DIAGNOSING READINESS *page 132*

1. $>$ **2.** $=$ **3.** $>$ **4.** $<$ **5.** $5 + |4 - 6| = 5 + |-2| = 5 + 2 = 7$ **6.** $|30 - 28| - 6 = |2| - 6 = 2 - 6 = -4$
7. $|-7 + 2| - 4 = |-5| - 4 = 5 - 1 = 1$

8.
$$x - 4 = -2$$
$$x - 4 + 4 = -2 + 4$$
$$x = 2$$
Check: $2 - 4 = 2$ ✓

9.
$$b + 4 = 7$$
$$b + 4 - 4 = 7 - 4$$
$$b = 3$$
Check: $3 + 4 = 7$ ✓

10.
$$-\tfrac{3}{4}y = 9$$
$$\left(-\tfrac{4}{3}\right)\left(-\tfrac{3}{4}y\right) = \left(-\tfrac{4}{3}\right)(9)$$
$$y = -12$$
Check: $-\tfrac{3}{4}(-12) = 9$ ✓

11.
$$\tfrac{m}{12} = 2.7$$
$$12\left(\tfrac{m}{12}\right) = 12(2.7)$$
$$m = 32.4$$
Check: $\tfrac{32.4}{12} = 2.7$ ✓

12.
$$-8 + x = 15$$
$$-8 + x + 8 = 15 + 8$$
$$x = 23$$
Check: $-8 + 23 = 15$

13.
$$n - 7 = 22.5$$
$$n - 7 + 7 = 22.5 + 7$$
$$n = 29.5$$
Check: $29.5 - 7 = 22.5$ ✓

14.
$$-\tfrac{12}{7}z = 48$$
$$-\tfrac{7}{12}\left(-\tfrac{12}{7}z\right) = -\tfrac{7}{12}(48)$$
$$z = -28$$
Check: $-\tfrac{12}{7}(-28) = 48$ ✓

15.
$$\tfrac{5y}{4} = -15$$
$$\tfrac{4}{5}\left(\tfrac{5y}{4}\right) = \tfrac{4}{5}(-15)$$
$$y = -12$$
Check: $\tfrac{5(-12)}{4} = -15$ ✓

16.
$$-5 + \tfrac{b}{4} = 7$$
$$-5 + \tfrac{b}{4} + 5 = 7 + 5$$
$$\tfrac{b}{4} = 12$$
$$4\left(\tfrac{b}{4}\right) = 4(12)$$
$$b = 48$$
Check: $-5 + \tfrac{48}{4} = -5 + 12 = 7$ ✓

17.
$$4.2m + 4 = 25$$
$$4.2m + 4 - 4 = 25 - 4$$
$$4.2m = 21$$
$$\tfrac{4.2m}{4.2} = \tfrac{21}{4.2}$$
$$m = 5$$
Check: $4.2(5) + 4 = 21 + 4 = 25$ ✓

18.
$$-12 = 6 + \tfrac{3}{4}x$$
$$-12 - 6 = 6 + \tfrac{3}{4}x - 6$$
$$-18 = \tfrac{3}{4}x$$
$$\tfrac{4}{3}(-18) = \tfrac{4}{3}\left(\tfrac{3}{4}x\right)$$
$$-24 = x$$
Check: $-12 = 6 + \tfrac{3}{4}(-24) = 6 - 18$ ✓

19.
$$6 = -z - 4$$
$$6 + z = -z - 4 + z$$
$$6 + z = -4$$
$$6 + z - 6 = -4 - 6$$
$$z = -10$$
Check: $6 = -(-10) - 4$ ✓

20.
$$4m + 2.3 = 9.7$$
$$4m + 2.3 - 2.3 = 9.7 - 2.3$$
$$4m = 7.4$$
$$\tfrac{4m}{4} = \tfrac{7.4}{4}$$
$$m = 1.85$$
Check: $4(1.85) + 2.3 = 7.4 + 2.3 = 9.7$ ✓

21.
$$\tfrac{5}{8}t - 7 = -22$$
$$\tfrac{5}{8}t - 7 + 7 = -22 + 7$$
$$\tfrac{5}{8}t = -15$$
$$\tfrac{8}{5}\left(\tfrac{5}{8}t\right) = \tfrac{8}{5}(-15)$$
$$t = -24$$
Check: $\tfrac{5}{8}(-24) - 7 = -15 - 7 = -22$ ✓

22.
$$-4.7 = 3y + 1.3$$
$$-4.7 - 1.3 = 3y + 1.3 - 1.3$$
$$-6 = 3y$$
$$\tfrac{-6}{3} = \tfrac{3y}{3}$$
$$y = -2$$
Check: $-4.7 = 3(-2) + 1.3 = -6 + 1.3$ ✓

23.
$$12.2 = 5.3x - 3.7$$
$$12.2 + 3.7 = 5.3x - 3.7 + 3.7$$
$$15.9 = 5.3x$$
$$\tfrac{5.3x}{5.3} = \tfrac{15.9}{5.3}$$
$$x = 3$$
Check: $12.2 = 5.3(3) - 3.7 = 15.9 - 3.7$ ✓

24.
$$4t + 7 + 6t = -33$$
$$10t + 7 = -33$$
$$10t + 7 - 7 = -33 - 7$$

$$10t = -40$$
$$\frac{10t}{10} = \frac{-40}{10}$$
$$t = -4$$

Check: $4(-4) + 7 + 6(-4) = -16 + 7 - 24 = -33$ ✓

25.
$$2a + 5 = 9a - 16$$
$$2a + 5 - 2a = 9a - 2a - 16$$
$$5 = 7a - 16$$
$$5 + 16 = 7a - 16 + 16$$
$$21 = 7a$$
$$\frac{7a}{7} = \frac{21}{7}$$
$$a = 3$$

Check: $2 \cdot 3 + 5 \stackrel{?}{=} 9 \cdot 3 - 16$
$$6 + 5 = 27 - 16 \checkmark$$

26.
$$\frac{1}{3} + \frac{4y}{6} = \frac{2}{3}$$
$$6\left(\frac{1}{3}\right) + 6\left(\frac{4y}{6}\right) = 6\left(\frac{2}{3}\right)$$
$$2 + 4y = 4$$
$$2 + 4y - 2 = 4 - 2$$
$$4y = 2$$
$$\frac{4y}{4} = \frac{2}{4}$$
$$y = \frac{1}{2}$$

Check: $\frac{1}{3} + \frac{4\left(\frac{1}{2}\right)}{6} \stackrel{?}{=} \frac{2}{3}$
$$\frac{1}{3} + \frac{1}{3} = \frac{2}{3} \checkmark$$

27.
$$6(y - 2) = 8 - 2y$$
$$6y - 12 = 8 - 2y$$
$$6y - 12 + 12 = 8 - 2y + 12$$
$$6y = -2y + 20$$
$$6y + 2y = -2y + 20 + 2y$$
$$8y = 20$$
$$\frac{8y}{8} = \frac{20}{8}$$
$$y = \frac{5}{2} = 2\frac{1}{2}$$

Check: $6\left(\frac{5}{2} - 2\right) \stackrel{?}{=} 8 - 2\left(\frac{5}{2}\right)$
$$15 - 12 = 8 - 5 \checkmark$$

28.
$$n + 3(n - 2) = 10.4$$
$$4n - 6 = 10.4$$
$$4n - 6 + 6 = 10.4 + 6$$
$$4n = 16.4$$
$$\frac{4n}{4} = \frac{16.4}{4}$$
$$n = 4.1$$

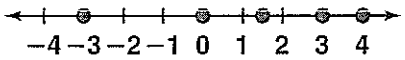
Check: $4.1 + 3(4.1 - 2) \stackrel{?}{=} 10.4$
$$4.1 + 12.3 - 6 = 10.4 \checkmark$$

29.
$$\frac{1}{2}w + 3 = \frac{2}{3}w - 5$$
$$6\left(\frac{1}{2}w\right) + 6 \cdot 3 = 6\left(\frac{2}{3}w\right) - 6(5)$$
$$3w + 18 = 4w - 30$$
$$3w - 3w + 18 = 4w - 3w - 30$$
$$18 = w - 30$$
$$18 + 30 = w - 30 + 30$$
$$48 = w$$

Check: $\frac{1}{2}(48) + 3 \stackrel{?}{=} \frac{2}{3}(48) - 5$
$$24 + 3 = 32 - 5 \checkmark$$

3-1 Inequalities and Their Graphs *pages 134–139*

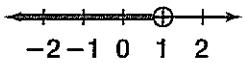
Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

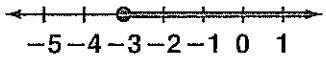
1–5.


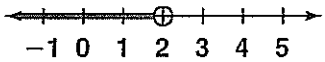
6. > **7.** < **8.** = **9.** = **10.** > **11.** <

CHECK UNDERSTANDING *pages 134–136*

1a. no **1b.** yes **1c.** yes **1d.** yes **2a.** no **2b.** no **2c.** yes **2d.** yes

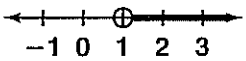
3a.


3b.


3c.


4a. $x \geq 2$ **4b.** $x < 0$ **5a.** Real numbers include negative numbers; speed can't be negative. **5b.** No; answers may vary. Sample: Wages are likely to be given in the hundredths of dollars, and hundreds of dollars per hour or more would not be reasonable, either.

Exercises **1.** yes **2.** no **3.** yes **4.** yes **5.** no **6.** yes **7.** no **8.** yes **9a.** no **9b.** no **9c.** yes **10a.** yes **10b.** no **10c.** yes **11a.** no **11b.** no **11c.** no **12a.** yes **12b.** no **12c.** no **13a.** no **13b.** yes **13c.** no **14a.** no **14b.** no **14c.** yes **15.** C **16.** B **17.** D **18.** A

19.


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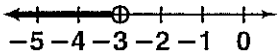

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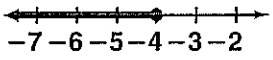

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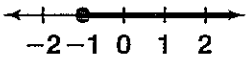

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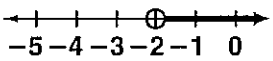

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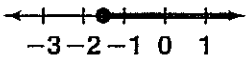

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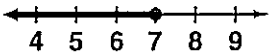

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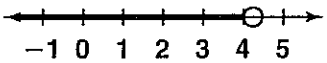
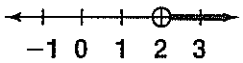


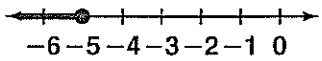
27. $x > -3$ **28.** $x \leq 7$ **29.** $x \geq 1$ **30.** $x < -6$ **31.** $x \geq 4.5$ **32.** $x < -0.5$ **33.** Let s = number of students; $s \leq 48$. **34.** Let a = age; $a \geq 16$. **35.** Let w = wattage; $w \leq 60$. **36.** Let n = number of students; $n \geq 350$. **37.** Let a = number of appearances; $a > 75$. **38.** n is less than 5. **39.** b is greater than 0. **40.** 7 is greater than or equal to x, or x is less than or equal to 7. **41.** z is greater than or equal to -5.6. **42.** q is less than 4, or 4 is greater than q. **43.** -1 is greater than or equal to m, or m is less than or equal to -1. **44.** 35 is greater than or equal to w, or w is less than or equal to 35. **45.** g minus 2 is less than 7. **46.** a is less than or equal to 3. **47.** 6 plus r is greater than -2. **48.** 8 is less than or equal to h, or h is greater than or equal to 8. **49.** 1.2 is greater than k, or k is less

than 1.2. **50.** Use an open dot for $<$ or $>$. Use a closed dot for $\leq$ or $\geq$. **51.** Answers may vary. Sample: For $x = -1, 3(-1) + 1 = -3 + 1 = -2$. $-2 \not> 0$. The inequality is invalid for x = any negative integer. **52.** Put an open dot at 3 and color the rest of the number line on both sides. **53.** Answers may vary. Sample: Every class has at least 18 students.

54. $x > 2$



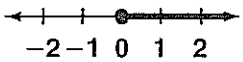
55. $b \leq -5$



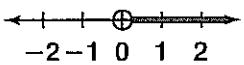
56. $r \geq 0$

57. $a < 5$

58.



59.



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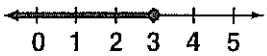
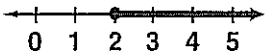
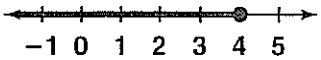


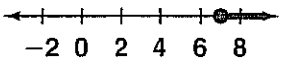
61.



62.



63.

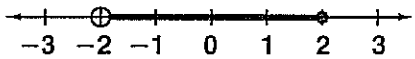


64. "At least" is translated as $\geq$, greater than or equal to; or not less than. "At most" is translated as $\leq$, less than or equal to, or not more than. **65.** $x \geq 2451$, where x is the mileage of any route. **66.** Option A mileage $= 798 + 433 = 1231$; Option B mileage $= 985 + 528 = 1513$; Option A $<$ Option B. **67.** "4 greater than x" refers to a quantity (sum), $x + 4$. "$4 > x$" refers to a relationship: 4 *is* greater than x. **68.** C; the inequality is true for $x = 3$ but not true for $x = 5$, so C is correct. **69.** Answers may vary. Sample: $a = -1, b = \frac{1}{2}$

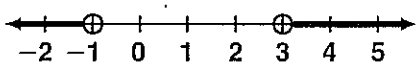
70. a is negative and a and b are opposites.

71. $5a + 4s \geq 4000$

72.



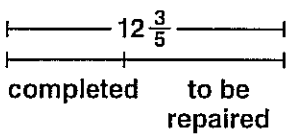
73.



74. $n > 5$ is equivalent to $5 < n$; the answer is C. **75.** The whole numbers are $\{0, 1, 2, 3, \ldots\}$; the answer is F.

76. Use $\geq$ for *at least*; the answer is B. **77.** $\left(\frac{1}{4}\right)^2 = \frac{1}{16} < \frac{1}{4}$; the answer is H. **78.** The graph in B) has one room count of 151; the answer is B.

79. [2]



Since half of $12\frac{3}{5}$ is $6\frac{3}{10}$, less than $6\frac{3}{10}$ has been completed, and more than $6\frac{3}{10}$ is to be repaired; $m > 6\frac{3}{10}$ miles

[1] incorrect inequality OR no diagram

80.
$$\begin{aligned} 2x + 3y &= 6 \\ 2x + 3y - 2x &= 6 - 2x \\ 3y &= 6 - 2x \\ \frac{3y}{3} &= \frac{6 - 2x}{3} \\ y &= 2 - \tfrac{2}{3}x \end{aligned}$$
or
$$y = -\tfrac{2}{3}x + 2$$

81.
$$\begin{aligned} 5x - y + 8 &= 4 \\ 5x - y + y + 8 &= 4 + y \\ 5x + 8 &= 4 + y \\ 5x + 8 - 4 &= 4 - 4 + y \\ 5x + 4 &= y \end{aligned}$$

82.
$$\begin{aligned} -5y + 4x &= 15 \\ -5y &= 15 - 4x \\ \frac{-5y}{-5} &= \frac{15 - 4x}{-5} \\ y &= \tfrac{4}{5}x - 3 \end{aligned}$$

83.
$$\begin{aligned} 2x + 4y &= -20 \\ 2x + 4y - 2x &= -2x - 20 \\ 4y &= -2x - 20 \\ \frac{4y}{4} &= \frac{-2x - 20}{4} \\ y &= -\tfrac{1}{2}x - 5 \end{aligned}$$

84. mean $= \dfrac{\text{sum of digits}}{\text{number of digits}} = \dfrac{69}{11} = 6.\overline{27}$

85. median $= 5$ **86.** mode $= 9$

87.
$$\begin{aligned} V &= IR \\ \frac{V}{R} &= \frac{IR}{R} \\ \frac{V}{R} &= I \end{aligned}$$

88.
$$\begin{aligned} P &= 2\ell + 2w \\ P - 2w &= 2\ell + 2w - 2w \\ P - 2w &= 2\ell \\ \frac{P - 2w}{2} &= \frac{2\ell}{2} \\ \frac{P - 2w}{2} &= \ell \\ \ell &= \frac{P}{2} - w \end{aligned}$$

89.
$$\begin{aligned} P &= a + b + c \\ P - a - c &= a + b + c - a - c \\ P - a - c &= b \end{aligned}$$

90. Associative Property of Multiplication
91. Commutative Property of Multiplication
92. Commutative Property of Addition

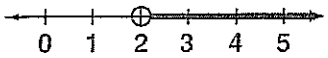
3-2 Solving Inequalities Using Addition and Subtraction *pages 140–145*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

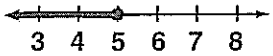
1. $>$ **2.** $<$ **3.** $>$ **4.** 9 **5.** -2 **6.** -9 **7.** $\frac{1}{6}$

Check Understanding

1.
$$m - 6 > -4$$
$$m - 6 + 6 > -4 + 6$$
$$m > 2$$

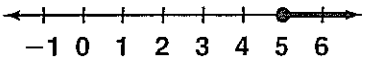


2.
$$n - 7 \le -2$$
$$n - 7 + 7 \le -2 + 7$$
$$n \le 5$$



Check: Convert the original inequality to an equation.
$$n - 7 = -2$$
Then test our solution $n = 5$.
$$5 - 7 \stackrel{?}{=} -2$$
$$-2 = -2 \checkmark$$
Test the direction of the inequality: test $n = 4$ in the original inequality.
$$4 - 7 \stackrel{?}{\le} -2$$
$$-3 \le -2 \checkmark$$

3.
$$t + 3 \ge 8$$
$$t + 3 - 3 \ge 8 - 3$$
$$t \ge 5$$

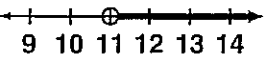


Check: Test $t = 5$ in the equation.
$$t + 3 = 8$$
$$5 + 3 \stackrel{?}{=} 8$$
$$8 = 8 \checkmark$$
Test $t = 6$ in the original inequality.
$$6 + 3 \stackrel{?}{\ge} 8$$
$$9 \ge 8 \checkmark$$

4. Let b = number of blankets donated by the team.
$$42 + 65 + b \ge 160$$
$$107 + b \ge 160$$
$$107 + b - 107 \ge 160 - 107$$
$$b \ge 53$$
The team must donate at least 53 blankets.

Exercises 1. 5 **2.** 8 **3.** 4.3

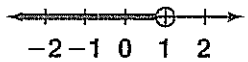
4.
$$x - 1 > 10$$
$$x - 1 + 1 > 10 + 1$$
$$x > 11$$



Check: Test $x = 11$ in the equation.
$$x - 1 = 10$$
$$11 - 1 \stackrel{?}{=} 10$$
$$10 = 10 \checkmark$$
This checks our computation because the steps in solving the inequality are identical (except for manipulation of inequality signs) with the steps in solving the corresponding equality.

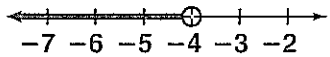
Test $x = 12$ in the original inequality.
$$12 - 1 \stackrel{?}{>} 10$$
$$11 > 10 \checkmark$$

5.
$$t - 3 < -2$$
$$t - 3 + 3 < -2 + 3$$
$$t < 1$$



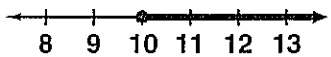
Check: Test $t = 1$ in the equation.
$$t - 3 = -2$$
$$1 - 3 \stackrel{?}{=} -2 \checkmark$$
Test $t = 0$ in the original inequality.
$$0 - 3 \stackrel{?}{<} -2 \checkmark$$

6.
$$-5 > b - 1$$
$$-5 + 1 > b - 1 + 1$$
$$-4 > b$$
$$b < -4$$



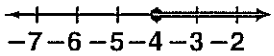
Check: Test $b = -4$ in the equation.
$$-5 = b - 1$$
$$-5 \stackrel{?}{=} -4 - 1 \checkmark$$
Test $b = -5$ in the original inequality.
$$-5 \stackrel{?}{>} -5 - 1$$
$$-5 > -6 \checkmark$$

7.
$$7 \le d - 3$$
$$7 + 3 \le d - 3 + 3$$
$$10 \le d$$



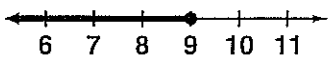
Check: Test $d = 10$ in the equation.
$$7 = d - 3$$
$$7 \stackrel{?}{=} 10 - 3 \checkmark$$
Test $d = 11$ in the original inequality.
$$7 \stackrel{?}{\le} 11 - 3 \checkmark$$

8.
$$s - 2 \ge -6$$
$$s - 2 + 2 \ge -6 + 2$$
$$s \ge -4$$



Check: Test $s = -4$ in the equation.
$$s - 2 = -6$$
$$-4 - 2 \stackrel{?}{=} -6 \checkmark$$
Test $s = -3$ in the original inequality.
$$-3 - 2 \stackrel{?}{\ge} -6 \checkmark$$

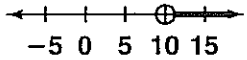
9.
$$r - 9 \le 0$$
$$r - 9 + 9 \le 0 + 9$$
$$r \le 9$$



Check: Test $r = 9$ in the equation.
$$r - 9 = 0$$
$$9 - 9 \stackrel{?}{=} 0 \checkmark$$
Test $r = 8$ in the original inequality.
$$8 - 9 \stackrel{?}{\le} 0 \checkmark$$

10.

$$8 < n - 2$$
$$8 + 2 < n - 2 + 2$$
$$10 < n$$



Check: Test $n = 10$ in the equation.

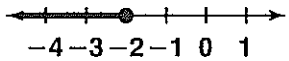
$$8 = n - 2$$
$$8 \stackrel{?}{=} 10 - 2 \checkmark$$

Test $n = 11$ in the original inequality.

$$8 \stackrel{?}{<} 11 - 2 \checkmark$$

11.

$$-4 \geq w - 2$$
$$-4 + 2 \geq w - 2 + 2$$
$$-2 \geq w$$



Check: Test $w = -2$ in the equation.

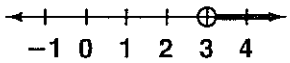
$$-4 = w - 2$$
$$-4 \stackrel{?}{=} -2 - 2 \checkmark$$

Test $w = -3$ in the original inequality.

$$-4 \stackrel{?}{\geq} -3 - 2 \checkmark$$

12.

$$-1 < -4 + d$$
$$-1 + 4 < -4 + d + 4$$
$$3 < d$$



Check: Test $d = 3$ in the equation.

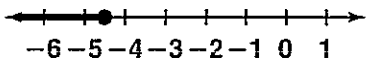
$$-1 = -4 + d$$
$$-1 \stackrel{?}{=} -4 + 3 \checkmark$$

Test $d = 4$ in the original inequality.

$$-1 \stackrel{?}{<} -4 + 4 \checkmark$$

13.

$$y - \tfrac{1}{2} \leq -5$$
$$y - \tfrac{1}{2} + \tfrac{1}{2} \leq -5 + \tfrac{1}{2}$$
$$y \leq -4\tfrac{1}{2}$$



Check: Test $y = -4\frac{1}{2}$ in the equation.

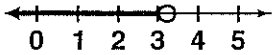
$$y - \tfrac{1}{2} = -5$$
$$-4\tfrac{1}{2} - \tfrac{1}{2} \stackrel{?}{=} -5 \checkmark$$

Test $y = -5$ in the original inequality.

$$-5 - \tfrac{1}{2} \stackrel{?}{\leq} -5 \checkmark$$

14.

$$-\tfrac{2}{3} > q - 4$$
$$-\tfrac{2}{3} + 4 > q - 4 + 4$$
$$3\tfrac{1}{3} > q$$



Check: Test $q = 3\frac{1}{3}$ in the equation.

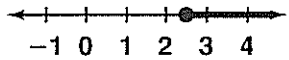
$$-\tfrac{2}{3} = q - 4$$
$$-\tfrac{2}{3} \stackrel{?}{=} 3\tfrac{1}{3} - 4 \checkmark$$

Test $q = 3$ in the original inequality.

$$-\tfrac{2}{3} \stackrel{?}{>} 3 - 4 \checkmark$$

15.

$$x - 2 \geq 0.5$$
$$x - 2 + 2 \geq 0.5 + 2$$
$$x \geq 2.5$$



Check: Test $x = 2.5$ in the equation.

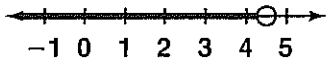
$$x - 2 = 0.5$$
$$2.5 - 2 \stackrel{?}{=} 0.5 \checkmark$$

Test $x = 3$ in the original inequality.

$$3 - 2 \stackrel{?}{\geq} 0.5 \checkmark$$

16.

$$3.2 > -1.3 + r$$
$$3.2 + 1.3 > -1.3 + 1.3 + r$$
$$4.5 > r$$



Check: Test $r = 4.5$ in the equation.

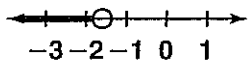
$$3.2 = -1.3 + r$$
$$3.2 \stackrel{?}{=} -1.3 + 4.5 \checkmark$$

Test $r = 4$ in the original inequality.

$$3.2 \stackrel{?}{>} -1.3 + 4$$
$$3.2 > 2.7 \checkmark$$

17.

$$-3.4 > m - 1.8$$
$$-3.4 + 1.8 > m - 1.8 + 1.8$$
$$-1.6 > m$$



Check: Test $m = -1.6$ in the equation.

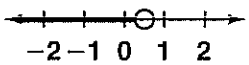
$$-3.4 = m - 1.8$$
$$-3.4 = -1.6 - 1.8 \checkmark$$

Test $m = -2$ in the original inequality.

$$-3.4 \stackrel{?}{>} -2 - 1.8 \checkmark$$

18.

$$b - \tfrac{3}{8} < \tfrac{1}{8}$$
$$b - \tfrac{3}{8} + \tfrac{3}{8} < \tfrac{1}{8} + \tfrac{3}{8}$$
$$b < \tfrac{1}{2}$$



Check: Test $b = \frac{1}{2}$ in the equation.

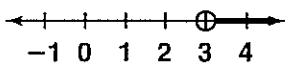
$$b - \tfrac{3}{8} = \tfrac{1}{8}$$
$$\tfrac{1}{2} - \tfrac{3}{8} \stackrel{?}{=} \tfrac{1}{8} \checkmark$$

Test $b = 0$ in the original inequality.

$$0 - \tfrac{3}{8} \stackrel{?}{<} \tfrac{1}{8} \checkmark$$

19.

$$n - 2\tfrac{1}{2} > \tfrac{1}{2}$$
$$n - 2\tfrac{1}{2} + 2\tfrac{1}{2} > \tfrac{1}{2} + 2\tfrac{1}{2}$$
$$n > 3$$



Check: Test $n = 3$ in the equation.

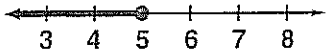
$$n - 2\tfrac{1}{2} = \tfrac{1}{2}$$
$$3 - 2\tfrac{1}{2} \stackrel{?}{=} \tfrac{1}{2} \checkmark$$

Test $n = 4$ in the original inequality.

$$4 - 2\tfrac{1}{2} \stackrel{?}{>} \tfrac{1}{2} \checkmark$$

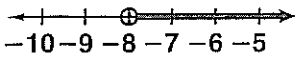
20. 2 **21.** $\frac{5}{3}$ **22.** 3.1

23.
$$w + 4 \le 9$$
$$w + 4 - 4 \le 9 - 4$$
$$w \le 5$$



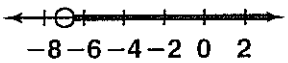
Check: Test $w = 5$ in the equation.
$$w + 4 = 9$$
$$5 + 4 \stackrel{?}{=} 9 \checkmark$$
Test $w = 4$ in the original inequality.
$$4 + 4 \stackrel{?}{\le} 9$$
$$8 \le 9 \checkmark$$

24.
$$m + 5 > -3$$
$$m + 5 - 5 > -3 - 5$$
$$m > -8$$



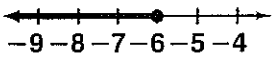
Check: Test $m = -8$ in the equation.
$$m + 5 = -3$$
$$-8 + 5 \stackrel{?}{=} -3 \checkmark$$
Test $m = -7$ in the original inequality.
$$-7 + 5 \stackrel{?}{>} -3 \checkmark$$

25.
$$1 < 8 + b$$
$$1 - 8 < 8 + b - 8$$
$$-7 < b \text{ (or } b > -7)$$



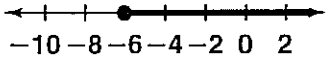
Check: Test $b = -7$ in the equation.
$$1 = 8 + b$$
$$1 \stackrel{?}{=} 8 + (-7) \checkmark$$
Test $b = -6$ in the original inequality.
$$1 \stackrel{?}{<} 8 + (-6) \checkmark$$

26.
$$-2 \ge 4 + a$$
$$-2 - 4 \ge 4 + a - 4$$
$$-6 \ge a$$



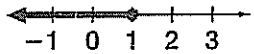
Check: Test $a = -6$ in the equation.
$$-2 = 4 + a$$
$$-2 \stackrel{?}{=} 4 + (-6) \checkmark$$
Test $a = -7$ in the original inequality.
$$-2 \stackrel{?}{\ge} 4 + (-7) \checkmark$$

27.
$$r + 1 \ge -5$$
$$r + 1 - 1 \ge -5 - 1$$
$$r \ge -6$$



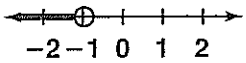
Check: Test $r = -6$ in the equation.
$$r + 1 = -5$$
$$-6 + 1 \stackrel{?}{=} -5 \checkmark$$
Test $r = -5$ in the original inequality.
$$-5 + 1 \stackrel{?}{\ge} -5 \checkmark$$

28.
$$k + 3 \le 4$$
$$k + 3 - 3 \le 4 - 3$$
$$k \le 1$$



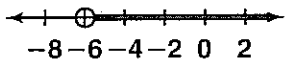
Check: Test $k = 1$ in the equation.
$$k + 3 = 4$$
$$1 + 3 \stackrel{?}{=} 4 \checkmark$$
Test $k = 0$ in the original inequality.
$$0 + 3 \stackrel{?}{\le} 4 \checkmark$$

29.
$$3 > 4 + x$$
$$3 - 4 > 4 + x - 4$$
$$-1 > x$$



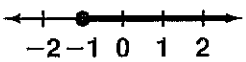
Check: Test $x = -1$ in the equation.
$$3 = 4 + x$$
$$3 \stackrel{?}{=} 4 + (-1) \checkmark$$
Test $x = -2$ in the original inequality.
$$3 \stackrel{?}{>} 4 + (-2) \checkmark$$

30.
$$-5 < 1 + p$$
$$-5 - 1 < 1 + p - 1$$
$$-6 < p$$



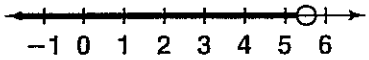
Check: Test $p = -6$ in the equation.
$$-5 = 1 + p$$
$$-5 \stackrel{?}{=} 1 + (-6) \checkmark$$
Test $p = -5$ in the original inequality.
$$-5 \stackrel{?}{<} 1 + (-5) \checkmark$$

31.
$$\tfrac{3}{5} + z \ge -\tfrac{2}{5}$$
$$\tfrac{3}{5} + z - \tfrac{3}{5} \ge -\tfrac{2}{5} - \tfrac{3}{5}$$
$$z \ge -1$$



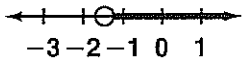
Check: Test $z = -1$ in the equation.
$$\tfrac{3}{5} + z = -\tfrac{2}{5}$$
$$\tfrac{3}{5} + (-1) \stackrel{?}{=} -\tfrac{2}{5} \checkmark$$
Test $z = 0$ in the original inequality.
$$\tfrac{3}{5} + 0 \stackrel{?}{\ge} -\tfrac{2}{5}$$
$$\tfrac{3}{5} \ge -\tfrac{2}{5} \checkmark$$

32.
$$7.5 + y < 13$$
$$7.5 + y - 7.5 < 13 - 7.5$$
$$y < 5.5$$



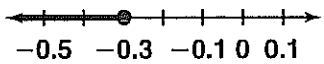
Check: Test $y = 5.5$ in the equation.
$$7.5 + y = 13$$
$$7.5 + 5.5 \stackrel{?}{=} 13 \checkmark$$
Test $y = 5$ in the original inequality.
$$7.5 + 5 \stackrel{?}{<} 13 \checkmark$$

33.
$$\tfrac{1}{2} < m + 2$$
$$\tfrac{1}{2} - 2 < m + 2 - 2$$
$$-\tfrac{3}{2} < m$$



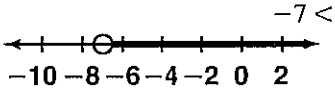
Check: Test $m = -\frac{3}{2}$ in the equation.
$$\tfrac{1}{2} = m + 2$$
$$\tfrac{1}{2} \stackrel{?}{=} -\tfrac{3}{2} + 2 \checkmark$$
Test $m = -1$ in the original inequality.
$$\tfrac{1}{2} \stackrel{?}{<} -1 + 2 \checkmark$$

34.
$$2.7 \geq a + 3$$
$$2.7 - 3 \geq a + 3 - 3$$
$$-0.3 \geq a$$



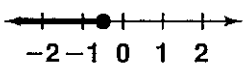
Check: Test $a = -0.3$ in the equation.
$$2.7 = a + 3$$
$$2.7 \stackrel{?}{=} -0.3 + 3 \checkmark$$
Test $a = -1$ in the original inequality.
$$2.7 \stackrel{?}{\geq} -1 + 3 \checkmark$$

35.
$$-2.9 < 4.1 + p$$
$$-2.9 - 4.1 < 4.1 + p - 4.1$$
$$-7 < p$$



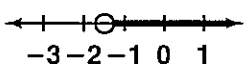
Check: Test $p = -7$ in the equation.
$$-2.9 = 4.1 + p$$
$$-2.9 \stackrel{?}{=} 4.1 + (-7) \checkmark$$
Test $p = -6$ in the original inequality.
$$-2.9 \stackrel{?}{<} 4.1 + (-6) \checkmark$$

36.
$$\tfrac{1}{4} \geq h + \tfrac{3}{4}$$
$$\tfrac{1}{4} - \tfrac{3}{4} \geq h + \tfrac{3}{4} - \tfrac{3}{4}$$
$$-\tfrac{1}{2} \geq h$$



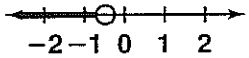
Check: Test $h = -\frac{1}{2}$ in the equation.
$$\tfrac{1}{4} = h + \tfrac{3}{4}$$
$$\tfrac{1}{4} = -\tfrac{1}{2} + \tfrac{3}{4} \checkmark$$
Test $h = -1$ in the original inequality.
$$\tfrac{1}{4} \stackrel{?}{\geq} -1 + \tfrac{3}{4} \checkmark$$

37.
$$5.3 + d > 3.8$$
$$5.3 + d - 5.3 > 3.8 - 5.3$$
$$d > -1.5$$



Check: Test $d = -1.5$ in the equation.
$$5.3 + d = 3.8$$
$$5.3 + (-1.5) \stackrel{?}{=} 3.8 \checkmark$$
Test $d = -1$ in the original inequality.
$$5.3 + (-1) \stackrel{?}{>} 3.8 \checkmark$$

38.
$$t + \tfrac{3}{8} < -\tfrac{1}{8}$$
$$t + \tfrac{3}{8} - \tfrac{3}{8} < -\tfrac{1}{8} - \tfrac{3}{8}$$
$$t < -\tfrac{1}{2}$$



Check: Test $t = -\frac{1}{2}$ in the equation.
$$y + \tfrac{3}{8} = -\tfrac{1}{8}$$
$$-\tfrac{1}{2} + \tfrac{3}{8} \stackrel{?}{=} -\tfrac{1}{8} \checkmark$$
Test $t = -1$ in the original inequality.
$$-1 + \tfrac{3}{8} \stackrel{?}{<} -\tfrac{1}{8} \checkmark$$

39.
$$s + 637 \leq 2000$$
$$s + 637 - 637 \leq 2000 - 637$$
$$s \leq 1363$$

Brother can spend \$1363 or less.

40.
$$s + 6.50 + 5 \leq 15$$
$$s + 11.50 \leq 15$$
$$s + 11.50 - 11.50 \leq 15 - 11.50$$
$$s \leq 3.50$$

You can spend no more than \$3.50.

41.
$$r + 17 + 12 \geq 50$$
$$r + 29 \geq 50$$
$$r + 29 - 29 \geq 50 - 29$$
$$r \geq 21$$

Selling 21 reflectors or more will meet your goal.

42. Add 4 to each side. **43.** Subtract 9 from each side.
44. Add $\frac{1}{2}$ to each side.

45.
$$w - 3 + 1 \geq 9$$
$$w - 2 \geq 9$$
$$w - 2 + 2 \geq 9 + 2$$
$$w \geq 11$$

46.
$$\tfrac{1}{2} + c \leq 3\tfrac{1}{2}$$
$$\tfrac{1}{2} + c - \tfrac{1}{2} \leq 3\tfrac{1}{2} - \tfrac{1}{2}$$
$$c \leq 3$$

47.
$$y - 0.3 < 2.8$$
$$y - 0.3 + 0.3 < 2.8 + 0.3$$
$$y < 3.1$$

48.
$$-6 > n - \tfrac{1}{5}$$
$$-6 + \tfrac{1}{5} > n - \tfrac{1}{5} + \tfrac{1}{5}$$
$$-5\tfrac{4}{5} > n$$

49.
$$z + 4.1 < -5.6$$
$$z + 4.1 - 4.1 < -5.6 - 4.1$$
$$z < -9.7$$

50.
$$-4.1 > y - 0.9$$
$$-4.1 + 0.9 > y - 0.9 + 0.9$$
$$-3.2 > y$$

51.
$$\tfrac{2}{3} + t - \tfrac{5}{6} > 0$$
$$t - \tfrac{1}{6} > 0$$
$$t - \tfrac{1}{6} + \tfrac{1}{6} > 0 + \tfrac{1}{6}$$
$$t > \tfrac{1}{6}$$

52.
$$5 \le v - 4 - 7$$
$$5 + 11 \le v - 11 + 11$$
$$16 \le v$$

53.
$$3.6 + k \ge -4.5$$
$$3.6 - 3.6 + k \ge -4.5 - 3.6$$
$$k \ge -8.1$$

54.
$$6 + b - 7 < 5$$
$$b - 1 < 5$$
$$b - 1 + 1 < 5 + 1$$
$$b < 6$$

55.
$$m + 2.3 \le -1.2$$
$$m + 2.3 - 2.3 \le -1.2 - 2.3$$
$$m \le -3.5$$

56.
$$4 \ge k - \tfrac{3}{4}$$
$$4 + \tfrac{3}{4} \ge k - \tfrac{3}{4} + \tfrac{3}{4}$$
$$4\tfrac{3}{4} \ge k$$

57.
$$h - \tfrac{1}{2} \ge -1$$
$$h - \tfrac{1}{2} + \tfrac{1}{2} \ge -1 + \tfrac{1}{2}$$
$$h \ge -\tfrac{1}{2}$$

58.
$$-7.7 \ge x - 2$$
$$-7.7 + 2 \ge x - 2 + 2$$
$$-5.7 \ge x$$

59.
$$-2 > 9 + 3 + w$$
$$-2 > 12 + w$$
$$-2 - 12 > 12 + w - 12$$
$$-14 > w$$

60.
$$\tfrac{3}{2} + w \le \tfrac{1}{3}$$
$$\tfrac{3}{2} + w - \tfrac{3}{2} \le \tfrac{1}{3} - \tfrac{3}{2}$$
$$w \le -\tfrac{7}{6} = -1\tfrac{1}{6}$$

61.
$$x + 4 - 7 < 13$$
$$x - 3 < 13$$
$$x - 3 + 3 < 13 + 3$$
$$x < 16$$

62.
$$3.5 < m - 2$$
$$3.5 + 2 < m - 2 + 2$$
$$5.5 < m$$

63.
$$9.4 \le t - 3.5$$
$$9.4 + 3.5 \le t - 3.5 + 3.5$$
$$12.9 \le t$$

64.
$$0 > k - 2\tfrac{3}{5}$$
$$0 + 2\tfrac{3}{5} > k - 2\tfrac{3}{5} + 2\tfrac{3}{5}$$
$$2\tfrac{3}{5} > k$$

65.
$$5.3 > 1.6 + n - 2.3$$
$$5.3 > n - 0.7$$
$$5.3 + 0.7 > n - 0.7 + 0.7$$
$$6 > n$$

66.
$$-7\tfrac{3}{4} + m + \tfrac{1}{2} \le -2\tfrac{1}{4}$$
$$-7\tfrac{1}{4} + m \le -2\tfrac{1}{4}$$
$$-7\tfrac{1}{4} + m + 7\tfrac{1}{4} \le -2\tfrac{1}{4} + 7\tfrac{1}{4}$$
$$m \le 5$$

67.
$$-1.4 + s + 2.1 > 11$$
$$s + 0.7 > 11$$
$$s + 0.7 - 0.7 > 11 - 0.7$$
$$s > 10.3$$

68a. yes **68b.** no **68c.** $a = b$ is equivalent to $b = a$. But $a < b$ is not equivalent to $b < a$. The equivalent to $a < b$ is $b > a$. When you switch the two sides of a relationship, you must also flip the operator in the middle, such as $<, >, \le$, or $\ge$. (When you flip $=$, you still get $=$.)

69a. Let f = score on floor exercise.
$$8.8 + 7.9 + 8.2 + f \ge 34.0$$
$$24.9 + f \ge 34.0$$
$$24.9 - 24.9 + f \ge 34.0 - 24.9$$
$$f \ge 9.1$$

69b. Your sister must score at least 9.1 points in the floor exercise to qualify for the regional competition.

69c. Qualifying scores would be 9.1, 9.2, 9.3, . . ., 9.9, 10.0.

70. Let m = memory used by other programs and functions.
$$m \le 64 - 12.8 = 51.2; 52 \text{ MB}$$

71.
$$516.46 - 31.96 + d \ge 500$$
$$484.50 + d \ge 500$$
$$484.50 + d - 484.50 \ge 500 - 484.50$$
$$d \ge 15.50$$

You must deposit at least \$15.50.

72. Let m = minimum score.
$$47 + 48 + m = 135$$
$$95 + m = 135$$
$$m = 135 - 95 = 40$$

40 points is the minimum score to get an A.

73a–b. Check students' work.

74a.
$$z - 8.6 \ge 5.2$$
$$z - 8.6 + 8.6 \ge 5.2 + 8.6$$
$$z \ge 13.8$$

No; Sam assumed that the solution involves an integer, which is unlikely, considering the original inequality.

74b. Answers may vary. Sample: Substituting a value can test the direction of the solution, but substitution is not enough by itself because of the possibility that the solution lies between a value that makes the inequality true and a value that does not.

75.
$$4x + 4 - 3x \ge 5$$
$$x + 4 \ge 5$$
$$x + 4 - 4 \ge 5 - 4$$
$$x \ge 1$$

76.
$$-5n - 3 + 6n < 2$$
$$n - 3 < 2$$
$$n - 3 + 3 < 2 + 3$$
$$n < 5$$

77.
$$7t - (6t - 2) \le -1$$
$$t + 2 \le -1$$
$$t + 2 - 2 \le -1 - 2$$
$$t \le -3$$

78.
$$5k - 2(2k + 1) > 8$$
$$5k - 4k - 2 > 8$$
$$k - 2 > 8$$
$$k - 2 + 2 > 8 + 2$$
$$k > 10$$

79.
$$3(r + 2) - 2r < 4$$
$$3r + 6 - 2r < 4$$
$$r + 6 < 4$$
$$r + 6 - 6 < 4 - 6$$
$$r < -2$$

80.
$$4(r+5)-3r \geq 7$$
$$4r+20-3r \geq 7$$
$$r+20 \geq 7$$
$$r+20-20 \geq 7-20$$
$$r \geq -13$$

81.
$$3a+6-2a \geq -19$$
$$a+6 \geq -19$$
$$a+6-6 \geq -19-6$$
$$a \geq -25$$

82.
$$-5 \leq 3m-10-2m$$
$$-5 \leq m-10$$
$$-5+10 \leq m-10+10$$
$$5 \leq m$$

83.
$$-3d+4(d+3) > 4$$
$$d+12 > 4$$
$$d+12-12 > 4-12$$
$$d > -8$$

84.
$$5(y-2)-4(y-1) < 0$$
$$5y-10-4y+4 < 0$$
$$y-6 < 0$$
$$y-6+6 < 0+6$$
$$y < 6$$

85.
$$-6(a+2)+7a \leq 12$$
$$-6a-12+7a \leq 12$$
$$a-12 \leq 12$$
$$a-12+12 \leq 12+12$$
$$a \leq 24$$

86.
$$-2(a-3)+3(a+2) < 4$$
$$-2a+3a+6+6 < 4$$
$$a+12 < 4$$
$$a+12-12 < 4-12$$
$$a < -8$$

87a.
$$a+b > c$$
$$a+b-b > c-b$$
$$a > c-b$$

87b.
$$b+c > a$$
$$b+c-c > a-c$$
$$b > a-c$$

87c.
$$a+c > b$$
$$a+c-a > b-a$$
$$c > b-a$$

87d. The length of any side of a triangle is greater than the difference of the lengths of the other two sides.

88. Not true; counterexample: If $b=-3, a-(-3) < a-3$ is equivalent to $3 < -3$, which is not true.

89. true (by the Additive Property of Inequality)

90.

c	d	a	$a-c$	$a-d$
5	2	3	−2	1
−1	−3	−3	−2	0
0	−2	0	0	2
4	1	2	−2	1

It appears that for $c > d$, $a-c < a-d$ is true for all real numbers. **91.** Not true; sample counterexample: for $a = 0, b = 1$, and $c = -2, 0 < 1$ and $0 \not< 1+(-2) = -1$.

92. One can add or subtract equalities but one can't always add or subtract inequalities. If $x = 2, y = 1, z = 4$, and $w = 3, 2 > 1$ and $4 > 3$, but $2-4 \not> 1-3$.

93.
$$x+5 < 13$$
$$x+5-5 < 13-5$$
$$x < 8$$

The answer is B.

94.
$$-12+n > 20$$
$$-12+n+12 > 20+12$$
$$n > 32$$

The answer is G.

95.
$$x+4 \geq 8$$
$$x+4-4 \geq 8-4$$
$$x \geq 4$$

The answer is A.

96.
$$5 < n-0.1$$
$$5+0.1 < n-0.1+0.1$$
$$5.1 < n$$

The answer is I.

97.
$$a+5500 \leq 35{,}000$$
$$a+5500-5500 \leq 35{,}000-5500$$
$$a \leq 29{,}500$$

The answer is D.

98. [2] Let x = your score in the last game. Total score = (number of games)(average score per game).
$$24(19.5)+x > 25(20)$$
$$468+x > 500$$
$$468+x-468 > 500-468$$
$$x > 32$$

You must score at least 33 points (scores are integers). [1] no work shown **99.** Let c = length of octopus in feet; $c \leq 10$. **100.** Let h = distance in miles a hummingbird migrates; $h > 1850$. **101.** Let a = average needed; $a \geq 90$. **102.** Let p = number of pages read; $p \geq 25$.

103.
$$n-4 = 9$$
$$n-4+4 = 9+4$$
$$n = 13$$

104.
$$8+w = 7$$
$$8+w-8 = 7-8$$
$$w = -1$$

105.
$$c+5 = -7$$
$$c+5-5 = -7-5$$
$$c = -12$$

106.
$$7-k = 3$$
$$7-k-7 = 3-7$$
$$-k = -4$$
$$k = 4$$

107.
$$4t = 52$$
$$\frac{4t}{4} = \frac{52}{4}$$
$$t = 13$$

108.
$$-\frac{2x}{3} = 12$$
$$-\frac{3}{2}\left(-\frac{2x}{3}\right) = -\frac{3}{2}12$$
$$x = -18$$

109.
$$\frac{k}{7} = -4$$
$$7\left(\frac{k}{7}\right) = 7(-4)$$
$$k = -28$$

110.
$$18 = y-4$$
$$18+4 = y-4+4$$
$$22 = y$$

111.
$$40 = \tfrac{5}{8}q$$
$$\tfrac{8}{5}(40) = \tfrac{8}{5}\left(\tfrac{5}{8}q\right)$$
$$64 = q$$

112. $9^2 + 17 = 81 + 17 = 98$ **113.** $4(5-3)^2 - 3^2 = 4 \cdot 4 - 9 = 7$ **114.** $0.2(4.2 - 3.4) + 0.4 = 0.2(0.8) + 0.4 = 0.16 + 0.4 = 0.56$ **115.** $3 \cdot 2 + 5^2 = 6 + 25 = 31$ **116.** $3 + 7^2 - 4 = 3 + 49 - 4 = 48$ **117.** $4^3 + 3^2 = 64 + 9 = 73$ **118.** $6(5-2)^2 + 4 = 6 \cdot 9 + 4 = 54 + 4 = 58$ **119.** $2 + 8(6 + 2^2) = 2 + 8 \cdot 10 = 82$ **120.** $3^3 - 2^3 + 7 = 27 - 8 + 7 = 26$

3-3 Solving Inequalities Using Multiplication and Division *pages 146–152*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 16 **2.** $-\frac{2}{3}$ **3.** -6 **4.** 6.4 **5.** -18 **6.** 18 **7.** $x \le -1$ **8.** $x > 3$

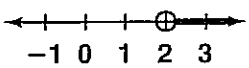
Investigation 1.

$4 \cdot 3 > 1 \cdot 3$
$4 \cdot 2 > 1 \cdot 2$
$4 \cdot 1 > 1 \cdot 1$
$4 \cdot 0 = 1 \cdot 0$
$4 \cdot -1 < 1 \cdot -1$
$4 \cdot -2 < 1 \cdot -2$
$4 \cdot -3 < 1 \cdot -3$

2. There is no change in the inequality sign. **3.** The inequality becomes an equality: $0 = 0$. **4.** The inequality sign is reversed.

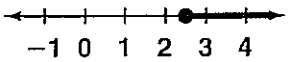
Check Understanding

1a.
$$\tfrac{b}{4} > \tfrac{1}{2}$$
$$4\left(\tfrac{b}{4}\right) > 4\left(\tfrac{1}{2}\right)$$
$$b > 2$$



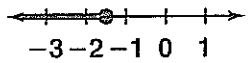
Check: Test $b = 2$ in the equation.
$$\tfrac{b}{4} = \tfrac{1}{2}$$
$$\tfrac{2}{4} \stackrel{?}{=} \tfrac{1}{2} \checkmark$$
Test $b = 3$ in the original inequality.
$$\tfrac{3}{4} \stackrel{?}{>} \tfrac{1}{2} \checkmark$$

1b.
$$\tfrac{d}{3} \ge \tfrac{5}{6}$$
$$3\left(\tfrac{d}{3}\right) \ge 3\left(\tfrac{5}{6}\right)$$
$$d \ge \tfrac{5}{2} = 2\tfrac{5}{2}$$



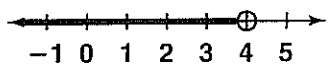
Check computation: Test $d = \frac{5}{2}$ in the equation.
$$\tfrac{d}{3} = \tfrac{5}{6}$$
$$\tfrac{\frac{5}{2}}{3} \stackrel{?}{=} \tfrac{5}{6} \checkmark$$
The steps in solving the equation are the same as the steps in solving the inequality.
Check direction of inequality: Test $d = 3$ in the original inequality.
$$\tfrac{3}{3} \stackrel{?}{\ge} \tfrac{5}{6}$$
$$1 \ge \tfrac{5}{6} \checkmark$$

1c.
$$\tfrac{y}{0.5} \le -3$$
$$0.5\left(\tfrac{y}{0.5}\right) \le 0.5(-3)$$
$$y \le -1.5$$



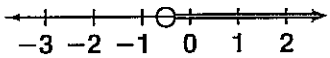
Check: Test $y = -1.5$ in the equation.
$$\tfrac{y}{0.5} = -3$$
$$\tfrac{-1.5}{0.5} \stackrel{?}{=} -3 \checkmark$$
Test $y = -2$ in the original inequality.
$$\tfrac{-2}{0.5} \stackrel{?}{\le} -3$$
$$-4 \le -3 \checkmark$$

2a.
$$-\tfrac{k}{4} > -1$$
$$-4\left(-\tfrac{k}{4}\right) < -4(-1)$$
$$k < 4$$



Check: Test $k = 4$ in the equation.
$$-\tfrac{k}{4} = -1$$
$$-\tfrac{4}{4} \stackrel{?}{=} -1 \checkmark$$
Test $k = 3$ in the original inequality.
$$-\tfrac{3}{4} \stackrel{?}{>} -1 \checkmark$$

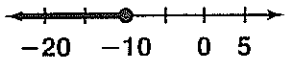
2b.
$$-t < \tfrac{1}{2}$$
$$(-1)(-t) > (-1)\left(\tfrac{1}{2}\right)$$
$$t > -\tfrac{1}{2}$$



Check: Test $t = -\frac{1}{2}$ in the equation.
$$-t = \tfrac{1}{2}$$
$$-\left(-\tfrac{1}{2}\right) \stackrel{?}{=} \tfrac{1}{2} \checkmark$$
Test $t = 0$ in the original inequality.
$$-0 \stackrel{?}{<} \tfrac{1}{2} \checkmark$$

2c.

$$6 \le -\tfrac{3}{5}w$$
$$\left(-\tfrac{5}{3}\right)6 \ge \left(-\tfrac{5}{3}\right)\left(-\tfrac{3}{5}w\right)$$
$$-10 \ge w$$



Check: Test $w = -10$ in the equation.

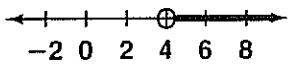
$$6 = -\tfrac{3}{5}w$$
$$6 \stackrel{?}{=} -\tfrac{3}{5}(-10)$$
$$6 = 6 \checkmark$$

Test $w = -11$ in the original inequality.

$$6 \stackrel{?}{\le} -\tfrac{3}{5}(-11)$$
$$6 \le 6\tfrac{3}{5} \checkmark$$

3a.

$$-2t < -8$$
$$\tfrac{-2t}{-2} > \tfrac{-8}{-2}$$
$$t > 4$$



Check: Test $t = 4$ in the equation.

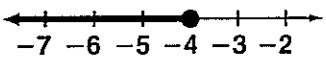
$$-2t = -8$$
$$-2 \cdot 4 \stackrel{?}{=} -8 \checkmark$$

Test $t = 5$ in the original inequality.

$$-2(5) \stackrel{?}{<} -8 \checkmark$$

3b.

$$-3w \ge 12$$
$$\tfrac{-3w}{-3} \le \tfrac{12}{-3}$$
$$w \le -4$$



Check: Test $w = -4$ in the equation.

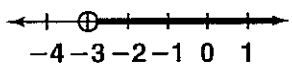
$$-3w = 12$$
$$-3(-4) \stackrel{?}{=} 12 \checkmark$$

Test $w = -5$ in the original inequality.

$$-3(-5) \stackrel{?}{\ge} 12 \checkmark$$

3c.

$$0.6 > -0.2n$$
$$\tfrac{0.6}{-0.2} < \tfrac{-0.2n}{-0.2}$$
$$-3 < n$$



Check: Test $n = -3$ in the equation.

$$0.6 = -0.2n$$
$$0.6 \stackrel{?}{=} -0.2(-3) \checkmark$$

Test $n = -2$ in the original inequality.

$$0.6 \stackrel{?}{>} -0.2(-2) \checkmark$$

4.

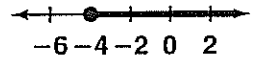
$$0.4c > 327$$
$$\tfrac{0.4c}{0.4} > \tfrac{327}{0.4}$$
$$c > 817.5 \approx 818$$

They must sell at least 818 calendars.

Exercises

1.

$$\tfrac{t}{4} \ge -1$$
$$4\left(\tfrac{t}{4}\right) \ge 4(-1)$$
$$t \ge -4$$



Check computation: Test $t = -4$ in the equation.

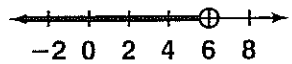
$$\tfrac{t}{4} = -1$$
$$\tfrac{-4}{4} \stackrel{?}{=} -1 \checkmark$$

Test $t = -3$ in the original inequality.

$$\tfrac{-3}{4} \stackrel{?}{\ge} -1 \checkmark$$

2.

$$\tfrac{s}{6} < 1$$
$$6\left(\tfrac{s}{6}\right) < 6(1)$$
$$s < 6$$



Check: Test $s = 6$ in the equation.

$$\tfrac{s}{6} = 1$$
$$\tfrac{6}{6} \stackrel{?}{=} 1 \checkmark$$

Test $s = 5$ in the original inequality.

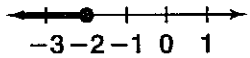
$$\tfrac{5}{6} < 1 \checkmark$$

3.

$$1 \le -\tfrac{w}{2}$$
$$-2(1) \ge -2\left(-\tfrac{w}{2}\right)$$

(Reverse inequality when multiplying by a negative.)

$$-2 \ge w$$



Check: Test $w = -2$ in the equation.

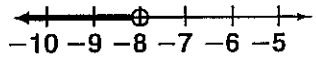
$$1 = -\tfrac{w}{2}$$
$$1 = -\tfrac{-2}{2} \checkmark$$

Test $w = -3$ in the original inequality.

$$1 \stackrel{?}{\le} -\tfrac{-3}{2}$$
$$1 \le \tfrac{3}{2} \checkmark$$

4.

$$2 < -\tfrac{p}{4}$$
$$-4(2) > -4\left(-\tfrac{p}{4}\right)$$
$$-8 > p$$



Check: Test $p = -8$ in the equation.

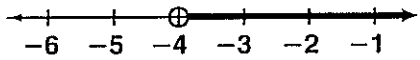
$$2 = -\tfrac{p}{4}$$
$$2 \stackrel{?}{=} -\tfrac{-8}{4} \checkmark$$

Test $p = -9$ in the original inequality.

$$2 \stackrel{?}{<} -\tfrac{-9}{4}$$
$$2 < 2\tfrac{1}{4} \checkmark$$

5.

$$-2 < \tfrac{y}{2}$$
$$2(-2) < 2\left(\tfrac{y}{2}\right)$$
$$-4 < y$$



Check: Test $y = -4$ in the equation.

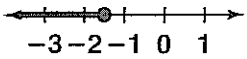
$$-2 = \frac{y}{2}$$
$$-2 \stackrel{?}{=} \frac{-4}{2} \checkmark$$

Test $y = -3$ in the original inequality.

$$-2 \stackrel{?}{<} \frac{-3}{2} \checkmark$$

6.

$$-\frac{v}{3} \geq 0.5$$
$$-3\left(-\frac{v}{3}\right) \leq -3(0.5) \text{ (flip inequality)}$$
$$v \leq -1.5$$



Check: Test $v = -1.5$ in the equation.

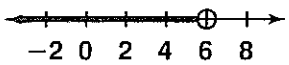
$$-\frac{v}{3} = 0.5$$
$$-\frac{1.5}{3} \stackrel{?}{=} 0.5 \checkmark$$

Test $v = -2$ in the original inequality.

$$-\frac{-2}{3} \stackrel{?}{\geq} 0.5 \checkmark$$

7.

$$4 > \frac{2}{3}x$$
$$\frac{3}{2}(4) > \frac{3}{2}\left(\frac{2}{3}x\right)$$
$$6 > x$$



Check: Test $x = 6$ in the equation.

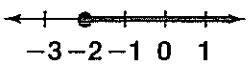
$$4 = \frac{2}{3}x$$
$$4 \stackrel{?}{=} \frac{2}{3}(6) \checkmark$$

Test $x = 4$ in the original inequality.

$$4 \stackrel{?}{>} \frac{2}{3}(4)$$
$$4 > 2\frac{2}{3} \checkmark$$

8.

$$-5 \leq \frac{5}{2}k$$
$$\frac{2}{5}(-5) \leq \frac{2}{5}\left(\frac{5}{2}k\right)$$
$$-2 \leq k$$



Check: Test $k = -2$ in the equation.

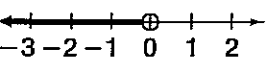
$$-5 = \frac{5}{2}k$$
$$-5 \stackrel{?}{=} \frac{5}{2}(-2) \checkmark$$

Test $k = -1$ in the original inequality.

$$-5 \stackrel{?}{\leq} \frac{5}{2}(-1) \checkmark$$

9.

$$0 < -\frac{7}{8}x$$
$$-\frac{8}{7}(0) > -\frac{8}{7}\left(-\frac{7}{8}x\right)$$
$$0 > x$$



Check: Test $x = 0$ in the equation.

$$0 = -\frac{7}{8}x$$
$$0 \stackrel{?}{=} -\frac{7}{8}(0) \checkmark$$

Test $x = -1$ in the original inequality.

$$0 \stackrel{?}{<} -\frac{7}{8}(-1)$$
$$0 < \frac{7}{8} \checkmark$$

10.

$$\frac{4}{3}y \geq 0$$
$$\frac{3}{4}\left(\frac{4}{3}y\right) \geq \frac{3}{4}(0)$$
$$y \geq 0$$

Check: Test $y = 0$ in the equation.

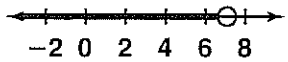
$$\frac{4}{3}y = 0$$
$$\frac{4}{3}(0) \stackrel{?}{=} 0 \checkmark$$

Test solution: $y = 1$ in the original inequality.

$$\frac{4}{3}(1) \geq 0 \checkmark$$

11.

$$-\frac{5}{7}x > -5$$
$$-\frac{7}{5}\left(-\frac{5}{7}x\right) < -\frac{7}{5}(-5)$$
$$x < 7$$



Check: Test $x = 7$ in the equation.

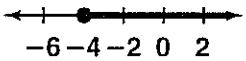
$$-\frac{5}{7}x = -5$$
$$-\frac{5}{7}(7) \stackrel{?}{=} -5 \checkmark$$

Test $x = 6$ in the original inequality.

$$-\frac{5}{7}(6) \stackrel{?}{>} -5$$
$$-4\frac{2}{7} > -5 \checkmark$$

12.

$$6 \geq -\frac{3}{2}d$$
$$-\frac{2}{3}(6) \leq -\frac{2}{3}\left(-\frac{3}{2}d\right)$$
$$-4 \leq d$$



Check: Test $d = -4$ in the equation.

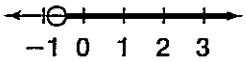
$$6 = -\frac{3}{2}d$$
$$6 \stackrel{?}{=} -\frac{3}{2}(-4) \checkmark$$

Test $d = -3$ in the original inequality.

$$6 \stackrel{?}{\geq} -\frac{3}{2}(-3)$$
$$6 \geq 4\frac{1}{2} \checkmark$$

13.

$$-\frac{4}{9} < \frac{2}{3}c$$
$$\frac{3}{2}\left(-\frac{4}{9}\right) < \frac{3}{2}\left(\frac{2}{3}c\right)$$
$$-\frac{2}{3} < c$$



Check: Test $c = -\frac{2}{3}$ in the equation.

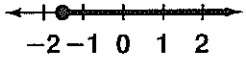
$$-\frac{4}{9} = \frac{2}{3}\left(-\frac{2}{3}\right) \checkmark$$

Test $c = 0$ in the original inequality.

$$-\frac{4}{9} \overset{?}{<} \frac{2}{3}(0) \checkmark$$

14.

$$\frac{3}{4}b \geq -\frac{9}{8}$$
$$\frac{4}{3}\left(\frac{3}{4}b\right) \geq \frac{4}{3}\left(-\frac{9}{8}\right)$$
$$b \geq -\frac{3}{2} = -1\frac{1}{2}$$



Check: Test $b = -\frac{3}{2}$ in the equation.

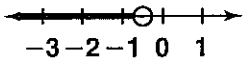
$$\frac{3}{4}b = \frac{9}{8}$$
$$\frac{3}{4}\left(-\frac{3}{2}\right) \overset{?}{=} \frac{9}{8} \checkmark$$

Test $b = -1$ in the original inequality.

$$\frac{3}{4}(-1) \overset{?}{\geq} -\frac{9}{8} \checkmark$$

15.

$$-\frac{5}{3}u > \frac{5}{6}$$
$$-\frac{3}{5}\left(-\frac{5}{3}u\right) < -\frac{3}{5}\left(\frac{5}{6}\right)$$
$$u < -\frac{1}{2}$$



Check: Test $u = -\frac{1}{2}$ in the equation.

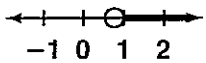
$$-\frac{5}{3}u = \frac{5}{6}$$
$$-\frac{5}{3}\left(-\frac{1}{2}\right) \overset{?}{=} \frac{5}{6}$$

Test $u = -1$ in the original inequality.

$$-\frac{5}{3}(-1) \overset{?}{>} \frac{5}{6} \checkmark$$

16.

$$-\frac{5}{8} > -\frac{5}{6}n$$
$$-\frac{6}{5}\left(-\frac{5}{8}\right) < -\frac{6}{5}\left(-\frac{5}{6}n\right)$$
$$\frac{3}{4} < n$$



Check: Test $n = \frac{3}{4}$ in the equation.

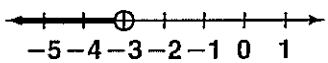
$$-\frac{5}{8} = -\frac{5}{6}n$$
$$-\frac{5}{8} \overset{?}{=} -\frac{5}{6}\left(\frac{3}{4}\right) \checkmark$$

Test $n = 1$ in the original inequality.

$$-\frac{5}{8} \overset{?}{>} -\frac{5}{6}(1) \checkmark$$

17.

$$3t < -9$$
$$\frac{3t}{3} < \frac{-9}{3}$$
$$t < -3$$



Check: Test $t = -3$ in the equation.

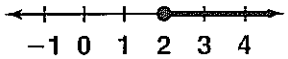
$$3t = -9$$
$$3(-3) \overset{?}{=} -9 \checkmark$$

Test $t = -4$ in the original inequality.

$$3(-4) \overset{?}{<} -9 \checkmark$$

18.

$$4m \geq 8$$
$$\frac{4m}{4} \geq \frac{8}{4}$$
$$m \geq 2$$



Check: Test $m = 2$ in the equation.

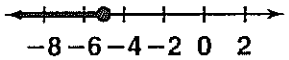
$$4m = 8$$
$$4 \cdot 2 \overset{?}{=} 8 \checkmark$$

Test $m = 3$ in the original inequality.

$$4 \cdot 3 \overset{?}{\geq} 8 \checkmark$$

19.

$$10 \leq -2w$$
$$\frac{10}{-2} \geq \frac{-2w}{-2}$$
$$-5 \geq w$$



Check: Test $w = -5$ in the equation.

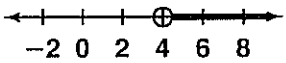
$$10 = -2w$$
$$10 \overset{?}{=} -2(-5) \checkmark$$

Test $w = -6$ in the original inequality.

$$10 \overset{?}{\leq} -2(-6) \checkmark$$

20.

$$-20 > -5c$$
$$\frac{-20}{-5} < \frac{-5c}{-5}$$
$$4 < c$$



Check: Test $c = 4$ in the equation.

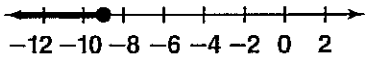
$$-20 = -5c$$
$$-20 \overset{?}{=} -5 \cdot 4 \checkmark$$

Test $c = 5$ in the original inequality.

$$-20 \overset{?}{>} -5(5) \checkmark$$

21.

$$-27 \geq 3z$$
$$\frac{-27}{3} \geq \frac{3z}{3}$$
$$-9 \geq z$$



Check: Test $z = -9$ in the equation.

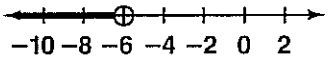
$$-27 = 3z$$
$$-27 \overset{?}{=} 3(-9) \checkmark$$

Test $z = -10$ in the original inequality.

$$-27 \overset{?}{\geq} 3(-10) \checkmark$$

22.

$$-7b > 42$$
$$\frac{-7b}{-7} < \frac{42}{-7}$$
$$b < -6$$



Check: Test $b = -6$ in the equation.

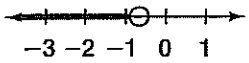
$$-7b = 42$$
$$-7(-6) \overset{?}{=} 42 \checkmark$$

Test $b = -7$ in the original inequality.

$$-7(-7) \overset{?}{>} 42 \checkmark$$

23.

$$18d < -12$$
$$\frac{18d}{18} < \frac{-12}{18}$$
$$d < -\frac{2}{3}$$



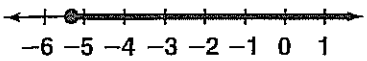
Check: Test $d = -\frac{2}{3}$ in the equation.

$$18d = -12$$
$$18\left(-\tfrac{2}{3}\right) \stackrel{?}{=} -12 \checkmark$$

Test $d = -1$ in the original inequality.

$$18(-1) \stackrel{?}{<} -12 \checkmark$$

24.
$$-3x \le 16$$
$$\frac{-3x}{-3} \ge \frac{16}{-3}$$
$$x \ge -5\tfrac{1}{3}$$



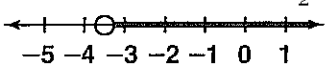
Check: Test $x = -\frac{16}{3}$ in the equation.

$$-3x = 16$$
$$-3\left(-\tfrac{16}{3}\right) = 16 \checkmark$$

Test $x = -5$ in the original inequality.

$$-3(-5) \stackrel{?}{\le} 16 \checkmark$$

25.
$$-7 < 2q$$
$$\frac{-7}{2} < \frac{2q}{2}$$
$$-3\tfrac{1}{2} < q$$



Check: Test $q = -\frac{7}{2}$ in the equation.

$$-7 = 2q$$
$$-7 \stackrel{?}{=} 2\left(-\tfrac{7}{2}\right) \checkmark$$

Test $q = -3$ in the original inequality.

$$-7 \stackrel{?}{<} 2(-3)$$

26.
$$16 > 3.2h$$
$$\frac{16}{3.2} > \frac{3.2h}{3.2}$$
$$5 > h$$

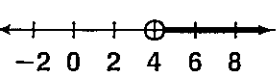
Check: Test $h = 5$ in the equation.

$$16 = 3.2h$$
$$16 \stackrel{?}{=} 3.2(5) \checkmark$$

Test $h = 4$ in the original inequality.

$$16 \stackrel{?}{>} 3.2(4) \checkmark$$

27.
$$-1.5d < -6$$
$$\frac{-1.5d}{-1.5} > \frac{-6}{-1.5}$$
$$d > 4$$



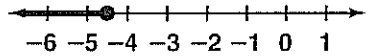
Check: Test $d = 4$ in the equation.

$$-1.5d = -6$$
$$-1.5 \cdot 4 \stackrel{?}{=} -6 \checkmark$$

Test $d = 5$ in the original inequality.

$$-1.5(5) \stackrel{?}{<} -6 \checkmark$$

28.
$$3.6 \le -0.8m$$
$$\frac{3.6}{-0.8} \ge \frac{-0.8m}{-0.8}$$
$$-4.5 \ge m$$



Check: Test $m = -4.5$ in the equation.

$$3.6 = -0.8m$$
$$3.6 = -0.8(-4.5) \checkmark$$

Test $m = -5$ in the original inequality.

$$3.6 \stackrel{?}{\le} -0.8(-5)$$

29. Let c = number of cars actually washed.

$$4.5c \ge 300$$
$$\frac{4.5c}{4.5} \ge \frac{300}{4.5}$$
$$c \ge 66.\overline{6}$$

The club must wash at least 67 cars.

30. Let h = number of actual hours worked.

$$6.15h \ge 100$$
$$\frac{6.15h}{6.15} \ge \frac{100}{6.15}$$
$$h \ge \text{about } 16.3$$

You must work at least 17 hours.

31–38. Answers may vary. Sample solutions are given.

31.
$$\frac{x}{2} \le -1$$
$$2\left(\frac{x}{2}\right) \le 2(-1)$$
$$x \le -2$$

$x = -2, -3, -4, -5$

32.
$$\frac{r}{3} \ge -4$$
$$3\left(\frac{r}{3}\right) \ge 3(-4)$$
$$r \ge -12$$

$r = -12, -11, -9, -3$

33.
$$-1 \ge \frac{t}{3}$$
$$3(-1) \ge 3\left(\frac{t}{3}\right)$$
$$-3 \ge t$$

$t = -3, -5, -10, -19$

34.
$$0.5 > \tfrac{1}{2}c$$
$$2(0.5) > 2\left(\tfrac{1}{2}c\right)$$
$$1 > c$$

$c = 0.9, 0.5, 0, -7$

35.
$$-\tfrac{3}{4}q > 4$$
$$-\tfrac{4}{3}\left(-\tfrac{3}{4}q\right) < -\tfrac{4}{3}(4)$$
$$q < -\tfrac{16}{3} = -5\tfrac{1}{5}$$

$q = -6, -7, -8, -9$

36.
$$1 < -\tfrac{5}{7}s$$
$$-\tfrac{7}{5}(1) > -\tfrac{7}{5}\left(-\tfrac{5}{7}s\right)$$
$$-\tfrac{7}{5} > s$$
$$\text{or } s < -1\tfrac{2}{5}$$

$s = -1\tfrac{3}{5}, -2, -3, -7$

37.
$$-4.5 \le -0.9p$$
$$\frac{-4.5}{-0.9} \ge \frac{-0.9p}{-0.9}$$
$$5 \ge p$$

$p = 5, 4, 3, 2$

38.
$$-2.7w \geq 28$$
$$\frac{-2.7w}{-2.7} \leq \frac{28}{-2.7}$$
$$w \leq -10.\overline{370}$$
$w = -10.4, -11, -12, -13$

39. Multiply each side by -4 and reverse the inequality symbol. **40.** Multiply each side by 5. **41.** Divide each side by 5. **42.** Multiply each side by $\frac{4}{3}$. **43.** Divide each side by 4. **44.** Multiply each side by -1 and reverse the inequality symbol. **45.** -2 **46.** -5 **47.** 4 **48.** 18 **49.** -10 **50.** 7.5 **51.** From $-x \geq -y$, we have $x \leq y$. So, x and y must be equal. **52–55.** Estimates may vary.

52. Approx.:
$$-2r < 4$$
$$\frac{-2r}{-2} > \frac{4}{-2}$$
$$r > -2$$

53. Approx.:
$$4j > -24$$
$$\frac{4j}{4} > \frac{-24}{4}$$
$$j > -6$$

54. Approx.:
$$21 \geq \tfrac{1}{2}p$$
$$2(21) \geq 2\left(\tfrac{1}{2}p\right)$$
$$42 \geq p$$

55. Approx.:
$$-\tfrac{20}{40}s \leq -14$$
$$-\tfrac{40}{20}\left(-\tfrac{20}{40}s\right) \geq -\tfrac{40}{20}(-14)$$
$$s \geq 28$$

56. Let n = number of concrete blocks lifted by an elevator.
$$42n \leq 4400$$
$$\frac{42n}{42} \leq \frac{4400}{42}$$
$$n \leq \text{about } 104.8$$
The elevator can lift safely no more than 104 concrete blocks.

57. To solve either the equation or the inequality, multiply both sides by -3. For the inequality, also reverse the $>$ symbol. **58.** Samples: $\frac{x}{10} > \frac{3}{10}$, $\frac{x}{-2} < \frac{3}{-2}$, $4x > 12$, $-x < -3$

59.
$$4d \leq -28$$
$$\frac{4d}{4} \leq \frac{-28}{4}$$
$$d \leq -7$$

60.
$$\tfrac{u}{7} > 5$$
$$7\left(\tfrac{u}{7}\right) > 7(5)$$
$$u > 35$$

61.
$$2 < -8s$$
$$\frac{2}{-8} > \frac{-8s}{-8}$$
$$-\tfrac{1}{4} > s$$

62.
$$\tfrac{3}{2}k \geq -45$$
$$\tfrac{2}{3}\left(\tfrac{3}{2}k\right) \geq \tfrac{2}{3}(-45)$$
$$k \geq -30$$

63.
$$0.3y < 2.7$$
$$\frac{0.3y}{0.3} < \frac{2.7}{0.3}$$
$$y < 9$$

64.
$$9.4 \leq -4t$$
$$\frac{9.4}{-4} \geq \frac{-4t}{-4}$$
$$-2.35 \geq t$$

65.
$$-h \geq 4$$
$$-1(-h) \leq -1(4)$$
$$h \leq -4$$

66.
$$\tfrac{5}{2}x > 5$$
$$\tfrac{2}{5}\left(\tfrac{5}{2}x\right) > \tfrac{2}{5}(5)$$
$$x > 2$$

67.
$$24 < -\tfrac{8}{3}x$$
$$-\tfrac{3}{8}(24) > -\tfrac{3}{8}\left(-\tfrac{8}{3}x\right)$$
$$-9 > x$$

68.
$$0 < -\tfrac{1}{6}b$$
$$-6(0) > -6\left(-\tfrac{1}{6}b\right)$$
$$0 > b$$

69.
$$\tfrac{5}{6} > -\tfrac{1}{3}p$$
$$-3\left(\tfrac{5}{6}\right) < -3\left(-\tfrac{1}{3}p\right)$$
$$-\tfrac{5}{2} < p$$
$$\text{or } p > -2\tfrac{1}{2}$$

70.
$$-0.2m \geq 9.4$$
$$\frac{-0.2m}{-0.2} \leq \frac{9.4}{-0.2}$$
$$m \leq -47$$

71.
$$6 < -9g$$
$$\frac{6}{-9} > \frac{-9g}{-9}$$
$$-\tfrac{2}{3} > g$$

72.
$$4n \geq 9$$
$$\frac{4n}{4} \geq \frac{9}{4}$$
$$n \geq 2\tfrac{1}{4}$$

73.
$$-3.5 < -m$$
$$-1(-3.5) > -1(-m)$$
$$3.5 > m$$

74.
$$\tfrac{2}{5}z \geq -1$$
$$\tfrac{5}{2}\left(\tfrac{2}{5}z\right) \geq \tfrac{5}{2}(-1)$$
$$z \geq -2\tfrac{1}{2}$$

75. Yes; the two solutions are equivalent to each other. $6 < y$ is equivalent to $y > 6$. **76.** Let r = average rate (speed) in miles per minute, and d = distance traveled in miles. Time to pedal 3 miles, t, is
$$t = \frac{d}{r}$$
$$\frac{d}{r} < 20$$
$$\frac{3}{r} < 20$$
$$r\frac{3}{r} < r(20)$$
$$3 < 20r$$
$$\frac{3}{20} < \frac{20r}{20}$$
$$0.15 < r$$

Average rate must be more than 0.15 mi/min or 9 mi/h. **77a.** We have 15 times q, not 15 minus q. The problem involves multiplication and/or division, not addition and/or subtraction. Kia should have divided each side by -15. **77b.** Kia's solution was $q \le 150$. The true solution is $q \ge -9$. Any number larger than -9 will satisfy the original inequality. **77c.** Kia's solution is $q \le 150$. Any number less than -9 will satisfy her solution but not satisfy the original inequality. Example: $q = -10$.
78. $a > 0$: If c is negative and a is positive, then ac is negative and is less than a. If $a = 0$, then we would have $0 < 0$, which is not true. **79.** $a > 0$: If a were negative, then the inequality should reverse. **80.** $a \ne 0$: a^2 is positive for any nonzero a. **81.** $a < 0$: a must be negative because the inequality flipped.
82. The diameter of the globe is $d = \frac{C}{\pi} = \frac{15}{\pi} \approx 4.77$; if b = side of box, then $b \ge 4.77$, and the 5-in. or 6-in. box will hold the globe.
83. Let x = number of tiles needed.

$$\frac{9}{16}x \ge 18 \cdot 15$$
$$\frac{16}{9}\left(\frac{9}{16}x\right) \ge \frac{16}{9}18 \cdot 15$$
$$x \ge 480$$

At least 480 tiles are needed.

84.
$$\frac{2}{5}x = 16$$
$$\frac{5}{2}\left(\frac{2}{5}x\right) = \frac{5}{2}(16)$$
$$x = 40$$

85.
$$16{,}800 \le \frac{1}{3}x$$
$$3(16{,}800) \le 3\left(\frac{1}{3}x\right)$$
$$50400 \le x$$

86.
$$\frac{30}{5}n \ge 320$$
$$\frac{5}{30}\left(\frac{30}{5}n\right) \ge \frac{5}{30}(320)$$
$$n \ge 53.\overline{3}$$

54 boxes are needed.

87.
$$0.34n \le 5.00$$
$$\frac{0.34n}{0.34} \le \frac{5.00}{0.34}$$
$$n \le \text{about } 14.7$$

You can buy only 14 stamps.

88.
$$A = \ell w$$
$$A < 380$$
$$\text{therefore } \ell w < 380$$
$$\frac{\ell w}{\ell} < \frac{380}{\ell}$$
$$w < \frac{380}{90} = 4.\overline{2}$$

greatest possible width: 4
89. 1 mile = (5280 ft)(12 in./ft) = 63,360 in.; 63360
Let n = actual number of cans.

$$4.75n \ge 63{,}360$$
$$\frac{4.75n}{4.75} \ge \frac{36{,}630}{4.75}$$
$$n \ge 13{,}339$$

They need at least 13339 cans.

90.
$$x + 3 \le -4$$
$$x + 3 - 3 \le -4 - 3$$
$$x \le -7$$

91.
$$\frac{5}{8} > \frac{3}{4} + w$$
$$\frac{5}{8} - \frac{3}{4} > \frac{3}{4} + w - \frac{3}{4}$$
$$-\frac{1}{8} > w$$

92.
$$t - 3.4 \ge 5.8$$
$$t - 3.4 + 3.4 \ge 5.8 + 3.4$$
$$t \ge 9.2$$

93.
$$0 < d - 4$$
$$0 + 4 < d - 4 + 4$$
$$4 < d$$

94.
$$3.2 \ge m + 7.1$$
$$3.2 - 7.1 \ge m + 7.1 - 7.1$$
$$-3.9 \ge m$$

95.
$$y - 2 < 6$$
$$y - 2 + 2 < 6 + 2$$
$$y < 8$$

96.
$$-3 > a - 4$$
$$-3 + 4 > a - 4 + 4$$
$$1 > a$$

97.
$$k + 12 \le 15$$
$$k + 12 - 12 \le 15 - 12$$
$$k \le 3$$

98.
$$3t + 5 - t = 9$$
$$2t + 5 = 9$$
$$2t + 5 - 5 = 9 - 5$$
$$2t = 4$$
$$\frac{2t}{2} = \frac{4}{2}$$
$$t = 2$$

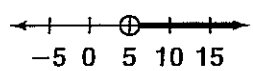
99.
$$-3(2n + 1) = 9$$
$$-6n - 3 = 9$$
$$-6n - 3 + 3 = 9 + 3$$
$$-6n = 12$$
$$\frac{-6n}{-6} = \frac{12}{-6}$$
$$n = -2$$

100.
$$\frac{3x}{4} - \frac{1}{2} = \frac{1}{4}$$
$$4\left(\frac{3x}{4}\right) - 4\left(\frac{1}{2}\right) = 4\left(\frac{1}{4}\right)$$
$$3x - 2 = 1$$
$$3x - 2 + 2 = 1 + 2$$
$$3x = 3$$
$$\frac{3x}{3} = \frac{3}{3}$$
$$x = 1$$

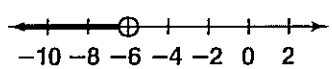
101. Prop. of Opposites **102.** Prop. of Reciprocals
103. Ident. Prop. of Add. **104.** Ident. Prop. of Mult.
105. Assoc. Prop. of Mult. **106.** Comm. Prop. of Mult.

CHECKPOINT QUIZ 1 *page 151*

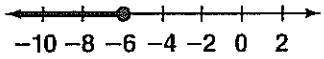
1.
$$6 < c + 1$$
$$6 - 1 < c + 1 - 1$$
$$5 < c$$



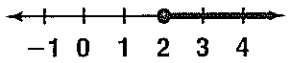
2.
$$5x < -30$$
$$\frac{5x}{5} < \frac{-30}{5}$$
$$x < -6$$



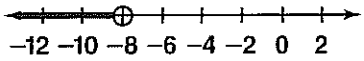
3.
$$\frac{p}{3} \le -2$$
$$3\left(\frac{p}{3}\right) \le 3(-2)$$
$$p \le -6$$



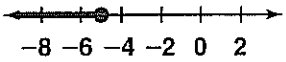
4.
$$y - 4 \ge -2$$
$$y - 4 + 4 \ge -2 + 4$$
$$y \ge 2$$



5.
$$12 + g < 4$$
$$12 + g - 12 < 4 - 12$$
$$g < -8$$



6.
$$-3b \ge 15$$
$$\frac{-3b}{-3} \le \frac{15}{-3}$$
$$b \le -5$$



7a. yes; $-4 + 7 = 3$ **7b.** no; $0 + 7 = 7$ **7c.** yes; $-\frac{17}{4} + 7 = 2\frac{3}{4}$ **7d.** no; $-3.9 + 7 = 3.1$ **8a.** no; $-4(3) = -12$ **8b.** no; $-4(0) = 0$ **8c.** no; $-4\left(\frac{7}{3}\right) = -9\frac{1}{3}$ **8d.** yes; $-4\pi \approx 12.57$

9a.
$$m + 38 + 50 \ge 180$$
9b.
$$m + 88 \ge 180$$
$$m + 88 - 88 \ge 180 - 88$$
$$m \ge 92$$
You must save at least \$92.

10a.
$$1.50p \le 20$$
$$\frac{1.50p}{1.50} \le \frac{20}{1.5}$$
$$p \le 13.\overline{3}$$
You can buy no more than 13 plants.

READING MATH *page 152*

a. Corect solution:
$$-\tfrac{1}{2}k \ge -5$$
$$-2\left(-\tfrac{1}{2}k\right) \le -2(-5)$$
$$k \le 10$$
Danny forgot to flip the inequality sign, which is necessary because we are multiplying by a negative number.

b. The test $t = 10$ would check his calculation, but would not check the direction of the inequality.

c. Any number less than 10 will satisfy the original inequality but not Danny's solution. Examples are 9, 8, 5, −3, ... Danny should have tested $t = 11$, which satisfies his solution but not the original inequality.

3-4 Solving Multi-Step Inequalities *pages 153–160*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. −2 **2.** no solution **3.** $-3\frac{1}{3}$ **4.** identity **5.** $1\frac{2}{9}$ **6.** −11 **7.** 40 cm **8.** 13 in.

CHECK UNDERSTANDING *pages 153–155*

1a.
$$-3x - 4 \le 14$$
$$-3x - 4 + 4 \le 14 + 4$$
$$-3x \le 18$$
$$\frac{-3x}{-3} \ge \frac{18}{-3}$$
$$x \ge -6$$
Check: Convert the original inequality to an equation. Test $x = -6$.
$$-3x - 4 = 14$$
$$-3(-6) - 4 \stackrel{?}{=} 14$$
$$18 - 4 = 14 \checkmark$$
Test the direction of the inequality; test $x = -5$.
$$-3(-5) - 4 \stackrel{?}{\le} 14$$
$$15 - 4 \le 14 \checkmark$$

1b.
$$5 < 7 - 2t$$
$$5 + 2t < 7 - 2t + 2t$$
$$5 + 2t < 7$$
$$5 + 2t - 5 < 7 - 5$$
$$2t < 2$$
$$\frac{2t}{2} < \frac{2}{2}$$
$$t < 1$$
Check: Test $t = 1$ in the equation.
$$5 = 7 - 2t$$
$$5 \stackrel{?}{=} 7 - 2(1)$$
$$5 = 7 - 2 \checkmark$$
Test $t = 0$ in the original inequality.
$$5 \stackrel{?}{<} 7 - 2(0)$$
$$5 < 7 \checkmark$$

1c.
$$-8 < 5n - 23$$
$$-8 + 23 < 5n - 23 + 23$$
$$15 < 5n$$
$$\frac{15}{5} < \frac{5n}{5}$$
$$3 < n$$
Check: Test $n = 3$ in the equation.
$$-8 = 5n - 23$$
$$-8 \stackrel{?}{=} 5(3) - 23$$
$$-8 = 15 - 23 \checkmark$$
Test $n = 4$ in the original inequality.
$$-8 \stackrel{?}{<} 5(4) - 23$$
$$-8 < 20 - 23 \checkmark$$

1d.
$$5k + 12 \le 2$$
$$5k + 12 - 12 \le 2 - 12$$
$$5k \le -10$$
$$\frac{5k}{5} \le \frac{-10}{5}$$
$$k \le -2$$
Check: Test $k = -2$ in the equation.
$$5k + 12 = 2$$
$$5(-2) + 12 \stackrel{?}{=} 2$$
$$-10 + 12 = 2 \checkmark$$
Test $k = -3$ in the original inequality.
$$5(-3) + 12 \stackrel{?}{\le} 2$$
$$-15 + 12 \le 2 \checkmark$$

2.
$$2(12) + 2w \le 40$$
$$24 + 2w \le 40$$
$$24 + 2w - 24 \le 40 - 24$$
$$2w \le 16$$
$$\frac{2w}{2} \le \frac{16}{2}$$
$$w \le 8$$

The width must be 8 ft or less.

3a.
$$4p + 2(p + 7) < 8$$
$$4p + 2p + 14 < 8$$
$$6p + 14 < 8$$
$$6p + 14 - 14 < 8 - 14$$
$$6p < -6$$
$$\frac{6p}{6} < -\frac{6}{6}$$
$$p < -1$$

Check: Test $p = -1$ in the equation.
$$4p + 2(p + 7) = 8$$
$$4(-1) + 2(-1 + 7) \stackrel{?}{=} 8$$
$$-4 + 2 \cdot 6 = 8 \checkmark$$

Test $p = -2$ in the original inequality.
$$4(-2) + 2(-2 + 7) \stackrel{?}{<} 8$$
$$-8 + 2 \cdot 5 < 8$$

3b.
$$15 \le 5 - 2(4m + 7)$$
$$15 \le 5 - 8m - 14$$
$$15 \le -8m - 9$$
$$15 + 9 \le -8m - 9 + 9$$
$$24 \le -8m$$
$$\frac{24}{-8} \ge \frac{-8m}{-8}$$
$$-3 \ge m$$

Check: Test $m = -3$ in the equation.
$$15 = 5 - 2(4m + 7)$$
$$15 \stackrel{?}{=} 5 - 2[4(-3) + 7]$$
$$15 \stackrel{?}{=} 5 - 2 \cdot (-5)$$
$$15 = 5 + 10 \checkmark$$

Test $m = -4$ in the original inequality.
$$15 \stackrel{?}{\le} 5 - 2[4(-4) + 7]$$
$$15 \le 5 - 2(-9) \checkmark$$

3c.
$$8 > 3(5 - b) + 2$$
$$8 > 15 - 3b + 2$$
$$8 > 17 - 3b$$
$$8 - 17 > 17 - 3b - 17$$
$$-9 > -3b$$
$$\frac{-9}{-3} < \frac{-3b}{-3}$$
$$3 < b$$

Check: Test $b = 3$ in the equation.
$$8 = 3(5 - b) + 2$$
$$8 \stackrel{?}{=} 3(5 - 3) + 2$$
$$8 = 3 \cdot 2 + 2 \checkmark$$

Test $b = 4$ in the original inequality.
$$8 \stackrel{?}{>} 3(5 - 4) + 2$$
$$8 > 3 \cdot 1 + 2 \checkmark$$

4.
$$3b + 12 > 27 - 2b$$
$$3b + 12 + 2b > 27 - 2b + 2b$$
$$5b + 12 > 27$$
$$5b + 12 - 12 > 27 - 12$$
$$5b > 15$$
$$\frac{5b}{5} > \frac{15}{5}$$
$$b > 3$$

Check: Test $b = 3$ in the equation.
$$3b + 12 = 27 - 2b$$
$$3 \cdot 3 + 12 \stackrel{?}{=} 27 - 2 \cdot 3$$
$$9 + 12 = 27 - 6 \checkmark$$

Test $b = 4$ in the original inequality.
$$3 \cdot 4 + 12 \stackrel{?}{>} 27 - 2 \cdot 4$$
$$12 + 12 > 27 - 8 \checkmark$$

5.
$$-6(x - 4) \ge 7(2x - 3)$$
$$-6x + 24 \ge 14x - 21$$
$$-6x + 24 + 6x \ge 14x - 21 + 6x$$
$$24 \ge 20x - 21$$
$$24 + 21 \ge 20x - 21 + 21$$
$$45 \ge 20x$$
$$\frac{45}{20} \ge \frac{20x}{20}$$
$$\frac{9}{4} \ge x$$
$$x \le 2\tfrac{1}{4}$$

Check: Test $x = 2\frac{1}{4}$ in the equation.
$$-6(x - 4) = 7(2x - 3)$$
$$-6\left(\frac{9}{4} - 4\right) \stackrel{?}{=} 7\left[2\left(\frac{9}{4}\right) - 3\right]$$
$$-\frac{27}{2} + 24 \stackrel{?}{=} \frac{63}{2} - 21$$
$$\frac{-27 + 48}{2} = \frac{63 - 42}{2} \checkmark$$

Test $x = 2$ in the original inequality.
$$-6(2 - 4) \ge 7(2 \cdot 2 - 3)$$
$$-6 \cdot -2 \ge 7 \cdot 1 \checkmark$$

Exercises

1.
$$4d + 7 \le 23$$
$$4d + 7 - 7 \le 23 - 7$$
$$4d \le 16$$
$$\frac{4d}{4} \le \frac{16}{4}$$
$$d \le 4$$

Check: Test $d = 4$ in the equation.
$$4d + 7 = 23$$
$$4 \cdot 4 + 7 = 23 \checkmark$$

Test $d = 3$ in the original inequality.
$$4 \cdot 3 + 7 \le 23 \checkmark$$

2.
$$5m - 3 > -18$$
$$5m - 3 + 3 > -18 + 3$$
$$5m > -15$$
$$\frac{15m}{5} > \frac{-15}{5}$$
$$m > -3$$

Check: Test $m = -3$ in the equation.
$$5m - 3 = -18$$
$$5(-3) - 3 = -18 \checkmark$$

Test $m = -2$ in the original inequality.
$$5(-2) - 3 > -18 \checkmark$$

3.
$$-4x - 2 < 8$$
$$-4x - 2 + 2 < 8 + 2$$
$$-4x < 10$$
$$\frac{-4x}{-4} > \frac{10}{-4}$$
$$x > -\frac{5}{2} = -2\tfrac{1}{2}$$

Check: Test $x = -\frac{5}{2}$ in the equation.

$$-4x - 2 = 8$$
$$-4\left(-\frac{5}{2}\right) - 2 \stackrel{?}{=} 8$$
$$10 - 2 = 8 \checkmark$$

Test $x = -2$ in the original inequality.

$$-4(-2) - 2 < 8 \checkmark$$

4.
$$5 - 3n \geq -4$$
$$5 - 3n - 5 \geq -4 - 5$$
$$-3n \geq -9$$
$$\frac{-3n}{-3} \leq \frac{-9}{-3}$$
$$n \leq 3$$

Check: Test $n = 3$ in the equation.

$$5 - 3n = -4$$
$$5 - 3 \cdot 3 = -4 \checkmark$$

Test $n = 2$ in the original inequality.

$$5 - 3 \cdot 2 \geq -4 \checkmark$$

5.
$$8 \leq -12 + 5q$$
$$8 + 12 \leq -12 + 5q + 12$$
$$20 \leq 5q$$
$$\frac{20}{5} \leq \frac{5q}{5}$$
$$q \geq 4$$

Check: Test $q = 4$ in the equation.

$$8 = -12 + 5q$$
$$8 = -12 + 5 \cdot 4 \checkmark$$

Test $q = 5$ in the original inequality.

$$8 \stackrel{?}{\leq} -12 + 5 \cdot 5$$
$$8 \leq -12 + 25 \checkmark$$

6.
$$5 \leq 11 + 3h$$
$$5 - 11 \leq 11 + 3h - 11$$
$$-6 \leq 3h$$
$$\frac{-6}{3} \leq \frac{3h}{3}$$
$$h \geq -2$$

Check: Test $h = -2$ in the equation.

$$5 = 11 + 3h$$
$$5 = 11 + 3(-2) \checkmark$$

Test $h = -1$ in the original inequality.

$$5 \leq 11 + 3(-1) \checkmark$$

7.
$$-7 \leq 5 - 4a$$
$$-7 - 5 \leq 5 - 4a - 5$$
$$-12 \leq -4a$$
$$\frac{-12}{-4} \geq \frac{-4a}{-4}$$
$$3 \geq a$$

Check: Test $a = 3$ in the equation.

$$-7 = 5 - 4a$$
$$-7 = 5 - 4 \cdot 3 \checkmark$$

Test $a = 2$ in the original inequality.

$$-7 \leq 5 - 4 \cdot 2 \checkmark$$

8.
$$10 > 29 - 3b$$
$$10 - 29 > 29 - 3b - 29$$
$$-19 > -3b$$
$$\frac{-19}{-3} < \frac{-3b}{-3}$$
$$\frac{19}{3} = 6\frac{1}{3} < b$$

Check: Test $b = \frac{19}{3}$ in the equation.

$$10 = 29 - 3b$$
$$10 \stackrel{?}{=} 29 - 3\left(\frac{19}{3}\right)$$
$$10 = 29 - 19 \checkmark$$

Test $b = 7$ in the original inequality.

$$10 > 29 - 3 \cdot 7 \checkmark$$

9.
$$5 - 9c > -13$$
$$5 - 9c - 5 > -13 - 5$$
$$-9c > -18$$
$$\frac{-9c}{-9} < \frac{-18}{-9} \text{ (Flip inequality sign.)}$$
$$c < 2$$

Check: Test $c = 2$ in the equation.

$$5 - 9c = -13$$
$$5 - 9(2) \stackrel{?}{=} -13$$
$$5 - 18 = -13 \checkmark$$

Test $c = 1$ in the original inequality.

$$5 - 9 \cdot 1 > -13 \checkmark$$

10. Let s = actual average rate of speed. We require

$$8s \geq 420$$
$$\frac{8s}{8} \geq \frac{420}{8}$$
$$s \geq 52.5$$

Their average speed should be at least 52.5 mi/h.

11. Let s = length of the two equal sides.

$$2s + 8 \leq 27$$
$$2s + 8 - 8 \leq 27 - 8$$
$$2s \leq 19$$
$$\frac{2s}{2} \leq \frac{19}{2}$$
$$s \leq 9.5$$

The two equal sides are 9.5 cm or less.

12. $-6x + 9$

13.
$$2(j - 4) \geq -6$$
$$2j - 8 \geq -6$$
$$2j - 8 + 8 \geq -6 + 8$$
$$2j \geq 2$$
$$\frac{2j}{2} \geq \frac{2}{2}$$
$$j \geq 1$$

14.
$$-(6b - 2) > 0$$
$$-6b + 2 > 0$$
$$-6b + 2 - 2 > 0 - 2$$
$$-6b > -2$$
$$\frac{-6b}{-6} < \frac{-2}{-6}$$
$$b < \frac{1}{3}$$

15.
$$-2(h + 2) < -14$$
$$-2h - 4 < -14$$
$$-2h - 4 + 4 < -14 + 4$$
$$-2h < -10$$
$$\frac{-2h}{-2} > \frac{-10}{-2}$$
$$h > 5$$

16.
$$-3 \leq 3(5x - 16)$$
$$-3 \leq 15x - 48$$
$$-3 + 48 \leq 15x - 48 + 48$$
$$45 \leq 15x$$
$$\frac{45}{15} \leq \frac{15x}{15}$$
$$3 \leq x$$

17.
$$25 > -(4y + 7)$$
$$25 > -4y - 7$$
$$25 + 7 > -4y - 7 + 7$$
$$32 > -4y$$
$$\frac{32}{-4} < \frac{-4y}{-4}$$
$$-8 < y$$

18.
$$4(w - 2) \leq 10$$
$$4w - 8 \leq 10$$
$$4w - 8 + 8 \leq 10 + 8$$
$$4w \leq 18$$
$$\frac{4w}{4} \leq \frac{18}{4}$$
$$w \leq 4\tfrac{1}{2}$$

19.
$$-3(c + 4) - 2 > 7$$
$$-3c - 14 > 7$$
$$-3c - 14 + 14 > 7 + 14$$
$$-3c > 21$$
$$\frac{-3c}{-3} < \frac{21}{-3}$$
$$c < -7$$

20.
$$-2(r - 3) + 7 \geq 8$$
$$-2r + 13 \geq 8$$
$$-2r + 13 - 13 \geq 8 - 13$$
$$-2r \geq -5$$
$$\frac{-2r}{-2} \leq \frac{-5}{-2}$$
$$r \leq 2\tfrac{1}{2}$$

21.
$$16 \leq 4 - 3(n - 13)$$
$$16 \leq 4 - 3n + 39$$
$$16 \leq -3n + 43$$
$$16 - 43 \leq -3n + 43 - 43$$
$$-27 \leq -3n$$
$$\frac{-27}{-3} \geq \frac{-3n}{-3}$$
$$n \leq 9$$

22.
$$3w + 2 < 2w + 5$$
$$3w + 2 - 2w < 2w + 5 - 2w$$
$$w + 2 < 5$$
$$w + 2 - 2 < 5 - 2$$
$$w < 3$$

23.
$$3t + 7 \geq 5t + 9$$
$$3t + 7 - 5t \geq 5t + 9 - 5t$$
$$-2t + 7 \geq 9$$
$$-2t + 7 - 7 \geq 9 - 7$$
$$-2t \geq 2$$
$$\frac{-2t}{-2} \leq \frac{2}{-2}$$
$$t \leq -1$$

24.
$$4d + 7 \geq 1 + 5d$$
$$4d + 7 - 4d \geq 1 + 5d - 4d$$
$$7 \geq 1 + d$$
$$7 - 1 \geq 1 + d - 1$$
$$6 \geq d$$

25.
$$5 - 2n \leq 3 - n$$
$$5 - 2n + n \leq 3 - n + n$$
$$5 - n \leq 3$$
$$5 - n - 5 \leq 3 - 5$$
$$-n \leq -2$$
$$n \geq 2$$

26.
$$2k - 3 \leq 5k + 9$$
$$2k - 3 - 2k \leq 5k + 9 - 2k$$
$$-3 \leq 3k + 9$$
$$-3 - 9 \leq 3k + 9 - 9$$
$$-12 \leq 3k$$
$$\frac{-12}{3} \leq \frac{3k}{3}$$
$$-4 \leq k$$

27.
$$3s + 16 > 6 + 4s$$
$$3s + 16 - 3s > 6 + 4s - 3s$$
$$16 > 6 + s$$
$$16 - 6 > 6 + s - 6$$
$$s < 10$$

28.
$$6p - 1 > 3p + 8$$
$$6p - 1 - 3p > 3p + 8 - 3p$$
$$3p - 1 > 8$$
$$3p - 1 + 1 > 8 + 1$$
$$3p > 9$$
$$\frac{3p}{3} > \frac{9}{3}$$
$$p > 3$$

29.
$$3x + 2 > -4x + 16$$
$$3x + 2 + 4x > -4x + 16 + 4x$$
$$7x + 2 > 16$$
$$7x + 2 - 2 > 16 - 2$$
$$7x > 14$$
$$\frac{7x}{7} > \frac{14}{7}$$
$$x > 2$$

30.
$$2 - 3m < 4 + 5m$$
$$2 - 3m + 3m < 4 + 5m + 3m$$
$$2 < 4 + 8m$$
$$2 - 4 < 4 + 8m - 4$$
$$-2 < 8m$$
$$\frac{-2}{8} < \frac{8m}{8}$$
$$-\tfrac{1}{4} < m$$

31.
$$4d + 5 < -4d - 3$$
$$4d + 5 + 4d < -4d - 3 + 4d$$
$$8d + 5 < -3$$
$$8d + 5 - 5 < -3 - 5$$
$$8d < -8$$
$$\frac{8d}{8} < \frac{-8}{8}$$
$$d < -1$$

32.
$$4 - 5y \geq 8 - y$$
$$4 - 5y + y \geq 8 - y + y$$
$$4 - 4y \geq 8$$
$$4 - 4y - 4 \geq 8 - 4$$
$$-4y \geq 4$$
$$\frac{-4y}{-4} \leq \frac{4}{-4}$$
$$y \leq -1$$

33.
$$2k + 6 \leq 4 + 5k$$
$$2k + 6 - 2k \leq 4 + 5k - 2k$$
$$6 \leq 4 + 3k$$
$$6 - 4 \leq 4 + 3k - 4$$
$$2 \leq 3k$$
$$\frac{2}{3} \leq \frac{3k}{3}$$
$$\frac{2}{3} \leq k$$

34.
$$-3(v-3) \geq 5-4v$$
$$-3v+9 \geq 5-4v$$
$$-3v+9+4v \geq 5-4v+4v$$
$$v+9 \geq 5$$
$$v+9-9 \geq 5-9$$
$$v \geq -4$$

35.
$$3q+6 \leq -5(q+2)$$
$$3q+6 \leq -5q-10$$
$$3q+6+5q \leq -5q-10+5q$$
$$8q+6 \leq -10$$
$$8q+6-6 \leq -10-6$$
$$8q \leq -16$$
$$\frac{8q}{8} \leq \frac{-16}{8}$$
$$q \leq -2$$

36.
$$3(2+r) \geq 15-2r$$
$$6+3r \geq 15-2r$$
$$6+3r+2r \geq 15-2r+2r$$
$$6+5r \geq 15$$
$$6+5r-6 \geq 15-6$$
$$5r \geq 9$$
$$\frac{5r}{5} \geq \frac{9}{5}$$
$$r \geq 1\tfrac{4}{5}$$

37.
$$9+x < 7-2(x-3)$$
$$9+x < 13-2x$$
$$9+x+2x < 13-2x+2x$$
$$9+3x < 13$$
$$9+3x-9 < 13-9$$
$$3x < 4$$
$$\frac{3x}{3} < \frac{4}{3}$$
$$x < 1\tfrac{1}{3}$$

38.
$$2(m-8) < -8+3m$$
$$2m-16 < -8+3m$$
$$2m-16-2m < -8+3m-2m$$
$$-16 < -8+m$$
$$-16+8 < -8+m+8$$
$$-8 < m$$

39.
$$2v-4 \leq 2(3v-6)$$
$$2v-4 \leq 6v-12$$
$$2v-4-2v \leq 6v-12-2v$$
$$-4 \leq 4v-12$$
$$-4+12 \leq 4v-12+12$$
$$8 \leq 4v$$
$$\frac{8}{4} \leq \frac{4v}{4}$$
$$2 \leq v$$

40. Subtract 8 from each side. **41.** Subtract 7 from each side. **42.** Subtract y from each side and add 5 to each side. **43.** Add 2 to each side, then multiply each side by -5, and reverse the inequality sign. **44.** Subtract $3j$ from each side and subtract 5 from each side. **45.** Expand $2(q-3) = 2q-6$; add $3q$ to each side and add 6 to each side; divide each side by 5.

46a.
$$5t+4 \leq 8t-5$$
$$5t+4-8t \leq 8t-5-8t$$
$$-3t+4 \leq -5$$
$$-3t+4-4 \leq -5-4$$
$$-3t \leq -9$$
$$\frac{-3t}{-3} \geq \frac{-9}{-3}$$
$$t \geq 3$$

46b.
$$5t+4 \leq 8t-5$$
$$5t+4+5 \leq 8t-5+5$$
$$5t+9 \leq 8t$$
$$5t+9-5t \leq 8t-5t$$
$$9 \leq 3t$$
$$\frac{9}{3} \leq \frac{3t}{3}$$
$$3 \leq t$$

46c. The results are the same. The solution to any inequality (or equation) should be independent of the details of the calculation.

47.
$$6-(r+3) < 15$$
$$3-r < 15$$
$$3-r-3 < 15-3$$
$$-r < 12$$
$$r > -12$$

48.
$$\tfrac{1}{2}(t-6) \leq 4$$
$$t-6 \leq 8$$
$$t-6+6 \leq 8+6$$
$$t \leq 14$$

49.
$$3(z+2) > 12$$
$$3z+6 > 12$$
$$3z+6-6 > 12-6$$
$$3z > 6$$
$$\frac{3z}{3} > \frac{6}{3}$$
$$z > 2$$

50.
$$2.5(p-4) > 3(p+2)$$

First eliminate the parentheses. Use the Distributive Property.
$$2.5p-10 > 3p+6$$

Move all the p's to the right by subtracting $-2.5p$ from each side, using the Subtraction Property of Inequality.
$$2.5p-10-2.5p > 3p+6-2.5p$$

Next do the subtraction.
$$-10 > 0.5p+6$$

Move the number terms to the left by subtracting 6 from each side (the Subtraction Property again).
$$-10-6 > 0.5p+6-6$$

Do the subtraction.
$$-16 > 0.5p$$

Now multiply each side by 2, using the Multiplication Property of Inequality.
$$2(-16) > 2(0.5p)$$
$$-32 > p$$

51a.i. Always true; since the expressions are equal, they satisfy greater than or equal. **ii.** Always true; if we subtract $3r$ (no matter whether r positive or negative), we have $5 > -2$, which is always true. **iii.** Never true; subtracting $4n$ from both sides (whatever n might be), we have $4 < -3$, which is never true.

51b. If you can eliminate the variable entirely, as in the equation $3x + a = 3x + b$, and get for example $a = b$, where a and b are numerical constants, then the equation is always true or never true, depending on a and b.

52. Let x = number of guests.

$$(0.75)200 + (1.25)x \geq 250$$
$$150 + 1.25x \geq 250$$
$$150 + 1.25x - 150 \geq 250 - 150$$
$$1.25x \geq 100$$
$$\frac{1.25x}{1.25} \geq \frac{100}{1.25}$$
$$x \geq 80$$

At least 80 guests must attend.

53a.
$$P \leq \tfrac{1}{2}a + 110$$
$$P \leq \tfrac{1}{2}20 + 110$$
$$P \leq 120$$

120 mm represents a maximum normal systolic pressure.

53b.
$$P \leq \tfrac{1}{2}50 + 110$$
$$P \leq 135$$

The normal systolic blood pressure should be 135 or less.

54.
$$-2x - 2 > 4$$
$$-2x - 2 + 2 > 4 + 2$$
$$-2x > 6$$
$$x < -3;$$ the graph is B.

55.
$$2 - 2x > 4$$
$$2 - 2x - 2 > 4 - 2$$
$$-2x > 2$$
$$x < -1;$$ the graph is E.

56.
$$2x + 2 > 4$$
$$2x + 2 - 2 > 4 - 2$$
$$2x > 2$$
$$x > 1;$$ the graph is F.

57.
$$2x + 2 > 4x$$
$$2x + 2 - 2x > 4x - 2x$$
$$2 > 2x$$
$$x < 1;$$ the graph is A.

58.
$$2x - 2 > 4$$
$$2x - 2 + 2 > 4 + 2$$
$$2x > 6$$
$$x > 3;$$ the graph is D.

59.
$$-2(x - 2) > 4$$
$$-2x + 4 > 4$$
$$-2x + 4 - 4 > 4 - 4$$
$$-2x > 0$$
$$x < 0;$$ the graph is C.

60. Answers may vary. Samples:

$$-\tfrac{1}{3}x - 5 > 0$$
$$-\tfrac{1}{3}x - 5 + 5 > 0 + 5$$
$$-\tfrac{1}{3}x > 5$$
$$-3\left(-\tfrac{1}{3}x\right) < -3(5)$$
$$x < -15;$$
$$-\tfrac{1}{3}x - 5 < 0$$
$$-\tfrac{1}{3}x - 5 + 5 < 0 + 5$$
$$-\tfrac{1}{3}x < 5$$
$$-3\left(-\tfrac{1}{3}x\right) > -3(5)$$
$$x > -15$$

61.
$$\tfrac{4}{3}r - 3 < r + \tfrac{2}{3} - \tfrac{1}{3}r$$
$$3\left(\tfrac{4}{3}r - 3\right) < 3\left(r + \tfrac{2}{3} - \tfrac{1}{3}r\right)$$
$$4r - 9 < 3r + 2 - r$$
$$4r - 9 < 2r + 2$$
$$4r - 9 - 2r < 2r + 2 - 2r$$
$$2r - 9 < 2$$
$$2r - 9 + 9 < 2 + 9$$
$$2r < 11$$
$$\frac{2r}{2} < \frac{11}{2}$$
$$r < 5\tfrac{1}{2}$$

62.
$$4 - 2m \leq 5 - m + 1$$
$$4 - 2m \leq 6 - m$$
$$4 - 2m + m \leq 6 - m + m$$
$$4 - m \leq 6$$
$$4 - m - 4 \leq 6 - 4$$
$$-m \leq 2$$
$$m \geq -2$$

63.
$$-2(0.5 - 4s) \geq -3(4 - 3.5s)$$
$$-1 + 8s \geq -12 + 10.5s$$
$$-1 + 8s - 8s \geq -12 + 10.5s - 8s$$
$$-1 \geq -12 + 2.5s$$
$$-1 + 12 \geq -12 + 2.5s + 12$$
$$11 \geq 2.5s$$
$$\frac{11}{2.5} \geq \frac{2.5s}{2.5}$$
$$4.4 \geq s$$

64.
$$\tfrac{1}{2}n - \tfrac{1}{8} \geq \tfrac{3}{4} + \tfrac{5}{6}n$$
$$24\left(\tfrac{1}{2}n - \tfrac{1}{8}\right) \geq 24\left(\tfrac{3}{4} + \tfrac{5}{6}n\right)$$
$$12n - 3 \geq 18 + 20n$$
$$12n - 3 - 12n \geq 18 + 20n - 12n$$
$$-3 \geq 18 + 8n$$
$$-3 - 18 \geq 18 + 8n - 18$$
$$-21 \geq 8n$$
$$\frac{-21}{8} \geq \frac{8n}{8}$$
$$-2\tfrac{5}{8} \geq n$$

65.
$$-(8 - s) < 0$$
$$-8 + s < 0$$
$$-8 + s + 8 < 0 + 8$$
$$s < 8$$

66.
$$3.8 - k \leq 5.2 - 2k$$
$$3.8 - k + k \leq 5.2 - 2k + k$$
$$3.8 \leq 5.2 - k$$
$$3.8 - 5.2 \leq 5.2 - k - 5.2$$
$$-1.4 \leq -k$$
$$1.4 \geq k$$

67.
$$10 > 3(2n - 1) - 5(4n + 3)$$
$$10 > 6n - 3 - 20n - 15$$
$$10 > -18 - 14n$$
$$10 + 18 > -18 - 14n + 18$$
$$28 > -14n$$
$$\frac{28}{-14} < \frac{-14n}{-14}$$
$$-2 < n$$

68. $3(3r+1)-(r+4)\le 13$
$$9r+3-r-4\le 13$$
$$8r-1\le 13$$
$$8r-1+1\le 13+1$$
$$8r\le 14$$
$$\tfrac{8r}{8}\le\tfrac{14}{8}$$
$$r\le\tfrac{7}{4}=1\tfrac{3}{4}$$

69. $2(3x+7)>4(7-2x)$
$$6x+14>28-8x$$
$$6x+14+8x>28-8x+8x$$
$$14x+14>28$$
$$14x+14-14>28-14$$
$$14x>14$$
$$\tfrac{14x}{14}>\tfrac{14}{14}$$
$$x>1$$

70. $4(a-2)-6a\le -9$
$$4a-8-6a\le -9$$
$$-8-2a\le -9$$
$$-8-2a+8\le -9+8$$
$$-2a\le -1$$
$$\tfrac{-2a}{-2}\ge\tfrac{-1}{-2}$$
$$a\ge\tfrac{1}{2}$$

71. $4(3m-1)\ge 2(m+3)$
$$12m-4\ge 2m+6$$
$$12m-4-2m\ge 2m+6-2m$$
$$10m-4\ge 6$$
$$10m-4+4\ge 6+4$$
$$10m\ge 10$$
$$\tfrac{10m}{10}\ge\tfrac{10}{10}$$
$$m\ge 1$$

72. $17-(4k-2)\ge 2(k+3)$
$$17-4k+2\ge 2k+6$$
$$19-4k\ge 2k+6$$
$$19-4k+4k\ge 2k+6+4k$$
$$19\ge 6k+6$$
$$19-6\ge 6k+6-6$$
$$13\ge 6k$$
$$\tfrac{13}{6}\ge\tfrac{6k}{6}$$
$$2\tfrac{1}{6}\ge k$$

73. $2n-3(n+3)\le 14$
$$2n-3n-9\le 14$$
$$-n-9\le 14$$
$$-n-9+9\le 14+9$$
$$-n\le 23$$
$$n\ge -23$$

74. $5x-\tfrac{1}{2}(3x+8)\le -4+3x$
$$10x-3x-8\le -8+6x$$
$$7x-8\le -8+6x$$
$$7x-8-6x\le -8+6x-6x$$
$$x-8\le -8$$
$$x-8+8\le -8+8$$
$$x\le 0$$

75. $5a-2(a-15)<10$
$$5a-2a+30<10$$
$$3a+30<10$$
$$3a+30-30<10-30$$
$$3a<-20$$
$$\tfrac{3a}{3}\le\tfrac{-20}{3}$$
$$a\le -6\tfrac{2}{3}$$

76. $5c+4(c-1)\ge 2+5(2+c)$
$$5c+4c-4\ge 2+10+5c$$
$$9c-4\ge 12+5c$$
$$9c-4-5c\ge 12+5c-5c$$
$$4c-4\ge 12$$
$$4c-4+4\ge 12+4$$
$$4c\ge 16$$
$$\tfrac{4c}{4}\ge\tfrac{16}{4}$$
$$c\ge 4$$

77. Let x = number of hours actually worked per month. Monthly expenses total $490+45+65=600$.
$$15x-600\ge 600$$
$$15x-600+600\ge 600+600$$
$$15x\ge 1200$$
$$\tfrac{15x}{15}\ge\tfrac{1200}{15}$$
$$x\ge 80$$
Mandela must work at least 80 hours per month.

78. Let x = dollar amount of her sales in week.
$$250+0.03x\ge 460$$
$$250+0.03x-250\ge 460-250$$
$$0.03x\ge 210$$
$$\tfrac{0.03x}{0.03}\ge\tfrac{210}{0.03}$$
$$x\ge 7000$$
She must have at least $7000 in sales.

79. $3x+3\le -2x+5$
$$3x+3-3\le -2x+5-3$$
$$3x\le -2x+2$$
$2x$ was substracted here on the left but added on right. Both sides should be treated the same! Add $2x$ on each side.
$$3x+2x\le -2x+2+2x$$
$$5x\le 2$$
$$\tfrac{5x}{5}\le\tfrac{2}{5}$$
$$x\le\tfrac{2}{5}$$

80. $4(n+2)>3n+1$
Here the 4 was multiplied by n but not by the 2. Multiply by both.
$$4n+8>3n+1$$
$$4n+8-8>3n+1-8$$
$$4n>3n-7$$
$$4n-3n>3n-7-3n$$
$$n>-7$$

81a. $ax+b>c$
$$ax+b-b>c-b$$
$$ax>c-b$$
$$\tfrac{ax}{a}>\tfrac{c-b}{a}(a>0)$$
$$x>\tfrac{c-b}{a}$$

81b.
$$ax + b > c$$
$$ax + b - b > c - b$$
$$ax > c - b$$
$$\frac{ax}{a} < \frac{c-b}{a} \text{ (flip >; } a < 0)$$
$$x < \frac{c-b}{a}$$

82.
$$A = \tfrac{1}{2}bh$$
$$\tfrac{1}{2}10(x+4) \le 56$$
$$10(x+4) \le 2 \cdot 56$$
$$10x + 40 \le 112$$
$$10x - 40 - 40 \le 112 - 40$$
$$10x \le 72$$
$$\frac{10x}{10} \le \frac{72}{10}$$
$$x \le 7.2$$

We also require that the height be positive.
$$x + 4 > 0$$
so
$$x > -4$$
Hence x can be $-3, -2, -1, 0, 1, 2, 3, 4, 5, 6$, or 7.

83.
$$P = 2\ell + 2w,\ \ell = 1.62w$$
$$2(1.62w) + 2w \le 46$$
$$3.24w + 2w \le 46$$
$$5.24w \le 46$$
$$\frac{5.24w}{5.24} \le \frac{46}{5.24}$$
$$w \le \text{about } 8.78$$
$$\ell = 1.62w \le 1.62(8.78) \approx 14.2$$
Dimensions round to 8.8 in. × 14.2 in.

84. Start with the equality shown by graph $x = 8$.
$$ax + 4 = -12$$
$$a(8) + 4 = -12$$
$$8a + 4 - 4 = -12 - 4$$
$$8a = -16$$
$$a = -2$$
Check:
$$-2x + 4 \le -12$$
$$-2x + 4 - 4 \le -12 - 4$$
$$-2x \le -16$$
$$x \ge 8 \checkmark$$

85. Let f = hours handing out flyers; let n = hours typing newsletter. $f + n = 20$; $n = 20 - f$
$$6.50f + 8n \ge 145$$
$$6.5f + 8(20 - f) \ge 145$$
$$6.5f + 160 - 8f \ge 145$$
$$-1.5f + 160 \ge 145$$
$$-1.5f + 160 - 160 \ge 145 - 160$$
$$-1.5f \ge -15$$
$$\frac{-1.5f}{-1.5} \le \frac{-15}{-1.5}$$
$$f \le 10$$
You should hand out flyers for no more than 10 hours.

86a. Let n = number of boxes in one trip.
$$50n + 160 + 95 \le 4000$$
$$50n + 255 \le 4000$$
$$50n + 255 - 255 \le 4000 - 255$$
$$50n \le 3745$$
$$\frac{50n}{50} \le \frac{3745}{50}$$
$$n \le 74.9$$
Maximum safe load = 74 boxes.

86b.
$$74t \ge 310$$
$$\frac{74t}{74} \ge \frac{310}{74}$$
$$t \le 4.\overline{189}$$
Five trips are needed.

87. The answer is C. x refers to remaining 20 weeks. 8 kg is to be subtracted from total goal.

88.
$$2x - 8 > 4x + 2$$
$$-8 > 2x + 2$$
$$-10 > 2x$$
$$-5 > x; \text{ the answer is F.}$$

89.
$$-5n + 16 \le -7n$$
$$2n + 16 \le 0$$
$$2n \le -16$$
$$n \le -8; \text{ the answer is A.}$$

90. 12 times x must be greater than or equal to 65 increased by 10%; the answer is F.

91. [2] Let n = number of bottles ordered per month. Maxwell should switch suppliers if competing charge per month is less.
$$4n + 5 < 3n + 25$$
$$4n + 5 - 3n < 3n + 25 - 3n$$
$$n + 5 < 25$$
$$n + 5 - 5 < 25 - 5$$
$$n < 20$$
But $n \ge 30$, so Maxwell should stay with his present supplier. 20 bottles per month is the break-even point.
[1] incorrect answer OR insufficient explanation

92.
$$-9m \ge 36$$
$$\frac{-9m}{-9} \le \frac{36}{-9}$$
$$m \le -4$$

93.
$$-24 \le 3y$$
$$\frac{-24}{3} \le \frac{3y}{3}$$
$$-8 \le y$$

94.
$$\frac{x}{3} > -4$$
$$3\left(\frac{x}{3}\right) > 3(-4)$$
$$x > -12$$

95.
$$-\frac{t}{3} \le 1$$
$$-3\left(-\frac{t}{3}\right) \ge -3(1)$$
$$t \ge -3$$

96.
$$\frac{2}{3}b < 18$$
$$\frac{3}{2}\left(\frac{2}{3}b\right) < \frac{3}{2}(18)$$
$$b < 27$$

97.
$$42 > -\frac{3}{7}w$$
$$-\frac{7}{3}(42) < -\frac{7}{3}\left(-\frac{3}{7}w\right) \text{ (Flip.)}$$
$$-98 < w$$

98.
$$56 < 42p$$
$$\frac{56}{42} < \frac{42p}{42}$$
$$1\tfrac{1}{3} < p$$

99.
$$0.5d \ge 3.5$$
$$2(0.5d) \ge 2(3.5)$$
$$d \ge 7$$

100. Let t = time from family departure to being overtaken.

$$45t = 60(t - 2)$$
$$45t = 60t - 120$$
$$45t - 60t = 60t - 120 - 60t$$
$$-15t = -120$$
$$\frac{-15t}{-15} = \frac{-120}{-15}$$
$$t = 8$$

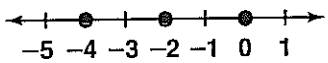
$t - 2 = 6$ h after neighbor's departure.

101. -16 **102.** 16 **103.** $(-8)(-3) = 24$
104. $-2^4 = -(2^4) = -16$

EXTENSION *page 160*

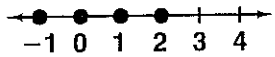
1.
$$9v + 6 \le 18$$
$$9v + 6 - 6 \le 18 - 6$$
$$9v \le 12$$
$$\frac{9v}{9} \le \frac{12}{9}$$
$$v \le 1\tfrac{1}{3}$$

Solution is $-4, -2$ or 0.



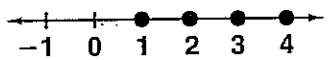
2.
$$2n + 6 < 12$$
$$2n + 6 - 6 < 12 - 6$$
$$2n < 6$$
$$\frac{2n}{2} < \frac{6}{2}$$
$$n < 3$$

Solution is $2, 1, 0, -1, -2, \ldots$.



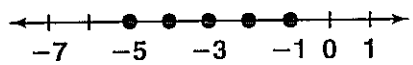
3.
$$-3(d - 1) \le 4.5$$
$$-3d + 1 \le 4.5$$
$$-3d + 1 - 1 \le 4.5 - 1$$
$$-3d \le 3.5$$
$$\frac{-3d}{-3} \ge \frac{3.5}{-3}$$
$$d \ge -1\tfrac{1}{6}$$

Solution is $1, 2, 3, \ldots$.



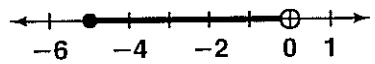
4.
$$-2 < 2(c + 5)$$
$$-2 < 2c + 10$$
$$-2 - 10 < 2c + 10 - 10$$
$$-12 < 2c$$
$$\frac{-12}{2} < \frac{2c}{2}$$
$$-6 < c$$

Solution is $-5, -4, -3, -2$, or -1.



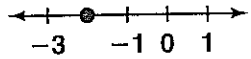
5.
$$-4 \le q + 1$$
$$-4 - 1 \le q + 1 - 1$$
$$-5 \le q$$

Solution is all real numbers greater than or equal to -5 and less than zero.



6.
$$4 < 2 - 2m$$
$$4 - 2 < 2 - 2m - 2$$
$$2 < -2m$$
$$\frac{2}{-2} > \frac{-2m}{-2}$$
$$-1 > m$$

Solution is -2.

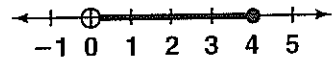


7.
$$P = 2\ell + 2w$$
$$2(20) + 2w \le 48;$$

replacement set is all positive real numbers;

$$40 + 2w \le 48$$
$$40 + 2w - 40 \le 48 - 40$$
$$2w \le 8$$
$$\frac{2w}{2} \le \frac{8}{2}$$
$$w \le 4$$

Since width is positive, $w > 0$.

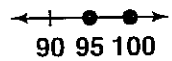


8. $4\left(\frac{85 + 80 + 75 + x}{4}\right) \ge 4(83)$;

replacement set is multiples of five, less than or equal to 100;

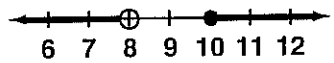
$$240 + x \ge 332$$
$$240 + x - 240 \ge 332 - 240$$
$$x \ge 92$$

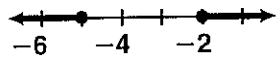
Solution is 95 or 100.

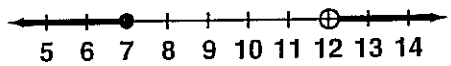


3-5 Compound Inequalities *pages 161–166*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1.


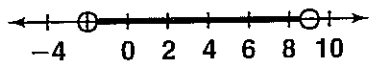
2.


3.


4. 6 **5.** -3 **6.** 14 **7.** 3

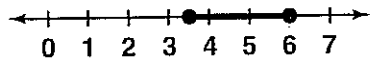
Check Understanding **1a.** $n > -2$ and $n < 9$

$-2 < n < 9$



1b. $b \ge 3.50$ and $b \le 6.00$

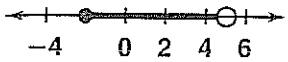
$3.50 \le b \le 6.00$



2a.

$-6 \le 3x$	and	$3x < 15$
$\frac{-6}{3} \le \frac{3x}{3}$		$\frac{3x}{3} < \frac{15}{3}$
$-2 \le x$	and	$x < 5$

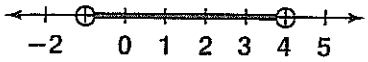
$-2 \le x < 5$



2b.

$-3 < 2x - 1$	and	$2x - 1 < 7$
$-3 + 1 < 2x - 1 + 1$		$2x - 1 + 1 < 7 + 1$
$-2 < 2x$		$2x < 8$
$\frac{-2}{2} < \frac{2x}{2}$		$\frac{2x}{x} < \frac{8}{2}$
$-1 < x$	and	$x < 4$

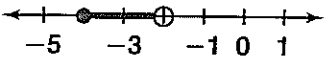
$-1 < x < 4$



2c.

$7 < -3n + 1$	and	$-3n + 1 \le 13$
$7 - 1 < -3n + 1 - 1$		$-3n + 1 - 1 \le 13 - 1$
$6 < -3n$		$-3n \le 12$
$\frac{6}{-3} > \frac{-3n}{-3}$		$\frac{-3n}{-3} \ge \frac{12}{-3}$
$-2 > n$	and	$n \ge -4$

$-4 \le n < -2$



3a.

$7.2 \le$	$\frac{7.0 + 7.9 + p}{3}$	≤ 7.8
$3(7.2) \le$	$3\left(\frac{7.0 + 7.9 + p}{3}\right)$	$\le 3(7.8)$
$21.6 \le$	$14.9 + p$	≤ 23.4
$21.6 - 14.9 \le$	$14.9 + p - 14.9$	$\le 23.4 - 14.9$
$6.7 \le p$	and	$p \le 8.5$

$6.7 \le p \le 8.5$

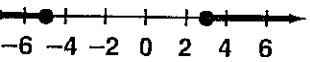
3b.

$7.2 \le$	$\frac{8.0 + 8.4 + p}{3}$	≤ 7.8
$3(7.2) \le$	$3\left(\frac{8.0 + 8.4 + p}{3}\right)$	$\le 3(7.8)$
$21.6 \le$	$16.4 + p$	≤ 23.4
$21.6 - 16.4 \le$	$16.4 + p - 16.4$	$\le 23.4 - 16.4$
$5.2 \le p$	and	$p \le 7.0$

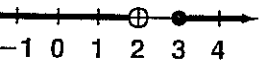
$5.2 \le p \le 7.0$

No; readings in this range are unlikely if the first readings are high.

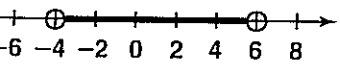
. $n \le -5$ or $n \le 3$



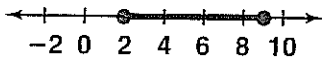
. $-2x + 7 > 3$	or	$3x - 4 \ge 5$
$-2x + 7 - 7 > 3 - 7$		$3x - 4 + 4 \ge 5 + 4$
$-2x > -4$		$3x \ge 9$
$\frac{-2x}{-2} < \frac{-4}{-2}$		$\frac{3x}{3} \ge \frac{9}{3}$
$x < 2$	or	$x \ge 3$



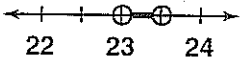
xercises **1.** $-4 < x$ and $x < 6$, or $-4 < x < 6$



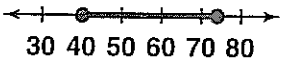
2. $2 \le n$ and $n \le 9$, or $2 \le n \le 9$



3. $23 < c < 23.5$



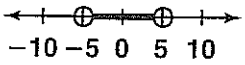
4. $40 \le w \le 74$



5.

$-3 < j + 2$	and	$j + 2 < 7$
$-3 - 2 < j + 2 - 2$		$j + 2 - 2 < 7 - 2$
$-5 < j$	and	$j < 5$

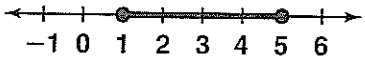
$-5 < j < 5$



6.

$3 \le w + 2$	and	$w + 2 \le 7$
$3 - 2 \le w + 2 - 2$		$w + 2 - 2 \le 7 - 2$
$1 \le w$	and	$w \le 5$

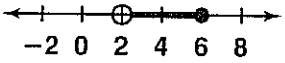
$1 \le w \le 5$



7.

$2 < 3n - 4$	and	$3n - 4 \le 14$
$2 + 4 < 3n - 4 + 4$		$3n - 4 + 4 \le 14 + 4$
$6 < 3n$		$3n \le 18$
$\frac{6}{3} < \frac{3n}{3}$		$\frac{3n}{3} \le \frac{18}{3}$
$2 < n$	and	$n \le 6$

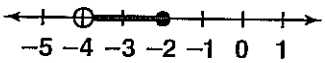
$2 < n \le 6$



8.

$7 \le 3 - 2p$	and	$3 - 2p < 11$
$7 - 3 \le 3 - 2p - 3$		$3 - 2p - 3 < 11 - 3$
$4 \le -2p$		$-2p < 8$
$\frac{4}{-2} \ge \frac{-2p}{-2}$		$\frac{-2p}{-2} > \frac{8}{-2}$
$-2 \ge p$	and	$p > -4$

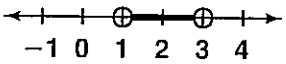
$-4 < p \le -2$



9.

$-2 < -3x + 7$	and	$-3x + 7 < 4$
$-2 - 7 < -3x + 7 - 7$		$-3x + 7 - 7 < 4 - 7$
$-9 < -3x$		$-3x < -3$
$\frac{-9}{-3} > \frac{-3x}{-3}$		$\frac{-3x}{-3} > \frac{-3}{-3}$
$3 > x$	and	$x > 1$

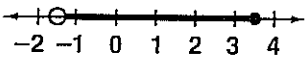
$1 < x < 3$



10.

$1.5 < w + 3$	and	$w + 3 \le 6.5$
$1.5 - 3 < w + 3 - 3$		$w + 3 - 3 \le 6.5 - 3$
$-1.5 < w$	and	$w \le 3.5$

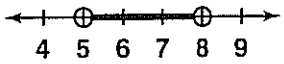
$-1.5 < w \le 3.5$



11.

$-16 < -3x + 8$	and	$-3x + 8 < -7$
$-16 - 8 < -3x + 8 - 8$		$-3x + 8 - 8 < -7 - 8$
$-24 < -3x$		$-3x < -15$
$\frac{-24}{-3} > \frac{-3x}{-3}$		$\frac{-3x}{-3} > \frac{-15}{-3}$
$8 > x$	and	$x > 5$

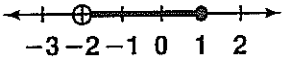
$5 < x < 8$



12.

$-1 < 4m + 7$	and	$4m + 7 \le 11$
$-1 - 7 < 4m + 7 - 7$		$4m + 7 - 7 \le 11 - 7$
$-8 < 4m$		$4m \le 4$
$\frac{-8}{4} < \frac{4m}{4}$		$\frac{4m}{4} \le \frac{4}{4}$
$-2 < m$	and	$m \le 1$

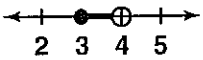
$-2 < m \le 1$



13.

$-9 < -2s - 1$	and	$-2s - 1 \le -7$
$-9 + 1 < -2s - 1 + 1$		$-2s - 1 + 1 \le -7 + 1$
$-8 < -2s$		$-2s \le -6$
$\frac{-8}{-2} > \frac{-2s}{-2}$		$\frac{-2s}{-2} \ge \frac{-6}{-2}$
$4 > s$	and	$s \ge 3$

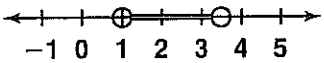
$3 \le s < 4$



14.

$-\frac{1}{2} < \frac{1}{4}t - \frac{3}{4}$	and	$\frac{1}{4}t - \frac{3}{4} < \frac{1}{8}$
$4\left(-\frac{1}{2}\right) < 4\left(\frac{1}{4}t - \frac{3}{4}\right)$		$8\left(\frac{1}{4}t - \frac{3}{4}\right) < 8\left(\frac{1}{8}\right)$
$-2 < t - 3$		$2t - 6 < 1$
$-2 + 3 < t - 3 + 3$		$2t - 6 + 6 < 1 + 6$
$1 < t$		$2t < 7$
		$\frac{2t}{2} < \frac{7}{2}$
$1 < t$	and	$t < 3\frac{1}{2}$

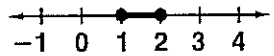
$1 < t < 3\frac{1}{2}$



15.

$3 \ge 4r - 5$	and	$4r - 5 \ge -1$
$3 + 5 \ge 4r - 5 + 5$		$4r - 5 + 5 \ge -1 + 5$
$8 \ge 4r$		$4r \ge 4$
$\frac{8}{4} \ge \frac{4r}{4}$		$\frac{4r}{4} \ge \frac{4}{4}$
$2 \ge r$	and	$r \ge 1$

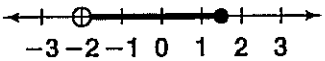
$1 \le r \le 2$



16.

$3.2 \ge 2r + 0.2$	and	$2r + 0.2 > -3.8$
$3.2 - 0.2 \ge 2r + 0.2 - 0.2$		$2r + 0.2 - 0.2 > -3.8 - 0.2$
$3 \ge 2r$		$2r > -4$
$0.5(3) \ge 0.5(2r)$		$0.5(2r) > 0.5(-4)$
$1.5 \ge r$	and	$r > -2$

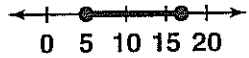
$-2 < r \le 1.5$



17.

$12 \le \frac{14 + 17 + a}{3}$	and	$\frac{14 + 17 + a}{3} \le 16$
$3(12) \le 3\left(\frac{14 + 17 + a}{3}\right)$		$3\left(\frac{14 + 17 + a}{3}\right) \le 3(16)$
$36 \le 31 + a$		$31 + a \le 48$
$36 - 31 \le 31 + a - 31$		$31 + a - 31 \le 48 - 31$
$5 \le a$	and	$a \le 17$

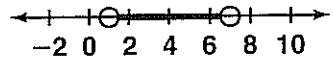
$5 \le a \le 17$



18.

$\frac{1}{2} < \frac{3x - 1}{4}$	and	$\frac{3x - 1}{4} < 5$
$4\left(\frac{1}{2}\right) < 4\left(\frac{3x - 1}{4}\right)$		$4\left(\frac{3x - 1}{4}\right) < 4(5)$
$2 < 3x - 1$		$3x - 1 < 20$
$2 + 1 < 3x - 1 + 1$		$3x - 1 + 1 < 20 + 1$
$3 < 3x$		$3x < 21$
$\frac{3}{3} < \frac{3x}{3}$		$\frac{3x}{3} < \frac{21}{3}$
$1 < x$	and	$x < 7$

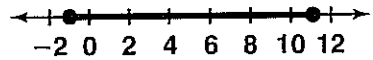
$1 < x < 7$



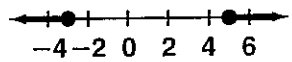
19.

$-2 \le \frac{5 - x}{3}$	and	$\frac{5 - x}{3} \le 2$
$3(-2) \le 3\left(\frac{5 - x}{3}\right)$		$3\left(\frac{5 - x}{3}\right) \le 3(2)$
$-6 \le 5 - x$		$5 - x \le 6$
$-6 - 5 \le 5 - x - 5$		$5 - x - 5 \le 6 - 5$
$-11 \le -x$		$-x \le 1$
$11 \le x$	and	$x \le -1$

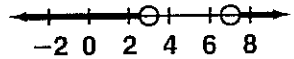
$-1 \le x \le 11$



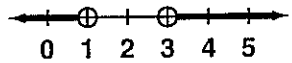
20. $n \le -3$ or $n \ge 5$



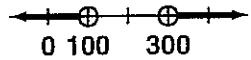
21. $x < 3$ or $x > 7$



22. $h < 1$ or $h > 3$

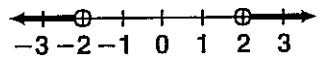


23. $b < 100$ or $b > 300$



24.

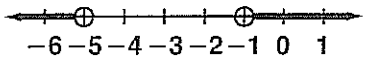
$3b - 1 < -7$	or	$4b + 1 > 9$
$3b - 1 + 1 < -7 + 1$		$4b + 1 - 1 > 9 - 1$
$3b < -6$		$4b > 8$
$\frac{3b}{3} < \frac{-6}{3}$		$\frac{4b}{4} > \frac{8}{4}$
$b < -2$	or	$b > 2$



25. $4 + k > 3$ or $6k < -30$

$4 + k - 4 > 3 - 4$ | $\frac{6k}{6} < \frac{-30}{6}$

$k > -1$ or $k < -5$



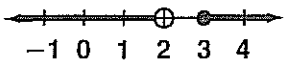
26. $3c + 4 \geq 13$ or $6c - 1 < 11$

$3c + 4 - 4 \geq 13 - 4$ | $6c - 1 + 1 < 11 + 1$

$3c \geq 9$ | $6c < 12$

$\frac{3c}{3} \geq \frac{9}{3}$ | $\frac{6c}{6} < \frac{12}{6}$

$c \geq 3$ or $c < 2$

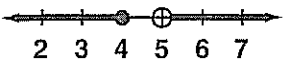


27. $6 - a < 1$ or $3a \leq 12$

$6 - a - 6 < 1 - 6$ | $\frac{3a}{3} \leq \frac{12}{3}$

$-a < -5$ | $a \leq 4$

$a > 5$ or $a \leq 4$



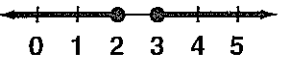
28. $7 - 3c \geq 1$ or $5c + 2 \geq 17$

$7 - 3c - 7 \geq 1 - 7$ | $5c + 2 - 2 \geq 17 - 2$

$-3c \geq -6$ | $5c \geq 15$

$\frac{-3c}{-3} \leq \frac{-6}{-3}$ | $\frac{5c}{5} \geq \frac{15}{5}$

$c \leq 2$ or $c \geq 3$



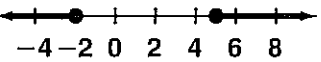
29. $5y + 7 \leq -3$ or $3y - 2 \geq 13$

$5y + 7 - 7 \leq -3 - 7$ | $3y - 2 + 2 \geq 13 + 2$

$5y \leq -10$ | $3y \geq 15$

$\frac{5y}{5} \leq \frac{-10}{5}$ | $\frac{3y}{3} \geq \frac{15}{3}$

$y \leq -2$ or $y \geq 5$



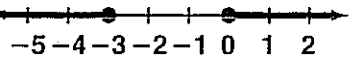
30. $2d + 5 \leq -1$ or $-2d + 5 \leq 5$

$2d + 5 - 5 \leq -1 - 5$ | $-2d + 5 - 5 \leq 5 - 5$

$2d \leq -6$ | $-2d \leq 0$

$\frac{2d}{2} \leq \frac{-6}{2}$ | $\frac{-2d}{-2} \geq \frac{0}{-2}$

$d \leq -3$ or $d \geq 0$



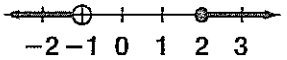
31. $5z - 3 > 7$ or $4z - 6 < -10$

$5z - 3 + 3 > 7 + 3$ | $4z - 6 + 6 < -10 + 6$

$5z > 10$ | $4z < -4$

$\frac{5z}{5} > \frac{10}{5}$ | $\frac{4z}{4} < \frac{-4}{4}$

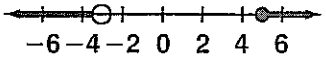
$z > 2$ or $z < -1$



32. $x - 5 \geq 0$ or $x + 1 < -2$

$x - 5 + 5 \geq 0 + 5$ | $x + 1 - 1 < -2 - 1$

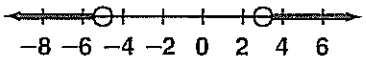
$x \geq 5$ or $x < -3$



33. $-3n < -9$ or $-2n > 10$

$\frac{-3n}{-3} > \frac{-9}{-3}$ | $\frac{-2n}{-2} < \frac{10}{-2}$

$n > 3$ or $n < -5$



34. $-2 < x < 3$ **35.** $x < -3$ or $x \geq 2$

36. $x \leq 0$ or $x > 2$ **37.** $-4 \leq x \leq 3$

38. $3q - 2 > 10$ or $3q - 2 \leq -10$

$3q - 2 + 2 > 10 + 2$ | $3q - 2 + 2 \leq -10 + 2$

$3q > 12$ | $3q \leq -8$

$\frac{3q}{3} > \frac{12}{3}$ | $\frac{3q}{3} \leq \frac{-8}{3}$

$q > 4$ or $q \leq -2\frac{2}{3}$

39. $3 - 2h > 17$ or $5h - 3 > 17$

$3 - 2h - 3 > 17 - 3$ | $5h - 3 + 3 > 17 + 3$

$-2h > 14$ | $5h > 20$

$\frac{-2h}{-2} < \frac{14}{-2}$ | $\frac{5h}{5} > \frac{20}{5}$

$h < -7$ or $h > 4$

40. $1 \leq 0.25t$ and $0.25t \leq 3.5$

$4(1) \leq 4(0.25t)$ | $4(0.25t) \leq 4(3.5)$

$4 \leq t$ and $t \leq 14$

$4 \leq t \leq 14$

41. $25r < 400$ or $100 < 4r$

$\frac{25r}{25} < \frac{400}{25}$ | $\frac{100}{4} < \frac{4r}{4}$

$r < 16$ or $25 < r$

42. $-20 \leq 3t - 2$ and $3t - 2 < 1$

$-20 + 2 \leq 3t - 2 + 2$ | $3t - 2 + 2 < 1 + 2$

$-18 \leq 3t$ | $3t < 3$

$\frac{-18}{3} \leq \frac{3t}{3}$ | $\frac{3t}{3} < \frac{3}{3}$

$-6 \leq t$ and $t < 1$

$-6 \leq t < 1$

43.

$\frac{3x+1}{4} - 4 > 3$	or	$\frac{3-2x}{5} > 3$
$4\left(\frac{3x+1}{4}\right) - 4(4) > 4(3)$		$5\left(\frac{3-2x}{5}\right) > 5(3)$
$3x + 1 - 16 > 12$		$3 - 2x > 15$
$3x - 15 + 15 > 12 + 15$		$3 - 2x - 3 > 15 - 3$
$3x > 27$		$-2x > 12$
$\frac{3x}{3} > \frac{27}{3}$		$\frac{-2x}{-2} < \frac{12}{-2}$
$x > 9$	or	$x < -6$

44.

$$\frac{d}{F} = 0.8$$
$$F\left(\frac{d}{F}\right) = F(0.8)$$
$$d = 0.8F$$
$$1.25(d) = 1.25(0.8F)$$
$$1.25d = F$$

$25 \geq F$	and	$F \leq 40$
$25 \leq 1.25d$		$1.25d \leq 40$
$0.8(25) \leq 0.8(1.25d)$		$0.8(1.25d) \leq 0.8(40)$
$20 \leq d$	and	$d \leq 32$

$$20 \leq d \leq 32$$

45.

$3x - 8 < 7$	or	$2x - 9 > 1$
$3x - 8 + 8 < 7 + 8$		$2x - 9 + 9 > 1 + 9$
$3x < 15$		$2x > 10$
$\frac{3x}{3} < \frac{15}{3}$		$\frac{2x}{2} > \frac{10}{2}$
$x < 5$	or	$x > 5$

x represents all real numbers except 5.

46. Inequality A *and* inequality B: both A and B must be true. Inequality A *or* inequality B: Either A or B must be true, but not necessarily both.

47.

$x + 2.5 > 5$	and	$2.5 + 5 > x$
$x + 2.5 - 2.5 > 5 - 2.5$		$7.5 > x$
$x > 2.5$	and	$7.5 > x$

The length of the third side is greater than 2.5 in. and less than 7.5 in.

48.

$x + 12 > 18$	and	$12 + 18 > x$
$x + 12 - 12 > 18 - 12$		$30 > x$
$x > 6$	and	$30 > x$

The length of the third side is greater than 6 ft and less than 30 ft.

49.

$x + 21 > 28$	and	$21 + 28 > x$
$x + 21 - 21 > 28 - 21$		$49 > x$
$x > 7$	and	$49 > x$

The length of the third side is greater than 7 mm and less than 49 mm.

50.

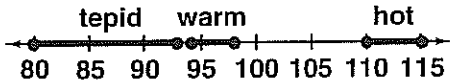
$x + 5 > 16$	and	$5 + 16 > x$
$x + 5 - 5 > 16 - 5$		$21 > x$
$x > 11$	and	$21 > x$

The length of the third side is greater than 11 m and less than 21 m.

51–53. Let C and D be the monthly average temperatures in Charlotte and Detroit, respectively.

51. $66 \leq C \leq 88$ **52.** $15 \leq D \leq 30$ **53.** $29 \leq C \leq 90$; $15 \leq D \leq 83$ **54.** Answers may vary. Sample: Elevation near a coastline varies between 2 m below and 8 m above sea level.

55.



56. $-2 < x < 0$ or $0 < x < 3$ **57.** $n = 0$ or $n \geq 3$

58a. $0.7(220 - 35) \leq R \leq 0.85(220 - 35)$ or $129.5 \leq R \leq 157.25$, which must be rounded to $130 \leq R \leq 157$.

58b.

$$0.7(220 - a) = 140$$
$$154 - 0.7a = 140$$
$$154 - 0.7a - 154 = 140 - 154$$
$$-0.7a = -14$$
$$\frac{-0.7a}{-0.7} = \frac{-14}{-0.7}$$
$$a = 20$$

Also,

$$0.85(220 - a) = 170$$
$$187 - 0.85a = 170$$
$$187 - 0.85a - 187 = 170 - 187$$
$$-0.85a = -17$$
$$\frac{-0.85a}{-0.85} = \frac{-17}{-0.85}$$
$$a = 20$$

Your cousin is 20 years old.

59. Let n = the first integer. Sum of integers $= n + n + 2 + n + 4 = 3n + 6$.

$48 < 3n + 6$	and	$3n + 6 < 60$
$48 - 6 < 3n + 6 - 6$		$3n + 6 - 6 < 60 - 6$
$42 < 3n$		$3n < 54$
$\frac{42}{3} < \frac{3n}{3}$		$\frac{3n}{3} < \frac{54}{3}$
$14 < n$	and	$n < 18$

The even integer solution is $n = 16$. Integers are 16, 18, and 20.

60. Again, let n = the first integer; sum $= 3n + 6$.

$15 < \frac{3n+6}{2}$	and	$\frac{3n+6}{2} < 21$
$2(15) < 2\left(\frac{3n+6}{2}\right)$		$2\left(\frac{3n+6}{2}\right) < 2(21)$
$30 < 3n + 6$		$3n + 6 < 42$
$30 - 6 < 3n + 6 - 6$		$3n + 6 - 6 < 42 - 6$
$24 < 3n$		$3n < 36$
$\frac{24}{3} < \frac{3n}{3}$		$\frac{3n}{3} < \frac{36}{3}$
$8 < n$	and	$n < 12$

The only even integer solution is $n = 10$. Integers are 10, 12, and 14.

61. Let x = distance between the hospital and the initial location of the emergency vehicle. It is possible that the three points lie on the same straight road.

$x + 5 \geq 10$	and	$x \leq 5 + 10$
$x + 5 - 5 \geq 10 - 5$		$x \leq 15$
$x \geq 5$	and	$x \leq 15$

Distance is between 5 and 15 mi. The answer is B.

62. $-3x - 7 \geq 8$ or $-2x - 11 \leq -31$

$-3x - 7 + 7 \geq 8 + 7$ | $-2x - 11 + 11 \leq -31 + 11$

$-3x \geq 15$ | $-2x \leq -20$

$\frac{-3x}{-3} \leq \frac{15}{-3}$ | $\frac{-2x}{-2} \geq \frac{-20}{-2}$

$x \leq -5$ or $x \geq 10$

The answer is G (all others satisfy above solution).

63. [2] Let g = water consumption in thousands of gallons.

$35 \leq 10.4 + 5.9g$ and $10.4 + 5.9g \leq 50$

$35 - 10.4 \leq 10.4 + 5.9g - 10.4$ | $10.4 + 5.9g - 10.4 \leq 50 - 10.4$

$24.6 \leq 5.9g$ | $5.9g \leq 39.6$

$\frac{24.6}{5.9} \leq \frac{5.9g}{5.9}$ | $\frac{5.9g}{5.9} \leq \frac{39.6}{5.9}$

$g \geq$ about 4.169 and $g \leq$ about 6.712

min. consumption: 4169 gal

max. consumption: 6712 gal

[1] incorrect answer OR insufficient explanation

64.
$$5 < 6b + 3$$
$$5 - 3 < 6b + 3 - 3$$
$$2 < 6b$$
$$\frac{2}{6} < \frac{6b}{6}$$
$$\frac{1}{3} < b$$

65.
$$12n \leq 3n + 27$$
$$12n - 3n \leq 3n + 27 - 3n$$
$$9n \leq 27$$
$$\frac{9n}{9} \leq \frac{27}{9}$$
$$n \leq 3$$

66.
$$2 + 4r \geq 5(r - 1)$$
$$2 + 4r \geq 5r - 5$$
$$2 + 4r - 4r \geq 5r - 5 - 4r$$
$$2 \geq r - 5$$
$$2 + 5 \geq r - 5 + 5$$
$$7 \geq r$$

67.
$$x - 3 = 5x + 1$$
$$x - 3 - x = 5x + 1 - x$$
$$-3 = 4x + 1$$
$$-3 - 1 = 4x + 1 - 1$$
$$-4 = 4x$$
$$\frac{-4}{4} = \frac{4x}{4}$$
$$-1 = x$$

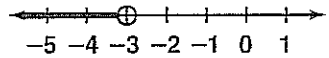
68.
$$4(w + 3) = 10w$$
$$4w + 12 = 10w$$
$$4w + 12 - 4w = 10w - 4w$$
$$12 = 6w$$
$$\frac{12}{6} = \frac{6w}{6}$$
$$2 = w$$

69.
$$8p - 4 = 4(2p - 1)$$
$$8p - 4 = 8p - 4$$

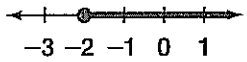
identity (true for all values of p)

CHECKPOINT QUIZ 2 *page 166*

1.
$$8d + 2 < 5d - 7$$
$$8d + 2 - 5d < 5d - 7 - 5d$$
$$3d + 2 < -7$$
$$3d + 2 - 2 < -7 - 2$$
$$3d < -9$$
$$\frac{3d}{3} < \frac{-9}{3}$$
$$d < -3$$



2.
$$2n + 1 \geq -3$$
$$2n + 1 - 1 \geq -3 - 1$$
$$2n \geq -4$$
$$\frac{2n}{2} \geq \frac{-4}{2}$$
$$n \geq -2$$



3. $-1 \leq 4m + 7$ and $4m + 7 \leq 11$

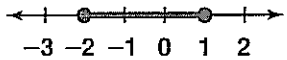
$-1 - 7 \leq 4m + 7 - 7$ | $4m + 7 - 7 \leq 11 - 7$

$-8 \leq 4m$ | $4m \leq 4$

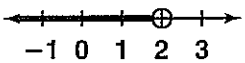
$\frac{-8}{4} \leq \frac{4m}{4}$ | $\frac{4m}{4} \leq \frac{4}{4}$

$-2 \leq m$ and $m \leq 1$

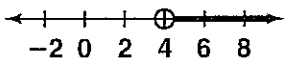
$-2 \leq m \leq 1$



4.
$$5s - 3 + 1 < 8$$
$$5s - 2 < 8$$
$$5s - 2 + 2 < 8 + 2$$
$$5s < 10$$
$$\frac{5s}{5} < \frac{10}{5}$$
$$s < 2$$



5.
$$5(3p - 2) > 50$$
$$15p - 10 > 50$$
$$15p - 10 + 10 > 50 + 10$$
$$15p > 60$$
$$\frac{15p}{15} > \frac{60}{15}$$
$$p > 4$$



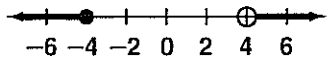
6. $3 - x \geq 7$ or $2x - 3 > 5$

$3 - x - 3 \geq 7 - 3$ | $2x - 3 + 3 > 5 + 3$

$-x \geq 4$ | $2x > 8$

$x \leq -4$ | $\frac{2x}{2} > \frac{8}{2}$

$x \leq -4$ or $x > 4$



7. $c < 8$ **8.** $65 \leq t \leq 75$

9.
$$2 \cdot 15 + 2w \leq 48$$
$$30 + 2w \leq 48$$
$$30 + 2w - 30 \leq 48 - 30$$
$$2w \leq 18$$
$$\frac{2w}{2} \leq \frac{18}{2}$$
$$w \leq 9$$

The width is at most 9 in.

10.
$$-2x + 7 \le 45$$
$$-2x + 7 - 7 \le 45 - 7$$
$$-2x \le 38$$
$$\frac{-2x}{-2} \ge \frac{38}{-2}$$
$$x \ge -19$$

3-6 Absolute Value Equations and Inequalities *pages 167–173*

Check Skills You'll Need For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 15 **2.** 3 **3.** 6 **4.** −7 **5.** 24 **6.** 2 **7.** = **8.** > **9.** < **10.** > **11.** > **12.** =

Check Understanding

1a.
$$|t| - 2 = -1$$
$$|t| - 2 + 2 = -1 + 2$$
$$|t| = 1$$
$$t = 1 \quad \text{or} \quad t = -1$$

Check:

$|1| - 2 \stackrel{?}{=} -1$ $\qquad$ $|-1| - 2 \stackrel{?}{=} -1$

$1 - 2 = -1$ ✓ $\qquad$ $1 - 2 = -1$ ✓

1b.
$$3|n| = 15$$
$$\frac{3|n|}{3} = \frac{15}{3}$$
$$|n| = 5$$
$$n = 5 \quad \text{or} \quad n = -5$$

Check: $3|5| \stackrel{?}{=} 15$ $\qquad$ $3|-5| \stackrel{?}{=} 15$

$3 \cdot 5 = 15$ ✓ $\qquad$ $3 \cdot 5 = 15$ ✓

1c.
$$4 = 3|w| - 2$$
$$4 + 2 = 3|w| - 2 + 2$$
$$6 = 3|w|$$
$$\frac{6}{3} = \frac{3|w|}{3}$$
$$2 = |w|$$
$$w = 2 \quad \text{or} \quad w = -2$$

Check:

$4 \stackrel{?}{=} 3|2| - 2$ $\qquad$ $4 \stackrel{?}{=} 3|-2| - 2$

$4 = 3 \cdot 2 - 2$ ✓ $\qquad$ $4 = 3 \cdot 2 - 2$ ✓

1d. No; an absolute value can never be negative.

2a. $|c - 2| = 6$

$c - 2 = 6$ or $c - 2 = -6$

$c - 2 + 2 = 6 + 2$ | $c - 2 + 2 = -6 + 2$

$c = 8$ or $c = -4$

Check:

$|8 - 2| = 6$ ✓ $\qquad$ $|-4 - 2| = 6$ ✓

2b. no solution

2c. $|7d| = 14$

$7d = 14$ or $7d = -14$

$\frac{7d}{7} = \frac{14}{7}$ | $\frac{7d}{7} = \frac{-14}{7}$

$d = 2$ or $d = -2$

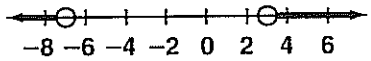
Check: $|7(2)| = 14$ ✓ $\qquad$ $|7(-2)| = 14$ ✓

3a. $|w + 2| > 5$

$w + 2 > 5$ or $w + 2 < -5$

$w + 2 - 2 > 5 - 2$ | $w + 2 - 2 < -5 - 2$

$w > 3$ or $w < -7$



3b. All real numbers; absolute value expressions are greater than or equal to 0.

4. Let w = actual weight of engines that are acceptable.

$$|w - 33.86| \le 0.05$$

$w - 33.86 \le 0.05$ and $w - 33.86 \ge -0.05$

$w \le 0.05 + 33.86$ | $w \ge -0.05 + 33.86$

$w \le 33.91$ and $w \ge 33.81$

$$33.81 \text{ oz} \le w \le 33.91 \text{ oz}$$

Exercises

1.
$$|b| = 2$$
$$b = 2 \quad \text{or} \quad b = -2$$

2.
$$4 = |y|$$
$$y = 4 \quad \text{or} \quad y = -4$$

3.
$$|w| = \tfrac{1}{2}$$
$$w = \tfrac{1}{2} \quad \text{or} \quad w = -\tfrac{1}{2}$$

4.
$$|n| + 2 = 8$$
$$|n| + 2 - 2 = 8 - 2$$
$$|n| = 6$$
$$n = 6 \quad \text{or} \quad n = -6$$

5.
$$7 = |s| + 4$$
$$7 - 4 = |s| + 4 - 4$$
$$3 = |s|$$
$$s = 3 \quad \text{or} \quad s = -3$$

6.
$$|x| - 10 = -3$$
$$|x| - 10 + 10 = -3 + 10$$
$$|x| = 7$$
$$x = 7 \quad \text{or} \quad x = -7$$

7.
$$4|d| = 20$$
$$\frac{4|d|}{4} = \frac{20}{4}$$
$$|d| = 5$$
$$d = 5 \quad \text{or} \quad d = -5$$

8.
$$-3|m| = -6$$
$$\frac{-3|m|}{-3} = \frac{-6}{-3}$$
$$|m| = 2$$
$$m = 2 \quad \text{or} \quad m = -2$$

9.
$$|y| + 3 = 3$$
$$|y| + 3 - 3 = 3 - 3$$
$$|y| = 0$$
$$y = 0$$

10.
$$12 = -4|k|$$
$$\frac{12}{-4} = \frac{-4|k|}{-4}$$
$$-3 = |k|$$

no solution

11.
$$2|z| - 5 = 1$$
$$2|z| - 5 + 5 = 1 + 5$$
$$2|z| = 6$$

$$\frac{2|z|}{2} = \frac{6}{2}$$
$$|z| = 3$$
$$z = 3 \quad \text{or} \quad z = -3$$

12.
$$16 = 5|p| - 4$$
$$16 + 4 = 5|p| - 4 + 4$$
$$20 = 5|p|$$
$$\frac{20}{5} = \frac{5|p|}{5}$$
$$4 = |p|$$
$$p = 4 \quad \text{or} \quad p = -4$$

13.
$$|r - 8| = 5$$

$r - 8 = 5$	or	$r - 8 = -5$
$r - 8 + 8 = 5 + 8$		$r - 8 + 8 = -5 + 8$
$r = 13$	or	$r = 3$

14.
$$|c + 2| = 6$$

$c + 2 = 6$	or	$c + 2 = -6$
$c + 2 - 2 = 6 - 2$		$c + 2 - 2 = -6 - 2$
$c = 4$	or	$c = -8$

15.
$$2 = |g + 1|$$

$2 = g + 1$	or	$-2 = g + 1$
$2 - 1 = g + 1 - 1$		$-2 - 1 = g + 1 - 1$
$1 = g$	or	$-3 = g$

16.
$$3 = |m + 2|$$

$3 = m + 2$	or	$-3 = m + 2$
$3 - 2 = m + 2 - 2$		$-3 - 2 = m + 2 - 2$
$1 = m$	or	$-5 = m$

17.
$$|v - 2| = 7$$

$v - 2 = 7$	or	$v - 2 = -7$
$v - 2 + 2 = 7 + 2$		$v - 2 + 2 = -7 + 2$
$v = 9$	or	$v = -5$

18.
$$-3|y - 3| = 9$$
$$\frac{-3|y - 3|}{-3} = \frac{9}{-3}$$
$$|y - 3| = -3$$

no solution

19.
$$2|d + 3| = 8$$
$$\frac{2|d + 3|}{2} = \frac{8}{2}$$
$$|d + 3| = 4$$

$d + 3 = 4$	or	$d + 3 = -4$
$d + 3 - 3 = 4 - 3$		$d + 3 - 3 = -4 - 3$
$d = 1$	or	$d = -7$

20.
$$-2|7d| = -14$$
$$\frac{-2|7d|}{-2} = \frac{-14}{-2}$$
$$|7d| = 7$$

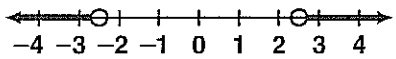
$7d = 7$	or	$7d = -7$
$\frac{7d}{7} = \frac{7}{7}$		$\frac{7d}{7} = \frac{-7}{7}$
$d = 1$	or	$d = -1$

21.
$$1.2|5p| = 3.6$$
$$\frac{1.2|5p|}{1.2} = \frac{3.6}{1.2}$$
$$|5p| = 3$$

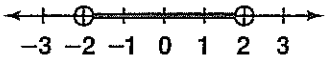
$5p = 3$	or	$5p = -3$
$\frac{5p}{5} = \frac{3}{5}$		$\frac{5p}{5} = \frac{-3}{5}$
$p = 0.6$	or	$p = -0.6$

22a. less than **22b.** greater than

23.
$$|k| > 2.5$$
$$k > 2.5 \quad \text{or} \quad k < -2.5$$



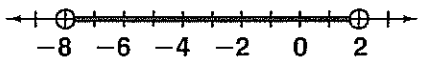
24.
$$|w| < 2$$
$$w < 2 \quad \text{and} \quad w > -2$$
$$-2 < w < 2$$



25.
$$|x + 3| < 5$$

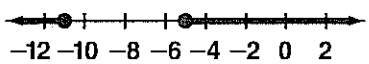
$x + 3 < 5$	and	$x + 3 > -5$
$x + 3 - 3 < 5 - 3$		$x + 3 - 3 > -5 - 3$
$x < 2$	and	$x > -8$

$$-8 < x < 2$$



26.
$$|n + 8| \geq 3$$

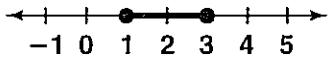
$n + 8 \geq 3$	or	$n + 8 \leq -3$
$n + 8 - 8 \geq 3 - 8$		$n + 8 - 8 \leq -3 - 8$
$n \geq -5$	or	$n \leq -11$



27.
$$|y - 2| \leq 1$$

$y - 2 \leq 1$	and	$y - 2 \geq -1$
$y - 2 + 2 \leq 1 + 2$		$y - 2 + 2 \geq -1 + 2$
$y \leq 3$	and	$y \geq 1$

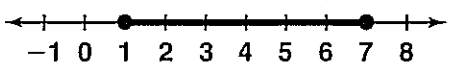
$$1 \leq y \leq 3$$



28.
$$|p - 4| \leq 3$$

$p - 4 \leq 3$	and	$p - 4 \geq -3$
$p - 4 + 4 \leq 3 + 4$		$p - 4 + 4 \geq -3 + 4$
$p \leq 7$	and	$p \geq 1$

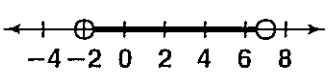
$$1 \leq p \leq 7$$



29.
$$|2c - 5| < 9$$

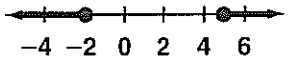
$2c - 5 < 9$	and	$2c - 5 > -9$
$2c - 5 + 5 < 9 + 5$		$2c - 5 + 5 > -9 + 5$
$2c < 14$		$2c > -4$
$\frac{2c}{2} < \frac{14}{2}$		$\frac{2c}{2} > \frac{-4}{4}$
$c < 7$	and	$c > -2$

$$-2 < c < 7$$



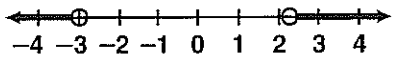
30. $|2y - 3| \geq 7$

$2y - 3 \geq 7$	or	$2y - 3 \leq -7$
$2y - 3 + 3 \geq 7 + 3$		$2y - 3 + 3 \leq -7 + 3$
$2y \geq 10$		$2y \leq -4$
$\frac{2y}{2} \geq \frac{10}{2}$		$\frac{2y}{2} \leq \frac{-4}{2}$
$y \geq 5$	or	$y \leq -2$



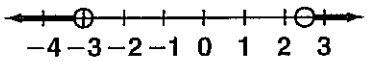
31. $|3t + 1| > 8$

$3t + 1 > 8$	or	$3t + 1 < -8$
$3t + 1 - 1 > 8 - 1$		$3t + 1 - 1 < -8 - 1$
$3t > 7$		$3t < -9$
$\frac{3t}{3} > \frac{7}{3}$		$\frac{3t}{3} < \frac{-9}{3}$
$t > 2\frac{1}{3}$	or	$t < -3$



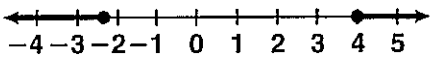
32. $|4x + 1| > 11$

$4x + 1 > 11$	or	$4x + 1 < -11$
$4x + 1 - 1 > 11 - 1$		$4x + 1 - 1 < -11 - 1$
$4x > 10$		$4x < -12$
$0.25(4x) > 0.25(10)$		$0.25(4x) < 0.25(-12)$
$x > 2.5$	or	$x < -3$



33. $|5t - 4| \geq 16$

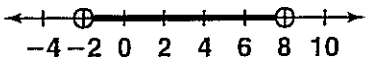
$5t - 4 \geq 16$	or	$5t - 4 \leq -16$
$5t - 4 + 4 \geq 16 + 4$		$5t - 4 + 4 \leq -16 + 4$
$5t \geq 20$		$5t \leq -12$
$\frac{5t}{5} \geq \frac{20}{5}$		$\frac{5t}{5} \leq \frac{-12}{5}$
$t \geq 4$	or	$t \leq -2.4$



34. $|3 - r| < 5$

$3 - r < 5$	and	$3 - r > -5$
$3 - r - 3 < 5 - 3$		$3 - r - 3 > -5 - 3$
$-r < 2$		$-r > -8$
$r > -2$	and	$r < 8$

$-2 < r < 8$



35. Let d = actual diameter of acceptable gears.

$|d - 12.24| < 0.06$

$d - 12.24 < 0.06$	and	$d - 12.24 > -0.06$
$d - 12.24 + 12.24 < 0.06 + 12.24$		$d - 12.24 + 12.24 > -0.06 + 12.24$
$d < 12.30$	and	$d > 12.18$

Acceptable gears have diameters between 12.18 and 12.30 mm.

36. Let w = actual width of acceptable conveyor belts.

$|w - 50| \leq \frac{7}{32}$

$w - 50 \leq \frac{7}{32}$	and	$w - 50 \geq -\frac{7}{32}$
$w - 50 + 50 \leq \frac{7}{32} + 50$		$w - 50 + 50 \geq -\frac{7}{32} + 50$
$w \leq 50\frac{7}{32}$ in.	and	$w \geq 49\frac{25}{32}$ in.

Acceptable belts have widths between $49\frac{25}{32}$ in. and $50\frac{7}{32}$ in., inclusive.

37.

$|2d| + 3 = 21$

$|2d| + 3 - 3 = 21 - 3$

$|2d| = 18$

$2d = 18$	or	$2d = -18$
$\frac{2d}{2} = \frac{18}{2}$		$\frac{2d}{2} = \frac{-18}{2}$
$d = 9$	or	$d = -9$

38.

$|-3n| - 2 = 7$

$|-3n| - 2 + 2 = 7 + 2$

$|-3n| = 9$

$-3n = 9$	or	$-3n = -9$
$\frac{-3n}{-3} = \frac{9}{-3}$		$\frac{-3n}{-3} = \frac{-9}{-3}$
$n = -3$	or	$n = 3$

39.

$|p| - \frac{2}{3} = \frac{5}{6}$

$|p| - \frac{2}{3} + \frac{2}{3} = \frac{5}{6} + \frac{2}{3}$

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

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

40.

$|t| + 2.7 = 4.5$

$|t| + 2.7 - 2.7 = 4.5 - 2.7$

$|t| = 1.8$

$t = 1.8$ or $t = -1.8$

41.

$4|k + 1| = 16$

$\frac{4|k + 1|}{4} = \frac{16}{4}$

$|k + 1| = 4$

$k + 1 = 4$	or	$k + 1 = -4$
$k + 1 - 1 = 4 - 1$		$k + 1 - 1 = -4 - 1$
$k = 3$	or	$k = -5$

42.

$-2|c - 4| = -8$

$\frac{-2|c - 4|}{-2} = \frac{-8}{-2}$

$|c - 4| = 4$

$c - 4 = 4$	or	$c - 4 = -4$
$c - 4 + 4 = 4 + 4$		$c - 4 + 4 = -4 + 4$
$c = 8$	or	$c = 0$

43. $|3d| \geq 6$

$3d \geq 6$	or	$3d \leq -6$
$\frac{3d}{3} \geq \frac{6}{3}$		$\frac{3d}{3} \leq \frac{-6}{3}$
$d \geq 2$	or	$d \leq -2$

44. $|n| - 3 > 7$

$|n| - 3 + 3 > 7 + 3$

$|n| > 10$

$n > 10$ or $n < -10$

45. $9 < |c + 7|$

$c + 7 > 9$ or $c + 7 < -9$

$c + 7 - 7 > 9 - 7$ | $c + 7 - 7 < -9 - 7$

$c > 2$ or $c < -16$

46. $\frac{|v|}{-3} = -4.2$

$-3\left(\frac{|v|}{-3}\right) = -3(-4.2)$

$|v| = 12.6$

$v = 12.6$ or $v = -12.6$

47. $|6.5x| < 39$

$6.5x < 39$ and $6.5x > -39$

$\frac{6.5x}{6.5} < \frac{39}{6.5}$ | $\frac{6.5x}{6.5} > \frac{-39}{6.5}$

$x < 6$ and $x > -6$

$-6 < x < 6$

48. $4|n| = 32$

$\frac{4|n|}{4} = \frac{32}{4}$

$|n| = 8$

$n = 8$ or $n = -8$

49. $|\frac{1}{2}a| + 1 = 5$

$|\frac{1}{2}a| + 1 - 1 = 5 - 1$

$|\frac{1}{2}a| = 4$

$\frac{1}{2}a = 4$ or $\frac{1}{2}a = -4$

$2\left(\frac{1}{2}a\right) = 2(4)$ | $2\left(\frac{1}{2}a\right) = 2(-4)$

$a = 8$ or $a = -8$

50. $|a| + \frac{1}{2} = 3\frac{1}{2}$

$|a| + \frac{1}{2} - \frac{1}{2} = 3\frac{1}{2} - \frac{1}{2}$

$|a| = 3$

$a = 3$ or $a = -3$

51. $4 - 3|m + 2| > -14$

$4 - 3|m + 2| - 4 > -14 - 4$

$-3|m + 2| > -18$

$\frac{-3|m + 2|}{-3} < \frac{-18}{-3}$

$|m + 2| < 6$

$m + 2 < 6$ and $m + 2 > -6$

$m + 2 - 2 < 6 - 2$ | $m + 2 - 2 > -6 - 2$

$m < 4$ and $m > -8$

$-8 < m < 4$

52. $|n| < 3$ **53.** $|n| > 7.5$ **54.** $|n - 6| > 2$
55. $|n + 1| \geq 3$
56. Let w = weight of acceptable boxes.

$|w - 16| \leq 0.05$

$w - 16 \leq 0.05$ and $w - 16 \geq -0.05$

$w - 16 + 16 \leq 0.05 + 16$ | $w - 16 + 16 \geq -0.05 + 16$

$w \leq 16.05$ and $w \geq 15.95$

$15.95 \leq w \leq 16.05$

Acceptable boxes have weights between 15.95 and 16.05 oz.

57. $|v - 42| \leq 3$

$v - 42 \leq 3$ and $v - 42 \geq -3$

$v - 42 + 42 \leq 3 + 42$ | $v - 42 + 42 \geq -3 + 42$

$v \leq 45$ and $v \geq 39$

$39 \leq v \leq 45$

least: 39%; greatest: 45%

58a. $|w - 454| < 5$

58b. $w - 454 < 5$ and $w - 454 > -5$

$w - 454 + 454 < 5 + 454$ | $w - 454 + 454 > -5 + 454$

$w < 459$ and $w > 449$

$449 < w < 459$

The allowable range is between 449 and 459 g.

59. $d \leq 6.29$ and $d \geq 6.25$

$d - 6.27 \leq 6.29 - 6.27$ | $d - 6.27 \geq 6.25 - 6.27$

$d - 6.27 \leq 0.02$ and $d - 6.27 \geq -0.02$

$|d - 6.27| \leq 0.02$

60. $|2c - 5| + 9 < 4$

$|2c - 5| + 9 - 9 < 4 - 9$

$|2c - 5| < -5$

This has no solution. No absolute value can be negative.

61. Sample: $5 - 3 = |-12x|$

$2 = |-12x|$

$-12x = 2$ or $-12x = -2$

$\frac{-12x}{-12} = \frac{2}{12}$ | $\frac{-12x}{-12} = \frac{-2}{12}$

$x = \frac{1}{6}$ or $x = -\frac{1}{6}$

62. Midpoint between 2 and 6 is 4; distance from 2 or 6 to midpoint is 2; equation is $|x - 4| = 2$. **63.** Midpoint between -2 and 6 is 2; distance from -2 or 6 is 4; equation is $|x - 2| = 4$. **64.** Midpoint is 3; distance to midpoint is 6; equation is $|x - 3| = 6$. **65.** Midpoint is $12\frac{1}{2}$; distance to midpoint is $3\frac{1}{2}$; equation is $|x - 12\frac{1}{2}| = 3\frac{1}{2}$. **66.** Midpoint is 3; distance to midpoint is 4; equation is $|x - 3| = 4$. **67.** Midpoint is $5\frac{1}{2}$; distance to midpoint is $2\frac{1}{2}$; equation is $|x - 5\frac{1}{2}| = 2\frac{1}{2}$. **68.** Midpoint is -9; distance to midpoint is 6; equation is $|x - (-9)| = 6$ or $|x + 9| = 6$ **69.** Midpoint is 6; distance to midpoint is 4; equation is $|x - 6| = 4$.

70a. Ideal roll weighs $40 \cdot 0.176 + 0.05 = 7.09$ oz. Let r = actual weight of acceptable roll.

$|r - 7.09| \leq 0.015$

$r - 7.09 \leq 0.015$ and $r - 7.09 \geq -0.015$

$r \le 0.015 + 7.09$ and $r \ge -0.015 + 7.09$

$r \le 7.105$ and $r \ge 7.075$

$$7.075 \le r \le 7.105$$

The roll should weigh between 7.075 and 7.105 oz., inclusive.

70b. No; weighing a roll does not check the individual coins. **71a.** 11°F, 39°F **71b.** $|t - 25| \le 14$

72. $|x + 4| = 3x$

$x + 4 = 3x$	or	$x + 4 = -3x$
$x + 4 - x = 3x - x$		$x + 4 - x = -3x - x$
$4 = 2x$		$4 = -4x$
$\frac{4}{2} = \frac{2x}{2}$		$\frac{4}{-4} = \frac{-4x}{-4}$
$2 = x$	or	$-1 = x$ (not a solution)

Check: $|2 + 4| = 3 \cdot 2$ ✓

73. $|4x - 5| = 2x + 1$

$4x - 5 = 2x + 1$	or	$4x - 5 = -2x - 1$
$4x - 5 - 2x = 2x + 1 - 2x$		$4x - 5 + 2x = -2x - 1 + 2x$
$2x - 5 = 1$		$6x - 5 = -1$
$2x - 5 + 5 = 1 + 5$		$6x - 5 + 5 = -1 + 5$
$2x = 6$		$6x = 4$
$\frac{2x}{2} = \frac{6}{2}$		$\frac{6x}{6} = \frac{4}{6}$
$x = 3$	or	$x = \frac{2}{3}$

Check:

$\lvert 4 \cdot 3 - 5\rvert \stackrel{?}{=} 2 \cdot 3 + 1$	$\lvert 4\left(\frac{2}{3}\right) - 5\rvert \stackrel{?}{=} 2\left(\frac{2}{3}\right) + 1$
$\lvert 7\rvert = 6 + 1$ ✓	$\lvert -\frac{7}{3}\rvert = \frac{4}{3} + 1$ ✓

74. $\frac{4}{3}|2x + 3| = 4x$

$$\frac{3}{4}\left(\frac{4}{3}|2x + 3|\right) = \frac{3}{4}(4x)$$

$$|2x + 3| = 3x$$

$2x + 3 = 3x$	or	$2x + 3 = -3x$
$2x + 3 - 2x = 3x - 2x$		$2x + 3 - 2x = -3x - 2x$
$3 = x$		$3 = -5x$
$3 = x$	or	$-\frac{3}{5} = x$

negative solution for x not allowed; only $x = 3$

Check: $\frac{4}{3}|2(3) + 3| \stackrel{?}{=} 4(3)$

$\frac{4}{3}(9) = 12$ ✓

75–78. The eight cases below exemplify all possible relationships between a and b.

75.

a	b	$\lvert a + b\rvert$	$\lvert a\rvert + \lvert b\rvert$	
2	3	5	5	=
−2	3	1	5	<
2	−3	1	5	<
−2	−3	5	5	=
3	2	5	5	=
−3	2	1	5	<
3	−2	1	5	<
−3	−2	5	5	=

Conclude $|a + b| \le |a| + |b|$.

76.

a	b	$\lvert a - b\rvert$	$\lvert a\rvert - \lvert b\rvert$	
2	3	1	−1	>
−2	3	5	−1	>
2	−3	5	−1	>
−2	−3	1	−1	>
3	2	1	1	=
−3	2	5	1	>
3	−2	5	1	>
−3	−2	1	1	=

Conclude $|a - b| \ge |a| - |b|$.

77.

a	b	$\lvert ab\rvert$	$\lvert a\rvert \cdot \lvert b\rvert$	
2	3	6	6	=
−2	3	6	6	=
2	−3	6	6	=
−2	−3	6	6	=
3	2	6	6	=
−3	2	6	6	=
3	−2	6	6	=
−3	−2	6	6	=

Conclude $|ab| = |a| \cdot |b|$.

78.

a	b	$\lvert\frac{a}{b}\rvert$	$\lvert\frac{a}{b}\rvert$	
2	3	$\frac{2}{3}$	$\frac{2}{3}$	=
−2	3	$\frac{2}{3}$	$\frac{2}{3}$	=
2	−3	$\frac{2}{3}$	$\frac{2}{3}$	=
−2	−3	$\frac{2}{3}$	$\frac{2}{3}$	=
3	2	$\frac{3}{2}$	$\frac{3}{2}$	=
−3	2	$\frac{3}{2}$	$\frac{3}{2}$	=
3	−2	$\frac{3}{2}$	$\frac{3}{2}$	=
−3	−2	$\frac{3}{2}$	$\frac{3}{2}$	=

Conclude $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}$.

79. Midpoint between −4 and 2 is −1; distance to midpoint is 3; equation is $|x - (-1)| > 3$ or $|x + 1| > 3$. **80.** Midpoint between −2 and 6 is 2; distance to midpoint is 4; equation is $|x - 2| \le 4$.

81. $|x + 4| > 8$

$x + 4 < 8$	and	$x + 4 > -8$
$x + 4 - 4 < 8 - 4$		$x + 4 - 4 > -8 - 4$
$x < 4$	and	$x > -12$

$-12 < x < 4$; the answer is A.

82. $|2 - x| < 4$

$2 - x < 4$	and	$2 - x > -4$
$2 - x - 2 < 4 - 2$		$2 - x - 2 > -4 - 2$
$-x < 2$		$-x > -6$
$x > -2$	and	$x < 6$

Any number that is both greater than −2 and less than 6 is a solution. The answer is G.

83. Allowable diameters are in range $(1.25 - 0.005) \le d \le (1.25 + 0.005)$ or $1.245 \le d \le 1.255$. A, B, and C are in that range. The answer is D.

84. The distance of x from 30 on a number line should be less than or equal to 5. The answer is I.

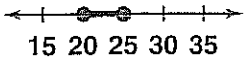
85. $|t - 122| < 90$

$t - 122 < 90$ and $t - 122 > -90$

$t - 122 + 122 < 90 + 122$ $\quad t - 122 + 122 > -90 + 122$

$t < 212$ and $t > 32$

The graph is A.

86 [2] a. 

b. The three graphs in the text have the range from 20 through 25 miles, inclusive, in common; this range is shown in the graph above. All points below 20 or above 25 are unacceptable to one of the three parties.

[1] no graph OR insufficient explanation

87. $-282 \le e \le 20{,}320$ **88.** $36.0 \le t \le 37.2$

89.
$$\begin{aligned} 3t + 4t &= -21 \\ 7t &= -21 \\ \tfrac{7t}{7} &= \tfrac{-21}{7} \\ t &= -3 \end{aligned}$$

90.
$$\begin{aligned} 9(-2n + 3) &= -27 \\ -18n + 27 &= -27 \\ -18n + 27 - 27 &= -27 - 27 \\ -18n &= -54 \\ \tfrac{-18n}{-18} &= \tfrac{-54}{-18} \\ n &= 3 \end{aligned}$$

91.
$$\begin{aligned} k + 5 - 4k &= -10 \\ -3k + 5 &= -10 \\ -3k + 5 - 5 &= -10 - 5 \\ -3k &= -15 \\ \tfrac{-3k}{-3} &= \tfrac{-15}{-3} \\ k &= 5 \end{aligned}$$

92.
$$\begin{aligned} 5x + 3 - 2x &= -21 \\ 3x + 3 &= -21 \\ 3x + 3 - 3 &= -21 - 3 \\ 3x &= -24 \\ \tfrac{3x}{3} &= \tfrac{-24}{3} \\ x &= -8 \end{aligned}$$

93.
$$\begin{aligned} 5.4m - 2.3 &= -0.5 \\ 5.4m - 2.3 + 2.3 &= -0.5 + 2.3 \\ 5.4m &= 1.8 \\ \tfrac{5.4m}{5.4} &= \tfrac{1.8}{5.4} \\ m &= \tfrac{1}{3} \end{aligned}$$

94.
$$\begin{aligned} 3(y - 4) &= 9 \\ 3y - 12 &= 9 \\ 3y - 12 + 12 &= 9 + 12 \\ 3y &= 21 \\ \tfrac{3y}{3} &= \tfrac{21}{3} \\ y &= 7 \end{aligned}$$

95. $-2.5, -2, 0, 3, \pi$ **96.** $-2, -1.5, -\frac{4}{3}$ [≈ -1.333], 7, $\frac{15}{2}$ [7.5]

97. 0.001, 0.009, 0.01, 0.011 **98.** $-\pi, -3, -2.5, 3, 2\pi$

EXTENSION *page 173*

1. Symmetric Property of Equality **2.** Transitive Property of Equality **3.** Reflexive Property of Equality **4.** Transitive Property of Equality **5.** Symmetric Property of Equality

6. To be shown: $(a + b) + (-a) = b$

$(a + b) + (-a) = (b + a) + (-a)$	Comm. Prop. of Add.
$= b + [a + (-a)]$	Assoc. Prop. of Add.
$= b + 0$	Inverse Prop. of Add.
$= b$	Identity Prop. of Add.
$(a + b) + (-a) = b$	Transitive Prop. of Eq.

7.

$a < b$	Given
$a + c < b + c$	Add. Prop. of Ineq.
$c < d$	Given
$b + c < b + d$	Add. Prop. of Ineq.
$a + c < b + d$	Trans. Prop. of Ineq.

TEST-TAKING STRATEGIES *page 174*

1. computation error; $2(3x) = 6x$, not $5x$

2. Let x = number of adults, $3x$ = number of children.

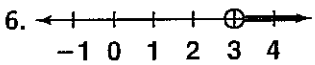
$$14(x) + 2(3x) \ge 440$$

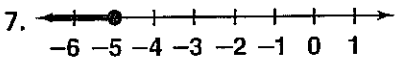
At least 24 adults and 72 children must attend.

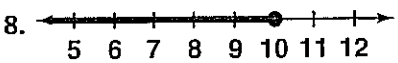
3. The inequality does not include prices of the tickets. The expression compares numbers of people with dollar amounts.

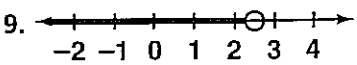
CHAPTER REVIEW *pages 175–177*

1. C **2.** B **3.** A **4.** C **5.** D

6. 

7. 

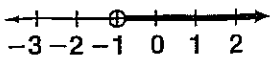
8. 

9. 

10. $n < -2$ **11.** $n \ge -3.5$ **12.** $n > -6$ **13.** $n \ge 2$

14. Let p = number of people; $p \ge 600$. **15.** Let n = number of people; $n \le 15$. **16.** Let t = temperature in degrees Fahrenheit; $t < 32$.

17.
$$\begin{aligned} h + 3 &> 2 \\ h + 3 - 3 &> 2 - 3 \\ h &> -1 \end{aligned}$$



Check: Test $h = -1$ in the equation.

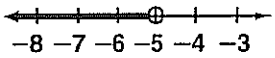
$$h + 3 = 2$$
$$-1 + 3 \stackrel{?}{=} 2 \checkmark$$

Test $h = 0$ in the original inequality.

$$0 + 3 \stackrel{?}{>} 2 \checkmark$$

18.

$$t - 4 < -9$$
$$t - 4 + 4 < -9 + 4$$
$$t < -5$$



Check: Test $t = -5$ in the equation.

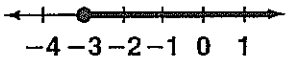
$$t - 4 = -9$$
$$-5 - 4 \stackrel{?}{=} -9 \checkmark$$

Test $t = -6$ in the original inequality.

$$-6 - 4 \stackrel{?}{<} -9 \checkmark$$

19.

$$8m \geq -24$$
$$\frac{8m}{8} \geq \frac{-24}{8}$$
$$m \geq -3$$



Check: Test $m = -3$ in the equation.

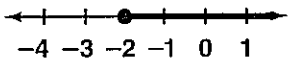
$$8m = -24$$
$$8(-3) \stackrel{?}{=} -24 \checkmark$$

Test $m = -2$ in the original inequality.

$$8(-2) \stackrel{?}{\geq} -24 \checkmark$$

20.

$$-6w \leq 12$$
$$\frac{-6w}{-6} \geq \frac{12}{-6}$$
$$w \geq -2$$



Check: Test $w = -2$ in the equation.

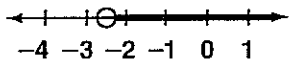
$$-6(-2) \stackrel{?}{=} 12 \checkmark$$

Test $w = -1$ in the original inequality.

$$-6(-1) \stackrel{?}{\leq} 12 \checkmark$$

21.

$$q + 0.5 > -2$$
$$q + 0.5 - 0.5 > -2 - 0.5$$
$$q > -2.5$$



Check: Test $q = -2.5$ in the equation.

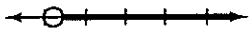
$$q + 0.5 = -2$$
$$-2.5 + 0.5 \stackrel{?}{=} -2 \checkmark$$

Test $q = -2$ in the original inequality.

$$-2 + 0.5 \stackrel{?}{>} -2 \checkmark$$

22.

$$y - 8 > -22$$
$$y - 8 + 8 > -22 + 8$$
$$y > -14$$



Check: Test $y = -14$ in the equation.

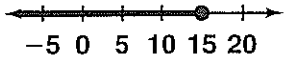
$$y - 8 = -22$$
$$-14 - 8 \stackrel{?}{=} -22 \checkmark$$

Test $y = -13$ in the original inequality.

$$-13 - 8 \stackrel{?}{>} -22 \checkmark$$

23.

$$-\tfrac{3}{5}n \geq -9$$
$$-\tfrac{5}{3}\left(-\tfrac{3}{5}n\right) \leq -\tfrac{5}{3}(-9)$$
$$n \leq 15$$



Check: Test $n = 15$ in the equation.

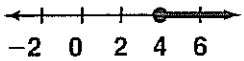
$$-\tfrac{3}{5}n = -9$$
$$-\tfrac{3}{5}(15) \stackrel{?}{=} -9$$
$$-3 \cdot 3 = -9 \checkmark$$

Test $n = 14$ in the original inequality.

$$-\tfrac{3}{5}(14) \stackrel{?}{\geq} -9$$
$$-8\tfrac{2}{5} \geq -9 \checkmark$$

24.

$$\tfrac{5}{8}d \geq \tfrac{5}{2}$$
$$\tfrac{8}{5}\left(\tfrac{5}{8}d\right) \geq \tfrac{8}{5}\left(\tfrac{5}{2}\right)$$
$$d \geq 4$$



Check: Test $d = 4$ in the equation.

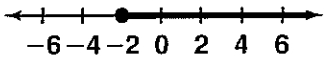
$$\tfrac{5}{8}d = \tfrac{5}{2}$$
$$\tfrac{5}{8}(4) \stackrel{?}{=} \tfrac{5}{2} \checkmark$$

Test $d = 5$ in the original inequality.

$$\tfrac{5}{8}(5) \stackrel{?}{\geq} \tfrac{5}{2}$$
$$3\tfrac{1}{8} \geq 2\tfrac{1}{2} \checkmark$$

25.

$$0 \leq 2 + t$$
$$0 - 2 \leq 2 + t - 2$$
$$-2 \leq t$$



Check: Test $t = -2$ in the equation.

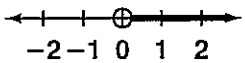
$$0 = 2 + t$$
$$0 \stackrel{?}{=} 2 + (-2) \checkmark$$

Test $t = -1$ in the original inequality.

$$0 \stackrel{?}{\leq} 2 + (-1) \checkmark$$

26.

$$0 < 4c$$
$$\frac{0}{4} < \frac{4c}{4}$$
$$0 < c$$



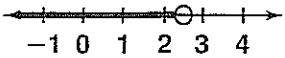
Check: Test $c = 0$ in the equation.

$$0 = 4c$$
$$0 \stackrel{?}{=} 4(0) \checkmark$$

Test $c = 1$ in the original inequality.

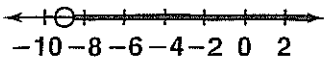
$$0 \stackrel{?}{<} 4 \cdot 1 \checkmark$$

27.
$$-0.3 \geq u - 2.8$$
$$-0.3 + 2.8 \geq u - 2.8 + 2.8$$
$$2.5 \geq u$$



Check: Test $u = 2.5$ in the equation.
$$-0.3 = u - 2.8$$
$$-0.3 \stackrel{?}{=} 2.5 - 2.8 \checkmark$$
Test $u = 2$ in the original inequality.
$$-0.3 \stackrel{?}{\geq} 2 - 2.8 \checkmark$$

28.
$$3 > -\tfrac{1}{3}p$$
$$-3(3) < -3\left(-\tfrac{1}{3}p\right)$$
$$-9 < p$$



Check: Test $p = -9$ in the equation.
$$3 = -\tfrac{1}{3}p$$
$$3 \stackrel{?}{=} -\tfrac{1}{3}(-9) \checkmark$$
Check: Test $p = -8$ in the original inequality.
$$3 \stackrel{?}{>} -\tfrac{1}{3}(-8)$$
$$3 > 2\tfrac{2}{3} \checkmark$$

29. Let x = additional cost of movie
$$3.50 + 2.75 + x \leq 12.00$$
$$6.25 + x \leq 12.00$$
$$6.25 - 6.25 + x \leq 12.00 - 6.25$$
$$x \leq 5.75$$
You don't know exactly how much you have left over, but it's no more than \$5.75.

30. Let h = number of hours worked.
$$7.25h \geq 200$$
$$\frac{7.25h}{7.25} \geq \frac{200}{7.25}$$
$$h \geq 27.59$$
You must work at least 28 hours.

31.
$$3n + 5 > -1$$
$$3n + 5 - 5 > -1 - 5$$
$$3n > -6$$
$$\frac{3n}{3} > \frac{-6}{3}$$
$$n > -2$$
Check: Test $n = -2$ in the equation.
$$3n + 5 = -1$$
$$3(-2) + 5 = -1 \checkmark$$
Test $n = -1$ in the original inequality.
$$3(-1) + 5 > -1 \checkmark$$

32.
$$4k - 1 \leq -3$$
$$4k - 1 + 1 \leq -3 + 1$$
$$4k \leq -2$$
$$\frac{4k}{4} \leq \frac{-2}{4}$$
$$k \leq -\tfrac{1}{2}$$
Check: Test $k = -\frac{1}{2}$ in the equation.
$$4k - 1 = -3$$
$$4\left(-\tfrac{1}{2}\right) - 1 \stackrel{?}{=} -3$$
$$-2 - 1 = -3 \checkmark$$
Test $k = -1$ in the original inequality.
$$4(-1) - 1 \leq -3 \checkmark$$

33.
$$\tfrac{5}{8}b < 25$$
$$\tfrac{8}{5}\left(\tfrac{5}{8}b\right) < \tfrac{8}{5}(25)$$
$$b < 40$$
Check: Test $b = 40$ in the equation.
$$\tfrac{5}{8}b = 25$$
$$\tfrac{5}{8}(40) = 25 \checkmark$$
Test $b = 32$ in the original inequality.
$$\tfrac{5}{8}(32) < 25 \checkmark$$

34.
$$6(c - 1) \leq -18$$
$$6c - 6 \leq -18$$
$$6c - 6 + 6 \leq -18 + 6$$
$$6c \leq -12$$
$$\frac{6c}{6} \leq \frac{-12}{6}$$
$$c \leq -2$$
Check: Test $c = -2$ in the equation.
$$6(c - 1) = -18$$
$$6(-2 - 1) = -18 \checkmark$$
Test $c = -3$ in the original inequality.
$$6(-3 - 1) \leq -18 \checkmark$$

35.
$$3m > 5m + 12$$
$$3m - 5m > 5m + 12 - 5m$$
$$-2m > 12$$
$$\frac{-2m}{-2} < \frac{12}{-2}$$
$$m < -6$$
Check: Test $m = -6$ in the equation.
$$3m = 5m + 12$$
$$3(-6) \stackrel{?}{=} 5(-6) + 12$$
$$-18 = -30 + 12 \checkmark$$
Test $m = -7$ in the original inequality.
$$3(-7) \stackrel{?}{>} 5(-7) + 12$$
$$-21 > -35 + 12 \checkmark$$

36.
$$t - 4t < -9$$
$$-3t < -9$$
$$\frac{-3t}{-3} > \frac{-9}{-3}$$
$$t > 3$$
Check: Test $t = 3$ in the equation.
$$t - 4t = -9$$
$$3 - 4 \cdot 3 = -9 \checkmark$$
Test $t = 4$ in the original inequality.
$$4 - 4 \cdot 4 < -9 \checkmark$$

37.

$$0.5x - 2 \geq -4x + 7$$
$$0.5x - 2 - 0.5x \geq -4x + 7 - 0.5x$$
$$-2 \geq -4.5x + 7$$
$$-2 - 7 \geq -4.5x + 7 - 7$$
$$-9 \geq -4.5x$$
$$\frac{-9}{-4.5} \leq \frac{-4.5x}{-4.5}$$
$$2 \leq x$$

Check: Test $x = 2$ in the equation.

$$0.5x - 2 = -4x + 7$$
$$0.5(2) - 2 \stackrel{?}{=} -4(2) + 7$$
$$1 - 2 = -8 + 7 \checkmark$$

Test $x = 3$ in the original inequality.

$$0.5(3) - 2 \stackrel{?}{\geq} -4(3) + 7$$
$$1.5 - 2 \geq -12 + 7 \checkmark$$

38.

$$-\tfrac{6}{7}y - 6 \geq 42$$
$$-\tfrac{7}{6}\left(-\tfrac{6}{7}y\right) - \left[-\tfrac{7}{6}(6)\right] \leq -\tfrac{7}{6}(42)$$
$$y + 7 \leq -49$$
$$y + 7 - 7 \leq -49 - 7$$
$$y \leq -56$$

Check: Test $y = -56$ in the equation.

$$-\tfrac{6}{7}y - 6 = 42$$
$$-\tfrac{6}{7}(-56) - 6 \stackrel{?}{=} 42$$
$$48 - 6 = 42 \checkmark$$

Test $y = -63$ in the original inequality.

$$-\tfrac{6}{7}(-63) - 6 \stackrel{?}{\geq} 42$$
$$54 - 6 \geq 42 \checkmark$$

39.

$$4 + \tfrac{x}{2} > 2x$$
$$2(4) + 2\left(\tfrac{x}{2}\right) > 2(2x)$$
$$8 + x > 4x$$
$$8 + x - x > 4x - x$$
$$8 > 3x$$
$$\tfrac{8}{3} > \tfrac{3x}{3}$$
$$\tfrac{8}{3} > x$$

Check: Test $x = \frac{8}{3}$ in the equation.

$$4 + \tfrac{x}{2} = 2x$$
$$4 + \tfrac{1}{2}\left(\tfrac{8}{3}\right) \stackrel{?}{=} 2\left(\tfrac{8}{3}\right)$$
$$4 + 1\tfrac{1}{3} = 5\tfrac{1}{3} \checkmark$$

Test $x = 2$ in the original inequality.

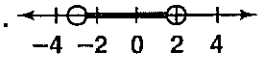
$$4 + \tfrac{2}{2} > 2(2) \checkmark$$

40. Let x = amount of sales.

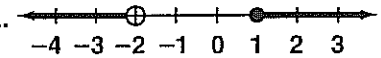
$$190 + 0.04x \geq 500$$
$$190 + 0.04x - 190 \geq 500 - 190$$
$$0.04x \geq 310$$
$$\frac{0.04x}{0.04} \geq \frac{310}{0.04}$$
$$x \geq 7750$$

Sales are \$7750 or greater.

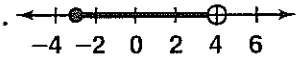
41.



42.



43.

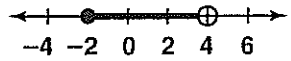


44.

$$-3 \leq z - 1 < 2$$

$-3 \leq z - 1$	and	$z - 1 < 3$
$-3 + 1 \leq z - 1 + 1$		$z - 1 + 1 < 3 + 1$
$-2 \leq z$	and	$z < 4$

$$-2 \leq z < 4$$

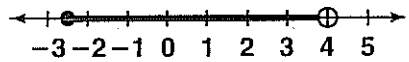


45.

$$-2 \leq d + \tfrac{1}{2} < 4\tfrac{1}{2}$$

$-2 \leq d + \frac{1}{2}$	and	$d + \frac{1}{2} < 4\frac{1}{2}$
$-2 - \frac{1}{2} \leq d + \frac{1}{2} - \frac{1}{2}$		$d + \frac{1}{2} - \frac{1}{2} < 4\frac{1}{2} - \frac{1}{2}$
$-2\frac{1}{2} \leq d$	and	$d < 4$

$$-2\tfrac{1}{2} \leq d < 4$$

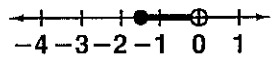


46.

$$0 < -8b \leq 12$$

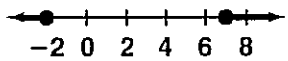
$0 < -8b$	and	$-8b \leq 12$
$\frac{0}{-8} > \frac{-8b}{-8}$		$\frac{-8b}{-8} \geq \frac{12}{-8}$
$0 > b$	and	$b \geq -1\frac{1}{2}$

$$-1\tfrac{1}{2} \leq b < 0$$



47.

$2t \leq -4$	or	$7t \geq 49$
$\frac{2t}{2} \leq \frac{-4}{2}$		$\frac{7t}{7} \geq \frac{49}{7}$
$t \leq -2$	or	$t \geq 7$

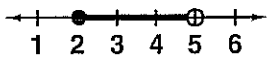


48.

$$-1 \leq a - 3 < 2$$

$-1 \leq a - 3$	and	$a - 3 < 2$
$-1 + 3 \leq a - 3 + 3$		$a - 3 + 3 < 2 + 3$
$2 \leq a$	and	$a < 5$

$$2 \leq a < 5$$

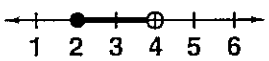


49.

$$-2 \leq 3a - 8 < 4$$

$-2 \leq 3a - 8$	and	$3a - 8 < 4$
$-2 + 8 \leq 3a - 8 + 8$		$3a - 8 + 8 < 4 + 8$
$6 \leq 3a$		$3a < 12$
$\frac{6}{3} \leq \frac{3a}{3}$		$\frac{3a}{3} < \frac{12}{3}$
$2 \leq a$	and	$a < 4$

$$2 \leq a < 4$$



50. $75 \le t \le 89$

51. $|n - (-2)| > 3$ or $|n + 2| > 3$ **52.** $|n - 12| \le 5$

53.
$$|y| = 5$$
$$y = 5 \quad \text{or} \quad y = -5$$

54.
$$|n + 2| \ge 4$$
$$n + 2 \ge 4 \quad \text{or} \quad n + 2 \le -4$$
$$n + 2 - 2 \ge 4 - 2 \quad \Big| \quad n + 2 - 2 \le -4 - 2$$
$$n \ge 2 \quad \text{or} \quad n \le -6$$

55.
$$|-5x| \le 15$$
$$-5x \le 15 \quad \text{and} \quad -5x \ge -15$$
$$\frac{-5x}{-5} \ge \frac{15}{-5} \quad \Big| \quad \frac{-5x}{-5} \le \frac{-15}{-5}$$
$$x \ge -3 \quad \text{and} \quad x \le 3$$
$$-3 \le x \le 3$$

56.
$$\left|\tfrac{1}{2}m\right| < 4.8$$
$$\tfrac{1}{2}m < 4.8 \quad \text{and} \quad \tfrac{1}{2}m > -4.8$$
$$2\left(\tfrac{1}{2}m\right) < 2(4.8) \quad \Big| \quad 2\left(\tfrac{1}{2}m\right) > 2(-4.8)$$
$$m < 9.6 \quad \text{and} \quad m > -9.6$$
$$-9.6 < m < 9.6$$

57.
$$|2x - 7| - 1 > 0$$
$$|2x - 7| - 1 + 1 > 0 + 1$$
$$|2x - 7| > 1$$
$$2x - 7 > 1 \quad \text{or} \quad 2x - 7 < -1$$
$$2x - 7 + 7 > 1 + 7 \quad \Big| \quad 2x - 7 + 7 < -1 + 7$$
$$2x > 8 \quad \Big| \quad 2x < 6$$
$$\frac{2x}{2} > \frac{8}{2} \quad \Big| \quad \frac{2x}{2} < \frac{6}{2}$$
$$x > 4 \quad \text{or} \quad x < 3$$

58.
$$|p + 3| = 9.5$$
$$p + 3 = 9.5 \quad \text{or} \quad p + 3 = -9.5$$
$$p + 3 - 3 = 9.5 - 3 \quad \Big| \quad p + 3 - 3 = -9.5 - 3$$
$$p = 6.5 \quad \text{or} \quad p = -12.5$$

59.
$$|k - 8| = 0$$
$$k - 8 = +0 \text{ or } k - 8 = -0$$
$$k - 8 + 8 = 0 + 8$$
$$k = 8$$

60. The absolute value of any real number is positive. So, $|\text{any real number}| > -2$, and x = any real number.

61. There is no solution. There is no value of b that can make this true.

62.
$$4|k + 5| > 8$$
$$\frac{4|k + 5|}{4} > \frac{8}{4}$$
$$|k + 5| > 2$$
$$k + 5 > 2 \quad \text{or} \quad k + 5 < -2$$
$$k + 5 - 5 > 2 - 5 \quad \Big| \quad k + 5 - 5 < -2 - 5$$
$$k > -3 \quad \text{or} \quad k < -7$$

63.
$$4 + |r + 2| = 7$$
$$4 + |r + 2| - 4 = 7 - 4$$
$$|r + 2| = 3$$
$$r + 2 = 3 \quad \text{or} \quad r + 2 = -3$$
$$r + 2 - 2 = 3 - 2 \quad \Big| \quad r + 2 - 2 = -3 - 2$$
$$r = 1 \quad \text{or} \quad r = -5$$

64.
$$-2 + |3.6z| \ge -1.1$$
$$-2 + |3.6z| + 2 \ge -1.1 + 2$$
$$|3.6z| \ge 0.9$$
$$3.6z \ge 0.9 \quad \text{or} \quad 3.6z \le -0.9$$
$$\frac{3.6z}{3.6} \ge \frac{0.9}{3.6} \quad \Big| \quad \frac{3.6z}{3.6} \le \frac{-0.9}{3.6}$$
$$z \ge 0.25 \quad \text{or} \quad z \le -0.25$$

65. Let d = actual diameters of acceptable rods. Then $(2.8 - 0.06) \le d \le (2.8 + 0.06)$ or $2.74 \le d \le 2.86$.

66. Let ℓ = actual length of acceptable nail. Then $(20 - 0.4) \le \ell \le (20 + 0.4)$ or $19.6 \le \ell \le 20.4$.

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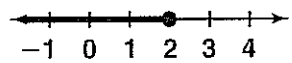
1.
$$4z + 7 \ge 15$$
$$4z + 7 - 7 \ge 15 - 7$$
$$4z \ge 8$$
$$\frac{4z}{4} \ge \frac{8}{4}$$
$$z \ge 2$$

1a. no **1b.** yes **1c.** yes

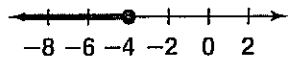
2.
$$-2g + 3 > 5$$
$$-2g + 3 - 3 > 5 - 3$$
$$-2g > 2$$
$$\frac{-2g}{-2} < \frac{2}{-2}$$
$$g < -1$$

2a. yes **2b.** no **2c.** no **3.** Let c = number of classes; $c \le 7$. **4.** Let r = number of runners; $r \ge 5$. **5.** Let g = number of gallons drunk; $g \le 40$. **6.** Let h = number of homes on route; $h > 32$. **7.** $n > 7$ **8.** $n \le 4.5$ **9.** $n \ge -5$ **10.** $n > 1.5$

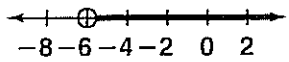
11.
$$z + 7 \le 9$$
$$z + 7 - 7 \le 9 - 7$$
$$z \le 2$$



12.
$$-16 \ge 4y$$
$$\frac{-16}{4} \ge \frac{4y}{4}$$
$$-4 \ge y$$

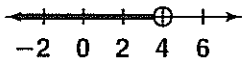


13.
$$-\tfrac{1}{3}x < 2$$
$$-3\left(-\tfrac{1}{3}x\right) > -3(2)$$
$$x > -6$$



14.

$$8 - u > 4$$
$$8 - u - 8 > 4 - 8$$
$$-u > -4$$
$$u < 4$$



15.

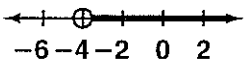
$$-5 + 4t \le 3$$
$$-5 + 4t + 5 \le 3 + 5$$
$$4t \le 8$$
$$\tfrac{4t}{4} \le \tfrac{8}{4}$$
$$t \le 2$$

16.

$$5w \ge -6w + 11$$
$$5w + 6w \ge -6w + 11 + 6w$$
$$11w \ge 11$$
$$\tfrac{11w}{11} \ge \tfrac{11}{11}$$
$$w \ge 1$$

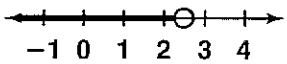
17.

$$-\tfrac{7}{2}m < 14$$
$$-\tfrac{2}{7}\left(-\tfrac{7}{2}m\right) > -\tfrac{2}{7}(14)$$
$$m > -4$$



18.

$$6y - 7 < -2y + 13$$
$$6y - 7 + 2y < -2y + 13 + 2y$$
$$8y - 7 < 13$$
$$8y - 7 + 7 < 13 + 7$$
$$8y < 20$$
$$\tfrac{8y}{8} < \tfrac{20}{8}$$
$$y < 2.5$$



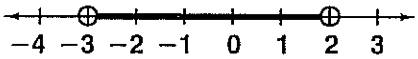
19. $|x - 5| \ge 3$

$x - 5 \ge 3$	or	$x - 5 \le -3$
$x - 5 + 5 \ge 3 + 5$		$x - 5 + 5 \le -3 + 5$
$x \ge 8$	or	$x \le 2$

20. $|2h + 1| < 5$

$2h + 1 < 5$	and	$2h + 1 > -5$
$2h + 1 - 1 < 5 - 1$		$2h + 1 - 1 > -5 - 1$
$2h < 4$		$2h > -6$
$\tfrac{2h}{2} < \tfrac{4}{2}$		$\tfrac{2h}{2} > \tfrac{-6}{2}$
$h < 2$	and	$h > -3$

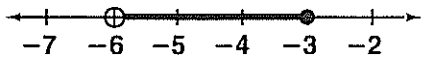
$$-3 < h < 2$$



21. $9 \le 6 - b < 12$

$9 \le 6 - b$	and	$6 - b < 12$
$9 - 6 \le 6 - b - 6$		$6 - b - 6 < 12 - 6$
$3 \le -b$		$-b < 6$
$-3 \ge b$	and	$b > -6$

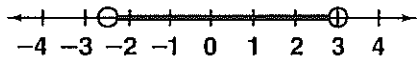
$$-6 < b \le -3$$



22. $-10 < 4q < 12$

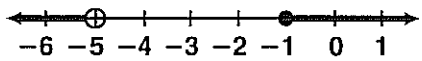
$-10 < 4q$	and	$4q < 12$
$\tfrac{-10}{4} < \tfrac{4q}{4}$		$\tfrac{4q}{4} < \tfrac{12}{4}$
$-2.5 < q$	and	$q < 3$

$$-2.5 < q < 3$$



23.

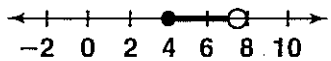
$4 + 3n \ge 1$	or	$-5n > 25$
$4 + 3n - 4 \ge 1 - 4$		$-5n > 25$
$3n \ge -3$		$-5n > 25$
$\tfrac{3n}{3} \ge \tfrac{-3}{3}$		$\tfrac{-5n}{-5} < \tfrac{25}{-5}$
$n \ge -1$	or	$n < -5$



24.

$10k < 75$	and	$4 - k \le 0$
$10k < 75$		$4 - k - 4 \le 0 - 4$
$\tfrac{10k}{10} < \tfrac{75}{10}$		$-k \le -4$
$k < 7.5$	and	$k \ge 4$

$$4 \le k < 7.5$$



25.

$$3(d - 1) > -4$$
$$\tfrac{3(d - 1)}{3} > \tfrac{-4}{3}$$
$$d - 1 > -\tfrac{4}{3}$$
$$d - 1 + 1 > -\tfrac{4}{3} + 1$$
$$d > -\tfrac{1}{3}$$

Check: Test $d = -\tfrac{1}{3}$ in the equation.

$$3(d - 1) = -4$$
$$3\left(-\tfrac{1}{3} - 1\right) \stackrel{?}{=} -4$$
$$-1 - 3 = -4 \checkmark$$

Test $d = 0$ in the original inequality.

$$3(0 - 1) \stackrel{?}{<} -4 \checkmark$$

26.

$$5(-2 + b) < 3b + 2$$
$$-10 + 5b < 3b + 2$$
$$-10 + 5b - 3b < 3b + 2 - 3b$$
$$-10 + 2b < 2$$
$$-10 + 2b + 10 < 2 + 10$$
$$2b < 12$$
$$\tfrac{2b}{2} < \tfrac{12}{2}$$
$$b < 6$$

Check: Test $b = 6$ in the equation.

$$5(-2 + b) = 3b + 2$$
$$5(-2 + 6) \stackrel{?}{=} 3 \cdot 6 + 2$$
$$5 \cdot 4 = 18 + 2 \checkmark$$

Test $b = 5$ in the original inequality.

$$5(-2 + 5) \stackrel{?}{<} 3 \cdot 5 + 2 \checkmark$$

27.

$$3(m + 3) + 4 \le 15$$
$$3m + 9 + 4 \le 15$$
$$3m + 13 \le 15$$
$$3m + 13 - 13 \le 15 - 13$$
$$3m \le 2$$
$$\frac{3m}{3} \le \frac{2}{3}$$
$$m \le \frac{2}{3}$$

Check: Test $m = \frac{2}{3}$ in the equation.

$$3(m + 3) + 4 = 15$$
$$3\left(\frac{2}{3} + 3\right) + 4 \stackrel{?}{=} 15$$
$$2 + 9 + 4 = 15 \checkmark$$

Test $m = 0$ in the original inequality.

$$3(0 + 3) + 4 \stackrel{?}{\le} 15 \checkmark$$

28.

$$0.5(x + 3) - 2.1 \ge -1$$
$$0.5x + 1.5 - 2.1 \ge -1$$
$$0.5x - 0.6 \ge -1$$
$$0.5x - 0.6 + 0.6 \ge -1 + 0.6$$
$$0.5x \ge -0.4$$
$$\frac{0.5x}{0.5} \ge \frac{-0.4}{0.5}$$
$$x \ge -0.8$$

Check: Test $x = -0.8$ in the equation.

$$0.5(x + 3) - 2.1 = -1$$
$$0.5(-0.8 + 3) - 2.1 \stackrel{?}{=} -1$$
$$0.5(2.2) - 2.1 = -1 \checkmark$$

Test $x = 0$ in the original inequality.

$$0.5(0 + 3) - 2.1 \stackrel{?}{\ge} -1 \checkmark$$

29–30. Answers may vary. Samples are given.

29. $x \le -6$ or $x > 2$ **30.** $-3 < x < 2$

31.

$$|4k - 2| = 11$$

$4k - 2 = 11$	or	$4k - 2 = -11$
$4k - 2 + 2 = 11 + 2$		$4k - 2 + 2 = -11 + 2$
$4k = 13$		$4k = -9$
$\frac{4k}{4} = \frac{13}{4}$		$\frac{4k}{4} = \frac{-9}{4}$
$k = 3.25$	or	$k = -2.25$

Check: $|4(3.25) - 2| = |13 - 2| = 11 \checkmark$

$|4(-2.25) - 2| = |-9 - 2| = 11 \checkmark$

32.

$$23 = |n + 10|$$

$n + 10 = 23$	or	$n + 10 = -23$
$n + 10 - 10 = 23 - 10$		$n + 10 - 10 = -23 - 10$
$n = 13$	or	$n = -33$

Check: $23 = |13 + 10| \checkmark$

$23 = |-33 + 10| \checkmark$

33.

$$|3c + 1| - 4 = 13$$
$$|3c + 1| - 4 + 4 = 13 + 4$$
$$|3c + 1| = 17$$

$3c + 1 = 17$	or	$3c + 1 = -17$
$3c + 1 - 1 = 17 - 1$		$3c + 1 - 1 = -17 - 1$
$3c = 16$		$3c = -18$
$\frac{3c}{3} = \frac{16}{3}$	or	$\frac{3c}{3} = \frac{-18}{3}$
$c = 5\frac{1}{3}$		$c = -6$

Check: $\left|3\left(5\frac{1}{3} + 1\right)\right| - 4 = |16 + 1| - 4 = 13 \checkmark$

$|3(-6) + 1| - 4 = |-18 + 1| - 4 = 13 \checkmark$

34.

$$4|5 - t| = 20$$
$$\frac{4|5 - t|}{4} = \frac{20}{4}$$
$$|5 - t| = 5$$

$5 - t = 5$	or	$5 - t = -5$
$5 - t - 5 = 5 - 5$		$5 - t - 5 = -5 - 5$
$-t = 0$		$-t = -10$
$t = 0$	or	$t = 10$

Check: $4|5 - 0| = 20 \checkmark$

$4|5 - 10| = 4|-5| = 20 \checkmark$

35. Answers may vary. Sample: Depending on the sign of a, the inequality symbol may need to be reversed.

$a = 2$:

$$2x - 1 < 3$$
$$2x - 1 + 1 < 3 + 1$$
$$2x < 4$$
$$\frac{2x}{2} < \frac{4}{2}$$
$$x < 2$$

$a = -2$:

$$-2x - 1 < 3$$
$$-2x - 1 + 1 < 3 + 1$$
$$-2x < 4$$
$$\frac{-2x}{-2} > \frac{4}{-2}$$
$$x > -2$$

36. Answers may vary. Sample: $|x| < 6$

37. Let c = number of cans collected in 5th week, and let sum = total collection in first four weeks.

$$\text{sum} = 702 + 470 + 492 + 547 = 2211$$
$$c + 2211 \ge 3000$$
$$c + 2211 - 2211 \ge 3000 - 2211$$
$$c \ge 3000 - 2211$$
$$c \ge 789$$

At least 789 cans should be collected.

38. Let b = number of boxes in safe load.

$$55b + 165 \le 2000$$
$$55b + 165 - 165 \le 2000 - 165$$
$$55b \le 1835$$
$$\frac{55b}{55} \le \frac{1835}{55}$$
$$b \le 33.\overline{36}$$

Safe limit is 33 boxes.