16 = 16y$$

$$\frac{16}{16} = y$$

$$y = 1 \text{ ft}$$

80. $y^2 = 4px$

$$y^2 = 4(12)(6)$$

$$y^2 = 288$$

$$y = 16.97$$

$$\text{diameter} = 2(16.97)$$

$$\approx 33.94 \text{ inches}$$

82. $y = ax^2, \frac{1}{a}y = x^2, 4p = \frac{1}{a}, p = \frac{4}{a}$

$$\text{focus: } \left(0, \frac{4}{a}\right)$$

$$\text{directrix: } y = -\frac{4}{a}$$

As $|a|$ increases, focus and directrix move closer to the origin.

83. a. $y^2 = \frac{32}{7}x$

$$4p = \frac{32}{7}$$

$$p = \frac{32}{28} = \frac{8}{7} = 1\frac{1}{7}$$

$$\text{depth is } 1\frac{1}{2}$$

$$1\frac{1}{7} < 1\frac{1}{2}$$

b. $y^2 = \frac{16}{7}(\frac{3}{1})$

$$y^2 = \frac{48}{7}$$

$$y = 2.62$$

$$2(2.62) \approx$$

$$5.2 \text{ inches}$$

c. $y^2 = 6x$

$$y^2 = 6(\frac{3}{2})$$

$$y^2 = 9$$

$$y = 3$$

$$2(3) =$$

$$6 \text{ inches}$$

If not, the bulb would extend outside of the flashlight.

d. $y^2 = 2x$

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

$$y^2 = 3$$

$$y \approx 1.73$$

$$2(1.73) \approx 3.46 \text{ inches}$$

84. $x^2 = 4py$, focus: $(0, p)$, directrix: $y = -p$

$$\sqrt{x^2} = \sqrt{4py}$$

$$x = \sqrt{4py}$$

$$2x = \text{width} = \text{latus rectum} = 2\sqrt{4py}$$

$$2x = 2\sqrt{4py}$$

$$2x = 2(2)\sqrt{py}$$

$$2x = 4\sqrt{p^2}$$

$$2x = 4p$$

79. $x = -1.5$

$$y^2 = 4px$$

$$y^2 = 4(1.5)x$$

$$y^2 = 6x$$

$$(3.5)^2 = 6x$$

$$12.25 = 6x$$

$$2.04 \text{ inches} = x$$

81. $x^2 = 4py$

$$(6)^2 = 4p(4)$$

$$36 = 16p$$

$$\frac{36}{16} = p$$

$$2.25 \text{ in.} = p$$

Chapter 10 continued

10.2 Mixed Review (p. 600)

85. $8^{5x} = 16^{2x+1}$

$$(2^3)^{5x} = (2^4)^{2x+1}$$

$$(2)^{15x} = (2)^{8x+4}$$

$$15x = 8x + 4$$

$$7x = 4$$

$$x = \frac{4}{7}$$

87. $5^x = 7$

$$\log_5 7 = x$$

$$\frac{\log 7}{\log 5} = x$$

$$1.209 \approx x$$

86. $3^x = 15$

$$\log_3 15 = x$$

$$\frac{\log 15}{\log 3} = x$$

$$2.465 \approx x$$

88. $10^{3x+1} + 4 = 33$

$$10^{3x+1} = 29$$

$$\log 29 = 3x + 1$$

$$\log 29 - 1 = 3x$$

$$\frac{\log 29 - 1}{3} = x$$

$$0.154 \approx x$$

89. $\log_7(3x - 5) = \log_7 8x$

$$3x - 5 = 8x$$

$$-5 = 5x$$

$$-1 = x$$

no solution

90. $\log_3(4x - 3) = 3$

$$3^3 = 4x - 3$$

$$27 = 4x - 3$$

$$30 = 4x$$

$$\frac{30}{4} = x$$

$$\frac{15}{2} = x$$

91. $\frac{3xy^3}{x^3y} \cdot \frac{y}{6x} = \frac{y^3}{2x^3}$

92. $\frac{3xy^3}{2x} \div \frac{2xy^3}{3x}$

$$\frac{3xy^3}{2x} \cdot \frac{3x}{2xy^3} = \frac{9}{4}$$

93. $\frac{x^2 - 9}{x^2 - x - 6} \cdot (x + 2) = \frac{(x-3)(x+3)}{(x-3)(x+2)} \cdot \frac{(x+2)}{1}$
 $= x + 3$

94. $\frac{-3x}{x+2} + \frac{4x}{x-1} = \frac{-3x(x-1)}{(x+2)(x-1)} + \frac{4x(x+2)}{(x+2)(x-1)}$
 $= \frac{-3x^2 + 3x + 4x^2 + 8x}{(x+2)(x-1)}$
 $= \frac{x^2 + 11x}{(x+2)(x-1)}$

95. $\frac{x+1}{6x^2} - \frac{x+1}{6x^2+6x} = \frac{(x+1)\left(1 + \frac{1}{x}\right)}{6x^2\left(1 + \frac{1}{x}\right)} - \frac{x+1}{6x^2+6x}$
 $= \frac{x+1+1+\frac{1}{x}-x-1}{6x^2\left(1 + \frac{1}{x}\right)}$
 $= \frac{1 + \frac{1}{x}}{6x^2\left(1 + \frac{1}{x}\right)} = \frac{1}{6x^2}$

96. $\frac{x^2 - 3x + 2}{x-1} - \frac{x^2 - 4}{x-2}$
 $= \frac{(x^2 - 3x + 2)(x-2) - (x^2 - 4)(x-1)}{(x-1)(x-2)}$
 $= \frac{x^3 - 3x^2 + 2x - 2x^2 + 6x - 4 - [x^3 - x^2 - 4x + 4]}{(x-1)(x-2)}$
 $= \frac{x^3 - 3x^2 + 2x - 2x^2 + 6x - 4 - x^3 + x^2 + 4x - 4}{(x-1)(x-2)}$
 $= \frac{-4x^2 + 12x - 8}{(x-1)(x-2)} = \frac{-4(x^2 - 3x + 2)}{(x-1)(x-2)}$
 $= \frac{-4(x-2)(x-1)}{(x-1)(x-2)} = -4$

97. (3, 4), (6, 7)

$$d = \sqrt{(6-3)^2 + (7-4)^2} = \sqrt{9+9}$$

$$= \sqrt{18} = \sqrt{9(2)} = 3\sqrt{2} \approx 4.243$$

98. (-3, 7), (-7, 3)

$$d = \sqrt{(-7+3)^2 + (3-7)^2} = \sqrt{16+16}$$

$$= \sqrt{2(16)} = 4\sqrt{2} \approx 5.657$$

99. (18, -4), (-2, 9)

$$d = \sqrt{(-2-18)^2 + (9+4)^2}$$

$$= \sqrt{400+169} = \sqrt{569} \approx 23.854$$

100. (3.7, 5.1), (2, 5)

$$d = \sqrt{(2-3.7)^2 + (5-5.1)^2}$$

$$= \sqrt{2.89+0.01} = \sqrt{2.9} \approx 1.703$$

101. (-9, -31), (8, 7)

$$d = \sqrt{(8+9)^2 + (7+31)^2}$$

$$= \sqrt{289+1444} = \sqrt{1733} \approx 41.629$$

102. (8.8, 3.3), (1.2, 6)

$$d = \sqrt{(1.2-8.8)^2 + (6-3.3)^2}$$

$$= \sqrt{57.76+7.29} = \sqrt{65.05} \approx 8.065$$

103. $A = 2.25$, $P = 1.5$, $\frac{A}{P} = x$

$$\frac{2.25}{1.5} = 1.5, \frac{A}{P} = x, A = xp, A = 1.5p$$

Lesson 10.3

10.3 Guided Practice (p. 604)

- The set of all points (x, y) equidistant from a fixed point.
- sometimes true
- They are negative reciprocals of each other (except if one line is vertical).
- The student failed to square the radius; $x^2 + y^2 = 16$

Chapter 10 *continued*

5. (4, 0)

$$r = \sqrt{(4-0)^2 + (0-0)^2}$$

$$= \sqrt{16+0} = \sqrt{16} = 4$$

$$x^2 + y^2 = (4)^2$$

$$x^2 + y^2 = 16$$

6. (0, -2)

$$r = \sqrt{(0-0)^2 + (-2-0)^2}$$

$$= \sqrt{0+4} = \sqrt{4} = 2$$

$$x^2 + y^2 = (2)^2$$

$$x^2 + y^2 = 4$$

7. (-8, 6)

$$r = \sqrt{(-8-0)^2 + (6-0)^2}$$

$$= \sqrt{64+36} = \sqrt{100} = 10$$

$$x^2 + y^2 = (10)^2$$

$$x^2 + y^2 = 100$$

8. (-5, -12)

$$r = \sqrt{(-5-0)^2 + (-12-0)^2}$$

$$= \sqrt{25+144} = \sqrt{169} = 13$$

$$x^2 + y^2 = (13)^2$$

$$x^2 + y^2 = 169$$

9. (6, -9)

$$r = \sqrt{(6-0)^2 + (-9-0)^2}$$

$$= \sqrt{36+81} = \sqrt{117}$$

$$x^2 + y^2 = (\sqrt{117})^2$$

$$x^2 + y^2 = 117$$

10. (3, 1)

$$r = \sqrt{(3-0)^2 + (1-0)^2}$$

$$= \sqrt{9+1} = \sqrt{10}$$

$$x^2 + y^2 = (\sqrt{10})^2$$

$$x^2 + y^2 = 10$$

11. (-5, -5)

$$r = \sqrt{(-5-0)^2 + (-5-0)^2}$$

$$= \sqrt{25+25} = \sqrt{50}$$

$$x^2 + y^2 = (\sqrt{50})^2$$

$$x^2 + y^2 = 50$$

12. (-2, 4)

$$r = \sqrt{(-2-0)^2 + (4-0)^2}$$

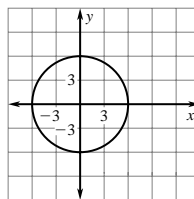
$$= \sqrt{4+16} = \sqrt{20}$$

$$x^2 + y^2 = (\sqrt{20})^2$$

$$x^2 + y^2 = 20$$

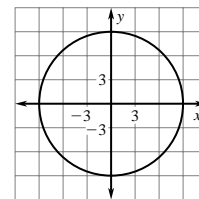
13. $x^2 + y^2 = 36$

radius = 6



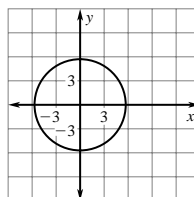
14. $x^2 + y^2 = 81$

radius = 9



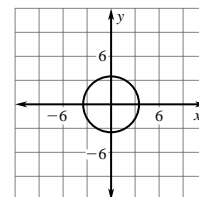
15. $x^2 + y^2 = 32$

radius = $\sqrt{32} = 4\sqrt{2}$
 ≈ 5.66



16. $x^2 + y^2 = 12$

radius = $\sqrt{12} = 2\sqrt{3}$
 ≈ 3.46

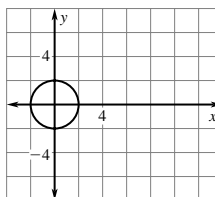


17. $36x^2 + 36y^2 = 144$

$$36(x^2 + y^2) = 36(4)$$

$$x^2 + y^2 = 4$$

radius = 2

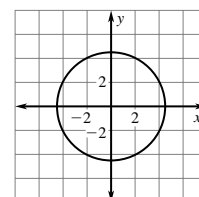


18. $9x^2 + 9y^2 = 162$

$$9(x^2 + y^2) = 9(18)$$

$$x^2 + y^2 = 18$$

$r = \sqrt{18} = 3\sqrt{2}$
 ≈ 4.24



19. diameter = 7

radius = 3.5

$$x^2 + y^2 = (3.5)^2$$

$$x^2 + y^2 = 12.25$$

Practice and Applications (pp. 604–606)

20. $x^2 + y^2 = 16$ C 21. $x^2 + y^2 = 5$ F

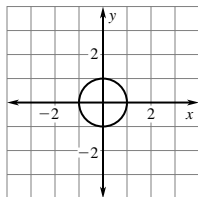
22. $x^2 + y^2 = 4$ D 23. $x^2 + y^2 = 25$ B

24. $x^2 + y^2 = 100$ E 25. $x^2 + y^2 = 10$ A

Chapter 10 continued

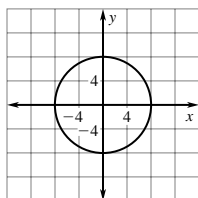
26. $x^2 + y^2 = 1$

$r = 1$



28. $x^2 + y^2 = 64$

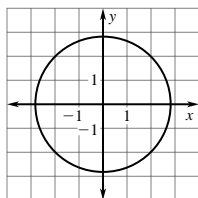
$r = 8$



30. $x^2 + y^2 = 8$

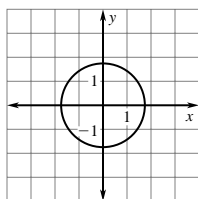
$r = \sqrt{8}$

$= 2\sqrt{2} \approx 2.83$



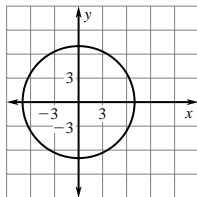
32. $x^2 + y^2 = 3$

$r = \sqrt{3} \approx 1.73$



27. $x^2 + y^2 = 49$

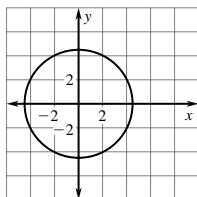
$r = 7$



29. $x^2 + y^2 = 20$

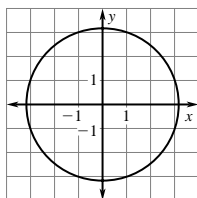
$r = \sqrt{20}$

$= 2\sqrt{5} \approx 4.47$



31. $x^2 + y^2 = 10$

$r = \sqrt{10} \approx 3.16$

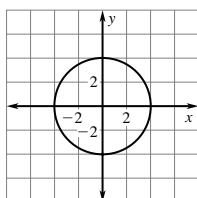


33. $5x^2 + 5y^2 = 80$

$5(x^2 + y^2) = 5(16)$

$x^2 + y^2 = 16$

$r = 4$

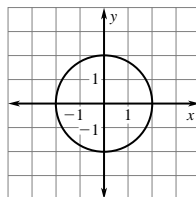


34. $24x^2 + 24y^2 = 96$

$24(x^2 + y^2) = 24(4)$

$x^2 + y^2 = 4$

$r = 2$



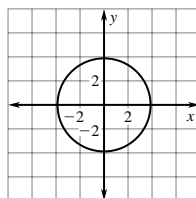
36. $9x^2 + 9y^2 = 135$

$9(x^2 + y^2) = 9(15)$

$x^2 + y^2 = 15$

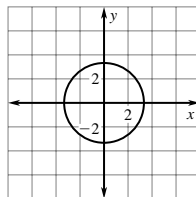
$r = \sqrt{15}$

≈ 3.87



38. $x^2 + y^2 = 11$

$r = \sqrt{11} \approx 3.32$



40. $x^2 + y = 0$

$x^2 = -y$

$4p = -1$

$p = -\frac{1}{4}$

focus: $(0, \frac{1}{4})$

directrix: $y = -\frac{1}{4}$

$p < 0$ parabola opens down, only negative y -values

x	-1	-2	-3
y	± 1	± 1.41	± 1.73

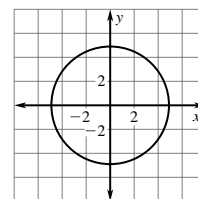
35. $8x^2 + 8y^2 = 192$

$8(x^2 + y^2) = 8(24)$

$x^2 + y^2 = 24$

$r = \sqrt{24}$

$= 2\sqrt{6} \approx 4.9$



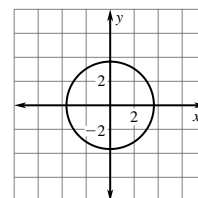
37. $4x^2 + 4y^2 = 52$

$4(x^2 + y^2) = 4(13)$

$x^2 + y^2 = 13$

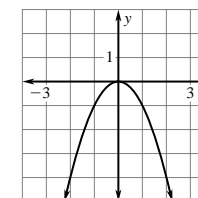
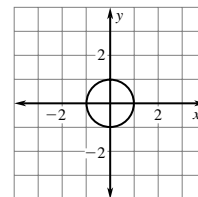
$r = \sqrt{13}$

≈ 3.61



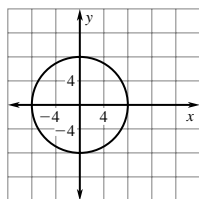
39. $x^2 + y^2 = 1$

$r = 1$

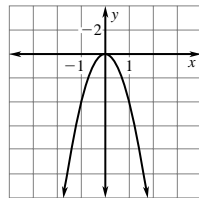


Chapter 10 *continued*

41. $\frac{1}{4}x^2 + \frac{1}{4}y^2 = 16$
 $\frac{1}{4}(x^2 + y^2) = \frac{1}{4}(64)$
 $x^2 + y^2 = 64$
 $r = 8$



42. $4x^2 + y = 0$
 $4x^2 = -y$
 $x^2 = -\frac{1}{4}y$
 $4p = -\frac{1}{4}$
 $p = -\frac{1}{16}$



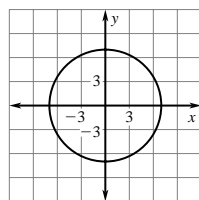
focus: $(0, -\frac{1}{16})$

directrix: $y = \frac{1}{16}$

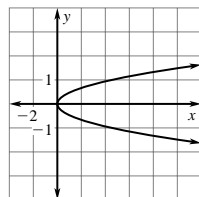
$p < 0$ parabola opens down only negative y -values

x	-1	-2	-3
y	$\pm\frac{1}{2}$	± 0.707	± 0.866

43. $9x^2 + 9y^2 = 441$
 $9(x^2 + y^2) = 9(49)$
 $x^2 + y^2 = 49$
 $r = 7$



44. $-2x + 9y^2 = 0$
 $9y^2 = 2x$
 $y^2 = \frac{2}{9}x$
 $4p = \frac{2}{9}$
 $p = \frac{2}{36} = \frac{1}{18}$



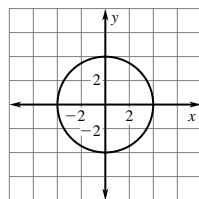
focus: $(\frac{1}{18}, 0)$

directrix: $x = -\frac{1}{18}$

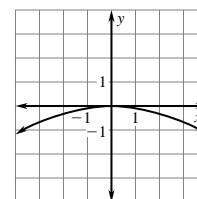
$p > 0$ parabola opens right, only positive x -values

x	1	2	3
y	± 0.47	± 0.67	± 0.82

45. $\frac{3}{8}x^2 + \frac{3}{8}y^2 = 6$
 $\frac{3}{8}(x^2 + y^2) = \frac{3}{8}(16)$
 $x^2 + y^2 = 16$
 $r = 4$



46. $x^2 + 12y = 0$
 $x^2 = -12y$
 $4p = -12$
 $p = -3$



focus: $(0, -3)$

directrix: $y = 3$

$p < 0$ parabola opens down

x	-1	-2	-3
y	± 3.46	± 4.9	± 6

47. $r = 3$
 $x^2 + y^2 = (3)^2$
 $x^2 + y^2 = 9$

48. $r = 9$
 $x^2 + y^2 = (9)^2$
 $x^2 + y^2 = 81$

49. $r = 6$
 $x^2 + y^2 = (6)^2$
 $x^2 + y^2 = 36$

50. $r = 11$
 $x^2 + y^2 = (11)^2$
 $x^2 + y^2 = 121$

51. $r = \sqrt{7}$
 $x^2 + y^2 = (\sqrt{7})^2$
 $x^2 + y^2 = 7$

52. $r = \sqrt{30}$
 $x^2 + y^2 = (\sqrt{30})^2$
 $x^2 + y^2 = 30$

53. $r = \sqrt{11}$
 $x^2 + y^2 = (\sqrt{11})^2$
 $x^2 + y^2 = 11$

54. $r = \sqrt{21}$
 $x^2 + y^2 = (\sqrt{21})^2$
 $x^2 + y^2 = 21$

55. $r = 5\sqrt{6}$
 $x^2 + y^2 = (5\sqrt{6})^2$
 $x^2 + y^2 = 25(6) = 150$

56. $r = 4\sqrt{5}$
 $x^2 + y^2 = (4\sqrt{5})^2$
 $x^2 + y^2 = 16(5) = 80$

57. $r = 2\sqrt{7}$
 $x^2 + y^2 = (2\sqrt{7})^2$
 $x^2 + y^2 = 4(7) = 28$

58. $r = 3\sqrt{3}$
 $x^2 + y^2 = (3\sqrt{3})^2$
 $x^2 + y^2 = 9(3) = 27$

59. $(0, -10)$
 $r = \sqrt{(0 - 0)^2 + (-10 - 0)^2} = \sqrt{100} = 10$
 $x^2 + y^2 = (10)^2$
 $x^2 + y^2 = 100$

60. $(8, 0)$
 $r = \sqrt{(8 - 0)^2 + (0 - 0)^2} = \sqrt{64} = 8$
 $x^2 + y^2 = (8)^2$
 $x^2 + y^2 = 64$

61. $(-3, -4)$
 $r = \sqrt{(-3 - 0)^2 + (-4 - 0)^2} = \sqrt{9 + 16}$
 $= \sqrt{25} = 5$
 $x^2 + y^2 = (5)^2$
 $x^2 + y^2 = 25$

Chapter 10 *continued*

62. $(-4, -1)$

$$r = \sqrt{(-4 - 0)^2 + (-1 - 0)^2}$$

$$= \sqrt{16 + 1} = \sqrt{17}$$

$$x^2 + y^2 = (\sqrt{17})^2$$

$$x^2 + y^2 = 17$$

63. $(5, -3)$

$$r = \sqrt{(5 - 0)^2 + (-3 - 0)^2}$$

$$= \sqrt{25 + 9} = \sqrt{34}$$

$$x^2 + y^2 = (\sqrt{34})^2$$

$$x^2 + y^2 = 34$$

64. $(-6, 4)$

$$r = \sqrt{(-6 - 0)^2 + (4 - 0)^2}$$

$$= \sqrt{36 + 16} = \sqrt{52}$$

$$x^2 + y^2 = (\sqrt{52})^2$$

$$x^2 + y^2 = 52$$

65. $(-6, 1)$

$$r = \sqrt{(-6 - 0)^2 + (1 - 0)^2}$$

$$= \sqrt{36 + 1} = \sqrt{37}$$

$$x^2 + y^2 = (\sqrt{37})^2$$

$$x^2 + y^2 = 37$$

66. $(-1, -9)$

$$r = \sqrt{(-1 - 0)^2 + (-9 - 0)^2}$$

$$= \sqrt{1 + 81} = \sqrt{82}$$

$$x^2 + y^2 = (\sqrt{82})^2$$

$$x^2 + y^2 = 82$$

67. $(7, -4)$

$$r = \sqrt{(7 - 0)^2 + (-4 - 0)^2}$$

$$= \sqrt{49 + 16} = \sqrt{65}$$

$$x^2 + y^2 = (\sqrt{65})^2$$

$$x^2 + y^2 = 65$$

68. $(10, 2)$

$$r = \sqrt{(10 - 0)^2 + (2 - 0)^2}$$

$$= \sqrt{100 + 4} = \sqrt{104}$$

$$x^2 + y^2 = (\sqrt{104})^2$$

$$x^2 + y^2 = 104$$

69. $(5, 8)$

$$r = \sqrt{(5 - 0)^2 + (8 - 0)^2}$$

$$= \sqrt{25 + 64} = \sqrt{89}$$

$$x^2 + y^2 = (\sqrt{89})^2$$

$$x^2 + y^2 = 89$$

70. $(2, -12)$

$$r = \sqrt{(2 - 0)^2 + (-12 - 0)^2}$$

$$= \sqrt{4 + 144} = \sqrt{148}$$

$$x^2 + y^2 = (\sqrt{148})^2$$

$$x^2 + y^2 = 148$$

71. $x^2 + y^2 = 10; (1, 3)$

$$m = \frac{3 - 0}{1 - 0} = 3$$

$$\text{Slope of tangent line} = -\frac{1}{3}$$

$$y - 3 = -\frac{1}{3}(x - 1)$$

$$y - 3 = -\frac{1}{3}x + \frac{1}{3}$$

$$y = -\frac{1}{3}x + \frac{1}{3} + \frac{9}{3}$$

$$y = -\frac{1}{3}x + \frac{10}{3}$$

72. $x^2 + y^2 = 5; (2, 1)$

$$m = \frac{1 - 0}{2 - 0} = \frac{1}{2}$$

$$\text{Slope of tangent line} = -2$$

$$y - 1 = -2(x - 2)$$

$$y - 1 = -2x + 4$$

$$y = -2x + 5$$

73. $x^2 + y^2 = 41; (-4, -5)$

$$m = \frac{-5 - 0}{-4 - 0} = \frac{5}{4}$$

$$\text{Slope of tangent line} = -\frac{4}{5}$$

$$y + 5 = -\frac{4}{5}(x + 4)$$

$$y + 5 = -\frac{4}{5}x - \frac{16}{5}$$

$$y = -\frac{4}{5}x - \frac{16}{5} - \frac{25}{5}$$

$$y = -\frac{4}{5}x - \frac{41}{5}$$

Chapter 10 *continued*

74. $x^2 + y^2 = 145; (12, 1)$

$$m = \frac{1 - 0}{12 - 0} = \frac{1}{12}$$

Slope of tangent line = -12

$$y - 1 = -12(x - 12)$$

$$y - 1 = -12x + 144$$

$$y = -12x + 145$$

75. $x^2 + y^2 = 65; (-8, 1)$

$$m = \frac{1 - 0}{-8 - 0} = -\frac{1}{8}$$

Slope of tangent line = 8

$$y - 1 = 8(x + 8)$$

$$y - 1 = 8x + 64$$

$$y = 8x + 65$$

76. $x^2 + y^2 = 40; (-2, 6)$

$$m = \frac{6 - 0}{-2 - 0} = -3$$

Slope of tangent line = $\frac{1}{3}$

$$y - 6 = \frac{1}{3}(x + 2)$$

$$y - 6 = \frac{1}{3}x + \frac{2}{3}$$

$$y = \frac{1}{3}x + \frac{2}{3} + \frac{18}{3}$$

$$y = \frac{1}{3}x + \frac{20}{3}$$

77. $x^2 + y^2 = 244; (-10, -12)$

$$m = \frac{-12 - 0}{-10 - 0} = \frac{12}{10} = \frac{6}{5}$$

Slope of tangent line = $-\frac{5}{6}$

$$y + 12 = -\frac{5}{6}(x + 10)$$

$$y + 12 = -\frac{5}{6}x - \frac{50}{6}$$

$$y = -\frac{5}{6}x - \frac{50}{6} - \frac{72}{6}$$

$$y = -\frac{5}{6}x - \frac{122}{6}$$

$$y = -\frac{5}{6}x - \frac{61}{3}$$

78. $x^2 + y^2 = \frac{257}{4}; \left(\frac{1}{2}, -8\right)$

$$m = \frac{-8 - 0}{\frac{1}{2} - 0} = \frac{-8}{\frac{1}{2}} = -8(2) = -16$$

Slope of tangent line = $\frac{1}{16}$

$$y + 8 = \frac{1}{16}\left(x - \frac{1}{2}\right)$$

$$y + 8 = \frac{1}{16}x - \frac{1}{32}$$

$$y = \frac{1}{16}x - \frac{1}{32} - \frac{256}{32}$$

$$y = \frac{1}{16}x - \frac{257}{32}$$

79. $x^2 + y^2 = 13; (2, -3)$

$$m = \frac{-3 - 0}{2 - 0} = -\frac{3}{2}$$

Slope of tangent line = $\frac{2}{3}$

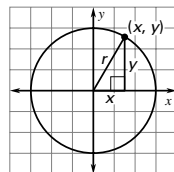
$$y + 3 = \frac{2}{3}(x - 2)$$

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

$$y = \frac{2}{3}x - \frac{13}{3}$$

They have opposite slopes and intercepts.

80. A radius of the circle from $(0, 0)$ to a point on the circle (x, y) is the hypotenuse of a right triangle, so $x^2 + y^2 = r^2$.



81. $x^2 + y^2 < 80^2$
 $(-60)^2 + (-45)^2 \stackrel{?}{<} 80^2$
 $3600 + 2025 \stackrel{?}{<} 6400$
 $5625 < 6400$ yes

$$x^2 + y^2 = 80$$

$$(-60)^2 + y^2 = (80)^2$$

$$3600 + y^2 = 6400$$

$$y^2 = 6400 - 3600$$

$$y^2 = 2800$$

$$y \approx \pm 52.92$$

$$-52.92 - (-45) = -7.92$$

about 7.92 mi

Chapter 10 *continued*

82. Area of circle

$$A = 2,400,000 = \pi r^2$$

$$\frac{2,400,000}{\pi} = r^2$$

$$763,944 \approx r^2$$

$$764,000 \approx r^2$$

$$x^2 + y^2 = r^2$$

$$x^2 + y^2 = 764,000$$

where x and y are in yards

83. $d = 20, r = 10$

$$d = 16, r = 8$$

$$x^2 + (-6)^2 = (10)^2$$

$$x^2 + 36 = 100$$

$$x^2 = 64$$

$$x = \pm 8$$

$$8 + 8 = 16 \text{ mm}$$

84. $r = 180 \text{ ft}$

$$180 - 45 = 135$$

$$x^2 + y^2 = r^2$$

$$(135)^2 + y^2 = (180)^2$$

$$18,225 + y^2 = 32,400$$

$$y^2 = 32,400 - 18,225$$

$$y^2 = 14,175$$

$$y \approx \pm 119$$

$$119 + 119 = 238 \text{ ft}$$

85. $30 - 6 = 24$

$$(24)^2 + y^2 = (30)^2$$

$$576 + y^2 = 900$$

$$y^2 = 900 - 576$$

$$y^2 = 324$$

$$y = \pm 18$$

$$18 + 18 = 36 \text{ in.}$$

86. $x^2 + y^2 \leq (50)^2$

$$x^2 + y^2 \leq 2500$$

$$(42)^2 + (43)^2 \stackrel{?}{\leq} 2500$$

$$1764 + 1849 \stackrel{?}{\leq} 2500$$

$$3613 \not\leq 2500$$

no

87. $(35)^2 + y^2 = (50)^2$

$$1225 + y^2 = 2500$$

$$y^2 = 2500 - 1225$$

$$y^2 = 1275$$

$$y \approx 35.71$$

$$66 - 35.71 = 30.29$$

$$\frac{500}{30.29} = \frac{60}{x}$$

$$500x = 1817.4$$

$$x \approx 3.63$$

$$x \approx 3.6 \text{ minutes}$$

88. $x^2 + y^2 = 53; (7, 2)$

$$m = \frac{2 - 0}{7 - 0} = \frac{2}{7}$$

Slope of tangent line is $-\frac{7}{2}$

$$y - 2 = -\frac{7}{2}(x - 7)$$

$$y - 2 = -\frac{7}{2}x + \frac{49}{2}$$

$$y = -\frac{7}{2}x + \frac{49}{2} + \frac{4}{2}$$

$$y = -\frac{7}{2}x + \frac{53}{2} \text{ B}$$

89. $(105)^2 + (120)^2 \stackrel{?}{\leq} (150)^2$

$$11,025 + 14,400 \stackrel{?}{\leq} 22,500$$

$$25,425 \not\leq 22,500 \text{ C}$$

90. $A \triangle ABC = \frac{1}{2}bh$

$$= \frac{1}{2}(8)2$$

$$= 8 \text{ units}^2$$

$$A(3, 4) \quad m = \frac{4 - 0}{3 - 0} = \frac{4}{3}$$

$$y - 4 = \frac{3}{4}(x - 3)$$

$$y - 4 = \frac{3}{4}x + \frac{9}{4}$$

$$y = \frac{3}{4}x + \frac{9}{4} + 4$$

$$y = \frac{3}{4}x + \frac{25}{4}$$

$$0 = -\frac{3}{4}x + \frac{25}{4}$$

—CONTINUED—

Chapter 10 *continued*

90. —CONTINUED—

$$\frac{3}{4}x = \frac{25}{4}$$

$$3x = 25$$

$$x = 8\frac{1}{3}$$

$$D\left(8\frac{1}{3}, 0\right)$$

$$A \triangle ABD = \frac{1}{2}bh$$

$$= \frac{1}{2}(8)\left(8\frac{1}{3} - 3\right)$$

$$= 4\left(5\frac{1}{3}\right)$$

$$= 21\frac{1}{3}$$

$$8 \text{ units}^2 < \text{Area} < 21\frac{1}{3} \text{ units}^2$$

10.3 Mixed Review (p. 607)

91. $x - 9y = 25$

$$6x - 5y = 3$$

$$-6x + 54y = -150$$

$$\frac{6x - 5y = 3}{49y = -147}$$

$$y = -3$$

$$x - 9(-3) = 25$$

$$x + 27 = 25$$

$$x = -27 + 25$$

$$x = -2$$

$$(-2, -3)$$

93. $2x - 3y = 2$

$$-7x + 4y = 6$$

$$8x - 12y = 8$$

$$\frac{-21x + 12y = 18}{-13x = 26}$$

$$x = -2$$

$$2(-2) - 3y = 2$$

$$-4 - 3y = 2$$

$$-3y = 6$$

$$y = -2$$

$$(-2, -2)$$

92. $9x - y = 8$

$$3x + 10y = -49$$

$$90x - 10y = 80$$

$$\frac{3x + 10y = -49}{93x = 31}$$

$$x = \frac{31}{93} = \frac{1}{3}$$

$$9\left(\frac{1}{3}\right) - y = 8$$

$$3 - y = 8$$

$$-y = 8 - 3$$

$$-y = 8 - 3$$

$$y = -5$$

$$\left(\frac{1}{3}, -5\right)$$

94. $8x - 5y = 4$

$$2x + y = 1$$

$$8x - 5y = 4$$

$$\frac{10x + 5y = 5}{18x = 9}$$

$$x = \frac{1}{2}$$

$$2\left(\frac{1}{2}\right) + y = 1$$

$$1 + y = 1$$

$$y = 0$$

$$\left(\frac{1}{2}, 0\right)$$

95. $-x + 5y = 3$

$$4x - 9y = 10$$

$$-4x + 20y = 12$$

$$\frac{4x - 9y = 10}{11y = 22}$$

$$y = 2$$

$$-x + 5(2) = 3$$

$$-x + 10 = 3$$

$$-x = -7$$

$$x = 7$$

$$(7, 2)$$

96. $-9x + 4y = 15$ $3\left(-\frac{1}{3}\right) + 2y = 5$

$$3x + 2y = 5$$

$$-1 + 2y = 5$$

$$-9x + 4y = 15$$

$$2y = 6$$

$$\frac{-6x - 4y = -10}{-15x = 5}$$

$$y = 3$$

$$x = -\frac{1}{3}$$

$$\left(-\frac{1}{3}, 3\right)$$

97. $f(x) = x + 1$

$$g(x) = 2x$$

$$f(g(x)) = 2x + 1$$

$$g(f(x)) = 2(x + 1)$$

$$= 2x + 2$$

98. $f(x) = 4x + 1$

$$g(x) = x - 5$$

$$f(g(x)) = 4(x - 5) + 1$$

$$= 4x - 20 + 1$$

$$= 4x - 19$$

$$g(f(x)) = 4x + 1 - 5$$

$$= 4x - 4$$

99. $f(x) = -x^2 - 1$

$$g(x) = x + 5$$

$$f(g(x)) = -(x + 5)^2 - 1$$

$$= -(x^2 + 10x + 25) - 1$$

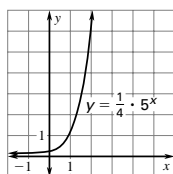
$$= -x^2 - 10x - 26$$

$$g(f(x)) = -x^2 - 1 + 5 = -x^2 + 4$$

Chapter 10 continued

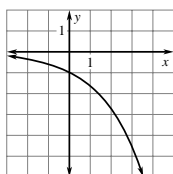
100. $f(x) = x^2 - 7$
 $g(x) = 3x + 1$
 $f(g(x)) = (3x + 1)^2 - 7 = 9x^2 + 6x + 1 - 7$
 $= 9x^2 + 6x - 6$
 $g(f(x)) = 3(x^2 - 7) + 1 = 3x^2 - 21 + 1 = 3x^2 - 20$

101. $y = \frac{1}{4} \cdot 5^x$



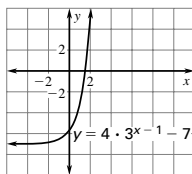
x	0	1	-1	2	-2
y	$\frac{1}{4}$	$\frac{5}{4}$	$\frac{1}{20}$	$\frac{25}{4}$	$\frac{1}{100}$

102. $y = -\left(\frac{5}{3}\right)^x$



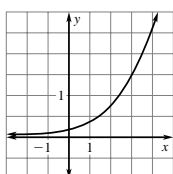
x	0	1	-1	2	-2
y	-1	$-\frac{5}{3}$	$-\frac{3}{5}$	$-\frac{25}{9}$	$-\frac{9}{25}$

103. $y = 4 \cdot 3^{x-1} - 7$



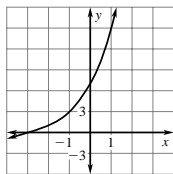
x	1	2	0	1.51
y	-3	5	$-\frac{17}{3}$	0.004

104. $y = 3 \cdot 2^{x-4}$



x	4	3	5	2	1	0
y	3	$\frac{3}{2}$	6	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{3}{16}$

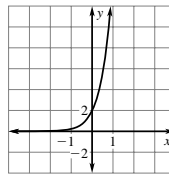
105. $y = 2^{x+3} - 1$



x	-3	-4	-2	-1	0
y	0	$-\frac{1}{2}$	1	3	7

106. $y = \frac{1}{4} \cdot 8^{x+1}$

x	-1	-2	0	1
y	$\frac{1}{4}$	$\frac{1}{32}$	2	16



107. $\begin{bmatrix} 35 & 52 \\ 112 & 40 \\ 95 & 63 \end{bmatrix}$

108. $6 \begin{bmatrix} 35 & 52 \\ 112 & 40 \\ 95 & 63 \end{bmatrix} = \begin{bmatrix} 210 & 312 \\ 672 & 240 \\ 570 & 378 \end{bmatrix}$ Total
 210
 672
 570
 312
 240
 378
 \$2382

Quiz 1 (p. 607)

1. $d = \sqrt{(0-8)^2 + (0-6)^2} = \sqrt{64 + 36} = \sqrt{100} = 10$

$\left(\frac{0+8}{2}, \frac{0+6}{2}\right) = \left(\frac{8}{2}, \frac{6}{2}\right) = (4, 3)$

2. $d = \sqrt{(3+3)^2 + (3+3)^2} = \sqrt{36 + 36} = \sqrt{72}$
 $= 6\sqrt{2} \approx 8.485$

$\left(\frac{3-3}{2}, \frac{3-3}{2}\right) = \left(\frac{0}{2}, \frac{0}{2}\right) = (0, 0)$

3. $d = \sqrt{(-2-4)^2 + (7+10)^2} = \sqrt{36 + 289} = \sqrt{325}$
 $= 5\sqrt{13} \approx 18.028$

$\left(\frac{-2+4}{2}, \frac{7-10}{2}\right) = \left(\frac{2}{2}, \frac{-3}{2}\right) = \left(1, -\frac{3}{2}\right)$

4. $d = \sqrt{(3+5)^2 + (-7+9)^2} = \sqrt{64 + 4} = \sqrt{68}$
 $= 2\sqrt{17} \approx 8.246$

$\left(\frac{3-5}{2}, \frac{-7-9}{2}\right) = \left(\frac{-2}{2}, \frac{-16}{2}\right) = (-1, -8)$

5. $d = \sqrt{(8+4)^2 + (6-4)^2} = \sqrt{144 + 4} = \sqrt{148}$
 $= 2\sqrt{37} \approx 12.166$

$\left(\frac{8-4}{2}, \frac{6+4}{2}\right) = \left(\frac{4}{2}, \frac{10}{2}\right) = (2, 5)$

6. $d = \sqrt{(-1-11)^2 + (-13-15)^2} = \sqrt{144 + 784}$
 $= \sqrt{928} = 4\sqrt{58} \approx 30.463$

$\left(\frac{-1+11}{2}, \frac{-13+15}{2}\right) = \left(\frac{10}{2}, \frac{2}{2}\right) = (5, 1)$

Chapter 10 continued

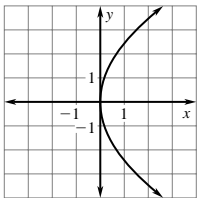
7. $y^2 = 6x$

$4p = 6$

$p = \frac{3}{2}$

focus: $(\frac{3}{2}, 0)$

directrix: $x = -\frac{3}{2}$



x	1	2	3
y	± 2.45	± 3.46	± 4.24

8. $3y = x^2$

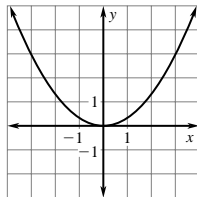
$4p = 3$

$p = \frac{3}{4}$

focus: $(0, \frac{3}{4})$

directrix: $y = -\frac{3}{4}$

$p > 0$ parabola opens up



x	1	2	3
y	± 1.73	± 2.45	± 3

9. $-x^2 = 5y$

$x^2 = -5y$

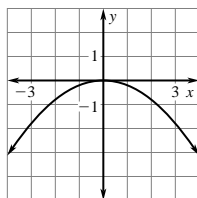
$4p = -5$

$p = -\frac{5}{4}$

focus: $(0, -\frac{5}{4})$

directrix: $y = \frac{5}{4}$

$p < 0$ parabola opens down



x	-1	-2	-3
y	± 2.24	± 3.16	± 3.87

10. $-4y^2 = 6x$

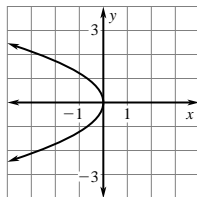
$y^2 = -\frac{6}{4}x = -\frac{3}{2}x$

$4p = -\frac{3}{2}$

$p = -\frac{3}{8}$

focus: $(-\frac{3}{8}, 0)$

directrix: $x = \frac{3}{8}$



x	-1	-2	-3
y	± 1.22	± 1.73	± 2.12

11. $3x^2 = 7y$

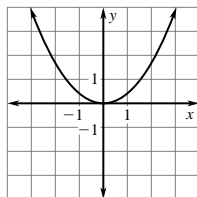
$x^2 = \frac{7}{3}y$

$4p = \frac{7}{3}$

$p = \frac{7}{12}$

focus: $(0, \frac{7}{12})$

directrix: $y = -\frac{7}{12}$



x	1	2	3
y	± 1.53	± 2.16	± 2.65

12. $\frac{1}{2}x = 2y^2$

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

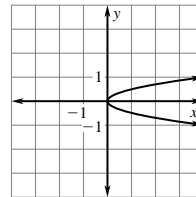
$y^2 = \frac{1}{4}x$

$4p = \frac{1}{4}$

$p = \frac{1}{16}$

focus: $(\frac{1}{16}, 0)$

directrix: $x = -\frac{1}{16}$



x	1	2	3
y	$\pm \frac{1}{2}$	± 0.71	± 0.87

13. $x + \frac{1}{8}y^2 = 0$

$\frac{1}{8}y^2 = -x$

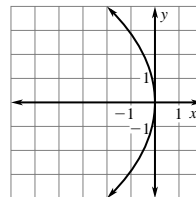
$y^2 = -8x$

$4p = -8$

$p = -2$

focus: $(-2, 0)$

directrix: $x = 2$



x	-1	-2	-3
y	± 2.38	± 4	± 4.9

14. $-x^2 - 12y = 0$

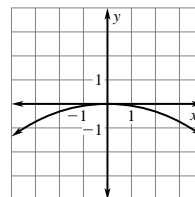
$x^2 = -12y$

$4p = -12$

$p = -3$

focus: $(0, -3)$

directrix: $y = 3$



x	-1	-2	-3
y	± 3.46	± 4.9	± 6

15. $(0, 3)$

$r = \sqrt{(0-0)^2 + (3-0)^2} = \sqrt{0+9} = \sqrt{9} = 3$

$x^2 + y^2 = 9$

16. $(-5, 0)$

$r = \sqrt{(-5-0)^2 + (0-0)^2} = \sqrt{25+0} = \sqrt{25} = 5$

$x^2 + y^2 = 25$

17. $(4, 7)$

$r = \sqrt{(4-0)^2 + (7-0)^2} = \sqrt{16+49} = \sqrt{65}$

$x^2 + y^2 = 65$

18. $(-2, -5)$

$r = \sqrt{(-2-0)^2 + (-5-0)^2} = \sqrt{4+25} = \sqrt{29}$

$x^2 + y^2 = 29$

Chapter 10 *continued*

19. $(-1, 9)$

$$r = \sqrt{(-1 - 0)^2 + (9 - 0)^2} = \sqrt{1 + 81} = \sqrt{82}$$

$$x^2 + y^2 = 82$$

20. $(6, -3)$

$$r = \sqrt{(6 - 0)^2 + (-3 - 0)^2} = \sqrt{36 + 9} = \sqrt{45}$$

$$x^2 + y^2 = 45$$

21. $(6, -6)$

$$r = \sqrt{(6 - 0)^2 + (-6 - 0)^2} = \sqrt{36 + 36} = \sqrt{72}$$

$$x^2 + y^2 = 72$$

22. $(-7, 8)$

$$r = \sqrt{(-7 - 0)^2 + (8 - 0)^2} = \sqrt{49 + 64} = \sqrt{113}$$

$$x^2 + y^2 = 113$$

23. $(35)^2 + (56)^2 \stackrel{?}{\leq} (65)^2$

$$1225 + 3136 \stackrel{?}{\leq} 4225$$

$$4361 \not\leq 4225 \text{ no } \sqrt{35^2 + 56^2} \approx 66 \text{ miles}$$

Technology Activity 10.3 (p. 608)

1. $x^2 + y^2 = 121$

$$-18 \leq x \leq 18$$

$$-12 \leq y \leq 12$$

3. $x^2 + y^2 = 484$

$$-36 \leq x \leq 36$$

$$-24 \leq y \leq 24$$

5. $x^2 + y^2 = \frac{16}{9}$

$$-3 \leq x \leq 3$$

$$-2 \leq y \leq 2$$

7. $\frac{4}{5}x^2 + \frac{4}{5}y^2 = 20$

$$-9 \leq x \leq 9$$

$$-6 \leq y \leq 6$$

9. $125x^2 + 125y^2 = 1000$

$$-6 \leq x \leq 6$$

$$-4 \leq y \leq 4$$

2. $x^2 + y^2 = 50$

$$-12 \leq x \leq 12$$

$$-8 \leq y \leq 8$$

4. $5x^2 + 5y^2 = 120$

$$-9 \leq x \leq 9$$

$$-6 \leq y \leq 6$$

6. $\frac{1}{2}x^2 + \frac{1}{2}y^2 = 72$

$$-24 \leq x \leq 24$$

$$-16 \leq y \leq 16$$

8. $9x^2 + 9y^2 = 4$

$$-1.5 \leq x \leq 1.5$$

$$-1 \leq y \leq 1$$

Lesson 10.4

10.4 Guided Practice (p. 612)

1. (a) vertices (b) co-vertices (c) foci (d) major axis

2. Write the equation in standard form; if the larger denominator is under x^2 , the major axis is horizontal; if the larger denominator is under y^2 , the major axis is vertical.

3. Find a and b , then use $c = \sqrt{a^2 - b^2}$. The foci are at $(\pm c, 0)$ for vertices at $(\pm a, 0)$, and at $(0, \pm c)$ for vertices at $(0, \pm a)$.

4. The student incorrectly identified a as 2 and b as 3. Since the major axis is horizontal, $a = 3$ and $b = 2$. The correct equation is $\frac{x^2}{9} + \frac{y^2}{4} = 1$.

5. $\frac{x^2}{16} + \frac{y^2}{25} = 1$

Vertex: $(0, 5)$

Co-vertex: $(-4, 0)$

7. $\frac{x^2}{49} + \frac{y^2}{9} = 1$

Vertex: $(-7, 0)$

Focus: $(-2\sqrt{10}, 0)$

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

$$b^2 = (-7)^2 - (-2\sqrt{10})^2$$

$$b^2 = 49 - 40 = 9$$

$$b = \pm 3$$

8. $\frac{x^2}{144} + \frac{y^2}{169} = 1$

Vertex: $(0, 13)$

Focus: $(0, -5)$

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

$$b^2 = (13)^2 - (-5)^2$$

$$b^2 = 169 - 25 = 144$$

$$b = 12$$

10. $\frac{x^2}{49} + \frac{y^2}{33} = 1$

Co-vertex: $(0, \sqrt{33})$

Focus: $(4, 0)$

$$a^2 = c^2 + b^2$$

$$a^2 = (4)^2 + (\sqrt{33})^2$$

$$a^2 = 16 + 33$$

$$a^2 = 49$$

$$a = 7$$

6. $\frac{x^2}{81} + \frac{y^2}{4} = 1$

Vertex: $(9, 0)$

Co-vertex: $(0, 2)$

9. $\frac{x^2}{91} + \frac{y^2}{100} = 1$

Co-vertex: $(\sqrt{91}, 0)$

Focus: $(0, 3)$

$$a^2 = c^2 + b^2$$

$$a^2 = (3)^2 + (\sqrt{91})^2$$

$$a^2 = 9 + 91 = 100$$

$$a = 10$$

11. $\frac{x^2}{49} + \frac{y^2}{25} = 1$

Vertex: $(-7, 0), (7, 0)$

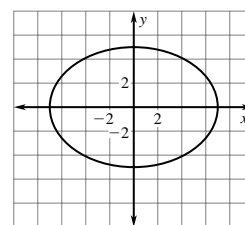
Co-vertices: $(0, -5), (0, 5)$

$$c^2 = (7)^2 - (5)^2$$

$$c^2 = 49 - 25 = 24$$

$$c = \sqrt{24} \approx \pm 4.9$$

Foci: $(-4.9, 0), (4.9, 0)$



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

Vertices: $(0, -4), (0, 4)$

Co-vertices: $(-3, 0), (3, 0)$

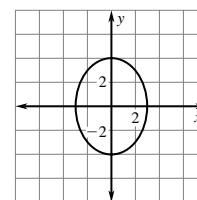
$$c^2 = a^2 - b^2$$

$$c^2 = (4)^2 - (3)^2$$

$$c^2 = 16 - 9 = 7$$

$$c = \sqrt{7} \approx \pm 2.65$$

Foci: $(0, -2.65), (0, 2.65)$



Chapter 10 continued

13. $\frac{x^2}{30} + \frac{y^2}{4} = 1$

Vertices: $(-5.48, 0), (5.48, 0)$

Co-vertices: $(0, -2), (0, 2)$

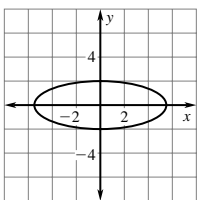
$$c^2 = a^2 - b^2$$

$$c^2 = (\sqrt{30})^2 - (2)^2$$

$$c^2 = 30 - 4 = 26$$

$$c = \sqrt{26} \approx \pm 5.1$$

Foci: $(-5.1, 0), (5.1, 0)$



14. $\frac{x^2}{64} + \frac{y^2}{45} = 1$

Vertices: $(-8, 0), (8, 0)$

Co-vertices: $(0, -\sqrt{45}), (0, \sqrt{45})$

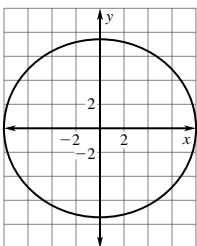
$$c^2 = a^2 - b^2$$

$$c^2 = (8)^2 - (\sqrt{45})^2$$

$$c^2 = 64 - 45 = 19$$

$$c = \sqrt{19} \approx \pm 4.39$$

Foci: $(-4.36, 0), (4.36, 0)$



15. $75x^2 + 36y^2 = 2700$

$$\frac{75x^2}{2700} + \frac{36y^2}{2700} = \frac{2700}{2700}$$

$$\frac{x^2}{36} + \frac{y^2}{75} = 1$$

Vertices: $(0, -\sqrt{75}), (0, \sqrt{75})$

Co-vertices: $(-6, 0), (6, 0)$

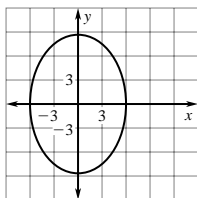
$$c^2 = a^2 - b^2$$

$$c^2 = (8.66)^2 - (6)^2$$

$$c^2 = 75 - 36 = 39$$

$$c = \sqrt{39} \approx \pm 6.24$$

Foci: $(0, -6.24), (0, 6.24)$



16. $81x^2 + 63y^2 = 5103$

$$\frac{81x^2}{5103} + \frac{63y^2}{5103} = \frac{5103}{5103}$$

$$\frac{x^2}{63} + \frac{y^2}{81} = 1$$

Vertices: $(0, -9), (0, 9)$

Co-vertices: $(-\sqrt{63}, 0), (\sqrt{63}, 0)$

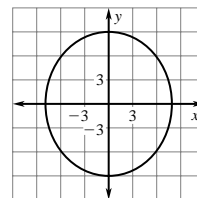
$$c^2 = a^2 - b^2$$

$$c^2 = (9)^2 - (7.94)^2$$

$$c^2 = 81 - 63 = 18$$

$$c = \sqrt{18} \approx \pm 4.24$$

Foci: $(0, -4.24), (0, 4.24)$



17. $\frac{x^2}{25} + \frac{y^2}{9} = 1$

Vertices: $(-5, 0), (5, 0)$

Co-vertices: $(0, -3), (0, 3)$

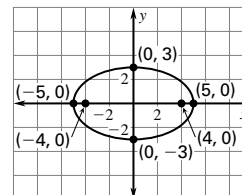
$$c^2 = a^2 - b^2$$

$$c^2 = (5)^2 - (3)^2$$

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

$$c = \pm 4$$

Foci: $(-4, 0), (4, 0)$



10.4 Practice and Applications (pp. 612–614)

18. $\frac{x^2}{25} + \frac{y^2}{16} = 1$

Vertices: $(-5, 0), (5, 0)$

Co-vertices: $(0, -4), (0, 4)$

$$c^2 = a^2 - b^2 = (5)^2 - (4)^2 = 25 - 16 = 9$$

$$c = \sqrt{9} = \pm 3$$

Foci: $(-3, 0), (3, 0)$

19. $\frac{x^2}{121} + \frac{y^2}{100} = 1$

Vertices: $(-11, 0), (11, 0)$

Co-vertices: $(0, -10), (0, 10)$

$$c^2 = a^2 - b^2 = (11)^2 - (10)^2 = 121 - 100 = 21$$

$$c = \sqrt{21} \approx \pm 4.58$$

Foci: $(-4.58, 0), (4.58, 0)$

20. $\frac{x^2}{4} + \frac{y^2}{9} = 1$

Vertices: $(0, -3), (0, 3)$

Co-vertices: $(-2, 0), (2, 0)$

$$c^2 = a^2 - b^2 = (3)^2 - (2)^2 = 9 - 4 = 5$$

$$c = \sqrt{5} \approx \pm 2.24$$

Foci: $(0, -2.24), (0, 2.24)$

Chapter 10 *continued*

21. $\frac{x^2}{9} + \frac{y^2}{25} = 1$

Vertices: (0, -5), (0, 5)

Co-vertices: (-3, 0), (3, 0)

$$c^2 = a^2 - b^2 = (5)^2 - (3)^2 = 25 - 9 = 16$$

$$c = \sqrt{16} = \pm 4$$

Foci: (0, -4), (0, 4)

22. $\frac{x^2}{12} + \frac{y^2}{36} = 1$

Vertices: (0, -6), (0, 6)

Co-vertices: $(-\sqrt{12}, 0)$, $(\sqrt{12}, 0)$

$$c^2 = a^2 - b^2 = (6)^2 - (\sqrt{12})^2 = 36 - 12 = 24$$

$$c = \sqrt{24} \approx \pm 4.9$$

Foci: (0, -4.9), (0, 4.9)

23. $\frac{x^2}{28} + \frac{y^2}{20} = 1$

Vertices: $(-\sqrt{28}, 0)$, $(\sqrt{28}, 0)$

Co-vertices: $(0, -\sqrt{20})$, $(0, \sqrt{20})$

$$c^2 = a^2 - b^2 = (\sqrt{28})^2 - (\sqrt{20})^2 = 28 - 20 = 8$$

$$c = \pm \sqrt{8} \approx \pm 2.83$$

Foci: (-2.83, 0), (2.83, 0)

24. $16x^2 + y^2 = 16$

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

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

Vertices: (0, -4), (0, 4)

Co-vertices: (-1, 0), (1, 0)

$$c^2 = a^2 - b^2 = (4)^2 - (1)^2 = 16 - 1 = 15$$

$$c = \pm \sqrt{15} \approx \pm 3.87$$

Foci: (0, -3.87), (0, 3.87)

25. $49x^2 + 4y^2 = 196$

$$\frac{49x^2}{196} + \frac{4y^2}{196} = \frac{196}{196}$$

$$\frac{x^2}{4} + \frac{y^2}{49} = 1$$

Vertices: (0, ± 7)

Co-vertices: (± 2 , 0)

$$c^2 = a^2 - b^2 = (7)^2 - (2)^2 = 49 - 4 = 45$$

$$c = \pm \sqrt{45} = \pm \sqrt{9 \cdot 5} = \pm 3\sqrt{5}$$

Foci: $(0, \pm 3\sqrt{5})$

26. $9x^2 + 100y^2 = 900$

$$\frac{9x^2}{900} + \frac{100y^2}{900} = \frac{900}{900}$$

$$\frac{x^2}{100} + \frac{y^2}{9} = 1$$

Vertices: (± 10 , 0)

Co-vertices: (0, ± 3)

$$c^2 = a^2 - b^2 = (10)^2 - (3)^2 = 100 - 9 = 91$$

$$c = \pm \sqrt{91}$$

Foci: $(\pm \sqrt{91}, 0)$

27. $x^2 + 10y^2 = 10$

$$\frac{x^2}{10} + \frac{10y^2}{10} = \frac{10}{10}$$

$$\frac{x^2}{10} + y^2 = 1$$

Vertices: $(\pm \sqrt{10}, 0)$

Co-vertices: (0, ± 1)

$$c^2 = a^2 - b^2 = (\sqrt{10})^2 - (1)^2 = 10 - 1 = 9$$

$$c = \pm 3$$

Foci: (± 3 , 0)

28. $10x^2 + 25y^2 = 250$

$$\frac{10x^2}{250} + \frac{25y^2}{250} = \frac{250}{250}$$

$$\frac{x^2}{25} + \frac{y^2}{10} = 1$$

Vertices: (± 5 , 0)

Co-vertices: $(0, \pm \sqrt{10})$

$$c^2 = a^2 - b^2 = 25 - 10 = 15$$

$$c = \pm \sqrt{15}$$

Foci: $(\pm \sqrt{15}, 0)$

29. $25x^2 + 15y^2 = 375$

$$\frac{25x^2}{375} + \frac{15y^2}{375} = \frac{375}{375}$$

$$\frac{x^2}{15} + \frac{y^2}{25} = 1$$

Vertices: (0, ± 5)

Co-vertices: $(\pm \sqrt{15}, 0)$

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

$$c^2 = 25 - 15 = 10$$

$$c = \pm \sqrt{10}$$

Foci: $(0, \pm \sqrt{10})$

Chapter 10 continued

30. $\frac{x^2}{16} + \frac{y^2}{36} = 1$

Vertices: $(0, \pm 6)$

Co-vertices: $(\pm 4, 0)$

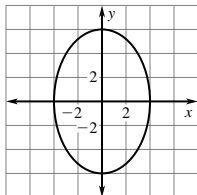
Foci: $(0, \pm 2\sqrt{5})$

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

$$c^2 = 36 - 16 = 20$$

$$c = \pm\sqrt{20} = \pm\sqrt{4 \cdot 5}$$

$$c = \pm 2\sqrt{5}$$



32. $\frac{x^2}{36} + \frac{y^2}{64} = 1$

Vertices: $(0, \pm 8)$

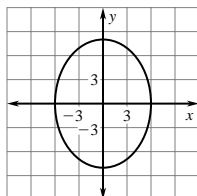
Co-vertices: $(\pm 6, 0)$

Foci: $(0, \pm 2\sqrt{7})$

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

$$c^2 = 64 - 36 = 28$$

$$c = \pm\sqrt{28} = \pm 2\sqrt{7}$$



34. $\frac{x^2}{196} + \frac{y^2}{100} = 1$

Vertices: $(\pm 14, 0)$

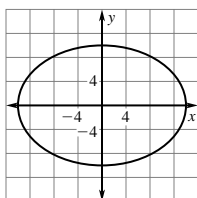
Co-vertices: $(0, \pm 10)$

Foci: $(\pm\sqrt{96}, 0)$

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

$$c^2 = 196 - 100 = 96$$

$$c = \pm\sqrt{96}$$



31. $\frac{x^2}{4} + \frac{y^2}{49} = 1$

Vertices: $(0, \pm 7)$

Co-vertices: $(\pm 2, 0)$

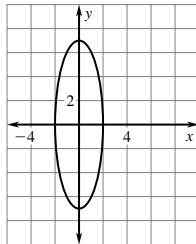
Foci: $(0, \pm 3\sqrt{5})$

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

$$c^2 = 49 - 4 = 45$$

$$c = \pm\sqrt{45}$$

$$c = \pm 3\sqrt{5}$$



33. $\frac{x^2}{49} + \frac{y^2}{144} = 1$

Vertices: $(0, \pm 12)$

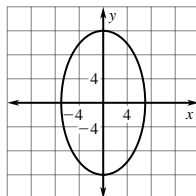
Co-vertices: $(\pm 7, 0)$

Foci: $(0, \pm\sqrt{95})$

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

$$c^2 = 144 - 49 = 95$$

$$c = \pm\sqrt{95}$$



35. $\frac{x^2}{256} + \frac{y^2}{36} = 1$

Vertices: $(\pm 16, 0)$

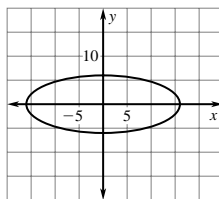
Co-vertices: $(0, \pm 6)$

Foci: $(\pm\sqrt{220}, 0)$

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

$$c^2 = 256 - 36 = 220$$

$$c = \pm\sqrt{220}$$



37. $\frac{x^2}{121} + \frac{y^2}{169} = 1$

Vertices: $(0, \pm 13)$

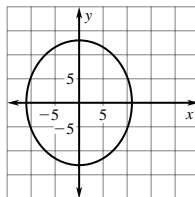
Co-vertices: $(\pm 11, 0)$

Foci: $(0, \pm 4\sqrt{3})$

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

$$c^2 = 169 - 121 = 48$$

$$c = \pm\sqrt{48} = 4\sqrt{3}$$



39. $\frac{x^2}{49} + \frac{y^2}{64} = 1$

Vertices: $(0, \pm 8)$

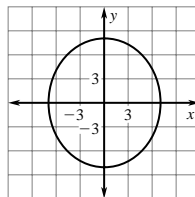
Co-vertices: $(\pm 7, 0)$

Foci: $(0, \pm\sqrt{15})$

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

$$c^2 = 64 - 49 = 15$$

$$c = \pm\sqrt{15}$$



36. $\frac{x^2}{225} + \frac{y^2}{81} = 1$

Vertices: $(\pm 15, 0)$

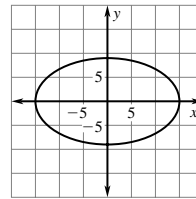
Co-vertices: $(0, \pm 9)$

Foci: $(\pm 12, 0)$

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

$$= 225 - 81 = 144$$

$$c = \pm 12$$



38. $\frac{x^2}{144} + \frac{y^2}{400} = 1$

Vertices: $(0, \pm 20)$

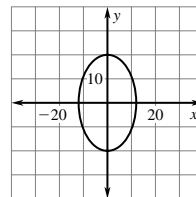
Co-vertices: $(\pm 12, 0)$

Foci: $(0, \pm 16)$

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

$$c^2 = 400 - 144 = 256$$

$$c = \pm 16$$



Chapter 10 *continued*

40. $\frac{x^2}{4} + \frac{y^2}{1} = 100$

$$\frac{x^2}{400} + \frac{y^2}{100} = \frac{100}{100}$$

$$\frac{x^2}{400} + \frac{y^2}{100} = 1$$

Vertices: $(\pm 20, 0)$

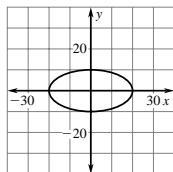
Co-vertices: $(0, \pm 10)$

Foci: $(\pm 10\sqrt{3}, 0)$

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

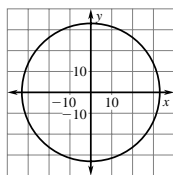
$$c^2 = 400 - 100 = 300$$

$$c = \pm\sqrt{300} = \pm 10\sqrt{3}$$



42. $x^2 + y^2 = 33^2$

$$r = 33$$



44. $24y + x^2 = 0$

$$x^2 = -24y$$

$$4p = -24$$

$$p = -6$$

Focus: $(0, -6)$

Directrix: $y = 6$

$p < 0$ parabola opens down

x	-1	-2	-3
y	± 4.9	± 6.93	± 8.49

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

$$4\left(\frac{x^2}{4} + \frac{y^2}{25}\right) = \frac{1}{4}(4)$$

$$\frac{x^2}{1} + \frac{y^2}{6.25} = 1$$

Vertices: $(0, \pm 2.5)$

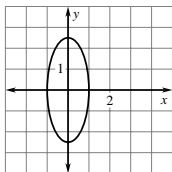
Co-vertices: $(\pm 1, 0)$

Foci: $(0, \pm 2.29)$

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

$$c^2 = 6.25 - 1 = 5.25$$

$$c = \pm\sqrt{5.25} \approx \pm 2.29$$



43. $64x^2 + 25y^2 = 1600$

$$\frac{64x^2}{1600} + \frac{25y^2}{1600} = \frac{1600}{1600}$$

$$\frac{x^2}{25} + \frac{y^2}{64} = 1$$

Vertices: $(0, \pm 8)$

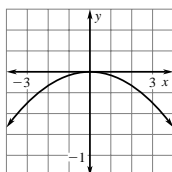
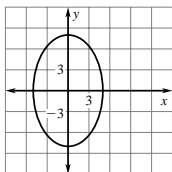
Co-vertices: $(\pm 5, 0)$

Foci: $(0, \pm\sqrt{39})$

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

$$c^2 = 64 - 25 = 39$$

$$c = \pm\sqrt{39}$$



45. $72x^2 = 144y$

$$x^2 = 2y$$

$$4p = 2$$

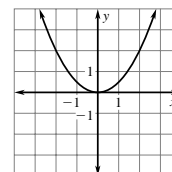
$$p = \frac{1}{2}$$

Focus: $(0, \frac{1}{2})$

Directrix: $y = -\frac{1}{2}$

$p > 0$ parabola opens up

x	1	2	3
y	± 1.41	± 2	± 2.45

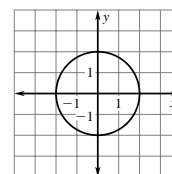


46. $24x^2 + 24y^2 = 96$

$$\frac{24x^2}{24} + \frac{24y^2}{24} = \frac{96}{24}$$

$$x^2 + y^2 = 4$$

$$r = 2$$



47. $\frac{x^2}{81} + \frac{4y}{9} = 1$

$$x^2 + 36y = 81$$

$$36y = 81 - x^2$$

$$y = \frac{81}{36} - \frac{x^2}{36}$$

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

$$\frac{-b}{2a} = \frac{0}{2\left(-\frac{1}{36}\right)} = 0$$

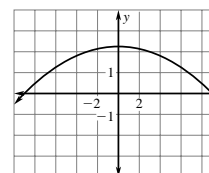
$$y = -\frac{1}{36}(0) + 0(0) + \frac{9}{4}$$

$$y = \frac{9}{4}$$

Vertex: $(0, \frac{9}{4})$

Axis of symmetry $x = 0$

x	0	6	-6
y	$\frac{9}{4}$	$\frac{5}{4}$	$\frac{5}{4}$



Chapter 10 *continued*

48. $\frac{3x^2}{12} + \frac{5y^2}{500} = 1$

$$\frac{x^2}{4} + \frac{y^2}{100} = 1$$

Vertices: $(0, \pm 10)$

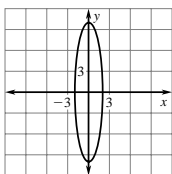
Co-vertices: $(\pm 2, 0)$

Foci: $(0, \pm \sqrt{96})$

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

$$c^2 = 100 - 4 = 96$$

$$c = \pm \sqrt{96}$$



50. $5x^2 + 9y^2 = 45$

$$\frac{5x^2}{45} + \frac{9y^2}{45} = \frac{45}{45}$$

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

Vertices: $(\pm 3, 0)$

Co-vertices: $(0, \pm \sqrt{5})$

Foci: $(\pm 2, 0)$

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

$$c^2 = 9 - 5 = 4$$

$$c = \pm 2$$

51. Vertex: $(0, 6)$

Co-vertex: $(5, 0)$

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

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

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

55. $\frac{x^2}{(9)^2} + \frac{y^2}{(-8)^2} = 1$

$$\frac{x^2}{81} + \frac{y^2}{64} = 1$$

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

$$b^2 = (7)^2 - (3)^2$$

$$b^2 = 49 - 9 = 40$$

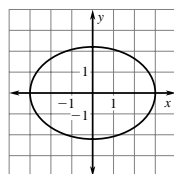
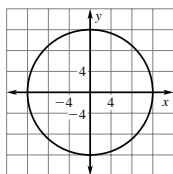
$$\frac{x^2}{40} + \frac{y^2}{49} = 1$$

49. $\frac{x^2}{36} + \frac{y^2}{36} = 4$

$$36\left(\frac{x^2}{36} + \frac{y^2}{36}\right) = 4(36)$$

$$x^2 + y^2 = 144$$

$$r = 12$$



52. Vertex: $(0, 6)$

Co-vertex: $(-2, 0)$

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

54. $\frac{x^2}{(-1)^2} + \frac{y^2}{(-7)^2} = 1$

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

56. $\frac{x^2}{(10)^2} + \frac{y^2}{(4)^2} = 1$

$$\frac{x^2}{100} + \frac{y^2}{16} = 1$$

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

$$b^2 = (-5)^2 - (2\sqrt{6})^2$$

$$b^2 = 25 - 24 = 1$$

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

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

$$b^2 = (8)^2 - (-4\sqrt{3})^2 = 64 - 48 = 16$$

$$\frac{x^2}{16} + \frac{y^2}{64} = 1$$

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

$$b^2 = (15)^2 - (12)^2$$

$$b^2 = 225 - 144 = 81$$

$$\frac{x^2}{225} + \frac{y^2}{81} = 1$$

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

$$b^2 = (-30)^2 - (20)^2$$

$$b^2 = 900 - 400 = 500$$

$$\frac{x^2}{500} + \frac{y^2}{900} = 1$$

64. $a^2 = c^2 + b^2$

$$a^2 = (-1)^2 + (-\sqrt{3})^2$$

$$a^2 = 1 + 3 = 4$$

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

66. $a^2 = c^2 + b^2$

$$a^2 = (3)^2 + (-3\sqrt{3})^2$$

$$a^2 = 9 + 27 = 36$$

$$\frac{x^2}{36} + \frac{y^2}{27} = 1$$

68. $a^2 = c^2 + b^2$

$$a^2 = (-2)^2 + (-\sqrt{77})^2$$

$$a^2 = 4 + 77 = 81$$

$$\frac{x^2}{81} + \frac{y^2}{77} = 1$$

70. $2(42.7) \approx 85.4$ ft.

about 85.4 ft

72. $a - c = 4132$

$$a + c = 4583$$

$$2a = 8715$$

$$a = 4357.5$$

$$4357.5 + c = 4583$$

$$c = 225.5$$

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

$$b^2 = (4357.5)^2 - (225.5)^2$$

$$b = 4351.7$$

$$\frac{x^2}{(4357.5)^2} + \frac{y^2}{(4351.7)^2} = 1$$

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

$$b^2 = (5)^2 - (-3)^2$$

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

$$\frac{x^2}{25} + \frac{y^2}{16} = 1$$

63. $a^2 = c^2 + b^2$

$$a^2 = (-3)^2 + (\sqrt{55})^2$$

$$a^2 = 9 + 55 = 64$$

$$\frac{x^2}{55} + \frac{y^2}{64} = 1$$

65. $a^2 = c^2 + b^2$

$$a^2 = (9)^2 + (-2\sqrt{10})^2$$

$$a^2 = 81 + 40 = 121$$

$$\frac{x^2}{40} + \frac{y^2}{121} = 1$$

67. $a^2 = c^2 + b^2$

$$a^2 = (-7)^2 + (5\sqrt{11})^2$$

$$a^2 = 49 + 275 = 324$$

$$\frac{x^2}{275} + \frac{y^2}{324} = 1$$

69. $(23)^2 = 529$

$$(48.5)^2 = 2352.25$$

$$\frac{x^2}{2352.25} + \frac{y^2}{529} = 1$$

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

$$c^2 = 2352.25 - 529$$

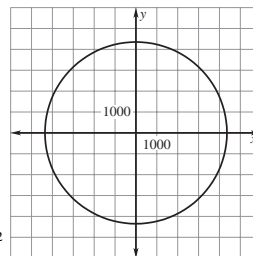
$$= 1823.25$$

$$c = \pm \sqrt{1823.25} \approx \pm 42.7$$

71. $A = \pi ab = \pi(48.5)(23)$

$$\approx 3504 \text{ ft}^2$$

about 3500 ft²



Chapter 10 continued

$$73. \frac{185}{2} = 92.5$$

$$\frac{155}{2} = 77.5$$

$$\frac{x^2}{(92.5)^2} + \frac{y^2}{(77.5)^2} = 1$$

$$75. A = \pi ab$$

$$\pi(67.5)(55) \leq A \leq \pi(92.5)(77.5)$$

$$3712.5\pi \leq A \leq 7168.75\pi$$

76. a. The greatest distance the boat can travel between islands is 20 miles, going straight out to a point and then straight to the other island. This is the definition of an ellipse.

b. $(\pm 6, 0)$

c. 20 mi; $(\pm 10, 0)$

d. $b^2 = a^2 - c^2 = (10)^2 - (6)^2 = 100 - 36 = 64$

$$\frac{x^2}{100} + \frac{y^2}{64} = 1$$

77. The distance from one focus to a vertex is $a - c$. The distance from the vertex to the other focus is $a + c$. So the distance from focus to vertex to other focus is $(a + c) + (a - c)$, or $2a$. The distance from each focus to a co-vertex is $\sqrt{b^2 + c^2}$, so from focus to co-vertex to other focus is $2\sqrt{b^2 + c^2}$. By the definition of an ellipse, these distances must be equal, so $2a = 2\sqrt{b^2 + c^2}$, $a^2 = b^2 + c^2$, so $c^2 = a^2 - b^2$.

10.4 Mixed Review (p. 614)

$$78. 125^{2/3} = \sqrt[3]{(125)^2} = \sqrt[3]{(5^3)^2} = \sqrt[3]{5^6} = \sqrt[3]{(5^2)^3} = 5^2 = 25$$

$$79. -8^{5/3} = \sqrt[3]{(-8)^5} = \sqrt[3]{(-8)^3(8)^2} = \sqrt[3]{(-8)^3(4)^3} = -8(4) = -32$$

$$80. 4^{5/2} = \sqrt{4^5} = \sqrt{4^2 \cdot 4^2 \cdot 4} = 4(4)\sqrt{4} = 4(4)(2) = 32$$

$$81. 27^{-2/6} = \frac{1}{(27)^{1/3}} = \frac{1}{\sqrt[3]{27}} = \frac{1}{\sqrt[3]{3^3}} = \frac{1}{3}$$

$$82. 4^{7/2} = \sqrt{4^7} = \sqrt{(4)^2(4)^2(4)^24} = 4(4)(4)\sqrt{4} = 4(4)(4)(2) = 128$$

$$83. 81^{3/4} = \sqrt[4]{(81)^3} = \sqrt[4]{(9^2)^3} \sqrt[4]{(9)^6} = \sqrt[4]{(9)^4(9)^2} = 9\sqrt[4]{(3^2)^2} = 9\sqrt[4]{(3)^4} = 9(3) = 27$$

$$84. 64^{-2/3} = \frac{1}{(64)^{2/3}} = \frac{1}{\sqrt[3]{(64)^2}} = \frac{1}{\sqrt[3]{(8^3)^2}} = \frac{1}{\sqrt[3]{8^6}} = \frac{1}{\sqrt[3]{(8^2)^3} \cdot 8} = \frac{1}{8\sqrt[3]{2^3}} = \frac{1}{8(2)} = \frac{1}{16}$$

$$74. \frac{135}{2} = 67.5$$

$$\frac{110}{2} = 55$$

$$\frac{x^2}{(67.5)^2} + \frac{y^2}{(55)^2} = 1$$

$$85. 32^{4/5} = \sqrt[5]{(32)^4} = \sqrt[5]{(2^5)^4} = \sqrt[5]{(2)^{20}} = \sqrt[5]{(2^4)^5} = (2)^4 = 16$$

$$86. x = 3, y = -2$$

$$y = -\frac{6}{x}$$

$$88. x = 5, y = 1$$

$$y = \frac{5}{x}$$

$$90. x = 9, y = 2$$

$$y = \frac{18}{x}$$

$$87. x = 4, y = 6$$

$$y = \frac{24}{x}$$

$$89. x = 8, y = 9$$

$$y = \frac{72}{x}$$

$$91. x = 0.5, y = 24$$

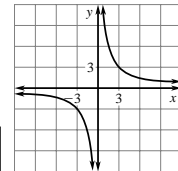
$$y = \frac{12}{x}$$

$$92. f(x) = \frac{9}{x}$$

Domain: $x \neq 0$

Range: $y \neq 0$

x	1	-1	2	-2
y	9	-9	$\frac{9}{2}$	$-\frac{9}{2}$

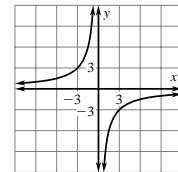


$$93. f(x) = -\frac{9}{x}$$

Domain: $x \neq 0$

Range: $y \neq 0$

x	1	-1	2	-2
y	9	-9	$\frac{9}{2}$	$-\frac{9}{2}$

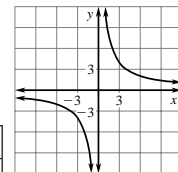


$$94. f(x) = \frac{12}{x}$$

Domain: $x \neq 0$

Range: $y \neq 0$

x	1	-1	2	-2
y	12	-12	6	-6

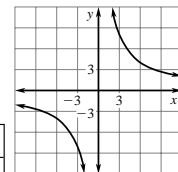


$$95. f(x) = \frac{24}{x}$$

Domain: $x \neq 0$

Range: $y \neq 0$

x	1	-1	2	-2
y	24	-24	12	-12

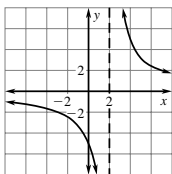


Chapter 10 *continued*

96. $f(x) = \frac{10}{x-2}$

Domain: $x \neq 2$

Range: $y \neq 0$

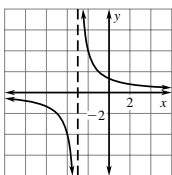


x	0	1	3	-1	-2
y	-5	-110	10	$-\frac{10}{3}$	$-\frac{5}{2}$

97. $f(x) = \frac{4}{x+3}$

Domain: $x \neq -3$

Range: $y \neq 0$



x	0	-2	2	-4	1	-1
y	$\frac{4}{3}$	4	$\frac{4}{5}$	-4	1	2

Lesson 10.5

10.5 Guided Practice (p. 618)

- Vertices; transverse axis
- Both involve all points a certain distance from 2 foci; for an ellipse, the sum of distances is constant; for a hyperbola, the difference is constant.
- Start at the vertices and draw curves that approach but don't meet the asymptotes.

4. $\frac{x^2}{49} - \frac{y^2}{81} = 1$

$$a^2 = 49, b^2 = 81$$

$$\text{so } a = 7, b = 9, 2a = 14, 2b = 18$$

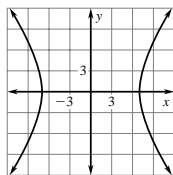
Vertices $(\pm 7, 0)$

$$c^2 = a^2 + b^2 = 49 + 81 = 130$$

$$c = \sqrt{130}$$

Foci: $(\pm \sqrt{130}, 0)$

$$\text{Asymptotes: } y = \pm \frac{b}{a}x = \pm \frac{9}{7}x$$



5. $\frac{y^2}{100} - \frac{x^2}{75} = 1$

$$a^2 = 100, b^2 = 75$$

$$\text{so } a = 10, b = \sqrt{75}$$

$$2a = 10, 2b = 2\sqrt{75}$$

Vertices: $(0, \pm 10)$

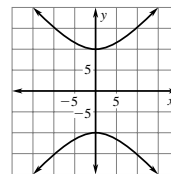
$$c^2 = a^2 + b^2 = 100 + 75 = 175$$

$$c = \sqrt{175} = \pm 5\sqrt{7}$$

Foci: $(0, \pm 5\sqrt{7})$

$$\text{Asymptotes: } y = \pm \frac{a}{b}x = \pm \frac{10}{\sqrt{75}}$$

$$= \pm \frac{10}{5\sqrt{3}} = \pm \frac{2}{\sqrt{3}} = \pm \frac{2\sqrt{3}}{3}$$



6. $\frac{x^2}{64} - y^2 = 1$

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

$$a^2 = 64, b^2 = 1$$

$$\text{so } a = 8, b = 1$$

$$2a = 16, 2b = 2$$

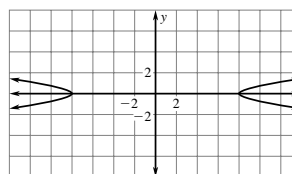
Vertices: $(\pm 8, 0)$

$$c^2 = a^2 + b^2 = 64 + 1 = 65$$

$$c = \sqrt{65}$$

Foci: $(\pm \sqrt{65}, 0)$

$$\text{Asymptotes: } y = \pm \frac{b}{a}x = \pm \frac{1}{8}x$$



7. $36x^2 - 4y^2 = 144$

$$\frac{36x^2}{144} - \frac{4y^2}{144} = \frac{144}{144}$$

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

$$a^2 = 4, b^2 = 36 \text{ so } a = 2, b = 6$$

$$2a = 4, 2b = 12$$

Vertices: $(\pm 2, 0)$

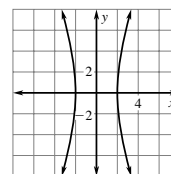
$$c^2 = a^2 + b^2 = 4 + 36 = 40$$

$$c = \sqrt{40} = \pm 2\sqrt{10}$$

Foci: $(\pm 2\sqrt{10}, 0)$

$$\text{Asymptotes: } y = \pm \frac{b}{a}x = \pm \frac{6}{2}x$$

$$= \pm 3x$$



Chapter 10 *continued*

8. $12y^2 - 25x^2 = 300$

$$\frac{12y^2}{300} - \frac{25x^2}{300} = \frac{300}{300}$$

$$\frac{y^2}{25} - \frac{x^2}{12} = 1$$

$$a^2 = 25, b^2 = 12, a = 5, b = \sqrt{12}$$

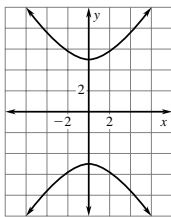
$$2a = 10, 2b = 2\sqrt{12}$$

Vertices: $(0, \pm 5)$

$$c^2 = a^2 + b^2 = 25 + 12 = 37, c = \sqrt{37}$$

Foci: $(0, \pm\sqrt{37})$

$$\begin{aligned} \text{Asymptotes: } y &= \pm \frac{a}{b}x = \pm \frac{5}{\sqrt{12}}x = \pm \frac{5}{2\sqrt{3}}x \\ &= \pm \frac{10\sqrt{3}}{12} = \pm \frac{5\sqrt{3}}{6} \end{aligned}$$



9. $y^2 - 9x^2 = 9$

$$\frac{y^2}{9} - \frac{9x^2}{9} = \frac{9}{9}$$

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

$$a^2 = 9, b^2 = 1, a = 3, b = 1$$

$$2a = 18, 2b = 2$$

Vertices: $(0, \pm 3)$

$$c^2 = a^2 + b^2 = 9 + 1 = 10, c = \sqrt{10}$$

Foci: $(0, \pm\sqrt{10})$

$$\text{Asymptotes: } y = \pm \frac{a}{b}x = \pm \frac{3}{1}x = \pm 3x$$

10. Foci: $(0, -5), (0, 5)$ $c = 5$

Vertices: $(0, -3), (0, 3)$ $a = 3$

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

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

11. Foci: $(-8, 0), (8, 0)$ $c = 8$

Vertices: $(-7, 0), (7, 0)$ $a = 7$

$$b^2 = c^2 - a^2 = 64 - 49 = 15$$

$$\frac{x^2}{49} - \frac{y^2}{15} = 1$$

12. Foci: $(-\sqrt{34}, 0), (\sqrt{34}, 0)$ $c = \sqrt{34}$

Vertices: $(-5, 0), (5, 0)$ $a = 5$

$$b^2 = c^2 - a^2 = 34 - 25 = 9$$

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

13. Foci: $(0, -9), (0, 9)$ $c = 9$

Vertices: $(0, -3\sqrt{5}), (0, 3\sqrt{5})$ $a = 3\sqrt{5}$

$$b^2 = c^2 - a^2 = 81 - 45 = 36$$

$$\frac{y^2}{45} - \frac{x^2}{36} = 1$$

14. $a^2 = 25, b^2 = 9, a = 5, b = 3$

$$c^2 = a^2 + b^2 = 25 + 9 = 34, c = \sqrt{34}$$

Vertices: $(\pm 5, 0)$

Foci: $(\pm\sqrt{34}, 0)$

lens at $(-\sqrt{34}, 0)$

Vertex: $(5, 0)$

distance between points is

$$5 - (-\sqrt{34}) = 5 + \sqrt{34} \approx 10.8 \text{ in.}$$

Practice and Applications (pp. 618–620)

15. $\frac{x^2}{16} - \frac{y^2}{4} = 1$ C 16. $\frac{y^2}{4} - \frac{x^2}{2} = 1$ A

17. $\frac{y^2}{16} - \frac{x^2}{4} = 1$ D 18. $\frac{x^2}{4} - \frac{y^2}{2} = 1$ B

19. $36x^2 - 9y^2 = 324$ 20. $y^2 - 81x^2 = 81$

$$\frac{36x^2}{324} - \frac{9y^2}{324} = \frac{324}{324}$$

$$\frac{y^2}{81} - \frac{81x^2}{81} = \frac{81}{81}$$

$$\frac{x^2}{9} - \frac{y^2}{36} = 1$$

$$\frac{y^2}{81} - x^2 = 1$$

21. $36y^2 - 4x^2 = 9$

$$\frac{36y^2}{9} - \frac{4x^2}{9} = \frac{9}{9}$$

$$4y^2 - \frac{4}{9}x^2 = 1$$

$$\left(\frac{1}{4}\right)\left(4y^2 - \frac{4}{9}x^2\right) = 1\left(\frac{1}{4}\right)$$

$$\left(\frac{1}{4}\right) - \left(\frac{1}{9}\right) = 1$$

Chapter 10 *continued*

22. $16y^2 - 36x^2 + 9 = 0$

$$16y^2 - 36x^2 = -9$$

$$\frac{16y^2}{(-9)} - \frac{36x^2}{(-9)} = \left(\frac{-9}{-9}\right)$$

$$4x^2 - \frac{16y^2}{9} = 1$$

$$\left(\frac{1}{16}\right)\left(\frac{16}{1}\right)\left(4x^2 - \frac{16y^2}{9}\right) = 1\left(\frac{1}{16}\right)\left(\frac{16}{1}\right)$$

$$\frac{\frac{1}{4}x^2}{\frac{1}{16}} - \frac{y^2}{\frac{9}{16}} = 1$$

$$\left(\frac{4}{4}\right)\left(\frac{1}{4}\right)\left(\frac{4x^2}{1} - \frac{y^2}{\frac{9}{16}}\right) = 1\left(\frac{4}{4}\right)$$

$$\frac{x^2}{\left(\frac{1}{4}\right)} - \frac{y^2}{\left(\frac{9}{16}\right)} = 1$$

23. $y^2 - \frac{x^2}{36} = 4$

$$\frac{y^2}{4} - \frac{x^2}{36 \cdot 4} = \frac{4}{4}$$

$$\frac{y^2}{4} - \frac{x^2}{144} = 1$$

24. $\frac{x^2}{9} - \frac{4y^2}{9} = 9$

$$\frac{x^2}{9(9)} - \frac{4y^2}{9(9)} = \frac{9}{9}$$

$$\frac{x^2}{81} - \frac{4y^2}{81} = 1$$

$$\left(\frac{1}{4}\right)\left(\frac{1}{1}\right)\left(\frac{x^2}{81} - \frac{4y^2}{81}\right) = 1\left(\frac{1}{4}\right)\left(\frac{1}{1}\right)$$

$$\frac{x^2}{81} - \frac{y^2}{\left(\frac{81}{4}\right)} = 1$$

25. $\frac{x^2}{9} - \frac{y^2}{64} = 1$

$$a^2 = 9, a = 3$$

$$\text{Vertices: } (\pm 3, 0)$$

$$b^2 = 64, b = 8$$

$$c^2 = a^2 + b^2 = 9 + 64 = 73$$

$$c = \sqrt{73}$$

$$\text{Foci: } (\pm\sqrt{73}, 0)$$

26. $\frac{y^2}{49} - x^2 = 1$

$$a^2 = 49, a = 7$$

$$\text{Vertices: } (0, \pm 7)$$

$$b^2 = 1, b = 1$$

$$c^2 = a^2 + b^2 = 49 + 1 = 50$$

$$c = \sqrt{50}$$

$$\text{Foci: } (0, \pm\sqrt{50})$$

27. $\frac{x^2}{121} - \frac{y^2}{4} = 1$

$$a^2 = 121, a = 11$$

$$\text{Vertices: } (\pm 11, 0)$$

$$b^2 = 4, b = 2$$

$$c^2 = a^2 + b^2 = 121 + 4 = 125$$

$$c = 5\sqrt{5}$$

$$\text{Foci: } (\pm 5\sqrt{5}, 0)$$

28. $4y^2 - 81x^2 = 324$

$$\frac{4y^2}{324} - \frac{81x^2}{324} = \frac{324}{324}$$

$$\frac{y^2}{81} - \frac{x^2}{4} = 1$$

$$a^2 = 81, a = 9$$

$$\text{Vertices: } (0, \pm 9)$$

$$b^2 = 4, b = 2$$

$$c^2 = a^2 + b^2 = 81 + 4 = 85$$

$$c = \sqrt{85}$$

$$\text{Foci: } (0, \pm\sqrt{85})$$

29. $25y^2 - 4x^2 = 100$

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

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

$$a^2 = 4, a = 2$$

$$\text{Vertices: } (0, \pm 2)$$

$$b^2 = 25, b = 5$$

$$c^2 = a^2 + b^2 = 4 + 25 = 29$$

$$c = \sqrt{29}$$

$$\text{Foci: } (0, \pm\sqrt{29})$$

30. $36x^2 - 10y^2 = 360$

$$\frac{36x^2}{360} - \frac{10y^2}{360} = \frac{360}{360}$$

$$\frac{x^2}{10} - \frac{y^2}{36} = 1$$

$$a^2 = 10, a = \sqrt{10}$$

$$\text{Vertices: } (\pm\sqrt{10}, 0)$$

Chapter 10 continued

30. —CONTINUED—

$$b^2 = 36, b = 6$$

$$c^2 = a^2 + b^2 = 10 + 36 = 46$$

$$c = \sqrt{46}$$

$$\text{Foci: } (\pm\sqrt{46}, 0)$$

$$31. \frac{x^2}{25} - \frac{y^2}{121} = 1$$

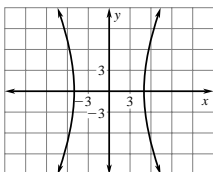
$$a^2 = 25, b^2 = 121, a = 5, b = 11$$

$$c^2 = a^2 + b^2 = 25 + 121 = 146$$

$$c = \sqrt{146}$$

$$\text{Foci: } (\pm\sqrt{146}, 0)$$

$$\text{Asymptotes: } y = \pm\frac{11}{5}x$$



$$32. \frac{x^2}{36} - y^2 = 1$$

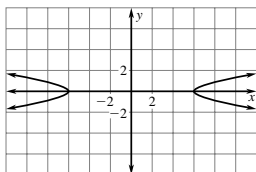
$$a^2 = 36, a = 6, b^2 = 1, b = 1$$

$$c^2 = a^2 + b^2 = 36 + 1 = 37$$

$$c = \sqrt{37}$$

$$\text{Foci: } (\pm\sqrt{37}, 0)$$

$$\text{Asymptotes: } y = \pm\frac{1}{6}x$$



$$33. \frac{y^2}{25} - \frac{x^2}{49} = 1$$

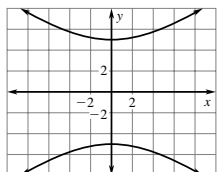
$$a^2 = 25, a = 5, b^2 = 49, b = 7$$

$$c^2 = a^2 + b^2 = 25 + 49 = 74$$

$$c = \sqrt{74}$$

$$\text{Foci: } (0, \pm\sqrt{74})$$

$$\text{Asymptotes: } y = \pm\frac{5}{7}x$$



$$34. \frac{y^2}{9} - \frac{x^2}{100} = 1$$

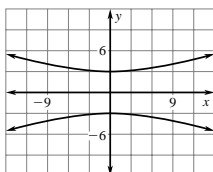
$$a^2 = 9, a = 3, b^2 = 100, b = 10$$

$$c^2 = a^2 + b^2 = 9 + 100 = 109$$

$$c = \sqrt{109}$$

$$\text{Foci: } (0, \pm\sqrt{109})$$

$$\text{Asymptotes: } y = \pm\frac{3}{10}x$$



$$35. \frac{x^2}{169} - \frac{y^2}{16} = 1$$

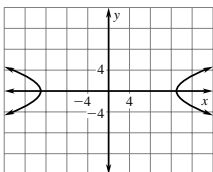
$$a^2 = 169, a = 13, b^2 = 16, b = 4$$

$$c^2 = a^2 + b^2 = 169 + 16 = 185$$

$$c = \sqrt{185}$$

$$\text{Foci: } (\pm\sqrt{185}, 0)$$

$$\text{Asymptotes: } y = \pm\frac{4}{13}x$$



$$36. \frac{y^2}{64} - x^2 = 1$$

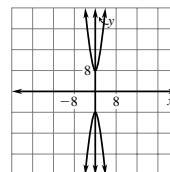
$$a^2 = 64, a = 8, b^2 = 1, b = 1$$

$$c^2 = a^2 + b^2 = 64 + 1 = 65$$

$$c = \sqrt{65}$$

$$\text{Foci: } (0, \pm\sqrt{65})$$

$$\text{Asymptotes: } y = \pm\frac{8}{1}x = \pm 8x$$



$$37. \frac{16x^2}{25} - \frac{y^2}{81} = 1$$

$$\left(\frac{1}{16}\right)\left(\frac{16x^2}{25} - \frac{y^2}{81}\right) = 1\left(\frac{1}{16}\right)$$

$$\frac{x^2}{\left(\frac{25}{16}\right)} - \frac{y^2}{81} = 1$$

$$a^2 = \frac{25}{16}, a = \frac{5}{4}, b^2 = 81, b = 9$$

$$c^2 = a^2 + b^2 = \frac{25}{16} + 81 = \frac{25}{16} + \frac{1296}{16} = \frac{1321}{16}$$

$$c = \frac{\sqrt{1321}}{4}$$

$$\text{Foci: } \left(\pm\frac{\sqrt{1321}}{4}, 0\right)$$

$$\text{Asymptotes: } y = \pm\frac{9}{\frac{5}{4}}x = \pm\frac{36}{5}x$$

$$y = \frac{9}{1} \cdot \left(\frac{4}{5}\right)x$$

$$y = \pm\frac{36}{5}x$$

$$38. \frac{x^2}{144} - \frac{y^2}{121} = 1$$

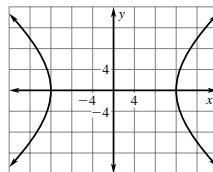
$$a^2 = 144, a = 12, b^2 = 121, b = 11$$

$$c^2 = a^2 + b^2 = 144 + 121 = 265$$

$$c = \sqrt{265}$$

$$\text{Foci: } (\pm\sqrt{265}, 0)$$

$$\text{Asymptotes: } y = \pm\frac{11}{12}x$$



Chapter 10 *continued*

39. $\frac{x^2}{64} - \frac{9y^2}{4} = 1$

$$\left(\frac{1}{9}\right)\left(\frac{x^2}{64} - \frac{9y^2}{4}\right) = 1\left(\frac{1}{9}\right)$$

$$\frac{x^2}{64} - \frac{y^2}{\left(\frac{4}{9}\right)} = 1$$

$$a^2 = 64, a = 8, b^2 = \frac{4}{9}, b = \frac{2}{3}$$

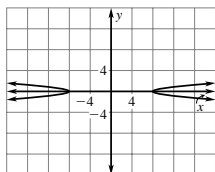
$$c^2 = a^2 + b^2 = 64 + \frac{4}{9} = \frac{576}{9} + \frac{4}{9} = \frac{580}{9}$$

$$c = \frac{\sqrt{580}}{3}$$

$$\text{Foci: } \left(\pm \frac{\sqrt{580}}{3}, 0\right)$$

$$\text{Asymptotes: } y = \pm \frac{2}{8}x$$

$$y = \pm \frac{2}{8}\left(\frac{1}{8}\right)x = \pm \frac{1}{12}x$$



40. $\frac{y^2}{25} - \frac{x^2}{16} = 16$

$$\frac{y^2}{25(16)} - \frac{x^2}{16(16)} = \frac{16}{16}$$

$$\frac{y^2}{400} - \frac{x^2}{256} = 1$$

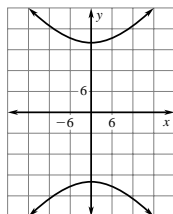
$$a^2 = 400, a = 20, b^2 = 256, b = 16$$

$$c^2 = a^2 + b^2 = 400 + 256 = 656$$

$$c = \sqrt{656} = \sqrt{16 \cdot 41} = 4\sqrt{41}$$

$$\text{Foci: } (0, \pm 4\sqrt{41})$$

$$\text{Asymptotes: } y = \pm \frac{20}{16}x = \pm \frac{5}{4}x$$



41. $100x^2 - 81y^2 = 8100$

$$\frac{100x^2}{8100} - \frac{81y^2}{8100} = \frac{8100}{8100}$$

$$\frac{x^2}{81} - \frac{y^2}{100} = 1$$

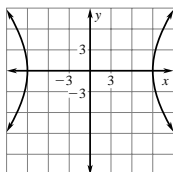
$$a^2 = 81, a = 9, b^2 = 100, b = 10$$

$$c^2 = a^2 + b^2 = 81 + 100 = 181$$

$$c = \sqrt{181}$$

$$\text{Foci: } (\pm \sqrt{181}, 0)$$

$$\text{Asymptotes: } y = \pm \frac{10}{9}x$$



42. $x^2 - 9y^2 = 25$

$$\frac{x^2}{25} - \frac{9y^2}{25} = \frac{25}{25}$$

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

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

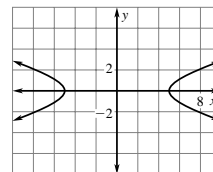
$$a^2 = 25, a = 5, b^2 = \frac{25}{9}, b = \frac{5}{3}$$

$$c^2 = a^2 + b^2 = 25 + \frac{25}{9} = \frac{225}{9} + \frac{25}{9} = \frac{250}{9}$$

$$c = \frac{\sqrt{250}}{3} = \frac{5\sqrt{10}}{3}$$

$$\text{Foci: } \left(\pm \frac{5\sqrt{10}}{3}, 0\right)$$

$$\text{Asymptotes: } y = \pm \frac{5}{3}x = \pm \frac{5}{3}\left(\frac{1}{5}\right)x = \pm \frac{1}{3}x$$



43. $\frac{y^2}{144} = \frac{x^2}{100} + 1$

$$y^2 = \frac{144x^2}{100} + 144$$

$$y = \pm \sqrt{\frac{144x^2 + 14,400}{100}} = \pm \frac{12\sqrt{x^2 + 100}}{10}$$

$$= \pm \frac{6\sqrt{x^2 + 100}}{5}$$

44. $\frac{y^2}{25} = \frac{x^2}{16} - 1$

$$y^2 = \frac{25x^2}{16} - 25$$

$$y = \pm \sqrt{\frac{25x^2 - 400}{16}} = \pm \frac{5\sqrt{x^2 - 16}}{4}$$

45. $\frac{y^2}{72.25} = \frac{x^2}{42.25} - 1$

$$y^2 = \frac{72.25x^2}{42.25} - 72.25$$

$$y = \pm \sqrt{\frac{72.25x^2 - 3052.5625}{42.25}}$$

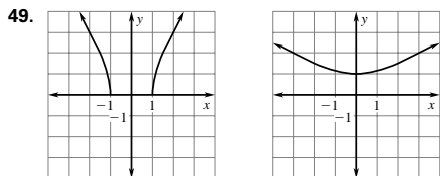
$$= \pm \frac{8.5\sqrt{x^2 - 42.25}}{6.5}$$

Chapter 10 *continued*

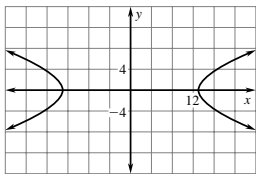
46. $\frac{y^2}{2.73} = \frac{x^2}{3.58} + 1$
 $y^2 = \frac{2.73x^2}{3.58} + 2.73$
 $y = \pm \sqrt{\frac{2.73(x^2 + 3.58)}{3.58}}$

47. $\frac{y^2}{22.3} = \frac{x^2}{10.1} - 1$
 $y^2 = \frac{22.3x^2}{10.1} - 22.3$
 $y = \pm \sqrt{\frac{22.3(x^2 - 10.1)}{10.1}}$

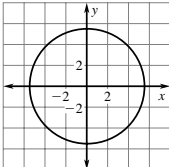
48. $12x^2 - 85y^2 = 46$
 $85y^2 = 12x^2 - 46$
 $y^2 = \frac{12x^2 - 46}{85}$
 $y = \pm \sqrt{\frac{12x^2 - 46}{85}}$



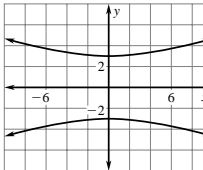
50. $\frac{x^2}{169} - \frac{y^2}{25} = 1$
 $a^2 = 169, a = 13, b^2 = 25, b = 5$
 $c^2 = a^2 + b^2 = 169 + 25 = 194$
 $c = \sqrt{194}$
 Foci: $(\pm\sqrt{194}, 0)$
 Asymptotes: $y = \pm \frac{5}{13}x$



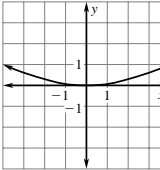
51. $x^2 + y^2 = 30$
 $r = \sqrt{30} \approx 5.48$



52. $\frac{y^2}{9} - \frac{x^2}{64} = 1$
 $a^2 = 9, a = 3, b^2 = 64, b = 8$
 $c^2 = a^2 + b^2 = 9 + 64 = 73$
 $c = \sqrt{73}$
 Foci: $(0, \pm\sqrt{73})$
 Asymptotes: $y = \pm \frac{3}{8}x$

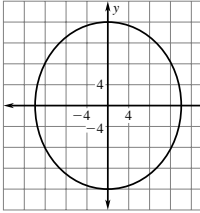


53. $x^2 = 15y$
 $4p = 15$
 $p = \frac{15}{4}$
 Focus: $(0, \frac{15}{4})$
 Directrix: $y = -\frac{15}{4}$
 $p > 0$ parabola opens up

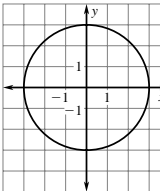


x	1	2	3
y	± 3.9	± 5.5	± 6.7

54. $\frac{x^2}{196} + \frac{y^2}{256} = 1$
 $c^2 = a^2 - b^2$
 $c^2 = 16 - 14 = 2$
 $c = \sqrt{2}$
 Vertices: $(0, \pm 16)$
 Co-vertices: $(\pm 14, 0)$
 Foci: $(0, \pm\sqrt{2})$



55. $14x^2 + 14y^2 = 126$
 $\frac{14x^2}{126} + \frac{14y^2}{126} = \frac{126}{126}$
 $\frac{x^2}{9} + \frac{y^2}{9} = 1$
 $x^2 + y^2 = 9$
 $r = 3$



56. Foci: $(0, -13), (0, 13)$ $c = 13$
 Vertices: $(0, -5), (0, 5)$ $a = 5$
 $b^2 = c^2 - a^2 = 169 - 25 = 144$
 $\frac{y^2}{25} - \frac{x^2}{144} = 1$

Chapter 10 *continued*

57. Foci: $(-8, 0), (8, 0)$ $c = 8$

Vertices: $(-6, 0), (6, 0)$ $a = 6$

$$b^2 = c^2 - a^2 = 64 - 36 = 28,$$

$$\frac{x^2}{36} - \frac{y^2}{28} = 1$$

58. Foci: $(-4, 0), (4, 0)$ $c = 4$

Vertices: $(-1, 0), (1, 0)$ $a = 1$

$$b^2 = c^2 - a^2 = 16 - 1 = 15,$$

$$x^2 - \frac{y^2}{15} = 1$$

59. Foci: $(-6, 0), (6, 0)$ $c = 6$

Vertices: $(-5, 0), (5, 0)$ $a = 5$

$$b^2 = c^2 - a^2 = 36 - 25 = 11,$$

$$\frac{x^2}{25} - \frac{y^2}{11} = 1$$

60. Foci: $(0, -7), (0, 7)$ $c = 7$

Vertices: $(0, -3), (0, 3)$, $a = 3$

$$b^2 = c^2 - a^2 = 49 - 9 = 40,$$

$$\frac{y^2}{9} - \frac{x^2}{40} = 1$$

61. Foci: $(0, -9), (0, 9)$ $c = 9$

Vertices: $(0, -8), (0, 8)$, $a = 8$

$$b^2 = c^2 - a^2 = 81 - 64 = 17$$

$$\frac{y^2}{64} - \frac{x^2}{17} = 1$$

62. Foci: $(-8, 0), (8, 0)$ $c = 8$

Vertices: $(-4\sqrt{3}, 0), (4\sqrt{3}, 0)$ $a = 4\sqrt{3}$

$$b^2 = c^2 - a^2 = 64 - 48 = 16$$

$$\frac{x^2}{48} - \frac{y^2}{16} = 1$$

63. Foci: $(0, -5\sqrt{6}), (0, 5\sqrt{6})$ $c = 5\sqrt{6}$

Vertices: $(0, -4), (0, 4)$ $a = 4$

$$b^2 = c^2 - a^2 = 150 - 16 = 134$$

$$\frac{y^2}{16} - \frac{x^2}{134} = 1$$

64. $355 - 266 = 89$, $a = 89$, $355 - 207 = 148$, $c = 148$

$$b^2 = c^2 - a^2 = (148)^2 - (89)^2 = 21,904 - 7921$$

$$= 13,983$$

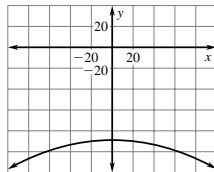
$$\frac{y^2}{7921} - \frac{x^2}{13,983} = 1$$

65. $419 - 355 = 64$, $c = 64$, $387 - 355 = 32$, $a = 32$

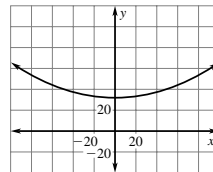
$$b^2 = c^2 - a^2 = (64)^2 - (32)^2 = 4096 - 1024 = 3072$$

$$\frac{y^2}{1024} - \frac{x^2}{3072} = 1$$

66. lower branch summer solstice



upper branch winter solstice



67. $\frac{x^2}{100} - \frac{y^2}{4} = 1$, $a = 10$, $b = 2$, $a^2 = 100$, $b^2 = 4$

Because the x^2 -term is positive, the transverse axis is horizontal and the vertices are at $(-10, 0), (10, 0)$ so the shortest horizontal distance is 10 miles.

68. a. Area of circle = πr^2

$$\text{Area of inner circle} = \pi x^2$$

$$\text{Area of outer circle} = \pi y^2$$

$$\text{Ring with area } 2\text{in.}^2: \pi y^2 - \pi x^2 = 4$$

- b. $(1.65, 2)$, $y - x = 2 - 1.65 = 0.35$ in.

$$\pi(2)^2 - \pi(1.65)^2 = 4$$

$$\pi(4) - \pi(2.7225) = 4$$

$$12.56 - 8.56 = 4$$

- $(2.23, 2.5)$, $y - x = 2.5 - 2.23 = 0.27$ in.

$$\pi(2.5)^2 - \pi(2.23)^2 = 4$$

$$\pi(6.25) - \pi(4.9729) = 4$$

$$19.63 - 15.63 = 4$$

- $(1.34, 1.75)$, $y - x = 1.75 - 1.34 = 0.41$ in.

$$\pi(1.75)^2 - \pi(1.34)^2 = 4$$

$$\pi(3.0625) - \pi(1.7956) = 4$$

$$9.62 - 5.64 = 3.98 \approx 4$$

- c. It decreases; the larger the outer circle of the ring, the more narrow the ring must become to keep the same area. If the inner circle is pushed out, so is the outer circle.

69. $d_2 - d_1$ is a constant by the definition of a hyperbola.

$$\text{Find } d_2 - d_1 \text{ at } (a, 0); d_2 - d_1 = (c + a) - (c - a) = c + a - c + a = 2a$$

70. No; You could create a branch of a hyperbola such that microphone A is a constant 2200 feet farther than microphone B. The sound from any point on that branch would reach microphone A 2 seconds later. However, you would need more information to decide which point on the branch was the source of the sound.

Chapter 10 *continued*

10.5 Mixed Review (p. 621)

71. $y = 2|x + 4| + 1$

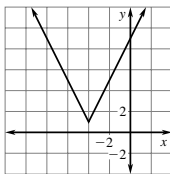
$x + 4 = 0$

$x = -4$

$y = 2|-4 + 4| + 1$

$y = 1$

Vertex: $(-4, 1)$



x	-7	-6	-5	-4	-3	-2	-1
y	7	5	3	1	3	5	7

72. $y = |x - 4| + 5$

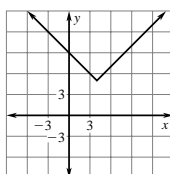
$x - 4 = 0$

$x = 4$

$y = |4 - 4| + 5$

$y = 5$

Vertex: $(4, 5)$



x	1	2	3	4	5	6	7
y	8	7	6	5	6	7	8

73. $y = -|x - 6| - 8$

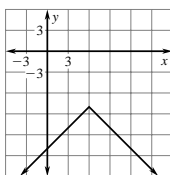
$x - 6 = 0$

$x = 6$

$y = -|6 - 6| - 8$

$y = -8$

Vertex: $(6, -8)$



x	3	4	5	6	7	8	9
y	-11	-10	-9	-8	-9	-10	-11

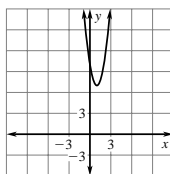
74. $y = 3(x - 1)^2 + 7$

$a = 3, a > 0$

curve opens up

Vertex = $(1, 7)$

Axis of symmetry: $x = 1$



x	2	0	3	-1
y	10	10	19	19

75. $y = -2(x - 3)^2 - 6$

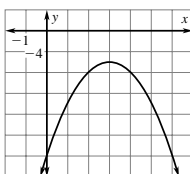
$a = -2$

$a < 0$

curve opens down

Vertex = $(3, -6)$

Axis of symmetry: $x = 3$



x	2	4	1	5
y	-8	-8	-14	-14

76. $y = \frac{1}{2}(x + 4)^2 + 5$

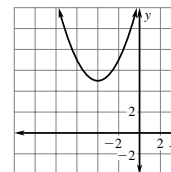
$a = \frac{1}{2}$

$a > 0$

Vertex = $(-4, 5)$

curve opens up

Axis of symmetry: $x = -4$



x	-2	-3	-5	-6
y	7	5.5	5.5	7

77. 3, 1, 2; $f(x) = x^3 - 6x^2 + 11x - 6$

$c = 6$ or -6

78. $-7, -1, 3$; $f(x) = x^3 + 5x^2 - 17x - 21$

$c = 21$ or -21

79. 6, $-2, 2$; $f(x) = x^3 - 6x^2 - 4x + 24$

$c = 24$ or -24

80. $-6, 4, 2$; $f(x) = x^3 - 28x + 48$

$c = 48$ or -48

81. 5, $i, -i$; $f(x) = x^3 - 5x^2 + x - 5$

$c = 5$ or -5

82. 3, $-3, 2i$; $f(x) = x^4 - 5x^2 - 36$

$c = 36$ or -36

83. $\log 10,000$; $10^x = 10,000$ so $10^4 = 10,000$; $x = 4$

84. $\log_3 27$; $3^x = 27$ so $x = 3$

85. $\log_5 625$; $5^x = 625$ so $x = 4$

86. $\log_2 128$; $2^x = 128$ so $x = 7$

87. $\log_4 64$; $4^x = 64$ so $x = 3$

88. $\log_3 243$; $3^x = 243$ so $x = 5$

89. $\log_6 216$; $6^x = 216$ so $x = 3$

90. $\log_{100} 100,000,000$; $100^x = 100,000,000$ so $x = 4$

91. 63, 67, 72, 75, 77, 78, 81, 81, 85, 86, 89, 91, 92, 99

Mean = 81.67; Median = 81; Modes: 81, 89

Range: $99 - 63 = 36$

Quiz 2 (p. 621)

1. Vertex: $(0, 7)$

2. Vertex: $(-6, 0)$

Co-vertex: $(-3, 0)$

Co-vertex: $(0, -1)$

$\frac{x^2}{9} + \frac{y^2}{49} = 1$

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

3. Vertex: $(-10, 0)$ $a = -10$

Focus: $(6, 0)$ $c = 6$

$b^2 = a^2 - c^2 = 100 - 36 = 64$

$b = 8$

$\frac{x^2}{100} + \frac{y^2}{64} = 1$

Chapter 10 *continued*

4. Vertex: $(0, 5)$ $a = 5$

$$\text{Focus: } (0, \sqrt{17}) \quad c = \sqrt{17}$$

$$b^2 = a^2 - c^2 = 25 - 17 = 8$$

$$\frac{x^2}{8} + \frac{y^2}{25} = 1$$

5. Co-vertex: $(0, 2\sqrt{3})$ $b = 2\sqrt{3}$

$$\text{Focus: } (-\sqrt{3}, 0) \quad c = -\sqrt{3}$$

$$a^2 = c^2 + b^2 = 3 + 12 = 15$$

$$\frac{x^2}{15} + \frac{y^2}{12} = 1$$

6. Co-vertex: $(-9, 0)$ $b = 9$

$$\text{Focus: } (0, 4) \quad c = 4$$

$$a^2 = c^2 + b^2 = 16 + 81 = 97$$

$$\frac{x^2}{81} + \frac{y^2}{97} = 1$$

7. $\frac{x^2}{4} + \frac{y^2}{49} = 1$

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

$$c^2 = 49 - 4$$

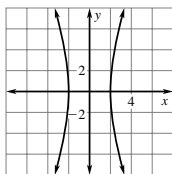
$$c^2 = 45$$

$$c = 3\sqrt{5}$$

$$\text{Vertices: } (0, \pm 7)$$

$$\text{Co-vertices: } (\pm 2, 0)$$

$$\text{Foci: } (0, \pm 3\sqrt{5})$$



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

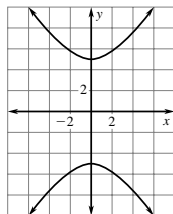
$$c^2 = a^2 - b^2 = 6 - 1 = 5$$

$$c = \sqrt{5}$$

$$\text{Vertices: } (\pm\sqrt{6}, 0)$$

$$\text{Co-vertices: } (0, \pm 1)$$

$$\text{Foci: } (\pm\sqrt{5}, 0)$$



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

$$\frac{x^2}{36} + \frac{9y^2}{36} = \frac{36}{36}$$

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

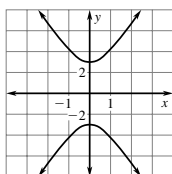
$$c^2 = a^2 - b^2 = 36 - 4 = 32$$

$$c = \sqrt{32}$$

$$\text{Vertices: } (\pm 6, 0)$$

$$\text{Co-vertices: } (0, \pm 2)$$

$$\text{Foci: } (\pm\sqrt{32}, 0)$$



10. Foci: $(0, -8), (0, 8)$ $c = 8$

$$\text{Vertices: } (0, 5), (0, -5) \quad a = 5$$

$$b^2 = c^2 - a^2 = 64 - 25 = 39$$

$$\frac{y^2}{25} - \frac{x^2}{39} = 1$$

11. Foci: $(-3, 0), (3, 0)$ $c = 3$

$$\text{Vertices: } (-1, 0), (1, 0) \quad a = 1$$

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

$$x^2 - \frac{y^2}{8} = 1$$

12. Foci: $(-6, 0), (6, 0)$ $c = 6$

$$b^2 = c^2 - a^2 = 36 - 16 = 20$$

$$\text{Vertices: } (-4, 0), (4, 0) \quad a = 4$$

$$\frac{x^2}{16} - \frac{y^2}{20} = 1$$

13. Foci: $(0, -2\sqrt{5}), (0, 2\sqrt{5})$ $c = 2\sqrt{5}$

$$\text{Vertices: } (0, -4), (0, 4)$$

$$b^2 = c^2 - a^2 = 20 - 16 = 4 \quad a = 4$$

$$\frac{y^2}{16} - \frac{x^2}{4} = 1$$

14. $\frac{y^2}{25} - \frac{x^2}{36} = 1$

$$a^2 = 25, a = 5, b^2 = 36, b = 6$$

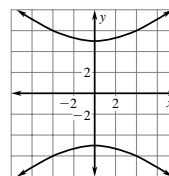
$$c^2 = a^2 + b^2 = 25 + 36 = 61$$

$$c = \sqrt{61}$$

$$\text{Vertices: } (0, \pm 5)$$

$$\text{Foci: } (0, \pm\sqrt{61})$$

$$\text{Asymptotes: } y = \pm \frac{a}{b}x = \pm \frac{5}{6}x$$



15. $8y^2 - 20x^2 = 160$

$$\frac{8y^2}{160} - \frac{20x^2}{160} = \frac{160}{160}$$

$$\frac{y^2}{20} - \frac{x^2}{8} = 1$$

$$a^2 = 20, a = \sqrt{20}, b^2 = 8,$$

$$b = \sqrt{8}$$

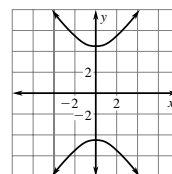
$$c^2 = a^2 + b^2 = 20 + 8 = 28; \quad c = \sqrt{28}$$

$$\text{Vertices: } (0, \pm 2\sqrt{5})$$

$$\text{Foci: } (0, \pm 2\sqrt{7})$$

$$\text{Asymptotes: } y = \pm \frac{\sqrt{20}}{\sqrt{8}} = \pm \frac{\sqrt{160}}{8} = \pm \frac{4\sqrt{10}}{8}$$

$$= \pm \frac{\sqrt{10}}{2}$$



Chapter 10 *continued*

16. $18x^2 - 4y^2 = 36$

$$\frac{18x^2}{36} - \frac{4y^2}{36} = \frac{36}{36}$$

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

$$a^2 = 2, a = \sqrt{2}$$

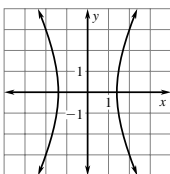
$$b^2 = 9, b = 3$$

$$c^2 = a^2 + b^2 = 2 + 9 = 11, c = \sqrt{11}$$

$$\text{Vertices: } (\pm\sqrt{2}, 0)$$

$$\text{Foci: } (\pm\sqrt{11}, 0)$$

$$\text{Asymptotes: } y = \pm \frac{3}{\sqrt{2}}x = \pm \frac{3\sqrt{2}}{2}x$$



17. $a - c = 4150$

$$a + c = 4600$$

$$2a = 8750$$

$$a = 4375$$

$$a + c = 4600$$

$$4375 + c = 4600$$

$$c = 225$$

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

$$b = \sqrt{a^2 - c^2}$$

$$b = \sqrt{(4375)^2 - (225)^2}$$

$$b = \sqrt{19,140,625 - 50,625}$$

$$b = \sqrt{19,090,000}$$

$$b \approx 4369$$

$$\frac{x^2}{4375^2} + \frac{y^2}{4369^2} = 1 \quad \text{where } x \text{ and } y \text{ are in miles}$$

Lesson 10.6

Developing Concepts Activity 10.6 (p. 622)

- Answers will vary; expect different equations, different size flashlight beams may be used and/or people may shine the flashlights at different angles to the graph paper.
- Answers will vary; expect different equations.

10.6 Guided Practice (p. 628)

- All are formed by intersecting a plane and a double-napped cone.
- They are each circles of radius 5; the first is centered at $(0, 0)$ and the second at $(1, -2)$.
- If the discriminant is greater than 0, it is a hyperbola. If it is 0, it is a parabola. If it is less than 0, it is a circle or an ellipse; a circle if $A = C$, an ellipse if $A \neq C$.
- $(x - 4)^2 + (y + 1)^2 = 49$

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

$$(h, k) = \left(\frac{8 + (-1)}{2}, \frac{-4 + (-4)}{2} \right)$$

$$(h, k) = (3.5, -4)$$

$$a = \sqrt{(-1 - 3.5)^2 + (-4 + 4)^2} = \sqrt{20.25 + 0} = 4.5$$

$$a^2 = 20.25$$

$$c = \sqrt{(2 - 3.5)^2 + (-4 + 4)^2} = \sqrt{2.25 + 0} = 1.5$$

$$c^2 = 2.25$$

$$b^2 = a^2 - c^2 = 20.25 - 2.25 = 18$$

$$b = \sqrt{18} = \sqrt{2 \cdot 9} = 3\sqrt{2}$$

$$\frac{(x - 3.5)^2}{20.25} + \frac{(y + 4)^2}{18} = 1$$

6. $(x - h)^2 = 4p(y - k)$

where $p < 0$ vertex at $(3, -2)$, so $h = 3$, and $k = -2$

$$|p| = \sqrt{(3 - 3)^2 + [-4 - (-2)]^2}$$

$$|p| = \sqrt{0 + 4} = 2$$

Since $p < 0$, $p = -2$.

$$(x - 3)^2 = -8(y + 2)$$

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

$$(h, k) = \left(\frac{5 + 5}{2}, \frac{0 + (-4)}{2} \right)$$

$$(h, k) = (5, -2)$$

$$a = \sqrt{(5 - 5)^2 + (0 + 2)^2}$$

$$a = \sqrt{4} = 2$$

$$c = \sqrt{(5 - 5)^2 + (2 + 2)^2}$$

$$c = \sqrt{16} = 4$$

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

$$b^2 = 16 - 4 = 12$$

$$b = 2\sqrt{3}$$

$$\frac{(y + 2)^2}{4} - \frac{(x - 5)^2}{12} = 1$$

8. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0$$

parabola

9. $A = 3, B = 0, C = -5$

$$B^2 - 4AC = 0^2 - 4(3)(-5) = 60$$

$$B^2 - 4AC > 0$$

hyperbola

Chapter 10 *continued*

10. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0$$

$$B = 0, A = C$$

circle

11. $A = -5, B = 0, C = -2$

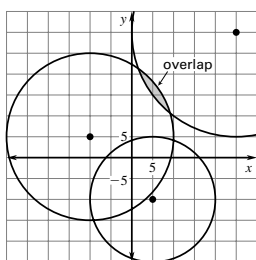
$$B^2 - 4AC = 0^2 - 4(-5)(-2) = -40$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

12. yes;



10.6 Practice and Applications (pp. 628–630)

13. $(x - h)^2 + (y - k)^2 = r^2$ 14. $(x - h)^2 + (y - k)^2 = r^2$
 $(x - 9)^2 + (y - 3)^2 = 16$ $(x + 4)^2 + (y - 2)^2 = 9$

15. parabola opens up

$$(x - h)^2 = 4p(y - k)$$

Vertex: $(1, -2)$ so $h = 1, k = -2$

$$|p| = \sqrt{(1 - 1)^2 + (1 + 2)^2} = \sqrt{9} = \pm 3$$

$$p > 0, p = 3$$

$$(x - 1)^2 = 4(3)(y + 2)$$

$$(x - 1)^2 = 12(y + 2)$$

16. $|p| = \sqrt{(-8 + 3)^2 + (1 - 1)^2} = \sqrt{25} = 5$

$$p > 0, p = 5$$

horizontal axis of symmetry $y = 1$

vertex $(-3, 1)$ so $h = -3, k = 1$

$$(y - k)^2 = 4p(x - h)$$

$$(y - 1)^2 = 4(5)(x + 3)$$

$$(y - 1)^2 = 20(x + 3)$$

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

$$(h, k) = \left(\frac{2 + 2}{2}, \frac{-3 + 6}{2} \right)$$

$$(h, k) = (2, 1.5)$$

$$a = \sqrt{(2 - 2)^2 + (-3 - 1.5)^2}$$

$$a = \sqrt{20.25} = 4.5$$

$$c = \sqrt{(2 - 2)^2 + (0 - 1.5)^2}$$

$$c = \sqrt{2.25} = 1.5$$

$$b^2 = a^2 - c^2 = 20.25 - 2.25 = 18$$

$$\frac{(x - 2)^2}{18} + \frac{(y - 1.5)^2}{20.25} = 1$$

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

$$(h, k) = \left(\frac{-2 + 4}{2}, \frac{2 + 2}{2} \right)$$

$$(h, k) = (1, 2)$$

$$a = \sqrt{(-2 - 1)^2 + (2 - 2)^2}$$

$$a = \sqrt{9} = 3$$

$$b = \sqrt{(1 - 1)^2 + (1 - 2)^2} = \sqrt{1} = 1$$

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

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

$$(h, k) = \left(\frac{5 + 5}{2}, \frac{-4 + 4}{2} \right)$$

$$(h, k) = (5, 0)$$

$$a = \sqrt{(5 - 5)^2 + (-4 - 0)^2} = \sqrt{16} = 4$$

$$c = \sqrt{(5 - 5)^2 + (-6 - 0)^2} = \sqrt{36} = 6$$

$$b^2 = c^2 - a^2 = 36 - 16 = 20$$

$$b = \sqrt{20} = 2\sqrt{5}$$

$$\frac{(y - 0)^2}{16} - \frac{(x - 5)^2}{20} = 1$$

$$\frac{y^2}{16} - \frac{(x - 5)^2}{20} = 1$$

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

$$(h, k) = \left(\frac{-4 + 1}{2}, \frac{2 + 2}{2} \right)$$

$$(h, k) = (-1.5, 2)$$

$$a = \sqrt{(-4 + 1.5)^2 + (2 - 2)^2} = \sqrt{6.25} = 2.5$$

$$c = \sqrt{(-7 + 1.5)^2 + (2 - 2)^2} = \sqrt{30.25} = 5.5$$

$$b^2 = c^2 - a^2 = 30.25 - 6.25 = 24$$

$$b = \sqrt{24} = 2\sqrt{6}$$

$$\frac{(x + 1.5)^2}{6.25} - \frac{(y - 2)^2}{24} = 1$$

Chapter 10 *continued*

21. $r = 2$;

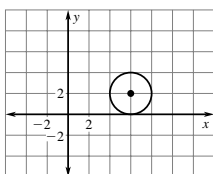
center: $(6, 2)$; points:

$$(6 + 2, 2) = (8, 2),$$

$$(6 - 2, 2) = (4, 2),$$

$$(6, 2 + 2) = (6, 4),$$

$$(6, 2 - 2) = (6, 0)$$

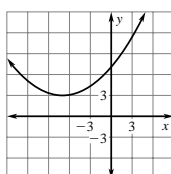


22. vertical axis

$$(x - h)^2 = 4p(y - k), 4p = 12 \text{ so } p = 3,$$

parabola opens up

$$\text{vertex: } (-7, 3); \text{ focus: } (-7, 6); \text{ directrix: } y = 0$$



23. vertical axis

$$a = 4, b = 2,$$

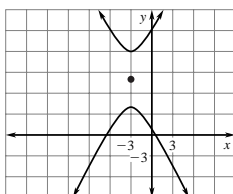
$$c^2 = a^2 + b^2$$

$$c^2 = (4)^2 + (2)^2 = 16 + 4 = 20$$

$$c = \sqrt{20} = 2\sqrt{5}$$

$$\text{center: } (-3, 8), \text{ vertices: } (-3, 4), (-3, 12);$$

$$\text{foci: } (-3, 8 \pm 2\sqrt{5})$$



24. Vertical axis

$$a = 7, b = 5$$

$$b = 5$$

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

$$c^2 = 49 - 25$$

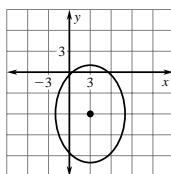
$$c^2 = 24$$

$$c = \pm 2\sqrt{6}$$

$$\text{center: } (3, -6);$$

$$\text{vertices: } (3, -13), (3, 1);$$

$$\text{co-vertices: } (-2, -6), (8, -6); \text{ foci: } (3, -6 \pm 2\sqrt{6})$$



25. horizontal axis

$$a = 4, b = 3$$

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

$$c^2 = 16 - 9$$

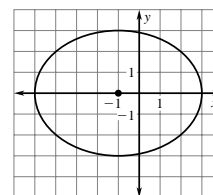
$$c^2 = 7$$

$$c = \pm \sqrt{7}$$

$$\text{center: } (-1, 0)$$

$$\text{vertices: } (-5, 0), (3, 0);$$

$$\text{co-vertices: } (-1, 3), (-1, -3); \text{ foci } (-1 \pm \sqrt{7}, 0)$$



26. horizontal axis

$$a = 4, b = 1$$

$$c^2 = a^2 + b^2$$

$$c^2 = 16 + 1$$

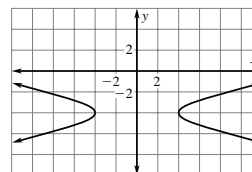
$$c^2 = 17$$

$$c = \pm \sqrt{17}$$

$$\text{center: } (0, -4);$$

$$\text{vertices: } (4, -4), (-4, -4);$$

$$\text{foci: } (\pm \sqrt{17}, -4)$$



27. $r = 1$;

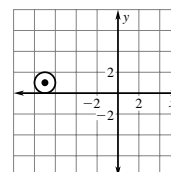
center: $(-7, 1)$; points:

$$(-7 - 1, 1) = (-8, 1),$$

$$(-7 + 1, 1) = (-6, 1),$$

$$(-7, 1 + 1) = (-7, 2),$$

$$(-7, 1 - 1) = (-7, 0)$$



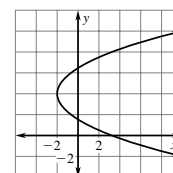
28. $(y - k)^2 = 4p(x - h)$,

$$4p = 3 \text{ so } p = \frac{3}{4}, \text{ parabola opens right}$$

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

$$\text{focus: } \left(-\frac{5}{4}, 4\right);$$

$$\text{directrix: } x = -\frac{11}{4}$$



29. $A = 9, B = 0, C = 4$,

$$B^2 - 4AC = 0^2 - 4(9)(4) = -144$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

Chapter 10 *continued*

30. $A = 1, B = 0, C = -4$

$$B^2 - 4AC = 0^2 - 4(1)(-4) = 16$$

$$B^2 - 4AC > 0$$

hyperbola

31. $A = 4, B = 0, C = -9$

$$B^2 - 4AC = 0^2 - 4(4)(-9) = 144$$

$$B^2 - 4AC > 0$$

hyperbola

32. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0,$$

$$B = 0, A = C$$

circle

33. $A = 36, B = 0, C = 16$

$$B^2 - 4AC = 0^2 - 4(36)(16) = -2304$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

34. $A = 4, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(4)(4) = -64$$

$$B^2 - 4AC < 0$$

$$B = 0, A = C$$

circle

35. $A = -1, B = 0, C = 9$

$$B^2 - 4AC = 0^2 - 4(-1)(9) = 36$$

$$B^2 - 4AC > 0$$

hyperbola

36. $A = 16, B = 0, C = 25$

$$B^2 - 4AC = 0^2 - 4(16)(25) = -1600$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

37. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0)$$

$$B^2 - 4AC = 0$$

parabola

38. $A = 0, B = 0, C = 2$

$$B^2 - 4AC = 0^2 - 4(0)(2) = 0$$

$$B^2 - 4AC = 0$$

parabola

39. $A = 12, B = 0, C = 20$

$$B^2 - 4AC = 0^2 - 4(12)(20) = -960$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

40. $A = 9, B = 0, C = -1$

$$B^2 - 4AC = 0^2 - 4(9)(-1) = 36$$

$$B^2 - 4AC > 0$$

hyperbola

41. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0$$

$$A = C, B = 0$$

circle

42. $A = 16, B = 0, C = 9$

$$B^2 - 4AC = 0^2 - 4(16)(9) = -576$$

$$B^2 - 4AC < 0$$

$$B = 0, A \neq C$$

ellipse

43. $A = -1, B = 0, C = 16$

$$B^2 - 4AC = 0^2 - 4(-1)(16) = 64$$

$$B^2 - 4AC > 0$$

hyperbola

44. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0$$

$$B^2 - 4AC = 0$$

parabola

45. $A = 9, B = 0, C = -4$

$$B^2 - 4AC = 0^2 - 4(9)(-4) = 144$$

$$B^2 - 4AC > 0; \text{ hyperbola}$$

Positive x^2 term means a horizontal transverse axis. E

46. $A = 0, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(0)(1) = 0$$

$$B^2 - 4AC = 0; \text{ parabola}$$

A

Chapter 10 *continued*

47. $A = 9, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(9)(4) = -144$$

$$B^2 - 4AC < 0, B = 0, A \neq C; \text{ ellipse}$$

$$9x^2 + 4y^2 + 36x + 24y + 36 = 0$$

$$(9x^2 + 36x) + (4y^2 + 24y) = -36$$

$$9(x^2 + 4x) + 4(y^2 + 6y) = -36$$

$$9(x^2 + 4x + 4) + 4(y^2 + 6y + 9) = -36 + 9(4) + 4(9)$$

$$9(x + 2)^2 + 4(y + 3)^2 = 36$$

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

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

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

$$h = -2, k = -3, a = 3, b = 2$$

D

48. $A = -1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(-1)(1) = 4$$

$$B^2 - 4AC > 0; \text{ hyperbola}$$

Negative x^2 term means a vertical transverse axis. F

49. $A = 4, B = 0, C = 9$

$$B^2 - 4AC = 0^2 - 4(4)(9) = -144$$

$$B^2 - 4AC < 0, B = 0, A \neq C, \text{ ellipse}$$

$$4x^2 + 9y^2 - 16x + 54y + 61 = 0$$

$$(4x^2 - 16x) + (9y^2 + 54y) = -61$$

$$4(x^2 - 4x) + 9(y^2 + 6y) = -61$$

$$4(x^2 - 4x + 4) + 9(y^2 + 6y + 9) = -61 + 4(4) + 9(9)$$

$$4(x - 2)^2 + 9(y + 3)^2 = 36$$

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

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

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

$$h = 2, k = -3, a = 3, b = 2$$

B

50. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0, B = 0, A = C; \text{ circle}$$

C

51. $A = 0, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(0)(1) = 0$$

$$B^2 - 4AC = 0; \text{ parabola}$$

$$y^2 - 12y + 4x + 4 = 0$$

$$(y^2 - 12y) = -4x - 4$$

$$(y^2 - 12y + 36) = -4x - 4 + 36$$

$$(y - 6)^2 = -4x + 32$$

$$(y - 6)^2 = -4(x - 8)$$

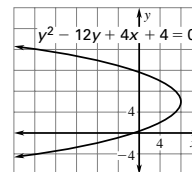
$$(h, k) = \text{vertex} = (8, 6)$$

horizontal axis

$$(y - k)^2 = 4p(x - h)$$

$$4p = -4, p = -1$$

$p < 0$, parabola opens left



52. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0, B = 0, A = C$$

Circle

$$x^2 + y^2 - 6x - 8y + 24 = 0$$

$$(x^2 - 6x) + (y^2 - 8y) = -24$$

$$(x^2 - 6x + 9) + (y^2 - 8y + 16) = -24 + 9 + 16$$

$$(x - 3)^2 + (y - 4)^2 = 1$$

$$(h, k) = \text{center} = (3, 4)$$

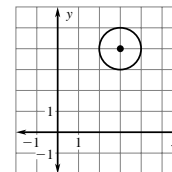
$r = 1$; points:

$$(3 - 1, 4) = (2, 4),$$

$$(3 + 1, 4) = (4, 4),$$

$$(3, 4 + 1) = (3, 5),$$

$$(3, 4 - 1) = (3, 3)$$



53. $A = 9, B = 0, C = -1$

$$B^2 - 4AC = 0^2 - 4(9)(-1) = 36$$

$$B^2 - 4AC > 0; \text{ hyperbola}$$

$$9x^2 - y^2 - 72x + 8y + 119 = 0$$

$$(9x^2 - 72x) - (y^2 - 8y) = -119$$

$$9(x^2 - 8x) - (y^2 - 8y) = -119$$

$$9(x^2 - 8x + 16) - (y^2 - 8y + 16)$$

$$= -119 + 9(16) - 16$$

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

$$\frac{1}{9}[9(x - 4)^2 - (y - 4)^2] = 9\left(\frac{1}{9}\right)$$

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

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

—CONTINUED—

Chapter 10 *continued*

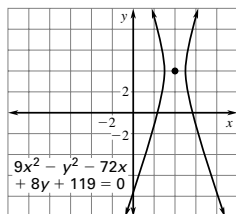
53. —CONTINUED—

$$(h, k) = \text{center} = (4, 4)$$

$$a = 1, b = 3$$

vertices:

$$(3, 4), (5, 4)$$



54. $A = 4, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(4)(1) = -16$$

$B^2 - 4AC < 0, B = 0, A \neq C$; ellipse

$$4x^2 + y^2 - 48x - 4y + 48 = 0$$

$$(4x^2 - 48x) + (y^2 - 4y) = -48$$

$$4(x^2 - 12x) + (y^2 - 4y) = -48$$

$$4(x^2 - 12x + 36) + (y^2 - 4y + 4) = -48 + 4(36) + 4$$

$$4(x - 6)^2 + (y - 2)^2 = 100$$

$$\frac{4(x - 6)^2}{100} + \frac{(y - 2)^2}{100} = \frac{100}{100}$$

$$\frac{(x - 6)^2}{25} + \frac{(y - 2)^2}{100} = 1$$

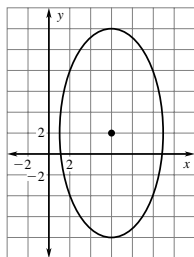
$$\frac{(x - h)^2}{b^2} + \frac{(y - k)^2}{a^2} = 1$$

$$(h, k) = \text{center} = (6, 2)$$

$$a = 10, b = 5$$

vertices: (6, 12), (6, -8);

co-vertices: (11, 2), (1, 2)



55. $A = 1, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(1)(4) = -16$$

$B^2 - 4AC < 0, B = 0, A \neq C$; ellipse

$$x^2 + 4y^2 - 2x - 8y + 1 = 0$$

$$(x^2 - 2x) + (4y^2 - 8y) = -1$$

$$(x^2 - 2x) + 4(y^2 - 2y) = -1$$

$$(x^2 - 2x + 1) + 4(y^2 - 2y + 1) = -1 + 1 + 4$$

$$(x - 1)^2 + 4(y - 1)^2 = 4$$

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

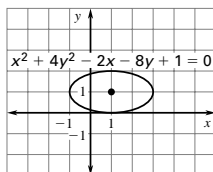
$$\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$$

$$(h, k) = \text{center} = (1, 1)$$

$$a = 2, b = 1$$

vertices: (3, 1), (-1, 1)

co-vertices: (1, 2), (1, 0)



56. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$B^2 - 4AC < 0, B = 0, A = C$; circle

$$x^2 + y^2 - 12x - 24y + 36 = 0$$

$$(x^2 - 12x) + (y^2 - 24y) = -36$$

$$(x^2 - 12x + 36) + (y^2 - 24y + 144) = -36 + 36 + 144$$

$$(x - 6)^2 + (y - 12)^2 = 144$$

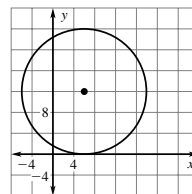
$(h, k) = \text{center} = (6, 12); r = 12$; points:

$$(6 + 12, 12) = (18, 12),$$

$$(6 - 12, 12) = (-6, 12),$$

$$(6, 12 + 12) = (6, 24),$$

$$(6, 12 - 12) = (6, 0)$$



57. $A = 16, B = 0, C = -1$

$$B^2 - 4AC = 0^2 - 4(16)(-1) = 64$$

$B^2 - 4AC > 0$; hyperbola

$$16x^2 - y^2 + 16y - 128 = 0$$

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

$$16x^2 - (y^2 - 16y) = 128$$

$$16x^2 - (y^2 - 16y + 64) = 128 - 64$$

$$16x^2 - (y - 8)^2 = 64$$

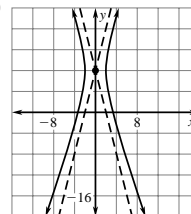
$$\frac{16x^2}{64} - \frac{(y - 8)^2}{64} = 1$$

$$\frac{x^2}{4} - \frac{(y - 8)^2}{64} = 1$$

$(h, k) = \text{center} = (0, 8)$

$$a = 2, b = 8$$

vertices: (2, 8), (-2, 8)



Chapter 10 *continued*

58. $A = 1, B = 0, C = 9$

$$B^2 - 4AC = 0^2 - 4(1)(9) = -36$$

$$B^2 - 4AC < 0, B = 0, A \neq C; \text{ ellipse}$$

$$x^2 + 9y^2 + 8x + 4y + 7 = 0$$

$$(x^2 + 8x) + (9y^2 + 4y) = -7$$

$$(x^2 + 8x) + 9\left(y^2 + \frac{4}{9}y\right) = -7$$

$$(x^2 + 8x + 16) + 9\left(y^2 + \frac{4}{9}y + \frac{4}{81}\right) = -7 + 16 + \frac{4}{9}$$

$$(x + 4)^2 + 9\left(y + \frac{2}{9}\right)^2 = -\frac{63}{9} + \frac{144}{9} + \frac{4}{9}$$

$$(x + 4)^2 + 9\left(y + \frac{2}{9}\right)^2 = \frac{85}{9}$$

$$\frac{9(x + 4)^2}{85} + \frac{81\left(y + \frac{2}{9}\right)^2}{85} = 1$$

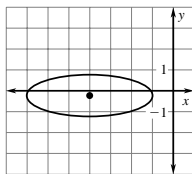
$$\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$$

$$(h, k) = \text{center} = \left(-4, -\frac{2}{9}\right)$$

$$a = \frac{\sqrt{85}}{3}, b = \frac{\sqrt{85}}{9}$$

$$\text{vertices: } \left(-4 \pm \frac{\sqrt{85}}{3}, -\frac{2}{9}\right)$$

$$\text{co-vertices: } \left(-4, -\frac{2}{9} \pm \frac{\sqrt{85}}{9}\right)$$



59. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0; B = 0, A = C; \text{ circle}$$

$$x^2 + y^2 - 12x - 12y + 36 = 0$$

$$(x^2 - 12x) + (y^2 - 12y) = -36$$

$$(x^2 - 12x + 36) + (y^2 - 12y + 36) = -36 + 36 + 36$$

$$(x - 6)^2 + (y - 6)^2 = 36$$

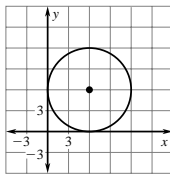
$$(h, k) = \text{center} = (6, 6); r = 6; \text{ points:}$$

$$(6 + 6, 6) = (12, 6),$$

$$(6 - 6, 6) = (0, 6),$$

$$(6, 6 + 6) = (6, 12),$$

$$(6, 6 - 6) = (6, 0)$$



60. $A = 0, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(0)(1) = 0$$

$$B^2 - 4AC = 0; \text{ parabola}$$

$$y^2 - 2x - 20y + 94 = 0$$

$$y^2 - 20y = 2x - 94$$

$$y^2 - 20y + 100 = 2x - 94 + 100$$

$$(y - 10)^2 = 2x + 6$$

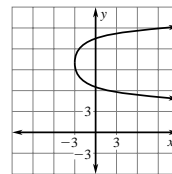
$$(y - 10)^2 = 2(x + 3)$$

$$(y - k)^2 = 4p(x - h)^2$$

$$(h, k) = \text{vertex} = (-3, 10)$$

$$4p = 2, p = \frac{1}{2}, p > 0$$

parabola opens right



61. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0$$

$$B^2 - 4AC = 0; \text{ parabola}$$

$$x^2 + 4x - 8y + 12 = 0$$

$$(x^2 + 4x) = 8y - 12$$

$$(x^2 + 4x + 4) = 8y - 12 + 4$$

$$(x + 2)^2 = 8y - 8$$

$$(x + 2)^2 = 8(y - 1)$$

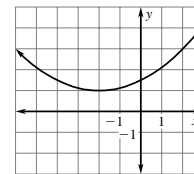
$$(x - h)^2 = 4p(y - k)$$

$$(h, k) = \text{vertex} = (-2, 1)$$

$$4p = 8$$

$$p = 2, p > 0$$

parabola opens up



62. $A = -9, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(-9)(4) = 144$$

$$B^2 - 4AC > 0; \text{ hyperbola}$$

$$-9x^2 + 4y^2 - 36x - 16y - 164 = 0$$

$$-9(x^2 + 4x) + 4(y^2 - 4y) = 164$$

$$-9(x^2 + 4x + 4) + 4(y^2 - 4y + 4) = 164 - 9(4) + 4(4)$$

$$-9(x + 2)^2 + 4(y - 2)^2 = 144$$

$$\frac{-9(x + 2)^2}{144} + \frac{4(y - 2)^2}{144} = \frac{144}{144}$$

$$\frac{-(x + 2)^2}{16} + \frac{(y - 2)^2}{36} = 1$$

$$\frac{(y - 2)^2}{36} - \frac{(x + 2)^2}{16} = 1$$

—CONTINUED—

Chapter 10 *continued*

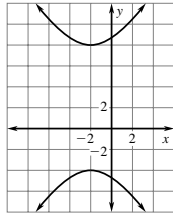
62. —CONTINUED—

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

$$(h, k) = \text{center} = (-2, 2)$$

$$a = 6, b = 4$$

$$\text{vertices: } (-2, -4), (-2, 8);$$



63. Vertex: (0, 0)

$$y^2 = 4px$$

$$\text{Focus: } (p, 0) = (3, 0)$$

$$y^2 = 4(3)x$$

$$y^2 = 12x$$

$$\text{Vertex: } (50, 0)$$

$$\text{Focus: } (47, 0)$$

$$(y - k)^2 = 4p(x - h)$$

$$h = 50, k = 0$$

$$|p| = \sqrt{(47 - 50)^2 + (0 - 0)^2}$$

$$|p| = \sqrt{9} = 3, p < 0, p = -3$$

$$(y - 0)^2 = 4(-3)(x - 50)$$

$$y^2 = -12(x - 50) \quad (x, y \text{ in ft})$$

64. Point: (3, 0)

$$\text{Origin: } (0, 0)$$

$$r = \frac{d}{2} = \frac{6}{2} = 3$$

$$x^2 + y^2 = r^2$$

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

$$x^2 + y^2 = 9$$

$$(h, k) = \text{center} = (0, 6); r = 3$$

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

$$(x - 0)^2 + (y - 6)^2 = (3)^2$$

$$x^2 + (y - 6)^2 = 9 \quad (x, y \text{ in ft})$$

65. ellipse

66. hyperbola branch

67. $A = 405, B = 0, C = 729$

$$B^2 - 4AC = 0^2 - 4(405)(729) = -1,180,980$$

$$B^2 - 4AC < 0, B = 0, A \neq C$$

ellipse

$$A = 0, B = 0, C = -120$$

$$B^2 - 4AC = 0^2 - 4(0)(-120) = 0$$

$$B^2 - 4AC = 0$$

parabola

The first is elliptical, the second parabolic.

$$68. \frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$$

$$(h, k) = \left(\frac{3 + 3}{2}, \frac{5 + (-1)}{2} \right) = (3, 2)$$

$$a = \sqrt{(3 - 3)^2 + (5 - 2)^2}$$

$$a = \sqrt{9} = 3$$

$$c = \sqrt{(3 - 3)^2 + (7 - 2)^2}$$

$$c = \sqrt{25} = 5$$

$$b^2 = c^2 - a^2 = 25 - 9 = 16, b = 4$$

$$\frac{(y - 2)^2}{9} - \frac{(x - 3)^2}{16} = 1$$

E

69. $A = 25, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(25)(1) = -100$$

$$B^2 - 4AC < 0, B = 0, A \neq C \text{ ellipse}$$

C

70. a. Where the cones meet, the intersection is a point.

b. When it passes through the point where the cones meet, the intersection is an X (2 intersecting lines).

c. When it passes through the point where the cones meet, the intersection is a line.

10.6 Mixed Review (p. 631)

$$71. \quad x - y = 10 \qquad -3x + 3y = -30$$

$$3x - 2y = 25 \qquad \frac{3x - 2y = 25}{y = -5}$$

$$y = -5$$

$$x - (-5) = 10$$

$$x = 10 - 5$$

$$x = 5$$

$$(5, -5)$$

$$72. \quad 4x + 3y = 1$$

$$-3x - 6y = 3$$

$$3(4x + 3y) = 1(3) \rightarrow \quad 12x + 9y = 3$$

$$4(-3x - 6y) = 3(4) \rightarrow \quad -12x - 24y = 12$$

$$-15y = 15$$

$$y = -1$$

$$4x + 3(-1) = 1$$

$$4x - 3 = 1$$

$$4x = 4$$

$$x = 1$$

$$(1, -1)$$

Chapter 10 *continued*

73. $4x + y = 2$

$$6x + 3y = 0$$

$$-12x - 3y = -6$$

$$\frac{6x + 3y = 0}{-6x = -6}$$

$$-6x = -6$$

$$x = 1$$

$$4(1) + y = 2$$

$$4 + y = 2$$

$$y = -2$$

$$(1, -2)$$

74. $2x - 3y = 0$

$$x + 6y = 14$$

$$2x - 3y = 0$$

$$\frac{-2x - 12y = -28}{-15y = -28}$$

$$-15y = -28$$

$$y = \frac{28}{15}$$

$$2x - 3\left(\frac{28}{15}\right) = 0$$

$$2x - \frac{28}{5} = 0$$

$$2x = \frac{28}{5}$$

$$x = \frac{28}{10} = \frac{14}{5}$$

$$\left(\frac{14}{5}, \frac{28}{15}\right)$$

75. $23x = 68$

$$x + 3y = 19$$

$$23x = 68$$

$$x = \frac{68}{23}$$

$$x + 3y = 19$$

$$\left(\frac{68}{23}\right) + 3y = 19$$

$$3y = 19 - \frac{68}{23}$$

$$3y = \frac{437}{23} - \frac{68}{23}$$

$$3y = \frac{369}{23}$$

$$y = \frac{369}{23} \cdot \frac{1}{3} = \frac{123}{23}$$

$$\left(\frac{68}{23}, \frac{123}{23}\right)$$

77. $\log_7 7^5 = 5$

78. $\log_4 64, 4^x = 64, 4^3 = 64, x = 3$

79. $\log_5 1, 5^x = 1, 5^0 = 1, x = 0$

80. $\log_{1/3} 9, \frac{1}{3}^x = 9, \frac{1}{3}^{(-2)} = 3^2 = 9, x = -2$

81. $\log_{25} 625, 25^x = 625, 25^2 = 625, x = 2$

82. $\log 0.0001, 10^x = 0.0001, 10^{-4} = 0.0001 = \frac{1}{10,000}$

$$x = -4$$

83. $\frac{40}{1 + 6e^{-4x}} = 20$

$$40 = 20(1 + 6e^{-4x})$$

$$2 = 1 + 6e^{-4x}$$

$$1 = 6e^{-4x}$$

$$\frac{1}{6} = e^{-4x}$$

$$\ln \frac{1}{6} = -4x$$

$$\frac{\ln \frac{1}{6}}{-4} = x$$

$$x \approx 0.45$$

76. $x = y$

$$123x - 18y = 17$$

$$123y - 18y = 17$$

$$105y = 17$$

$$y = \frac{17}{105}$$

$$x = y = \frac{17}{105}$$

$$\left(\frac{17}{105}, \frac{17}{105}\right)$$

85. $\frac{8}{1 + 8e^{-x}} = 7$

$$8 = 7(1 + 8e^{-x})$$

$$\frac{8}{7} = 1 + 8e^{-x}$$

$$\frac{1}{7} = 8e^{-x}$$

$$\frac{1}{56} = e^{-x}$$

$$\ln \frac{1}{56} = -x$$

$$x = -\left(\ln \frac{1}{56}\right)$$

$$x \approx 4.03$$

86. $\frac{15}{1 + 3e^{-6x}} = 3$

$$15 = 3(1 + 3e^{-6x})$$

$$5 = 1 + 3e^{-6x}$$

$$4 = 3e^{-6x}$$

$$\frac{4}{3} = e^{-6x}$$

$$\ln \frac{4}{3} = -6x$$

$$\frac{\ln \frac{4}{3}}{-6} = x$$

$$x \approx -0.048$$

87. $\frac{24}{1 + 5e^{-4x}} = 9$

$$24 = 9(1 + 5e^{-4x})$$

$$\frac{24}{9} = 1 + 5e^{-4x}$$

$$\frac{8}{3} - \frac{3}{3} = 5e^{-4x}$$

$$\frac{5}{3} = 5e^{-4x}$$

$$\frac{1}{3} = e^{-4x}$$

$$\ln \frac{1}{3} = -4x$$

$$\frac{\ln \frac{1}{3}}{-4} = x$$

$$x \approx 0.27$$

88. $\frac{9}{1 + 2e^{-3x}} = 7$

$$9 = 7(1 + 2e^{-3x})$$

$$\frac{9}{7} = 1 + 2e^{-3x}$$

$$\frac{2}{7} = 2e^{-3x}$$

$$\frac{1}{7} = e^{-3x}$$

$$\ln \frac{1}{7} = -3x$$

$$\frac{\ln \frac{1}{7}}{-3} = x$$

$$x \approx 0.65$$


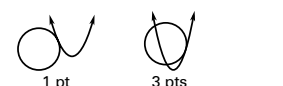
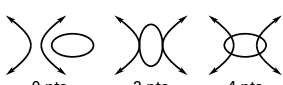
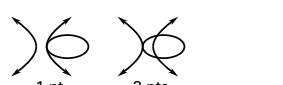
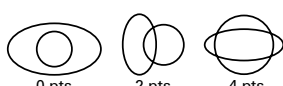
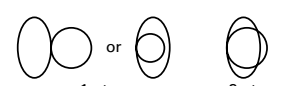

Chapter 10 *continued*

Math and History (p. 631)

- $A = 3550, B = 0, C = 0$
 $B^2 - 4AC = 0^2 - 4(3550)(0) = 0$
 $B^2 - 4AC = 0$
 parabolic
- $A = 2200, B = 0, C = 4600$
 $B^2 - 4AC = 0^2 - 4(2200)(4600) = -40,480,000$
 $B^2 - 4AC < 0, B = 0, A \neq C$
 Elliptical; will pass by the sun more than once.
- $A = 5000, B = 0, C = -6500$
 $B^2 - 4AC = 0^2 - 4(5000)(-6500) = 130,000,000$
 $B^2 - 4AC > 0$
 hyperbolic

Lesson 10.7

Activity (p. 632)

- a.
- 
- 0 pts 2 pts 4 pts
- 
- 1 pt 3 pts
- b.
- 
- 0 pts 2 pts 4 pts
- 
- 1 pt 3 pts
- c.
- 
- 0 pts 2 pts 4 pts
- 
- 1 pt 3 pts
- d.
- 
- 0 pts 1 pt 2 pts

10.7 Guided Practice (page 635)

1. quadratic

2. Sample answer:



3. Sample answer: Linear combination since the y^2 terms can be eliminated.

$$4. x^2 + y^2 = 17$$

$$y = x + 3$$

$$x^2 + (x + 3)^2 = 17$$

$$x^2 + x^2 + 6x + 9 = 17$$

$$2x^2 + 6x + 9 = 17$$

$$2x^2 + 6x - 8 = 0$$

$$2(x^2 + 3x - 4) = 0$$

$$2(x + 4)(x - 1) = 0$$

$$x = -4, x = 1$$

$$y = -4 + 3 = -1 \quad (-4, -1)$$

$$y = 1 + 3 = 4 \quad (1, 4)$$

$$5. x^2 + y^2 + 8x - 20y + 7 = 0$$

$$-(x^2 + 9y^2 + 8x + 4y + 7) = 0$$

$$-8y^2 - 24y = 0$$

$$-8y(y + 3) = 0$$

$$y = 0 \text{ or } y = -3$$

$$x^2 + (0)^2 + 8x - 20(0) + 7 = 0$$

$$x^2 + 8x + 7 = 0$$

$$(x + 1)(x + 7) = 0$$

$$x = -1 \text{ or } x = -7$$

$$x^2 + (-3)^2 + 8x - 20(-3) + 7 = 0$$

$$x^2 + 9 + 8x + 60 + 7 = 0$$

$$x^2 + 8x + 76 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4AC}}{2A}$$

$$x = \frac{-8 \pm \sqrt{64 - 4(1)(76)}}{2(1)}$$

$$x = \frac{-8 \pm \sqrt{64 - 304}}{2}$$

$$x = \frac{-8 \pm \sqrt{-240}}{2}, \text{ no real roots}$$

$$y = 0, x = -1 \text{ or } x = -7$$

$$(-1, 0), (-7, 0)$$

$$6. x^2 + y^2 - 3x = 8$$

$$2(-2)^2 - y^2 = 10$$

$$2x^2 - y^2 = 10$$

$$8 - y^2 = 10$$

$$3x^2 - 3x = 18$$

$$-y^2 = 10 - 8$$

$$3x^2 - 3x - 18 = 0$$

$$-y^2 = 2$$

$$3(x^2 - x - 6) = 0$$

$$y^2 = -2$$

$$3(x - 3)(x + 2) = 0$$

$$y = \pm \sqrt{-2}$$

$$x = 3 \text{ or } x = -2$$

no real roots

—CONTINUED—

Chapter 10 *continued*

6. —CONTINUED—

$$2(3)^2 - y^2 = 10$$

$$18 - y^2 = 10$$

$$-y^2 = -8$$

$$y^2 = 8$$

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

$$(3, \pm 2\sqrt{2})$$

7. $x^2 - 2x + 2y + 2 = 0$

$$\frac{-x^2 + 2x - y + 3 = 0}{y + 5 = 0}$$

$$y = -5$$

$$x^2 - 2x + 2(-5) + 2 = 0$$

$$x^2 - 2x - 10 + 2 = 0$$

$$x^2 - 2x - 8 = 0$$

$$(x - 4)(x + 2) = 0$$

$$x = 4 \text{ or } x = -2$$

$$(4)^2 - 2(4) + 2y + 2 = 0$$

$$16 - 8 + 2y + 2 = 0$$

$$2y + 10 = 0$$

$$2y = -10$$

$$y = -5$$

$$(-2)^2 - 2(-2) + 2y + 2 = 0$$

$$4 + 4 + 2y + 2 = 0$$

$$2y + 10 = 0$$

$$2y = -10$$

$$y = -5$$

$$(4, -5), (-2, -5)$$

8. Because 2 circles can intersect in 2 points.

10.7 Practice and Applications (pp. 635–637)

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

$$y = -3$$

$$4 \neq -3$$

No

10. $x^2 + y^2 = 41$

$$y = -x - 1$$

$$4^2 + (-5)^2 \stackrel{?}{=} 41 \quad -5 \stackrel{?}{=} -4 - 1$$

$$16 + 25 \stackrel{?}{=} 41 \quad -5 = -5$$

$$41 = 41$$

yes

11. $x^2 + 4x - 4y - 16 = 0$

$$-2x + y + 1 = 0$$

$$6^2 + 4(6) - 4(11) - 16 \stackrel{?}{=} 0 \quad -2(6) + 11 + 1 \stackrel{?}{=} 0$$

$$36 + 24 - 44 - 16 \stackrel{?}{=} 0 \quad -12 + 12 = 0$$

$$0 = 0 \quad 0 = 0$$

yes

12. $3x^2 - 5y^2 + 2y = 45$

$$y = 2x + 10$$

$$3(-3)^2 - 5(4)^2 + 2(4) \stackrel{?}{=} 45$$

$$27 - 80 + 8 \stackrel{?}{=} 45$$

$$-45 \neq 45$$

no

13. $2x^2 - 4y = 22$

$$y = -2x + 3$$

$$2(-5)^2 - 4(7) \stackrel{?}{=} 22 \quad 7 \stackrel{?}{=} -2(-5) + 3$$

$$50 - 28 \stackrel{?}{=} 22 \quad 7 \stackrel{?}{=} 10 + 3$$

$$22 = 22 \quad 7 \neq 13$$

no

14. $6x^2 - 5x + 8y^2 + y = 23$

$$y = x - 1$$

$$6(2)^2 - 5(2) + 8(1)^2 + 1 \stackrel{?}{=} 23 \quad 1 = 2 - 1$$

$$24 - 10 + 8 + 1 = 23 \quad 1 = 1$$

$$23 = 23$$

yes

15. $x^2 - y = 5$

$$-3x + y = -7$$

$$y = 3x - 7$$

$$x^2 - (3x - 7) = 5$$

$$x^2 - 3x + 7 - 5 = 0$$

$$x^2 - 3x + 2 = 0$$

$$(x - 2)(x - 1) = 0$$

$$x = 2 \text{ or } x = 1$$

$$-3(2) + y = -7$$

$$-6 + y = -7$$

$$y = -7 + 6$$

$$y = -1$$

$$-3(1) + y = -7$$

$$-3 + y = -7$$

$$y = -7 + 3$$

$$y = -4$$

$$(2, -1), (1, -4)$$

16. $x^2 + y^2 = 18$

$$x - y = 0 \rightarrow x = y$$

$$x^2 + x^2 = 18$$

$$2x^2 = 18$$

$$x^2 = 9$$

$$x = \pm 3$$

$$3 = y$$

$$-3 = y$$

$$(3, 3), (-3, -3)$$

Chapter 10 *continued*

17. $-3x^2 + y^2 = 9$

$$-2x + y = 0 \rightarrow y = 2x$$

$$-3x^2 + (2x)^2 = 9$$

$$-3x^2 + 4x^2 = 9$$

$$x^2 = 9$$

$$x = \pm 3$$

$$y = 2(3) = 6$$

$$y = 2(-3) = -6$$

$$(3, 6), (-3, -6)$$

18. $9x^2 + 4y^2 = 36$

$$-x + y = -4 \rightarrow y = -4 + x$$

$$9x^2 + 4(-4 + x)^2 - 36 = 0$$

$$9x^2 + 4(16 - 8x + x^2) - 36 = 0$$

$$9x^2 + 64 - 32x + 4x^2 - 36 = 0$$

$$13x^2 - 32x + 36 = 0$$

$$x = \frac{32 \pm \sqrt{1024 - 4(13)(36)}}{2(13)}$$

$$x = \frac{32 \pm \sqrt{1024 - 1872}}{26}$$

$$x = \frac{32 \pm \sqrt{-848}}{26}, \text{ no real roots}$$

none

19. $x^2 + y^2 = 5$

$$x^2 + (-2x)^2 = 5 \quad y = -2x$$

$$x^2 + 4x^2 = 5 \quad y = -2(1) = -2$$

$$5x^2 = 5 \quad y = -2(-1) = 2$$

$$x^2 = 1$$

$$x = \pm 1$$

$$(1, -2), (-1, 2)$$

20. $x + 2y^2 = -6$

$$x + 8y = 0 \rightarrow x = -8y \quad x = -8y$$

$$-8y + 2y^2 = -6 \quad x = -8(3)$$

$$2y^2 - 8y + 6 = 0 \quad x = -24$$

$$2(y^2 - 4y + 3) = 0$$

$$2(y - 3)(y - 1) = 0 \quad x = -8(1)$$

$$y = 3, y = 1 \quad x = -8$$

$$(-24, 3), (-8, 1)$$

21. $5x^2 + 3y^2 = 17$

$$-x + y = -1 \rightarrow y = x - 1$$

$$5x^2 + 3(x - 1)^2 = 17$$

$$5x^2 + 3(x^2 - 2x + 1) = 17$$

$$5x^2 + 3x^2 - 6x + 3 - 17 = 0$$

$$8x^2 - 6x - 14 = 0$$

$$2(4x^2 - 3x - 7) = 0$$

$$2(4x - 7)(x + 1) = 0$$

$$x = \frac{7}{4} \text{ or } x = -1$$

$$y = x - 1$$

$$y = \frac{7}{4} - 1 = \frac{3}{4}$$

$$y = -1 - 1 = -2$$

$$\left(\frac{7}{4}, \frac{3}{4}\right), (-1, -2)$$

22. $4x^2 - 5y^2 = 16$

$$3x + y = 6 \rightarrow y = -3x + 6$$

$$4x^2 - 5(-3x + 6)^2 = 16$$

$$4x^2 - 5(9x^2 - 36x + 36) = 16$$

$$4x^2 - 45x^2 + 180x - 180 - 16 = 0$$

$$-41x^2 + 180x - 196 = 0$$

$$41x^2 - 180x + 196 = 0$$

$$(41x - 98)(x - 2) = 0$$

$$x = \frac{98}{41} \text{ or } x = 2$$

$$y = -3\left(\frac{98}{41}\right) + 6$$

$$y = -\frac{294}{41} + 6$$

$$y = -\frac{48}{41}$$

$$y = -3(2) + 6$$

$$y = 0$$

$$\left(\frac{98}{41}, -\frac{48}{41}\right), (2, 0)$$

Chapter 10 *continued*

23. $2x^2 + 2y^2 = 15$

$$x + 2y = 6 \rightarrow x = -2y + 6$$

$$2(-2y + 6)^2 + 2y^2 - 15 = 0$$

$$2(4y^2 - 24y + 36) + 2y^2 - 15 = 0$$

$$8y^2 - 48y + 72 + 2y^2 - 15 = 0$$

$$10y^2 - 48y + 57 = 0$$

$$y = \frac{48 \pm \sqrt{2304 - 4(10)(57)}}{20}$$

$$y = \frac{48 \pm \sqrt{2304 - 2280}}{20}$$

$$y = \frac{48 \pm \sqrt{24}}{20}$$

$$y = \frac{48 \pm 2\sqrt{6}}{20}$$

$$y = \frac{24 \pm \sqrt{6}}{10}$$

$$x = -2\left(\frac{24 + \sqrt{6}}{10}\right) + 6 \quad x = -2\left(\frac{24 - \sqrt{6}}{10}\right) + 6$$

$$x = \frac{6 - \sqrt{6}}{5} \quad x = \frac{6 + \sqrt{6}}{5}$$

$$\left(\frac{6 - \sqrt{6}}{5}, \frac{24 + \sqrt{6}}{10}\right), \left(\frac{6 + \sqrt{6}}{5}, \frac{24 - \sqrt{6}}{10}\right)$$

24. $x^2 + y^2 = 1$

$$x + y = -1 \rightarrow y = -x - 1$$

$$x^2 + (-x - 1)^2 = 1$$

$$x^2 + x^2 + 2x + 1 - 1 = 0$$

$$2x^2 + 2x = 0$$

$$2x(x + 1) = 0$$

$$x = 0 \text{ or } x = -1$$

$$y = -0 - 1 = -1$$

$$y = -(-1) - 1 = 0$$

$$(0, -1), (-1, 0)$$

25. $x^2 + y^2 = 20$

$$y = x - 4$$

$$x^2 + (x - 4)^2 = 20$$

$$x^2 + x^2 - 8x + 16 - 20 = 0$$

$$2x^2 - 8x - 4 = 0$$

$$2(x^2 - 4x - 2) = 0$$

$$x = \frac{4 \pm \sqrt{16 - 4(1)(-2)}}{2(1)}$$

$$x = \frac{4 \pm \sqrt{24}}{2}$$

$$x = \frac{4 \pm 2\sqrt{6}}{2}$$

$$x = 2 \pm \sqrt{6}$$

$$y = 2 + \sqrt{6} - 4$$

$$y = -2 + \sqrt{6}$$

$$y = 2 - \sqrt{6} - 4$$

$$y = -2 - \sqrt{6}$$

$$(2 + \sqrt{6}, -2 + \sqrt{6}), (2 - \sqrt{6}, -2 - \sqrt{6})$$

26. $x^2 + y^2 = 5$

$$y = 3x + 5$$

$$x^2 + (3x + 5)^2 = 5$$

$$x^2 + 9x^2 + 30x + 25 - 5 = 0$$

$$10x^2 + 30x + 20 = 0$$

$$10(x^2 + 3x + 2) = 0$$

$$10(x + 1)(x + 2) = 0$$

$$x = -1 \text{ or } x = -2$$

$$y = 3(-1) + 5 = 2$$

$$y = 3(-2) + 5 = -1$$

$$(-1, 2), (-2, -1)$$

27. $x^2 = 6y$

$$x = 0 \text{ or } x = -6$$

$$y = -x$$

$$y = 0$$

$$x^2 = 6(-x)$$

$$y = -(-6) = 6$$

$$x^2 = -6x$$

$$(0, 0), (-6, 6)$$

$$x^2 + 6x = 0$$

$$x(x + 6) = 0$$

28. $x^2 + y^2 = 9$

$$x - 3y = 3 \rightarrow x = 3y + 3$$

$$(3y + 3)^2 + y^2 = 9$$

$$9y^2 + 18y + 9 + y^2 - 9 = 0$$

$$10y^2 + 18y = 0$$

$$2y(5y + 9) = 0$$

$$y = 0 \text{ or } y = -\frac{9}{5}$$

$$x = 3(0) + 3$$

$$x = 3$$

$$x = 3\left(-\frac{9}{5}\right) + 3$$

$$x = -\frac{27}{5} + \frac{15}{5}$$

$$x = -\frac{12}{5}$$

$$(3, 0), \left(-\frac{12}{5}, -\frac{9}{5}\right)$$

Chapter 10 continued

29. $x^2 + y^2 = 7$

$$y = x - 7$$

$$x^2 + (x - 7)^2 = 7$$

$$x^2 + x^2 - 14x + 49 - 7 = 0$$

$$2x^2 - 14x + 42 = 0$$

$$2(x^2 - 7x + 21) = 0$$

$$x = \frac{7 \pm \sqrt{49 - 4(1)(21)}}{2(1)}$$

$$x = \frac{7 \pm \sqrt{-35}}{2}, \text{ no real roots}$$

none

30. $y^2 - 2x^2 = 6$

$$y = -2x$$

$$(-2x)^2 - 2x^2 - 6 = 0$$

$$y = -2(\sqrt{3})$$

$$4x^2 - 2x^2 - 6 = 0$$

$$y = -2\sqrt{3}$$

$$2x^2 - 6 = 0$$

$$y = -2(-\sqrt{3})$$

$$2(x^2 - 3) = 0$$

$$y = 2\sqrt{3}$$

$$x^2 = 3$$

$$x = \pm\sqrt{3}$$

$$(\sqrt{3}, -2\sqrt{3}), (-\sqrt{3}, 2\sqrt{3})$$

31. $6x^2 + 3y^2 = 12$

$$6x^2 + 3(-x + 2)^2 = 12$$

$$6x^2 + 3(x^2 - 4x + 4) - 12 = 0$$

$$6x^2 + 3x^2 - 12x + 12 - 12 = 0$$

$$9x^2 - 12x = 0$$

$$3x(3x - 4) = 0$$

$$x = 0 \text{ or } x = \frac{4}{3}$$

$$y = -x + 2$$

$$y = -\frac{4}{3} + 2$$

$$y = -\frac{4}{3} + \frac{6}{3}$$

$$y = \frac{2}{3}$$

$$y = 0 + 2 = 2$$

$$(0, 2), \left(\frac{4}{3}, \frac{2}{3}\right)$$

32. $3x^2 - y^2 = -6$

$$y = 2x + 1$$

$$3x^2 - (2x + 1)^2 = -6$$

$$3x^2 - (4x^2 + 4x + 1) + 6 = 0$$

$$3x^2 - 4x^2 - 4x - 1 + 6 = 0$$

$$-x^2 - 4x + 5 = 0$$

$$x^2 + 4x - 5 = 0$$

$$(x + 5)(x - 1) = 0$$

$$x = -5 \text{ or } x = 1$$

$$y = 2(-5) + 1$$

$$y = -10 + 1 = -9$$

$$y = 2(1) + 1 = 3$$

$$(-5, -9), (1, 3)$$

33. $x^2 + y^2 = 16$

$$x^2 - 5y = 5$$

$$x^2 + y^2 = 16$$

$$-x^2 + 5y = -5$$

$$y^2 + 5y = 11$$

$$y^2 + 5y - 11 = 0$$

$$y = \frac{-5 \pm \sqrt{25 - 4(1)(-11)}}{2(1)}$$

$$y = \frac{-5 \pm \sqrt{69}}{2}$$

$$x^2 = 5\left(\frac{-5 - \sqrt{69}}{2}\right) + 5$$

$$x^2 = \frac{-25 - 5\sqrt{69} + 10}{2}$$

$$x^2 = \frac{-5\sqrt{69} - 15}{2}$$

$$x = \pm \sqrt{\frac{-5\sqrt{69} - 15}{2}}, \text{ no real roots}$$

$$x^2 = 5\left(\frac{-5 + \sqrt{69}}{2}\right) + 5$$

$$x^2 = \frac{-25 + 5\sqrt{69} + 10}{2}$$

$$x^2 = \frac{5\sqrt{69} - 15}{2}$$

$$x = \pm \sqrt{\frac{5\sqrt{69} - 15}{2}}$$

$$\left(\pm \sqrt{\frac{5\sqrt{69} - 15}{2}}, \frac{-5 \pm \sqrt{69}}{2}\right)$$

Chapter 10 continued

34. $-3x^2 + y^2 - 3x = 0$
 $x^2 - y^2 + 27 = 0$
 $-2x^2 - 3x + 27 = 0$
 $2x^2 + 3x - 27 = 0$
 $(2x + 9)(x - 3) = 0$
 $x = -\frac{9}{2}$ or $x = 3$
 $-3(3)^2 + y^2 - 3(3) = 0$
 $-27 + y^2 - 9 = 0$
 $y^2 = 36$
 $y = \pm 6$
 $-3\left(-\frac{9}{2}\right)^2 + y^2 - 3\left(-\frac{9}{2}\right) = 0$
 $-\frac{243}{4} + y^2 + \frac{27}{2} = 0$
 $y^2 = \frac{243}{4} - \frac{54}{4} = \frac{189}{4}$
 $y = \pm \frac{\sqrt{189}}{2} = \pm \frac{3\sqrt{21}}{2}$
 $(3, \pm 6), \left(-\frac{9}{2}, \pm \frac{3\sqrt{21}}{2}\right)$

35. $-x^2 + y^2 + 10 = 0$
 $-3y^2 + x + 1 = 0$
 $-3x^2 + 3y^2 + 30 = 0$
 $-3y^2 + x + 1 = 0$
 $-3x^2 + x + 31 = 0$
 $x = \frac{-1 \pm \sqrt{1 - 4(-3)(31)}}{2(-3)}$
 $x = \frac{-1 \pm \sqrt{1 + 372}}{-6}$
 $x = \frac{1 \pm \sqrt{373}}{6}$
 $-\left(\frac{1 + \sqrt{373}}{6}\right)^2 + y^2 + 10 = 0$
 $y^2 = \left(\frac{(1 + \sqrt{373})(1 + \sqrt{373})}{36}\right) - \frac{360}{36}$
 $y^2 = \frac{1 + 2\sqrt{373} + 373}{36} - \frac{360}{36}$
 $y^2 = \frac{374 - 360}{36} + \frac{2\sqrt{373}}{36}$
 $y^2 = \frac{7 + \sqrt{373}}{18}$
 $y = \pm \sqrt{\frac{7 + \sqrt{373}}{18}}$
 $-\left(\frac{1 - \sqrt{373}}{6}\right)^2 + y^2 + 10 = 0$

$$y^2 = \left(\frac{(1 - \sqrt{373})(1 - \sqrt{373})}{36}\right) - \frac{360}{36}$$

$$y^2 = \frac{1 - 2\sqrt{373} + 373}{36} - \frac{360}{36}$$

$$y^2 = \frac{374 - 2\sqrt{373} - 360}{36}$$

$$y^2 = \frac{374 - 360}{36} + \frac{-2\sqrt{373}}{36}$$

$$y^2 = \frac{7 - \sqrt{373}}{18}$$

$$y = \pm \sqrt{\frac{7 - \sqrt{373}}{18}}; \text{ no real roots}$$

$$\left(\frac{1 + \sqrt{373}}{6}, \pm \sqrt{\frac{7 + \sqrt{373}}{18}}\right)$$

36. $x^2 + 2y^2 - 10 = 0$
 $4y^2 + x + 4 = 0$
 $-2x^2 - 4y^2 + 20 = 0$
 $4y^2 + x + 4 = 0$
 $-2x^2 + x + 24 = 0$
 $x = \frac{-1 \pm \sqrt{1 - 4(-2)(24)}}{2(-2)}$
 $x = \frac{-1 \pm \sqrt{1 + 192}}{-4}$
 $x = \frac{1 \pm \sqrt{193}}{4}$
 $\left(\frac{1 - \sqrt{193}}{4}\right)^2 + 2y^2 - 10 = 0$
 $2y^2 = -\left(\frac{1 - 2\sqrt{193} + 193}{16}\right) - \frac{160}{16}$
 $2y^2 = -\left(\frac{194 - 2\sqrt{193}}{16}\right) - \frac{160}{16}$
 $2y^2 = \frac{-194 - 160 + 2\sqrt{193}}{16}$
 $2y^2 = \frac{-354 + 2\sqrt{193}}{16}$
 $y^2 = \frac{-177 + \sqrt{193}}{8}$
 $y = \pm \sqrt{\frac{-177 + \sqrt{193}}{8}}; \text{ no real roots}$
 $\left(\frac{1 + \sqrt{193}}{4}\right)^2 + 2y^2 - 10 = 0$
 $\frac{(1 + \sqrt{193})(1 + \sqrt{193})}{16} + 2y^2 - 10 = 0$

—CONTINUED—

Chapter 10 continued

36. —CONTINUED—

$$2y^2 = -\left(\frac{1 + 2\sqrt{193} + 193}{16}\right) - \frac{160}{16}$$

$$2y^2 = -\left(\frac{194 + 2\sqrt{193}}{16}\right) - \frac{160}{16}$$

$$2y^2 = \frac{-194 - 2\sqrt{193}}{16} - \frac{160}{16}$$

$$2y^2 = \frac{-194 - 160 - 2\sqrt{193}}{16}$$

$$y^2 = \frac{-177 - \sqrt{193}}{8}$$

$$y = \sqrt{\frac{-177 - \sqrt{193}}{8}}, \text{ no real roots}$$

none

37. $y^2 = 16x$

$$4x - y = -24$$

$$-y = -4x - 24 \rightarrow y = 4x + 24$$

$$y^2 = 16x$$

$$(4x + 24)^2 = 16x$$

$$16x^2 + 192x + 576 = 16x$$

$$16x^2 + 192x - 16x + 576 = 0$$

$$16x^2 + 176x + 576 = 0$$

$$16(x^2 + 11x + 36) = 0$$

$$x = \frac{-11 \pm \sqrt{121 - 4(1)(36)}}{2(1)}$$

$$x = \frac{-11 \pm \sqrt{121 - 144}}{2}$$

$$x = \frac{-11 \pm \sqrt{-23}}{2}, \text{ no real roots}$$

none

38. $10y = x^2$

$$x^2 - 6 = -2y$$

$$10y - 6 = -2y$$

$$12y = 6$$

$$y = \frac{1}{2}$$

$$x^2 = 10\left(\frac{1}{2}\right)$$

$$x^2 = 5$$

$$x = \pm\sqrt{5}$$

$$\left(\pm\sqrt{5}, \frac{1}{2}\right)$$

39. $y^2 + x = 2$

$$3x + y = 8 \rightarrow y = -3x + 8$$

$$(-3x + 8)^2 + x = 2$$

$$9x^2 - 48x + 64 + x - 2 = 0$$

$$9x^2 - 47x + 62 = 0$$

$$x = \frac{47 \pm \sqrt{2209 - 4(9)(62)}}{2(9)}$$

$$x = \frac{47 \pm \sqrt{2209 - 2232}}{18}$$

$$x = \frac{47 \pm \sqrt{-23}}{18}, \text{ no real roots}$$

none

40. $x^2 - 16y^2 = 16$

$$x^2 + y^2 = 9$$

$$x^2 = 16y^2 + 16$$

$$(16y^2 + 16) + y^2 - 9 = 0$$

$$17y^2 + 7 = 0$$

$$17y^2 = -7$$

$$y^2 = -\frac{7}{17}$$

$$y = \pm\sqrt{-\frac{7}{17}}, \text{ no real roots}$$

none

41. $x^2 + y^2 = 81$

$$x + y = 0$$

$$y = -x$$

$$x^2 + (-x)^2 = 81$$

$$2x^2 = 81$$

$$x^2 = \frac{81}{2}$$

$$x = \frac{\pm 9}{\sqrt{2}} = \frac{\pm 9\sqrt{2}}{2}$$

$$-\left(\frac{9\sqrt{2}}{2}\right) = y$$

$$y = \frac{9\sqrt{2}}{2}$$

$$-\left(\frac{-9\sqrt{2}}{2}\right) = y$$

$$y = \frac{9\sqrt{2}}{2}$$

$$\left(\frac{9\sqrt{2}}{2}, -\frac{9\sqrt{2}}{2}\right), \left(-\frac{9\sqrt{2}}{2}, \frac{9\sqrt{2}}{2}\right)$$

Chapter 10 *continued*

42. $16x^2 - y^2 + 16y - 128 = 0$

$$\frac{y^2 - 48x - 16y - 32 = 0}{16x^2 - 48x - 32 - 128 = 0}$$

$$16x^2 - 48x - 160 = 0$$

$$16x^2 - 48x - 160 = 0$$

$$16(x^2 - 3x - 10) = 0$$

$$16(x - 5)(x + 2) = 0$$

$$x = 5 \text{ or } x = -2$$

$$y^2 - 48(5) - 16y - 32 = 0$$

$$y^2 - 16y - 240 - 32 = 0$$

$$y^2 - 16y - 272 = 0$$

$$y = \frac{16 \pm \sqrt{256 - (4)(1)(-272)}}{2(1)}$$

$$y = \frac{16 \pm \sqrt{256 + 1088}}{2}$$

$$y = \frac{16 \pm \sqrt{1344}}{2}$$

$$y = \frac{16 \pm \sqrt{64 \cdot 21}}{2}$$

$$y = \frac{16 \pm 8\sqrt{21}}{2}$$

$$y = 8 \pm 4\sqrt{21}$$

$$y^2 - 48(-2) - 16y - 32 = 0$$

$$y^2 - 16y + 96 - 32 = 0$$

$$y^2 - 16y + 64 = 0$$

$$(y - 8)(y - 8) = 0$$

$$y = 8$$

$$(-2, 8), (5, 8 \pm 4\sqrt{21})$$

43. $x^2 - y^2 - 8x + 8y - 24 = 0$

$$\frac{x^2 + y^2 - 8x - 8y + 24 = 0}{2x^2 - 16x = 0}$$

$$2x^2 - 16x = 0$$

$$2x(x - 8) = 0$$

$$x = 0 \text{ or } x = 8$$

$$(0) - y^2 - 8(0) + 8y - 24 = 0$$

$$-y^2 + 8y - 24 = 0$$

$$-(y^2 - 8y + 24) = 0$$

$$y = \frac{8 \pm \sqrt{64 - 4(1)(24)}}{2(1)}$$

$$y = \frac{8 \pm \sqrt{-32}}{2}, \text{ no real roots}$$

$$8^2 - y^2 - 8(8) + 8y - 24 = 0$$

$$64 - y^2 - 64 + 8y - 24 = 0$$

$$-y^2 + 8y - 24 = 0$$

$$-(y^2 - 8y + 24) = 0$$

$$y = 8 \pm \sqrt{64 - 4(1)(24)}$$

$$y = \frac{8 \pm \sqrt{-32}}{2}, \text{ no real roots}$$

none

44. $x^2 + 4y^2 - 4x - 8y + 4 = 0$

$$x^2 + 4y - 4 = 0$$

$$x^2 - 4x + 4y^2 - 8y = -4$$

$$(x^2 - 4x + 4) + 4(y^2 - 2y + 1) = -4 + 4 + 4(1)$$

$$(x - 2)^2 + 4(y - 1)^2 = 4$$

$$x^2 + 4y - 4 = 0$$

$$x^2 = -4y + 4$$

$$x^2 = -4(y - 1)$$

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

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

$$(x^2 - 4x + 4) + 4\left(-\frac{x^2}{4}\right)^2 - 4 = 0$$

$$(x^2 - 4x + 4) + 4\left(\frac{x^4}{16}\right) - 4 = 0$$

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

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

$$\frac{4(x^2 - 4x)}{4} + \frac{x^4}{4} = 0$$

$$\frac{4x^2 - 16x + x^4}{4} = 0$$

$$\frac{x^4 + 4x^2 - 16x}{4} = 0$$

$$\frac{1}{4}x^4 + x^2 - 4x = 0$$

x	1	2	3
y	-2.75	0	5.75

$$x\left(\frac{1}{4}x^3 + x - 4\right) = 0 \quad x = 2$$

$$x = 0 \quad \frac{1}{4}x^3 + x - 4 = 0$$

$$0^2 + 4y - 4 = 0 \quad 2^2 + 4y - 4 = 0$$

$$4y = 4 \quad 4y = 0$$

$$y = 1 \quad y = 0$$

$$(0, 1), (2, 0)$$

Chapter 10 *continued*

45. $4x^2 - 56x + 9y^2 + 160 = 0$

$$4x^2 + y^2 - 64 = 0$$

$$4x^2 + y^2 - 64 = 0 \rightarrow y^2 = -4x^2 + 64$$

$$4x^2 - 56x + 9y^2 + 160 = 0$$

$$9y^2 = -4x^2 + 56x - 160$$

$$y^2 = \frac{-4x^2 + 56x - 160}{9}$$

$$\frac{-4x^2 + 56x - 160}{9} = -4x^2 + 64$$

$$-4x^2 + 56x - 160 = 9(-4x^2 + 64)$$

$$-4x^2 + 56x - 160 = -36x^2 + 576$$

$$-4x^2 + 36x^2 + 56x - 160 - 576 = 0$$

$$32x^2 + 56x - 736 = 0$$

$$8(4x^2 + 7x - 92) = 0$$

$$8(4x + 23)(x - 4) = 0$$

$$x = 4 \text{ or } x = -\frac{23}{4}$$

$$y^2 = -4x^2 + 64$$

$$y^2 = -4(4)^2 + 64$$

$$y^2 = -64 + 64 = 0 \rightarrow y = 0$$

$$y^2 = -4\left(-\frac{23}{4}\right)^2 + 64$$

$$y^2 = -4\left(\frac{529}{16}\right) + 64$$

$$y^2 = -\frac{529}{4} + 64 = -132.25 + 64 = -68.25,$$

no real roots

$$(4, 0)$$

46. $x^2 + y^2 - 16x + 39 = 0$

$$x^2 - y^2 - 9 = 0$$

$$y^2 = -x^2 + 16x - 39$$

$$y^2 = x^2 - 9$$

$$-x^2 + 16x - 39 = x^2 - 9$$

$$-2x^2 + 16x - 39 + 9 = 0$$

$$-2x^2 + 16x - 30 = 0$$

$$2x^2 - 16x + 30 = 0$$

$$2(x^2 - 8x + 15) = 0$$

$$2(x - 5)(x - 3) = 0$$

$$x = 5 \text{ or } x = 3$$

$$y^2 = x^2 - 9$$

$$y^2 = (5)^2 - 9 = 25 - 9 = 16$$

$$y = \pm 4$$

$$y^2 = (3)^2 - 9 = 9 - 9 = 0$$

$$y = 0$$

$$(5, \pm 4), (3, 0)$$

47. $x^2 - 4y^2 - 20x - 64y - 172 = 0$

$$4x^2 + y^2 - 80x + 16y + 400 = 0$$

$$x^2 - 20x - 4y^2 - 64y = 172$$

$$(x^2 - 20x + 100) - 4(y^2 + 16y + 64)$$

$$= 172 + 100 - 4(64)$$

$$(x - 10)^2 - 4(y + 8)^2 = 272 - 256$$

$$(x - 10)^2 - 4(y + 8)^2 = 16$$

$$\frac{(x - 10)^2}{16} - \frac{(y + 8)^2}{4} = 1$$

$$4x^2 + y^2 - 80x + 16y + 400 = 0$$

$$(4x^2 - 80x) + (y^2 + 16y) = -400$$

$$4(x^2 - 20x + 100) + (y^2 + 16y + 64)$$

$$= -400 + 4(100) + 64$$

$$4(x - 10)^2 + (y + 8)^2 = 64$$

$$\frac{(x - 10)^2}{16} + \frac{(y + 8)^2}{64} = 1$$

$$\frac{(x - 10)^2}{16} - \frac{(y + 8)^2}{4}$$

$$= \frac{(x - 10)^2}{16} + \frac{(y + 8)^2}{64}$$

$$\frac{(x - 10)^2}{16} - \frac{(x - 10)^2}{16} - \frac{(y + 8)^2}{4} = \frac{(y + 8)^2}{64}$$

$$\frac{(y + 8)^2}{64} + \frac{(y + 8)^2}{4} = 0$$

$$(y + 8)^2 + 16(y + 8)^2 = 0$$

$$(y^2 + 16y + 64) + 16(y^2 + 16y + 64) = 0$$

$$y^2 + 16y + 64 + 16y^2 + 256y + 1024 = 0$$

$$17y^2 + 272y + 1088 = 0$$

$$(17y + 136)(y + 8) = 0$$

$$y = -8$$

$$x^2 - 4(-8)^2 - 20x - 64(-8) - 172 = 0$$

$$x^2 - 256 - 20x + 512 - 172 = 0$$

$$x^2 - 20x + 84 = 0$$

$$(x - 14)(x - 6) = 0$$

$$x = 14 \text{ or } x = 6$$

$$(14, -8), (6, -8)$$

48. $x^2 - 2x + 4 + y^2 - 10 = 0$

$$2y^2 - x + 3 = 0$$

$$x^2 - 2x + y^2 - 6 = 0$$

$$-2x^2 + 4x - 2y^2 + 12 = 0$$

$$2y^2 - x + 3 = 0$$

—CONTINUED—

Chapter 10 *continued*

48. —CONTINUED—

$$\begin{aligned}
 & -2x^2 + 3x + 15 = 0 \\
 x &= \frac{-3 \pm \sqrt{9 - 4(-2)(15)}}{2(-2)} \\
 x &= \frac{-3 \pm \sqrt{9 + 120}}{-4} \\
 x &= \frac{-3 \pm \sqrt{129}}{-4} \\
 x &= \frac{3 \pm \sqrt{129}}{4} \\
 2y^2 - x + 3 &= 0 \\
 2y^2 &= x - 3 \\
 y^2 &= \frac{x - 3}{2} \\
 y^2 &= \left(\frac{3 + \sqrt{129}}{4} \right) - 3 \\
 y^2 &= \frac{1}{2} \left(\frac{3 + \sqrt{129}}{4} - \frac{12}{4} \right) \\
 y^2 &= \frac{1}{2} \left(\frac{3 - 12 + \sqrt{129}}{4} \right) \\
 y^2 &= \frac{1}{2} \left(\frac{-9 + \sqrt{129}}{4} \right) \\
 y &= \pm \sqrt{\frac{-9 + \sqrt{129}}{8}} \\
 y &= \pm \frac{1}{2} \sqrt{\frac{-9 + \sqrt{129}}{2}} \\
 y^2 &= \left(\frac{3 - \sqrt{129}}{4} \right) - 3 \\
 y^2 &= \frac{1}{2} \left(\frac{3 - \sqrt{129}}{4} - \frac{12}{4} \right) \\
 y^2 &= \frac{1}{2} \left(\frac{-9 - \sqrt{129}}{4} \right) \\
 y &= \pm \sqrt{\frac{-9 - \sqrt{129}}{8}}, \text{ no real roots} \\
 & \left(\frac{3 + \sqrt{129}}{4}, \pm \frac{1}{2} \sqrt{\frac{-9 + \sqrt{129}}{2}} \right)
 \end{aligned}$$

49. $4x^2 - y^2 - 8x + 6y - 9 = 0$

$$\begin{aligned}
 2x^2 - 3y^2 + 4x + 18y - 43 &= 0 \\
 -12x^2 + 3y^2 + 24x - 18y + 27 &= 0 \\
 \hline
 2x^2 - 3y^2 + 4x + 18y - 43 &= 0 \\
 -10x^2 + 28x - 16 &= 0 \\
 -2(5x^2 - 14x + 8) &= 0 \\
 -2(5x - 4)(x - 2) &= 0 \\
 x = 2 \text{ or } x = \frac{4}{5}
 \end{aligned}$$

$$\begin{aligned}
 2(2)^2 - 3y^2 + 4(2) + 18y - 43 &= 0 \\
 8 - 3y^2 + 8 + 18y - 43 &= 0 \\
 -3y^2 + 16 + 18y - 43 &= 0 \\
 -3y^2 + 18y - 27 &= 0 \\
 -3(y^2 - 6y + 9) &= 0 \\
 3(y - 3)(y - 3) &= 0
 \end{aligned}$$

$$\begin{aligned}
 y &= 3 \\
 2x^2 - 3y^2 + 4x + 18y - 43 &= 0 \\
 2\left(\frac{4}{5}\right)^2 - 3y^2 + 4\left(\frac{4}{5}\right) + 18y - 43 &= 0 \\
 2\left(\frac{16}{25}\right) - 3y^2 + \left(\frac{16}{5}\right) + 18y - 43 &= 0 \\
 \frac{32}{25} - 3y^2 + \frac{80}{25} + 18y - \frac{1075}{25} &= 0 \\
 -3y^2 + 18y - \frac{1075}{25} + \frac{112}{25} &= 0 \\
 -3y^2 + 18y - \frac{963}{25} &= 0 \\
 -18 \pm \sqrt{324 - 4(-3)\left(-\frac{963}{25}\right)} & \\
 y &= \frac{2(-3)}{2(-3)} \\
 y &= \frac{-18 \pm 1\sqrt{324 - 462.24}}{-6} \\
 y &= \frac{-18 \pm \sqrt{-138.24}}{-6}, \text{ no real roots}
 \end{aligned}$$

(2, 3)

50. $10x^2 - 25y^2 - 100x = -160$

$$\begin{aligned}
 y^2 - 2x + 16 &= 0 \\
 10x^2 - 25y^2 - 100x + 160 &= 0 \\
 \underline{25y^2 - 50x + 400 = 0} \\
 10x^2 - 150x + 560 &= 0 \\
 10(x^2 - 15x + 56) &= 0 \\
 10(x - 7)(x - 8) &= 0 \\
 x = 7 \text{ or } x = 8 \\
 y^2 - 2x + 16 &= 0 \\
 y^2 = 2x - 16 \\
 y^2 = 2(7) - 16 \\
 y^2 = 14 - 16 \\
 y^2 = -2, \text{ no real roots} \\
 y^2 = 2(8) - 16 \\
 y^2 = 16 - 16 \\
 y^2 = 0 \\
 y = 0 \\
 (8, 0)
 \end{aligned}$$

Chapter 10 *continued*

51. $x^2 - y - 4 = 0$

$$x^2 + 3y^2 - 4y - 10 = 0$$

$$x^2 + 3y^2 - 4y - 10 = 0$$

$$\underline{-x^2 + y + 4 = 0}$$

$$3y^2 - 3y - 6 = 0$$

$$3(y^2 - y - 2) = 0$$

$$3(y + 1)(y - 2) = 0$$

$$y = -1 \text{ or } y = 2$$

$$x^2 - y - 4 = 0$$

$$x^2 = y + 4$$

$$x^2 = y + 4$$

$$x^2 = (-1) + 4$$

$$x^2 = (2) + 4$$

$$x^2 = 3$$

$$x^2 = 6$$

$$x = \pm\sqrt{3}$$

$$x = \pm\sqrt{6}$$

$$(\pm\sqrt{3}, -1), (\pm\sqrt{6}, 2)$$

52. $x^2 + y^2 + 8x + 7 = 0$

$$x^2 + y^2 + 4x + 4y - 5 = 0$$

$$x^2 + y^2 = 1$$

$$x^2 + y^2 + 4x + 4y - 5 = 0$$

$$\underline{-(x^2 + y^2) = 1}$$

$$4x + 4y - 5 = -1$$

$$4x + 4y = 4$$

$$x^2 + y^2 + 8x + 7 = 0$$

$$\underline{-(x^2 + y^2) = 1}$$

$$8x + 7 = -1$$

$$8x = -8$$

$$8x = -8$$

$$4x + 4y = 4$$

$$8x = -8$$

$$\underline{-8x - 8y = -8}$$

$$-8y = -16$$

$$y = -2$$

$$4x + 4(-2) = 4$$

$$4x + (-8) = 4$$

$$4x = 12$$

$$x = 3$$

$$x^2 + y^2 \stackrel{?}{=} 1$$

$$(3)^2 + (-2)^2 \stackrel{?}{=} 1$$

$$9 + 4 \stackrel{?}{=} 1$$

$$13 \neq 1$$

no intersection

53. $x^2 + y^2 - 8 = 0$

$$x^2 + y^2 - 3x + y = 0$$

$$2x^2 + 2y^2 - 5x - 10 = 0$$

$$2x^2 + 2y^2 - 5x - 10 = 0$$

$$\underline{-(2x^2 + 2y^2) = 16}$$

$$-5x - 10 = -16$$

$$-5x = -6$$

$$x^2 + y^2 - 3x + y = 0$$

$$\underline{-(x^2 + y^2) = 8}$$

$$-3x + y = -8$$

$$-3x + y = -8$$

$$-5x = -6$$

$$15x - 5y = 40$$

$$\underline{-15x = -18}$$

$$-5y = 22$$

$$y = -\frac{22}{5}$$

$$-3x + \left(-\frac{22}{5}\right) = -8$$

$$-3x = -8 + \frac{22}{5}$$

$$-3x = -\frac{40}{5} + \frac{22}{5}$$

$$-3x = -\frac{18}{5}$$

$$x = -\frac{18}{5} \left(-\frac{1}{3}\right)$$

$$x = \frac{6}{5}$$

$$x^2 + y^2 - 8 = 0$$

$$\left(\frac{6}{5}\right)^2 + \left(-\frac{22}{5}\right)^2 - 8 = 0$$

$$\frac{36}{25} - \frac{484}{25} = 8$$

$$-\frac{348}{25} = 8$$

$$13.92 \neq 8$$

no intersection

54. $x^2 + 3y^2 = 16$

$$3(2)^2 + y^2 = 16$$

$$3x^2 + y^2 = 16$$

$$12 + y^2 = 16$$

$$y = -x$$

$$y = \pm 2$$

$$x^2 + 3(-x)^2 = 16$$

$$3(-2)^2 + y^2 = 16$$

$$x^2 + 3x^2 = 16$$

$$12 + y^2 = 16$$

$$4x^2 = 16$$

$$y = \pm 2$$

—CONTINUED—

Chapter 10 *continued*

54. —CONTINUED—

$$x^2 = 4$$

$$x = \pm 2$$

$$y = -x$$

$$y = -(-2) = 2$$

$$y = -(2) = -2$$

$$(-2, 2), (2, -2)$$

55. $x^2 + y^2 - 4x - 4y = 26$

$$x^2 + y^2 - 4x = 54$$

$$y = 3x - 8$$

$$x^2 + y^2 - 4x - 4y = 26$$

$$\underline{-(x^2 + y^2 - 4x) = 54}$$

$$-4y = -28$$

$$y = 7$$

$$3x = y + 8$$

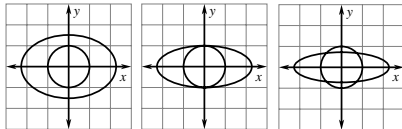
$$x = \frac{y + 8}{3}$$

$$x = \frac{7 + 8}{3} = \frac{15}{3} = 5$$

$$(5, 7)$$

56. Use rotation by 180° . If one is at (a, b) , the other is at $(-a, -b)$.

57.



0 points

2 points

4 points

58. $d = 60t$

$$d = 3600t^2$$

$$3600t^2 = 60t$$

$$3600t^2 - 60t = 0$$

$$60t(60t - 1) = 0$$

$$t = 0, t = \frac{1}{60}h = 1 \text{ min}$$

59. $x^2 + y^2 = 1620$

$$y = -\frac{1}{3}x + 30$$

$$x^2 + \left(-\frac{1}{3}x + 30\right)^2 = 1620$$

$$x^2 + \frac{1}{9}x^2 - 20x + 900 - 1620 = 0$$

$$\frac{10}{9}x^2 - 20x - 720 = 0$$

$$10x^2 - 180x - 6480 = 0$$

$$10(x^2 - 18x - 648) = 0$$

$$10(x - 36)(x + 18) = 0$$

$$x = 36 \text{ or } x = -18$$

$$y = -\frac{1}{3}x + 30$$

$$y = -\frac{1}{3}(36) + 30 = -12 + 30 = 18$$

$$y = -\frac{1}{3}(-18) + 30 = 6 + 30 = 36$$

$$(36, 18), (-18, 36)$$

$$d = \sqrt{(-18 - 36)^2 + (36 - 18)^2} = \sqrt{2916 + 324}$$

$$d = \sqrt{3240} \approx 59.6 \text{ miles}$$

60. Slope of line containing Clark Street: $m = \frac{0 - (-1)}{5 - (-2)} = \frac{1}{7}$

$$\text{Equation of the line: } y - 0 = \frac{1}{7}(x - 5)$$

$$y = \frac{1}{7}x - \frac{5}{7}$$

$$\text{Equation of circle: } x^2 + y^2 = 1$$

$$x^2 + y^2 = 1$$

$$y = \frac{1}{7}x - \frac{5}{7}$$

$$x^2 + \left(\frac{1}{7}x - \frac{5}{7}\right)^2 = 1$$

$$x^2 + \frac{1}{49}x^2 - \frac{10}{49}x + \frac{25}{49} = 1$$

$$\frac{50}{49}x^2 - \frac{10}{49}x - \frac{24}{49} = 0$$

$$50x^2 - 10x - 24 = 0$$

$$2(25x^2 - 5x - 12) = 0$$

$$2(5x + 3)(5x - 4) = 0$$

$$x = -\frac{3}{5} \text{ or } x = \frac{4}{5}$$

$$y = \frac{1}{7}\left(-\frac{3}{5}\right) - \frac{5}{7} \quad y = \frac{1}{7}\left(\frac{4}{5}\right) - \frac{5}{7}$$

$$y = -\frac{3}{35} - \frac{5}{7} \quad y = \frac{4}{35} - \frac{5}{7}$$

$$y = -\frac{4}{5} \quad y = -\frac{3}{5}$$

$$\left(-\frac{3}{5}, -\frac{4}{5}\right), \left(\frac{4}{5}, -\frac{3}{5}\right)$$

—CONTINUED—

Chapter 10 *continued*

60. —CONTINUED—

$$\begin{aligned} d &= \sqrt{\left(-\frac{3}{5} - \frac{4}{5}\right)^2 + \left(-\frac{4}{5} - \left(-\frac{3}{5}\right)\right)^2} \\ &= \sqrt{\frac{49}{25} + \frac{1}{25}} \\ &= \sqrt{\frac{50}{25}} \\ &= \sqrt{2} \end{aligned}$$

$$d \approx 1.41 \text{ mi}$$

61. $xy - 24 = 0$

$$x^2 - 25y^2 + 100 = 0$$

$$xy = 24$$

$$x = \frac{24}{y}$$

$$\left(\frac{24}{y}\right)^2 - 25y^2 + 100 = 0$$

$$\frac{576}{y^2} - 25y^2 + 100 = 0$$

$$\frac{576 - 25y^4 + 100y^2}{y^2} = 0$$

$$25y^4 - 100y^2 - 576 = 0$$

$$(5y^2 - 36)(5y^2 + 16) = 0$$

$$5y^2 = 36 \quad 5y^2 = -16$$

$$y^2 = \frac{36}{5} \quad y^2 = -\frac{16}{5}, \text{ no real roots}$$

$$y = \pm \frac{6}{\sqrt{5}}$$

$$x\left(\pm \frac{6}{\sqrt{5}}\right) - 24 = 0$$

$$\pm \frac{6}{\sqrt{5}}x = 24$$

$$x = 24\left(\pm \frac{\sqrt{5}}{6}\right)$$

$$x = \pm 4\sqrt{5}$$

$$\left(4\sqrt{5}, \frac{6\sqrt{5}}{5}\right) \approx (8.9, 2.7)$$

62. $m = \frac{8 - 0}{0 - 10} = -\frac{8}{10} = -\frac{4}{5}$

$$\text{Equation of line: } y - 8 = -\frac{4}{5}(x - 0)$$

$$y = -\frac{4}{5}x + 8$$

$$\text{Equation of hyperbola: } \frac{x^2}{36} - \frac{y^2}{64} = 1$$

$$\frac{x^2}{36} - \frac{y^2}{64} = 1$$

$$y = -\frac{4}{5}x + 8$$

$$\frac{x^2}{36} - \frac{\left(-\frac{4}{5}x + 8\right)^2}{64} = 1$$

$$16x^2 - 9\left(-\frac{4}{5}x + 8\right)^2 = 576$$

$$16x^2 - 9\left(\frac{16}{25}x^2 - \frac{64}{5}x + 64\right) = 576$$

$$16x^2 - \frac{144}{25}x^2 + \frac{576}{5}x - 576 - 576 = 0$$

$$400x^2 - 144x^2 + 2880x - 14,400 - 14,400 = 0$$

$$256x^2 + 2880x - 28,880 = 0$$

$$64(4x^2 + 45x - 450) = 0$$

$$x = \frac{-45 \pm \sqrt{2025 - 4(4)(-450)}}{2(4)}$$

$$x = \frac{-45 \pm \sqrt{9225}}{8}$$

$$x = \left(\frac{-45 \pm 15\sqrt{41}}{8}\right)$$

$$y = -\frac{4}{5}\left(\frac{-45 \pm 15\sqrt{41}}{8}\right) + 8$$

$$y = \frac{9 - 3\sqrt{41}}{2} + 8$$

$$y = \frac{9 - 3\sqrt{41} + 16}{2}$$

$$y = \frac{25 - 3\sqrt{41}}{2}$$

$$\left(\frac{-45 + 15\sqrt{41}}{8}, \frac{25 - 3\sqrt{41}}{2}\right) \approx (6.38, 2.90)$$

63. Location 1: $x^2 + y^2 = (13)^2$

$$x^2 + y^2 = 169$$

Location 2: $(x - 12)^2 + (y + 19)^2 = 169$

$$x^2 - 24x + 144 + y^2 + 38y + 361 = 169$$

Location 3: $(x - 11)^2 + (y - 10)^2 = 625$

$$x^2 - 22x + 121 + y^2 - 20y + 100 = 625$$

$$x^2 - 24x + 144 + y^2 + 38y + 361 = 169$$

$$-(x^2 + y^2) = (-169)$$

$$-24x + 144 + 38y + 361 = 0$$

$$-24x + 38y + 505 = 0$$

$$-24x + 38y = -505$$

Chapter 10 *continued*

63. —CONTINUED—

$$\begin{array}{r} x^2 - 22x + 121 + y^2 - 20y + 100 = 625 \\ \hline -(x^2 \qquad \qquad + y^2) \qquad \qquad = (-169) \\ \hline -22x + 121 \qquad -20y + 100 = 456 \\ -22x \qquad \qquad -20y + 221 = 456 \\ -22x \qquad \qquad -20y \qquad = 235 \\ -24x + 38y = -505 \\ -22x - 20y = 235 \\ 528x - 836y = 11,110 \\ \hline -528x - 480y = 5640 \\ \hline -1316y = 16,750 \\ y \approx -12.73 \\ -22x - 20y = 235 \\ -22x - 20(-12.73) = 235 \\ -22x = 235 - 254.6 \\ -22x = 19.6 \\ x \approx 0.89 \end{array}$$

$$(0.89, -12.73)$$

Epicenter is approximately 100 kilometers east,
1300 kilometers south of location 1.

64. $x^2 + y^2 = 6$

$$2x^2 + 4y^2 = 7$$

$$-2x^2 - 2y^2 = -12$$

$$\frac{2x^2 + 4y^2 = 7}{-2x^2 - 2y^2 = -12}$$

$$2y^2 = -5$$

$$y^2 = -\frac{5}{2}, \text{ no real roots}$$

A

65. $25x^2 + 36y^2 - 900 = 0$

$$-2x^2 + y + 5 = 0$$

$$y = 2x^2 - 5$$

$$25x^2 + 36(2x^2 - 5)^2 - 900 = 0$$

$$25x^2 + 36(4x^4 - 20x^2 + 25) - 900 = 0$$

$$25x^2 + 144x^4 - 720x^2 + 900 - 900 = 0$$

$$144x^4 - 695x^2 = 0$$

$$x^2(144x^2 - 695) = 0$$

$$x^2 = 0 \qquad 144x^2 = 695$$

$$x = 0 \qquad x^2 = \frac{695}{144}$$

$$x = \pm \frac{\sqrt{695}}{12}$$

$$y = 2x^2 - 5 = 2(0)^2 - 5 = -5$$

$$(0, 5)$$

E

66. Sample answer: $\frac{x^2}{16} + \frac{(y-6)^2}{4} = 1$

$$y = \frac{3}{8}x^2$$

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

10.7 Mixed Review (p. 638)

67. $2(4) + 5 = 8 + 5 = 13$

68. $\frac{1}{(2)^3} - 1 = \frac{1}{8} - 1 = \frac{1}{8} - \frac{8}{8} = -\frac{7}{8}$

69. $(-2)^{5-1} = (-2)^4 = 16$

70. $\frac{3}{(-3)^{4-2}} = \frac{3}{(-3)^2} = \frac{3}{9} = \frac{1}{3}$

71. $f(x) = (x-3)(x+3)(x-1)$
 $= (x^2-9)(x-1)$
 $= x^3 - x^2 - 9x + 9$

72. $f(x) = x(x-2)^2(x-4)$
 $= x(x^2-4x+4)(x-4)$
 $= x(x^3-4x^2+4x-4x^2+16x-16)$
 $= x(x^3-8x^2+20x-16)$
 $= x^4-8x^3+20x^2-16x$

73. $f(x) = (x-2i)(x+2i)$
 $= x^2-4i^2$
 $= x^2+4$

74. $f(x) = (x-3-i)(x-3+i)$
 $= x^2-3x+xi-3x+9-3i-xi+3i-i^2$
 $= x^2-6x+9+1$
 $= x^2-6x+10$

75. $f(x) = (x-2)(x+1)(x+1+i)(x+1-i)$
 $= (x^2-x-2)(x^2+x-xi+x+1-i+xi+i-i^2)$
 $= (x^2-x-2)(x^2+2x+1+1)$
 $= (x^2-x-2)(x^2+2x+2)$
 $= x^4+2x^3+2x^2-x^3-2x^2-2x-2x^2-4x-4$
 $= x^4+x^3-2x^2-6x-4$

76. $f(x) = (x+2)(x+3)(x-i)(x+i)(x-i)(x+i)$
 $= (x^2+5x+6)(x^2-i^2)(x^2-i^2)$
 $= (x^2+5x+6)(x^2+1)(x^2+1)$
 $= (x^2+5x+6)(x^4+2x^2+1)$
 $= x^6+2x^4+x^2+5x^5+10x^3+5x+6x^4+12x^2+6$
 $= x^6+5x^5+8x^4+10x^3+13x^2+5x+6$

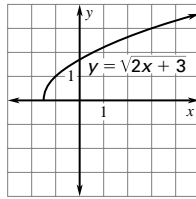
Chapter 10 continued

77. $f(x) = \sqrt{2x + 3}$

x	$-\frac{3}{2}$	0	$\frac{1}{2}$	3
y	0	$\sqrt{3}$	2	3

domain: $x \geq -\frac{3}{2}$

range: $y \geq 0$

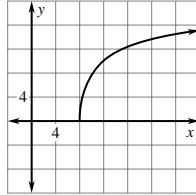


78. $f(x) = 5\sqrt{x - 8}$

x	8	9	12
y	0	5	10

domain: $x \geq 8$

range: $y \geq 0$

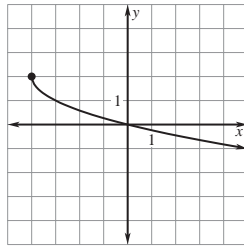


79. $f(x) = -(x + 4)^{1/2} + 2$

x	0	-4	5
y	0	2	-1

domain: $x \geq -4$

range: $y \leq 2$

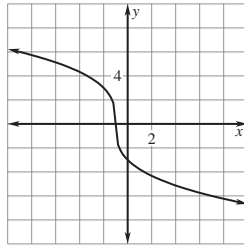


80. $f(x) = -3\sqrt[3]{x + 1}$

x	-1	7	-9
y	0	-6	6

domain: all reals

range: all reals

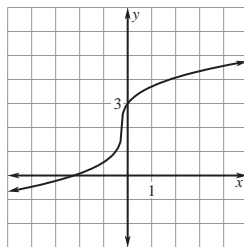


81. $f(x) = \sqrt[3]{4x + 1} + 2$

x	$\frac{7}{4}$	1
y	4	3.71

domain: all reals

range: all reals

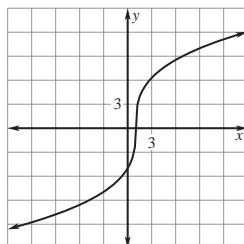


82. $f(x) = 5(x - 1)^{1/3}$

x	1	9	-7
y	0	10	-10

domain: all reals

range: all reals



83. $A = 3, B = 0, C = 1$

$B^2 - 4AC = 0^2 - 4(3)(1) = -12$

$B^2 - 4AC < 0, B = 0, A \neq C$

ellipse

84. $A = 4, B = 0, C = -1$

$B^2 - 4AC = 0^2 - 4(4)(-1) = 16$

$B^2 - 4AC > 0$

hyperbola

85. $A = 1, B = 0, C = 0$

$B^2 - 4AC = 0^2 - 4(1)(0) = 0$

$B^2 - 4AC = 0$

parabola

86. $A = 1, B = 0, C = 1$

$B^2 - 4AC = 0^2 - 4(1)(1) = -4$

$B^2 - 4AC < 0, B = 0, A = C$

circle

Quiz 3 (p. 638)

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

$(x + 3)^2 + (y + 5)^2 = 64$

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

$(h, k) = \left(\frac{-7 + 6}{2}, \frac{2 + 2}{2}\right) = \left(-\frac{1}{2}, 2\right)$

$a = \sqrt{\left(-7 + \frac{1}{2}\right)^2 + (2 - 2)^2}$

$a = \sqrt{\left(-\frac{14}{2} + \frac{1}{2}\right)^2} = \sqrt{\left(-\frac{13}{2}\right)^2} = \sqrt{\frac{169}{4}} = \frac{13}{2}$

$c = \sqrt{\left(4 + \frac{1}{2}\right)^2 + (2 - 2)^2}$

$c = \sqrt{\left(\frac{8}{2} + \frac{1}{2}\right)^2} = \sqrt{\left(\frac{9}{2}\right)^2} = \frac{9}{2}$

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

$= \left(\frac{13}{2}\right)^2 - \left(\frac{9}{2}\right)^2 = \frac{169}{4} - \frac{81}{4} = \frac{88}{4} = 22$

$\frac{(x + 0.5)^2}{42.25} + \frac{(y - 2)^2}{22} = 1$

3. parabola opens right $p > 0$

$(y - k)^2 = 4p(x - h)$

vertex $(4, -1)$, so $h = 4, k = -1$

$|p| = \sqrt{(7 - 4)^2 + (-1 + 1)^2} = \sqrt{(3)^2} = 3 \rightarrow p = 3$

$(y - k)^2 = 4p(x - h)$

$(y + 1)^2 = 4(3)(x - 4)$

$(y + 1)^2 = 12(x - 4)$

Chapter 10 *continued*

4. Vertical: $\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$

$$(h, k) = \left(\frac{2 + 2}{2}, \frac{3 + 4}{2} \right)$$

$$(h, k) = \left(2, \frac{7}{2} \right) = (2, 3.5)$$

$$a = \sqrt{(2 - 2)^2 + (3 - 3.5)^2}$$

$$= \sqrt{(-0.5)^2} = \sqrt{0.25} = 0.5$$

$$c = \sqrt{(2 - 2)^2 + (-1 - 3.5)^2} = \sqrt{(-4.5)^2}$$

$$= \sqrt{20.25} = 4.5$$

$$b^2 = c^2 - a^2 = 4.5^2 - 0.5^2 = 20.25 - 0.25 = 20$$

$$\frac{(y - 3.5)^2}{0.25} - \frac{(x - 2)^2}{20} = 1$$

5. $A = 1, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(1)(4) = -16$$

$$B^2 - 4AC < 0, B = 0, A \neq C$$

ellipse

6. $A = -1, B = 0, C = -1$

$$B^2 - 4AC = 0^2 - 4(-1)(-1) = -4$$

$$B^2 - 4AC < 0, B = 0, A \neq C$$

circle

7. $A = 0, B = 0, C = -2$

$$B^2 - 4AC = 0^2 - 4(0)(-2) = 0$$

$$B^2 - 4AC = 0$$

parabola

8. $A = -6, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(-6)(4) = 96$$

$$B^2 - 4AC > 0$$

hyperbola

9. $3x^2 - 4x - y + 2 = 0$

$$y = -5x + 4$$

$$3x^2 - 4x - (-5x + 4) + 2 = 0$$

$$3x^2 - 4x + 5x - 4 + 2 = 0$$

$$3x^2 + x - 2 = 0$$

$$(3x - 2)(x + 1) = 0$$

$$x = \frac{2}{3} \text{ or } x = -1$$

$$y = -5\left(\frac{2}{3}\right) + 4 = -\frac{10}{3} + \frac{12}{3} = \frac{2}{3}$$

$$y = -5(-1) + 4 = 5 + 4 = 9$$

$$\left(\frac{2}{3}, \frac{2}{3}\right), (-1, 9)$$

10. $-x^2 + y^2 + 4x - 6y + 4 = 0$

$$x^2 + y^2 - 4x - 6y + 12 = 0$$

$$2y^2 - 12y + 16 = 0$$

$$2(y^2 - 6y + 8) = 0$$

$$2(y - 4)(y - 2) = 0$$

$$y = 4 \text{ or } y = 2$$

$$x^2 + (4)^2 - 4x - 6(4) + 12 = 0$$

$$x^2 + 16 - 4x - 24 + 12 = 0$$

$$x^2 - 4x + 4 = 0$$

$$(x - 2)(x - 2) = 0$$

$$x = 2$$

$$x^2 + (2)^2 - 4x - 6(2) + 12 = 0$$

$$x^2 - 4x + 4 = 0$$

$$(x - 2)(x - 2) = 0$$

$$x = 2$$

$$(2, 4), (2, 2)$$

11. $x^2 + y^2 + 4y - 12 = 0$

$$x^2 - 16y^2 - 64y - 80 = 0$$

$$x^2 - 16y^2 - 64y - 80 = 0$$

$$-x^2 - y^2 - 4y + 12 = 0$$

$$-17y^2 - 68y - 68 = 0$$

$$-17(y^2 + 4y + 4) = 0$$

$$(y + 2)(y + 2) = 0$$

$$y = -2$$

$$x^2 + (-2)^2 + 4(-2) - 12 = 0$$

$$x^2 + 4 - 8 - 12 = 0$$

$$x^2 - 16 = 0$$

$$(x - 4)(x + 4) = 0$$

$$x = \pm 4$$

$$(-4, -2), (4, -2)$$

12. $y^2 - 6x - 2y - 3 = 0$

$$2y^2 - 4y + x + 6 = 0$$

$$y^2 - 6x - 2y - 3 = 0$$

$$12y^2 - 24y + 6x + 36 = 0$$

$$13y^2 - 26y + 33 = 0$$

$$y = \frac{26 \pm \sqrt{676 - 4(13)(33)}}{2(13)}$$

$$y = \frac{26 \pm \sqrt{676 - 1716}}{26}, \text{ no real roots}$$

none

13. The epicenter of the earthquake is 50 miles due west of the seismograph.

Chapter 10 continued

Chapter 10 Extension (p. 640)

1. $A = 3, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(3)(0) = 0, \text{ parabola so } e = 1$$

2. $25(x - 3)^2 + 9(y + 6)^2 = 225$

$$\frac{(x - 3)^2}{9} + \frac{(y + 6)^2}{25} = 1, \text{ ellipse}$$

$$b = 3, a = 5$$

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

$$c = 4$$

$$e = \frac{c}{a} = \frac{4}{5} = 0.8$$

3. $x^2 + 16(y - 4)^2 = 16$

$$\frac{x^2}{16} + (y - 4)^2 = 1, \text{ ellipse}$$

$$a = 4, b = 1$$

$$c^2 = a^2 - b^2 = 16 - 1 = 15$$

$$c = \sqrt{15}$$

$$e = \frac{c}{a} = \frac{\sqrt{15}}{4} \approx 0.968$$

4. $\frac{(x - 3)^2}{8} + \frac{(y - 5)^2}{8} = 8$

$$(x - 3)^2 + (y - 5)^2 = 1, \text{ circle, so } e = 0$$

5. $\frac{(x + 6)^2}{25} - \frac{(y - 6)^2}{100} = 1, \text{ hyperbola}$

$$a = 5, b = 10$$

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

$$c^2 = b^2 + a^2 = 100 + 25 = 125$$

$$c = \sqrt{125} = \sqrt{5 \cdot 25} = 5\sqrt{5}$$

$$e = \frac{c}{a} = \frac{5\sqrt{5}}{5} = \sqrt{5} \approx 2.236$$

6. $\frac{(x + 2)^2}{49} + \frac{(y + 2)^2}{16} = 1, \text{ ellipse}$

$$a = 7, b = 4$$

$$c^2 = a^2 - b^2 = 49 - 16 = 33$$

$$c = \sqrt{33}$$

$$e = \frac{c}{a} = \frac{\sqrt{33}}{7} \approx 0.821$$

7. $4(x + 1)^2 - 8(y - 2)^2 = 16$

$$\frac{(x + 1)^2}{4} - \frac{(y - 2)^2}{2} = 1, \text{ hyperbola}$$

$$a = 2, b = \sqrt{2}$$

$$c^2 = b^2 + a^2 = 2 + 4 = 6$$

$$c = \sqrt{6}$$

$$e = \frac{c}{a} = \frac{\sqrt{6}}{2} \approx 1.225$$

8. $(x - 4)^2 - (y - 3)^2 = 1, \text{ hyperbola}$

$$a = 1, b = 1$$

$$c = \sqrt{1^2 + 1^2} = \sqrt{2}$$

$$e = \frac{c}{a} = \sqrt{2} \approx 1.414$$

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

$$(h, k) = \left(\frac{-5 + 5}{2}, \frac{-1 + (-1)}{2} \right) = (0, -1)$$

$$a = \sqrt{(-5 - 0)^2 + (-1 + 1)^2}$$

$$a = \sqrt{25} = 5$$

$$\frac{c}{5} = 0.6$$

$$c = 0.6(5) = 3$$

$$c^2 = a^2 - b^2 \rightarrow b^2 = a^2 - c^2 = 25 - 9 = 16$$

$$b = 4$$

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

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

$$\frac{c}{a} = e$$

$$\frac{4}{a} = 0.5$$

$$4 = 0.5a$$

$$a = \frac{4}{0.5} = 8$$

$$\text{Center} = (2, 0) = (h, k)$$

$$c = 4$$

$$b^2 = a^2 - c^2 = 64 - 16 = 48$$

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

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

$$c = \sqrt{(2 - 2)^2 + (2 - 0)^2} = \sqrt{4} = 2$$

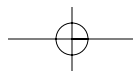
$$\frac{c}{a} = e$$

$$\frac{2}{a} = 0.25$$

$$a = \frac{2}{0.25} = 8$$

$$b^2 = a^2 - c^2 = 64 - 4 = 60$$

$$\frac{(x - 2)^2}{60} + \frac{y^2}{64} = 1$$



Chapter 10 continued

$$12. \frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

$$a = \sqrt{(3-0)^2 + (6-6)^2}$$

$$a = \sqrt{9} = 3$$

$$\frac{c}{a} = e$$

$$\frac{c}{3} = 0.1$$

$$c = 0.3$$

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

$$b^2 = 9 - 0.09 = 8.91$$

$$\frac{x^2}{9} + \frac{(y-6)^2}{8.91} = 1$$

$$13. \frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

$$(h, k) = \text{center} = \left(\frac{3+3}{2}, \frac{-7+9}{2} \right)$$

$$= (3, 1)$$

$$c = \sqrt{(3-3)^2 + (-7-1)^2}$$

$$= \sqrt{64} = 8$$

$$\frac{c}{a} = e$$

$$\frac{8}{a} = 3$$

$$8 = 3a$$

$$a = \frac{8}{3}$$

$$b^2 = c^2 - a^2 = 64 - \frac{64}{9} = \frac{512}{9}$$

$$\frac{(y-1)^2}{\left(\frac{64}{9}\right)} - \frac{(x-3)^2}{\left(\frac{512}{9}\right)} = 1$$

$$14. \frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$(h, k) = \text{center} = \left(\frac{-10-2}{2}, \frac{4+4}{2} \right)$$

$$= (-6, 4)$$

$$a = \sqrt{(-10+6)^2 + (4-4)^2}$$

$$= \sqrt{16} = 4$$

$$\frac{c}{a} = e$$

$$\frac{c}{4} = 2.4$$

$$c = 9.6$$

$$b^2 = c^2 - a^2 = 92.16 - 16 = 76.16$$

$$\frac{(x+6)^2}{16} - \frac{(y-4)^2}{76.16} = 1$$

$$15. \frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$

$$a = \sqrt{(3-3)^2 + (5-2)^2}$$

$$= \sqrt{9} = 3$$

$$\frac{c}{a} = e$$

$$\frac{c}{3} = 1.9$$

$$c = 5.7$$

$$b^2 = c^2 - a^2 = 32.49 - 9 = 23.49$$

$$\frac{(y-2)^2}{9} - \frac{(x-3)^2}{23.49} = 1$$

$$16. \frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$

$$c = \sqrt{(4-(-1))^2 + (2-2)^2}$$

$$= \sqrt{25} = 5$$

$$\frac{c}{a} = e$$

$$\frac{5}{a} = 5$$

$$5 = 5a$$

$$a = 1$$

$$b^2 = c^2 - a^2 = 25 - 1 = 24$$

$$(x+1)^2 - \frac{(y-2)^2}{24} = 1$$

17. Let the major axis be horizontal so,

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

$$2a = 72 \rightarrow a = 36$$

$$e = \frac{c}{a} \rightarrow 0.2056 = \frac{c}{36}$$

$$c \approx 7.4$$

$$b^2 = a^2 - c^2 = 1296 - 54.76 \approx 1241$$

$$\frac{x^2}{1296} + \frac{y^2}{1241} = 1 \quad (x, y \text{ in millions of miles})$$

Chapter 10 *continued*

18. $a - c = 128.4$
 $c = a - 128.4$
 $e = \frac{c}{a}$
 $0.0932 = \frac{a - 128.4}{a}$
 $0.0932a = a - 128.4$
 $-0.9068a = -128.4$
 $a \approx 141.596824$
 $c = a - 128.4$
 $= 141.596824 - 128.4$
 $= 13.196824$
 $b^2 = a^2 - c^2$
 $= (141.596824)^2 - (13.196824)^2$
 $= 20,049.66 - 174.16$
 $= 19,875.50$
 $\frac{x^2}{20,049.66} + \frac{y^2}{19,875.50} = 1$
 (x, y in millions of miles)

19. In an ellipse the foci are always within the major axis, so $c < a$ and $\frac{c}{a} < 1$. In a hyperbola the foci are always outside the major axis, so $c > a$ and $\frac{c}{a} > 1$.

Chapter 10 Review (pp. 642–644)

1. $d = \sqrt{(4 + 2)^2 + (2 + 3)^2} = \sqrt{36 + 25} = \sqrt{61} \approx 7.81$
 $\left(\frac{-2 + 4}{2}, \frac{-3 + 2}{2}\right) = \left(1, -\frac{1}{2}\right)$

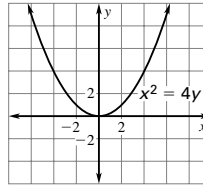
2. $d = \sqrt{(10 + 5)^2 + (-3 - 4)^2} = \sqrt{225 + 49}$
 $= \sqrt{274} \approx 16.6$
 $\left(\frac{-5 + 10}{2}, \frac{4 - 3}{2}\right) = \left(\frac{5}{2}, \frac{1}{2}\right)$

3. $d = \sqrt{(-4 - 0)^2 + (4 - 0)^2} = \sqrt{16 + 16}$
 $= \sqrt{32} = 4\sqrt{2} \approx 5.66$
 $\left(\frac{0 - 4}{2}, \frac{0 + 4}{2}\right) = (-2, 2)$

4. $d = \sqrt{(0 + 2)^2 + (-8 - 0)^2} = \sqrt{4 + 64}$
 $= \sqrt{68} = 2\sqrt{17} \approx 8.25$
 $\left(\frac{-2 + 0}{2}, \frac{0 - 8}{2}\right) = (-1, -4)$

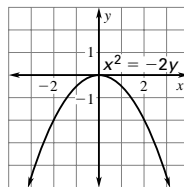
5. $x^2 = 4y$
 vertex: $(0, 0)$, vertical axis of symmetry
 $x^2 = 4py = 4y \rightarrow p = 1$, parabola opens up
 focus: $(0, p) = (0, 1)$
 directrix: $y = -p = -1$

x	0	1	-1	2	-2
y	0	$\frac{1}{4}$	$\frac{1}{4}$	1	1



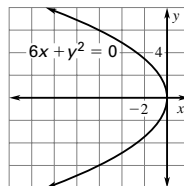
6. $x^2 = -2y$
 vertex: $(0, 0)$, vertical axis of symmetry
 $x^2 = 4py = -2y \rightarrow p = -\frac{1}{2}$, parabola opens down
 focus: $(0, p) = \left(0, -\frac{1}{2}\right)$
 directrix: $y = -p = \frac{1}{2}$

x	0	1	-1	2	-2
y	0	$-\frac{1}{2}$	$-\frac{1}{2}$	-2	-2



7. $6x + y^2 = 0$
 $y^2 = -6x$
 vertex $(0, 0)$, horizontal axis of symmetry
 $y^2 = 4px = -6x \rightarrow p = -\frac{3}{2}$, parabola opens left
 focus: $(p, 0) = \left(-\frac{3}{2}, 0\right)$
 directrix: $x = -p = \frac{3}{2}$

y	0	1	-1	2	-2
x	0	$-\frac{1}{6}$	$-\frac{1}{6}$	$-\frac{2}{3}$	$-\frac{2}{3}$



Chapter 10 *continued*

8. $y^2 - 12x = 0$

$$y^2 = 12x$$

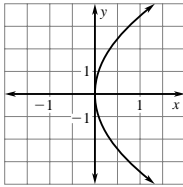
vertex: (0, 0) horizontal axis of symmetry

$$y^2 = 4px = 12x \rightarrow p = 3, \text{ parabola opens right}$$

focus: $(p, 0) = (3, 0)$

directrix: $x = -p = -3$

y	0	1	-1	2	-2
x	0	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{3}$	$\frac{1}{3}$



9. $p = 4$

$p > 0$, horizontal axis of symmetry

$$y^2 = 4px$$

$$y^2 = 4(4)x = 16x$$

$$y^2 = 16x$$

10. $p = -3$

$p < 0$, vertical axis of symmetry

$$x^2 = 4py$$

$$= 4(-3)y$$

$$= -12y$$

$$x^2 = -12y$$

11. $y = -p$, so $p = 2$

Vertical axis of symmetry $x^2 = 4py = 4(2)y = 8y$

$$x^2 = 8y$$

12. $x = -p$, so $p = -1$ $y^2 = 4px = 4(-1)x = -4x$

$$y^2 = -4x$$

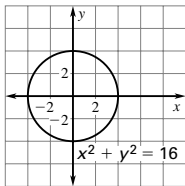
13. center: (0, 0)

$$r = 4$$

points on circle:

(0, 4), (0, -4), (4, 0),

(-4, 0)



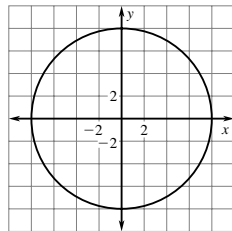
14. center: (0, 0)

$$r = 8$$

points on circle:

(0, 8), (0, -8), (8, 0),

(-8, 0)



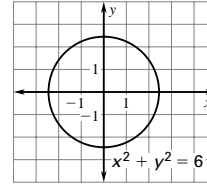
15. center: (0, 0)

$$r = \sqrt{6}$$

points on circle:

$(\sqrt{6}, 0), (-\sqrt{6}, 0),$

$(0, \sqrt{6}), (0, -\sqrt{6})$



16. $3x^2 + 3y^2 = 363$

$$x^2 + y^2 = \frac{1}{3}(363)$$

$$x^2 + y^2 = 121$$

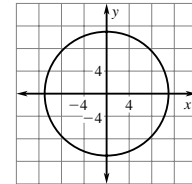
center: (0, 0)

$$r = 11$$

points on circle:

(11, 0), (-11, 0),

(0, 11), (0, -11)



17. $x^2 + y^2 = (5)^2$

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

19. $x^2 + y^2 = r^2$

$$(-2)^2 + (3)^2 = r^2$$

$$4 + 9 = r^2$$

$$13 = r^2$$

$$x^2 + y^2 = 13$$

18. $x^2 + y^2 = (\sqrt{10})^2$

$$x^2 + y^2 = 10$$

20. Point: (1, 8)

$$x^2 + y^2 = r^2$$

$$(1)^2 + (8)^2 = r^2$$

$$1 + 64 = r^2$$

$$65 = r^2$$

$$x^2 + y^2 = 65$$

21. $4x^2 + 81y^2 = 324$

$$\frac{x^2}{81} + \frac{y^2}{4} = 1$$

horizontal major axis:

$$81 > 4$$

$$a = 9, b = 2$$

$$c^2 = a^2 - b^2 = 81 - 4 = 77$$

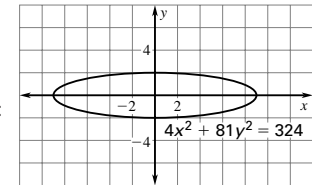
$$c = \sqrt{77}$$

center: (0, 0)

vertices: (-9, 0), (9, 0)

co-vertices: (0, -2), (0, 2)

foci: $(-\sqrt{77}, 0), (\sqrt{77}, 0)$



22. $-9x^2 - 4y^2 = -36$

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

vertical major axis: $4 < 9$

$$a = 3, b = 2$$

$$c^2 = a^2 - b^2 = 9 - 4 = 5$$

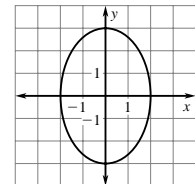
$$c = \sqrt{5}$$

center: (0, 0)

vertices: (0, -3), (0, 3)

co-vertices: (-2, 0), (2, 0)

foci: $(0, -\sqrt{5}), (0, \sqrt{5})$



Chapter 10 *continued*

23. $49x^2 + 36y^2 = 1764$

$$\frac{x^2}{36} + \frac{y^2}{49} = 1$$

vertical major axis: $36 < 49$

$$\sqrt{49} = 7$$

$$\sqrt{36} = 6$$

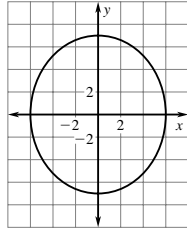
$$49 - 36 = 13$$

center: $(0, 0)$

vertices: $(0, -7), (0, 7)$

co-vertices: $(-6, 0), (6, 0)$

foci: $(0, -\sqrt{13}), (0, \sqrt{13})$



24. $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$ 25. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$$a = 5, b = 1$$

$$a = 4, c = 3$$

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

$$b^2 = a^2 - c^2 = 16 - 9 = 7$$

$$\frac{x^2}{16} + \frac{y^2}{7} = 1$$

26. horizontal transverse axis: x^2
term > 0

$$a = 10, b = 8$$

center: $(0, 0)$

vertices: $(-10, 0), (10, 0)$

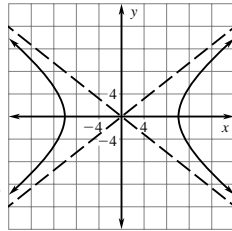
$$c^2 = a^2 + b^2 = 100 + 64 = 164$$

$$c = 2\sqrt{41}$$

foci: $(-2\sqrt{41}, 0), (2\sqrt{41}, 0)$

$$\text{asymptotes: } y = \pm \frac{b}{a}x$$

$$y = \pm \frac{8}{10}x = \pm \frac{4}{5}x$$



27. $16y^2 - 9x^2 = 144$

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

vertical transverse axis: y^2
term > 0

$$a = 3, b = 4$$

center: $(0, 0)$

vertices: $(0, -3), (0, 3)$

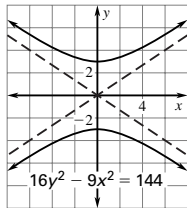
$$c^2 = a^2 + b^2 = 9 + 16 = 25$$

$$c = 5$$

foci: $(0, -5), (0, 5)$

$$\text{asymptotes: } y = \pm \frac{a}{b}x$$

$$y = \pm \frac{3}{4}x$$



28. $y^2 - 4x^2 = 4$

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

vertical transverse axis: y^2
term > 0

$$a = 2, b = 1$$

$$c^2 = a^2 + b^2 = 4 + 1 = 5$$

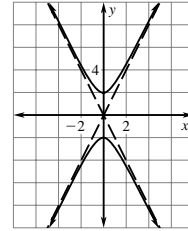
$$c = \sqrt{5}$$

center: $(0, 0)$

vertices: $(0, -2), (0, 2)$

foci: $(0, -\sqrt{5}), (0, \sqrt{5})$

$$\text{asymptotes: } y = \pm \frac{a}{b}x = \pm \frac{2}{1}x = \pm 2x$$



29. $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$

$$c = 3, a = 1$$

$$c^2 = a^2 + b^2$$

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

$$y^2 - \frac{x^2}{8} = 1$$

30. $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$

$$\frac{y^2}{4} - \frac{x^2}{12} = 1$$

$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$

$$c = 4, a = 2$$

$$b^2 = c^2 - a^2 = 16 - 4 = 12$$

31. $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$$c = 5, a = 3$$

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

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

32. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0$$

$$B^2 - 4AC = 0, \text{ parabola}$$

$$(x^2 + 8x) - 8y = -16$$

$$(x^2 + 8x + 16) - 8y = -16 + 16$$

$$x^2 + 8x + 16 = 8y$$

$$(x + 4)^2 = 8y$$

—CONTINUED—

Chapter 10 *continued*

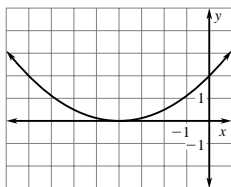
32. —CONTINUED—

vertex: $(-4, 0)$

$$(x + 4)^2 = 8y$$

$$(x + 4)^2 = 4(2)y$$

$p = 2, p > 0$, parabola opens up



33. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$B^2 - 4AC < 0, B = 0, A = C$, circle

$$x^2 + y^2 - 10x + 2y - 74 = 0$$

$$x^2 - 10x + y^2 + 2y = 74$$

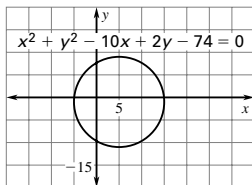
$$(x^2 - 10x + 25) + (y^2 + 2y + 1) = 74 + 25 + 1$$

$$(x - 5)^2 + (y + 1)^2 = 100$$

$r = 10$

center: $(5, -1)$

points on circle: $(15, -1), (5, 9), (-5, -1), (5, -11)$



34. $A = 9, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(9)(1) = -36$$

$B^2 - 4AC < 0, B = 0, A \neq C$, ellipse

$$9x^2 + y^2 + 72x - 2y + 136 = 0$$

$$9x^2 + 72x + y^2 - 2y = -136$$

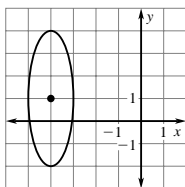
$$9(x^2 + 8x + 16) + (y^2 - 2y + 1) = -136 + 9(16) + 1$$

$$9(x + 4)^2 + (y - 1)^2 = 9$$

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

center: $(-4, 1)$; vertices: $(-4, 3), (-4, -2)$;

co-vertices: $(-3, 1), (-5, 1)$



35. $A = -4, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(-4)(1) = 16$$

$B^2 - 4AC > 0$, hyperbola

$$y^2 - 4x^2 - 18y - 8x + 76 = 0$$

$$y^2 - 18y - 4x^2 - 8x = -76$$

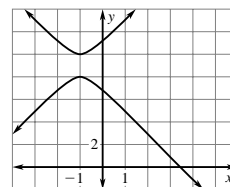
$$(y^2 - 18y + 81) - 4(x^2 + 2x + 1) = -76 + 81 - 4$$

$$(y - 9)^2 - 4(x + 1)^2 = 1$$

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

center: $(-1, 9)$;

vertices: $(-1, 8), (-1, 10)$



36. $x^2 + y^2 - 18x + 24y + 200 = 0$

$$4x + 3y = 0$$

$$3y = -4x$$

$$y = -\frac{4}{3}x$$

$$x^2 + \left(-\frac{4}{3}x\right)^2 - 18x + 24\left(-\frac{4}{3}x\right) + 200 = 0$$

$$x^2 + \frac{16}{9}x^2 - 18x - 32x + 200 = 0$$

$$\frac{25}{9}x^2 - 50x + 200 = 0$$

$$\frac{25}{9}(x^2 - 18x + 72) = 0$$

$$\frac{25}{9}(x - 12)(x - 6) = 0$$

$$x = 12 \text{ or } x = 6$$

$$y = \left(-\frac{4}{3}\right)(12) = -16$$

$$y = \left(-\frac{4}{3}\right)(6) = -8$$

$$(12, -16), (6, -8)$$

37. $5x^2 + 3x - 8y + 2 = 0$

$$3x + y - 6 = 0$$

$$5x^2 + 3x - 8y + 2 = 0$$

$$\underline{24x + 8y - 48 = 0}$$

$$5x^2 + 27x - 46 = 0$$

$$x = \frac{-27 \pm \sqrt{729 - 4(5)(-46)}}{2(5)}$$

$$= \frac{-27 \pm \sqrt{1649}}{10}$$

$$3\left(\frac{-27 + \sqrt{1649}}{10}\right) + y - 6 = 0$$

$$y = \frac{81 - 3\sqrt{1649}}{10} + \frac{60}{10}$$

$$y = \frac{141 - 3\sqrt{1649}}{10}$$

—CONTINUED—

Chapter 10 continued

37. —CONTINUED—

$$3\left(\frac{-27 - \sqrt{1649}}{10}\right) + y - 6 = 0$$

$$y = \frac{81 + 3\sqrt{1649}}{10} + \frac{60}{10}$$

$$y = \frac{141 + 3\sqrt{1649}}{10}$$

$$\left(\frac{-27 + \sqrt{1649}}{10}, \frac{141 - 3\sqrt{1649}}{10}\right), \left(\frac{-27 - \sqrt{1649}}{10}, \frac{141 + 3\sqrt{1649}}{10}\right)$$

$$\approx (1.361, 1.918), (-6.761, 26.282)$$

38. $4x^2 + y^2 - 48x - 2y + 129 = 0$

$$x^2 + y^2 - 2x - 2y - 7 = 0$$

$$4x^2 + y^2 - 48x - 2y + 129 = 0$$

$$\frac{-x^2 - y^2 + 2x + 2y + 7 = 0}{3x^2 - 46x + 136 = 0}$$

$$3x^2 - 46x + 136 = 0$$

$$(3x - 34)(x - 4) = 0$$

$$x = \frac{34}{3} \text{ or } x = 4$$

$$(4)^2 + y^2 - 2(4) - 2y - 7 = 0$$

$$16 + y^2 - 8 - 2y - 7 = 0$$

$$y^2 - 2y + 1 = 0$$

$$(y - 1)(y - 1) = 0$$

$$y = 1$$

$$x^2 + y^2 - 2x - 2y - 7 = 0$$

$$\left(\frac{34}{3}\right)^2 + y^2 - 2\left(\frac{34}{3}\right) - 2y - 7 = 0$$

$$\frac{1156}{9} + y^2 - \frac{68}{3} - 2y - 7 = 0$$

$$y^2 - 2y + \frac{889}{9} = 0$$

$$y = \frac{2 \pm \sqrt{4 - 4(1)\left(\frac{889}{9}\right)}}{2(1)}$$

$$y = \frac{2 \pm \sqrt{-\frac{3520}{9}}}{2}; \text{ no real roots}$$

$$(4, 1)$$

39. $9x^2 - 16y^2 + 18x + 153 = 0$

$$\frac{9x^2 + 16y^2 + 18x - 135 = 0}{18x^2 + 36x + 18 = 0}$$

$$18x^2 + 36x + 18 = 0$$

$$18(x^2 + 2x + 1) = 0$$

$$(x + 1)^2 = 0$$

$$(x + 1)(x + 1) = 0$$

$$x = -1$$

$$9(-1)^2 - 16y^2 + 18(-1) + 153 = 0$$

$$9 - 16y^2 - 18 + 153 = 0$$

$$-16y^2 + 144 = 0$$

$$-16(y^2 - 9) = 0$$

$$-16(y - 3)(y + 3) = 0$$

$$y = \pm 3$$

$$(-1, 3), (-1, -3)$$

Chapter 10 Test (p. 645)

1. $d = \sqrt{(5 - 1)^2 + (3 - 9)^2}$

$$d = \sqrt{16 + 36} = \sqrt{52} = 2\sqrt{13} \approx 7.21$$

$$\left(\frac{1 + 5}{2}, \frac{9 + 3}{2}\right) = (3, 6)$$

2. $d = \sqrt{(4 + 8)^2 + (7 - 3)^2}$

$$d = \sqrt{144 + 16} = \sqrt{160}$$

$$d = 4\sqrt{10} \approx 12.6$$

$$\left(\frac{-8 + 4}{2}, \frac{3 + 7}{2}\right) = (-2, 5)$$

3. $d = \sqrt{(3 + 4)^2 + (10 + 2)^2}$

$$d = \sqrt{49 + 144} = \sqrt{193} \approx 13.9$$

$$\left(\frac{-4 + 3}{2}, \frac{-2 + 10}{2}\right) = \left(-\frac{1}{2}, 4\right)$$

4. $d = \sqrt{(-3 + 11)^2 + (7 + 5)^2}$

$$d = \sqrt{64 + 144} = \sqrt{208}$$

$$d = 4\sqrt{13} \approx 14.4$$

$$\left(\frac{-11 + (-3)}{2}, \frac{-5 + 7}{2}\right) = (-7, 1)$$

5. $d = \sqrt{(2 + 1)^2 + (8 - 6)^2}$

$$d = \sqrt{9 + 4} = \sqrt{13} \approx 3.61$$

$$\left(\frac{-1 + 2}{2}, \frac{6 + 8}{2}\right) = \left(\frac{1}{2}, 7\right)$$

6. $d = \sqrt{(4 - 3)^2 + (9 + 2)^2} = \sqrt{1 + 121}$

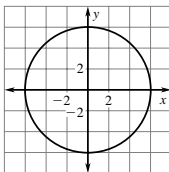
$$= \sqrt{122} \approx 11.0$$

$$\left(\frac{3 + 4}{2}, \frac{-2 + 9}{2}\right) = \left(\frac{7}{2}, \frac{7}{2}\right)$$

Chapter 10 *continued*

7. $r = 6$

center: $(0, 0)$;
points on circle:
 $(6, 0), (0, 6), (-6, 0), (0, -6)$

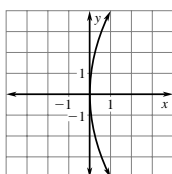


8. vertex: $(0, 0)$, horizontal axis of symmetry

$$y^2 = 4px = 16x \rightarrow p = 4, \text{ parabola opens right}$$

focus: $(p, 0) = (4, 0)$

directrix: $x = -p = -4$



x	0	1	4	1	4
y	0	4	8	-4	-8

9. $9y^2 - 81x^2 = 729$

$$\frac{y^2}{81} - \frac{x^2}{9} = 1$$

vertical transverse axis: y^2 term > 0

center: $(0, 0)$

$$a = 9, b = 3$$

$$c^2 = a^2 + b^2 = 81 + 9 = 90$$

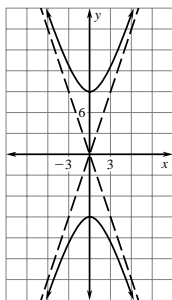
$$c = \sqrt{90}$$

vertices: $(0, \pm 9)$

foci: $(0, \pm \sqrt{90})$

asymptotes: $y = \pm \frac{a}{b}x$

$$y = \pm \frac{3}{9}x = \pm \frac{1}{3}x$$



10. $25x^2 + 9y^2 = 225$

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

vertical major axis: $9 < 25$

center: $(0, 0)$

$$a = 5, b = 3$$

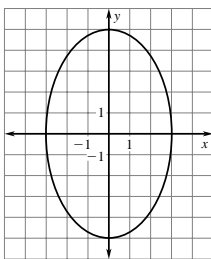
$$c^2 = a^2 - b^2 = 25 - 9 = 16$$

$$c = 4$$

vertices: $(0, \pm 5)$

co-vertices: $(\pm 3, 0)$

foci: $(0, 4), (0, -4)$

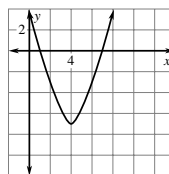


11. vertex: $(4, -7)$, vertical axis of symmetry

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

parabola opens up

$$\text{focus: } (h, k + p) = \left(4, -\frac{27}{4}\right)$$

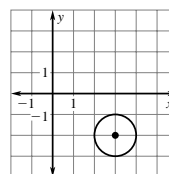


12. $r = 1$

center: $(3, -2)$

points on circle: $(4, -2)$

$(2, -2), (3, -1), (3, -3)$



13. horizontal major axis: $4 > 1$

$$a = 2, b = 1$$

$$c^2 = a^2 - b^2 = 4 - 1 = 3$$

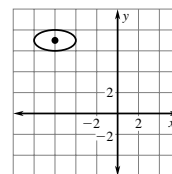
$$c = \sqrt{3}$$

center: $(-6, 7)$

vertices: $(-8, 7), (-4, 7)$

co-vertices: $(-6, 8), (-6, 6)$

foci: $(-6 \pm \sqrt{3}, 7)$



14. horizontal transverse axis, x^2 term > 0

$$a = 4, b = 4$$

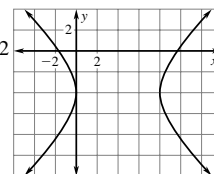
$$c^2 = a^2 + b^2 = 16 + 16 = 32$$

$$c = 4\sqrt{2}$$

center: $(4, -4)$

vertices: $(0, -4), (8, -4)$

foci: $(4, -4 \pm 4\sqrt{2})$



15. vertical transverse axis, y^2 term > 0

$$a = 2, b = 4$$

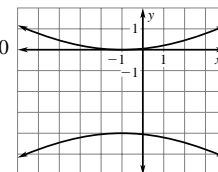
$$c^2 = a^2 + b^2 = 4 + 16 = 20$$

$$c = 2\sqrt{5}$$

center: $(-1, -2)$

vertices: $(-1, 0), (-1, -4)$

foci: $(-1 \pm 2\sqrt{5}, -2)$



Chapter 10 *continued*

16. $x = -p, p = -5$

$$y^2 = 4px$$

$$y^2 = 4(-5)x$$

$$y^2 = -20x$$

17. $p > 0$, horizontal axis of symmetry

$$(x - h)^2 = 4p(y - k)$$

$$h = 3, k = -6$$

$$|p| = \sqrt{(3 - 3)^2 + (-4 + 6)^2} = \sqrt{4} = 2$$

Since $p > 0, p = 2$.

$$(x - 3)^2 = 4(2)(y + 6)$$

$$(x - 3)^2 = 8(y + 6)$$

18. $x^2 + y^2 = r^2$

$$r = \sqrt{(4 - 0)^2 + (6 - 0)^2} = \sqrt{16 + 36} = \sqrt{52}$$

$$x^2 + y^2 = 52$$

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

$$(x + 8)^2 + (y - 3)^2 = 25$$

20. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$$a = 4, b = 2$$

$$\frac{x^2}{16} + \frac{y^2}{4} = 1$$

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

$$(h, k) = \text{center} = \left(\frac{3 + 3}{2}, \frac{-4 + (-2)}{2} \right) = (3, -3)$$

$$a = \sqrt{(3 - 3)^2 + (-5 + 3)^2} = \sqrt{4} = 2$$

$$c = \sqrt{(3 - 3)^2 + (-3 + 4)^2} = \sqrt{1} = 1$$

$$b^2 = a^2 - c^2 = 4 - 1 = 3$$

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

22. $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$$a = 7, c = 9$$

$$b^2 = c^2 - a^2 = 81 - 49 = 32$$

$$\frac{x^2}{49} - \frac{y^2}{32} = 1$$

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

$$a = \sqrt{(4 - 4)^2 + (2 + 1)^2} = \sqrt{9} = 3$$

$$c = \sqrt{(4 - 4)^2 + (4 + 1)^2} = \sqrt{25} = 5$$

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

$$\frac{(y + 1)^2}{9} - \frac{(x - 4)^2}{16} = 1$$

24. $A = 1, B = 0, C = 4$

$$B^2 - 4AC = 0^2 - 4(1)(4) = -16$$

$$B^2 - 4AC < 0, B = 0, A \neq C, \text{ ellipse}$$

$$x^2 + 4y^2 - 2x - 3 = 0$$

$$(x^2 - 2x + 1) + 4y^2 = 3 + 1$$

$$(x - 1)^2 + 4y^2 = 4$$

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

25. $A = 2, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(2)(0) = 0, \text{ parabola}$$

$$2x^2 + 20x - y + 41 = 0$$

$$2x^2 + 20x = y - 41$$

$$2(x^2 + 10x + 25) = y - 41 + 2(25)$$

$$2(x + 5)^2 = (y + 9)$$

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

26. $A = 5, B = 0, C = -3$

$$B^2 - 4AC = 0^2 - 4(5)(-3) = 60$$

$$B^2 - 4AC > 0, \text{ hyperbola}$$

$$5x^2 - 3y^2 - 30 = 0$$

$$5x^2 - 3y^2 = 30$$

$$\frac{x^2}{6} - \frac{y^2}{10} = 1$$

27. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0, B = 0, A = C, \text{ circle}$$

$$x^2 + y^2 - 12x + 4y + 31 = 0$$

$$(x^2 - 12x + 36) + (y^2 + 4y + 4) = -31 + 36 + 4$$

$$(x - 6)^2 + (y + 2)^2 = 9$$

28. $A = 0, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(0)(1) = 0, \text{ parabola}$$

$$y^2 - 8x - 4y + 4 = 0$$

$$y^2 - 4y + 4 = 8x - 4 + 4$$

$$(y - 2)^2 = 8x$$

29. $A = -1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(-1)(1) = 4$$

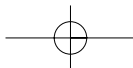
$$B^2 - 4AC > 0, \text{ hyperbola}$$

$$-x^2 - 6x + y^2 - 6y = 4$$

$$-(x^2 + 6x + 9) + (y^2 - 6y + 9) = 4 + (-1)(9) + 9$$

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

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



Chapter 10 *continued*

30. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0, \text{ parabola}$$

$$x^2 - 8x + 4y + 16 = 0$$

$$x^2 - 8x = -4y - 16$$

$$x^2 - 8x + 16 = -4y - 16 + 16$$

$$(x - 4)^2 = -4y$$

31. $A = 3, B = 0, C = 3$

$$B^2 - 4AC = 0^2 - 4(3)(3) = -36$$

$$B^2 - 4AC < 0, B = 0, A = C, \text{ circle}$$

$$3x^2 - 30x + 3y^2 = -59$$

$$3(x^2 - 10x + 25) + 3y^2 = -59 + 3(25)$$

$$3(x - 5)^2 + 3y^2 = 16$$

$$(x - 5)^2 + y^2 = \frac{16}{3}$$

32. $A = 1, B = 0, C = 2$

$$B^2 - 4AC = 0^2 - 4(1)(2) = -8$$

$$B^2 - 4AC < 0, B = 0, A \neq C, \text{ ellipse}$$

$$x^2 - 8x + 2y^2 = -7$$

$$x^2 - 8x + 16 + 2y^2 = -7 + 16$$

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

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

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

33. $A = 4, B = 0, C = -1$

$$B^2 - 4AC = 0^2 - 4(4)(-1) = 16$$

$$B^2 - 4AC > 0, \text{ hyperbola}$$

$$4x^2 + 16x - y^2 + 6y = 3$$

$$4(x^2 + 4x) - (y^2 - 6y) = 3$$

$$4(x^2 + 4x + 4) - (y^2 - 6y + 9) = 3 + 4(4) - 9$$

$$4(x + 2)^2 - (y - 3)^2 = 10$$

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

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

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

34. $A = 3, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - (4)(3)(1) = -12$$

$$B^2 - 4AC < 0, B = 0, A \neq C, \text{ ellipse}$$

$$3x^2 + y^2 - 4y + 3 = 0$$

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

$$3x^2 + (y - 2)^2 = 1$$

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

35. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0, B = 0, A = C, \text{ circle}$$

$$x^2 + y^2 - 2x + 10y + 1 = 0$$

$$(x^2 - 2x) + (y^2 + 10y) = -1$$

$$(x^2 - 2x + 1) + (y^2 + 10y + 25) = -1 + 1 + 25$$

$$(x - 1)^2 + (y + 5)^2 = 25$$

36. $x^2 + y^2 = 64$

$$x - 2y = 17$$

$$x = 2y + 17$$

$$(2y + 17)^2 + y^2 - 64 = 0$$

$$4y^2 + 68y + 289 + y^2 - 64 = 0$$

$$5y^2 + 68y + 225 = 0$$

$$y = \frac{-68 \pm \sqrt{4624 - 4(5)(225)}}{2(5)}$$

$$y = \frac{-68 \pm \sqrt{4624 - 4500}}{10}$$

$$y = \frac{-68 \pm \sqrt{124}}{10}$$

$$y = \frac{-68 \pm 2\sqrt{31}}{10}$$

$$y = \frac{-34 \pm \sqrt{31}}{5}$$

$$x = 2\left(\frac{-34 \pm \sqrt{31}}{5}\right) + 17$$

$$x = \frac{-68 \pm 2\sqrt{31}}{5} + \frac{85}{5}$$

$$x = \frac{17 + 2\sqrt{31}}{5}$$

$$\left(\frac{17 + 2\sqrt{31}}{5}, \frac{-34 + \sqrt{31}}{5}\right), \left(\frac{17 - 2\sqrt{31}}{5}, \frac{-34 - \sqrt{31}}{5}\right)$$

$$\approx (5.627, -5.686), (1.173, -7.914)$$

Chapter 10 *continued*

37. $x^2 + y^2 = 20$

$$x^2 + 4y^2 - 2x - 2 = 0$$

$$-4x^2 - 4y^2 + 80 = 0$$

$$\frac{x^2 + 4y^2 - 2x - 2 = 0}{-4x^2 - 4y^2 + 80 = 0}$$

$$-3x^2 - 2x + 78 = 0$$

$$x = \frac{2 \pm \sqrt{4 - 4(-3)(78)}}{2(-3)}$$

$$x = \frac{2 \pm \sqrt{4 + 936}}{-6}$$

$$x = \frac{2 \pm \sqrt{940}}{-6}$$

$$x = \frac{2 \pm 2\sqrt{235}}{-6}$$

$$x = \frac{-1 \pm \sqrt{235}}{3}$$

$$\left(\frac{-1 + \sqrt{235}}{3}\right)^2 + y^2 = 20$$

$$\frac{236 - 2\sqrt{235}}{9} + y^2 = 20$$

$$y^2 = 20 - \frac{236 - 2\sqrt{235}}{9}$$

$$y^2 = \frac{180}{9} - \frac{236 - 2\sqrt{235}}{9}$$

$$y^2 = \frac{-56 + 2\sqrt{235}}{9}, \text{ no real roots}$$

$$\left(\frac{-1 - \sqrt{235}}{3}\right)^2 + y^2 = 20$$

$$\frac{236 + 2\sqrt{235}}{9} + y^2 = 20$$

$$y^2 = 20 - \frac{236 + 2\sqrt{235}}{9}$$

$$y^2 = \frac{180}{9} - \frac{236 + 2\sqrt{235}}{9}$$

$$y^2 = \frac{-56 - 2\sqrt{235}}{9}, \text{ no real roots}$$

none

38. $x^2 = 8y$

$$x^2 = 2y + 12$$

$$8y = 2y + 12$$

$$6y = 12$$

$$y = 2$$

$$x^2 = 2(2) + 12$$

$$x^2 = 16$$

$$x = \pm 4$$

$$(4, 2), (-4, 2)$$

39. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$$2a = 230$$

$$a = 115$$

$$2b = 200$$

$$b = 100$$

vertices: $(\pm 115, 0)$

co-vertices: $(0, \pm 100)$

$$\frac{x^2}{13,225} + \frac{y^2}{10,000} = 1$$

40. First location: $x^2 + y^2 = 9$; $r = 3$; center: $(0, 0)$

Second location center: $(0, 2)$

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

$$(x - 0)^2 + (y - 2)^2 = 9$$

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

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

$$x^2 + y^2 - 4y + 4 = 9$$

$$x^2 + y^2 = 9 + 4y - 4$$

$$-x^2 - y^2 + 4y - 4 = -9$$

$$4y - 4 = 0$$

$$4(y - 1) = 0$$

$$y = 1$$

$$x^2 + y^2 = 9$$

$$x^2 + (1)^2 = 9$$

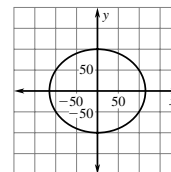
$$x^2 + 1 = 9$$

$$x^2 = 8$$

$$x = \pm\sqrt{8} \approx \pm 2.83$$

$$x^2 + y^2 = 9$$

Farthest point east would be $2\sqrt{2}$ or about 2.83 miles east of the midpoint between the other two members.



Chapter 10 Standardized Test (pp. 646–647)

1. $\left(\frac{0 + (-8)}{2}, \frac{0 + 2}{2}\right) = (-4, 1)$

A

Chapter 10 *continued*

2. $\left(\frac{-7+9}{2}, \frac{1+13}{2}\right) = (1, 7)$

$$m = \frac{13-1}{9+7} = \frac{12}{16} = \frac{3}{4}$$

Slope of perpendicular bisector is $-\frac{4}{3}$.

$$y - 7 = -\frac{4}{3}(x - 1)$$

$$y - 7 = -\frac{4}{3}x + \frac{4}{3}$$

$$y = -\frac{4}{3}x + \frac{4}{3} + \frac{21}{3}$$

$$y = -\frac{4}{3}x + \frac{25}{3}$$

A

3. $r = 8$; center: $(0, 0)$

$$x^2 + y^2 = r^2$$

$$x^2 + y^2 = 64$$

$$9(x^2 + y^2) = 9(64)$$

$$9x^2 + 9y^2 = 576$$

D

4. $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$

$$a = 9, b = 4$$

$$\frac{x^2}{16} + \frac{y^2}{81} = 1$$

D

5. Focus of parabola: $2x^2 = -120y$

$$x^2 = -\frac{120}{2}y$$

$$x^2 = -60y$$

$$x^2 = 4py$$

$$x^2 = 4(-15)y$$

$$p = -15$$

$$\text{Focus: } (0, p) = (0, -15)$$

E

6. Directrix of parabola: $y^2 = 24x$

$$y^2 = 4px$$

$$y^2 = 4(6)x$$

$$p = 6$$

$$\text{Directrix: } x = -p$$

$$x = -6$$

B

7. $\frac{y^2}{25} - \frac{x^2}{9} = 1$

hyperbola, vertical transverse axis

Vertices: $(0, \pm a) = (0, \pm 5)$

$$c^2 = a^2 + b^2 = 25 + 9 = 34$$

$$c = \sqrt{34}$$

Foci: $(0, \pm\sqrt{34})$

C

8. $A = 1, B = 0, C = 0$

$$B^2 - 4AC = 0^2 - 4(1)(0) = 0$$

$$B^2 - 4AC = 0, \text{ parabola}$$

D

9. Point of intersection of the graph

$$x^2 + y^2 = 41$$

$$y = 3x - 7$$

$$x^2 + (3x - 7)^2 = 41$$

$$x^2 + 9x^2 - 42x + 49 - 41 = 0$$

$$10x^2 - 42x + 8 = 0$$

$$2(5x^2 - 21x + 4) = 0$$

$$2(5x - 1)(x - 4) = 0$$

$$x = \frac{1}{5} \text{ or } x = 4$$

$$y = 3x - 7 = 3(4) - 7 = 5$$

$$y = 3x - 7 = 3\left(\frac{1}{5}\right) - 7$$

$$y = \frac{3}{5} - \frac{35}{5}$$

$$y = -\frac{32}{5}$$

$$(4, 5), \left(\frac{1}{5}, -\frac{32}{5}\right)$$

B

10. $d_A = \sqrt{(-5 - 3)^2 + (7 + 2)^2}$

$$= \sqrt{64 + 81}$$

$$= \sqrt{145} \approx 12.04$$

$$d_B = \sqrt{(0 + 8)^2 + (8 + 1)^2}$$

$$= \sqrt{64 + 81}$$

$$= \sqrt{145} \approx 12.04$$

C

Chapter 10 *continued*

11. discriminant of A:

$$A = 1, B = 0, C = 1$$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

discriminant of B:

$$A = 3, B = 0, C = 1$$

$$B^2 - 4AC = 0^2 - 4(3)(1) = -12$$

A

12. a. $A = 1, B = 0, C = 1$

$$B^2 - 4AC = 0^2 - 4(1)(1) = -4$$

$$B^2 - 4AC < 0, B = 0, A = C, \text{ circle}$$

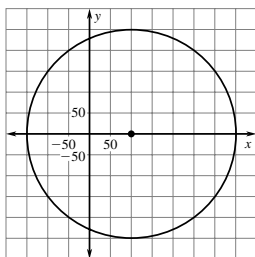
- b. $x^2 + y^2 - 200x - 52,500 = 0$

$$x^2 - 200x + y^2 = 52,500$$

$$(x^2 - 200x + 10,000) + y^2 = 52,500 + 10,000$$

$$(x - 100)^2 + y^2 = 62,500$$

$$r = 250; \text{ center } (0, 0)$$



- c. $c = \sqrt{a^2 + b^2}$

$$c = \sqrt{(100)^2 + (150)^2}$$

$$c = \sqrt{10,000 + 22,500}$$

$$c = \sqrt{32,500}$$

$$c \approx 180.28$$

about 180.28 meters

13. a. $(0, -53,764)$;

the foci of an ellipse are equidistant from the vertices of the ellipse.

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

$$(h, k) = \text{center} = \left(\frac{0+0}{2}, \frac{0-53,764}{2} \right) \\ = (0, 26,882)$$

$$a = \sqrt{(0-0)^2 + (5662 + 26,882)^2}$$

$$= \sqrt{1,059,111,936} = 32,544$$

$$c = \sqrt{(0-0)^2 + (0 + 26,882)^2}$$

$$= \sqrt{722,641,924} = 26,882$$

$$b^2 = a^2 - c^2 = 32,544^2 - 26,882^2$$

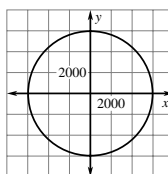
$$= 336,470,012$$

$$\frac{x^2}{336,470,012} + \frac{(y - 26,882)^2}{1,059,111,936} = 1$$

- c. $r = 5400 + 410 = 5810$

$$x^2 + y^2 = 5810^2$$

$$x^2 + y^2 = 33,756,100$$



14. a. $x^2 + y^2 = (5)^2$

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

- b. $x^2 - y^2 - 4x - 23 = 0$

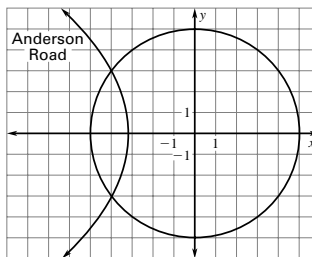
$$(x^2 - 4x + 4) - y^2 = 23 + 4$$

$$(x - 2)^2 - y^2 = 27$$

$$\frac{(x - 2)^2}{27} - \frac{y^2}{27} = 1$$

Center: $(2, 0)$

$$a = 3\sqrt{3} \approx 5.2, b = 3\sqrt{3} \approx 5.2$$



- c. $(-4, 3)$; this point represents the second intersection of the circle and left branch of the hyperbola.

- d. $(-4, 3), (0, 0)$

$$m = \frac{0 - 3}{0 + 4} = -\frac{3}{4}$$

$$y - 0 = -\frac{3}{4}(x - 0)$$

$$y = -\frac{3}{4}x$$

- $(4, -3)$