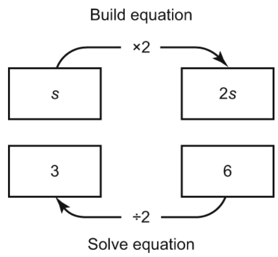
Lesson 6.1 **Solving Equations by Using Inverse Operations** **Practice (pages 271–274)**

Check

5. a) 2s = 6



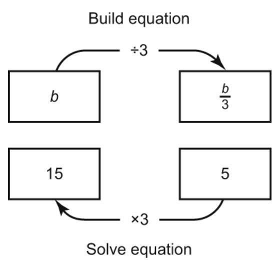
s = 3

To verify the solution, substitute *s* = 3 into 2*s* = 6.

Left side = 2(3) Right side = 6
= 6

Since the left side equals the right side, the solution *s* = 3 is correct.

b) $\frac{b}{3} = 5$



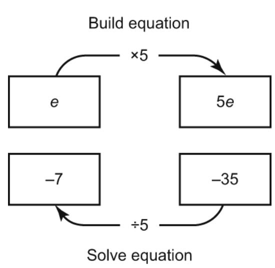
b = 15

To verify the solution, substitute *b* = 15 into $\frac{b}{3} = 5$.

Left side = $\frac{15}{3}$ Right side = 5
= 5

Since the left side equals the right side, the solution *b* = 15 is correct.

c) 5*e* = –35



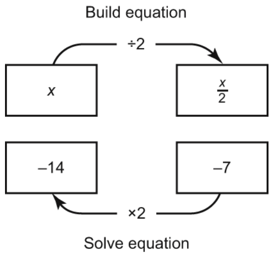
e = –7

To verify the solution, substitute *e* = –7 into 5*e* = –35.

Left side = 5(–7) Right side = –35
= –35

Since the left side equals the right side, the solution *e* = –7 is correct.

d) $\frac{x}{2} = -7$



$x = -14$

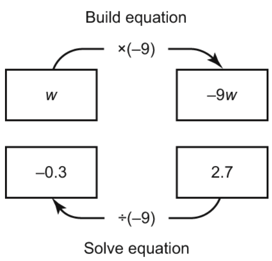
To verify the solution, substitute $x = -14$ into $\frac{x}{2} = -7$.

Left side $= \frac{-14}{2}$ Right side $= -7$

$= -7$

Since the left side equals the right side, the solution $x = -14$ is correct.

e) $-9w = 2.7$



$w = -0.3$

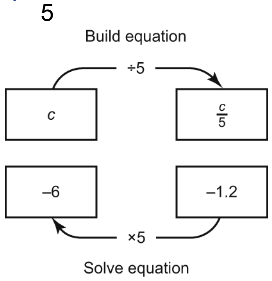
To verify the solution, substitute $w = -0.3$ into $-9w = 2.7$.

Left side $= (-9)(-0.3)$ Right side $= 2.7$

$= 2.7$

Since the left side equals the right side, the solution $w = -0.3$ is correct.

f) $\frac{c}{5} = -1.2$



$c = -6$

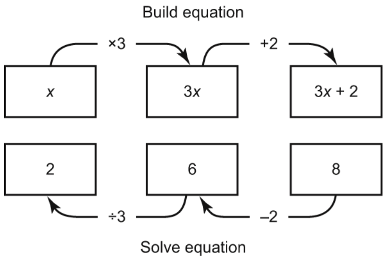
To verify the solution, substitute $c = -6$ into $\frac{c}{5} = -1.2$.

Left side $= \frac{-6}{5}$ Right side $= -1.2$

$= -1.2$

Since the left side equals the right side, the solution $c = -6$ is correct.

6. a) $3x + 2 = 8$



$x = 2$

To verify the solution, substitute $x = 2$ into $3x + 2 = 8$.

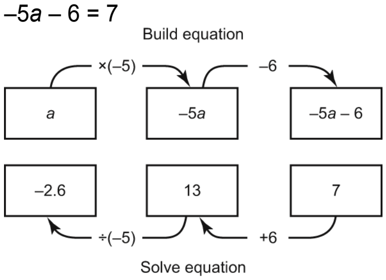
Left side $= 3(2) + 2$ Right side $= 8$

$= 6 + 2$

$= 8$

Since the left side equals the right side, the solution $x = 2$ is correct.

b) $-5a - 6 = 7$



$a = -2.6$

To verify the solution, substitute $a = -2.6$ into $-5a - 6 = 7$.

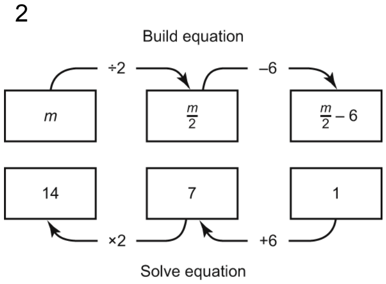
Left side $= (-5)(-2.6) - 6$ Right side $= 7$

$= 13 - 6$

$= 7$

Since the left side equals the right side, the solution $a = -2.6$ is correct.

c) $\frac{m}{2} - 6 = 1$



$m = 14$

To verify the solution, substitute $m = 14$ into $\frac{m}{2} - 6 = 1$.

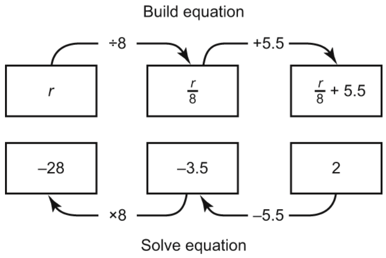
Left side $= \frac{14}{2} - 6$ Right side $= 1$

$= 7 - 6$

$= 1$

Since the left side equals the right side, the solution $m = 14$ is correct.

d) $\frac{r}{8} + 5.5 = 2$



$r = –28$

To verify the solution, substitute $r = –28$ into $\frac{r}{8} + 5.5 = 2$.

Left side $= \frac{-28}{8} + 5.5$ Right side = 2

$= –3.5 + 5.5$

$= 2$

Since the left side equals the right side, the solution $r = –28$ is correct.

7. The student did not use the correct inverse operation to solve the equation. Since $–5m$ represents $–5 \times m$, the inverse operation to use is divide, not add.

$-5m = 15$

$m = \frac{15}{-5}$

$m = -3$

Apply

8. a) I divided both sides by 4.

$4x = 9.6$

$\frac{4x}{4} = \frac{9.6}{4}$

$x = 2.4$

To verify the solution, substitute $x = 2.4$ into $4x = 9.6$.

Left side = 4(2.4) Right side = 9.6

= 9.6

Since the left side equals the right side, the solution $x = 2.4$ is correct.

b) I added 12.5 to both sides, then divided both sides by 3.

$10 = 3b – 12.5$

$10 + 12.5 = 3b – 12.5 + 12.5$

$\frac{22.5}{3} = \frac{3b}{3}$

$7.5 = b$

To verify the solution, substitute $b = 7.5$ into $10 = 3b – 12.5$.

Left side = 10 Right side = 3(7.5) – 12.5

= 22.5 – 12.5

= 10

Since the left side equals the right side, the solution $b = 7.5$ is correct.

c) I divided both sides by −5.25.

$-5.25x = -210$

$\frac{-5.25x}{-5.25} = \frac{-210}{-5.25}$

$x = 40$

To verify the solution, substitute $x = 40$ into $-5.25x = -210$.

Left side $= -5.25(40)$ Right side $= -210$

$= -210$

Since the left side equals the right side, the solution $x = 40$ is correct.

d) I subtracted 8.1 from both sides, then divided both sides by −2.

$-0.5 = -2x + 8.1$

$-0.5 - 8.1 = -2x + 8.1 - 8.1$

$\frac{-8.6}{-2} = \frac{-2x}{-2}$

$4.3 = x$

To verify the solution, substitute $x = 4.3$ into $-0.5 = -2x + 8.1$.

Left side $= -0.5$ Right side $= (-2)(4.3) + 8.1$

$= -8.6 + 8.1$

$= -0.5$

Since the left side equals the right side, the solution $x = 4.3$ is correct.

e) I subtracted 250 from both sides, then divided both sides by 3.5.

$250 + 3.5n = 670$

$250 + 3.5n - 250 = 670 - 250$

$\frac{3.5n}{3.5} = \frac{420}{3.5}$

$n = 120$

To verify the solution, substitute $n = 120$ into $250 + 3.5n = 670$.

Left side $= 250 + 3.5(120)$ Right side $= 670$

$= 250 + 420$

$= 670$

Since the left side equals the right side, the solution $n = 120$ is correct.

f) I added 30.5 to both sides, then divided both sides by −2.

$-22.5 = -2c - 30.5$

$-22.5 + 30.5 = -2c - 30.5 + 30.5$

$\frac{8}{-2} = \frac{-2c}{-2}$

$-4 = c$

To verify the solution, substitute $c = -4$ in $-22.5 = -2c - 30.5$.

Left side $= -22.5$ Right side $= (-2)(-4) - 30.5$

$= 8 - 30.5$

$= -22.5$

Since the left side equals the right side, the solution $c = -4$ is correct.

9. Let n represent the number each time.

a) 2 times n is −10.
The equation is: $2n = -10$

$2n = -10$ Divide each side by 2.

$\frac{2n}{2} = -\frac{10}{2}$

$n = -5$
The number is −5.

To verify the solution, go back to the original problem.
Two times a number is –10.
Check: $2 \times (-5) = -10$
My solution is correct.

b) 3 times the number, plus 6.4, is 13.9.
The equation is: $3n + 6.4 = 13.9$
$3n + 6.4 = 13.9$ Subtract 6.4 from each side.
$3n + 6.4 - 6.4 = 13.9 - 6.4$
$3n = 7.5$ Divide each side by 3.

$\frac{3n}{3} = \frac{7.5}{3}$

$n = 2.5$
The number is 2.5.

To verify the solution, go back to the original problem.
Three times a number, plus 6.4, is 13.9.
Check: $3 \times 2.5 + 6.4 = 13.9$
My solution is correct.

c) 4 times the number is −8.8.
The equation is: $4n = -8.8$
$4n = -8.8$ Divide each side by 4.

$\frac{4n}{4} = \frac{-8.8}{4}$

$n = -2.2$
The number is −2.2.

To verify the solution, go back to the original problem.
Four times a number is –8.8.
Check: $4 \times (-2.2) = -8.8$
My solution is correct.

d) 10 is equal to 2 times the number, plus 3.6.
The equation is: $10 = 2n + 3.6$
$10 = 2n + 3.6$ Subtract 3.6 from each side.
$10 - 3.6 = 2n + 3.6 - 3.6$
$6.4 = 2n$ Divide each side by 2.
$\frac{6.4}{2} = \frac{2n}{2}$
$n = 3.2$
The number is 3.2.

To verify the solution, go back to the original problem.
Ten is equal to two times a number, plus 3.6
Check: $10 = 2 \times 3.2 + 3.6$
$10 = 10$
My solution is correct.

10. a) $\frac{c}{3} = 15$ Multiply each side by 3.

$3 \times \frac{c}{3} = 3 \times 15$

$c = 45$

To verify, substitute $c = 45$ into $\frac{c}{3} = 15$.

Left side $= \frac{45}{3}$ Right side $= 15$
$= 15$
Since the left side equals the right side, the solution $c = 45$ is correct.

b) $\frac{m}{6} - 1.5 = -7$ Add 1.5 to each side.

$\frac{m}{6} - 1.5 + 1.5 = -7 + 1.5$

$\frac{m}{6} = -5.5$ Multiply each side by 6.

$6 \times \frac{m}{6} = 6 \times (-5.5)$

$m = -33$

To verify, substitute $m = -33$ into $\frac{m}{6} - 1.5 = -7$.

Left side $= \frac{-33}{6} - 1.5$ Right side $= -7$
$= -5.5 - 1.5$
$= -7$
Since the left side equals the right side, the solution $m = -33$ is correct.

c) $-1.5 = \frac{n}{4}$ Multiply each side by 4.

$(-1.5) \times 4 = \frac{n}{4} \times 4$

$-6 = n$

To verify, substitute $n = -6$ into $-1.5 = \frac{n}{4}$.

Left side $= -1.5$ Right side $= \frac{-6}{4}$

$= -1.5$

Since the left side equals the right side, the solution $n = -6$ is correct.

d) $5 = \frac{q}{-2} - 5$ Add 5 to each side.

$5 + 5 = \frac{q}{-2} - 5 + 5$

$10 = \frac{q}{-2}$ Multiply each side by −2.

$(-2) \times 10 = (-2) \times \frac{q}{-2}$

$-20 = q$

To verify, substitute $q = -20$ into $5 = \frac{q}{-2} - 5$.

Left side $= 5$ Right side $= \frac{-20}{-2} - 5$

$= 10 - 5$

$= 5$

Since the left side equals the right side, the solution $q = -20$ is correct.

e) $\frac{2c}{5} = 1.2$ Multiply each side by 5.

$\frac{2c}{5} \times 5 = 1.2 \times 5$

$2c = 6$ Divide each side by 2.

$\frac{2c}{2} = \frac{6}{2}$

$c = 3$

To verify, substitute $c = 3$ into $\frac{2c}{5} = 1.2$.

Left side $= \frac{2 \times 3}{5}$ Right side $= 1.2$

$= \frac{6}{5}$

$= 1.2$

Since the left side equals the right side, the solution $c = 3$ is correct.

f) $1.2 = \frac{2a}{3} + 5.1$ Subtract 5.1 from each side.

$1.2 - 5.1 = \frac{2a}{3} + 5.1 - 5.1$

$-3.9 = \frac{2a}{3}$ Multiply each side by 3.

$(-3.9) \times 3 = \frac{2a}{3} \times 3$

$-11.7 = 2a$ Divide each side by 2.

$a = \frac{-11.7}{2}$

$a = -5.85$

To verify, substitute $a = -5.85$ into $1.2 = \frac{2a}{3} + 5.1$.

Left side = 1.2 Right side $= \frac{2 \times (-5.85)}{3} + 5.1$

$= \frac{-11.7}{3} + 5.1$

$= -3.9 + 5.1$

$= 1.2$

Since the left side equals the right side, the solution $a = -5.85$ is correct.

11. Let n represent the number each time.

a) A number divided by 4 is –7.

The equation is:

$\frac{n}{4} = -7$ Multiply each side by 4.

$\frac{n}{4} \times 4 = -7 \times 4$

$n = -28$

The number is −28.

To verify the solution, check in the original problem: A number divided by 4 is −7.

Check: $-28 \div 4 = -7$. The solution is correct.

b) Three, plus a number divided by 5 is 6.

The equation is:

$3 + \frac{n}{5} = 6$ Subtract 3 from each side.

$3 + \frac{n}{5} - 3 = 6 - 3$

$\frac{n}{5} = 3$ Multiply each side by 5.

$\frac{n}{5} \times 5 = 3 \times 5$

$n = 15$

The number is 15.

To verify the solution, check in the original problem: Three, plus a number divided by 5 is 6.

Check: $3 + \frac{15}{5} = 3 + 3$

$= 6$

The solution is correct.

c) One-half of a number is 2.5.

The equation is:

$\frac{n}{2} = 2.5$ Multiply each side by 2.

$\frac{n}{2} \times 2 = 2.5 \times 2$

$n = 5$

The number is 5.

To verify the solution, check in the original problem: One-half of a number is 2.5.

Check: $\frac{5}{2} = 2.5$

The solution is correct.

d) One-third of a number, minus 4, is 2.

The equation is:

$\frac{n}{3} - 4 = 2$ Add 4 to each side.

$\frac{n}{3} - 4 + 4 = 2 + 4$

$\frac{n}{3} = 6$ Multiply each side by 3.

$\frac{n}{3} \times 3 = 6 \times 3$

$n = 18$

The number is 18.

To verify the solution, check in the original problem: One-third of a number, minus 4, is 2.

Check: $\frac{18}{3} - 4 = 6 - 4$

$= 2$

The solution is correct.

12. No. To undo Jenna's sequence of operations, her partner must perform the inverse operations in reverse order. She must first subtract 4 from each side, and then divide each side by −2.

13. a) *b* divided by 3, subtract 13.5, is 2.8.

The equation is: $\frac{b}{3} - 13.5 = 2.8$

b) $\frac{b}{3} - 13.5 = 2.8$ Add 13.5 to each side.

$\frac{b}{3} - 13.5 + 13.5 = 2.8 + 13.5$

$\frac{b}{3} = 16.3$ Multiply each side by 3.

$\frac{b}{3} \times 3 = 16.3 \times 3$

$b = 48.9$

The number is 48.9.

c) To verify the solution, substitute $b = 48.9$ into $\frac{b}{3} - 13.5 = 2.8$.

Left side $= \frac{48.9}{3} - 13.5$ Right side = 2.8

$= 16.3 - 13.5$

$= 2.8$

Since the left side equals the right side, $b = 48.9$ is correct.

14. a) The perimeter is the sum of the measures of all sides. Let l represent the length of the longer side, in centimetres. The perimeter of the parallelogram is twice the sum of the length and width: $2(l + 1.2) = 6.6$

b) $2(l + 1.2) = 6.6$ Divide both sides by 2.

$\frac{2(l+1.2)}{2} = \frac{6.6}{2}$

$l + 1.2 = 3.3$ Subtract 1.2 from each side.

$l + 1.2 - 1.2 = 3.3 - 1.2$

$l = 2.1$ Divide each side by 2.

The longer side is 2.1 cm.

c) To verify the solution, substitute $l = 2.1$ into $2(l + 1.2) = 6.6$.

Left side $= 2(l + 1.2) = 6.6$ Right side = 6.6

$= 2(2.1) + 2(1.2)$

$= 4.2 + 2.4$

$= 6.6$

Since the left side equals the right side, $l = 2.1$ is correct.

15. a) Let n represent the number. Then, 12% of the number is $12\% \times n$, or $0.12n$.

An equation is: $0.12n = 39.48$

$0.12n = 39.48$ Divide each side by 0.12.

$\frac{0.12n}{0.12} = \frac{39.48}{0.12}$

$n = 329$

The number is 329.

b) To check the solution, go back to the original problem.

Twelve percent of a number is 39.84.

Check: 12% of 329 $= 0.12 \times 329$

$= 39.48$

My solution is correct.

16. a) $2780 = 2500 + 0.08s$ Subtract 2500 from each side.
$2780 – 2500 = 2500 + 0.08s – 2500$
$280 = 0.08s$ Divide each side by 0.08.
$\frac{280}{0.08} = \frac{0.08s}{0.08}$
$s = 3500$; Stephanie's sales are $3500 for that month.

b) To verify the solution, substitute $s = 3500$ into $2780 = 2500 + 0.08s$.
Left side = 2780 Right side = 2500 + 0.08(3500)
= 2500 + 280
= 2780
Since the left side equals the right side, $s = 3500$ is correct.

17. a) Let s represent Steve's sales, in dollars. 10% of Steve's sales is 10% × s, or $0.1s$.
An equation is: $1925 + 0.1s = 2725$

b) $1925 + 0.1s = 2725$ Subtract 1925 from each side.
$1925 + 0.1s – 1925 = 2725 – 1925$
$0.1s = 800$ Divide each side by 0.1.
$\frac{0.1s}{0.1} = \frac{800}{0.1}$
$s = 8000$; Steve had $8000 in sales that month.

To verify the solution, check back in the original problem.
Suppose Steve made $8000 in sales.
Then he'll earn $1925 plus 10% of $8000, or 1925 + 0.10 × 8000 = 1925 + 800
= 2725
This matches his given earnings, so the answer is correct.

18. a) $5(x – 7) = –15$ Use the distributive property to expand $5(x – 7)$.
$5(x) + 5(–7) = –15$
$5x – 35 = –15$ Add 35 to each side.
$5x – 35 + 35 = –15 + 35$
$5x = 20$ Divide each side by 5.
$\frac{5x}{5} = \frac{20}{5}$
$x = 4$
To verify the solution, substitute $x = 4$ into $5(x – 7) = –15$.
Left side = 5(4 – 7) Right side = –15
= 5(–3)
= –15
Since the left side equals the right side, the solution $x = 4$ is correct.

b) $2(m + 4) = 11$ Use the distributive property to expand $2(m + 4)$.
$2(m) + 2(4) = 11$
$2m + 8 = 11$ Subtract 8 from each side.
$2m + 8 – 8 = 11 – 8$
$2m = 3$ Divide each side by 2.
$\frac{2m}{2} = \frac{3}{2}$
$m = 1.5$

To verify the solution, substitute $m = 1.5$ into $2(m + 4) = 11$.

Left side $= 2(1.5 + 4)$ Right side $= 11$
$= 2(5.5)$
$= 11$

Since the left side equals the right side, the solution $m = 1.5$ is correct.

c) $-3(t - 2.7) = 1.8$ Use the distributive property to expand $-3(t - 2.7)$.
$-3(t) + (-3)(-2.7) = 1.8$
$-3t + 8.1 = 1.8$ Subtract 8.1 from each side.
$-3t + 8.1 - 8.1 = 1.8 - 8.1$
$-3t = -6.3$ Divide each side by -3.
$$\frac{-3t}{-3} = \frac{-6.3}{-3}$$
$t = 2.1$

To verify the solution, substitute $t = 2.1$ into $-3(t - 2.7) = 1.8$.

Left side $= -3(2.1 - 2.7)$ Right side $= 1.8$
$= -3(-0.6)$
$= 1.8$

Since the left side equals the right side, the solution $t = 2.1$ is correct.

d) $7.6 = -2(-3 - y)$ Use the distributive property to expand $-2(-3 - y)$.
$7.6 = -2(-3) + (-2)(-y)$
$7.6 = 6 + 2y$ Subtract 6 from each side.
$7.6 - 6 = 6 + 2y - 6$
$1.6 = 2y$ Divide each side by 2.
$$\frac{1.6}{2} = \frac{2y}{2}$$
$y = 0.8$

To verify the solution, substitute $y = 0.8$ into $7.6 = -2(-3 - y)$.

Left side $= 7.6$ Right side $= -2(-3 - 0.8)$
$= -2(-3.8)$
$= 7.6$

Since the left side equals the right side, the solution $y = 0.8$ is correct.

e) $8.4 = -6(a + 2.4)$ Use the distributive property to expand $-6(a + 2.4)$.
$8.4 = (-6)(a) + (-6)(2.4)$
$8.4 = -6a - 14.4$ Add 14.4 to both sides.
$8.4 + 14.4 = -6a - 14.4 + 14.4$
$22.8 = -6a$ Divide each side by -6.
$$\frac{22.8}{-6} = \frac{-6a}{-6}$$
$a = -3.8$

To verify the solution, substitute $a = -3.8$ into $8.4 = -6(a + 2.4)$.

Left side $= 8.4$ Right side $= -6(-3.8 + 2.4)$
$= (-6)(-3.8) + (-6)(2.4)$
$= 22.8 - 14.4$
$= 8.4$

Since the left side equals the right side, the solution $a = -3.8$ is correct.

19. a) Let w represent the volume of 1 bottle of water, in litres.
Then, 4 bottles of water is represented by $4 \times w$, or $4w$.
6 bottles of juice of 0.5 L each is represented by 6×0.5, or $6(0.5)$.
An equation is: $4w + 6(0.5) = 4.42$

b)
$$\begin{aligned}
4w + 6(0.5) &= 4.42 \\
4w + 3 &= 4.42 && \text{Subtract 3 from each side.} \\
4w + 3 - 3 &= 4.42 - 3 \\
4w &= 1.42 && \text{Divide each side by 4.} \\
\frac{4w}{4} &= \frac{1.42}{4} \\
w &= 0.355
\end{aligned}$$
Each bottle of water has a volume of 0.355 L, or 355 mL.

c) To verify the solution, go back to the original problem.
4 bottles of water and 6 bottles of juice have a total volume of 4.42 L.
Check: $4 \times 0.355 + 6 \times 0.5 = 1.42 + 3$
$= 4.42$
The solution is correct.

20. a) The student should not have multiplied 4.2 by 3 in line 2. The student used the distributive law on the left side, but made a mistake by also multiplying the right side.

A correct solution:
$$\begin{aligned}
3(x - 2.4) &= 4.2 && \text{Use the distributive property to expand } 3(x - 2.4). \\
3x - 3(2.4) &= 4.2 \\
3x - 7.2 &= 4.2 && \text{Add 7.2 to each side.} \\
3x - 7.2 + 7.2 &= 4.2 + 7.2 \\
3x &= 11.4 && \text{Divide each side by 3.} \\
\frac{3x}{3} &= \frac{11.4}{3} \\
x &= \frac{11.4}{3} \\
x &= 3.8
\end{aligned}$$

b) The student forgot the negative sign in front of $\frac{1}{2}x$ in line 3, and should have multiplied each side by −2 instead of dividing by 2 in line 4.

A correct solution:
$$\begin{aligned}
5 - \frac{1}{2}x &= 3 && \text{Subtract 5 from each side.} \\
5 - \frac{1}{2}x - 5 &= 3 - 5 \\
-\frac{1}{2}x &= -2 && \text{Multiply each side by } -2. \\
\left(-\frac{1}{2}x\right)(-2) &= -2(-2) \\
x &= 4
\end{aligned}$$

21. a) Let t represent the number of extra toppings.
The cost of the additional toppings is represented by $1.50 \times t$, or $1.50t$.
A large pizza, plus toppings, is represented by $7.50 + 1.50t$.
An equation is: $7.50 + 1.50t = 16.50$

b) $7.50 + 1.50t = 16.50$ Add 7.50 to each side.
$7.50 + 1.50t - 7.50 = 16.50 - 7.50$
$1.50t = 9$
$$\frac{1.50t}{1.50} = \frac{9}{1.50}$$
$t = 6$
The customer ordered an additional 6 toppings. If you include tomato sauce and cheese there were 8 toppings in total.

To verify the solution, go back to the original problem.
A pizza costs \$7.50, plus \$1.50 for each additional topping.
The customer orders 6 additional toppings so pays:
$$\begin{aligned}\$7.50 + 6 \times \$1.50 &= \$7.50 + \$9\\ &= \$16.50\end{aligned}$$
This matches what the customer was charged so the solution is correct.

22. a) Let c represent the original price of the item in dollars. 9% of the cost is $9\% \times c$, or $0.09c$.
An equation is: $0.09c = 4.95$

b) $0.09c = 4.95$ Divide both sides by 0.09.
$$\frac{0.09c}{0.09} = \frac{4.95}{0.09}$$
$c = 55$
The item cost \$55.00 before the price increase.

To verify the solution, go back to the original problem.
9% of \$55.00 is $0.09 \times 55 = 4.95$.
\$4.95 is equal to the price increase so the solution is correct.

Take It Further

23. a) Since the sum of the interior angles is 1080, an equation is $180(n - 2) = 1080$

b)
$$\begin{aligned}180(n-2) &= 1080 && \text{Use the distributive property to expand } 180(n-2).\\ 180n + (180)(-2) &= 1080\\ 180n - 360 &= 1080 && \text{Add 360 to both sides.}\\ 180n - 360 + 360 &= 1080 + 360\\ 180n &= 1440 && \text{Divide both sides by 180.}\\ \frac{180n}{180} &= \frac{1440}{180}\\ n &= 8\end{aligned}$$
The polygon has 8 sides.

c)

$$180(n-2) = 1080$$ Divide each side by 180.

$$\frac{180(n-2)}{180} = \frac{1080}{180}$$

$$n - 2 = 6$$ Add 2 to each side.

$$n - 2 + 2 = 6 + 2$$

$$n = 8$$

The polygon has 8 sides.

d) Answers may vary. For example: I prefer Esta's method for this equation, since 180 is a factor of 1080, her method involves fewer steps. Or, I prefer Kyler's method, because using the distributive property is faster for me.

24. a) $4x + \frac{37}{5} = -17$ Subtract $\frac{37}{5}$ from each side.

$$4x + \frac{37}{5} - \frac{37}{5} = -17 - \frac{37}{5}$$ Write −17 as a fraction with denominator 5.

$$4x = \frac{(-17)(5)}{5} - \frac{37}{5}$$

$$4x = \frac{-85-37}{5}$$

$$4x = \frac{-122}{5}$$ Divide each side by 4.

$$\frac{4x}{4} = \frac{-122}{5}\left(\frac{1}{4}\right)$$

$$x = \frac{-122}{4 \times 5}$$

$$x = \frac{-122}{20}$$

$$x = \frac{-61}{10}\text{, or } -6.1$$

To verify the solution, substitute $x = -6.1$ into $4x + \frac{37}{5} = -17$.

Left side $= 4(-6.1) + 7.4$
$= -24.4 + 7.4$
$= -17$

Right side $= -17$

Since the left side equals the right side, $x = -6.1$ is correct.

b) $8m - \frac{6}{7} = \frac{176}{7}$ Add $\frac{6}{7}$ to each side.

$8m - \frac{6}{7} + \frac{6}{7} = \frac{176}{7} + \frac{6}{7}$

$8m = \frac{182}{7}$ Divide each side by 8.

$\frac{8m}{8} = \frac{182}{7}(\frac{1}{8})$

$m = \frac{182}{7 \times 8}$

$m = \frac{182}{56}$

$m = \frac{13}{4}$, or 3.25

To verify the solution, substitute $m = \frac{13}{4}$ into $8m - \frac{6}{7} = \frac{176}{7}$.

Left side $= 8(\frac{13}{4}) - \frac{6}{7}$ Right side $= \frac{176}{7}$

$= 26 - \frac{6}{7}$

$= \frac{182 - 6}{7}$

$= \frac{176}{7}$

Since the left side equals the right side, $m = \frac{13}{4}$ is correct.

c) $\frac{3}{4} - 5p = \frac{67}{6}$ Subtract $\frac{3}{4}$ from each side.

$\frac{3}{4} - 5p - \frac{3}{4} = \frac{67}{6} - \frac{3}{4}$ Write equivalent fractions with the least common denominator 12.

$-5p = \frac{134}{12} - \frac{9}{12}$

$-5p = \frac{125}{12}$ Divide each side by −5.

$\frac{-5p}{-5} = \frac{125}{12}(\frac{1}{-5})$

$p = -\frac{125}{60}$

$p = -\frac{25}{12}$

To verify the solution, substitute $p = -\frac{25}{12}$ into $\frac{3}{4} - 5p = \frac{67}{6}$.

Left side $= \frac{3}{4} - 5(-\frac{25}{12})$ Right side $= \frac{67}{6}$

$= \frac{3}{4} + \frac{125}{12}$

$= \frac{134}{12}$

$= \frac{67}{6}$

Since the left side equals the right side, $p = -\frac{25}{12}$ is correct.

d) $\frac{22}{8} + 10g = \frac{62}{5}$ Subtract $\frac{22}{8}$ from each side.

$\frac{22}{8} + 10g - \frac{22}{8} = \frac{62}{5} - \frac{22}{8}$ Write equivalent fractions with the least common denominator 40.

$10g = \frac{496}{40} - \frac{110}{40}$

$10g = \frac{386}{40}$ Divide each side by 10.

$\frac{10g}{10} = \frac{386}{40}(\frac{1}{10})$

$g = \frac{386}{400}$

$g = \frac{193}{200}$, or 0.965

To verify the solution, substitute $g = \frac{193}{200}$ into $\frac{22}{8} + 10g = \frac{62}{5}$.

Left side $= \frac{22}{8} + 10(\frac{193}{200})$ Right side $= \frac{62}{5}$

$= \frac{22}{8} + \frac{193}{20}$

$= \frac{110+386}{40}$

$= \frac{496}{40}$

$= \frac{62}{5}$

Since the left side equals the right side, $g = \frac{193}{200}$ is correct.

Lesson 6.2 Solving Equations by Using Balance Strategies Practice (pages 280–283)

Check

4. a) The balance scales have three *t*-masses and two 1-g masses on the left; and one *t*-mass and eight 1-g masses on the right.
So, the equation is: $3t + 2 = t + 8$.

$3t + 2 = t + 8$	Remove one *t*-mass from each pan.
$3t + 2 - t = t + 8 - t$	
$2t + 2 = 8$	Remove two 1-g masses from each pan.
$2t + 2 - 2 = 8 - 2$	
$2t = 6$	Divide the masses into 2 equal groups.
$\frac{2t}{2} = \frac{6}{2}$	
$t = 3$	Each *t*-mass in the left pan corresponds to a group of 3g in the right pan.

b) The balance scales have five *s*-masses and three 1-g masses on the left; and two *s*-masses and nine 1-g masses on the right.
So, the equation is: $5s + 3 = 2s + 9$.

$5s + 3 = 2s + 9$	Remove two *s*-masses from each pan.
$5s + 3 - 2s = 2s + 9 - 2s$	
$3s + 3 = 9$	Remove three 1-g masses from each pan.
$3s + 3 - 3 = 9 - 3$	
$3s = 6$	Divide the masses into 3 equal groups.
$\frac{3s}{3} = \frac{6}{3}$	
$s = 2$	Each *s*-mass in the left pan corresponds to 2g in the right pan.

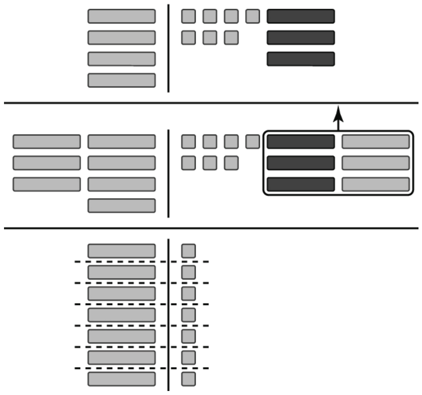
5. a) Step 1: Subtract *f* from each side.

Step 2: Add 2 to each side and remove the zero pairs from the left side.

Step 3: Divide each side by 2.

b) $3f - 2 = f + 4$
$3f - 2 - f = f + 4 - f$
$2f - 2 = 4$
$2f - 2 + 2 = 4 + 2$
$2f = 6$
$\frac{2f}{2} = \frac{6}{2}$
$f = 3$

6. a)



$4g = 7 - 3g$ Add $3g$ to each side.

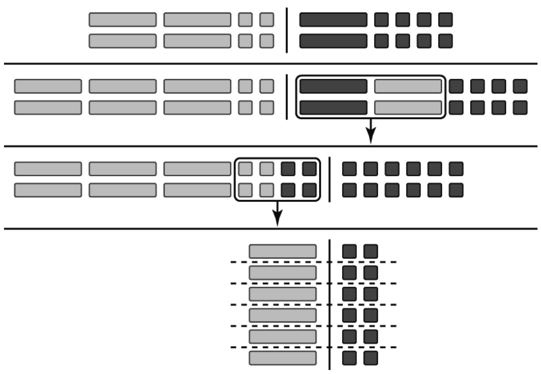
$4g + 3g = 7 - 3g + 3g$

$7g = 7$ Divide each side by 7.

$\frac{7g}{7} = \frac{7}{7}$

$g = 1$

b)



$4k + 4 = -2k - 8$ Add $2k$ to each side.

$4k + 4 + 2k = -2k - 8 + 2k$

$6k + 4 = -8$ Subtract 4 from each side.

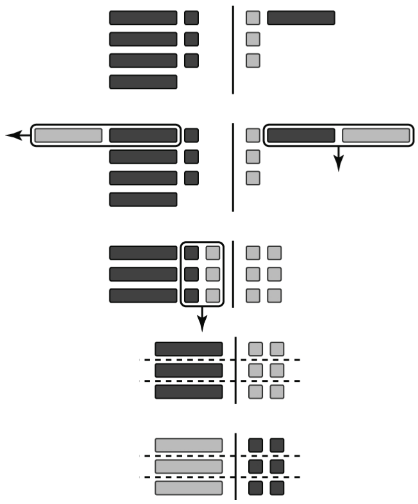
$6k + 4 - 4 = -8 - 4$

$6k = -12$ Divide each side by 6.

$\frac{6k}{6} = \frac{-12}{6}$

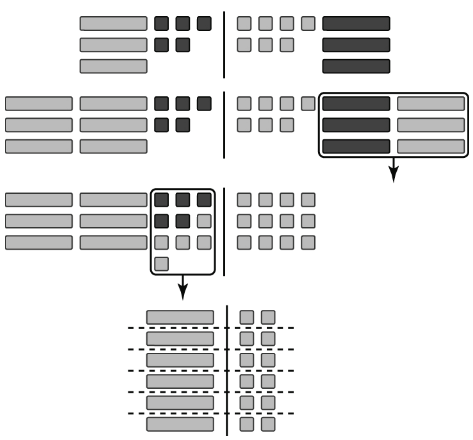
$k = -2$

c)



$-4a - 3 = 3 - a$ Add a to each side.
$-4a - 3 + a = 3 - a + a$
$-3a - 3 = 3$ Add 3 to each side.
$-3a - 3 + 3 = 3 + 3$
$-3a = 6$ Divide each side by −3.
$\frac{-3a}{-3} = \frac{6}{-3}$
$a = -2$

d)



$3h - 5 = 7 - 3h$ Add $3h$ to each side.
$3h - 5 + 3h = 7 - 3h + 3h$
$6h - 5 = 7$ Add 5 to each side.
$6h - 5 + 5 = 7 + 5$
$6h = 12$ Divide each side by 6.
$\frac{6h}{6} = \frac{12}{6}$
$h = 2$

Apply

7. a) i) $\frac{6}{h} = 2$ Multiply each side by *h*.

$h \times \frac{6}{h} = 2 \times h$ Think: $\frac{h}{1} \times \frac{6}{h} = \frac{6}{1}$

$6 = 2h$ Divide each side by 2.

$\frac{6}{2} = \frac{2h}{2}$

$3 = h$

ii) $\frac{-6}{h} = 2$ Multiply each side by *h*.

$h \times \frac{-6}{h} = 2 \times h$ Think: $\frac{h}{1} \times \frac{-6}{h} = \frac{-6}{1}$

$-6 = 2h$ Divide each side by 2.

$\frac{-6}{2} = \frac{2h}{2}$

$-3 = h$

iii) $-2 = \frac{6}{h}$ Multiply each side by *h*.

$h \times (-2) = \frac{6}{h} \times h$ Think: $\frac{6}{h} \times \frac{h}{1} = \frac{6}{1}$

$-2h = 6$ Divide each side by −2.

$\frac{-2h}{2} = \frac{6}{-2}$

$h = -3$

iv) $\frac{6}{-h} = 2$ Multiply each side by *h*.

$h \times \frac{6}{-h} = 2 \times h$ Think: $\frac{h}{1} \times \frac{6}{-h} = \frac{6}{-1}$

$-6 = 2h$ Divide each side by 2.

$\frac{-6}{2} = \frac{2h}{2}$

$-3 = h$

v) $-2 = \frac{-6}{h}$ Multiply each side by *h*.

$h \times (-2) = \frac{-6}{h} \times h$ Think: $\frac{-6}{h} \times \frac{h}{1} = \frac{-6}{1}$

$-2h = -6$ Divide each side by −2.

$\frac{-2h}{-2} = \frac{-6}{-2}$

$h = 3$

vi) $\frac{6}{-h} = -2$ Multiply each side by h.

$h \times \frac{6}{-h} = -2 \times h$ Think: $\frac{h}{1} \times \frac{6}{-h} = \frac{6}{-1}$

$-6 = -2h$ Divide each side by –2.

$\frac{-6}{-2} = \frac{-2h}{-2}$

$3 = h$

b) There are only two solutions because the equations in parts i, v, and vi are equivalent, they can all be written as $\frac{6}{h} = 2$; and the equations in parts ii, iii, and iv are equivalent, they can all be written as $\frac{-6}{h} = 2$.

8. I created an equivalent equation without fractions each time.

a) $2.4 = \frac{4.8}{s}$ Multiply each side by s.

$2.4 \times s = \frac{4.8}{s} \times s$

$2.4s = 4.8$ Divide each side by 2.4.

$\frac{2.4s}{2.4} = \frac{4.8}{2.4}$

$s = 2$

To verify the solution, substitute $s = 2$ into $2.4 = \frac{4.8}{s}$.

Left side = 2.4 Right side = $\frac{4.8}{2}$

= 2.4

Since the left side equals the right side, $s = 2$ is correct.

b) $\frac{-5.4}{t} = 1.8$ Multiply each side by t.

$\frac{-5.4}{t} \times t = 1.8 \times t$

$-5.4 = 1.8t$ Divide each side by 1.8.

$\frac{-5.4}{1.8} = \frac{1.8t}{1.8}$

$t = -3$

To verify the solution, substitute $t = -3$ into $\frac{-5.4}{t} = 1.8$.

Left side = $\frac{-5.4}{-3}$ Right side = 1.8

= 1.8

Since the left side equals the right side, $t = -3$ is correct.

c) $-6.5 = \dfrac{-1.3}{w}$ Multiply each side by w.

$-6.5 \times w = \dfrac{-1.3}{w} \times w$

$-6.5w = -1.3$ Divide each side by -6.5.

$\dfrac{-6.5w}{-6.5} = \dfrac{-1.3}{-6.5}$

$w = 0.2$

To verify the solution, substitute $w = 0.2$ into $-6.5 = \dfrac{-1.3}{w}$.

Left side $= -6.5$ Right side $= \dfrac{-1.3}{0.2}$

$= -6.5$

Since the left side equals the right side, $w = 0.2$ is correct.

9. Let n represent the number. Then, ten divided by the number is –3. An equation is: $\dfrac{10}{n} = -3$.

$\dfrac{10}{n} = -3$ Multiply each side by n.

$\dfrac{10}{n} \times n = -3 \times n$

$10 = -3n$ Divide each side by –3.

$\dfrac{10}{-3} = \dfrac{-3n}{-3}$

$n = \dfrac{10}{-3}$

The number is $\dfrac{10}{-3}$.

To verify the solution, go back to the original problem.
Ten divided by a number is –3.

$10 \div \dfrac{10}{-3} = 10 \times \dfrac{-3}{10}$

$= -3$

The solution is correct.

10. I used inverse operations to solve each equation.

a) $-12a = 15 - 15a$ Add $15a$ to each side.

$-12a + 15a = 15 - 15a + 15a$

$3a = 15$ Divide each side by 3.

$\dfrac{3a}{3} = \dfrac{15}{3}$

$a = \dfrac{15}{3}$

$a = 5$

To verify the solutions, substitute $a = 5$ in $-12a = 15 - 15a$.

Left side $= (-12) \times 5$ Right side $= 15 - 15(5)$

$= 15 - 75$

$= -60$

Since the left side equals the right side, $a = 5$ is correct.

b) $10.6y = 2.1y - 27.2$ Subtract $2.1y$ from each side.

$10.6y - 2.1y = 2.1y - 27.2 - 2.1y$

$8.5y = -27.2$ Divide by 8.5.

$$\frac{8.5y}{8.5} = \frac{-27.2}{8.5}$$

$$y = \frac{-27.2}{8.5}$$

$y = -3.2$

To verify the solution, substitute $y = -3.2$ in $10.6y = 2.1y - 27.2$.

Left side $= 10.6(-3.2)$ Right side $= 2.1(-3.2) - 27.2$

$= -6.72 - 27.2$

$= -33.92$

Since the left side equals the right side, $y = -3.2$ is correct.

c) $-10.8 + 7z = 5z$ Subtract $7z$ from each side.

$-10.8 + 7z - 7z = 5z - 7z$

$-10.8 = -2z$ Divide each side by -2.

$$\frac{-10.8}{-2} = \frac{-2z}{-2}$$

$z = 5.4$

To verify the solution, substitute $z = 5.4$ in $-10.8 + 7z = 5z$.

Left side $= -10.8 + 7 \times 5.4$ Right side $= 5 \times 5.4$

$= -10.8 + 37.8$ $= 27$

$= 27$

Since the left side equals the right side, $z = 5.4$ is correct.

d) $6u - 11.34 = 4.2u$ Subtract $6u$ from each side.

$6u - 11.34 - 6u = 4.2u - 6u$

$-11.34 = -1.8u$ Divide each side by -1.8

$$\frac{-11.34}{-1.8} = \frac{-1.8u}{-1.8}$$

$u = 6.3$

To verify the solution, substitute $u = 6.3$ in $6u - 11.34 = 4.2u$.

Left side $= 6 \times 6.3 - 11.34$ Right side $= 4.2 \times 6.3$

$= 37.8 - 11.34$ $= 26.46$

$= 26.46$

Since the left side equals the right side, $u = 6.3$ is correct.

e) $-20.5 - 2.2b = -7.2b$ Add $2.2b$ to each side.

$-20.5 - 2.2b + 2.2b = -7.2b + 2.2b$

$-20.5 = -5b$ Divide each side by -5.

$$\frac{-20.5}{-5} = \frac{-5b}{-5}$$

$b = 4.1$

To verify the solution, substitute $b = 4.1$ in $-20.5 - 2.2b = -7.2b$.

Left side $= -20.5 - 2.2 \times 4.1$ Right side $= (-7.2) \times 4.1$

$= -20.5 - 9.02$ $= -29.52$

$= -29.52$

Since the left side equals the right side, $b = 4.1$ is correct.

f) $-5.3p = -9 - 8.9p$ Add 8.9p to each side.
$-5.3p + 8.9p = -9 - 8.9p + 8.9p$
$3.6p = -9$ Divide each side by 3.6.
$\frac{3.6p}{3.6} = \frac{-9}{3.6}$
$p = -2.5$

To verify the solution, substitute $p = -2.5$ in $-5.3p = -9 - 8.9p$.
Left side $= (-5.3)(-2.5)$ Right side $= -9 - (8.9)(-2.5)$
$= 13.25$ $= -9 + 22.25$
$= 13.25$
Since the left side equals the right side, $p = -2.5$ is correct.

11. a) $2 - 3n = 2n + 7$ Add 3n to each side.
$2 - 3n + 3n = 2n + 7 + 3n$
$2 = 5n + 7$ Subtract 7 from each side.
$2 - 7 = 5n + 7 - 7$
$-5 = 5n$ Divide each side by 5.
$\frac{-5}{5} = \frac{5n}{5}$
$n = -1$
To verify the solution, substitute $n = -1$ in $2 - 3n = 2n + 7$.
Left side $= 2 - 3(-1)$ Right side $= 2(-1) + 7$
$= 2 + 3$ $= -2 + 7$
$= 5$ $= 5$
Since the left side equals the right side, $n = -1$ is correct.

b) $13 - 3q = 4 - 2q$ Add 3q to each side.
$13 - 3q + 3q = 4 - 2q + 3q$
$13 = 4 + q$ Subtract 4 from each side.
$13 - 4 = 4 + q - 4$
$9 = q$
To verify the solution, substitute $q = 9$ in $13 - 3q = 4 - 2q$.
Left side $= 13 - 3 \times 9$ Right side $= 4 - 2 \times 9$
$= 13 - 27$ $= 4 - 18$
$= -14$ $= -14$
Since the left side equals the right side, $q = 9$ is correct.

c) $-2.4a + 3.7 = -16.1 + 3.1a$ Add 2.4a to each side.
$-2.4a + 3.7 + 2.4a = -16.1 + 3.1a + 2.4a$
$3.7 = -16.1 + 5.5a$ Add 16.1 to each side.
$3.7 + 16.1 = -16.1 + 5.5a + 16.1$
$19.8 = 5.5a$ Divide each side by 5.5.
$\frac{19.8}{5.5} = \frac{5.5a}{5.5}$
$a = 3.6$
To verify the solution, substitute $a = 3.6$ in $-2.4a + 3.7 = -16.1 + 3.1a$.
Left side $= (-2.4)(3.6) + 3.7$ Right side $= -16.1 + 3.1(3.6)$
$= -8.64 + 3.7$ $= -16.1 + 11.16$
$= -4.94$ $= -4.94$
Since the left side equals the right side, $a = 3.6$ is correct.

d) $8.8v + 2.1 = 2.3v - 16.1$ Subtract 2.1 from each side.
$8.8v + 2.1 - 2.1 = 2.3v - 16.1 - 2.1$
$8.8v = 2.3v - 18.2$ Subtract 2.3v from each side.
$8.8v - 2.3v = 2.3v - 18.2 - 2.3v$
$6.5v = -18.2$ Divide each side by 6.5.
$\frac{6.5v}{6.5} = \frac{-18.2}{6.5}$
$v = -2.8$
To verify the solution, substitute $v = -2.8$ in $8.8v + 2.1 = 2.3v - 16.1$.
Left side $= 8.8(-2.8) + 2.1$
$= -24.64 + 2.1$
$= -22.54$
Right side $= 2.3(-2.8) - 16.1$
$= -6.44 - 16.1$
$= -22.54$
Since the left side equals the right side, $v = -2.8$ is correct.

e) $-2.5x - 2 = -5.7x + 6$ Add 2 to each side.
$-2.5x - 2 + 2 = -5.7x + 6 + 2$
$-2.5x = -5.7x + 8$ Add 5.7x to each side.
$-2.5x + 5.7x = -5.7x + 8 + 5.7x$
$3.2x = 8$ Divide each side by 3.2.
$\frac{3.2x}{3.2} = \frac{8}{3.2}$
$x = 2.5$
To verify the solution, substitute $x = 2.5$ in $-2.5x - 2 = -5.7x + 6$.
Left side $= (-2.5)(2.5) - 2$ Right side $= (-5.7)(2.5) + 6$
$= -6.25 - 2$ $= -14.25 + 6$
$= -8.25$ $= -8.25$
Since the left side equals the right side, $x = 2.5$ is correct.

f) $6.4 - 9.3b = 25.3 - 3.9b$ Subtract 6.4 from each side.
$6.4 - 9.3b - 6.4 = 25.3 - 3.9b - 6.4$
$-9.3b = 18.9 - 3.9b$ Add 3.9b to each side.
$-9.3b + 3.9b = 18.9 - 3.9b + 3.9b$
$-5.4b = 18.9$ Divide each side by -5.4.
$\frac{-5.4b}{-5.4} = \frac{18.9}{-5.4}$
$b = -3.5$
To verify the solution, substitute $b = -3.5$ in $6.4 - 9.3b = 25.3 - 3.9b$.
Left side $= 6.4 - 9.3(-3.5)$
$= 6.4 + 32.55$
$= 38.95$
Right side $= 25.3 - 3.9(-3.5)$
$= 25.3 + 13.65$
$= 38.95$
Since the left side equals the right side, $b = -3.5$ is correct.

12. a) Let n represent the number of people for which the halls cost the same.
Hall A costs \$50 per person, or $50 \times n = 50n$.
Hall B costs \$2000 plus \$40 per person, or $2000 + 40 \times n = 2000 + 40n$.
When the costs are equal, an equation is: $50n = 2000 + 40n$

b) $50n = 2000 + 40n$ Subtract $40n$ from each side.
$50n - 40n = 2000 + 40n - 40n$
$10n = 2000$ Divide each side by 10.
$\frac{10n}{10} = \frac{2000}{10}$
$n = 200$; the two halls will cost the same with 200 people.

c) To verify the solution, return to the original problem.
Hall A costs \$50 per person, or \$50 × 200 = \$10 000.
Hall B costs \$2000 plus \$40 per person, or \$2000 + \$40 × 200 = \$2000 + \$8000
= \$10 000
Since both costs are equal, the solution is correct.

13. Let n represent the number.
5 subtract the number can be represented as $5 - 3 \times n$, or $5 - 3n$.
3.5 times the number, subtract 8, can be represented as $3.5 \times n - 8$, or $3.5n - 8$.
When the numbers are equal, an equation is: $5 - 3n = 3.5n - 8$

$5 - 3n = 3.5n - 8$ Add $3n$ to each side.
$5 - 3n + 3n = 3.5n - 8 + 3n$
$5 = 6.5n - 8$ Add 8 to each side.
$5 + 8 = 6.5n - 8 + 8$
$13 = 6.5n$ Divide each side by 6.5.
$\frac{13}{6.5} = \frac{6.5n}{6.5}$
$n = 2$

To verify the solution, go back to the original problem.
Five subtract 3 times a number is equal to 3.5 times the same number, subtract 8.
Check: Five subtract 3 times a number = $5 - (3 \times 2) = 5 - 6 = -1$
3.5 times the same number, subtract 8 = $(3.5 \times 2) - 8 = 7 - 8 = -1$
Since both numbers are equal, the solution is correct.

14. a) 4% of sales is 4% × s, or $0.04s$.
An equation is: $1500 + 0.04s$

b) 2% of sales is 2% × s, or $0.02s$.
An equation is: $1700 + 0.02s$

c) When earnings from Plans A and B are the same, the equations are equal.
An equation is: $1500 + 0.04s = 1700 + 0.02s$

d) $1500 + 0.04s = 1700 + 0.02s$ Subtract $0.02s$ from each side.
$1500 + 0.04s - 0.02s = 1700 + 0.02s - 0.02s$
$1500 + 0.02s = 1700$ Subtract 1500 from each side.
$1500 + 0.02s - 1500 = 1700 - 1500$
$0.02s = 200$ Divide each side by 0.02.
$\frac{0.02s}{0.02} = \frac{200}{0.02}$
$s = 10\ 000$
The equation solution indicates that \$10 000 in sales would result in the same total earnings from both plans.

15. a) Student A forgot to write the negative sign for –5 in the last line.
Correct solution:

$2.2x = 7.6x + 27$ Subtract $7.6x$ from each side.
$2.2x - 7.6x = 7.6x + 27 - 7.6x$
$-5.4x = 27$ Divide each side by -5.4.
$\frac{-5.4x}{-5.4} = \frac{27}{-5.4}$
$x = -5$

b) Student B should subtract $2.2x$ instead of adding $2.2x$ on each side in line 2.
Correct solution:

$-2.3x - 2.7 = 2.2x + 11.7$ Subtract $2.2x$ from each side.
$-2.3x - 2.7 - 2.2x = 2.2x + 11.7 - 2.2x$
$-4.5x - 2.7 = 11.7$ Subtract 2.7 from each side.
$-4.5x - 2.7 + 2.7 = 11.7 + 2.7$
$-4.5x = 14.4$ Divide each side by -4.5.
$\frac{-4.5x}{-4.5} = \frac{14.4}{-4.5}$
$x = -3.2$

16. a) i) $\frac{x}{27} = 3$ Multiply each side by 27.
$27 \times \frac{x}{27} = 3 \times 27$
$x = 81$

$\frac{27}{x} = 3$ Multiply each side by x.
$x \times \frac{27}{x} = 3 \times x$
$27 = 3x$ Divide each side by 3.
$\frac{27}{3} = \frac{3x}{3}$
$x = 9$

ii) $\frac{a}{36} = 12$ Multiply each side by 36.
$36 \times \frac{a}{36} = 12 \times 36$
$a = 432$

$\frac{36}{a} = 12$ Multiply each side by a.
$a \times \frac{36}{a} = 12 \times a$
$36 = 12a$ Divide each side by 12.
$\frac{36}{12} = \frac{12a}{12}$
$a = 3$

b) The steps are similar because we clear the fraction by multiplying each side by the denominator. When the variable is in the denominator, there is an additional step of dividing by the coefficient of the variable to isolate the variable.

17. a) $4(g + 5) = 5(g - 3)$ — Use the distributive property to expand the brackets.
$4(g) + 4(5) = 5(g) - 5(3)$
$4g + 20 = 5g - 15$ — Subtract $4g$ from each side.
$4g + 20 - 4g = 5g - 15 - 4g$
$20 = g - 15$ — Add 15 to both sides.
$20 + 15 = g - 15 + 15$
$g = 35$

To verify the solution, substitute $g = 35$ into $4(g + 5) = 5(g - 3)$.

Left side $= 4(35 + 5)$
$= 4(40)$
$= 160$

Right side $= 5(35 - 3)$
$= 5(32)$
$= 160$

Since the left side equals the right side, $g = 35$ is correct.

b) $3(4j + 5) = 2(-10 + 5j)$ — Use the distributive property to expand the brackets.
$3(4j) + 3(5) = 2(-10) + 2(5j)$
$12j + 15 = -20 + 10j$ — Subtract $10j$ from each side.
$12j + 15 - 10j = -20 + 10j - 10j$
$2j + 15 = -20$ — Subtract 15 from each side.
$2j + 15 - 15 = -20 - 15$
$2j = -35$ — Divide both sides by 2.
$\frac{2j}{2} = \frac{-35}{2}$
$j = -17.5$

To verify the solution, substitute $j = -17.5$ into $3(4j + 5) = 2(-10 + 5j)$.

Left side $= 3[4(-17.5) + 5]$
$= 3[-70 + 5]$
$= 3[-65]$
$= -195$

Right side $= 2[-10 + 5(-17.5)]$
$= 2[-10 - 87.5]$
$= 2[-97.5]$
$= -195$

Since the left side equals the right side, $j = -17.5$ is correct.

c) $2.2(h - 5.3) = 0.2(-32.9 + h)$ — Use the distributive property to expand the brackets.
$2.2(h) + 2.2(-5.3) = 0.2(-32.9) + 0.2(h)$
$2.2h - 11.66 = -6.58 + 0.2h$ — Subtract $0.2h$ from each side.
$2.2h - 11.66 - 0.2h = -6.58 + 0.2h - 0.2h$
$2h - 11.66 = -6.58$ — Add 11.66 to each side.
$2h - 11.66 + 11.66 = -6.58 + 11.66$
$2h = 5.08$ — Divide both sides by 2.
$\frac{2h}{2} = \frac{5.08}{2}$
$h = 2.54$

To verify the solution, substitute $h = 2.54$ into $2.2(h - 5.3) = 0.2(-32.9 + h)$.

Left side $= 2.2(2.54 - 5.3)$
$= 2.2(-2.76)$
$= -6.072$

Right side $= 0.2(-32.9 + 2.54)$
$= 0.2(-30.36)$
$= -6.072$

Since the left side equals the right side, $h = 2.54$ is correct.

d) $0.04(5 - s) = 0.05(6 - s)$ — Use the distributive property to expand the brackets.
$0.04(5) + 0.04(-s) = 0.05(6) + 0.05(-s)$
$0.2 - 0.04s = 0.3 - 0.05s$ — Add $0.05s$ to each side.
$0.2 - 0.04s + 0.05s = 0.3 - 0.05s + 0.05s$
$0.2 + 0.01s = 0.3$ — Subtract 0.2 from each side.
$0.2 + 0.01s - 0.2 = 0.3 - 0.2$
$0.01s = 0.1$ — Divide each side by 0.01.
$\frac{0.01s}{0.01} = \frac{0.1}{0.01}$
$s = 10$

To verify the solution, substitute $s = 10$ into $0.04(5 - s) = 0.05(6 - s)$.
Left side $= 0.04(5 - 10)$
$= 0.04(-5)$
$= -0.2$
Right side $= 0.05(6 - 10)$
$= 0.05(-4)$
$= -0.2$
Since the left side equals the right side, $s = 10$ is correct.

18. a) Let k represent the number of kilometres driven. Company A charges \$199 plus 0.20 per kilometre, which can be represented as $199 + 0.20 \times k$, or $199 + 0.20k$. Company B charges \$149 plus \$0.25 per kilometre, which can be represented as $149 + 0.25 \times k$, or $149 + 0.25k$.
When the costs are equal, an equation is: $199 + 0.2k = 149 + 0.25k$

b) $199 + 0.2k = 149 + 0.25k$ — Subtract $0.2k$ from each side.
$199 + 0.2k - 0.2k = 149 + 0.25k - 0.2k$
$199 = 149 + 0.05k$ — Subtract 149 from each side.
$199 - 149 = 149 + 0.05k - 149$
$50 = 0.05k$ — Divide each side by 0.05.
$\frac{50}{0.05} = \frac{0.05k}{0.05}$
$k = 1000$
Hendrik must drive 1000 km for the two rental costs to be the same.

c) To verify the solution, go back to the original problem.
Company A charges \$199 per week, plus \$0.20 per kilometre driven.
If Hendrik drives 1000 km, he is charged:
$\$199 + \$0.20 \times 1000 = \$199 + \$200$
$= \$399$

Company B charges \$149 per week, plus \$0.25 per kilometre driven.
If Hendrik drives 1000 km, he is charged:
$\$149 + \$0.25 \times 1000 = \$149 + \$250$
$= \$399$
Since these two charges are equal, the solution is correct.

19. a) $\frac{7}{2}(m + 12) = \frac{5}{2}(20 + m)$ Multiply each side by the denominator 2 to clear the fractions.

$2 \times [\frac{7}{2}(m + 12)] = 2 \times [\frac{5}{2}(20 + m)]$

$7(m + 12) = 5(20 + m)$ Use the distributive property to expand the brackets.

$7(m) + 7(12) = 5(20) + 5(m)$

$7m + 84 = 100 + 5m$ Subtract $5m$ from each side.

$7m + 84 - 5m = 100 + 5m - 5m$

$2m + 84 = 100$ Subtract 84 from each side.

$2m + 84 - 84 = 100 - 84$

$2m = 16$ Divide both sides by 2.

$\frac{2m}{2} = \frac{16}{2}$

$m = 8$

b) $\frac{1}{3}(5 - 3t) = \frac{5}{6}(t - 2)$ Multiply each side by the common denominator 6 to

$6 \times [\frac{1}{3}(5 - 3t)] = 6 \times [\frac{5}{6}(t - 2)]$ Clear the fractions.

$\overset{2}{\cancel{6}} \times \frac{1}{\underset{1}{\cancel{3}}}(5 - 3t) = 6 \times \overset{1}{\cancel{6}} \times \frac{5}{\underset{1}{\cancel{6}}}(t - 2)$

$2(5 - 3t) = 5(t - 2)$ Use the distributive property to expand the brackets.

$2(5) + 2(-3t) = 5(t) + 5(-2)$

$10 - 6t = 5t - 10$ Add $6t$ to each side.

$10 - 6t + 6t = 5t - 10 + 6t$

$10 = 11t - 10$ Add 10 to each side.

$10 + 10 = 11t - 10 + 10$

$20 = 11t$ Divide both sides by 11.

$\frac{20}{11} = \frac{11t}{11}$

$t = \frac{20}{11}$

c) $\frac{3}{2}(1 + 3r) = \frac{2}{3}(2 - 3r)$ Multiply each side by the common denominator 6 to clear the

$6 \times [\frac{3}{2}(1 + 3r)] = 6 \times [\frac{2}{3}(2 - 3r)]$ Clear the fractions.

$\overset{3}{\cancel{6}} \times \frac{3}{\underset{1}{\cancel{2}}}(1 + 3r) = \overset{2}{\cancel{6}} \times \frac{2}{\underset{1}{\cancel{3}}}(2 - 3r)$

$9(1 + 3r) = 4(2 - 3r)$ Use the distributive property to expand the brackets.

$9(1) + 9(3r) = 4(2) + 4(-3r)$

$9 + 27r = 8 - 12r$ Add $12r$ to each side.

$9 + 27r + 12r = 8 - 12r + 12r$

$9 + 39r = 8$ Subtract 9 from each side.

$9 + 39r - 9 = 8 - 9$

$39r = -1$ Divide each side by 39.

$\frac{39r}{39} = \frac{-1}{39}$

$r = \frac{-1}{39}$

d) $\frac{2}{3}(6x + 5) = \frac{4}{5}(20x - 7)$ Multiply each side by the common denominator 15.

$15 \times [\frac{2}{3}(6x + 5)] = 15 \times [\frac{4}{5}(20x - 7)]$ Clear the fractions.

$\cancel{15}^{5} \times \frac{2}{\cancel{3}_{1}}(6x + 5) = \cancel{15}^{3} \times \frac{4}{\cancel{5}_{1}}(20x - 7)$

$10(6x + 5) = 12(20x - 7)$ Use the distributive property to expand the brackets.

$10(6x) + 10(5) = 12(20x) + 12(-7)$

$60x + 50 = 240x - 84$ Subtract $60x$ from each side.

$60x + 50 - 60x = 240x - 84 - 60x$

$50 = 180x - 84$ Add 84 to each side.

$50 + 84 = 180x - 84 + 84$

$134 = 180x$ Divide each side by 180.

$\frac{134}{180} = \frac{180x}{180}$

$x = \frac{134}{180}$ Simplify the fraction.

$x = \frac{67}{90}$

20. a) Dembe's method:

$\frac{x}{3} + \frac{x}{4} = x - \frac{1}{6}$ Multiply each side by the common denominator 12 to clear the fractions.

$12(\frac{x}{3} + \frac{x}{4}) = 12(x - \frac{1}{6})$ Use the distributive property.

$\cancel{12}^{4} \times \frac{x}{\cancel{3}_{1}} + \cancel{12}^{3} \times \frac{x}{\cancel{4}_{1}} = 12x - \cancel{12}^{2} \times \frac{1}{\cancel{6}_{1}}$

$4x + 3x = 12x - 2$

$7x = 12x - 2$ Subtract $12x$ from each side.

$7x - 12x = 12x - 2 - 12x$

$-5x = -2$ Divide each side by -5.

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

$x = \frac{2}{5}$

Bianca's method:

$\frac{x}{3} + \frac{x}{4} = x - \frac{1}{6}$ Multiply each side by the common denominator 24.

$24(\frac{x}{3} + \frac{x}{4}) = 24(x - \frac{1}{6})$ Use the distributive property.

$\cancel{24}^{8} \times \frac{x}{\cancel{3}_1} + \cancel{24}^{6} \times \frac{x}{\cancel{4}_1} = 24x - \cancel{24}^{4} \times \frac{1}{\cancel{6}_1}$

$8x + 6x = 24x - 4$

$14x = 24x - 4$ Subtract $24x$ from each side.

$14x - 24x = 24x - 4 - 24x$

$-10x = -4$ Divide each side by -10.

$\frac{-10x}{-10} = \frac{-4}{-10}$

$x = \frac{4}{10}$ Simplify the fraction.

$x = \frac{2}{5}$

The solutions are the same.

b) Using the least common denominator saves the second last step of simplifying the fraction.

21. a) $\frac{x}{4} + \frac{7}{4} = \frac{5}{6}$ Multiply each side by the least common denominator 12.

$12(\frac{x}{4} + \frac{7}{4}) = 12(\frac{5}{6})$ Use the distributive property.

$\cancel{12}^{3} \times \frac{x}{\cancel{4}_1} + \cancel{12}^{3} \times \frac{7}{\cancel{4}_1}) = \cancel{12}^{2} \times \frac{5}{\cancel{6}_1}$

$3(x) + 3(7) = 2(5)$

$3x + 21 = 10$ Subtract 21 from each side.

$3x + 21 - 21 = 10 - 21$

$3x = -11$ Divide each side by 3.

$\frac{3x}{3} = \frac{-11}{3}$

$x = \frac{-11}{3}$

To verify the solution, substitute $x = \frac{-11}{3}$ into $\frac{x}{4} + \frac{7}{4} = \frac{5}{6}$.

Left side $= \frac{(\frac{-11}{3})}{4} + \frac{7}{4}$ Right side $= \frac{5}{6}$

$= \frac{-11}{3} \times \frac{1}{4} + \frac{7}{4}$

$= \frac{-11}{12} + \frac{21}{12}$

$= \frac{10}{12}$

$= \frac{5}{6}$

Since the left side equals the right side, $x = \frac{-11}{3}$ is correct.

b) $\frac{5x}{16} - \frac{5}{4} = \frac{x}{4}$ Multiply each side by the least common denominator 16.

$16(\frac{5x}{16} - \frac{5}{4}) = 16(\frac{x}{4})$ Use the distributive property.

$\cancel{16}^{1} \times \frac{5x}{\cancel{16}_1} - \cancel{16}^{4} \times \frac{5}{\cancel{4}_1} = \cancel{16}^{4} \times \frac{x}{\cancel{4}_1}$

$5x - 4(5) = 4x$ Subtract $4x$ from each side.

$5x - 20 - 4x = 4x - 4x$

$x - 20 = 0$ Add 20 to each side.

$x - 20 + 20 = 20$

$x = 20$

To verify the solution, substitute $x = 20$ into $\frac{5x}{16} - \frac{5}{4} = \frac{x}{4}$.

Left side $= \frac{5(20)}{16} - \frac{5}{4}$

$= \frac{100}{16} - \frac{20}{16}$

$= \frac{80}{16}$

$= 5$

Right side $= \frac{20}{4}$

$= 5$

Since the left side equals the right side, $x = 20$ is correct.

c) $2 - \frac{x}{24} = \frac{5x}{24} + 1$ Multiply each side by 24 to clear the fractions.

$24(2 - \frac{x}{24}) = 24(\frac{5x}{24} + 1)$ Use the distributive property.

$24(2) - \cancel{24}^{1} \times \frac{x}{\cancel{24}_1} = \cancel{24}^{1} \times \frac{5x}{\cancel{24}_1} + 24(1)$

$48 - x = 5x + 24$ Add x to each side.

$48 - x + x = 5x + 24 + x$

$48 = 6x + 24$ Subtract 24 from each side.

$48 - 24 = 6x + 24 - 24$

$24 = 6x$ Divide each side by 6.

$\frac{24}{6} = \frac{6x}{6}$

$x = 4$

To verify the solution, substitute $x = 4$ into $2 - \frac{x}{24} = \frac{5x}{24} + 1$.

Left side $= 2 - \frac{4}{24}$

$= 2 - \frac{1}{6}$

$= \frac{2(6) - 1}{6}$

$= \frac{11}{6}$

Right side $= \frac{5(4)}{24} + 1$

$= \frac{5}{6} + 1$

$= \frac{5 + 1(6)}{6}$

$= \frac{11}{6}$

Since the left side equals the right side, $x = 4$ is correct.

d) $\frac{25}{9} + \frac{x}{9} = \frac{7x}{6} - \frac{5}{2}$ Multiply each side by the least common denominator 18.

$18(\frac{25}{9} + \frac{x}{9}) = 18(\frac{7x}{6} - \frac{5}{2})$ Use the distributive property.

$\cancel{18}^{2} \times \frac{25}{\cancel{9}_1} + \cancel{18}^{2} \times \frac{x}{\cancel{9}_1} = \cancel{18}^{3} \times \frac{7x}{\cancel{6}_1} - \cancel{18}^{9} \times \frac{5}{\cancel{2}_1}$

$2(25) + 2x = 3(7x) - 9(5)$

$50 + 2x = 21x - 45$ Add $2x$ to each side.

$50 + 2x - 2x = 21x - 45 - 2x$

$50 = 19x - 45$ Add 45 to each side.

$50 + 45 = 19x - 45 + 45$

$95 = 19x$ Divide both sides by 19.

$\frac{95}{19} = \frac{19x}{19}$

$x = 5$

To verify the solution, substitute $x = 5$ into $\frac{25}{9} + \frac{x}{9} = \frac{7x}{6} - \frac{5}{2}$.

Left side $= \frac{25}{9} + \frac{5}{9}$
$= \frac{30}{9}$
$= \frac{10}{3}$

Right side $= \frac{7(5)}{6} - \frac{5}{2}$
$= \frac{35 - 15}{6}$
$= \frac{20}{6}$
$= \frac{10}{3}$

Since the left side equals the right side, $x = 5$ is correct.

Take It Further

22. Substitute $B = 9$ and $M = 4$ into the equation $B = M + \frac{1}{2}A$.

$9 = 4 + \frac{1}{2}A$

To find the number of assisted blocks Marlene made, we must isolate A.

$9 = 4 + \frac{1}{2}A$ Multiply each side by 2 to clear the fraction.

$2(9) = 2(4) + 2(\frac{1}{2}A)$

$18 = 8 + A$ Subtract 8 from each side.

$18 - 8 = 8 + A - 8$

$A = 10$

Marlene made 10 assisted blocks.

To verify the solution, substitute $A = 10$ in $9 = 4 + \frac{1}{2}A$.

Left side = 9 Right side $= 4 + \frac{1}{2}(10)$
$= 4 + 5$
$= 9$

Since the left side equals the right side, I know my answer is correct.

23. a) Let m represent the time in minutes that results in equal monthly costs.
The cost of Plan A is $28 + 0.45(m - 30)$.
The cost of Plan B is $40 + 0.25m$.
When both plans are equal, an equation is:
$28 + 0.45(m - 30) = 40 + 0.25m$

b) $28 + 0.45(m - 30) = 40 + 0.25m$ Use the distributive property to expand $0.45(m - 30)$.
$28 + 0.45(m) + 0.45(-30) = 40 + 0.25m$
$28 + 0.45m - 13.5 = 40 + 0.25m$
$14.5 + 0.45m = 40 + 0.25m$ Subtract $0.25m$ from each side.
$14.5 + 0.45m - 0.25m = 40 + 0.25m - 0.25m$
$14.5 + 0.2m = 40$ Subtract 14.5 from each side.
$14.5 + 0.2m - 14.5 = 40 - 14.5$
$0.2m = 25.5$ Divide each side by 0.2.
$$\frac{0.2m}{0.2} = \frac{25.5}{0.2}$$
$m = 127.5$
The monthly costs for both plans are the same at 127.5 min.

c) To verify the solution, go back to the original problem.
Plan A charges \$28 plus \$0.45 per minute, after the first 30 minutes.
Check: $\$28 + (127.5 - 30) \times \$0.45 = \$28 + 97.5 \times \$0.45$
$= \$28 + \$43.875$
$= \$71.875$
$= \$71.88$
Plan B charges \$40 plus \$0.25 per minute.
Check: $\$40 + 127.5 \times \$0.25 = \$40 + \$31.875$
$= \$71.875$
$= \$71.88$
Since the two charges are equal, the solution is correct.

Mid-Unit Review (page 286)

Lesson 6.1

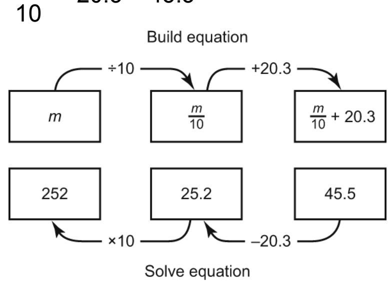
1. a) Divide each side by −3; this will isolate the variable.

b) Add 2 to each side; this isolates variable term.
Or, multiply each side by 4; this will clear the fraction.

c) Divide each side by 2; this will clear the brackets.

d) Subtract 9 from each side; this isolates the variable term.

2. a) $\frac{m}{10} + 20.3 = 45.5$



b) $\frac{m}{10} + 20.3 = 45.5$ Subtract 20.3 from each side.

$\frac{m}{10} + 20.3 - 20.3 = 45.5 - 20.3$

$\frac{m}{10} = 25.2$ Multiply each side by 10.

$\frac{m}{10} \times 10 = 25.2 \times 10$

$m = 252$

3. a) The fare is represented by \$2.50 plus \$1.50 times distance travelled, or 2.50 + 1.50*k*.
$2.5 + 1.2k = 27.7$ Subtract 2.5 from each side.
$2.5 + 1.2k - 2.5 = 27.7 - 2.5$
$1.2k = 25.2$ Divide each side by 1.2.
$k = \frac{25.2}{1.2}$
$k = 21$
Sheila travelled 21 km.

b) To verify the solution, return to the original problem.
Sheila is charged \$2.50 plus \$1.20 times distance travelled:
$2.50 + 1.20\,(21) = 2.50 + 25.20$
$= 27.70$
\$27.70 is equal to the fare Sheila was charged so the solution is correct.

4. a) Let *s* represent the length of the third side in centimetres.
The perimeter is equal to the sum of the measures of all sides.
Since 2 sides are of equal length, an equation for the perimeter of the triangle is:
$2(2.7) + s = 7.3$, or $5.4 + s = 7.3$

b) $5.4 + s = 7.3$ Subtract 5.4 from both sides.
$5.4 + s - 5.4 = 7.3 - 5.4$
$s = 1.9$
The third side is 1.9 cm long.

c) To verify the solution, go back to the original problem.
The perimeter of the triangle is:
2×2.7 cm + 1.9 cm = 5.4 cm + 1.9 cm
= 7.3 cm
This is equal to the given perimeter so the solution is correct.

5. a) $\frac{k}{3} = -1.5$ Multiply each side by 3 to clear the fraction.
$3 \times \frac{k}{3} = 3(-1.5)$
$k = -4.5$
To verify the solution, substitute $k = -4.5$ into $\frac{k}{3} = -1.5$.
Left side $= \frac{-4.5}{3}$ Right side $= -1.5$
$= -1.5$
Since the left side equals the right side, $k = -4.5$ is correct.

b) $10.5 = 3b - 12.5$ Add 12.5 to each side.
$10.5 + 12.5 = 3b - 12.5 + 12.5$
$23 = 3b$ Divide each side by 3.
$\frac{23}{3} = \frac{3b}{3}$
$b = \frac{23}{3}$
To verify the solution, substitute $b = \frac{23}{3}$ into $10.5 = 3b - 12.5$.
Left side = 10.5 Right side $= 3(\frac{23}{3}) - 12.5$
$= 23 - 12.5$
$= 10.5$
Since the left side equals the right side, $b = \frac{23}{3}$ is correct.

c) $5(x - 7.2) = 14.5$ Use the distributive property to expand $5(x - 7.2)$.
$5(x) + 5(-7.2) = 14.5$
$5x - 36 = 14.5$ Add 36 to each side.
$5x - 36 + 36 = 14.5 + 36$
$5x = 50.5$ Divide both sides by 5.
$\frac{5x}{5} = \frac{50.5}{5}$
$x = 10.1$
To verify the solution, substitute $x = 10.1$ into $5(x - 7.2) = 14.5$.
Left side $= 5(10.1 - 7.2)$ Right side = 14.5
$= 5(2.9)$
$= 14.5$
Since the left side equals the right side, $x = 10.1$ is correct.

d) $8.4 = 1.2b$ Divide both sides by 1.2 to isolate b.

$\frac{8.4}{1.2} = \frac{1.2b}{1.2}$

$b = 7$

To verify the solution, substitute $b = 7$ into $8.4 = 1.2b$.

Left side = 8.4 Right side = 1.2(7)
= 8.4

Since the left side equals the right side, $b = 7$ is correct.

e) $2 + \frac{n}{3} = 2.8$ Subtract 2 from each side.

$2 + \frac{n}{3} - 2 = 2.8 - 2$

$\frac{n}{3} = 0.8$ Multiply each side by 3.

$3 \times \frac{n}{3} = 3 \times 0.8$

$n = 2.4$

To verify the solution, substitute $n = 2.4$ into $2 + \frac{n}{3} = 2.8$.

Left side = $2 + \frac{2.4}{3}$ Right side = 2.8
= 2 + 0.8
= 2.8

Since the left side equals the right side, $n = 2.4$ is correct.

f) $-8 = 0.4(3.2 + h)$ Use the distributive property to expand $0.4(3.2 + h)$.

$-8 = 0.4(3.2) + (0.4)(h)$

$-8 = 1.28 + 0.4h$ Subtract 1.28 from each side.

$-8 - 1.28 = 1.28 + 0.4h - 1.28$

$-9.28 = 0.4h$ Divide each side by 0.4.

$\frac{-9.28}{0.4} = \frac{0.4h}{0.4}$

$h = -23.2$

To verify the solution, substitute $h = -23.2$ into $-8 = 0.4(3.2 + h)$.

Left side = –8 Right side = 0.4[3.2 + (–23.2)]
= 0.4(–20)
= –8

Since the left side equals the right side, $h = -23.2$ is correct.

Lesson 6.2

6. The left pan has six k-masses and one 1-g mass. This can be represented by $6k + 1$.
The right pan has two k-masses and nine 1-g masses. This can be represented by $2k + 9$.
The equation is: $6k + 1 = 2k + 9$

$6k + 1 = 2k + 9$ Subtract $2k$ from each side.

$6k + 1 - 2k = 2k + 9 - 2k$

$4k + 1 = 9$ Subtract 1 from each side.

$4k + 1 - 1 = 9 - 1$

$4k = 8$ Divide each side by 4.

$\frac{4k}{4} = \frac{8}{4}$

$k = 2$

To verify the solution, substitute $k = 2$ into $6k + 1 = 2k + 9$.

Left side $= 6(2) + 1$ Right side $= 2(2) + 9$
$= 12 + 1$ $= 4 + 9$
$= 13$ $= 13$

Since the left side equals the right side, $k = 2$ is correct.

7. a) $\frac{56}{a} = -3.5$ Multiply each side by a.

$\left(\frac{56}{a}\right) \times a = (-3.5) \times a$

$56 = -3.5a$ Divide each side by –3.5.

$\frac{56}{-3.5} = \frac{-3.5a}{-3.5}$

$a = -16$

To verify the solution, substitute $a = -16$ into $\frac{56}{a} = -3.5$.

Left side $= \frac{56}{-16}$ Right side $= -3.5$
$= -3.5$

Since the left side equals the right side, $a = -16$ is correct.

b) $8w - 12.8 = 6w$ Subtract $6w$ from each side.

$8w - 12.8 - 6w = 6w - 6w$

$2w - 12.8 = 0$ Add 12.8 to each side.

$2w - 12.8 + 12.8 = 0 + 12.8$

$2w = 12.8$ Divide each side by 2.

$\frac{2w}{2} = \frac{12.8}{2}$

$w = 6.4$

To verify the solution, substitute $w = 6.4$ into $8w - 12.8 = 6w$.

Left side $= 8(6.4) - 12.8$ Right side $= 6(6.4)$
$= 51.2 - 12.8$ $= 38.4$
$= 38.4$

Since the left side equals the right side, $w = 6.4$ is correct.

c) $-8z + 11 = -10 - 5.5z$ Add $5.5z$ to each side.

$-8z + 11 + 5.5z = -10 - 5.5z + 5.5z$

$-2.5z + 11 = -10$ Subtract 11 from each side.

$-2.5z + 11 - 11 = -10 - 11$

$-2.5z = -21$ Divide each side by –2.5.

$\frac{-2.5z}{-2.5} = \frac{-21}{-2.5}$

$z = 8.4$

To verify the solution, substitute $z = 8.4$ into $-8z + 11 = -10 - 5.5z$.

Left side $= -8(8.4) + 11$ Right side $= -10 - 5.5(8.4)$
$= -67.2 + 11$ $= -10 - 46.2$
$= -56.2$ $= -56.2$

Since the left side equals the right side, $z = 8.4$ is correct.

d) $\frac{5x}{2} = 11 + \frac{2x}{3}$ Multiply each side by the least common denominator 6.

$6\left(\frac{5x}{2}\right) = 6\left(11 + \frac{2x}{3}\right)$ Use the distributive property to expand the brackets.

$\overset{3}{\cancel{6}} \times \frac{5x}{\cancel{2}_1} = 6(11) + \overset{2}{\cancel{6}} \times \frac{2x}{\cancel{3}_1}$

$3(5x) = 6(11) + 2(2x)$

$15x = 66 + 4x$ Subtract $4x$ from each side.

$15x - 4x = 66 + 4x - 4x$

$11x = 66$ Divide each side by 11.

$\frac{11x}{11} = \frac{66}{11}$

$x = 6$

To verify the solution, substitute $x = 6$ into $\frac{5x}{2} = 11 + \frac{2x}{3}$.

Left side $= \frac{5(6)}{2}$ Right side $= 11 + \frac{2(6)}{3}$

$= \frac{30}{2}$ $= 11 + \frac{12}{3}$

$= 15$ $= 11 + 4$

$= 15$

Since the left side equals the right side, $x = 6$ is correct.

e) $0.2(5 - 2r) = 0.3(1 - r)$ Use the distributive property to expand the brackets.

$0.2(5) + 0.2(-2r) = 0.3(1) + 0.3(-r)$

$1 - 0.4r = 0.3 - 0.3r$ Add $0.4r$ to each side.

$1 - 0.4r + 0.4r = 0.3 - 0.3r + 0.4r$

$1 = 0.3 + 0.1r$ Subtract 0.3 from each side.

$1 - 0.3 = 0.3 + 0.1r - 0.3$

$0.7 = 0.1r$ Divide each side by 0.1.

$\frac{0.7}{0.1} = \frac{0.1r}{0.1}$

$r = 7$

To verify the solution, substitute $r = 7$ into $0.2(5 - 2r) = 0.3(1 - r)$.

Left side $= 0.2[5 - 2(7)]$ Right side $= 0.3(1 - 7)$

$= 0.2(-9)$ $= 0.3(-6)$

$= -1.8$ $= -1.8$

f) $12.9 + 2.3y = 4.5y + 19.5$ Subtract $2.3y$ from each side.

$12.9 + 2.3y - 2.3y = 4.5y + 19.5 - 2.3y$

$12.9 = 2.2y + 19.5$ Subtract 19.5 from each side.

$12.9 - 19.5 = 2.2y + 19.5 - 19.5$

$-6.6 = 2.2y$ Divide each side by 2.2.

$\frac{-6.6}{2.2} = \frac{2.2y}{2.2}$

$y = -3$

To verify the solution, substitute $y = -3$ into $12.9 + 2.3y = 4.5y + 19.5$.

Left side $= 12.9 + 2.3(-3)$ Right side $= 4.5(-3) + 19.5$

$= 12.9 - 6.9$ $= -13.5 + 19.5$

$= 6$ $= 6$

Since the left side equals the right side, $y = -3$ is correct.

g) $\frac{2}{5}(m + 4) = \frac{1}{5}(3m + 9)$ Multiply both sides by 5 to clear the fractions.

$5 \times [\frac{2}{5}(m + 4)] = 5 \times [\frac{1}{5}(3m + 9)]$ Use the distributive property.

$\cancel{5}^{1} \times \frac{2}{\cancel{5}_{1}}(m + 4) = \cancel{5}^{1} \times \frac{1}{\cancel{5}_{1}}(3m + 9)$

$2(m + 4) = 3m + 9$ Use the distributive property to expand $2(m + 4)$.

$2m + 8 = 3m + 9$ Subtract $2m$ from each side.

$2m + 8 - 2m = 3m + 9 - 2m$

$8 = m + 9$ Subtract 9 from each side.

$8 - 9 = m + 9 - 9$

$m = -1$

To verify the solution, substitute $m = -1$ into $\frac{2}{5}(m + 4) = \frac{1}{5}(3m + 9)$.

Left side $= \frac{2}{5}(-1 + 4)$ Right side $= \frac{1}{5}[3(-1) + 9]$

$= \frac{2}{5}(3)$ $= \frac{1}{5}(6)$

$= \frac{6}{5}$ $= \frac{6}{5}$

Since the left side equals the right side, $m = -1$ is correct.

8. a) Let t represent the time in hours for which the rental charges in both shops are equal.
Shop Y charges \$15 plus \$3 per hour, or $15 + 3t$.
Shop Z charges \$12 plus \$4 per hour, or $12 + 4t$.
When both charges are equal, an equation is: $15 + 3t = 12 + 4t$

b) $15 + 3t = 12 + 4t$ Subtract $3t$ from both sides.

$15 + 3t - 3t = 12 + 4t - 3t$

$15 = 12 + t$ Subtract 12 from both sides.

$15 - 12 = 12 + t - 12$

$t = 3$

Rental charges are equal for 3 h of rental.

c) To verify the solution, go back to the original problem.
Shop Y charges \$15 plus \$3 per hour, or \$15 + \$3 × 3 = \$15 + \$9
= \$24
Shop Z charges \$12 plus \$4 per hour, or \$12 + \$4 × 3 = \$12 + \$12
= \$24
Since these two charges are equal, the solution is correct.

Lesson 6.3 Introduction to Linear Inequalities Practice (pages 292–293)

Check

3. **a)** True. 5 is less than 8.

b) False. −5 is greater than −8.

c) False. 5 is greater than −8.

d) False. 5 is not less than 5.

e) True. 5 is less than or *equal to* 5.

f) True. 0 is *greater than* or equal to −5.

g) True. 5.01 is less than 5.1.

h) False. $\frac{1}{5}$ = 0.2 and $\frac{1}{8}$ = 0.125, so $\frac{1}{5}$ is greater than $\frac{1}{8}$.

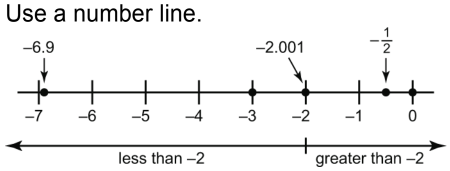
4. **a)** Use the less than sign: $x < -2$

b) Use the greater than or equal to sign: $p \geq 6$

c) Negative numbers are less than zero. Use the less than sign: $y < 0$

d) Positive numbers are greater than zero. Use the greater than sign: $m > 0$

5. Use a number line.



a) No, for a number to be less than –2, it must lie to the left of –2. So, 0 > –2

b) Yes, –6.9 is to the left of –2. So, –6.9 < –2

c) Yes, –2.001 is to the left of –2. So, −2.001 < –2

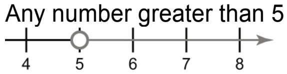
d) Yes, –3 is to the left of –2. So, –3 < –2

e) No, –2 is equal to –2. So, –2 = –2

f) No, $-\frac{1}{2}$ is to the right of –2. So, $-\frac{1}{2} > -2$

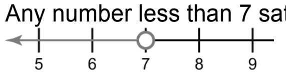
6. **a)** $b > 5$

Any number greater than 5 satisfies the inequality.



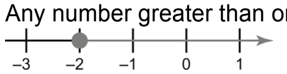
Four possible solutions are: 5.1, 6, 10, 20

b) $7 < x$
Any number less than 7 satisfies the inequality.



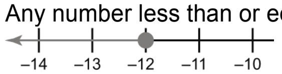
Four possible solutions are: 6.9, 6, 0, −2

c) $-2 \le v$
Any number greater than or equal to −2 satisfies the inequality.



Four possible solutions are: −1.9, 0, 3, 7

d) $w \le -12$
Any number less than or equal to −12 satisfies the inequality.



−12, −12.01, −13, −15

Apply

7. Use substitution.

a) No; $3 < 3$ is false, 3 is not a solution.
3 is equal to 3. So, 3 is a solution for the inequality $w \le 3$.

b) Yes $-3.5 < 0$ is true.

c) No; $5.05 \ge 5\frac{1}{2}$ is false, 5.05 is not a solution.

5.05 is less than $5\frac{1}{2}$. So, 5.05 is a solution for the inequality $m < 5\frac{1}{2}$.

d) Yes, $-15 \le -2$ is true.

8. a) Let *c* represent the number of cups of water a coffee maker can hold.
"No more than" means the coffee maker can hold 12, or 11, or 10, and so on, cups of water.
So, *c* can be less than or equal to 12.
The inequality is $c \le 12$

b) Let *a* represent the age to obtain a learner's permit to drive in Nunavut.
"At least" means that you must be15, or 16, or 17, or so on, years old.
So, *a* can be greater than or equal to 15.
The inequality is $a \ge 15$

c) Let *m* represent the maximum seating capacity of a school bus.
"Maximum" means the bus can hold 48, or 47, or 46, and so on, students.
So, *m* can be less than or equal to 48.
The inequality is $m \le 48$

d) Let *n* represent the number of people participating in the charity bike-a-thon each year.
"Over 2500" means greater than 2500.
The inequality is $n > 2500$

e) Let *s* represent the size of shoes in a shoe store.
"No larger than" means that 13 is the largest size.
So, *s* must be less than or equal to 13.
The inequality is $s \le 13$

9. a) Graph v; the solution represents all numbers greater than 3 (but not equal to 3).

b) Graph iii; the solution is equal to 3.

c) Graph iv; the solution represents all numbers less than or equal to 3.

d) Graph ii; the solution represents all numbers less than 3 (but not equal to 3).

e) Graph i; the solution represents all numbers greater than or equal to 3.

f) Graph v; the solution represents all numbers greater than 3 (but not equal to 3).

g) Graph iv; the solution represents all numbers less than or equal to 3.

h) Graph i; the solution represents all numbers greater than or equal to 3.

10. Both are correct.
Tom's inequality says that a is greater than 4 while Stevie's says that 4 is less than b.
Both these mean that the variable must be greater than 4.

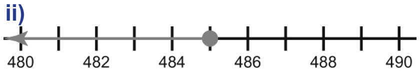
11. a) i) Let k represent the mass in kilograms of a child who must ride in a car seat in Canada.
"Under" means that a child must weigh less than 23 kg.
So, k must be less than 23.
The inequality is $k < 23$

ii) Let t represent the temperature in degrees Celsius that a silicone oven mitt can resist.
"Up to" includes the maximum temperature 485 degrees Celsius.
So, t can be less than or equal to 485.
The inequality is $t \leq 485$

iii) Let w represent the hourly wage in dollars in Alberta.
"Minimum" means that the wage must be \$8.40 or greater.
So, w must be greater than or equal to 8.40.
The inequality is $w \geq 8.40$

b) i)

ii)



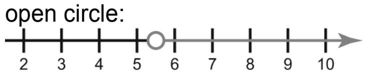
iii)

12. a) The open circle indicates that 1 is not part of the solution. The graph represents all numbers greater than 1. The inequality is $x > 1$
Neither 1 nor −3 are part of the solution because they do not lie to the right of 1.
To check, substitute 1 for x in the inequality $x > 1$; since $1 > 1$ is false, 1 is not a solution.
Substitute 3 for x in the inequality $x > 1$; since $-3 > 1$ is false, −3 is not a solution.

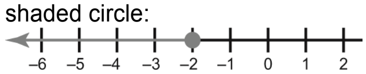
b) The shaded circle indicates that 2 is part of the solution. The graph represents all numbers less than or equal to 2. The inequality is $x \le 2$
Both 1 and −3 are part of the solution because they both lie to the left of 2.
To check, substitute 1 for x in the inequality $x \le 2$; since $1 \le 2$, 1 is a solution.
Substitute −3 for x in the inequality $x \le 2$; since $-3 \le 2$, −3 is a solution.

c) The open circle indicates that −10 is not part of the solution. The graph represents all numbers less than −10. The inequality is $x < -10$
Neither 1 nor −3 are part of the solution because they do not lie to the left of −10.
To check, substitute 1 for x in $x < -10$; since $1 < -10$ is false, 1 is not a solution.
Substitute −3 for x in $x < -10$; since $-3 < -10$ is false, −3 is not a solution.

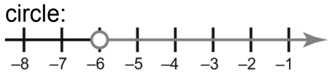
13. a) $w > 5.5$
For $w > 5.5$, the solution is all numbers greater than 5.5. Since 5.5 is not part of the solution, draw an open circle:



b) $x \le -2$
For $x \le -2$, the solution is all numbers less than or equal to –2. Since –2 is part of the solution, draw a shaded circle:

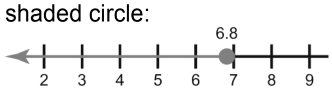


c) $z > -6$
For $z > -6$, the solution is all numbers greater than –6. Since –6 is not part of the solution, draw an open circle:



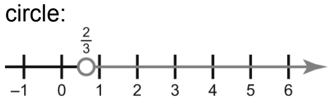
d) $a < 6.8$
For $a < 6.8$, the solution is all numbers less than –6.8. Since –6.8 is not part of the solution, draw an open circle:

e) $b \le 6.8$
For $b \le 6.8$, the solution is all numbers less than or equal to 6.8. Since 6.8 is part of the solution, draw a shaded circle:



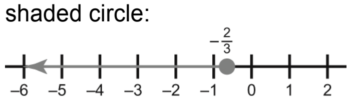
f) $c > \frac{2}{3}$

For $c > \frac{2}{3}$, the solution is all numbers greater than $\frac{2}{3}$. Since $\frac{2}{3}$ is not part of the solution, draw an open circle:



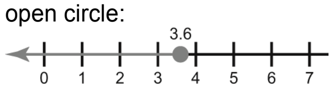
g) $d \le -\frac{2}{3}$

For $d \le -\frac{2}{3}$, the solution is all numbers less than or equal to $\frac{2}{3}$. Since $\frac{2}{3}$ is part of the solution, draw a shaded circle:



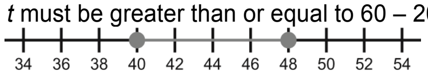
h) $x < \frac{18}{5}$

For $x < \frac{18}{5}$, the solution is all numbers less than $\frac{18}{5}$. Since $\frac{18}{5}$ is not part of the solution, draw an open circle:



Take It Further

14. Let t represent the possible show time in minutes. One hour is 60 min.
The show must have at least 12 min of commercials.
So, t must be less than or equal to 60 – 12 = 48, or $t \le 48$.
The show must have no more than 20 min of commercials.
So, t must be greater than or equal to 60 – 20 = 40, or $t \ge 40$.



The inequalities are $t \le 48$ and $t \ge 40$

15. a) Over is >; under is <; maximum is ≤ ; minimum is ≥ ; at least is ≥ ; no more than is ≤ .

b) Over: To ride on a roller coaster, a child must be over 122 cm tall.
Let h represent the height in centimetres:
$h > 122$
Under: The number of people riding in the elevator must be under 10.
Let n represent the number of people:
$n < 10$
Maximum: The maximum seating capacity for the arena is 15 000.
Let s represent the number of seats:
$s \le 15\,000$
Minimum: The minimum purchase to receive a discount is \$100.
Let p represent the minimum purchase, in dollars:
$p \ge 100$
At least: The batter must get at least 2 hits this game to break the record.
Let h represent the number of hits:
$h \ge 2$
No more than: Drivers may drive at a speed no more than 30 km/h through a school zone.
Let s represent the speed in kilometres per hour:
$s \le 30$

16. $y \ge 0$. “Not negative” means the answer could be zero or any positive number, since zero is neither negative nor positive.

Lesson 6.4 **Solving Linear Inequalities by Using Addition and Subtraction** **Practice (pages 298–299)**

Check

4. **a)** Subtract 4 from each side.
$a + 4 - 4 > 3 - 4$
$a > -1$

b) Add $\frac{2}{3}$ to each side.
$0 + \frac{2}{3} < -\frac{2}{3} + m + \frac{2}{3}$
$\frac{2}{3} < m$

c) Add 4 to each side.
$r - 4 + 4 \geq -3 + 4$
$r \geq 1$

d) Add 4.5 to each side.
$k - 4.5 + 4.5 \leq 5.7 + 4.5$
$k \leq 10.2$

e) Subtract $\frac{3}{10}$ from each side.
$s + \frac{3}{10} - \frac{3}{10} \leq -3 - \frac{3}{10}$
$s \leq -\frac{33}{10}$

f) Subtract 4.9 from each side.
$6.1 - 4.9 > 4.9 + z - 4.9$
$1.2 > z$

5. **a)** Add 2 to each side.
$x - 2 + 2 > 8 + 2$
$x > 10$

b) Subtract 4.2 from each side.
$12.9 - 4.2 \leq y + 4.2 - 4.2$
$8.7 \leq y$
$y \geq 8.7$

c) Add $\frac{1}{2}$ to each side.
$p - \frac{1}{2} + \frac{1}{2} \leq \frac{1}{2} + \frac{1}{2}$
$p \leq 1$

6. Solve the inequalities.

a) $x + 3 \geq 7$ Subtract 3 from each side.
$x + 3 - 3 \geq 7 - 3$
$x \geq 4$
The solution of the inequality $x \geq 4$ is all numbers greater than or equal to 4.
3 possible solutions are: 4, $\frac{13}{3}$, 4.1

b) $x - 3 \leq 7$ Add 3 to each side.
$x - 3 + 3 \leq 7 + 3$
$x \leq 10$
The solution of the inequality $x \leq 10$ is all numbers less than or equal to 10.
3 possible solutions are: 10, $\frac{13}{3}$, 9.5

c) $x + 7 < 3$ Subtract 7 from each side.
$x + 7 - 7 < 3 - 7$
$x < -4$
The solution of the inequality $x < -4$ is all numbers less than –4.
3 possible solutions are: −5, $-\frac{9}{2}$, −4.1

d) $x - 3 > 7$ Add 3 to each side.
$x - 3 + 3 > 7 + 3$
$x > 10$
The solution of the inequality $x > 10$ is all numbers greater than 10.
3 possible solutions are: 11, $\frac{37}{3}$, 10.01

Apply

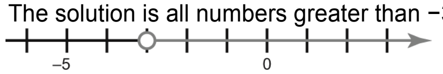
7. a) $c - 2 > 2$ Add 2 to each side.
$c - 2 + 2 > 2 + 2$
$c > 4$
The solution of the inequality $c > 4$ is all numbers greater than 4.
$c > 4$ corresponds to graph iii; 3 is not a solution, since 3 is not greater than 4.

b) $8 \geq -5 + w$ Add 5 to each side.
$8 + 5 \geq -5 + w + 5$
$13 \geq w$
$w \leq 13$
The solution of the inequality $w \leq 13$ is all numbers greater than or equal to 13.
$w \leq 13$ corresponds to graph ii; 3 is a possible solution, since 3 is less than 13.

c) $1 > r + 8$ Subtract 8 from each side.
$1 - 8 > r + 8 - 8$
$-7 > r$
$r < -7$
The solution of the inequality $r < -7$ is all numbers less than−7.
$r < -7$ corresponds to graph i; 3 is not a solution, since 3 is not less than −7.

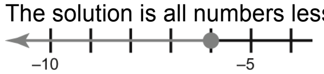
d) $7 + m \le -2$ Subtract 7 from each side.
$7 + m - 7 \le -2 - 7$
$m \le -9$
The solution of the inequality $m \le -9$ is all numbers less than or equal to −9.
$m \le -9$ corresponds to graph iv; 3 is not a solution, since 3 is not less than or equal to −9.

8. a) $x + 5 > 2$ Subtract 5 from each side.
$x + 5 - 5 > 2 - 5$
$x > -3$
The solution is all numbers greater than −3.



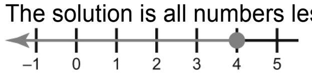
Choose a number greater than −3, such as 0.
Substitute $x = 0$ in $x + 5 > 2$.
Left side = 0 + 5 Right side = 2
= 5
Since 5 > 2, the left side is greater than the right side, and $x = 0$ satisfies the inequality.

b) $-9 \ge y - 3$ Add 3 to each side.
$-9 + 3 \ge y - 3 + 3$
$-6 \ge y$
$y \le -6$
The solution is all numbers less than or equal to −6.



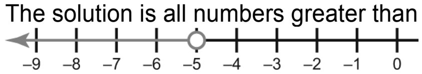
Choose a number less than −6, such as −10.
Substitute $y = -10$ in $-9 \ge y - 3$.
Left side = −9 Right side = −10 − 3
= −13
Since −9 > −13, the left side is greater than the right side, and $y = -10$ satisfies the inequality.

c) $4 + a \le 8$ Subtract 4 from each side.
$4 + a - 4 \le 8 - 4$
$a \le 4$
The solution is all numbers less than or equal to 4.



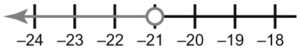
Choose a number less than 4, such as 1.
Substitute $a = 1$ in $4 + a \le 8$.
Left side = 4 + 1 Right side = 8
= 5
Since 5 < 8, the left side is less than the right side, and $a = 1$ satisfies the inequality.

d) $2 > x + 7$ Subtract 7 from each side.
$2 - 7 > x + 7 - 7$
$-5 > x$
$x < -5$
The solution is all numbers greater than −3.



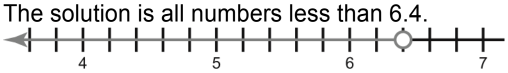
Choose a number less than −5, such as −10.
Substitute $x = -10$ in $2 > x + 7$.
Left side = 2 Right side = −10 + 7
= −3
Since 2 > −3, the left side is greater than the right side, and $x = -10$ satisfies the inequality.

e) $k + 8 < -13$ Subtract 8 from each side.
$k + 8 - 8 < -13 - 8$
$k < -21$
The solution is all numbers less than −21.



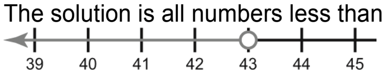
Choose a number less than −21, such as −30.
Substitute $k = -30$ in $k + 8 < -13$.
Left side = −30 + 8 Right side = −13
= −38
Since −38 < −13, the left side is less than the right side, and $k = -10$ satisfies the inequality.

f) $q - 2.5 < 3.9$ Add 2.5 to each side.
$q - 2.5 + 2.5 < 3.9 + 2.5$
$q < 6.4$
The solution is all numbers less than 6.4.



Choose a number less than 6.4, such as 2.
Substitute $q = 2$ in $q - 2.5 < 3.9$.
Left side = 2 − 2.5 Right side = 3.9
= 0.5
Since 0.5 < 3.9, the left side is less than the right side, and $q = 2$ satisfies the inequality.

9. a) $4t - 19 < 24 + 3t$ Subtract $3t$ from each side.
$4t - 19 - 3t < 24 + 3t - 3t$
$t - 19 < 24$ Add 19 to each side.
$t - 19 + 19 < 24 + 19$
$t < 43$
The solution is all numbers less than 43.



Choose 3 numbers less than 43, such as 0, 1, and 10.

Substitute $t = 0$ in $4t - 19 < 24 + 3t$.
Left side = 4(0) – 19 Right side = 24 + 3(0)
= –19 = 24
Since –19 < 24, the left side is less than the right side, and $t = 0$ satisfies the inequality.

Substitute $t = 1$ in $4t - 19 < 24 + 3t$.
Left side = 4(1) – 19 Right side = 24 + 3(1)
= –15 = 27
Since –15 < 27, the left side is less than the right side, and $t = 1$ satisfies the inequality.

Substitute $t = 10$ in $4t - 19 < 24 + 3t$.
Left side = 4(10) – 19 Right side = 24 + 3(10)
= 21 = 54
Since 21 < 54, the left side is less than the right side, and $t = 10$ satisfies the inequality.

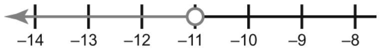
Since all 3 substitutions verify the inequality, it suggests that $t < 43$ is correct.

b) $3x < 2x - 11$ Subtract $2x$ from each side.

$3x - 2x < 2x - 11 - 2x$

$x < -11$

The solution is all numbers less than −11.



Choose 3 numbers less than −11, such as −20, −25, and −50.

Substitute $x = -20$ in $3x < 2x - 11$.

Left side = 3(−20) Right side = 2(−20) – 11

= −60 = −51

Since −60 < −51, the left side is less than the right side, and $x = -20$ satisfies the inequality.

Substitute $x = -25$ in $3x < 2x - 11$.

Left side = 3(−25) Right side = 2(−25) – 11

= −75 = −61

Since −75 < −61, the left side is less than the right side, and $x = -25$ satisfies the inequality.

Substitute $x = -50$ in $3x < 2x - 11$.

Left side = 3(−50) Right side = 2(−50) – 11

= −150 = −111

Since −150 < −111, the left side is less than the right side, and $x = -50$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $x < -11$ is correct.

c) $5x - 7 < 4x + 4$ Subtract $4x$ from each side.

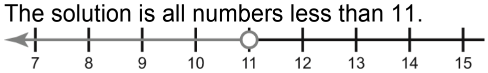
$5x - 7 - 4x < 4x + 4 - 4x$

$x - 7 < 4$ Add 7 to each side.

$x - 7 + 7 < 4 + 7$

$x < 11$

The solution is all numbers less than 11.



Choose 3 numbers less than 11, such as 10, 1, and 0.

Substitute $x = 10$ in $5x - 7 < 4x + 4$.

Left side = 5(10) – 7 Right side = 4(10) + 4

= 43 = 44

Since 43 < 44, the left side is less than the right side, and $x = 10$ satisfies the inequality.

Substitute $x = 1$ in $5x - 7 < 4x + 4$.

Left side = 5(1) – 7 Right side = 4(1) + 4

= –2 = 8

Since –2 < 8, the left side is less than the right side, and $x = 1$ satisfies the inequality.

Substitute $x = 0$ in $5x - 7 < 4x + 4$.

Left side = 5(0) – 7 Right side = 4(0) + 4

= –7 = 4

Since –7 < 4, the left side is less than the right side, and $x = 0$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $x < 11$ is correct.

d) $2 + 3a \le 2a - 5$ Subtract $2a$ from each side.
$2 + 3a - 2a \le 2a - 5 - 2a$
$2 + a \le -5$ Subtract 2 from each side.
$2 + a - 2 \le -5 - 2$
$a \le -7$
The solution is all numbers less than or equal to −7.

Choose 3 numbers less than −7, such as −10, −20, and −100.

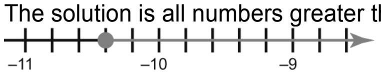
Substitute $a = -10$ in $2 + 3a \le 2a - 5$.
Left side $= 2 + 3(-10)$ Right side $= 2(-10) - 5$
$= -28$ $= -25$
Since $-28 < -25$, the left side is less than the right side, and $a = -10$ satisfies the inequality.

Substitute $a = -20$ in $2 + 3a \le 2a - 5$.
Left side $= 2 + 3(-20)$ Right side $= 2(-20) - 5$
$= -58$ $= -45$
Since $-58 < -45$, the left side is less than the right side, and $a = -20$ satisfies the inequality.

Substitute $a = -100$ in $2 + 3a \le 2a - 5$.
Left side $= 2 + 3(-100)$ Right side $= 2(-100) - 5$
$= -298$ $= -205$
Since $-298 < -205$, the left side is less than the right side, and $a = -100$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $a \le -7$ is correct.

e) $1.7p + 2.8 \ge 0.7p - 7.6$ Subtract $0.7p$ from each side.
$1.7p + 2.8 - 0.7p \ge 0.7p - 7.6 - 0.7p$
$p + 2.8 \ge -7.6$ Subtract 2.8 from each side.
$p + 2.8 - 2.8 \ge -7.6 - 2.8$
$p \ge -10.4$
The solution is all numbers greater than or equal to −10.4.



Choose 3 numbers greater than −10.4, such as −10, 0, and 10.

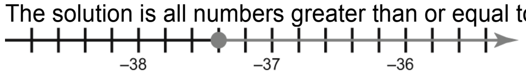
Substitute $p = -10$ in $1.7p + 2.8 \ge 0.7p - 7.6$.
Left side $= 1.7(-10) + 2.8$ Right side $= 0.7(-10) - 7.6$
$= -17 + 2.8$ $= -7 - 7.6$
$= -14.2$ $= -14.6$
Since $-14.2 > -14.6$, the left side is greater than the right side, and $p = -10$ satisfies the inequality.

Substitute $p = 0$ in $1.7p + 2.8 \ge 0.7p - 7.6$.
Left side $= 1.7(0) + 2.8$ Right side $= 0.7(0) - 7.6$
$= 2.8$ $= -7.6$
Since $2.8 > -7.6$, the left side is greater than the right side, and $p = 0$ satisfies the inequality.

Substitute $p = 10$ in $1.7p + 2.8 \ge 0.7p - 7.6$.
Left side $= 1.7(10) + 2.8$ Right side $= 0.7(10) - 7.6$
$= 17 + 2.8$ $= 7 - 7.6$
$= 19.8$ $= -0.6$
Since $19.8 > -0.6$, the left side is greater than the right side, and $p = 10$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $p \ge -10.4$ is correct.

f) $2y + 13.3 \geq y - 24.1$ Subtract y from each side.
$2y + 13.3 - y \geq y - 24.1 - y$
$y + 13.3 \geq -24.1$ Subtract 13.3 from each side.
$y + 13.3 - 13.3 \geq -24.1 - 13.3$
$y \geq -37.4$
The solution is all numbers greater than or equal to −37.4.



Choose 3 numbers greater than −37.4, such as −1, 0, and 1.

Substitute $y = -1$ in $2y + 13.3 \geq y - 24.1$.
Left side $= 2(-1) + 13.3$ Right side $= -1 - 24.1$
$= -2 + 13.3$ $= -25.1$
$= 11.3$
Since $11.3 > -25.1$, the left side is greater than the right side, and $y = -1$ satisfies the inequality.

Substitute $y = 0$ in $2y + 13.3 \geq y - 24.1$.
Left side $= 2(0) + 13.3$ Right side $= 0 - 24.1$
$= 13.3$ $= -24.1$
Since $13.3 > -24.1$, the left side is greater than the right side, and $y = 0$ satisfies the inequality.

Substitute $y = 1$ in $2y + 13.3 \geq y - 24.1$.
Left side $= 2(1) + 13.3$ Right side $= 1 - 24.1$
$= 2 + 13.3$ $= -23.1$
$= 15.3$
Since $15.3 > -23.1$, the left side is greater than the right side, and $y = 1$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $y \geq -37.4$ is correct.

10. No, −9 is only one of the possible solutions.
The solution of $-7 \geq b + 2$ is $-9 \geq b$; that is, b is any number that is less than or equal to −9.

11. a) $7.4 + 2p = p - 2.8$ Subtract 7.4 from each side.
$7.4 + 2p - 7.4 = p - 2.8 - 7.4$
$2p = p - 10.2$ Subtract p from each side.
$2p - p = p - 10.2 - p$
$p = -10.2$

b) $7.4 + 2p \geq p - 2.8$ Subtract 7.4 from each side.
$7.4 + 2p - 7.4 \geq p - 2.8 - 7.4$
$2p \geq p - 10.2$ Subtract p from each side.
$2p - p \geq p - 10.2 - p$
$p \geq -10.2$

c) I solved the inequality and the equation the same way, by first subtracting 7.4 from each side, then subtracting p from each side. The difference was that I used an equal sign in the equation, and an inequality sign in the inequality.

d) In both the inequality and the related equation, the solutions are numbers. The solution of an inequality is a set of numbers, whereas the solution of the related equation is one number.

12. a) Let v dollars represent the money that Joel can deposit in his account. His balance plus his deposit must be greater than or equal to \$750. So, an inequality is $212.35 + v \geq 750$

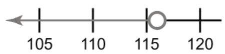
b) $212.35 + v \geq 750$ Subtract 212.35 from each side.
$212.35 + v - 212.35 \geq 750 - 212.35$
$v \geq 537.65$
Joel can deposit $537.65 or more in his account to avoid paying a monthly fee.

c)


13. a) Let x represent the money, in dollars, that Teagan has in her savings before adding $20.
Her savings plus $20 is less than $135.99.
So, an inequality is: $x + 20 < 135.99$

b) $x + 20 < 135.99$ Subtract 20 from each side.
$x + 20 - 20 < 135.99 - 20$
$x < 115.99$
Teagan has less than $115.99 in her savings. She cannot buy the helmet with this amount.

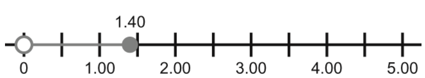
c) Choose a number less than 115.99, such as 100.
Substitute $x = 100$ in $x + 20 < 135.99$.
Left side = 100 + 20 Right side = 135.99
= 120
Since 120 < 135.99, the left side is less than the right side, and $x = 100$ satisfies the inequality.



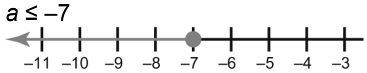
Take It Further

14. a) Let m dollars represent the money that Marie can spend on a muffin.
The cost of the cake and the muffin must be less than or equal to $1.45.
So, an inequality is: $3.45 + m \leq 4.85$

b) $3.45 + m \leq 4.85$ Subtract 3.45 from each side.
$3.45 + m - 3.45 \leq 4.85 - 3.45$
$m \leq 1.40$; Marie can spend up to $1.40 on a muffin.

c)


d) No; since $1.40 (the maximum amount Marie can spend) is less than $1.45, she cannot afford to buy the deluxe muffin.

15. a) i) $2a - 5 \geq 2 + 3a$ Subtract $2a$ from each side.
$2a - 5 - 2a \geq 2 + 3a - 2a$
$-5 \geq 2 + a$ Subtract 2 from each side.
$-5 - 2 \geq 2 + a - 2$
$-7 \geq a$
$a \leq -7$


ii) $0.7p - 7.6 \le 1.7p + 2.8$ Subtract $0.7p$ from each side.

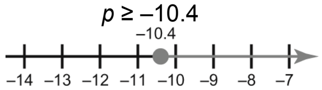
$0.7p - 7.6 - 0.7p \le 1.7p + 2.8 - 0.7p$

$-7.6 \le p + 2.8$ Subtract 2.8 from each side.

$-7.6 - 2.8 \le p + 2.8 - 2.8$

$-10.4 \le p$

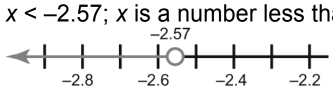
$p \ge -10.4$



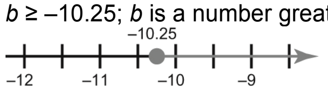
b) I used inverse operations were used to solve both inequalities. There were variables on both sides, so I subtracted the variable term with the least coefficient to ensure that the remaining variable term had a positive coefficient.

c) The graphs and solutions of part a are the same as those for questions 9d and 9e. The difference is the inequalities in 9d and 9e are written in reverse order than in part a.

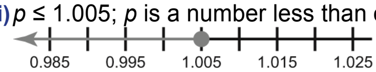
16. a) i) $x < -2.57$; x is a number less than -2.57.



ii) $b \ge -10.25$; b is a number greater than or equal to -10.25.



iii) $p \le 1.005$; p is a number less than or equal to 1.005.



b) These inequalities are different from previous ones because the decimals cannot easily be graphed accurately.

c) An inequality is a more accurate way to describe a solution. It is difficult to graph fractions and decimals.

Lesson 6.5 **Solving Linear Inequalities by Using Multiplication and Division** **Practice (pages 305–306)**

Check

3. Explanations may vary.

a) No, the direction of the inequality sign will not change.
Check:
$-9 < -2$; multiply each side by 4.
Left side $= (-9) \times 4$ $= -36$ Right side $= (-2) \times 4$ $= -8$
Since $-36 < -8$, my prediction was correct. The left side is less than the right side, and the direction of the inequality sign does not change.

b) Yes, the direction of the inequality sign will change.
Check:
$14.5 > 11.5$; multiply each side by -3.
Left side $= 14.5 \times (-3)$ $= -43.5$ Right side $= 11.5 \times (-3)$ $= -34.5$
Since $-43.5 < -34.5$, my prediction was correct. The left side is less than the right side, and the direction of the inequality sign changes. When I multiply by a negative number, I reverse the inequality sign.

c) Yes, the direction of the inequality sign will change.
$6 > -12$; divide each side by -4.
Check:
Left side $= \frac{6}{-4}$ $= \frac{3}{-2}$ Right side $= \frac{-12}{-4}$ $= 3$
Since $\frac{3}{-2} < 3$, my prediction was correct. The left side is less than the right side, and the direction of the inequality sign changes. When I divide by a negative number, I reverse the inequality sign.

d) No, the direction of the inequality sign will not change.
Check:
$-4 < 10$; divide each side by 4.
Left side $= \frac{-4}{4}$ $= -1$ Right side $= \frac{10}{4}$ $= \frac{5}{2}$
Since $-1 < \frac{5}{2}$, my prediction was correct. The left side is less than the right side, and the direction of the inequality sign does not change.

4. a) $4w < 3$
Substitute $w = -2$.
Left side $= 4(-2)$ $= -8$ Right side $= 3$
Since $-8 < 3$, the left side is less than the right side, and -2 is a solution.

Substitute $w = 0$.
Left side $= 4(0)$ $= 0$ Right side $= 3$
Since $0 < 3$, the left side is less than the right side, and 0 is a solution.

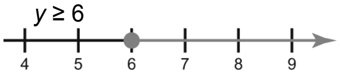
Substitute w = 2.5.
Left side = 4(2.5) Right side = 3
= 10
Since 10 > 3, the left side is greater than the right side, and 2.5 is not a solution.

b) $3d \geq 5d + 10$
Substitute d = –5.
Left side = 3(–5) Right side = 5(–5) + 10
= –15 = –25 + 10
= –15
Since –15 = –15, the left side equals the right side, and –5 is a solution.

Substitute d = 0.
Left side = 3(0) Right side = 5(0) + 10
= 0 = 0 + 10
= 10
Since 0 < 10, the left side is less than the right side, and 0 is not a solution.

Substitute d = 5.
Left side = 3(5) Right side = 5(5) + 10
= 15 = 25 + 10
= 35
Since 15 < 35, the left side is less than the right side, and 5 is not a solution.

5. a) i) Yes, I would reverse the inequality sign.
$10 - y \leq 4$ Subtract 10 from each side.
$10 - y - 10 \leq 4 - 10$
$-y \leq -6$ Divide both sides by –1 and reverse the inequality sign.
$$\frac{-y}{-1} \geq \frac{-6}{-1}$$
$y \geq 6$



ii) No, I would not reverse the inequality sign.
$3c > -12$ Divide both sides by 3.
$$\frac{3c}{3} > \frac{-12}{3}$$
$c > -4$

iii) Yes, I would reverse the inequality sign.
$-6x < 30$ Divide both sides by –6 and reverse the inequality sign.
$$\frac{-6x}{-6} > \frac{30}{-6}$$
$x > -5$

iv) Yes, I would reverse the inequality sign.

$\frac{m}{-2} < 3$ Multiply each side by –2 and reverse the inequality sign.

$(\frac{m}{-2}) \times (-2) > 3 \times (-2)$

$m > -6$

b) i) The solution of the inequality $y \geq 6$ is all numbers greater than or equal to 6. For example: 6, 6.48, $\frac{25}{4}$

ii) The solution of the inequality $c > -4$ is all numbers greater than −4. For example: −3, 0.5, $\frac{1}{2}$

iii) The solution of the inequality $x > -5$ is all numbers greater than −5. For example: −4, 0.5, $\frac{1}{2}$

iv) The solution of the inequality $m > -6$ is all numbers greater than −6. For example: −5, 0.5, $\frac{1}{2}$

6. No. Multiplying both sides by −3 would require you to reverse the inequality sign.
The inequality should be $-3c < -27$.

Apply

7. a) $4 - 2t < 7$ Subtract 4 from each side.

$4 - 2t - 4 < 7 - 4$

$-2t < 3$ Divide each side by –2 and reverse the inequality sign.

$\frac{-2t}{-2} > \frac{3}{-2}$

$t > \frac{3}{-2}$

The solution of the inequality $t > \frac{3}{-2}$ is all numbers greater than $\frac{3}{-2}$. For example, –1, 0, 1

Substitute t = –1 in the original inequality.

Left side = 4 – 2(–1) Right side = 7
= 4 + 2
= 6

Since 6 < 7, the left side is less than the right side, and t = –1 satisfies the inequality.

Substitute t = 0 in the original inequality.

Left side = 4 – 2(0) Right side = 7
= 4 – 0
= 4

Since 4 < 7, the left side is less than the right side, and t = 0 satisfies the inequality.

Substitute t = 1 in the original inequality.

Left side = 4 – 2(1) Right side = 7
= 4 – 2
= 2

Since 2 < 7, the left side is less than the right side, and t = 1 satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $t > \frac{3}{-2}$ is correct.

b) $-5x + 2 > 24$ Subtract 2 from each side.
$-5x + 2 - 2 > 24 - 2$
$-5x > 22$ Divide each side by –5 and reverse the inequality sign.
$\frac{-5x}{5} < \frac{22}{-5}$
$x < \frac{22}{-5}$
The solution of the inequality $x < \frac{22}{-5}$ is all numbers less than $\frac{22}{-5}$, or –4.4. For example, –5, –10, –20

Substitute $x = -5$ in the original inequality.
Left side $= -5(-5) + 2$ Right side = 24
$= 25 + 2$
$= 27$
Since 27 > 24, the left side is greater than the right side, and $x = -5$ satisfies the inequality.

Substitute $x = -10$ in the original inequality.
Left side $= -5(-10) + 2$ Right side = 24
$= 50 + 2$
$= 52$
Since 52 > 24, the left side is greater than the right side, and $x = -10$ satisfies the inequality.

Substitute $x = -20$ in the original inequality.
Left side $= -5(-20) + 2$ Right side = 24
$= 100 + 2$
$= 102$
Since 102 > 24, the left side is greater than the right side, and $x = -20$ satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $x < \frac{22}{-5}$ is correct.

c) $2m + 3 \le -7$ Subtract 3 from each side.
$2m + 3 - 3 \le -7 - 3$
$2m \le -10$ Divide each side by 2.
$\frac{2m}{2} \le \frac{-10}{2}$
$m \le -5$
The solution of the inequality $m \le -5$ is all numbers less than or equal to –5. For example, –5, –6, –10

Substitute $m = -5$ in the original inequality.
Left side $= 2(-5) + 3$ Right side = –7
$= -10 + 3$
$= -7$
Since –7 = –7, the left side equals the right side, and $m = -5$ satisfies the inequality.

Substitute $m = -6$ in the original inequality.
Left side $= 2(-6) + 3$ Right side = –7
$= -12 + 3$
$= -9$
Since –9 < –7, the left side is less than the right side, and $m = -6$ satisfies the inequality.

Substitute $m = -10$ in the original inequality.
Left side $= 2(-10) + 3$ Right side $= -7$
$= -20 + 3$
$= -17$
Since $-17 < -7$, the left side is less than the right side, and $m = -10$ satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $m \le -5$ is correct.

d) $-4x - 2 > 10$ Add 2 to each side.
$-4x - 2 + 2 > 10 + 2$
$-4x > 12$ Divide each side by -4 and reverse the inequality sign.
$$\frac{-4x}{-4} < \frac{12}{-4}$$
$x < -3$
The solution of the inequality $x < -3$ is all numbers less than -3. For example, -4, -5, -10

Substitute $x = -4$ in the original inequality.
Left side $= -4(-4) - 2$ Right side $= 10$
$= 16 - 2$
$= 14$
Since $14 > 10$, the left side is greater than the right side, and $x = -4$ satisfies the inequality.

Substitute $x = -5$ in the original inequality.
Left side $= -4(-5) - 2$ Right side $= 10$
$= 20 - 2$
$= 18$
Since $18 > 10$, the left side is greater than the right side, and $x = -5$ satisfies the inequality.

Substitute $x = -10$ in the original inequality.
Left side $= -4(-10) - 2$ Right side $= 10$
$= 40 - 2$
$= 38$
Since $38 > 10$, the left side is greater than the right side, and $x = -10$ satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $x < -3$ is correct.

8. Let c represent the number of cars washed.
The amount earned for all the car washes is $5c$. This must be greater than or equal to \$300.
So, an inequality is: $5c \ge 300$

$5c \ge 300$ Divide both sides by 5.
$$\frac{5c}{5} \ge \frac{300}{5}$$
$c \ge 60$
At least 60 cars would have to be washed.

9. a) $1 - k \le 4 + k$ Subtract k from each side.

$1 - k - k \le 4 + k - k$

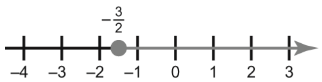
$1 - 2k \le 4$ Subtract 1 from each side.

$1 - 2k - 1 \le 4 - 1$

$-2k \le 3$

$\frac{-2k}{-2} \ge \frac{3}{-2}$ Divide each side by –2 and reverse the inequality sign.

$k \ge -\frac{3}{2}$



b) $2 + 3g < g - 5$ Subtract g from each side.

$2 + 3g - g < g - 5 - g$

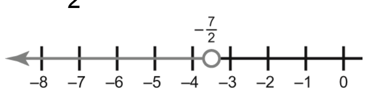
$2 + 2g < -5$ Subtract 2 from each side.

$2 + 2g - 2 < -5 - 2$

$2g < -7$ Divide each side by 2.

$\frac{2g}{2} < \frac{-7}{2}$

$g < -\frac{7}{2}$



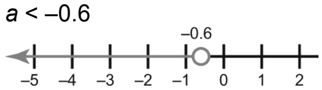
c) $4.5 - 2.5a > 6$ Subtract 4.5 from each side.

$4.5 - 2.5a - 4.5 > 6 - 4.5$

$-2.5a > 1.5$ Divide each side by –2.5 and reverse the inequality sign.

$\frac{-2.5a}{-2.5} < \frac{1.5}{-2.5}$

$a < -0.6$



d) $4.7b - 9 \ge 11 - 1.3b$ Add $1.3b$ to each side.

$4.7b - 9 + 1.3b \ge 11 - 1.3b + 1.3b$

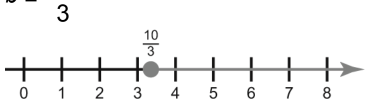
$6b - 9 \ge 11$ Add 9 to each side.

$6b - 9 + 9 \ge 11 + 9$

$6b \ge 20$ Divide each side by 6.

$\frac{6b}{6} \ge \frac{20}{6}$

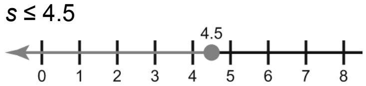
$b \ge \frac{10}{3}$



e) $-6.4 + 3.6s \leq 1.8s + 1.7$ Subtract 1.8*s* from each side.
$-6.4 + 3.6s - 1.8s \leq 1.8s + 1.7 - 1.8s$
$-6.4 + 1.8s \leq 1.7$ Add 6.4 to each side.
$-6.4 + 1.8s + 6.4 \leq 1.7 + 6.4$
$1.8s \leq 8.1$ Divide each side by 1.8.

$$\frac{1.8s}{1.8} \leq \frac{8.1}{1.8}$$

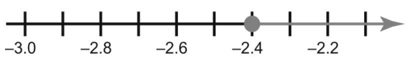
$s \leq 4.5$



f) $-2.5v + 4.7 \geq -3.8v + 1.58$ Add 3.8*v* to each side.
$-2.5v + 4.7 + 3.8v \geq -3.8v + 1.58 + 3.8v$
$1.3v + 4.7 \geq 1.58$ Subtract 4.7 from each side.
$1.3v + 4.7 - 4.7 \geq 1.58 - 4.7$
$1.3v \geq -3.12$ Divide each side by 1.3.

$$\frac{1.3v}{1.3} \geq \frac{-3.12}{1.3}$$

$v \geq -2.4$



10. a) Let *s* represent the number of tickets sold. The amount raised after selling *s* tickets is $7.5s - 1200$. This must be greater than \$1500 in order to make a profit. So, an inequality is: $7.5s - 1200 > 1500$

b) $7.5s - 1200 > 1500$ Add 1200 to each side.
$7.5s - 1200 + 1200 > 1500 + 1200$
$7.5s > 2700$ Divide each side by 7.5.

$$\frac{7.5s}{7.5} > \frac{2700}{7.5}$$

$s > 360$; more than 360 tickets need to be sold to make a profit of more than \$1500.

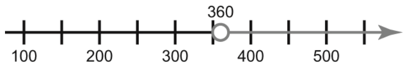
c) The solution of the inequality $s > 360$ is all numbers greater than 360. Choose several numbers greater than 360; for example, 361, 400, 500

Substitute $s = 361$ in the original inequality.
Left side $= 7.5(361) - 1200$ Right side $= 1500$
$= 2707.7 - 1200$
$= 1507.5$
Since $1507.5 > 1500$, the left side is greater than the right side, and $s = 361$ satisfies the inequality.

Substitute $s = 400$ in the original inequality.
Left side $= 7.5(400) - 1200$ Right side $= 1500$
$= 3000 - 1200$
$= 1800$
Since $1800 > 1500$, the left side is greater than the right side, and $s = 400$ satisfies the inequality.

Substitute $s = 500$ in the original inequality.
Left side $= 7.5(500) - 1200$ Right side $= 1500$
$= 3750 - 1200$
$= 2550$
Since $2550 > 1500$, the left side is greater than the right side, and $s = 500$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $s > 360$ is correct.



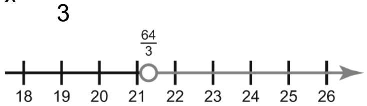
11. a) $1 + \frac{3}{4}x > 17$ Subtract 1 from each side.

$1 + \frac{3}{4}x - 1 > 17 - 1$

$\frac{3}{4}x > 16$ Multiply each side by $\frac{4}{3}$.

$(\frac{4}{3})(\frac{3}{4}x) > (\frac{4}{3})(16)$

$x > \frac{64}{3}$



b) $-2 \le -6 + \frac{1}{4}c$ Add 6 to each side.

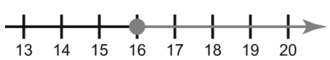
$-2 + 6 \le -6 + \frac{1}{4}c + 6$

$4 \le \frac{1}{4}c$ Multiply each side by 4.

$4 \times 4 \le 4 \times \frac{1}{4}c$

$16 \le c$

$c \ge 16$



c) $4 - \frac{2}{3}d \ge \frac{5}{6}d - 5$ Multiply by the common denominator 6.

$6(4 - \frac{2}{3}d) \ge 6(\frac{5}{6}d - 5)$ Use the distributive property to expand the brackets.

$24 - 4d \ge 5d - 30$ Subtract $5d$ from each side.

$24 - 4d - 5d \ge 5d - 30 - 5d$

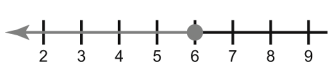
$24 - 9d \ge -30$ Subtract 24 from each side.

$24 - 9d - 24 \ge -30 - 24$

$-9d \ge -54$ Divide each side by –9 and reverse the inequality sign.

$\frac{-9d}{-9} \le \frac{-54}{-9}$

$d \le 6$



d) $\frac{3}{5}f - \frac{1}{2} < 2 + f$ Multiply by the common denominator 10.

$10(\frac{3}{5}f - \frac{1}{2}) < 10(2 + f)$ Use the distributive property to expand the brackets.

$6f - 5 < 20 + 10f$ Subtract 10*f* from each side.

$6f - 5 - 10f < 20 + 10f - 10f$

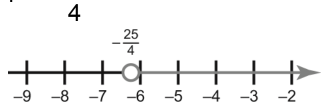
$-4f - 5 < 20$ Add 5 to each side.

$-4f - 5 + 5 < 20 + 5$

$-4f < 25$ Divide each side by –4 and reverse the inequality sign.

$\frac{-4f}{-4} > \frac{25}{-4}$

$f > -\frac{25}{4}$



12. a) $4a - 5 \geq a + 2$ Subtract *a* from each side.

$4a - 5 - a \geq a + 2 - a$

$3a - 5 \geq 2$ Add 5 to each side.

$3a - 5 + 5 \geq 2 + 5$

$3a \geq 7$ Divide each side by 3.

$\frac{3a}{3} \geq \frac{7}{3}$

$a \geq \frac{7}{3}$

The solution of the inequality $a \geq \frac{7}{3}$ is all numbers greater than or equal to $\frac{7}{3}$.

Choose 3 numbers greater than $\frac{7}{3}$, such as 3, 4, and 5.

Substitute *a* = 3 in the original inequality.

Left side = 4(3) − 5 Right side = 3 + 2
= 12 − 5 = 5
= 7

Since 7 > 5, the left side is greater than the right side, and *a* = 3 satisfies the inequality.

Substitute *a* = 4 in the original inequality.

Left side = 4(4) – 5 Right side = 4 + 2
= 16 – 5 = 6
= 11

Since 11 > 6, the left side is greater than the right side, and *a* = 4 satisfies the inequality.

Substitute *a* = 5 in the original inequality.

Left side = 4(5) – 5 Right side = 5 + 2
= 20 – 5 = 7
= 15

Since 15 > 7, the left side is greater than the right side, and *a* = 5 satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $a \geq \frac{7}{3}$ is correct.

b) $15t - 17 \geq 21 - 4t$ Add $4t$ to each side.
$15t - 17 + 4t \geq 21 - 4t + 4t$
$19t - 17 \geq 21$ Add 17 to each side.
$19t - 17 + 17 \geq 21 + 17$
$19t \geq 38$ Divide each side by 19.
$\frac{19t}{19} \geq \frac{38}{19}$
$t \geq 2$

The solution of the inequality $t \geq 2$ is all numbers greater than or equal to 2.
Choose 3 numbers greater than 2, such as 5, 10, and 20.

Substitute $t = 5$ in the original inequality.
Left side = $15(5) - 17$ Right side = $21 - 4(5)$
= $75 - 17$ = $21 - 20$
= 58 = 1
Since 58 > 1, the left side is greater than the right side, and $t = 5$ satisfies the inequality.

Substitute $t = 10$ in the original inequality.
Left side = $15(10) - 17$ Right side = $21 - 4(10)$
= $150 - 17$ = $21 - 40$
= 133 = –19
Since 133 > –19, the left side is greater than the right side, and $t = 10$ satisfies the inequality.

Substitute $t = 20$ in the original inequality.
Left side = $15(20) - 17$ Right side = $21 - 4(20)$
= $300 - 17$ = $21 - 80$
= 283 = –59
Since 283 > –59, the left side is greater than the right side, and $t = 20$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $t \geq 2$ is correct.

c) $10.5z + 16 \leq 12.5z + 12$ Subtract $10.5z$ from each side.
$10.5z + 16 - 10.5z \leq 12.5z + 12 - 10.5z$
$16 \leq 2z + 12$ Subtract 12 from each side.
$16 - 12 \leq 2z + 12 - 12$
$4 \leq 2z$ Divide each side by 2.
$\frac{4}{2} \leq \frac{2z}{2}$
$2 \leq z$
$z \geq 2$

The solution of the inequality $z \geq 2$ is all numbers greater than or equal to 2.
Choose 3 numbers greater than 2, such as 3, 6, and 10.

Substitute $z = 3$ in the original inequality.
Left side = $10.5(3) + 16$ Right side = $12.5(3) + 12$
= $31.5 + 16$ = $37.5 + 12$
= 47.5 = 49.5
Since 47.5 < 49.5, the left side is less than the right side, and $z = 3$ satisfies the inequality.

Substitute $z = 6$ in the original inequality.

Left side = 10.5(6) + 16 = 63 + 16 = 79

Right side = 12.5(6) + 12 = 75 + 12 = 87

Since 79 < 87, the left side is less than the right side, and $z = 6$ satisfies the inequality.

Substitute $z = 10$ in the original inequality.

Left side = 10.5(10) + 16 = 105 + 1 = 121

Right side = 12.5(10) + 12 = 125 + 12 = 137

Since 121 < 137, the left side is less than the right side, and $z = 10$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $z \geq 2$ is correct.

d) $7 + \frac{1}{3}b \leq 2b + 22$ Multiply each side by 3.

$3(7 + \frac{1}{3}b) \leq 3(2b + 22)$ Use the distributive property to expand the brackets.

$21 + b \leq 6b + 66$ Subtract b from each side.

$21 + b - b \leq 6b + 66 - b$

$21 \leq 5b + 66$ Subtract 66 from each side.

$21 - 66 \leq 5b + 66 - 66$

$-45 \leq 5b$ Divide each side by 5.

$\frac{-45}{5} \leq \frac{5b}{5}$

$-9 \leq b$

$b \geq -9$

The solution of the inequality $b \geq -9$ is all numbers greater than or equal to −9.
Choose 3 numbers greater than −9, such as −3, 0, and 3.

Substitute $b = -3$ in the original inequality.

Left side $= 7 + \frac{1}{3}(-3) = 7 - 1 = 6$

Right side $= 2(-3) + 22 = -6 + 22 = 16$

Since 6 < 16, the left side is less than the right side, and $b = -3$ satisfies the inequality.

Substitute $b = 0$ in the original inequality.

Left side $= 7 + \frac{1}{3}(0) = 7 + 0 = 7$

Right side $= 2(0) + 22 = 0 + 22 = 22$

Since 7 < 22, the left side is less than the right side, and $b = 0$ satisfies the inequality.

Substitute $b = 3$ in the original inequality.

Left side $= 7 + \frac{1}{3}(3) = 7 + 1 = 8$

Right side $= 2(3) + 22 = 6 + 22 = 28$

Since 8 < 28, the left side is less than the right side, and $b = 3$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $b \geq -9$ is correct.

13. a) Let k represent the number of kilometres driven. The cost of Jake's trip is 2.50 + 1.20k. This must be less than or equal to \$12.00. So, an inequality is: $2.5 + 1.2k \le 12$

b) $2.5 + 1.2k \le 12$ Subtract 2.5 from each side.

$2.5 + 1.2k - 2.5 \le 12 - 2.5$

$1.2k \le 9.5$ Divide each side by 1.2.

$$\frac{1.2k}{1.2} \le \frac{9.5}{1.2}$$

$k \le 7.91\overline{6}$

Jake can travel up to approximately 8 km for \$12.

c) The solution of the inequality $k \le 7.91\overline{6}$ is all numbers less than or equal to $7.91\overline{6}$.
Choose 3 numbers less than $7.91\overline{6}$, such as 7.8, 7, and 1.

Substitute $k = 7.8$ in the original inequality.

Left side = 2.5 + 1.2(7.8) Right side = 12
= 2.5 + 9.36
= 11.86

Since 11.86 < 12, the left side is less than the right side, and $k = 7.8$ satisfies the inequality.

Substitute $k = 7$ in the original inequality.

Left side = 2.5 + 1.2(7) Right side = 12
= 2.5 + 8.4
= 10.9

Since 10.9 < 12, the left side is less than the right side, and $k = 7$ satisfies the inequality.

Substitute $k = 1$ in the original inequality.

Left side = 2.5 + 1.2(1) Right side = 12
= 2.5 + 1.2
= 3.7

Since 3.7 < 12, the left side is less than the right side, and $k = 1$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $k \le 7.91\overline{6}$ is correct.

d)

14. a) $2 - \frac{3}{4}w = 3w + \frac{1}{2}$ Multiply by the common denominator 4.

$4(2 - \frac{3}{4}w) = 4(3w + \frac{1}{2})$ Use the distributive property to expand the brackets.

$8 - 3w = 12w + 2$ Add $3w$ to each side.

$8 - 3w + 3w = 12w + 2 + 3w$

$8 = 15w + 2$ Subtract 2 from each side.

$8 - 2 = 15w + 2 - 2$

$6 = 15w$ Divide each side by 15.

$$\frac{6}{15} = \frac{15w}{15}$$

$$\frac{2}{5} = w$$

b) $2 - \frac{3}{4}w \geq 3w + \frac{1}{2}$ Multiply by the common denominator 4.

$4(2 - \frac{3}{4}w) \geq 4(3w + \frac{1}{2})$ Use the distributive property to expand the brackets.

$8 - 3w \geq 12w + 2$ Add $3w$ to each side.

$8 - 3w + 3w \geq 12w + 2 + 3w$

$8 \geq 15w + 2$ Subtract 2 from each side.

$8 - 2 \geq 15w + 2 - 2$

$6 \geq 15w$ Divide each side by 15.

$\frac{6}{15} \geq \frac{15w}{15}$

$\frac{2}{5} \geq w$

c) The processes are the same. If I had not isolated the variable on the right side of the inequality, I would have had to divide by a negative number and change the direction of the inequality sign.

d) Both solutions involve the same fraction. The solution of the inequality is the set of numbers that are less than or equal to $\frac{2}{5}$, whereas the solution of the related equation is the number $\frac{2}{5}$.

15. a) Let h represent the number of hours that each bulb is used.
The regular bulb costs \$0.55 plus \$0.004 20 per hour, or $0.55 + 0.004\,20h$.
The energy saver bulb costs \$5.00 plus \$0.001 05 per hour, or $5 + 0.001\,05h$.
For the energy saver bulb to be cheaper, it must cost less than the regular bulb.
So, an inequality is: $0.55 + 0.004\,20h > 5 + 0.001\,05h$

b) $0.55 + 0.004\,20h > 5 + 0.001\,05h$ Subtract $0.001\,05h$ from each side.

$0.55 + 0.004\,20h - 0.001\,05h > 5 + 0.001\,05h - 0.001\,05h$

$0.55 + 0.003\,15h > 5$ Subtract 0.55 from each side.

$0.55 + 0.003\,15h - 0.55 > 5 - 0.55$

$0.003\,15h > 4.45$ Divide each side by 0.003 15.

$\frac{0.00315h}{0.00315} > \frac{4.45}{0.00315}$

$h > 1412.698$; I need to check the time of use near 1413 h for a more accurate solution.

For 1413 h, the electricity cost of a regular light bulb:
\$0.55 + \$0.004 20(1413) = \$6.48
For 1413 h, the electricity cost of an energy saver light bulb:
\$5.00 + \$0.001 05(1413) = \$6.48

For 1414 h, the electricity cost of a regular light bulb:
\$0.55 + \$0.004 20(1414) = \$6.49
For 1414 h, the electricity cost of an energy saver light bulb:
\$5.00 + \$0.001 05(1414) = \$6.48

So, for 1414 h or more, it is cheaper to use an energy saver light bulb.

c) Choose 3 numbers greater than 1414, such as 1420, 1500, and 2000.
Substitute h = 1420 in the original inequality.

Left side = 0.55 + 0.004 20(1420)	Right side = 5 + 0.001 05(1420)
= 6.514	= 6.491

Since 6.514 > 6.491, the left side is greater than the right side, and h = 1420 satisfies the inequality.

Substitute h = 1500 in the original inequality.

Left side = 0.55 + 0.004 20(1500)	Right side = 5 + 0.001 05(1500)
= 6.85	= 6.575

Since 6.85 > 6.575, the left side is greater than the right side, and h = 1500 satisfies the inequality.

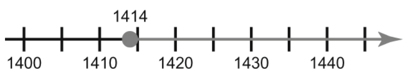
Substitute h = 2000 in the original inequality.

Left side = 0.55 + 0.004 20(2000)	Right side = 5 + 0.001 05(2000)
= 8.95	= 7.1

Since 8.95 > 7.1, the left side is greater than the right side, and h = 2000 satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $h \geq 1414$ is correct.

d)

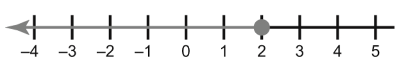


16. a)

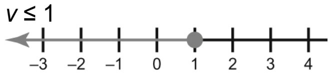
$3(0.4h + 5) > 4(0.2h + 7)$	Use the distributive property to expand the brackets.
$1.2h + 15 > 0.8h + 28$	Subtract 0.8h from each side.
$1.2h + 15 - 0.8h > 0.8h + 28 - 0.8h$	
$0.4h + 15 > 28$	Subtract 15 from each side.
$0.4h + 15 - 15 > 28 - 15$	
$0.4h > 13$	Divide each side by 0.4.
$\frac{0.4h}{0.4} > \frac{13}{0.4}$	
$h > 32.5$	

b)

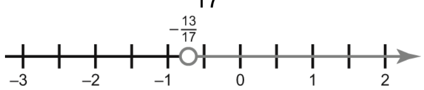
$-2(3 - 1.5n) \leq 3(2 - n)$	Use the distributive property to expand the brackets.
$-6 + 3n \leq 6 - 3n$	Add 3n to each side.
$-6 + 3n + 3n \leq 6 - 3n + 3n$	
$-6 + 6n \leq 6$	Add 6 to each side.
$-6 + 6n + 6 \leq 6 + 6$	
$6n \leq 12$	Divide each side by 6.
$\frac{6n}{6} \leq \frac{12}{6}$	
$n \leq 2$	



c) $-4(2.4v - 1.4) \geq -2(0.8 + 1.2v)$ Use the distributive property to expand the brackets.
$-9.6v + 5.6 \geq -1.6 - 2.4v$ Add $2.4v$ to each side.
$-9.6v + 5.6 + 2.4v \geq -1.6 - 2.4v + 2.4v$
$-7.2v + 5.6 \geq -1.6$ Subtract 5.6 from each side.
$-7.2v + 5.6 - 5.6 \geq -1.6 - 5.6$
$-7.2v \geq -7.2$ Divide each side by -7.2 and reverse the inequality sign.
$\frac{-7.2v}{-7.2} \leq \frac{-7.2}{-7.2}$
$v \leq 1$



d) $-5(3.2 + 2.3z) < 2(-1.5z - 4.75)$ Use the distributive property to expand the brackets.
$-16 - 11.5z < -3z - 9.5$ Add $3z$ to each side.
$-16 - 11.5z + 3z < -3z - 9.5 + 3z$
$-16 - 8.5z < -9.5$ Add 16 to each side.
$-16 - 8.5z + 16 < -9.5 + 16$
$-8.5z < 6.5$ Divide each side by -8.5.
$\frac{-8.5z}{-8.5} > \frac{6.5}{-8.5}$
$z > -0.76$, or $z > \frac{-13}{17}$



Take It Further

17. a) $\frac{3}{2}a + \frac{1}{2} < \frac{7}{3}a - \frac{3}{4}$ Multiply by the common denominator 12.
$12(\frac{3}{2}a + \frac{1}{2}) < 12(\frac{7}{3}a - \frac{3}{4})$ Use the distributive property to expand the brackets.
$18a + 6 < 28a - 9$ Subtract $18a$ from each side.
$18a + 6 - 18a < 28a - 9 - 18a$
$6 < 10a - 9$ Add 9 to each side.
$6 + 9 < 10a - 9 + 9$
$15 < 10a$ Divide each side by 10.
$\frac{15}{10} < \frac{10a}{10}$
$\frac{3}{2} < a$
$a > 1.5$

The solution of the inequality $a > 1.5$ is all numbers greater than 1.5. Choose several numbers greater than 1.5; for example, 2, 6, 12
Substitute $a = 2$ in the original inequality.

Left side $= \frac{3}{2}(2) + \frac{1}{2}$
$= 3 + \frac{1}{2}$
$= 3.5$

Right side $= \frac{7}{3}(2) - \frac{3}{4}$
$= \frac{14}{3} - \frac{3}{4}$
$= \frac{56 - 9}{12}$
$= \frac{47}{12}$
$= 3.91\overline{6}$

Since $3.5 < 3.91\overline{6}$, the left side is less than the right side, and $a = 2$ satisfies the inequality.

Substitute $a = 6$ in the original inequality.

Left side $= \frac{3}{2}(6) + \frac{1}{2}$

$= 9 + \frac{1}{2}$

$= 9.5$

Right side $= \frac{7}{3}(6) - \frac{3}{4}$

$= 14 - \frac{3}{4}$

$= \frac{56-3}{4}$

$= \frac{53}{4}$

$= 13.25$

Since $9.5 < 13.25$, the left side is less than the right side, and $a = 6$ satisfies the inequality.

Substitute $a = 12$ in the original inequality.

Left side $= \frac{3}{2}(12) + \frac{1}{2}$

$= 18 + \frac{1}{2}$

$= 18.5$

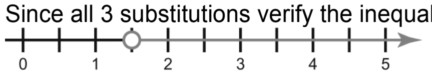
Right side $= \frac{7}{3}(12) - \frac{3}{4}$

$= 28 - \frac{3}{4}$

$= 27.25$

Since $18.5 < 27.25$, the left side is less than the right side, and $a = 12$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $a > 1.5$ is correct.



b) $\frac{3}{5}(5.2 - 3m) > -\frac{7}{10}(2m + 7.5)$ Multiply each side by the common denominator 10.

$10 \times \frac{3}{5}(5.2 - 3m) > 10 \times \left(-\frac{7}{10}\right)(2m + 7.5)$

$6(5.2 - 3m) > (-7)(2m + 7.5)$ Use the distributive property to expand the brackets.

$6(5.2) + 6(-3m) > (-7)(2m) + (-7)(7.5)$

$31.2 - 18m > -14m - 52.5$ Add $14m$ to each side.

$31.2 - 18m + 14m > -14m - 52.5 + 14m$

$31.2 - 4m > -52.5$ Subtract 31.2 from each side.

$31.2 - 4m - 31.2 > -52.5 - 31.2$

$-4m > -83.7$ Divide each side by -4.

$\frac{-4m}{-4} < \frac{-83.7}{-4}$

$m < 20.925$

The solution of the inequality $m < 20.925$ is all numbers less than 20.925. Choose several numbers less than 20.925; for example, 20, 10, 0

Substitute $m = 20$ in the original inequality.

Left side $= \frac{3}{5}(5.2 - 3(20))$

$= \frac{3}{5}(5.2 - 60)$

$= \frac{3 \times (-54.8)}{5}$

$= \frac{-164.4}{5}$

$= -32.88$

Right side $= -\frac{7}{10}(2(20) + 7.5)$

$= -\frac{7}{10}(40 + 7.5)$

$= \frac{(-7) \times 47.5}{10}$

$= \frac{-332.5}{10}$

$= = -33.25$

Since $-32.88 > -33.25$, the left side is greater than the right side, and $m = 20$ satisfies the inequality.

Substitute m = 10 in the original inequality.

Left side $= \frac{3}{5}(5.2 - 3(10))$
$= \frac{3}{5}(5.2 - 30)$
$= \frac{3 \times (-24.8)}{5}$
$= \frac{-74.4}{5}$
$= -14.88$

Right side $= -\frac{7}{10}(2(10) + 7.5)$
$= -\frac{7}{10}(20 + 7.5)$
$= \frac{(-7) \times 27.5}{10}$
$= \frac{-192.5}{10}$
$= -19.25$

Since –14.88 > –19.25, the left side is greater than the right side, and m = 10 satisfies the inequality.

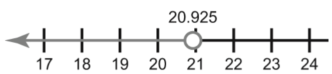
Substitute m = 0 in the original inequality.

Left side $= \frac{3}{5}(5.2 - 3(0))$
$= \frac{3 \times 5.2}{5}$
$= \frac{15.6}{6}$
$= 3.12$

Right side $= -\frac{7}{10}(2(0) + 7.5)$
$= \frac{(-7) \times 7.5}{10}$
$= \frac{-52.5}{10}$
$= -5.25$

Since 3.12 > –5.25, the left side is greater than the right side, and m = 0 satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that m < 20.925 is correct.



18. a) Let c represent the number of brochures.
Company A charges 900 + 0.5c.
Company B charges 1500 + 0.38c.
For the cost to be the same, both equations must be equal.
So, solve the equation 900 + 0.5c = 1500 + 0.38c

$900 + 0.5c = 1500 + 0.38c$ — Subtract 0.38c from each side.
$900 + 0.5c - 0.38c = 1500 + 0.38c - 0.38c$
$900 + 0.12c = 1500$ — Subtract 900 from each side.
$900 + 0.12c - 900 = 1500 - 900$
$0.12c = 600$ — Divide each side by 0.12.
$\frac{0.12c}{0.12} = \frac{600}{0.12}$
$c = 5000$

For the costs to be the same at both companies, 5000 brochures must be printed.

b) $900 + 0.5c < 1500 + 0.38c$ — Subtract 0.38c from each side.
$900 + 0.5c - 0.38c < 1500 + 0.38c - 0.38c$
$900 + 0.12c < 1500$ — Subtract 900 from each side.
$900 + 0.12c - 900 < 1500 - 900$
$0.12c < 600$ — Divide each side by 0.12.
$\frac{0.12c}{0.12} < \frac{600}{0.12}$
$c < 5000$

For c < 5000 brochures, Company A is less expensive.

c) $900 + 0.5c > 1500 + 0.38c$ — Subtract $0.38c$ from each side.
$900 + 0.5c - 0.38c > 1500 + 0.38c - 0.38c$
$900 + 0.12c > 1500$ — Subtract 900 from each side.
$900 + 0.12c - 900 > 1500 - 900$
$0.12c > 600$ — Divide each side by 0.12.
$$\frac{0.12c}{0.12} > \frac{600}{0.12}$$
$c > 5000$

For $c > 5000$ brochures, Company B is less expensive.

d) For part a, I solved an equation.

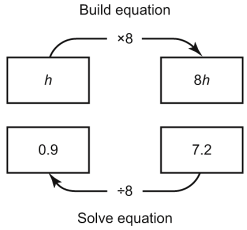
For part b, I wrote the inequality:
$900 + 0.5c < 1500 + 0.38c$
I solved the inequality the same way I solved the equation and the solution is $c < 5000$. This means that Company A is less expensive for any number of brochures up to 5000.

For part c, I wrote the inequality:
$900 + 0.5c > 1500 + 0.38c$
The solution is similar to the preceding inequality except that the inequality sign is reversed: $c > 5000$
This means that Company B is less expensive for any number of brochures greater than 5000.
I know that for $c = 5000$, the costs are the same for both companies. For $c < 5000$, the initial cost that each company charges is the determining factor.
Company A charges $900, which is less than what Company B charges ($1500). So Company A will be less expensive for $c < 5000$.
For $c > 5000$, the cost per copy is the determining factor.
Company A charges $0.50 per copy, while Company B charges $0.38 per copy. So Company B will be less expensive for $c > 5000$.

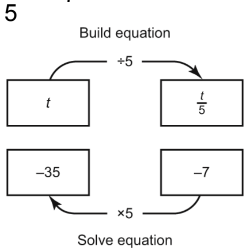
Review (pages 308–309)

Lesson 6.1

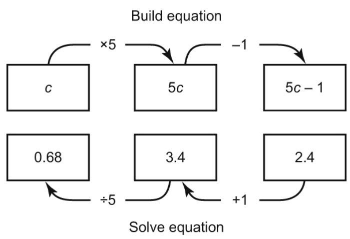
1. a) i) $8h = 7.2$



ii) $\frac{t}{5} = -7$



iii) $5c - 1 = 2.4$



b) i) $8h = 7.2$ Divide each side by 8.

$$\frac{8h}{8} = \frac{7.2}{8}$$

$$h = 0.9$$

ii) $\frac{t}{5} = -7$ Multiply each side by 5.

$$5\left(\frac{t}{5}\right) = 5(-7)$$

$$t = -35$$

iii) $5c - 1 = 2.4$ Add 1 to each side.

$$5c - 1 + 1 = 2.4 + 1$$

$5c = 3.4$ Divide each side by 5.

$$\frac{5c}{5} = \frac{3.4}{5}$$

$$c = 0.68$$

2. **a)** Milan's steps:

$4(3.2s + 5.7) = -6$ Divide each side by 4.

$\frac{4(3.2s + 5.7)}{4} = \frac{-6}{4}$

$3.2s + 5.7 = -1.5$ Subtract 5.7 from each side.

$3.2s + 5.7 - 5.7 = -1.5 - 5.7$

$3.2s = -7.2$ Divide each side by 3.2.

$\frac{3.2s}{3.2} = \frac{-7.2}{3.2}$

$s = -2.25$

b) Daria's steps:

$4(3.2s + 5.7) = -6$ Use the distributive property to expand the brackets.

$4(3.2s) + 4(5.7) = -6$

$12.8s + 22.8 = -6$ Subtract 22.8 from each side.

$12.8s + 22.8 - 22.8 = -6 - 22.8$

$12.8s = -28.8$ Divide each side by 12.8.

$\frac{12.8s}{12.8} = \frac{-28.8}{12.8}$

$s = -2.25$

c) One advantage of Milan's method is that the numbers are smaller. One disadvantage of Milan's method is that he has to divide twice, and the quotients are decimals. One advantage of Daria's method is that she only has to divide at the end. One disadvantage of Daria's method is that the numbers are greater.

3. **a)** $-20.5 = 3b + 16.7$ Subtract 16.7 from each side.

$-20.5 - 16.7 = 3b + 16.7 - 16.7$

$-37.2 = 3b$ Divide each side by 3.

$\frac{-37.2}{3} = \frac{3b}{3}$

$b = -12.4$

To verify the solution, substitute $b = -12.4$ into $-20.5 = 3b + 16.7$.

Left side $= -20.5$ Right side $= 3(-12.4) + 16.7$

$= -37.2 + 16.7$

$= -20.5$

Since the left side equals the right side, $b = -12.4$ is correct.

b) $\frac{t}{3} + 1.2 = -2.2$ Subtract 1.2 from each side.

$\frac{t}{3} + 1.2 - 1.2 = -2.2 - 1.2$

$\frac{t}{3} = -3.4$ Multiply each side by 3.

$3(\frac{t}{3}) = 3(-3.4)$

$t = -10.2$

To verify the solution, substitute $t = -10.2$ into $\frac{t}{3} + 1.2 = -2.2$.

Left side $= \frac{-10.2}{3} + 1.2$ Right side $= -2.2$

$= -3.4 + 1.2$

$= -2.2$

Since the left side equals the right side, $t = -10.2$ is correct.

c) $-8.5 = 6.3 - \frac{w}{2}$ Add $\frac{w}{2}$ to each side.

$-8.5 + \frac{w}{2} = 6.3 - \frac{w}{2} + \frac{w}{2}$

$-8.5 + \frac{w}{2} = 6.3$ Add 8.5 to each side.

$-8.5 + \frac{w}{2} + 8.5 = 6.3 + 8.5$

$\frac{w}{2} = 14.8$ Multiply each side by 2.

$2(\frac{w}{2}) = 2(14.8)$

$w = 29.6$

To verify the solution, substitute $w = 29.6$ into $-8.5 = 6.3 - \frac{w}{2}$.

Left side = –8.5 Right side $= 6.3 - \frac{29.6}{2}$

$= 6.3 - 14.8$

$= -8.5$

Since the left side equals the right side, $w = 29.6$ is correct.

d) $-2.3(x + 25.5) = -52.9$ Use the distributive property to expand the bracket.

$-2.3(x) + -2.3(25.5)$

$-2.3x - 58.65 = -52.9$ Add 58.65 to each side.

$-2.3x - 58.65 + 58.65 = -52.9 + 58.65$

$-2.3x = 5.75$ Divide both sides by –2.3.

$\frac{-2.3x}{-2.3} = \frac{5.75}{-2.3}$

$x = -2.5$

To verify the solution, substitute $x = -2.5$ into $-2.3(x + 25.5) = -52.9$.

Left side $= -2.3[(-2.5) + 25.5]$ Right side = –52.9

$= -2.3(23)$

$= -52.9$

Since the left side equals the right side, $x = -2.5$ is correct.

4. **a)** Let l represent the length of a shorter side in centimetres.
The perimeter is the sum of the measures of all sides.
The perimeter of the kite is 2 × (length of longer side + length of shorter side).
So, an equation is: $2(3.1 + l) = 8.4$

b) $2(3.1 + l) = 8.4$ Use the distributive property to expand the bracket.

$2(3.1) + 2(l) = 8.4$

$6.2 + 2l = 8.4$ Subtract 6.2 from each side.

$6.2 + 2l - 6.2 = 8.4 - 6.2$

$2l = 2.2$ Divide each side by 2.

$\frac{2l}{2} = \frac{2.2}{2}$

$l = 1.1$; the length of a shorter side is 1.1 cm.

c) To verify the solution, go back to the original problem.
The perimeter of the kite is: 2(3.1 cm) + 2(1.1 cm) = 6.2 cm + 2.2 cm
= 8.4 cm
This is equal to the given perimeter so the solution is correct.

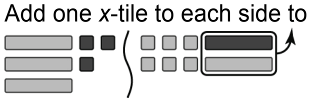
Lesson 6.2

5. There are three *r*-masses and three 1-g masses in the left pan; and one *r*-mass and seven 1-g masses in the right pan. So, solve the equation $3r + 3 = r + 7$

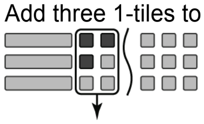
$3r + 3 = r + 7$ Subtract 3 from each side.
$3r + 3 - 3 = r + 7 - 3$
$3r = r + 4$ Subtract *r* from each side.
$3r - r = r + 4 - r$
$2r = 4$ Divide each side by 2.
$\frac{2r}{2} = \frac{4}{2}$
$r = 2$

6. There are two *x*-tiles and three –1-tiles on the left; and one –*x*-tile and six 1-tiles on the left. So, the equation is $2x - 3 = 6 - x$.

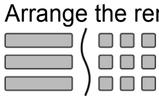
Add one *x*-tile to each side to get the terms containing *x* on the same side. Remove zero pairs.



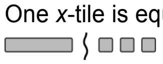
Add three 1-tiles to each side to get the constant terms on the same side. Remove zero pairs.



Arrange the remaining tiles on each side into 3 groups.



One *x*-tile is equal to 3.



Algebraically:
$2x - 3 = 6 - x$ Add *x* to each side.
$2x - 3 + x = 6 - x + x$
$3x - 3 = 6$ Add 3 to each side.
$3x - 3 + 3 = 6 + 3$
$3x = 9$ Divide each side by 3.
$\frac{3x}{3} = \frac{9}{3}$
$x = 3$

7. a) $\frac{-72}{a} = -4.5$ Multiply each side by *a*.
$a\left(\frac{-72}{a}\right) = a(-4.5)$
$-72 = -4.5a$ Divide each side by –4.5.
$\frac{-72}{-4.5} = \frac{-4.5a}{-4.5}$
$a = 16$

To verify the solution, substitute a = 16 into $\frac{-72}{a} = -4.5$.

Left side = $\frac{-72}{16}$ Right side = –4.5

$= -4.5$

Since the left side equals the right side, a = 16 is correct.

b) $-\frac{1}{3} + 2m = -\frac{1}{5}$ Multiply each side by the common denominator 15.

$15(-\frac{1}{3} + 2m) = 15(-\frac{1}{5})$ Use the distributive property to expand the bracket.

$\cancel{15}^{5}\left(-\frac{1}{\cancel{3}_1}\right) + 15(2m) = \cancel{15}^{3}\left(-\frac{1}{\cancel{5}_1}\right)$

$-5 + 30m = -3$ Add 5 to each side.

$-5 + 30m + 5 = -3 + 5$

$30m = 2$ Divide each side by 30.

$\frac{30m}{30} = \frac{2}{30}$

$m = \frac{1}{15}$

To verify the solution, substitute $m = \frac{1}{15}$ into $-\frac{1}{3} + 2m = -\frac{1}{5}$.

Left side = $-\frac{1}{3} + 2(\frac{1}{15})$ Right side = $-\frac{1}{5}$

$= -\frac{5}{15} + \frac{2}{15}$

$= -\frac{3}{15}$

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

Since the left side equals the right side, $m = \frac{1}{15}$ is correct.

c) $12.5x = 6.2x + 88$ Subtract $6.2x$ from each side.

$12.5x - 6.2x = 6.2x + 88 - 6.2x$

$6.3x = 88$ Divide each side by 6.3.

$\frac{6.3x}{6.3} = \frac{88}{6.3}$

$x = \frac{88}{6.3}$ Write an equivalent fraction to remove the decimal.

$x = \frac{880}{63}$

To verify the solution, substitute $x = \frac{880}{63}$ into $12.5x = 6.2x + 88$.

Left side = $12.5(\frac{880}{63})$ Right side = $6.2(\frac{880}{63}) + 88$

$\doteq 174.6$ $\doteq 174.6$

Since the left side equals the right side, $x = \frac{880}{63}$ is correct.

d) $2.1g - 0.3 = -3.3g - 30$ Add $3.3g$ to each side.
$2.1g - 0.3 + 3.3g = -3.3g - 30 + 3.3g$
$5.4g - 0.3 = -30$ Add 0.3 to each side.
$5.4g - 0.3 + 0.3 = -30 + 0.3$
$5.4g = -29.7$ Divide each side by 5.4.
$\frac{5.4g}{5.4} = \frac{-29.7}{5.4}$
$g = -5.5$
To verify the solution, substitute $g = -5.5$ into $2.1g - 0.3 = -3.3g - 30$.
Left side $= 2.1(-5.5) - 0.3$
$= -11.55 - 0.3$
$= -11.85$q
Right side $= (-3.3)(-5.5) - 30$
$= 18.15 - 30$
$= -11.85$
Since the left side equals the right side, $g = -5.5$ is correct.

e) $\frac{3}{2}x + \frac{4}{3} = \frac{5}{8}x + \frac{5}{2}$ Multiply by the common denominator 24.
$24(\frac{3}{2}x + \frac{4}{3}) = 24(\frac{5}{8}x + \frac{5}{2})$ Use the distributive property to expand the brackets.
$\cancel{24}^{12}\left(\frac{3}{\cancel{2}_1}x\right) + \cancel{24}^{8}\left(\frac{4}{\cancel{3}_1}\right) = \cancel{24}^{3}\left(\frac{5}{\cancel{8}_1}x\right) + \cancel{24}^{12}\left(\frac{5}{\cancel{2}_1}\right)$
$36x + 32 = 15x + 60$ Subtract $15x$ from each side.
$36x + 32 - 15x = 15x + 60 - 15x$
$21x + 32 = 60$ Subtract 32 from each side.
$21x + 32 - 32 = 60 - 32$
$21x = 28$ Divide each side by 21.
$\frac{21x}{21} = \frac{28}{21}$
$x = \frac{4}{3}$

To verify the solution, substitute $x = \frac{4}{3}$ into $\frac{3}{2}x + \frac{4}{3} = \frac{5}{8}x + \frac{5}{2}$.
Left side $= (\frac{3}{2})(\frac{4}{3}) + \frac{4}{3}$
$= 2 + \frac{4}{3}$
$= \frac{10}{3}$
Right side $= (\frac{5}{8})(\frac{4}{3}) + \frac{5}{2}$
$= \frac{5}{6} + \frac{5}{2}$
$= \frac{5}{6} + \frac{15}{6}$
$= \frac{20}{6}$, or $\frac{10}{3}$
Since the left side equals the right side, $x = \frac{4}{3}$ is correct.

f) $5.4(2 - p) = -1.4(p + 2)$ Use the distributive property to expand the brackets.
$10.8 - 5.4p = -1.4p - 2.8$ Add $5.4p$ to each side.
$10.8 - 5.4p + 5.4p = -1.4p - 2.8 + 5.4p$
$10.8 = 4p - 2.8$ Add 2.8 to each side.
$10.8 + 2.8 = 4p - 2.8 + 2.8$
$13.6 = 4p$ Divide each side by 4.
$\frac{13.6}{4} = \frac{4p}{4}$
$p = 3.4$

To verify the solution, substitute $p = 3.4$ into $5.4(2 - p) = -1.4(p + 2)$.

Left side $= 5.4(2 - 3.4)$	Right side $= -1.4(3.4 + 2)$
$= 5.4(-1.4)$	$= -1.4(5.4)$
$= -7.56$	$= -7.56$

Since the left side equals the right side, $p = 3.4$ is correct.

8. a) Let k represent the distance driven in kilometres. Company A charges \$200, or 200. Company B charges \$25 plus \$0.35 per kilometre, or $25 + 0.35k$. When these two costs are equal, the equation is $200 = 25 + 0.35k$.

b) $200 = 25 + 0.35k$ Subtract 25 from each side.
$200 - 25 = 25 + 0.35k - 25$
$175 = 0.35k$ Divide each side by 0.35.
$$\frac{175}{0.35} = \frac{0.35k}{0.35}$$
$k = 500$
For a distance of 500 km, the cost will be the same for the two companies.

c) To verify the solution, go back to the original problem.
Company A charges \$200.
Company B charges \$25 plus \$0.35 per kilometre driven, or \$25 + \$0.35 × 500 = \$25 + \$175
= \$200
Since these two charges are equal, the solution is correct.

9. The student forgot to multiply 5.4 by 3.5 and to multiply 1.2 by 2.5 in line 2. The result of $7v - 7.5v$ should be $-0.5v$ instead of $0.5v$ in line 4.

Correct solution:

$3.5(2v - 5.4) = 2.5(3v - 1.2)$	Use the distributive property to expand the brackets.
$7v - 18.9 = 7.5v - 3$	Subtract $7.5v$ from each side.
$7v - 7.5v - 18.9 = 7.5v - 3 - 7.5v$	
$-0.5v - 18.9 = -3$	Add 18.9 to each side.
$-0.5v - 18.9 + 18.9 = -3 + 18.9$	
$-0.5v = 15.9$	Divide each side by -0.5.
$\frac{-0.5v}{-0.5} = \frac{15.9}{-0.5}$	
$v = -31.8$	

To verify the solution, substitute $v = -31.8$ into $3.5(2v - 5.4) = 2.5(3v - 1.2)$.

Left side $= 3.5[2(-31.8) - 5.4]$	Right side $= 2.5[3(-31.8) - 1.2]$
$= 3.5(-63.6 - 5.4)$	$= 2.5(-95.4 - 1.2)$
$= 3.5(-69)$	$= 2.5(-96.6)$
$= -241.5$	$= -241.5$

Since the left side equals the right side, the solution $v = -31.8$ is correct.

Lesson 6.3

10. a) Let a years represent the age of a person being admitted.
"Under 18" means that persons 18, or 19, or 20, and so on, are admitted.
So, a can be equal to 18 or greater than 18.
The inequality is $a \geq 18$

b) Let h centimetres represent the height of a person admitted to the ride.
"At least" means that a person must be 90 cm, or 91 cm, or 92 cm, and so on.
So, h can be equal to 90 or greater than 90.
The inequality is $h \geq 90$

c) Let c dollars represent the amount that Horton can spend.
"Maximum" means that Horton can spend \$50 or less than \$50.
So, c can be equal to 50 or less than 50.
The inequality is $c \leq 50$

d) Let y years represent the age of a player for the game.
"5 years and older" means that players can be 5, or 6, or 7, and so on.
So, y can be equal to 5 or greater than 5.
The inequality is $y \geq 5$

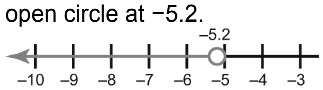
11. a) The shaded circle at −5 indicates that −5 is part of the solution. So, the inequality is $x \leq -5$.

b) The open circle at 1 indicates that 1 is not part of the solution. So, the inequality $x < 1$

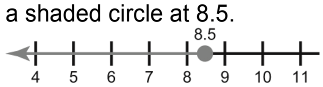
c) The open circle at 3.5 indicates that 3.5 is not part of the solution. So, the inequality $x > 3.5$

d) The shaded circle at $1\frac{2}{3}$ indicates that $1\frac{2}{3}$ is part of the solution. So, the inequality $x \geq 1\frac{2}{3}$

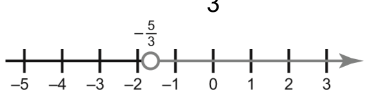
12. a) i) For $a < -5.2$, the solution is all numbers less than −5.2. Since −5.2 is not part of the solution, draw an open circle at −5.2.



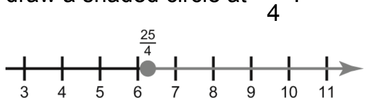
ii) For $b \leq 8.5$, the solution is all numbers less than or equal to 8.5. Since 8.5 is part of the solution, draw a shaded circle at 8.5.



iii) For $c > -\frac{5}{3}$, the solution is all numbers greater than $-\frac{5}{3}$. Since $-\frac{5}{3}$ is not part of the solution, draw an open circle at $-\frac{5}{3}$.



iv) For $d \geq \frac{25}{4}$, the solution is all numbers greater than or equal to $\frac{25}{4}$. Since $\frac{25}{4}$ is part of the solution, draw a shaded circle at $\frac{25}{4}$.



b) i) Substitute $a = -3$ in the inequality $a < -5.2$. Since $-3 > -5.2$, the left side is greater than the right side, so $a = -3$ is not a solution.
Substitute $a = 5$ in the inequality $a < -5.2$. Since $5 > -5.2$, the left side is greater than the right side, so $a = 5$ is not a solution.

ii) Substitute $b = -3$ in the inequality $b \le 8.5$. Since $-3 < 8.5$, the left side is less than the right side, so $b = -3$ is a solution.
Substitute $b = 5$ in the inequality $b \le 8.5$. Since $5 < 8.5$, the left side is less than the right side, so $b = 5$ is a solution.

iii) Substitute $c = -3$ in the inequality $c > -\frac{5}{3}$. Since $-3 < -\frac{5}{3}$, the left side is less than the right side, so $c = -3$ is not a solution.
Substitute $c = 5$ in the inequality $c > -\frac{5}{3}$. Since $5 > -\frac{5}{3}$, the left side is greater than the right side, so $c = 5$ is a solution.

iv) Substitute $d = -3$ in the inequality $d \ge \frac{25}{4}$. Since $-3 < \frac{25}{4}$, the left side is less than the right side, so $d = -3$ is not a solution.
Substitute $d = 5$ in the inequality $d \ge \frac{25}{4}$. Since $5 < \frac{25}{4}$, the left side is less than the right side, so $d = 5$ is not a solution.

Lessons 6.4 and 6.5

13. Solve each inequality.

a) $h - 2 < -5$ Add 2 to each side.
$h - 2 + 2 < -5 + 2$
$h < -3$
The solution to the inequality $h < -3$ is all numbers less than -3.
Three possible solutions are: -10, $-\frac{9}{2}$, -7.5

b) $3k > -9$ Divide each side by 3.
$\frac{3k}{3} > \frac{-9}{3}$
$k > -3$
The solution to the inequality $k > -3$ is all numbers greater than -3.
Three possible solutions are: 0, $\frac{12}{5}$, -1.5

c) $5 - y > 0$ Add y to each side.
$5 - y + y > 0 + y$
$5 > y$
$y < 5$
The solution to the inequality $y < 5$ is all numbers less than 5.
Three possible solutions are: 4, $\frac{1}{2}$, 3.5

14. a) No, the inequality sign will not be reversed if I multiply each side by 4.
When each side of an inequality is multiplied by the same positive number, the resulting inequality is still true.

b) No, the inequality sign will not be reversed if I add –5 to each side.
When the same number is added to each side of an inequality, the resulting inequality is still true.

c) No, the inequality sign will not be reversed if I subtract –2 from each side.
When the same number is subtracted from each side of an inequality, the resulting inequality is still true.

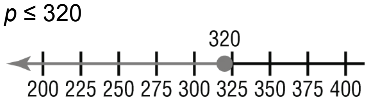
d) Yes, the inequality sign will be reversed if I divide each side by –6.
When each side of an inequality is divided by the same negative number, the inequality sign must be reversed for the inequality to remain true.

15. a) Let p represent the number of students that can attend the prom.
The cost of the prom is \$400 plus \$30 per person, or $400 + 30p$.
This must be less than or equal to 10 000, so an equation is $400 + 30p \le 10\,000$

b) $400 + 30p \le 10\,000$ Subtract 400 from each side.
$400 + 30p - 400 \le 10\,000 - 400$
$30p \le 9600$ Divide each side by 30.

$$\frac{30p}{30} \le \frac{9600}{30}$$

$p \le 320$



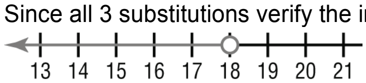
16. a) $7 + y < 25$ Subtract 7 from each side.
$7 + y - 7 < 25 - 7$
$y < 18$
The solution of the inequality y < 18 is all numbers less than 18.
Choose several numbers less than 18; for example, 10, 1, 0

Substitute $y = 10$ in the original inequality.
Left side = 7 + 10 Right side = 25
= 17
Since 17 < 25, the left side is less than the right side, and $y = 10$ satisfies the inequality.

Substitute $y = 1$ in the original inequality.
Left side = 7 + 1 Right side = 25
= 8
Since 8 < 25, the left side is less than the right side, and $y = 1$ satisfies the inequality.

Substitute $y = 0$ in the original inequality.
Left side = 7 + 0 Right side = 25
= 7
Since 7 < 25, the left side is less than the right side, and $y = 0$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $y < 18$ is correct.



b) $-7y < 14$ Divide each side by –7 and reverse the inequality sign.

$$\frac{-7y}{-7} > \frac{14}{-7}$$

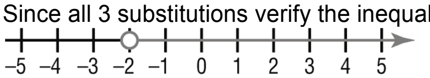
$y > -2$
The solution of the inequality y > –2 is all numbers greater than –2.
Choose several numbers greater than –2; for example, –1, 0, 2

Substitute $y = -1$ in the original inequality.
Left side = –7(–1) Right side = 14
= 7
Since 7 < 14, the left side is less than the right side, and $y = -1$ satisfies the inequality.

Substitute $y = 0$ in the original inequality.
Left side $= –7(0)$ Right side $= 14$
$= 0$
Since $0 < 14$, the left side is less than the right side, and $y = 0$ satisfies the inequality.

Substitute $y = 2$ in the original inequality.
Left side $= –7(2)$ Right side $= 14$
$= –14$
Since $–14 < 14$, the left side is less than the right side, and $y = 2$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $y > –2$ is correct.



c) $\frac{x}{4} > –2.5$ Multiply each side by 4.

$4(\frac{x}{4}) > 4(–2.5)$

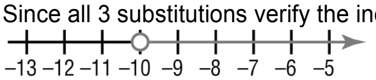
$x > –10$
The solution of the inequality $x > –10$ is all numbers greater than –10.
Choose several numbers greater than –10; for example, –4, 0, 4

Substitute $x = –4$ in the original inequality.
Left side $= \frac{–4}{4}$ Right side $= –2.5$
$= –1$
Since $–1 > –2.5$, the left side is greater than the right side, and $x = –4$ satisfies the inequality.

Substitute $x = 0$ in the original inequality.
Left side $= \frac{0}{4}$ Right side $= –2.5$
$= 0$
Since $0 > –2.5$, the left side is greater than the right side, and $x = 0$ satisfies the inequality.

Substitute $x = 4$ in the original inequality.
Left side $= \frac{4}{4}$ Right side $= –2.5$
$= 1$
Since $1 > –2.5$, the left side is greater than the right side, and $x = 4$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $x > –10$ is correct.



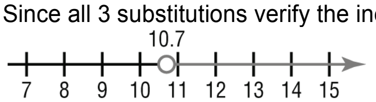
d) $5.2 – y < –5.5$ Add y to each side.
$5.2 – y + y < –5.5 + y$
$5.2 < –5.5 + y$ Add 5.5 to each side.
$5.2 + 5.5 < –5.5 + y + 5.5$
$10.7 < y$
$y > 10.7$
The solution of the inequality $y > 10.7$ is all numbers greater than 10.7.
Choose several numbers greater than 10.7. For example, 11, 12.2, 20

Substitute $y = 11$ in the original inequality.
Left side = 5.2 – 11 Right side = –5.5
= –5.8
Since –5.8 < –5.5, the left side is less than the right side, and $y = 11$ satisfies the inequality.

Substitute $y = 12.2$ in the original inequality.
Left side = 5.2 – 12.2 Right side = –5.5
= –7
Since –7 < –5.5, the left side is less than the right side, and $y = 12.2$ satisfies the inequality.

Substitute $y = 20$ in the original inequality.
Left side = 5.2 – 20 Right side = –5.5
= –14.8
Since –14.8 < –5.5, the left side is less than the right side, and $y = 20$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $y > 10.7$ is correct.



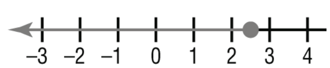
e) $13.5 + 2y \leq 18.5$ Subtract 13.5 from each side.
$13.5 + 2y - 13.5 \leq 18.5 - 13.5$
$2y \leq 5$ Divide each side by 2.
$\frac{2y}{2} \leq \frac{5}{2}$
$y \leq 2.5$
The solution of the inequality $y \leq 2.5$ is all numbers less than or equal to 2.5.
Choose several numbers less than or equal to 2.5; for example, 2, 1, 0

Substitute $y = 2$ in the original inequality.
Left side = 13.5 + 2(2) Right side = 18.5
= 13.5 + 4
= 17.5
Since 17.5 < 18.5, the left side is less than the right side, and $y = 2$ satisfies the inequality.

Substitute $y = 1$ in the original inequality.
Left side = 13.5 + 2(1) Right side = 18.5
= 15.5
Since 15.5 < 18.5, the left side is less than the right side, and $y = 1$ satisfies the inequality.

Substitute $y = 0$ in the original inequality.
Left side = 13.5 + 2(0) Right side = 18.5
= 13.5
Since 13.5 < 18.5, the left side is less than the right side, and $y = 0$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $y \leq 2.5$ is correct.



f) $24 + 3a \leq -6 + 7a$ Subtract $7a$ from each side.

$24 + 3a - 7a \leq -6 + 7a - 7a$

$24 - 4a \leq -6$ Subtract 24 from each side.

$24 - 4a - 24 \leq -6 - 24$

$-4a \leq -30$ Divide each side by –4.

$\frac{-4a}{-4} \geq \frac{-30}{-4}$

$a \geq 7.5$

The solution of the inequality $a \geq 7.5$ is all numbers greater than or equal to 7.5
Choose several numbers greater than 7.5; for example, 8, 10, 20

Substitute $a = 8$ in the original inequality.

Left side $= 24 + 3(8)$ Right side $= -6 + 7(8)$
$= 24 + 24$ $= -6 + 56$
$= 48$ $= 50$

Since $48 < 50$, the left side is less than the right side, and $a = 8$ satisfies the inequality.

Substitute $a = 10$ in the original inequality.

Left side $= 24 + 3(10)$ Right side $= -6 + 7(10)$
$= 24 + 30$ $= -6 + 70$
$= 54$ $= 64$

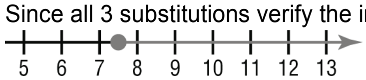
Since $54 < 64$, the left side is less than the right side, and $a = 10$ satisfies the inequality.

Substitute $a = 20$ in the original inequality.

Left side $= 24 + 3(20)$ Right side $= -6 + 7(20)$
$= 24 + 60$ $= -6 + 140$
$= 84$ $= 134$

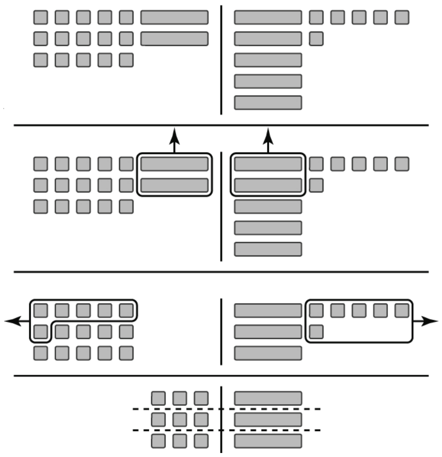
Since $84 < 134$, the left side is less than the right side, and $a = 20$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $a \geq 7.5$ is correct.



Practice Test (page 310)

1. Models may vary.



2. **a)** $-3x - 0.7 = -7$ Add 0.7 to each side.

$-3x - 0.7 + 0.7 = -7 + 0.7$

$-3x = -6.3$ Divide each side by –3.

$\frac{-3x}{-3} = \frac{-6.3}{-3}$

$x = 2.1$

b) $\frac{26}{x} = 5 - 1.5$ Multiply each side by x.

$x(\frac{26}{x}) = x(3.5)$

$26 = 3.5x$ Divide each side by 3.5.

$\frac{26}{3.5} = \frac{3.5x}{3.5}$

$x = \frac{26}{3.5}$ Rewrite the fraction to remove the decimal.

$x = \frac{260}{35}$, or $\frac{52}{7}$

c) $\frac{r}{3} + 5.4 = -3.2$ Subtract 5.4 from each side.

$\frac{r}{3} + 5.4 - 5.4 = -3.2 - 5.4$

$\frac{r}{3} = -8.6$ Multiply each side by 3.

$3\left(\frac{r}{3}\right) = 3(-8.6)$

$r = -25.8$

d) $2.4w - 5.6 = 3.7 + 1.9w$ Subtract 19*w* from each side.

$2.4w - 5.6 - 1.9w = 3.7 + 1.9w - 1.9w$

$0.5w - 5.6 = 3.7$ Add 5.6 to each side.

$0.5w - 5.6 + 5.6 = 3.7 + 5.6$

$0.5w = 9.3$ Divide each side by 0.5.

$\frac{0.5w}{0.5} = \frac{9.3}{0.5}$

$w = 18.6$

e) $\frac{1}{4}c - \frac{7}{2} = \frac{1}{2}c + \frac{3}{4}$ Multiply by the common denominator 4.

$4\left(\frac{1}{4}c - \frac{7}{2}\right) = 4\left(\frac{1}{2}c + \frac{3}{4}\right)$ Use the distributive property to expand the brackets.

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

$c - 14 = 2c + 3$ Subtract *c* from each side.

$c - 14 - c = 2c + 3 - c$

$-14 = c + 3$ Subtract 3 from each side.

$-14 - 3 = c + 3 - 3$

$c = -17$

f) $4.5(1.2 - m) = 2.4(-2m + 2.1)$ Use the distributive property to expand the brackets.

$4.5(1.2) + 4.5(-m) = 2.4(-2m) + 2.4(2.1)$

$5.4 - 4.5m = -4.8m + 5.04$ Add 4.8*m* to each side.

$5.4 - 4.5m + 4.8m = -4.8m + 5.04 + 4.8m$

$5.4 + 0.3m = 5.04$ Subtract 5.4 from each side.

$5.4 + 0.3m - 5.4 = 5.04 - 5.4$

$0.3m = -0.36$ Divide each side by 0.3.

$\frac{0.3m}{0.3} = \frac{-0.36}{0.3}$

$m = -1.2$

3. a) Let *n* represent the number of meals.
Tina's Catering charges 100 + 15*n*.
Norman's Catering charges 25 + 20*n*.
When the two costs are equal, the equation is $100 + 15n = 25 + 20n$.

b) $100 + 15n = 25 + 20n$ Subtract 15*n* from both sides.

$100 + 15n - 15n = 25 + 20n - 15n$

$100 = 25 + 5n$ Subtract 25 from both sides.

$100 - 25 = 25 + 5n - 25$

$75 = 5n$ Divide both sides by 5.

$\frac{75}{5} = \frac{5n}{5}$

$n = 15$

For 15 meals, the costs at the two companies are equal.

To verify the solution, go back to the original problem.

Tina's Catering charges \$100 plus \$15 per meal, or $\$100 + \$15 \times 15 = \$100 + \$225$
$= \$325$

Norman's Catering charges \$25, plus \$20 per meal, or $\$25 + \$20 \times 15 = \$25 + \$300$
$= \$325$

Since both charges are equal, the solution is correct.

4. a) $5 - t > 3$ Add *t* to both sides.

$5 - t + t > 3 + t$

$5 > 3 + t$ Subtract 3 from each side.

$5 - 3 > 3 + t - 3$

$2 > t$

$t < 2$

The solution of the inequality $t < 2$ is all numbers less than 2.

To verify the solution, choose several numbers less than 2; for example, 1, 0, –5

Substitute $t = 1$ in the original inequality.

Left side $= 5 - 1$ Right side $= 3$
$= 4$

Since $4 > 3$, the left side is greater than the right side, and $t = 1$ satisfies the inequality.

Substitute $t = 0$ in the original inequality.

Left side $= 5 - 0$ Right side $= 3$
$= 5$

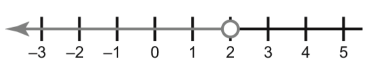
Since $5 > 3$, the left side is greater than the right side, and $t = 0$ satisfies the inequality.

Substitute $t = -5$ in the original inequality.

Left side $= 5 - (-5)$ Right side $= 3$
$= 5 + 5$
$= 10$

Since $10 > 3$, the left side is greater than the right side, and $t = -5$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $t < 2$ is correct.



b) $3(t + 2) \geq 11 - 5t$	Use the distributive property to expand $3(t + 2)$.
$3t + 6 \geq 11 - 5$	Add $5t$ to each side.
$3t + 6 + 5t \geq 11 - 5t + 5t$	
$8t + 6 \geq 11$	Subtract 6 from each side.
$8t + 6 - 6 \geq 11 - 6$	
$8t \geq 5$	Divide each side by 8.
$\frac{8t}{8} \geq \frac{5}{8}$	
$t \geq \frac{5}{8}$	

The solution of the inequality $t \geq \frac{5}{8}$ is all numbers greater or equal to $\frac{5}{8}$.

To verify the solution, choose several numbers greater than $\frac{5}{8}$; for example, 1, 5, 10

Substitute $t = 1$ in the original inequality.

Left side $= 3(1 + 2)$ Right side $= 11 - 5(1)$
$= 3(3)$ $= 11 - 5$
$= 9$ $= 6$

Since $9 > 6$, the left side is greater than the right side, and $t = 1$ satisfies the inequality.

Substitute $t = 5$ in the original inequality.

Left side $= 3(5 + 2)$ Right side $= 11 - 5(5)$
$= 3(7)$ $= 11 - 25$
$= 21$ $= -14$

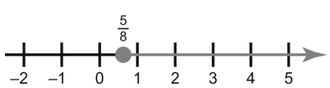
Since $21 > -14$, the left side is greater than the right side, and $t = 5$ satisfies the inequality.

Substitute $t = 10$ in the original inequality.

Left side $= 3(10 + 2)$ Right side $= 11 - 5(10)$
$= 3(12)$ $= 11 - 50$
$= 36$ $= -39$

Since $36 > -39$, the left side is greater than the right side, and $t = 10$ satisfies the inequality.

Since all 3 substitutions satisfy the inequality, it suggests that $t \geq \frac{5}{8}$ is correct.



c) $\frac{m}{4} + 5 \leq \frac{1}{2} - m$	Multiply by the common denominator 4.
$4(\frac{m}{4} + 5) \leq 4(\frac{1}{2} - m)$	
$4(\frac{m}{4}) + 4(5) \leq 4(\frac{1}{2}) + 4(-m)$	
$m + 20 \leq 2 - 4m$	Add $4m$ to each side.
$m + 20 + 4m \leq 2 - 4m + 4m$	
$5m + 20 \leq 2$	Subtract 20 from each side.
$5m + 20 - 20 \leq 2 - 20$	
$5m \leq -18$	Divide each side by 5.
$\frac{5m}{5} \leq \frac{-18}{5}$	
$m \leq -3.6$	

The solution of the inequality $m \leq -3.6$ is all numbers less than or equal to -3.6.

To verify the solution, choose several numbers less than -3.6; for example, -4, -8, -12

Substitute $m = -4$ in the original inequality.

Left side $= \frac{-4}{4} + 5$ Right side $= \frac{1}{2} - (-4)$

$= -1 + 5$ $= \frac{1}{2} + 4$

$= 4$ $= 4.5$

Since $4 < 4.5$, the left side is less than the right side, and $m = -4$ satisfies the inequality.

Substitute $m = -8$ in the original inequality.

Left side $= \frac{-8}{4} + 5$ Right side $= \frac{1}{2} - (-8)$

$= -2 + 5$ $= \frac{1}{2} + 8$

$= 3$ $= 8.5$

Since $3 < 8.5$, the left side is less than the right side, and $m = -8$ satisfies the inequality.

Substitute $m = -12$ in the original inequality.

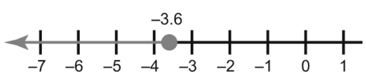
Left side $= \frac{-12}{4} + 5$ Right side $= \frac{1}{2} - (-12)$

$= -3 + 5$ $= \frac{1}{2} + 12$

$= 2$ $= 12.5$

Since $2 < 12.5$, the left side is less than the right side, and $m = -12$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $m \le -3.6$ is correct.



5. a) Let k represent the distance the business person can travel, in kilometres.
The cost of the car rental company is $24.95 + 0.35k$. This cost must be less than or equal to \$50.
So, an inequality is $24.95 + 0.35k \le 50$

b) $24.95 + 0.35k \le 50$ Subtract 24.95 from each side.

$24.95 + 0.35k - 24.95 \le 50 - 24.95$

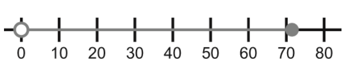
$0.35k \le 25.05$ Divide each side by 0.35.

$\frac{0.35k}{0.35} \le \frac{25.05}{0.35}$

$k \le \frac{2505}{35}$ Simplify the fraction.

$k \le \frac{501}{7}$, or about 71; the business person can travel about 71 km without exceeding her daily budget.

The number line begins with an open circle at 0 because the person cannot travel a negative number of kilometres.



The solution of the inequality $k \le \frac{501}{7}$ is all numbers less than or equal to $\frac{501}{7}$.

To verify the solution, choose several numbers less than $\frac{501}{7}$; for example, 70, 50, 10

Substitute $k = 70$ in the original inequality.

Left side $= 24.95 + 0.35(70)$ Right side $= 50$
$= 24.95 + 24.5$ $= 50$
$= 49.45$

Since $49.45 < 50$, the left side is less than the right side, and $k = 70$ satisfies the inequality.

Substitute $k = 50$ in the original inequality.

Left side $= 24.95 + 0.35(50)$ Right side $= 50$
$= 24.95 + 17.5$
$= 42.45$

Since $42.45 < 50$, the left side is less than the right side, and $k = 50$ satisfies the inequality.

Substitute $k = 10$ in the original inequality.

Left side $= 24.95 + 0.35(10)$ Right side $= 50$
$= 24.95 + 3.5$
$= 28.45$

Since $28.45 < 50$, the left side is less than the right side, and $k = 10$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $k \le \frac{501}{7}$ is correct.

6. a) The student forgot to multiply 2 by 4 in line 2.

Correct solution:

$\frac{1}{4}c - 2 = 3$ Multiply each side by 4.

$4(\frac{1}{4}c - 2) = 4(3)$ Use the distributive property to expand $4(\frac{1}{4}c - 2)$.

$c - 8 = 12$ Add 8 to each side.

$c - 8 + 8 = 12 + 8$

$c = 20$

b) The student should not reverse the inequality sign when subtracting 4 in line 2. The negative sign for -12 should remain in line 5.

Correct solution:

$x + 4 < -8 - 2x$ Subtract 4 from each side.

$x + 4 - 4 < -8 - 2x - 4$

$x < -12 - 2x$ Add $2x$ to each side.

$x + 2x < -12 - 2x + 2x$

$3x < -12$ Divide each side by 3.

$\frac{3x}{3} < \frac{-12}{3}$

$x < -4$

Unit Problem Raising Money for the Pep Club (page 311)

1. a) Let u represent the number of uniforms.
The cost in dollars for Company A is $500 + 22u$.
The cost in dollars for Company B is $360 + 28u$.
When the uniform costs are equal, an equation is: $500 + 22u = 360 + 28u$

b)

$500 + 22u = 360 + 28u$	Subtract $22u$ from each side.
$500 + 22u - 22u = 360 + 28u - 22u$	
$500 = 360 + 6u$	Subtract 360 from each side.
$500 - 360 = 360 + 6u - 360$	
$140 = 6u$	Divide each side by 6.
$\frac{140}{6} = \frac{6u}{6}$	
$u = 23.\overline{3}$	

The number of uniforms must be a whole number. Verify for $u = 23$ and $u = 24$.

Check for 23 uniforms. Substitute $u = 23$ into $500 + 22u = 360 + 28u$.
Left side $= 500 + 22(23)$ Right side $= 360 + 28(23)$
$= 1006$ $= 1004$
For 23 uniforms, the cost for Company B is slightly less; the difference is \$2.

Check for 24 uniforms. Substitute $u = 24$ into $500 + 22u = 360 + 28u$.
Left side $= 500 + 22(24)$ Right side $= 360 + 28(24)$
$= 1028$ $= 1032$
For 24 uniforms, the cost for Company A is slightly less; the difference is \$4.

So, the costs will be approximately equal at both companies for 23 uniforms.

c) There are 25 students in the school's Pep Club, so substitute $u = 25$ in the two equations.
Company A charges \$500 + \$22(25) = \$1050
Company B charges \$360 + \$28(25) = \$1060
The Pep Club should choose Company A, because it is less expensive for 25 uniforms.

I know that for 23 uniforms, the costs are approximately equal at both companies. For more than 23 uniforms ($u > 23$), the cost per uniform that each company charges will be the determining factor. Company A charges \$22 per uniform, while Company B charges \$28 per uniform. So Company A will be less expensive for $u > 23$.

d) To purchase 25 uniforms from Company A, the Pep Club must raise \$1050.

2. a) 30 snacks cost \$6.00. So, one snack costs $\frac{\$6.00}{30} = \$0.20$.

b) Each snack costs the Pep Club \$0.20. To make a profit of \$0.25 on each snack sold, the Pep Club must sell the snacks at \$0.20 + \$0.25 = \$0.45 each.

Let n represent the number of snacks sold.
The total number of snacks sold is $0.45n$. This must be greater than or equal to \$1050.
So, an inequality is $0.45n \geq 1050$.

c) $0.45n \geq 1050$ Divide both sides by 0.45.

$\frac{0.45n}{0.45} \geq \frac{1050}{0.45}$

$n \geq 2333.\overline{3}$

The Pep Club must have sold at least 2334 snacks to have raised the money it needs.

Since there are 30 snacks per box, the Pep Club needed $\frac{2334}{30}$ boxes, or about 78 boxes.

d) The solution of the inequality $n \geq 2333.\overline{3}$ is all numbers greater than or equal to $2333.\overline{3}$.
Choose several numbers greater than $2333.\overline{3}$; for example, 2350, 2400, 2500

Substitute $n = 2350$ into the original inequality.
Left side = 0.45(2350) Right side = 1050
= 1057.5
Since 1057.5 > 1050, the left side is greater than the right side, and $n = 2350$ satisfies the inequality.

Substitute $n = 2400$ into the original inequality.
Left side = 0.45(2400) Right side = 1050
= 1080
Since 1080 > 1050, the left side is greater than the right side, and $n = 2400$ satisfies the inequality.

Substitute $n = 2500$ into the original inequality.
Left side = 0.45(2500) Right side = 1050
= 1125
Since 1125 > 1050, the left side is greater than the right side, and $n = 2500$ satisfies the inequality.

Since all 3 substitutions verify the inequality, it suggests that $n \geq 2333.\overline{3}$ is correct.

