4.3 Exercise Set

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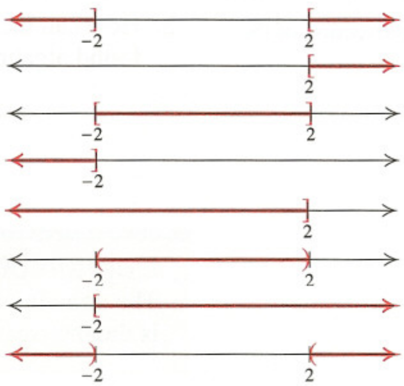
Concept Reinforcement *In each of Exercises 1–10, match the set with the most appropriate choice from the column on the right.*

1. (h) $\{x \mid x < -2 \text{ or } x > 2\}$
2. (j) $\{x \mid x < -2 \text{ and } x > 2\}$
3. (f) $\{x \mid x > -2\} \cap \{x \mid x < 2\}$
4. (a) $\{x \mid x \le -2\} \cup \{x \mid x \ge 2\}$
5. (e) $\{x \mid x \le -2\} \cup \{x \mid x \le 2\}$
6. (d) $\{x \mid x \le -2\} \cap \{x \mid x \le 2\}$
7. (b) $\{x \mid x \ge -2\} \cap \{x \mid x \ge 2\}$
8. (g) $\{x \mid x \ge -2\} \cup \{x \mid x \ge 2\}$
9. (c) $\{x \mid x \le 2\}$ *and* $\{x \mid x \ge -2\}$
10. (i) $\{x \mid x \le 2\}$ *or* $\{x \mid x \ge -2\}$

a) b) c) d) e) f) g) h)



i) $\mathbb{R}$

j) $\varnothing$

Find each indicated intersection or union.

11. $\{5, 9, 11\} \cap \{9, 11, 18\}$ $\{9, 11\}$

12. $\{2, 4, 8\} \cup \{8, 9, 10\}$ $\{2, 4, 8, 9, 10\}$

13. $\{0, 5, 10, 15\} \cup \{5, 15, 20\}$ $\{0, 5, 10, 15, 20\}$

14. $\{2, 5, 9, 13\} \cap \{5, 8, 10\}$ $\{5\}$

15. $\{a, b, c, d, e, f\} \cap \{b, d, f\}$ $\{b, d, f\}$

16. $\{a, b, c\} \cup \{a, c\}$ $\{a, b, c\}$

17. $\{r, s, t\} \cup \{r, u, t, s, v\}$ $\{r, s, t, u, v\}$

18. $\{m, n, o, p\} \cap \{m, o, p\}$ $\{m, o, p\}$

19. $\{3, 6, 9, 12\} \cap \{5, 10, 15\}$ $\varnothing$

20. $\{1, 5, 9\} \cup \{4, 6, 8\}$ $\{1, 4, 5, 6, 8, 9\}$

21. $\{3, 5, 7\} \cup \varnothing$ $\{3, 5, 7\}$

22. $\{3, 5, 7\} \cap \varnothing$ $\varnothing$

Graph and write interval notation for each compound inequality.

23. $3 < x < 7$ ⊡

24. $0 \le y \le 4$ ⊡

25. $-6 \le y \le 0$ ⊡

26. $-9 \le x < -5$ ⊡

27. $x < -1$ *or* $x > 4$ ⊡

28. $x < -5$ *or* $x > 1$ ⊡

29. $x \le -2$ *or* $x > 1$ ⊡

30. $x \le -5$ *or* $x > 2$ ⊡

31. $x > -2$ *and* $x < 4$ ⊡

32. $x > -7$ *and* $x < -2$ ⊡

33. $-4 \le -x < 2$ ⊡

34. $3 > -x \ge -1$ ⊡

35. $5 > a$ *or* $a > 7$ ⊡

36. $t \ge 2$ *or* $-3 > t$ ⊡

37. $x \ge 5$ *or* $-x \ge 4$ ⊡

38. $-x < 3$ *or* $x < -6$ ⊡

39. $7 > y$ *and* $y \ge -3$ ⊡

40. $6 > -x \ge 0$ ⊡

41. $x < 7$ *and* $x \ge 3$ ⊡

42. $x \ge -3$ *and* $x < 3$ ⊡

Aha! **43.** $t < 2$ *or* $t < 5$ ⊡

44. $t > 4$ *or* $t > -1$ ⊡

Solve and graph each solution set.

45. $-2 < t + 1 < 8$ ⊡

46. $-3 < t + 1 \le 5$ ⊡

47. $4 < x + 4$ *and* $x - 1 < 3$ ⊡

48. $-1 < x + 2$ *and* $x - 4 < 3$ ⊡

49. $-7 \ge 2a - 3$ *or* $3a + 1 > 7$ ⊡

50. $-4 \le 3n + 5$ *or* $2n - 3 \le 7$ ⊡

Aha! **51.** $x + 7 \le -2$ *or* $x + 7 \ge -3$ ⊡

52. $x + 5 < -3$ *or* $x + 5 \ge 4$ ⊡

53. $-7 \le 4x + 5 \le 13$ ⊡

54. $-4 \le 2x + 3 \le 15$ ⊡

55. $5 > \dfrac{x - 3}{4} > 1$ ⊡

56. $3 \ge \dfrac{x - 1}{2} \ge -4$ ⊡

⊡ Answers to Exercises 23–56 are on p. IA-9.

57. $-2 \le \frac{x+2}{-5} \le 6$ ⊡

58. $-10 \le \frac{x+6}{-3} \le -8$ ⊡

59. $2 \le f(x) \le 8$, where $f(x) = 3x - 1$ ⊡

60. $7 \ge g(x) \ge -2$, where $g(x) = 3x - 5$ ⊡

61. $-21 \le f(x) < 0$, where $f(x) = -2x - 7$ ⊡

62. $4 > g(t) \ge 2$, where $g(t) = -3t - 8$ ⊡

63. $f(t) < 3$ *or* $f(t) > 8$, where $f(t) = 5t + 3$ ⊡

64. $g(x) \le -2$ *or* $g(x) \ge 10$, where $g(x) = 3x - 5$ ⊡

65. $6 > 2a - 1$ *or* $-4 \le -3a + 2$ ⊡

66. $3a - 7 > -10$ *or* $5a + 2 \le 22$ ⊡

67. $a + 3 < -2$ *and* $3a - 4 < 8$ ⊡

68. $1 - a < -2$ *and* $2a + 1 > 9$ ⊡

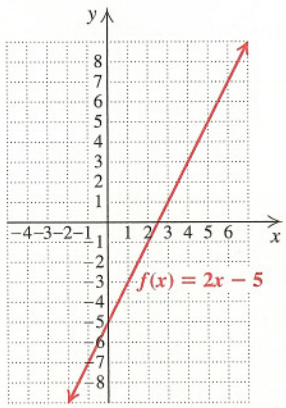
69. $3x + 2 < 2$ *and* $3 - x < 1$ $\varnothing$

70. $2x - 1 > 5$ *and* $2 - 3x > 11$ $\varnothing$

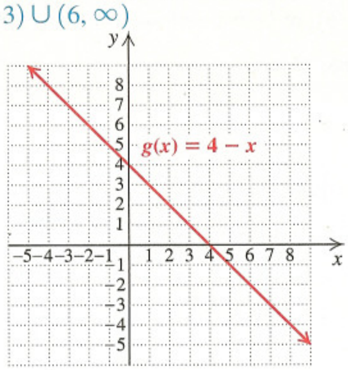
71. $2t - 7 \le 5$ *or* $5 - 2t > 3$ ⊡

72. $5 - 3a \le 8$ *or* $2a + 1 > 7$ ⊡

73. Use the accompanying graph of $f(x) = 2x - 5$ to solve $-7 < 2x - 5 < 7$. $(-1, 6)$



74. Use the accompanying graph of $g(x) = 4 - x$ to solve $4 - x < -2$ *or* $4 - x > 7$. $(-\infty, -3) \cup (6, \infty)$



⊡ Answers to Exercises 57–68, 71, 72, and 93–96 are on p. IA-9.

For $f(x)$ as given, use interval notation to write the domain of f.

75. $f(x) = \frac{9}{x+8}$ $(-\infty, -8) \cup (-8, \infty)$

76. $f(x) = \frac{2}{x+3}$ $(-\infty, -3) \cup (-3, \infty)$

77. $f(x) = \frac{-8}{x}$ $(-\infty, 0) \cup (0, \infty)$

78. $f(x) = \frac{x+3}{2x-8}$ $(-\infty, 4) \cup (4, \infty)$

79. $f(x) = \sqrt{x-6}$ $[6, \infty)$

80. $f(x) = \sqrt{x-2}$ $[2, \infty)$

81. $f(x) = \sqrt{2x+7}$ $\left[-\frac{7}{2}, \infty\right)$

82. $f(x) = \sqrt{8-5x}$ $\left(-\infty, \frac{8}{5}\right]$

83. $f(x) = \sqrt{8-2x}$ $(-\infty, 4]$

84. $f(x) = \sqrt{10-2x}$ $(-\infty, 5]$

Use interval notation to write each domain.

85. The domain of $f + g$, if $f(x) = \sqrt{x-5}$ and $g(x) = \sqrt{\frac{1}{2}x + 1}$ $[5, \infty)$

86. The domain of $f - g$, if $f(x) = \sqrt{x+3}$ and $g(x) = \sqrt{2x-1}$ $\left[\frac{1}{2}, \infty\right)$

87. The domain of $f \cdot g$, if $f(x) = \sqrt{3-x}$ and $g(x) = \sqrt{3x-2}$ $\left[\frac{2}{3}, 3\right]$

88. The domain of $f + g$, if $f(x) = \sqrt{3-4x}$ and $g(x) = \sqrt{x+2}$ $\left[-2, \frac{3}{4}\right]$

TW 89. Why can the conjunction $2 < x$ *and* $x < 5$ be rewritten as $2 < x < 5$, but the disjunction $2 < x$ *or* $x < 5$ cannot be rewritten as $2 < x < 5$?

TW 90. Can the solution set of a disjunction be empty? Why or why not?

SKILL REVIEW

To prepare for Section 4.4, review absolute value and graphing (Sections 1.2 and 2.2).

Find the absolute value. [1.2]

91. $|-5 - 2|$ 7

92. $|6 - 0|$ 6

Graph. [2.2]

93. $g(x) = 2x$ ⊡

94. $f(x) = 4$ ⊡

95. $g(x) = -3$ ⊡

96. $f(x) = |x|$ ⊡

SYNTHESIS

TW 97. What can you conclude about a, b, c, and d, if $[a, b] \cup [c, d] = [a, d]$? Why?

TW 98. What can you conclude about a, b, c, and d, if $[a, b] \cap [c, d] = [a, b]$? Why?

99. *Counseling.* The function given by $s(t) = 500t + 16{,}500$ can be used to estimate the number of student visits to Cornell University's counseling center t years after 2000. For what years is the number of student visits between 18,000 and 21,000? Between 2003 and 2009
Source: Based on data from Cornell University

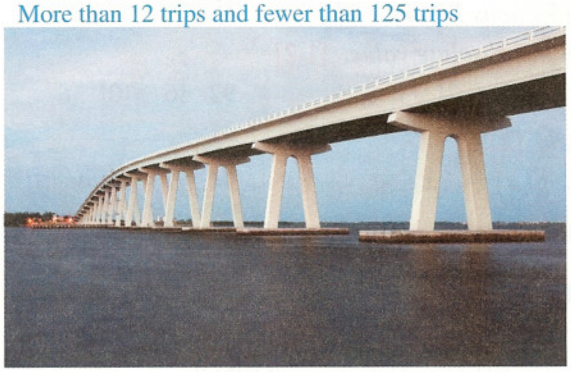
100. *Pressure at Sea Depth.* The function given by $P(d) = 1 + (d/33)$ gives the pressure, in atmospheres (atm), at a depth of d feet in the sea. For what depths d is the pressure at least 1 atm and at most 7 atm? $0 \text{ ft} \le d \le 198 \text{ ft}$

101. *Converting Dress Sizes.* The function given by $f(x) = 2(x + 10)$ can be used to convert dress sizes x in the United States to dress sizes $f(x)$ in Italy. For what dress sizes in the United States will dress sizes in Italy be between 32 and 46?
Sizes between 6 and 13

102. *Solid-Waste Generation.* The function given by $w(t) = 0.0125t + 4.525$ can be used to estimate the number of pounds of solid waste, $w(t)$, produced daily, on average, by each person in the United States, t years after 2000. For what years will waste production range from 4.6 lb to 4.8 lb per person per day? From 2006 through 2022

103. *Body-Fat Percentage.* The function given by $F(d) = (4.95/d - 4.50) \times 100$ can be used to estimate the body fat percentage $F(d)$ of a person with an average body density d, in kilograms per liter. A woman's body fat percentage is considered acceptable if $25 \le F(d) \le 31$. What body densities are considered acceptable for a woman?
Densities between 1.03 kg/L and 1.04 kg/L

104. *Minimizing Tolls.* A $6.00 toll is charged to cross the bridge from mainland Florida to Sanibel Island. A six-month reduced-fare pass, costing $50.00, reduces the toll to $2.00. A six-month unlimited-trip pass costs $300 and allows free crossings. How many crossings in six months does it take for the reduced-fare pass to be the more economical choice?
Source: www.leewayinfo.com
More than 12 trips and fewer than 125 trips



Solve and graph.

105. $4m - 8 > 6m + 5$ *or* $5m - 8 < -2$

106. $4a - 2 \le a + 1 \le 3a + 4$

107. $3x < 4 - 5x < 5 + 3x$

108. $x - 10 < 5x + 6 \le x + 10$

Determine whether each sentence is true or false for all real numbers a, b, and c.

109. If $-b < -a$, then $a < b$. True

110. If $a \le c$ and $c \le b$, then $b > a$. False

111. If $a < c$ and $b < c$, then $a < b$. False

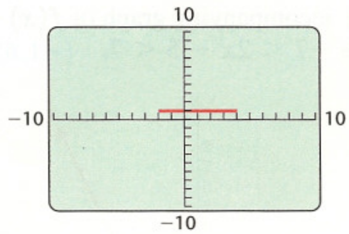
112. If $-a < c$ and $-c > b$, then $a > b$. True

For $f(x)$ as given, use interval notation to write the domain of f.

113. $f(x) = \dfrac{\sqrt{3 - 4x}}{x + 7}$ $\quad (-\infty, -7) \cup \left(-7, \frac{3}{4}\right]$

114. $f(x) = \dfrac{\sqrt{5 + 2x}}{x - 1}$ $\quad \left[-\frac{5}{2}, 1\right) \cup (1, \infty)$

115. On many graphing calculators, the TEST key provides access to inequality symbols, while the LOGIC option of that same key accesses the conjunction *and* and the disjunction *or*. Thus, if $y_1 = x > -2$ and $y_2 = x < 4$, Exercise 31 can be checked by forming the expression $y_3 = y_1$ *and* y_2. The interval(s) in the solution set appears as a horizontal line 1 unit above the x-axis. (Be careful to "deselect" y_1 and y_2 so that only y_3 is drawn.) Use the TEST key to check Exercises 35, 39, 41, and 43.



Try Exercise Answers: Section 4.3

11. $\{9, 11\}$ **13.** $\{0, 5, 10, 15, 20\}$
27. $(-\infty, -1) \cup (4, \infty)$
31. $(-2, 4)$
45. $\{t \mid -3 < t < 7\}$, or $(-3, 7)$
49. $\{a \mid a \le -2 \text{ or } a > 2\}$, or $(-\infty, -2] \cup (2, \infty)$
51. $\mathbb{R}$, or $(-\infty, \infty)$
65. $\left\{a \mid a < \frac{7}{2}\right\}$, or $\left(-\infty, \frac{7}{2}\right)$
67. $\{a \mid a < -5\}$, or $(-\infty, -5)$ **69.** $\varnothing$
79. $[6, \infty)$ **85.** $[5, \infty)$

105. $\left\{m \mid m < \frac{6}{5}\right\}$, or $\left(-\infty, \frac{6}{5}\right)$
106. $\left\{a \mid -\frac{3}{2} \le a \le 1\right\}$, or $\left[-\frac{3}{2}, 1\right]$;
107. $\left\{x \mid -\frac{1}{8} < x < \frac{1}{2}\right\}$, or $\left(-\frac{1}{8}, \frac{1}{2}\right)$
108. $\{x \mid -4 < x \le 1\}$, or $(-4, 1]$;