Answers for Exercises 1, 2, 4c, 31–52, 87, and 88 are on pages AA2–AA3.

EXERCISE SET 2.1

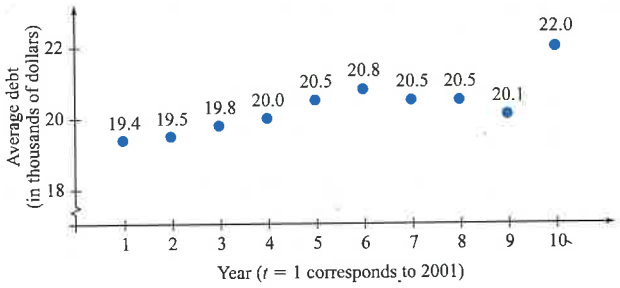
Concept Check

In Exercises 1 and 2, plot the points whose coordinates are given on a Cartesian coordinate system.

1. $(2, 4), (0, -3), (-2, 1), (-5, -3)$

2. $(-3, -5), (-4, 3), (0, 2), (-2, 0)$

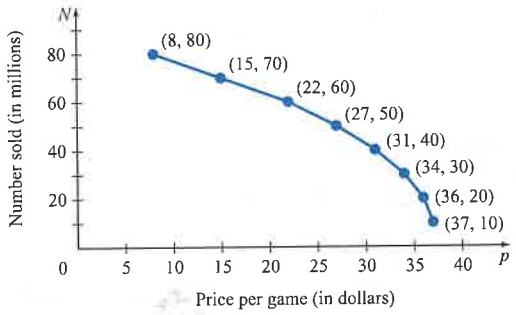
3. **College Debt** The following graph shows the average debt, in constant 2010 dollars per borrower, of college students upon graduation.



   a. According to the graph, between which consecutive years did the average debt decrease?
   2006 and 2007, 2008 and 2009

   b. If the increase between 2010 and 2011 was the same as the increase between 2009 and 2010, what would be the average debt in 2011? $23,900

4. **Computer Games** The graph below shows the results of market research conducted by a developer of computer games. It shows the projected numbers of sales N, in millions, of a game for selected selling prices p in dollars per game.



   a. Explain the meaning of the ordered pair (22, 60) in the context of this problem. When the cost of a game is $22, 60 million games can be sold.

   b. Based on the graph, does the projected number of sales increase or decrease as the price of this game increases? Decreases

   c. The product of the coordinates of the ordered pairs, $R = p \cdot N$, indicates the revenue R to the company generated by the sale of N games at p dollars per game. Create a scatter plot of (p, R).

   d. Based on the scatter plot in **c.**, what happens to the revenue as the price of the game increases?
   It increases to a certain point and then decreases.

In Exercises 5 to 8, determine whether the given ordered pair is a solution of the equation.

5. $2x + 5y = 16; (-2, 4)$
   Yes

6. $2x^2 - 3y = 4; (1, -1)$
   No

7. $y = 3x^2 - 4x + 2; (-3, 17)$
   No

8. $x^2 + y^2 = 169; (-2, 12)$
   No

In Exercises 9 to 18, find the distance between the points whose coordinates are given.

9. $(6, 4), (-8, 11)$
   $7\sqrt{5}$

10. $(-5, 8), (-10, 14)$
    $\sqrt{61}$

11. $(-4, -20), (-10, 15)$
    $\sqrt{1261}$

12. $(40, 32), (36, 20)$
    $4\sqrt{10}$

13. $(5, -8), (0, 0)$
    $\sqrt{89}$

14. $(0, 0), (5, 13)$
    $\sqrt{194}$

15. $(\sqrt{3}, \sqrt{8}), (\sqrt{12}, \sqrt{27})$
    $\sqrt{38 - 12\sqrt{6}}$

16. $(\sqrt{125}, \sqrt{20}), (6, 2\sqrt{5})$
    $\sqrt{161 - 60\sqrt{5}}$

17. $(a, b), (-a, -b)$
    $2\sqrt{a^2 + b^2}$

18. $(a - b, b), (a, a + b)$
    $\sqrt{a^2 + b^2}$

19. $(x, 4x), (-2x, 3x)$, given that $x < 0$
    $-x\sqrt{10}$ (since $x < 0$, $\sqrt{x^2} = -x$)

20. $(x, 4x), (-2x, 3x)$, given that $x > 0$
    $x\sqrt{10}$ (since $x > 0$, $\sqrt{x^2} = x$)

In Exercises 21 to 26, find the midpoint of the line segment with the given endpoints.

21. $(1, -1), (5, 5)$
    $(3, 2)$

22. $(-5, -2), (6, 10)$
    $\left(\frac{1}{2}, 4\right)$

23. $(6, -3), (6, 11)$
    $(6, 4)$

24. $(4, 7), (-10, 7)$
    $(-3, 7)$

25. $(1.75, 2.25), (-3.5, 5.57)$
    $(-0.875, 3.91)$

26. $(-8.2, 10.1), (-2.4, -5.7)$
    $(-5.3, 2.2)$

In Exercises 27 to 30, find the other endpoint of the line segment that has the given endpoint and midpoint.

27. Endpoint $(5, 1)$, midpoint $(9, 3)$ $(13, 5)$

28. Endpoint $(4, -6)$, midpoint $(-2, 11)$ $(-8, 28)$

29. Endpoint $(-3, -8)$, midpoint $(2, -7)$ $(7, -6)$

30. Endpoint $(5, -4)$, midpoint $(0, 0)$ $(-5, 4)$

In Exercises 31 to 44, graph each equation by plotting points that satisfy the equation.

31. $x - y = 4$

32. $2x + y = -1$

Indicates Try It Exercises

33. $y = 0.25x^2$

34. $3x^2 + 2y = -4$

35. $y = -2|x - 3|$

36. $y = |x + 3| - 2$

37. $y = x^2 - 3$

38. $y = x^2 + 1$

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

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

41. $y = x^2 + 2x - 8$

42. $y = x^2 - 2x - 8$

43. $y = -x^2 + 2$

44. $y = -x^2 - 1$

In Exercises 45 to 52, find the *x*- and *y*-intercepts of the graph of each equation. Use the intercepts and additional points as needed to draw the graph of the equation.

45. $2x + 5y = 12$
$(6, 0), \left(0, \frac{12}{5}\right)$

46. $3x - 4y = 15$
$(5, 0), \left(0, -\frac{15}{4}\right)$

47. $x = -y^2 + 5$
$(5, 0), (0, \pm\sqrt{5})$

48. $x = y^2 - 6$
$(-6, 0), (0, \pm\sqrt{6})$

49. $x = |y| - 4$
$(-4, 0), (0, \pm 4)$

50. $x = y^3 - 2$
$(-2, 0), (0, \sqrt[3]{2})$

51. $x^2 + y^2 = 4$
$(\pm 2, 0), (0, \pm 2)$

52. $x^2 = y^2$
$(0, 0)$

In Exercises 53 to 60, determine the center and radius of the circle with the given equation.

53. $x^2 + y^2 = 36$
Center $(0, 0)$, radius 6

54. $x^2 + y^2 = 49$
Center $(0, 0)$, radius 7

55. $(x - 1)^2 + (y - 3)^2 = 49$
Center $(1, 3)$, radius 7

56. $(x - 2)^2 + (y - 4)^2 = 25$
Center $(2, 4)$, radius 5

57. $(x + 2)^2 + (y + 5)^2 = 25$
Center $(-2, -5)$, radius 5

58. $(x + 3)^2 + (y + 5)^2 = 121$
Center $(-3, -5)$, radius 11

59. $(x - 8)^2 + y^2 = \frac{1}{4}$
Center $(8, 0)$, radius $\frac{1}{2}$

60. $x^2 + (y - 12)^2 = 1$
Center $(0, 12)$, radius 1

In Exercises 61 to 68, find an equation of the circle that satisfies the given conditions. Write your answer in standard form.

61. Center $(4, 1)$, radius 2 $(x - 4)^2 + (y - 1)^2 = 4$

62. Center $(5, -3)$, radius 4 $(x - 5)^2 + (y + 3)^2 = 16$

63. Center $\left(\frac{1}{2}, \frac{1}{4}\right)$, radius $\sqrt{5}$ $\left(x - \frac{1}{2}\right)^2 + \left(y - \frac{1}{4}\right)^2 = 5$

64. Center $\left(0, \frac{2}{3}\right)$, radius $\sqrt{11}$ $(x - 0)^2 + \left(y - \frac{2}{3}\right)^2 = 11$

65. Center $(0, 0)$, passing through $(-3, 4)$
$(x - 0)^2 + (y - 0)^2 = 25$

66. Center $(0, 0)$, passing through $(5, 12)$
$(x - 0)^2 + (y - 0)^2 = 169$

67. Center $(1, 3)$, passing through $(4, -1)$
$(x - 1)^2 + (y - 3)^2 = 25$

68. Center $(-2, 5)$, passing through $(1, 7)$
$(x + 2)^2 + (y - 5)^2 = 13$

In Exercises 69 to 76, find the equation of the circle described. Write your answers in standard form.

69. The coordinates of the center are $(-2, 5)$ and the length of the diameter is 10. $(x + 2)^2 + (y - 5)^2 = 25$

70. The coordinates of the center are $(0, -1)$ and the length of the diameter is 8. $x^2 + (y + 1)^2 = 16$

71. The circle has a diameter with endpoints whose coordinates are $(2, 3)$ and $(-4, 11)$. $(x + 1)^2 + (y - 7)^2 = 25$

72. The circle has a diameter with endpoints whose coordinates are $(7, -2)$ and $(-3, 5)$. $(x - 2)^2 + \left(y - \frac{3}{2}\right)^2 = \frac{149}{4}$

73. The circle has a diameter with endpoints whose coordinates are $(5, -3)$ and $(-1, -5)$. $(x - 2)^2 + (y + 4)^2 = 10$

74. The circle has a diameter with endpoints whose coordinates are $(4, -6)$ and $(0, -2)$. $(x - 2)^2 + (y + 4)^2 = 8$

75. The circle has center with coordinates $(7, 11)$ and is tangent to the x-axis. $(x - 7)^2 + (y - 11)^2 = 121$

76. The circle has center with coordinates $(-2, 3)$ and is tangent to the y-axis. $(x + 2)^2 + (y - 3)^2 = 4$

In Exercises 77 to 84, find the center and radius of the graph of the circle. The equations of the circles are written in general form.

77. $x^2 + y^2 - 6x + 5 = 0$ Center $(3, 0)$, radius 2

78. $x^2 + y^2 - 6x - 4y + 12 = 0$ Center $(3, 2)$, radius 1

79. $x^2 + y^2 - 14x + 8y + 53 = 0$ Center $(7, -4)$, radius $2\sqrt{3}$

80. $x^2 + y^2 - 10x + 2y + 18 = 0$ Center $(5, -1)$, radius $2\sqrt{2}$

81. $x^2 + y^2 - x + 3y - \frac{15}{4} = 0$ Center $\left(\frac{1}{2}, -\frac{3}{2}\right)$, radius $\frac{5}{2}$

82. $x^2 + y^2 + 3x - 5y + \frac{25}{4} = 0$ Center $\left(-\frac{3}{2}, \frac{5}{2}\right)$, radius $\frac{3}{2}$

83. $x^2 + y^2 + 3x - 6y + 2 = 0$ Center $\left(-\frac{3}{2}, 3\right)$, radius $\frac{\sqrt{37}}{2}$

84. $x^2 + y^2 - 5x - y - 4 = 0$ Center $\left(\frac{5}{2}, \frac{1}{2}\right)$, radius $\frac{\sqrt{42}}{2}$