14.

15. (a) $(-1, 0), (1, 0)$ (b) x-axis, y-axis, origin **16.** (a) $(0, 1)$ (b) none

17. (a) $\left(-\frac{\pi}{2}, 0\right), (0, 1), \left(\frac{\pi}{2}, 0\right)$ (b) y-axis **18.** (a) $(-2, 0), (0, -3), (2, 0)$ (b) y-axis

19. (a) $(0, 0)$ (b) x-axis **20.** (a) $(-2, 0), (2, 0), (0, -2), (0, 2)$ (b) x-axis, y-axis, origin

21. (a) $(1, 0)$ (b) none **22.** (a) $(0, 0)$ (b) none **23.** (a) $(-1, 0), (0, -1), (1, 0)$ (b) y-axis

24. (a) $(0, 0)$ (b) origin **25.** (a) none (b) origin **26.** (a) none (b) x-axis

27. $(0, 0)$ is on the graph. **28.** $(0, 0)$ and $(1, -1)$ are on the graph. **29.** $(0, 3)$ is on the graph.

30. $(0, 1)$ and $(-1, 0)$ are on the graph. **31.** $(0, 2)$ and $(\sqrt{2}, \sqrt{2})$ are on the graph.

32. $(0, 1)$ and $(2, 0)$ are on the graph. **33.** $(0, 0)$; symmetric with respect to the origin

34. $(0, 0)$; symmetric with respect to the y-axis **35.** $(0, 0)$; symmetric with respect to the origin

36. $(0, 0)$; symmetric with respect to the x-axis **37.** $(0, 9), (3, 0), (-3, 0)$; symmetric with respect to the y-axis

38. $(-4, 0), (0, -2), (0, 2)$; symmetric with respect to the x-axis, y-axis, and origin

39. $(-2, 0), (2, 0), (0, -3), (0, 3)$; symmetric with respect to the x-axis, y-axis, and origin **41.** $(0, -27), (3, 0)$; no symmetry

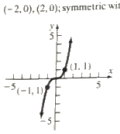
40. $(-1, 0), (1, 0), (0, -2), (0, 2)$; symmetric with respect to the y-axis **43.** $(0, -4), (4, 0), (-1, 0)$; no symmetry

42. $(-1, 0), (1, 0), (0, -1)$; symmetric with respect to the y-axis **45.** $(0, 0)$; symmetric with respect to the origin

44. $(0, 4)$; symmetric with respect to the y-axis **47.** $(0, 0)$; symmetric with respect to the y-axis **48.** $(0, 0)$; no symmetry

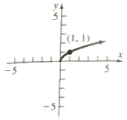
46. $(-2, 0), (2, 0)$; symmetric with respect to the y-axis

49.

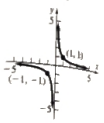


50.

51.

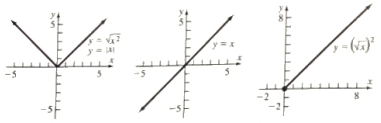


52.



53. $a = -1$ **54.** $b = 12$ **55.** $2a + 3b = 6$ **56.** $m = -\frac{5}{2}, b = 5$

57. (a)



(b) Since $\sqrt{x^2} = |x|$, for all x, the graphs of $y = \sqrt{x^2}$ and $y = |x|$ are the same.

(c) For $y = (\sqrt{x})^2$, the domain of the variable x is $x \geq 0$; for $y = x$, the domain of the variable x is all real numbers. Thus, $(\sqrt{x})^2 = x$ only for $x \geq 0$.

(d) For $y = \sqrt{x^2}$, the range of the variable y is $y \geq 0$; for $y = x$, the range of the variable y is all real numbers. Also, $\sqrt{x^2} = |x|$, which equals x only if $x \geq 0$.

2.3 Concepts and Vocabulary *(page 179)*

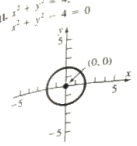
4. radius **5.** True **6.** $(2, -5)$; 6

2.3 Exercises *(page 179)*

7. Center $(2, 1)$; Radius 2; $(x - 2)^2 + (y - 1)^2 = 4$ **8.** Center $(1, 2)$; Radius $= 2$; $(x - 1)^2 + (y - 2)^2 = 4$

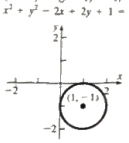
9. Center $\left(\frac{5}{2}, 2\right)$; Radius $\frac{3}{2}$; $\left(x - \frac{5}{2}\right)^2 + (y - 2)^2 = \frac{9}{4}$ **10.** Center $(1, 2)$; Radius $= \sqrt{2}$; $(x - 1)^2 + (y - 2)^2 = 2$

11. $x^2 + y^2 = 4$;
$x^2 + y^2 - 4 = 0$

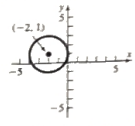


12. $x^2 + y^2 = 9$;
$x^2 + y^2 - 9 = 0$

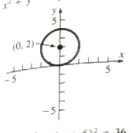
13. $(x - 1)^2 + (y + 1)^2 = 1$;
$x^2 + y^2 - 2x + 2y + 1 = 0$



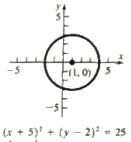
14. $(x + 2)^2 + (y - 1)^2 = 4$;
$x^2 + y^2 + 4x - 2y + 1 = 0$



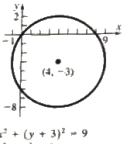
15. $x^2 + (y - 2)^2 = 4$;
$x^2 + y^2 - 4y = 0$



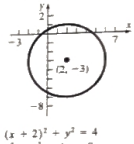
16. $(x - 1)^2 + y^2 = 9$;
$x^2 + y^2 - 2x - 8 = 0$



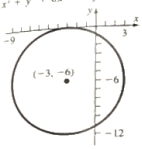
17. $(x - 4)^2 + (y + 3)^2 = 25$;
$x^2 + y^2 - 8x + 6y = 0$



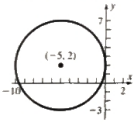
18. $(x - 2)^2 + (y + 3)^2 = 16$;
$x^2 + y^2 - 4x + 6y - 3 = 0$



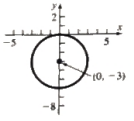
19. $(x + 3)^2 + (y + 6)^2 = 36$
$x^2 + y^2 + 6x + 12y + 9 = 0$



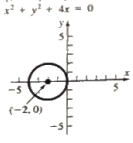
20. $(x + 5)^2 + (y - 2)^2 = 25$
$x^2 + y^2 + 10x - 4y + 4 = 0$



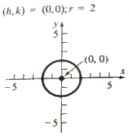
21. $x^2 + (y + 3)^2 = 9$
$x^2 + y^2 + 6y = 0$



22. $(x + 2)^2 + y^2 = 4$
$x^2 + y^2 + 4x = 0$

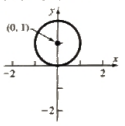


23. (a) $(h, k) = (0, 0); r = 2$ (b)



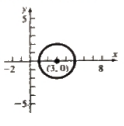
(c) $(\pm 2, 0); (0, \pm 2)$

24. (a) $(h, k) = (0, 1); r = 1$ (b)



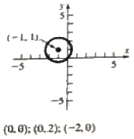
(c) $(0, 0); (0, 2)$

25. (a) $(h, k) = (3, 0); r = 2$ (b)



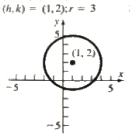
(c) $(1, 0); (5, 0)$

26. (a) $(h, k) = (-1, 1); r = \sqrt{2}$ (b)



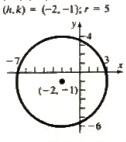
(c) $(0, 0); (0, 2); (-2, 0)$

27. (a) $(h, k) = (1, 2); r = 3$ (b)



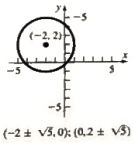
(c) $(1 \pm \sqrt{5}, 0); (0, -2 \pm 2\sqrt{2})$

28. (a) $(h, k) = (-2, -1); r = 5$ (b)



(c) $(-2 \pm 2\sqrt{6}, 0); (0, -1 \pm \sqrt{21})$

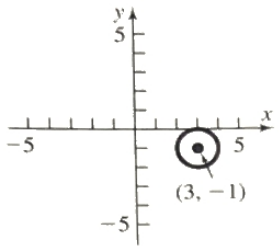
29. (a) $(h, k) = (-2, 2); r = 3$ (b)



(c) $(-2 \pm \sqrt{5}, 0); (0, 2 \pm \sqrt{5})$

30. **(a)** $(h, k) = (3, -1); r = 1$

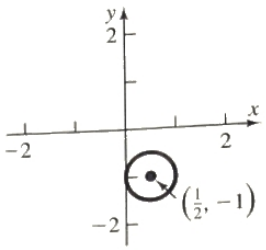
(b)



(c) $(3, 0)$

31. **(a)** $(h, k) = \left(\frac{1}{2}, -1\right); r = \frac{1}{2}$

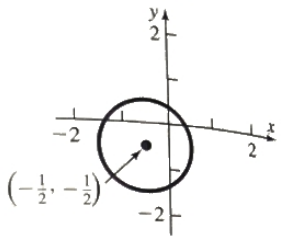
(b)



(c) $(0, -1)$

32. **(a)** $(h, k) = \left(-\frac{1}{2}, -\frac{1}{2}\right); r = 1$

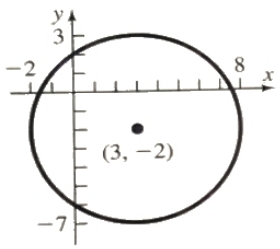
(b)



(c) $\left(\frac{-1 \pm \sqrt{3}}{2}, 0\right); \left(0, \frac{-1 \pm \sqrt{3}}{2}\right)$

33. **(a)** $(h, k) = (3, -2); r = 5$

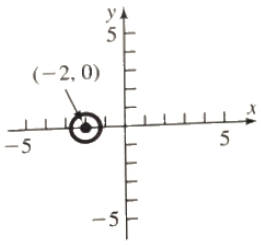
(b)



(c) $(3 \pm \sqrt{21}, 0); (0, -6), (0, 2)$

34. **(a)** $(h, k) = (-2, 0); r = \frac{\sqrt{2}}{2}$

(b)



(c) $\left(-2 \pm \frac{\sqrt{2}}{2}, 0\right)$

35. $x^2 + y^2 - 13 = 0$ **36.** $x^2 + y^2 - 2$

37. $x^2 + y^2 - 4x - 6y + 4 = 0$ **38.** $x^2 + y^2 + 6$

39. $x^2 + y^2 + 2x - 6y + 5 = 0$ **40.** $x^2 + y^2 - 4$

41. (c) **42.** (d) **43.** (b) **44.** (a) **45.** $(x + 3)^2 +$

46. $(x - 4)^2 + (y + 2)^2 = 9$ **47.** $(x - 2)^2 + (y$

48. $(x - 1)^2 + (y - 3)^2 = 4$ **49.** b **50.** b, e, g

51. $x^2 + y^2 + 2x + 4y - 4168.16 = 0$