Solutions Manual

MathWorks 10

Workbook

Pacific Educational Press

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1.1 Proportional Reasoning

BUILD YOUR SKILLS, p. 11

1. Divide the numerator and the denominator by the largest common factor.

a) $\frac{4}{16} = \frac{4 \div 4}{16 \div 4}$

$\frac{4}{16} = \frac{1}{4}$

b) $\frac{3}{12} = \frac{3 \div 3}{12 \div 3}$

$\frac{3}{12} = \frac{1}{4}$

c) $\frac{25}{75} = \frac{25 \div 25}{75 \div 25}$

$\frac{25}{75} = \frac{1}{3}$

d) $\frac{15}{21} = \frac{15 \div 3}{21 \div 3}$

$\frac{15}{21} = \frac{5}{7}$

e) $\frac{8}{18} = \frac{8 \div 2}{18 \div 2}$

$\frac{8}{18} = \frac{4}{9}$

f) $\frac{45}{100} = \frac{45 \div 5}{100 \div 5}$

$\frac{45}{100} = \frac{9}{20}$

g) $\frac{20}{50} = \frac{20 \div 10}{50 \div 10}$

$\frac{20}{50} = \frac{2}{5}$

h) $\frac{3}{21} = \frac{3 \div 3}{21 \div 3}$

$\frac{3}{21} = \frac{1}{7}$

i) $\frac{7}{56} = \frac{7 \div 7}{56 \div 7}$

$\frac{7}{56} = \frac{1}{8}$

2. Multiply both sides of the equation by the product of the denominators and simplify.

a) $\frac{x}{10} = \frac{40}{50}$

$50 \times \cancel{10} \times \frac{x}{\cancel{10}} = \frac{40}{\cancel{50}} \times 10 \times \cancel{50}$

$50x = 400$

$\frac{50x}{50} = \frac{400}{50}$

$x = 8$

b) $\frac{12}{16} = \frac{18}{x}$

$\cancel{16} \times x \times \frac{12}{\cancel{16}} = \frac{18}{\cancel{x}} \times \cancel{x} \times 16$

$12x = 18 \times 16$

$12x = 288$

$\frac{12x}{12} = \frac{288}{12}$

$x = 24$

c) $\frac{56}{64} = \frac{x}{8}$

$\cancel{64} \times \frac{56}{\cancel{64}} = \frac{x}{8} \times 64$

$56 = \frac{64x}{8}$

$56 = 8x$

$\frac{56}{8} = \frac{8x}{8}$

$7 = x$

d) $\frac{18}{27} = \frac{36}{x}$

$\cancel{27} \times x \times \frac{18}{\cancel{27}} = \frac{36}{\cancel{x}} \times \cancel{x} \times 27$

$18x = 36 \times 27$

$18x = 972$

$\frac{18x}{18} = \frac{972}{18}$

$x = 54$

e) $\frac{x}{2056} = \frac{3}{4}$

$\cancel{2056} \times \frac{x}{\cancel{2056}} = \frac{3}{4} \times 2056$

$x = 1542$

f) $\frac{3}{12} = \frac{15}{x}$

$\cancel{12} \times x \times \frac{3}{\cancel{12}} = \frac{15}{\cancel{x}} \times \cancel{x} \times 12$

$3x = 15 \times 12$

$3x = 180$

$\frac{3x}{3} = \frac{180}{3}$

$x = 60$

g) $\frac{3}{5} = \frac{x}{460}$

$460 \times \frac{3}{5} = \frac{x}{\cancel{460}} \times \cancel{460}$

$276 = x$

h) $\frac{25}{x} = \frac{40}{200}$

$200 \times \cancel{x} \times \frac{25}{\cancel{x}} = \frac{40}{\cancel{200}} \times x \times \cancel{200}$

$200 \times 25 = 40x$

$5000 = 40x$

$\frac{5000}{40} = \frac{40x}{40}$

$125 = x$

3. a) The ratio of yellow ink to white ink is 3:1, or $\frac{3}{1}$.

Set up a proportion to solve for x, the amount of yellow ink needed.

$\frac{3}{1} = \frac{x}{500}$

$500 \times \frac{3}{1} = \frac{x}{\cancel{500}} \times \cancel{500}$

$1500 = x$

Jan would need 1500 mL of yellow ink.

b) The ratio of red ink to yellow ink is 2:3, or $\frac{2}{3}$.

Set up a proportion to solve for the amount of red ink needed.

$$\frac{2}{3} = \frac{x}{750}$$

$$750 \times \frac{2}{3} = \frac{x}{\cancel{750}} \times \cancel{750}$$

$$500 = x$$

Jan would need 500 mL of red ink.

4. The ratio of front teeth to back teeth is 30:10.

   Simplify the ratio by dividing both numbers of the ratio by the largest common factor.

   front teeth : back teeth = (30 ÷ 10):(10 ÷ 10)

   front teeth : back teeth = 3:1

   The ratio of the front to back teeth is 3 to 1, or 3:1.

5. The ratio of the smaller diameter to the larger diameter is 20:45.

   Simplify this ratio by dividing by the largest common factor.

   smaller diameter : larger diameter
   = (20 ÷ 5):(45÷5)

   smaller diameter : larger diameter = 4:9

   The ratio of the smaller diameter to the larger diameter is 4 to 9, or 4:9.

6. $1.00 CAD is approximately equal to $1.13 Australian.

   The ratio of Canadian dollars to Australian dollars is 1 to 1.13, or 1:1.13.

7. The ratio of grape juice concentrate to water is 250 mL to 1 L. Convert 1 L to mL. The ratio is 250:1000.

   Simplify this ratio by dividing by the largest common factor.

   grape juice concentrate : water = 250:1000

   grape juice concentrate : water
   = (250 ÷ 250):(1000 ÷ 250)

   grape juice concentrate : water = 1:4

   The ratio of grape juice concentrate to water is 1 to 4, or 1:4.

8. The ratio of oil to gas is 1:32.

9. The ratio of flour to shortening is 2:1, or $\frac{2}{1}$.

   For every 3 cups of piecrust, there are 2 cups of flour and 1 cup of shortening. Therefore, in a mixture of piecrust, flour makes up $\frac{2}{3}$ and shortening makes up $\frac{1}{3}$.

   Calculate how much of each ingredient would be needed in 30 cups of mixture.

   Flour:

   $$\frac{2}{3} \times 30 \text{ cups} = 20 \text{ cups}$$

   Shortening:

   $$\frac{1}{3} \times 30 \text{ cups} = 10 \text{ cups}$$

   The baker uses 20 cups of flour and 10 cups of shortening.

10. The ratio of chemical 1 to chemical 2 is 3:10. Therefore, there are total of 13 parts, and chemical 1 makes up $\frac{3}{13}$ of the mixture and chemical 2 makes up $\frac{10}{13}$ of the mixture.

To calculate the amount of each chemical in 45 L of compound, multiply 45 by the fractions $\frac{3}{13}$ and $\frac{10}{13}$.

Chemical 1:

$$\frac{3}{13} \times 45 = 10.4$$

Chemical 2:

$$\frac{10}{13} \times 45 = 34.6$$

There are 10.4 L of the first chemical and 34.6 L of the second chemical in 45 L in the compound.

11. The ratio of paint to thinner is 5:3. For every 8 parts of mixture, $\frac{5}{8}$ is paint and $\frac{3}{8}$ is thinner. Multiply these fractions by 24 L to calculate the amount of paint and thinner in 24 L of the mixture.

Paint:

$$\frac{5}{8} \times 24 = 15$$

Thinner:

$$\frac{3}{8} \times 24 = 9$$

Cheryl will use 15 L of paint and 9 L of thinner.

12. The rate can be written as \$65.00:3 months, \$65.00/3 months, or $\frac{\$65.00}{3 \text{ months}}$.

13. Calculate how much you earn in 8 hours.

$$\frac{\$9.25}{1 \text{ h}} \times 8 \text{ h} = \$74.00$$

The rate of earning is \$74.00:8-hour day, \$74.00/8-hour day, or $\frac{\$74.00}{8\text{-hour day}}$.

14. The rate statement is 1 cm : 2500 km.

15. Set up a proportion to solve for x, the cost for 350 g of salami.

$$\frac{\$1.59}{100 \text{ g}} = \frac{\$\, x}{350 \text{ g}}$$

$$\frac{1.59}{100} = \frac{x}{350}$$

$$350 \times \cancel{100} \times \frac{1.59}{\cancel{100}} = \frac{x}{\cancel{350}} \times 100 \times \cancel{350}$$

$$556.5 = 100x$$

$$\frac{556.5}{100} = \frac{100x}{100}$$

$$5.57 \approx x$$

You will pay \$5.57/350 g.

16. Set up a proportion to solve for the amount of powdered cleanser needed for 5 L of water.

$$\frac{30 \text{ g}}{2 \text{ L}} = \frac{x}{5 \text{ L}}$$

$$\frac{30}{2} = \frac{x}{5}$$

$$5 \times \cancel{2} \times \frac{30}{\cancel{2}} = \frac{x}{\cancel{5}} \times 2 \times \cancel{5}$$

$$150 = 2x$$

$$\frac{150}{2} = \frac{2x}{2}$$

$$75 = x$$

Janine will need 75 g of powder for 5 L of water.

17. Set up a proportion to solver for the weight of 700 sheets of paper.

$$\frac{4.9 \text{ kg}}{500 \text{ sheets}} = \frac{x}{700 \text{ sheets}}$$

$$\frac{4.9}{500} = \frac{x}{700}$$

$$700 \times \cancel{500} \times \frac{4.9}{\cancel{500}} = \frac{x}{\cancel{700}} \times 500 \times \cancel{700}$$

$$3430 = 500x$$

$$\frac{3430}{500} = \frac{500x}{500}$$

$$6.9 \approx x$$

700 sheets of paper will weigh approximately 6.9 kg.

PRACTISE YOUR NEW SKILLS, p. 21

1. Solve the proportion to one decimal place.

a) $$\frac{24}{18} = \frac{x}{12}$$

$$\cancel{18} \times 12 \times \frac{24}{\cancel{18}} = \frac{x}{\cancel{12}} \times \cancel{12} \times 18$$

$$12 \times 24 = 18x$$

$$\frac{288}{18} = \frac{18x}{18}$$

$$16 = x$$

b) $$\frac{168 \text{ km}}{2 \text{ h}} = \frac{548 \text{ km}}{x \text{ h}}$$

$$\frac{168}{2} = \frac{548}{x}$$

$$\cancel{2} \times x \times \frac{168}{\cancel{2}} = \frac{548}{\cancel{x}} \times \cancel{x} \times 2$$

$$168x = 548 \times 2$$

$$\frac{168x}{168} = \frac{1096}{168}$$

$$x \approx 6.5$$

c) $$\frac{40}{28} = \frac{60}{x}$$

$$\cancel{28} \times x \times \frac{40}{\cancel{28}} = \frac{60}{\cancel{x}} \times \cancel{x} \times 28$$

$$40x = 60 \times 28$$

$$\frac{40x}{40} = \frac{1680}{40}$$

$$x = 42$$

d) $$\frac{6 \text{ pizza slices}}{2 \text{ people}} = \frac{x \text{ slices}}{21 \text{ people}}$$

$$\frac{6}{2} = \frac{x}{21}$$

$$\cancel{2} \times 21 \times \frac{6}{\cancel{2}} = \frac{x}{\cancel{21}} \times \cancel{21} \times 2$$

$$21 \times 6 = 2x$$

$$\frac{126}{2} = \frac{2x}{2}$$

$$63 = x$$

e) $$\frac{87 \text{ blankets}}{x \text{ bundles}} = \frac{24 \text{ blankets}}{8 \text{ bundles}}$$

$$\frac{87}{x} = \frac{24}{8}$$

$$\cancel{x} \times 8 \times \frac{87}{\cancel{x}} = \frac{24}{\cancel{8}} \times \cancel{8} \times x$$

$$8 \times 87 = 24x$$

$$\frac{696}{24} = \frac{24x}{24}$$

$$29 = x$$

f) $$\frac{12}{25} = \frac{25}{x}$$

$$\cancel{25} \times x \times \frac{12}{\cancel{25}} = \frac{25}{\cancel{x}} \times \cancel{x} \times 25$$

$$12x = 25 \times 25$$

$$\frac{12x}{12} = \frac{625}{12}$$

$$x \approx 52.1$$

g) $\frac{7}{15} = \frac{x}{1}$

$\cancel{15} \times \frac{7}{\cancel{15}} = \frac{x}{1} \times 15$

$7 = 15x$

$\frac{7}{15} = \frac{15x}{15}$

$0.5 \approx x$

h) $\frac{12}{45} = \frac{16}{x}$

$\cancel{45} \times x \times \frac{12}{\cancel{45}} = \frac{16}{\cancel{x}} \times \cancel{x} \times 45$

$12x = 16 \times 45$

$\frac{12x}{12} = \frac{720}{12}$

$x = 60$

2. a) Express the ratio of hair colour to thickener as a fraction. The mixture uses 20 mL of hair colour and 3 mL of thickener. This can be written as $\frac{20}{3}$.

b) Express the ratio of thickener to conditioner as a fraction. The mixture uses 3 mL of thickener and 15 mL of conditioner. The ratio of thickener to conditioner is $\frac{3}{15}$. This fraction can be simplified.

$\text{thickener : conditioner} = \frac{3}{15}$

$\text{thickener : conditioner} = \frac{3 \div 3}{15 \div 3}$

$\text{thickener : conditioner} = \frac{1}{5}$

The ratio of thickener to conditioner is $\frac{1}{5}$.

c) Express the ratio of colour developer to hair colour as a fraction. The mixture uses 40 mL of colour developer and 20 mL of hair colour. The ratio of colour developer to hair colour is $\frac{40}{20}$. This fraction can be simplified.

$\text{colour developer : hair colour} = \frac{40}{20}$

$\text{colour developer : hair colour} = \frac{40 \div 20}{20 \div 20}$

$\text{colour developer : hair colour} = \frac{2}{1}$

The ratio of colour developer to hair colour is $\frac{2}{1}$.

d) Express the ratio of customer price to actual cost as a fraction. The customer price is \$68.00, and the actual cost is \$14.20. The ratio of customer price to actual cost is $\frac{\$68.00}{\$14.20}$. This fraction can be simplified.

$\text{customer cost : actual cost} = \frac{68 \div 14.20}{14.20 \div 14.20}$

$\text{customer cost : actual cost} = \frac{4.8}{1}$

The ratio of customer price to actual cost is $\frac{4.8}{1}$.

3. Set up a proportion to solve for x, the amount of yellow pigment needed.

$\frac{2 \text{ drops yellow}}{3 \text{ drops blue}} = \frac{x \text{ drops yellow}}{12 \text{ drops blue}}$

$\frac{2}{3} = \frac{x}{12}$

$\cancel{3} \times 12 \times \frac{2}{\cancel{3}} = \frac{x}{\cancel{12}} \times \cancel{12} \times 3$

$24 = 3x$

$\frac{24}{3} = \frac{3x}{3}$

$8 = x$

8 drops of yellow pigment will be needed.

4. Set up a proportion to solve for x, the representation on the map. Ignore units during the calculation.

$$\frac{5 \text{ cm}}{2.5 \text{ km}} = \frac{x \text{ cm}}{15 \text{ km}}$$

$$\frac{5}{2.5} = \frac{x}{15}$$

$$15 \times \cancel{2.5} \times \frac{5}{\cancel{2.5}} = \frac{x}{\cancel{15}} \times 2.5 \times \cancel{15}$$

$$15 \times 5 = 2.5x$$

$$75 = 2.5x$$

$$\frac{75}{2.5} = \frac{2.5x}{2.5}$$

$$30 = x$$

15 km of actual ground would be represented by 30 cm on the map.

5. Set up a proportion to solve for x, the number of cans of paint needed.

$$\frac{1 \text{ can}}{48 \text{ m}^2} = \frac{x \text{ cans}}{220 \text{ m}^2}$$

$$\frac{1}{48} = \frac{x}{220}$$

$$220 \times \cancel{48} \times \frac{1}{\cancel{48}} = \frac{x}{\cancel{220}} \times 48 \times \cancel{220}$$

$$220 = 48x$$

$$\frac{220}{48} = \frac{48x}{48}$$

$$4.6 \approx x$$

You will need 5 cans of paint to cover 220 m^2.

6. Set up a proportion to solve for x, the number of teeth on the smaller gear.

$$\frac{13}{6} = \frac{52}{x}$$

$$x \times \cancel{6} \times \frac{13}{\cancel{6}} = \frac{52}{\cancel{x}} \times 6 \times \cancel{x}$$

$$13x = 312$$

$$\frac{13x}{13} = \frac{312}{13}$$

$$x = 24$$

The smaller gear has 24 teeth.

7. Set up a proportion to solve for x, time it will take Stephie to type 800 words.

$$\frac{75 \text{ words}}{1 \text{ min}} = \frac{800 \text{ words}}{x \text{ min}}$$

$$\frac{75}{1} = \frac{800}{x}$$

$$x \times \frac{75}{1} = \frac{800}{\cancel{x}} \times \cancel{x}$$

$$75x = 800$$

$$\frac{75x}{75} = \frac{800}{75}$$

$$x = 10.\overline{6}$$

It will take Stephie approximately 11 minutes to type her paper. This is a rate problem, because it deals with numbers with different units (words and minutes).

8. Set up a proportion to solve for x, the amount of flour needed.

$$\frac{3}{2} = \frac{x}{1.5}$$

$$\cancel{2} \times 1.5 \times \frac{3}{\cancel{2}} = \frac{x}{\cancel{1.5}} \times \cancel{1.5} \times 2$$

$$4.5 = 2x$$

$$\frac{4.5}{2} = \frac{2x}{2}$$

$$2.25 = x$$

You will need 2.25 cups, or $2\frac{1}{4}$ cups, of flour.

9. Set up a proportion to solve for x, the number of parts produced in 8 hours.

$$\frac{85 \text{ parts}}{40 \text{ min}} = \frac{x \text{ parts}}{8 \text{ hours}}$$

Convert 8 hours to minutes.

$$8 \text{ hours} \times \frac{60 \text{ min}}{1 \text{ h}} = 480 \text{ min}$$

Substitute the time in minutes into the proportion.

$$\frac{85 \text{ parts}}{40 \text{ min}} = \frac{x \text{ parts}}{480 \text{ min}}$$

$$\frac{85}{40} = \frac{x}{480}$$

$$\cancel{40} \times 480 \times \frac{85}{\cancel{40}} = \frac{x}{\cancel{480}} \times \cancel{480} \times 40$$

$$40\,800 = 40x$$

$$\frac{40\,800}{40} = \frac{40x}{40}$$

$$1020 = x$$

The machine will produce 1020 parts in 8 hours.

1.2 Unit Price

BUILD YOUR SKILLS, p. 27

1. Set up a proportion to solve for x, the cost of 1 apple.

$$\frac{12 \text{ apples}}{\$10.20} = \frac{1 \text{ apple}}{x}$$

$$\frac{12}{10.20} = \frac{1}{x}$$

$$x \times \cancel{10.20} \times \frac{12}{\cancel{10.20}} = \frac{1}{\cancel{x}} \times 10.20 \times \cancel{x}$$

$$12x = 10.20$$

$$\frac{12x}{12} = \frac{10.20}{12}$$

$$x = 0.85$$

One apple costs \$0.85.

2. Set up a proportion to solve for x, the cost of 1 cup.

$$\frac{\$94.83}{1000 \text{ cups}} = \frac{x}{1 \text{ cup}}$$

$$\frac{94.83}{1000} = \frac{x}{1}$$

$$\cancel{1000} \times \frac{94.83}{\cancel{1000}} = \frac{x}{1} \times 1000$$

$$94.83 = 1000x$$

$$\frac{94.83}{1000} = \frac{1000x}{100}$$

$$0.095 \approx x$$

Each cup costs about \$0.095 or about 10 cents.

3. a) Set up a proportion to solve for x, the cost of 1 lock.

$$\frac{\$244.97}{144 \text{ locks}} = \frac{x}{1 \text{ lock}}$$

$$\frac{244.97}{144} = \frac{x}{1}$$

$$\cancel{144} \times \frac{244.97}{\cancel{144}} = \frac{x}{1} \times 144$$

$$244.97 = 144x$$

$$\frac{244.97}{144} = \frac{144x}{144}$$

$$1.70 \approx x$$

Each lock costs approximately \$1.70.

b) To calculate Frank's profit, subtract the cost to Frank from the cost to the customer.

$5.50 - 1.70 = 3.80$

Frank makes a profit of \$3.80 when he sells one lock.

4. Set up a proportion to solve for x, the cost of 1 notebook.

At *La Boutique du Livre:*

$$\frac{\$15.48}{12 \text{ notebooks}} = \frac{x}{1 \text{ notebook}}$$

$$\frac{15.48}{12} = \frac{x}{1}$$

$$\cancel{12} \times \frac{15.48}{\cancel{12}} = \frac{x}{1} \times 12$$

$$15.48 = 12x$$

$$\frac{15.48}{12} = \frac{12x}{12}$$

$$1.29 = x$$

At *La Boutique du Livre*, the cost is $1.29 per notebook.

At the second bookstore:

$$\frac{\$19.65}{15 \text{ notebooks}} = \frac{x}{1 \text{ notebook}}$$

$$\frac{19.65}{15} = \frac{x}{1}$$

$$\cancel{15} \times \frac{19.65}{\cancel{15}} = \frac{x}{1} \times 15$$

$$19.65 = 15x$$

$$1.31 = x$$

At the second bookstore, the cost is $1.31 per notebook.

The package at *La Boutique du Livre* (12 notebooks for $15.48) is a better price.

5. Set up a proportion to solve for x, the cost of 1 muffin.

In the package of 6 muffins:

$$\frac{\$7.59}{6 \text{ muffins}} = \frac{x}{1 \text{ muffin}}$$

$$\frac{7.59}{6} = \frac{x}{1}$$

$$\cancel{6} \times \frac{7.59}{\cancel{6}} = \frac{x}{1} \times 6$$

$$7.59 = 6x$$

$$\frac{7.59}{6} = \frac{6x}{6}$$

$$1.27 = x$$

The first option is $1.27/muffin.

In the package of 12 muffins:

$$\frac{\$14.99}{12 \text{ muffins}} = \frac{x}{1 \text{ muffin}}$$

$$\frac{14.99}{12} = \frac{x}{1}$$

$$\cancel{12} \times \frac{14.99}{\cancel{12}} = \frac{x}{1} \times 12$$

$$14.99 = 12x$$

$$\frac{14.99}{12} = \frac{12x}{12}$$

$$1.25 = x$$

The second option is $1.25/muffin.

A dozen muffins for $14.99 is a better buy.

6. Set up a proportion to solve for x, the cost of 1 foot of lumber.

8-foot pieces of lumber:

$$\frac{\$2.60}{8 \text{ feet}} = \frac{x}{1 \text{ foot}}$$

$$\frac{2.60}{8} = x$$

$$0.33 \approx x$$

The cost of 1 foot of lumber is $0.33.

6-foot pieces of lumber:

$$\frac{\$1.92}{6 \text{ feet}} = \frac{x}{1 \text{ foot}}$$

$$\frac{1.92}{6} = x$$

$$0.32 = x$$

The cost of 1 foot of lumber is $0.32.

Buying pieces of 6-foot lumber is a better deal.

7. a) Set up a proportion to solve for x, the cost of 1 foot of string trimmer line.

First roll of string trimmer line:

$$\frac{\$18.75}{200 \text{ feet}} = \frac{x}{1 \text{ foot}}$$

$$\frac{18.75}{200} = \frac{x}{1}$$

$$\cancel{200} \times \frac{18.75}{\cancel{200}} = \frac{x}{1} \times 200$$

$$18.75 = 200x$$

$$\frac{18.75}{200} = \frac{200x}{200}$$

$$0.094 \approx x$$

The first roll of string trimmer line costs approximately \$0.09 per foot.

Second roll of string trimmer line:

$$\frac{\$15.21}{150 \text{ feet}} = \frac{x}{1 \text{ foot}}$$

$$150 \times \frac{15.21}{150} = \frac{x}{1} \times 150$$

$$15.21 = 150x$$

$$0.10 \approx x$$

The second roll of string trimmer line costs approximately \$0.10 per foot.

The first roll is less expensive per foot.

b) Subtract the cost of the first roll from the cost of the second roll.

$0.10 - 0.09 = 0.01$

The difference in price is \$0.01 per foot.

8. Calculate the unit price, per kilogram, of the tomatoes.

$\$8.25 \div 2.5 = \$3.30$

1 kg of tomatoes costs \$3.30.

Multiply by the total number of kilograms.

$$\frac{\$3.30}{1 \text{ kg}} \times 7 \text{ kg} = \$23.10$$

7 kg of tomatoes costs \$23.10.

9. Calculate the unit price of gas.

$\$5.45 \div 5 = \$1.09$

One litre of gas costs \$1.09.

Multiply by the total number of litres of gas.

$\$1.09 \times 48 = \$52.32$

Wayne will have to pay \$52.32 to fill his car with 48 L of gas.

PRACTISE YOUR NEW SKILLS, p. 32

1. a) Set up a proportion to solve for x, the cost of 1 bottle of water in the case of 12.

$$\frac{\$8.50}{12 \text{ bottles}} = \frac{x}{1 \text{ bottle}}$$

$$\frac{8.50}{12} = \frac{x}{1}$$

$$\cancel{12} \times \frac{8.50}{\cancel{12}} = \frac{x}{1} \times 12$$

$$8.50 = 12x$$

$$\frac{8.50}{12} = \frac{12x}{12}$$

$$0.71 \approx x$$

Each bottle in the case costs approximately \$0.71.

b) Calculate the cost to purchase 12 individual bottles of water.

$1.55 \times 12 = 18.60$

It would cost \$18.60 to purchase 12 individual bottles.

Calculate the savings from purchasing a case of bottled water by subtracting the cost of the case from the cost of 12 individual bottles.

$18.60 - 8.50 = 10.10$

A customer would save \$10.10 if they purchased a case of water.

2. a) Calculate the area of room to be carpeted.

$A = lw$

$A = 7 \times 12$

$A = 84$

The area of the room is 84 m^2, so Maureen bought at least that much carpet.

b) Calculate the cost of the carpet by multiplying the total area by the cost per square metre.

$84 \times 8.15 = 684.60$

The carpet cost \$684.60.

3. a) Set up a proportion to solve for x, the cost of 1 sheet of aluminum.

$$\frac{\$4000.00}{25 \text{ sheets}} = \frac{x}{1 \text{ sheet}}$$

$$\frac{4000}{25} = \frac{x}{1}$$

$$\cancel{25} \times \frac{4000}{\cancel{25}} = \frac{x}{1} \times 25$$

$$4000 = 25x$$

$$\frac{4000}{25} = \frac{25x}{25}$$

$$160 = x$$

Each sheet of aluminum costs \$160.00.

b) Calculate the surface area of one sheet.

$A = lw$

$A = 4 \times 8$

$A = 32$

The surface area of one sheet is 32 ft^2.

Set up a proportion to solve for x, the cost of 1 square foot.

$$\frac{\$160.00}{32 \text{ square feet}} = \frac{x}{1 \text{ square foot}}$$

$$\frac{160}{32} = \frac{x}{1}$$

$$\cancel{32} \times \frac{160}{\cancel{32}} = \frac{x}{1} \times 32$$

$$160 = 32x$$

$$\frac{160}{32} = \frac{32x}{32}$$

$$5 = x$$

The aluminum costs \$5.00 per square foot.

4. a) Set up a proportion to solve for x, the cost of 2 brushes.

$$\frac{\$31.29}{6 \text{ brushes}} = \frac{x}{2 \text{ brushes}}$$

$$\frac{31.29}{6} = \frac{x}{2}$$

$$\cancel{6} \times \frac{31.29}{\cancel{6}} = \frac{x}{2} \times 6$$

$$31.29 = 3x$$

$$\frac{31.29}{3} = \frac{3x}{3}$$

$$10.43 \approx x$$

Two brushes would cost about \$10.43.

b) Calculate the cost of 1 case, with the 10 percent reduction.

Convert 10% to a decimal, 0.10.

$$31.29 \times 0.10 = 3.129$$

$$31.29 - 3.129 \approx 28.16$$

The cost of 1 case reduced by 10 percent, is approximately \$28.16. The cost of 3 cases would be 3 times this amount, or \$84.48.

Set up a proportion to solve for x, the cost of 1 brush.

$$\frac{\$28.16}{6 \text{ brushes}} = \frac{x}{1 \text{ brush}}$$

$$\frac{28.16}{6} = \frac{x}{1}$$

$$\cancel{6} \times \frac{28.16}{\cancel{6}} = \frac{x}{1} \times 6$$

$$28.16 = 6x$$

$$\frac{28.16}{6} = \frac{6x}{6}$$

$$4.69 \approx x$$

Each brush would cost approximately \$4.69.

5. Calculate the cost of cheese per ounce.

8 ounces for \$4.95:

$\$4.95 \div 8 = \$0.619$

12 ounces for \$7.49:

$\$7.49 \div 12 = \$0.624$

8 ounces of Brie cheese for \$4.95 is a better buy.

6. a) Calculate the number of loaves needed for one week.

$$9 \times 6 = 54$$

Debbie uses an average of 54 loaves each week.

b) Calculate the number of loaves needed for one month.

$$54 \times 4 = 216$$

Multiply this by the cost per loaf from the wholesaler.

$216 \times \$1.25 = \$270.00$

Debbie should budget \$270.00 for bread for the month of June.

7. Calculate the cost per millilitre of juice in the 355-mL can.

$$\frac{\$1.25}{355\text{ mL}} = \frac{x}{1\text{ mL}}$$

$$\frac{1.25}{355} = \frac{x}{1}$$

$$\frac{1.25}{355} = x$$

$$0.0035 \approx x$$

1 mL costs about $0.0035.

Calculate the cost per millilitre of juice in the carton.

$$\frac{\$3.89}{1890\text{ mL}} = \frac{x}{1\text{ mL}}$$

$$\frac{3.89}{1890} = \frac{x}{1}$$

$$\frac{3.89}{1890} = x$$

$$0.0021 \approx x$$

1 mL costs about $0.0021.

Calculate the difference in price per millilitre.

$$0.0035 - 0.0021 = 0.0014$$

You would save $0.0014/mL if you bought the juice from the grocery store.

8. For option 1, add the cost of delivery to the cost of the carton.

$34.68 + $5.45 = $40.13

Calculate the unit price.

$40.13 ÷ 12 = $3.34

For option 1, the cost per carton is $3.34.

For option 2, add the cost of delivery to the cost of the carton.

$51.30 + $6.25 = $57.55

Calculate the unit price.

$57.55 ÷ 18 = $3.20

For option 2, the cost per carton is $3.20.

Calculate the difference in price per carton.

$3.34 – $3.20 = $0.14

A carton of 18 is a better buy, by $0.14 per unit.

1.3 Setting a Price

BUILD YOUR SKILLS, p. 37

1. Divide the percentage by 100 to convert to a decimal.

a) $78\% = \frac{78}{100}$

$78\% = 0.78$

b) $93\% = \frac{93}{100}$

$93\% = 0.93$

c) $125\% = \frac{125}{100}$

$125\% = 1.25$

d) $324\% = \frac{324}{100}$

$324\% = 3.24$

e) $0.5\% = \frac{0.5}{100}$

$0.5\% = 0.005$

f) $0.38\% = \frac{0.38}{100}$

$0.38\% = 0.0038$

g) $1.2\% = \frac{1.2}{100}$

$1.2\% = 0.012$

h) $100\% = \frac{100}{100}$

$100\% = 1$

2. Divide the percentage by 100 to convert to a decimal, then multiply.

a) $15 \div 100 = 0.15$

$0.15 \times 300 = 45$

ALTERNATIVE SOLUTION

Use proportional reasoning to solve for x.

$$\frac{15}{100} = \frac{x}{300}$$

$$300 \times \frac{15}{100} = \frac{x}{300} \times 300$$

$$3 \times 15 = x$$

$$45 = x$$

b) $45 \div 100 = 0.45$

$0.45 \times 1500 = 675$

ALTERNATIVE SOLUTION

Use proportional reasoning to solve for x.

$$\frac{45}{100} = \frac{x}{1500}$$

$$1500 \times \frac{45}{100} = \frac{x}{1500} \times 1500$$

$$15 \times 45 = x$$

$$675 = x$$

c) $140 \div 100 = 1.4$

$1.4 \times 70 = 98$

d) $175 \div 100 = 1.75$

$1.75 \times 24 = 42$

e) $7.8 \div 100 = 0.078$

$0.078 \times 50 = 3.9$

f) $0.3 \div 100 = 0.003$

$0.003 \times 175 = 0.525$

g) $200 \div 100 = 2.00$

$2.00 \times 56 = 112$

h) $135 \div 100 = 1.35$

$1.35 \times 25 = 33.75$

3. Divide the second number by the first number, then multiply by 100.

a) $65 \div 325 = 0.2$

$0.2 \times 100 = 20\%$

ALTERNATIVE SOLUTION

Use proportional reasoning to solve for x.

$$\frac{x}{100} = \frac{65}{325}$$

$$100 \times 325 \times \frac{x}{100} = \frac{65}{325} \times 325 \times 100$$

$$325x = 6500$$

$$x = \frac{6500}{325}$$

$$x = 20\%$$

b) $135 \div 405 = 0.\overline{3}$

$0.333 \times 100 = 33.3\%$

ALTERNATIVE SOLUTION

Use proportional reasoning to solve for x.

$$\frac{x}{100} = \frac{135}{405}$$

$$100 \times 405 \times \frac{x}{100} = \frac{135}{405} \times 405 \times 100$$

$$405x = 13\,500$$

$$x = \frac{13\,500}{405}$$

$$x = 33.\overline{3}\%$$

c) $68 \div 42 = 1.62$

$1.62 \times 100 = 162\%$

d) $13 \div 65 = 0.2$

$0.2 \times 100 = 20\%$

e) $1 \div 12 = 0.08333$

$0.0833 \times 100 = 8.33\%$

f) $625 \div 50 = 12.5$

$12.5 \times 100 = 1250\%$

4. Calculate 125% of $450.00.

$125 \div 100 = 1.25$

$450.00 \times 1.25 = 562.50$

The markup is $562.50.

5. Calculate 25% of $7.25.

$25 \div 100 = 0.25$

$0.25 \times 7.25 \approx 1.81$

The markup is about $1.81.

6. Calculate 60% of $117.45, then add this markup to the wholesale price.

$$\$117.45 \times 0.60 = \$70.47$$
$$\$117.45 + \$70.47 = \$187.92$$

The retail price of the *hanbok* should be $187.92.

7. Calculate 7% of $9.00, then add this amount to the wholesale price.

$$75 \div 100 = 0.75$$
$$0.75 \times 9.00 = 6.75$$
$$9.00 + 6.75 = 15.75$$

Max should charge $15.75 for the paper plates.

8. Calculate 5% of $99.95, then add this amount to the retail price.

$$5 \div 100 = 0.05$$
$$\$99.95 \times 0.05 = \$5.00$$
$$\$99.95 + \$5.00 = \$104.95$$

You would pay $104.95.

9. Calculate 5% and 6% of the retail price, and add these amounts to the retail price.

$$5 \div 100 = 0.05$$
$$\$944.98 \times 0.05 = \$47.25$$
$$6 \div 100 = 0.06$$
$$\$944.98 \times 0.06 = \$56.70$$
$$\$944.98 + \$47.25 + \$56.7 = \$1048.93$$

The total cost is $1048.93.

10. Calculate 12% of the cost of the flight.

$$12 \div 100 = 0.12$$
$$0.12 \times 372.00 = 44.64$$

The HST will be $44.64.

11. Calculate the taxes on the can of paint.

GST:

$$\$45.89 \times 0.05 = \$2.30$$

PST:

$$\$45.89 \times 0.06 = \$2.75$$

Krista would pay $2.30 in GST and $2.75 in PST.

12. First calculate the dollar amount of the 125% markup.

$$\$30.00 \times 1.25 = \$37.50$$

Calculate the retail price of the jeans by adding the markup to the wholesale price.

$$\$30.00 + \$37.50 = \$67.50$$

Calculate the GST and PST on the retail price of the jeans.

$$\$67.50 \times 0.05 = \$3.38$$

Calculate the total cost to the consumer by adding the retail price plus the two taxes.

$$\$67.50 + \$3.38 + \$3.38 = \$74.26$$

The consumer will pay $74.26 for the jeans.

13. Calculate the dollar amount of the markup.

$$250 \div 100 = 2.50$$
$$2.50 \times 7.25 = 18.13$$

To calculate the retail price, add the markup to the cost to produce the meal.

$$7.25 + 18.13 = 25.38$$

The meal will cost $25.38 to the customer, before tax.

Calculate the 5% GST.

$0.05 \times 25.38 = 1.27$

Add the GST to the meal cost.

$\$25.38 + \$1.27 = \$26.65$

The customer will pay $26.65 for the meal.

PRACTISE YOUR NEW SKILLS, p. 46

1. Divide the percentage by 100 to convert to a decimal, then multiply.

   a) $5 \div 100 = 0.05$

   $0.05 \times 72 = 3.6$

   b) $275 \div 100 = 2.75$

   $2.75 \times 8 = 22$

   c) $152 \div 100 = 1.52$

   $1.52 \times 200 = 304$

   d) Convert $6\frac{3}{4}$ to a decimal, 6.75.

   $6.75 \div 100 = 0.0675$

   $0.0675 \times 700 = 47.25$

2. a) Calculate the dollar amount of the 20% markup.

   Convert the markup to a decimal.

   $20 \div 100 = 0.2$

   Multiply.

   $\$2.53.75 \times 0.2 = \$50.75$

   The markup is $50.75.

   b) Add the markup to the cost at the hardware store.

   $\$253.75 + \$50.75 = \$304.50$

   The electrician charges the customer $304.50.

3. Subtract the wholesale price from the retail price to find the dollar amount of the markup.

   $\$19.85 - \$8.50 = \$11.45$

   Calculate the markup as a decimal by dividing the wholesale price by the markup, then convert to a percentage.

   $\$11.45 \div \$8.50 \approx 1.35$

   $1.35 \times 100 = 135\%$

   The percent markup is 135%.

4. Calculate the retail price per tire by multiplying by 140% (the 40% markup plus 100% of the wholesale cost).

   $\$79.00 \times 1.4 = \$110.60$

   Multiply by 4 to calculate the retail price for 4 tires.

   $4 \times \$110.60 = \$442.40$

   Calculate the total cost including 12% tax.

   $\$442.40 \times 1.12 = \$495.49$

   The customer will pay $495.49.

   ALTERNATIVE SOLUTION

   Calculate the dollar amount of the 40% markup.

   $\$79.00 \times 0.4 = \$31.60$

Add the markup to the wholesale price to calculate the retail price of 1 tire.

$79.00 + $31.60 = $110.60

Multiply by 4 to calculate the retail price for 4 tires.

$4 \times \$110.60 = \$442.40$

Calculate 12% tax on the retail price.

$\$442.40 \times 0.12 = \$53.09$

Add the tax to the retail price.

$442.40 + $53.09 = $495.49

The customer will pay $495.49.

5. Calculate 112% of the original price of the salmon fillet.

$\$17.95 \times 1.12 = \$20.10$

Maurice will now charge $20.10 for the salmon fillet.

6. Calculate the wholesale cost of 1 T-shirt by dividing the cost of one dozen shirts by 12.

$\$132.00 \div 12 = \$11.00$

Calculate the retail cost of 1 T-shirt by multiplying the wholesale price by 1.75 (100% of the wholesale price plus a 75% markup).

$\$11.00 \times 1.75 = \$19.25$

Calculate the total cost including 12% tax.

$\$19.25 \times 1.12 = \$21.56$

The customer will pay $21.56 for 1 T-shirt.

ALTERNATIVE SOLUTION

Calculate the wholesale cost of 1 T-shirt by dividing the cost of one dozen shirts by 12.

$132.00 ÷ 12 = $11.00

Calculate the dollar amount of the 75% markup.

$\$11.00 \times 0.75 = \$8.25$

Add the markup to the wholesale cost to determine the retail cost.

$11.00 + 8.25 = $19.25

Calculate the dollar amounts of tax applied to the retail cost.

$\$19.25 \times 0.05 = \$0.96$

$\$19.25 \times 0.07 = \$1.35$

Add the taxes to the retail cost.

$19.25 + $0.96 + $1.35 = $21.56

The customer will pay $21.56 for 1 T-shirt.

7. Calculate the total cost in BC, including the 12% HST.

$\$89.95 \times 1.12 = \$100.75$

Calculate the total cost in Alberta, including 5% GST.

$\$94.89 \times 1.05 = \$99.64$

Calculate the difference in cost between BC and Alberta.

$100.75 – $99.64 = $1.11

Harry will save $1.11 by buying the MP3 player in Alberta.

1.4 On Sale!

BUILD YOUR SKILLS, p. 50

1. Calculate 30% of the original asking price.

   $\$989.98 \times 0.30 = \$296.99$

   Jordan will save $296.99.

2. Calculate 60% of the original price.

   $\$2.98 \times 0.60 = \$1.79$

   You will save $1.79 by buying a day-old loaf.

3. Calculate 25% of the original price.

   $\$999.97 \times 0.25 = \$249.99$

   You will save $249.99 on the price of the sofa.

4. Calculate 30% of the regular price, then subtract the discount from the regular price.

   $\$24.95 \times 0.30 = \$7.49$

   $\$24.95 - \$7.49 = \$17.46$

   You will have to pay $17.46.

5. You will get the $25.00 item at 15% off. Calculate 15% of $25.00, then subtract that amount from $25.00.

   $\$25.00 \times 0.15 = \$3.75$

   $\$25.00 - \$3.75 = \$21.25$

   The first item will cost $21.25.

   You will get the $12.00 item at 20% off.

   $\$12.00 \times 0.20 = \$2.40$

   $\$12.00 - \$2.40 = \$9.60$

   The second item will cost $9.60.

   You will get the $10.00 item at 30% off.

   $\$10.00 \times 0.30 = \$3.00$

   $\$10.00 - \$3.00 = \$7.00$

   The third item will cost $7.00.

   Add to find the total cost.

   $\$21.25 + \$9.60 + \$7.00 = \$37.85$

   You will pay $37.85 for the three items.

6. Calculate the cost of painting 4 rooms if no discount were given.

   $\$75.00 \times 4 = \$300.00$

   Calculate 15% of $300.00, then subtract that amount from $300.00.

   $\$300.00 \times 0.15 = \$45.00$

   $\$300.00 - \$45.00 = \$255.00$

   Chiu will charge $255.00 for 4 rooms.

7. Calculate the dollar amount of markdown.

   $\$175.00 - \$150.00 = \$25.00$

   Calculate what percent $25.00 is of $175.00.

   $25.00 \div 175.00 \approx 0.14$

   $0.14 \times 100 = 14\%$

   The markdown is approximately 14%.

8. Calculate the cost of 5 T-shirts at regular price.

$$\$15.97 \times 5 = \$79.85$$

The discount is the cost of 1 T-shirt, $15.97.

Calculate the discount rate by dividing the regular price by the discount and converting to a percentage.

$$\frac{\$15.97}{\$79.85} \times 100\% = 20\%$$

The discount is 20%.

9. Calculate the regular price of buying 6 computers.

$$\$789.00 \times 6 = \$4734.00$$

Cameron is saving the cost of one computer, $789.00.

Calculate what percentage the cost of one computer is of the regular price of 6 computers.

$$\frac{\$789.00}{\$4734.00} \times 100 \approx 17\%$$

Cameron will save about 17%.

10. Calculate 30% of the original price, and subtract that amount from $149.00.

$$\$149.00 \times 0.30 = \$44.70$$
$$\$149.00 - \$44.70 = \$104.30$$

The discounted retail price of the frames will be $104.30.

Calculate how much the frames will cost including tax by multiplying the retail price by 105% (1.05).

$$\$104.30 \times 1.05 = \$109.52$$

You will pay $109.52.

11. Calculate the sale price of the coat, before tax. Because the discount is 25%, Nicole will be paying 75% (or 0.75) of the original price.

$$\$249.95 \times 0.75 = \$187.46$$

Calculate the cost of the coat including taxes. Add 5% GST and 5% PST to 100% of the cost, and calculate 110% (or 1.10) of the sale price.

$$\$187.46 \times 1.10 = \$206.21$$

Nicole will pay $206.21 for the coat.

12. a) Calculate the cost to the customer at regular price including GST and PST.

$$\$249.95 \times 1.13 = \$282.44$$

At regular price, the sink would cost $282.44.

Calculate the cost at a 40% discount, then add GST and PST.

$$\$249.95 \times 0.60 = \$149.97$$
$$\$149.97 \times 1.13 = \$169.47$$

At a 40% discount, the sink would cost $169.47.

Calculate the total savings.

$$\$282.44 - \$169.47 = \$112.97$$

The customer would save $112.97.

b) Calculate what percent $112.97 is of the original price plus tax ($282.44).

$$\frac{\$112.97}{\$282.44} \times 100 = 40\%$$

The percentage of savings is 40%.

PRACTISE YOUR NEW SKILLS, p. 56

1. Calculate 15% (0.15) of the regular price.

   $\$9879.00 \times 0.15 = \$1481.85$

   The car will be reduced by $1481.85 for a repeat customer.

2. a) Calculate 30% (0.30) of the original price.

   $\$49.98 \times 0.30 = \$14.99$

   The discount is $14.99.

   b) Subtract the amount of the discount from the original price.

   $\$49.98 - \$14.99 = \$34.99$

   The cost of the fishing rod before tax will be $34.99.

3. Add the regular price of the two meals, then calculate 20% (0.20).

   $\$14.98 + \$17.98 = \$32.96$

   $\$32.96 \times 0.20 = \$6.59$

   They will save $6.59.

4. Calculate the regular price of 5 cans of paint, then calculate 20% of the regular price.

   $\$59.95 \times 5 = \$299.75$

   $\$299.75 \times 0.20 = \$59.95$

   The contractor will save $59.95 if he buys 5 cans.

5. a) Since the discount is 80%, you will pay 20% of the original price. Calculate 20% of $2989.97.

   $\$2989.97 \times 0.20 = \$597.99$

   GST of 5% plus PST of 7%, added to 100% of the sale price, is 112%. Calculate 112% (or 1.12) of the sale price.

   $\$597.99 \times 1.12 = \$669.75$

   You will pay $669.75.

   b) Calculate how much you would pay, including 12% tax, at the original price.

   $\$2989.97 \times 1.12 = \$3348.77$

   To calculate the total savings, subtract the amount from part a) from the original price including tax.

   $\$3348.77 - \$669.75 = \$2679.02$

   You will save a total of $2679.02.

6. Calculate the dollar value of the discount.

   $\$785.00 - \$553.00 = \$232.00$

   Calculate what percent $232.00 is of the original asking price.

   $\frac{\$232.00}{\$785.00} \times 100 \approx 30\%$

   Robert offered a 30% markdown on the bicycle.

7. a) Calculate 65% of the wholesale price, then add this amount to the wholesale price.

$$\$53.00 \times 0.65 = \$34.45$$

$$\$53.00 + \$34.45 = \$87.45$$

The original asking price was $87.45.

b) Calculate the original price of the *tawa*, $87.45, including 5% GST and 5% PST. The two taxes, plus 100% of the asking price, equal 110%, or 1.10. Multiply the original asking price by 1.10.

$$\$87.45 \times 1.10 = \$96.20$$

The original price including taxes was $96.20.

c) Calculate 60% of the original asking price (the amount from part a), then subtract from the original asking price.

$$\$87.45 \times 0.6 = \$52.47$$

$$\$87.45 - \$52.47 = \$34.98$$

The end-of-season sale price was $34.98.

d) Calculate 110% of the sale price.

$$\$34.98 \times 1.10 = \$38.48$$

The customer would pay $38.48.

e) Subtract the total sale cost (part d) from the total original cost (part b).

$$\$96.20 - \$38.48 = \$57.72$$

If the *tawa* were bought on sale, the savings would be $57.72.

f) Calculate what percent $57.72 is of the original asking price plus tax (part b).

$$\frac{\$57.72}{\$96.20} \times 100 \approx 60\%$$

Total percent savings is 60%.

1.5 Currency Exchange Rates

BUILD YOUR SKILLS, p. 60

1. Multiply the amount in Canadian dollars by the exchange rate.

$$\$1.00 = 180.0779 \text{ Ft}$$
$$\$500.00 \times 180.0779 = 90\,038.95 \text{ Ft}$$

Ray will receive 90 038.95 Hungarian forints for $500.00 CAD.

2. Multiply $200.00 CAD by the exchange rate.

$$\$1.00 = £0.5911$$
$$\$200.00 \times 0.5911 = £118.22$$

You will get 118.22 British pounds sterling for $200.00 CAD.

3. Multiply $200.00 CAD by the exchange rate.

$$\$1.00 = 5.3541 \text{ kr}$$
$$\$100.00 \times 5.3541 = 535.41 \text{ kr}$$

Madeline will receive 535.40 Danish kroner for $100.00 CAD.

4. Multiply $300.00 CAD by the exchange rate.

$$\$1.00 \text{ CAD} = €0.7180$$
$$\$300.00 \times 0.7180 = €215.40$$

You will get 215.40 euros for $300.00 CAD.

5. Multiply $400.00 CAD by the exchange rate.

$$\$1.00 \text{ CAD} = 1.0542 \text{ SFr}$$
$$\$400.00 \times 1.0542 = 421.68 \text{ SFr}$$

You will get 421.68 Swiss francs for $400.00 CAD.

6. Multiply $200.00 CAD by the exchange rate.

$1.00 CAD = 6.1805 Trinidad and Tobago dollars

$200.00 × 6.1805 = 1236.10

You will get 1236.10 Trinidad and Tobago dollars for $200.00 CAD.

7. Multiply $200.00 CAD by the exchange rate.

a) $1.00 CAD = 1.72904 Brazilian reals

$200.00 CAD = 1.72904 × 200

$200.00 CAD ≈ 345.81 Brazilian reals

You would receive 345.81 Brazilian reals for $200.00 CAD.

b) $1.00 CAD = 8.71137 Moroccan dirhams

$200.00 CAD = 8.71137 × 200

$200.00 CAD = 1742.27 Moroccan dirhams

You would receive 1742.27 Moroccan dirhams for $200.00 CAD.

c) $1.00 CAD = 7.72277 Ukrainian hryvnia

$200.00 CAD = 7.72277 × 200

$200.00 CAD = 1544.55 Ukrainian hryvnia

You would receive 1544.55 Ukrainian hryvnia for $200.00 CAD.

d) $1.00 CAD = 3.19889 Polish zloty

$200.00 CAD = 3.19889 × 200

$200.00 CAD = 639.78 Polish zloty

You would receive 639.78 Polish zloty for $200.00 CAD.

8. Multiply the cost in Singapore dollars by the exchange rate.

$1.00 Singapore = $0.75529 CAD

449.75 × 0.75529 = $339.69

The item will cost $339.69 CAD.

9. Multiply the cost of the jacket in euros by the exchange rate.

€1.00 = $1.3987

$$€125.98 \times \frac{\$1.3987}{€1.00} = \$176.21$$

The cost of Henry's jacket is $176.21 CAD.

10. Multiply the cost of the item in South African rand by the exchange rate.

1.00 South African rand = $0.138469 CAD

639.00 × 0.138469 = $88.48 CAD

The item costs $88.48 CAD.

11. 1 unit of the currency equals $0.00519 CAD. So, you will get more units of the currency than of Canadian dollars.

12. Multiply £250.00 by the exchange rate.

1 British pound = $1.5379 CAD

£250.00 × 1.5379 = $384.48

£250.00 would cost $384.48 CAD.

13. The bank will sell euros to you, so first use the selling rate of 1.4768. Divide $1000.00 CAD by the exchange rate.

$1000.00 ÷ 1.4768 = €677.14

You will first receive €677.14 for $1000.00 CAD.

Next, the bank will buy the euros back from you at an exchange rate of 1.4287. Multiply €677.14 by this exchange rate.

€677.14 × 142.87 = $967.43 CAD

You will receive $967.43 CAD when you sell your euros back to the bank.

Calculate how much money you lost.

$1000.00 – $967.43 = $32.57

You would lose $32.57.

PRACTISE YOUR NEW SKILLS, p. 67

1. Multiply $500.00 CAD by the exchange rate.

a) $1.00 CAD = 95.4911 Japanese yen

$500.00 × 95.4911 ≈ 47 746 Japanese yen

b) $1.00 CAD = 1.41046 Turkish lira

$500.00 × 1.41046 ≈ 705 Turkish lira

c) $1.00 CAD = €0.680228

$500.00 × 0.680228 ≈ 340 euro

d) $1.00 CAD = 6.43033 Chinese yuan

$500.00 × 6.43033 ≈ 3215 Chinese yuan

2. Use proportional reasoning to calculate how much foreign currency Damien will give to the customer for $500.00 CAD.

a) 1 Mexican peso = $0.0818085 CAD

$$\frac{1 \text{ Mexican peso}}{\$0.0818085 \text{ CAD}} = \frac{x \text{ Mexican pesos}}{\$500.00 \text{ CAD}}$$

$$\frac{1}{0.0818085} = \frac{x}{500}$$

$$500 \times \frac{1}{0.0818085} = \frac{x}{500} \times 500$$

$$\frac{500}{0.0818085} = x$$

$$6112 \approx x$$

The customer will receive about 6112 Mexican pesos.

b) 1 Estonian kroon = $0.0939564 CAD

$$\frac{1}{0.0939564} = \frac{x}{500}$$

$$500 \times \frac{1}{0.0939564} = \frac{x}{500} \times 500$$

$$\frac{500}{0.0939564} = x$$

$$5322 \approx x$$

The customer will receive about 5322 Estonian kroon.

c) 1 British pound (£) = $1.3376 CAD

$$\frac{1}{1.3376} = \frac{x}{500}$$

$$500 \times \frac{1}{1.3376} = \frac{x}{500} \times 500$$

$$\frac{500}{1.3376} = x$$

$$374 \approx x$$

The customer will receive about £374.00.

d) 1 South Korean won = $0.000922277 CAD

$$\frac{1}{0.000922277} = \frac{x}{500}$$

$$500 \times \frac{1}{0.000922277} = \frac{x}{500} \times 500$$

$$\frac{500}{0.000922277} = x$$

$$54\,213 \approx x$$

The customer will receive about 54 213 South Korean won.

e) 1 Indian rupee = $0.0229526 CAD

$$\frac{1}{0.0229526} = \frac{x}{500}$$

$$500 \times \frac{1}{0.0229526} = \frac{x}{500} \times 500$$

$$\frac{500}{0.0229526} = x$$

$$21\,784 \approx x$$

The customer will receive about 21 784 Indian rupees.

f) 1 Russian ruble = $0.0352667 CAD

$$\frac{1}{0.0352667} = \frac{x}{500}$$

$$500 \times \frac{1}{0.0352667} = \frac{x}{500} \times 500$$

$$\frac{500}{0.0352667} = x$$

$$14\,178 \approx x$$

The customer will receive about 14 178 Russian rubles.

3. Divide the amount in foreign currency by the exchange rate from question #1.

a) $1.00 CAD = 95.4911 Japanese yen

$8750 \div 95.4911 = \$91.63$ CAD

You would get about $91.63 CAD.

b) $1.00 CAD = 1.41046 Turkish lira

900 ÷ 1.41046 = $638.09 CAD

You would get about $638.09 CAD.

c) $1.00 CAD = €0.680228

€250 ÷ 0.680228 = $367.52 CAD

You would get about $367.52 CAD.

d) $1.00 CAD = 6.43033 Chinese yuan

3000 ÷ 6.43033 = $466.54 CAD

You would get about $466.54 CAD.

4. Multiply the foreign currency by the exchange rate.

a) 1 Mexican peso = $0.0818085 CAD

6750 × 0.0818085 = $552.21 CAD

You would get about $552.21 CAD.

b) 1 British pound = $1.3376 CAD

145 × 1.3376 = $193.95 CAD

You would get about $193.95 CAD.

c) 1 Indian rupee = $0.0229526 CAD

15 000 × 0.0229526 = $344.29 CAD

You would get about $344.29 CAD.

d) 1 Russian ruble = $0.0352667 CAD

750 × 0.0352667 = $26.45 CAD

You would get about $26.45 CAD.

5. 1 Norwegian krone = $0.1736 CAD

Multiply the cost of the item in Norwegian krone by the exchange rate.

275 × 0.1736 = $47.74

The item will cost about $47.74 CAD.

6. 1 Botswana pula = $0.1515

Multiply the cost of the item in Botswana pula by the exchange rate.

35 × 0.1515 = $5.30

The shawl costs about $5.30 CAD.

7. The bank will sell Omani rials to you, so first use the selling rate of 2.96845. Divide $800.00 CAD by the exchange rate.

$800.00 ÷ 2.96845 = 269.50 Omani rials

Next, the bank will buy the rials back from you at an exchange rate of 2.86145. Multiply 269.50 rials by this exchange rate.

269.50 × 2.86145 = $771.16 CAD

Calculate how much money you would lose.

$800.00 – $771.16 = $28.84

You would lose $28.84.

CHAPTER TEST, p. 70

1. Set up a proportion to solve for x, the amount of water needed for 3 L of powder.

$$\frac{x \text{ water}}{3 \text{ L powder}} = \frac{14 \text{ parts water}}{1 \text{ part powder}}$$

$$\frac{x}{3} = \frac{14}{1}$$

$$\cancel{3} \times \frac{x}{\cancel{3}} = \frac{14}{1} \times 3$$

$$x = 3 \times 14$$

$$x = 42$$

If Mark uses 3 L of powder, he will need 42 L of water.

2. a) The car uses 5.5 L of gas for 100 km, so the rate can be expressed as 5.5 L/100 km, 5.5 L:100 km, or $\frac{5.5 \text{ L}}{100 \text{ km}}$.

   b) Set up a proportion to solve for x, the amount of fuel needed for a 400-km trip.

$$\frac{5.5 \text{ L}}{100 \text{ km}} = \frac{x}{400 \text{ km}}$$

$$\frac{5.5}{100} = \frac{x}{400}$$

$$400 \times \frac{5.5}{100} = \frac{x}{\cancel{400}} \times \cancel{400}$$

$$4 \times 5.5 = x$$

$$22 = x$$

For a 400 km trip, 22 L of fuel would be needed.

ALTERNATIVE SOLUTION

The rate of fuel consumption is 5.5 L/100 km. A trip of 400 km would use 4 times the amount of fuel.

$$5.5 \text{ L/100 km} \times 4 = 22 \text{ L/400 km}$$

For a 400 km trip, 22 L of fuel would be needed.

3. Set up a proportion to solve for x, the actual distance between the sites.

$$\frac{2.5 \text{ cm}}{100 \text{ km}} = \frac{7.4 \text{ cm}}{x}$$

$$\frac{2.5}{100} = \frac{7.4}{x}$$

$$x \times \cancel{100} \times \frac{2.5}{\cancel{100}} = \frac{7.4}{\cancel{x}} \times 100 \times \cancel{x}$$

$$2.5x = 740$$

$$\frac{2.5x}{2.5} = \frac{740}{2.5}$$

$$x = 296$$

The distance between the two sites is 296 km.

4. Divide the cost of the package by 12 to determine the unit cost of pens.

$\$38.98 \div 12 = \$3.25$

The cost of 1 pen is \$3.25.

5. Calculate the wholesale cost of 1 package of smoked salmon.

$\$99.50 \div 10 = \$9.95$

Calculate the retail cost of 1 package. The markup is 45%. Add this to 100% (the wholesale cost). Calculate 145% (1.45) of the wholesale cost.

$\$9.95 \times 1.45 = \$14.43$

The cost of 1 package will be \$14.43.

6. Calculate 40% (0.4) of the original cost of buns, and subtract from the original cost.

$\$4.79 \times 0.4 = \$1.92$

$\$4.79 - \$1.92 = \$2.87$

The reduced price is \$2.87/dozen.

7. a) Calculate the price after the first, 35% (0.35) reduction.

$$\$1899.00 \times 0.35 = \$664.65$$

$$\$1899.00 - \$664.65 = \$1234.35$$

Calculate the price after the second, 20% (0.2) reduction.

$$\$1234.35 \times 0.2 = \$246.87$$

$$\$1234.35 - \$246.87 = \$987.48$$

Calculate the taxes, and the total price.

$$\$987.48 \times 0.05 = \$49.37$$

$$\$987.48 \times 0.07 = \$69.12$$

$$\$987.48 + \$49.37 + \$69.12 = \$1105.97$$

The final price of the sofa will be $1105.97.

b) No, a 35% reduction followed by a 20% reduction is not the same as a 55% reduction. The original price is reduced by 35%, and then the sale price is reduced by 20%. A 55% reduction would give the following cost, before taxes.

$$\$1899.00 \times 0.55 = \$1044.45$$

$$\$1899.00 - \$1044.45 = \$854.55$$

8. Calculate the cost of the item with GST and PST.

$$\$24.97 \times 0.05 = \$1.25$$

$$\$24.97 + \$1.25 + \$1.25 = \$27.47$$

Calculate what percent $24.97 is of $27.47.

$$\$24.97 \div \$27.47 \approx 0.91$$

$$0.91 \times 100 = 91\%$$

Calculate the percent savings by subtracting from 100.

$$100 - 91 = 9\%$$

You will actually save 9%.

9. Calculate what percent $15.00 is of $39.00. Then calculate the percent savings by subtracting from 100.

$$\$15.00 \div \$39.00 \approx 0.38$$

$$0.38 \times 100 = 38\%$$

$$100 - 38 = 62\%$$

The percentage markdown is 62%.

10. Calculate 12% (0.12) of $865.00.

$$\$865.00 \times 0.12 = \$103.80$$

A non-profit agency will save $103.80 on the printing job.

11. $1.00 CAD = 7.318 Hong Kong dollars

Divide the cost in Hong Kong dollars by the exchange rate.

$$1295.31 \div 7.3181 = \$177.00 \text{ CAD}$$

The cost of the fluorescent track lighting unit is $177.00 CAD.

12. a) $1.00 CAD = €0.680228

Multiply the amount in Canadian dollars by the exchange rate.

$$450.00 \times 0.680228 = €306.10$$

Marian will receive €306.10.

b) $1.00 CAD = €0.680228

Divide the cost in euros by the exchange rate.

$$125.00 \div 0.680228 = \$183.76 \text{ CAD}$$

The cost of the purse is $183.76 CAD.

Chapter 2

Earning an Income

2.1 Wages and Salaries

BUILD YOUR SKILLS, p. 76

1. Use long division to divide the numerator by the denominator.

a)
$$\begin{array}{r} 4 \\ 7\overline{)29} \\ \underline{28} \\ 1 \end{array}$$

$29 \div 7 = 4$, remainder 1

$\frac{29}{7} = 4\frac{1}{7}$

b)
$$\begin{array}{r} 54 \\ 9\overline{)493} \\ \underline{45} \\ 43 \\ \underline{36} \\ 7 \end{array}$$

$\frac{493}{9} = 54$, remainder 7

$\frac{493}{9} = 54\frac{7}{9}$

c)
$$\begin{array}{r} 34 \\ 29\overline{)1005} \\ \underline{87} \\ 135 \\ \underline{116} \\ 19 \end{array}$$

$1005 \div 29 = 34$, remainder 19

$\frac{1009}{29} = 34\frac{19}{29}$

d)
$$\begin{array}{r} 7 \\ 6\overline{)45} \\ \underline{42} \\ 3 \end{array}$$

$45 \div 6 = 7$, remainder 3

$\frac{45}{6} = 7\frac{3}{6}$

$\frac{3}{6} = \frac{3 \div 3}{6 \div 3}$

$\frac{3}{6} = \frac{1}{2}$

$\frac{45}{6} = 7\frac{1}{2}$

e)
$$\begin{array}{r} 24 \\ 16\overline{)398} \\ \underline{32} \\ 78 \\ \underline{64} \\ 14 \end{array}$$

$398 \div 16 = 24$, remainder 14

$$\frac{398}{16} = 24\frac{14}{16}$$

$$\frac{398}{16} = 24\frac{7}{8}$$

ALTERNATIVE SOLUTION

$$\frac{398}{16} = \frac{398 \div 2}{398 \div 2}$$

$$\frac{398 \div 2}{398 \div 2} = \frac{199}{8}$$

$199 \div 8 = 24$, remainder 7

$$\frac{398}{16} = 24\frac{7}{8}$$

f)
$$\frac{1000}{15} = \frac{1000 \div 5}{15 \div 5}$$

$$\frac{1000 \div 5}{15 \div 5} = \frac{200}{3}$$

$200 \div 3 = 66$, remainder 2

$$200 \div 3 = 66\frac{2}{3}$$

$$\frac{1000}{15} = 66\frac{2}{3}$$

2. a)
$$5\frac{6}{11} = 5 + \frac{6}{11}$$

$$5\frac{6}{11} = \frac{5 \times 11}{1 \times 11} + \frac{6}{11}$$

$$5\frac{6}{11} = \frac{55}{11} + \frac{6}{11}$$

$$5\frac{6}{11} = \frac{61}{11}$$

ALTERNATIVE SOLUTION

$$5\frac{6}{11} = 5 + \frac{6}{11}$$

$$5\frac{6}{11} = \frac{(5 \times 11) + 6}{11}$$

$$5\frac{6}{11} = \frac{55 + 6}{11}$$

$$5\frac{6}{11} = \frac{61}{11}$$

b)
$$4\frac{7}{9} = 4 + \frac{7}{9}$$

$$4\frac{7}{9} = \frac{4 \times 9}{1 \times 9} + \frac{7}{9}$$

$$4\frac{7}{9} = \frac{36}{9} + \frac{7}{9}$$

$$4\frac{7}{9} = \frac{43}{9}$$

ALTERNATIVE SOLUTION

$$4\frac{7}{9} = 4 + \frac{7}{9}$$

$$4\frac{7}{9} = \frac{(4 \times 9) + 7}{9}$$

$$4\frac{7}{9} = \frac{36 + 7}{9}$$

$$4\frac{7}{9} = \frac{43}{9}$$

Encourage students to use the shortcut (alternative solution).

c)
$$15\frac{8}{17} = 15 + \frac{18}{17}$$

$$15\frac{8}{17} = \frac{15(17) + 18}{17}$$

$$15\frac{8}{17} = \frac{255 + 18}{17}$$

$$15\frac{8}{17} = \frac{263}{17}$$

d) $7\frac{5}{8} = 7 + \frac{5}{8}$

$7\frac{5}{8} = \frac{7(8) + 5}{8}$

$7\frac{5}{8} = \frac{56 + 5}{8}$

$7\frac{5}{8} = \frac{61}{8}$

e) $12\frac{4}{5} = 12 + \frac{4}{5}$

$12\frac{4}{5} = \frac{12(5) + 4}{5}$

$12\frac{4}{5} = \frac{60 + 4}{5}$

$12\frac{4}{5} = \frac{64}{5}$

f) $10\frac{7}{12} = 10 + \frac{7}{12}$

$10\frac{7}{12} = \frac{10(12) + 7}{12}$

$10\frac{7}{12} = \frac{120 + 7}{12}$

$10\frac{7}{12} = \frac{127}{12}$

3. Multiply Martha's hourly wage by the number of hours she works.

$\frac{\$16.72}{\text{h}} \times 5 \text{ h} = \$83.60$

Martha's gross pay for the job will be $83.60.

4. Multiply Ben's hourly wage by the number of hours he works.

$\frac{\$20.87}{\text{h}} \times 40 \text{ h} = \$834.80$

Ben will earn $834.80.

5. Calculate the number of hours Harpreet worked.

$6 + 8 + 8 + 12 = 34$

Harpreet worked 34 hours.

Multiply his hourly rate by the number of hours he worked.

$\frac{\$35.75}{\text{h}} \times 34 \text{ h} = \$1215.50$

Harpreet's gross income for the week was $1215.50.

6. a) Divide Liliana's annual income by 12 months.

$\$45\,183.36 \div 12 = \$3765.28$

Liliana's average monthly income is $3765.28.

b) Divide Liliana's annual income by 52 weeks.

$\$45\,183.36 \div 52 = \$868.91$

Liliana's avereage weekly income was $868.91.

7. Divide Janny's weekly income by the number of hours she works in one week.

$\$552.88 \div 40 = \$13.82$

Janny earns $13.82 per hour.

8. Divide Emile's income for the week by the number of hours he worked.

$\$321.25 \div 32.5 = \$9.88$

Emile's hourly wage is $9.88.

9. Calculate how many hours Monty worked each day.

Time Card: Monty			
Day			**Total Hours**
	IN	OUT	
Monday	3:30	6:45	3.25 h
Tuesday			
Wednesday	5:00	9:30	4.5 h
Thursday	5:00	9:30	4.5 h
Friday	3:30	7:00	3.5 h

Calculate how many hours Monty worked that week.

$3.25 + 4.5 + 4.5 + 3.5 = 15.75$

Monty worked 15.75 hours.

Multiply this by his hourly wage.

$\frac{\$9.45}{\text{h}} \times 15.75 \text{ h} = \$148.84$

Monty earned $148.84 for the week.

10. Calculate how many hours Hae-rin worked each day.

Time Card: Hae-rin					
Day	**Morning**		**Afternoon**		**Total Hours**
	IN	OUT	IN	OUT	
Monday	7:45	9:00	5:00	7:45	1.25 h + 2.75 h
Tuesday			4:00	8:00	4 h
Wednesday	9:00	11:00			2 h
Thursday	9:00	11:00	3:00	5:00	2 h + 2 h
Friday			3:00	6:00	3 h
Saturday	9:00	12:00			3 h

Calculate how many total hours Hae-rin worked that week.

$1.25 + 2.75 + 4 + 2 + 2 + 2 + 3 + 3 = 20$

Hae-rin worked 20 hours.

Multiply this by her hourly wage.

$\frac{\$12.76}{\text{h}} \times 20 \text{ h} = \$255.20$

Hae-rin earned $255.20 during the week.

11. Calculate how many hours Pete worked overtime during the week.

$45.25 - 40 = 5.25$

He worked 5.25 h overtime during the week. He will be paid time and a half for these hours.

Calculate his pay rate at time and a half.

$1.5 \times \$15.77 = \$23.66$

Calculate Pete's pay rate at double time and a half.

$2.5 \times \$15.77 = \$39.43$

Calculate Pete's income for the week by adding his regular pay, his weekday overtime pay, and his weekend overtime pay.

Pay from regular hours:

$\frac{\$15.77}{\text{h}} \times 40 \text{ h} = \$630.80$

Pay from weekday overtime hours:

$\frac{\$23.66}{\text{h}} \times 5.25 \text{ h} = \$124.19$

Pay from weekend overtime hours:

$\frac{\$39.43}{\text{h}} \times 5.75 \text{ h} = \$226.69$

Total pay:

$\$630.80 + \$124.19 + \$226.68 = \$971.68$

Pete will earn $971.68 for the week.

12. Calculate how many hours Ingrid will work at an overtime rate.

    42 – 35 = 7 hours

    Calculate her overtime pay rate.

    $$1.5 \times \frac{\$11.82}{\text{h}} = \frac{\$17.73}{\text{h}}$$

    Calculate how much she will earn per week at regular pay.

    $$\frac{\$11.82}{\text{h}} \times 35 \text{ h} = \$413.70$$

    Calculate how much she will earn per week in overtime pay.

    $$\frac{\$17.73}{\text{h}} \times 7 \text{ h} = \$124.11$$

    Calculate her total pay.

    $413.70 + $124.11 = $537.81

    Ingrid will earn $537.81 per week.

13. Calculate Nathalie's total overtime hour for the summer.

    $$3 \text{ h/week} \times 8 \text{ weeks} = 24 \text{ h}$$

    Calculate her overtime pay rate.

    $$\frac{\$15.27}{\text{h}} \times 1.5 = \frac{\$22.91}{\text{h}}$$

    Calculate how much she will earn from overtime pay during the summer.

    $$\frac{\$22.91}{\text{h}} \times 24 \text{ h} = \$549.84$$

    Calculate how many hours she will work at regular pay.

    $$40 \text{ h/week} \times 8 \text{ weeks} = 320 \text{ h}$$

    Calculate how much she will earn from regular pay during the summer.

    $$\frac{\$15.27}{\text{h}} \times 320 \text{ h} = \$4886.40$$

    Calculate her total pay.

    $549.84 + $4886.40 = $5436.24

    Nathalie will earn $5436.24 during the summer.

PRACTISE YOUR NEW SKILLS, p. 85

1. Multiply the hourly rate by the number of hours worked.

    $$\frac{\$10.75}{\text{h}} \times 10 \text{ h} = \$107.50$$

    You will earn $107.50 per day.

2. Multiply Lauren's hourly rate by the number of hours she worked.

    $$\frac{\$12.36}{\text{h}} \times 7\frac{1}{2} \text{ h} = \$92.70$$

    Lauren earned $92.70.

3. Juanita's income per week at the first job would be $497.35.

    Calculate what her income per week would be for the second job.

    $$\frac{\$16.75}{\text{h}} \times 30 \text{ h} = \$502.50$$

    Juanita would earn more per week at the second job, even though she would be working fewer hours, so she should take the second job.

4. Divide Rita's annual salary by the number of weeks per year.

    $$\$6758.00/\text{year} \div 52 \text{ weeks} = \$129.96$$

    Rita's weekly salary is $129.96.

5. Calculate the number of hours Abdul worked each day.

Time Card: Abdul					
Day	Morning		Afternoon		Total Hours
	IN	OUT	IN	OUT	
Monday	9:05	12:15	1:20	5:00	3 h 10 min + 3 h 40 min
Tuesday	9:02	12:13	1:12	4:25	3 h 11 min + 3 h 13 min
Wednesday	8:58	12:14	1:05	4:19	3 h 16 min + 3 h 14 min
Thursday	9:02	12:12	12:58	4:14	3 h 10 min + 3 h 16 min
Friday	8:45	12:35	1:05	4:15	3 h 50 min + 3 h 10 min

Calculate the total time Abdul worked during the week.

3 h 10 min
+ 3 h 40 min
+ 3 h 11 min
+ 3 h 13 min
+ 3 h 16 min
+ 3 h 14 min
+ 3 h 10 min
+ 3 h 16 min
+ 3 h 50 min
+ 3 h 10 min
30 h 190 min

Convert 190 min to hours and minutes.

$190 \div 60 = 3\frac{10}{60}$

190 min = 3 h 10 min

Add this to the hours portion of the time Abdul worked.

3 h 10 min + 30 h = 33 h 10 min

Abdul worked 33 h 10 min during the week. This is equal to $33\frac{10}{60}$ or $33\frac{1}{6}$ hours.

Multiply this by his hourly wage.

$\frac{\$9.05}{\text{h}} \times 33\frac{1}{6}\ \text{h} = \$300.16$

Abdul will earn $300.16 during the week.

6. Calculate how many hours Tandor worked overtime.

35 – 30 = 5 hours

Calculate his overtime pay rate.

$\frac{\$10.53}{\text{h}} \times 1.25 = \frac{\$13.16}{\text{h}}$

Calculate how much he earns for overtime work for the week.

$\frac{\$13.16}{\text{h}} \times 5\ \text{h} = \$65.80$

Calculate how much he earns for regular hours for the week.

$\frac{\$10.53}{\text{h}} \times 30\ \text{h} = \$315.90$

Calculate his total pay for the week.

$315.90 + $65.80 = $381.70

Tandor will earn $381.70 for the week.

2.2 Alternative Ways to Earn Money

BUILD YOUR SKILLS, p. 87

1. Calculate Thomasina's earnings per sweater size.

$$3 \text{ large sweaters} \times \$75.50 = \$226.50$$
$$2 \text{ medium sweaters} \times \$69.75 = \$139.50$$

Add to calculate Thomasina's earnings.

$\$226.50 + \$139.50 = \$366.00$

Thomasina will earn $366.00 for the five sweaters.

2. Calculate Patricia's earnings for 12 dresses and 15 waistbands.

$$12 \text{ hems} \times \frac{\$1.50}{\text{hem}} = \$18.00$$
$$15 \text{ waistbands} \times \frac{\$2.25}{\text{waistband}} = \$33.75$$

Add to calculate Patricia's earnings.

$\$18.00 + \$33.75 = \$51.75$

Patricia will earn $51.75.

3. Calculate Jack's earnings for main floor and second-storey windows.

$$7 \text{ windows} \times \frac{\$3.00}{\text{window}} = \$21.00$$
$$6 \text{ windows} \times \frac{\$5.00}{\text{window}} = \$30.00$$

Add to calculate his total earnings.

$\$21.00 + \$30.00 = \$51.00$

Jack will earn $51.00.

4. Divide the gross earnings by the number of auto detailing jobs completed.

$\$3048.00 \div 12 = \$254.00$

Each job cost $254.00.

5. Divide Karissa's earnings by the number of quarts of strawberries she picked.

$\$67.50 \div 18 = \$3.75$

Karissa earned $3.75 for each quart picked.

6. Divide Joey's earnings for the article by the pay rate per word.

$\$192.50 \div \$0.35 = 550$

Joey's article was 550 words long.

7. To calculate Peter's commission, first convert 12% to a decimal.

$12 \div 100 = 0.12$

Multiply by the price of the bicycle.

$$\$785.95 \times 0.12 = \$94.31$$

Peter earns $94.31 on the sale of the bicycle.

8. Sue will make 5% on $250 000.00. Calculate this in dollars.

$$\$250\,000.00 \times 0.05 = \$12\,500.00$$

Calculate on what amount Sue will make 2%.

$375 900.00 – $250 000.00 = $125 900.00

Calculate 2% of $125 900.00.

$$\$125\,900.00 \times 0.02 = \$2518.00$$

Calculate the total commission.

$12 500.00 + 2518.00 = $15 018.00

Sue will earn a commission of $15 018.00 on the sale.

9. To calculate David's commission, first calculate 5% of $6521.00.

$$\$6521.00 \times 0.05 = \$326.05$$

Add this to David's weekly salary.

$375.00 + $326.05 = $701.05

David will earn a total of $701.05.

10. Calculate what percent $6.86 is of $95.95.

$$\$6.86 \div \$95.95 \approx 0.07$$
$$0.07 \times 100 = 7\%$$

Freddi's rate of commission is about 7%.

11. Calculate what percent $592.00 is of $12 589.00.

$$\$592.00 \div \$12\,589.00 \approx 0.05$$
$$0.05 \times 100 = 5\%$$

Your rate of commission is about 5%.

12. Use proportional reasoning to solve for x, Don's total sales for the week.

$$\frac{45}{100} = \frac{\$958.00}{x}$$
$$x \times 100 \times \frac{45}{100} = \frac{\$958.00}{x} \times 100 \times x$$
$$45x = 958.00 \times 100$$
$$45x = 95\,800$$
$$x = \frac{95\,800}{45}$$
$$x = \$2128.89$$

He sold $2128.89 worth of goods.

13. Calculate the cost of the concrete.

$$3\ \text{yd}^3 \times \frac{\$100.00}{\text{cu yd}} = \$300.00$$

Calculate the cost of paying the employees.

$$\frac{\$12.45}{\text{h}} \times 4\ \text{h} \times 2 = \$99.60$$

Calculate the total actual cost.

$300.00 + $99.60 = $399.60

Calculate 20% of the actual cost.

$$\$399.60 \times 0.20 = \$79.92$$

Add the profit to the actual cost to determine how much Marcel should charge the client.

$399.60 + $79.92 = $479.52

Marcel should charge the client $479.52.

14. Calculate the total wages that Tien must pay.

$$\frac{\$8.00}{\text{h}} \times 8\text{ h} \times 3 = \$192.00$$

Calculate the total amount of sales.

$$\$785.96 + \$452.87 + \$616.42 = \$1855.25$$

Calculate the total commission (12% of the total sales).

$$\$1855.25 \times 0.12 = \$222.63$$

Add the cost of wages and commission to find Tien's total cost for the day.

$$\$192.00 + \$222.63 = \$414.63$$

Tien must pay a total of $414.63 for the day.

15. Calculate the total value of the contracts.

$5600.00 + $2800.00 + 7450.00 + $1900.00 + $8900.00 = $26 6500.00

Calculate the total profits by subtracting the expenses from the total value of the contracts.

$$\$26\,650.00 - \$23\,750.00 = \$2900.00$$

Calculate what percentage $2900.00 is of $26 650.00.

$$\$2900.00 \div \$26\,650.00 \approx 0.11$$

$$0.11 \times 100 = 11\%$$

The profits are about 11%.

PRACTISE YOUR NEW SKILLS, p. 95

1. a) Calculate the son's earnings by multiplying his rate per bucket by the number of buckets he picks.

$$\$8.25/\text{bucket} \times 28\text{ buckets} = \$231.00$$

The son earns $231.00 for picking 28 buckets.

b) Calculate how much the farmer earns per bucket.

$$\$15.00 - \$8.25 = \$6.75$$

Calculate how much the farmer earns for 28 buckets.

$$28 \times \$6.75 = \$189.00$$

The farmer earns $189.00 on the sale of 28 buckets of blueberries.

ALTERNATIVE SOLUTION

Calculate how much the farmer takes in on the sale of 28 buckets.

$$28\text{ buckets} \times \$15.00/\text{bucket} = \$420.00$$

To calculate the farmer's earnings, subtract from this the amount the farmer pays his son (solution from part a).

$$\$420.00 - \$231.00 = \$189.00$$

The farmer earns $189.00 on the sale of 28 buckets of blueberries.

2. Calculate the amount of the sale on which Joey earns commission.

$$\$23\,000.00 - \$15\,000.00 = \$8000.00$$

Calculate 2% of $8000.00.

$$\$8000.00 \times 0.02 = \$160.00$$

Joey earns a $160.00 commission.

3. Calculate the dollar amount of the commission Larissa needs to make to supplement her $500.00 salary.

$$\$750.00 - \$500.00 = \$250.00$$

Using proportional reasoning, calculate what number $250.00 is 4% of.

$$\frac{4}{100} = \frac{250}{x}$$

$$100 \times x \times \frac{4}{100} = \frac{250}{x} \times x \times 100$$

$$4x = 25\,000$$

$$x = \frac{25\,000}{4}$$

$$x = \$6250.00$$

Larissa will have to make sales totalling $6250.00.

4. Calculate how much Paulette earns per dress.

$$\$240.00 - \$120.00 = \$120.00$$

Divide her profit per dress by the number of hours it takes to make each dress to calculate how much she earns per hour.

$$\$120.00 \div 9.5 \approx \$12.63$$

Paulette earns $12.63 per hour.

5. a) Calculate Jeff's labour cost.

$$\frac{\$12.45}{\text{h}} \times 36 \text{ h} = \$448.20$$

Calculate his total costs.

$$\$12\,250.00 + \$448.20 = \$12\,698.20$$

Calculate the amount of the other contractor's bid. It is 10% lower than Jeff's bid, so it is equal to 90% (0.90) of Jeff's bid.

$$\$15\,980.00 \times 0.90 = \$14\,382.00$$

Jeff could lower his bid to that amount, because he would still make a profit. The amount of his profit would be:

$$\$14\,382.00 - \$12\,698.20 = \$1683.80$$

b) Divide the amount of his profit calculated in part a ($1683.80) by 50 hours.

$$\$1683.80 \div 50 \text{ h} = \$33.68/\text{h}$$

Jeff would earn $33.68/h.

2.3 Additional Earnings

BUILD YOUR SKILLS, p. 98

1. Chester sold 3 cars in the $15 000.00 to $19 999.00 range. Calculate his bonus for these cars.

   $3 \times \$40.00 = \$120.00$

   He sold 1 car in the $10 000.00 to $14 999.00 range, for a bonus of $30.00.

   He sold 1 car for less than $10 000.00, for a bonus of $25.00.

   Calculate Chester's total bonus.

   $\$120.00 + \$30.00 + \$25.00 = \$175.00$

   Chester's total bonus pay is $175.00.

2. Calculate 12% of Raymond's regular monthly pay.

   $\$2245.00 \times 0.12 = \$269.40$

   Since $275.00/month is more than 12% of his regular pay, he should take this offer.

3. Calculate Darren's income for an 8-hour day.

   $\frac{\$24.80}{\text{h}} \times 8\text{ h} = \$198.40$

   Darren makes $198.40 in an 8-hour day.

   To calculate Sean's hourly wage, first calculate the percentage of Darren's wage that Sean earns.

   $100\% - 38\% = 62\%$

   Calculate 62% of Darren's wage.

   $62 \div 100 = 0.62$

   $\$24.80/\text{h} \times 0.62 = \$15.38/\text{h}$

   Sean makes $15.38/h.

   Calculate Sean's income for an 8-hour day.

   $\frac{\$15.38}{\text{h}} \times 8\text{ h} = \$123.04$

   Sean makes $123.04 in an 8-hour day.

4. Determine the total of Denise's regular hours of work.

   Monday: 8 hours

   Tuesday: 3 hours

   Wednesday: 3 hours

   Thursday: 5 hours

   Total: 19 hours

   Determine the total of Denise's premium shift hours of work.

   Tuesday: 3 hours

   Wednesday: 2 hours

   Thursday: 3 hours

   Saturday: 6 hours

   Total: 14 hours

Calculate Denise's pay for regular hours of work.

$15.25/h × 19 h = $289.75

Calculate Denise's shift premium pay per hour.

$15.25/h + $1.75/h = $17.00/h

Calculate Denise's pay for premium shifts for the week.

$17.00/h × 14 h = $238.00

Calculate Denise's total pay for the week.

$289.75 + $238.00 = $527.75

Denise earned $527.75 for the week.

5. Determine the total of Baljeet's regular hours of work.

Monday: 7 hours

Tuesday: 8 hours

Wednesday: 2 hours

Thursday: 8 hours

Friday: 5 hours

Total: 30 hours

Determine the total of Baljeet's premium shift hours of work.

Wednesday: 4 hours

Friday: 1 hour

Total: 5 hours

Calculate Baljeet's pay for regular hours of work.

$12.75/h × 30 h = $382.50

Calculate Baljeet's premium pay per hour.

$12.75/h + $7.00/h = $19.75/h

Calculate Baljeet's pay for premium shifts for the week.

$19.75/h × 5 h = $98.75

Calculate Baljeet's total earnings for the week.

$382.50 + $96.25 = $481.25

Baljeet earned $481.25 for the week.

6. Calculate Chen's regular salary for 10 weeks.

$532.00/week × 10 weeks = $5320.00

Calculate his bonus pay for 10 weeks at 28% of his regular salary.

$5320.00 × 0.28 = $1489.60

This bonus of 28% of his regular pay is more than $1250.00, so Chen should take the 28% bonus.

7. Calculate Kirsten's base salary for an 8-hour day.

$8.20/h × 8 h = $65.60

Calculate the amount of her tips on a typical day (15% of $950.00).

$950.00 × 0.15 = $142.50

Calculate Kirsten's average daily income by adding her base salary plus tips.

$65.60 + $142.50 = $208.10

Kirsten's average daily income is $208.10.

8. Use proportional reasoning to calculate what percent $3.00 is of $24.75.

$$\frac{3.00}{24.75} = \frac{x}{100}$$
$$100 \times 24.75 \times \frac{3.00}{24.75} = \frac{x}{100} \times 24.75 \times 100$$
$$100 \times 3.00 = 24.75x$$
$$300 = 24.75x$$
$$\frac{300}{24.75} = x$$
$$12.12 \approx x$$

Mandeep left a tip of about 12%.

9. Calculate Rosita's regular pay from wages for 35 hours.

$\$8.21/\text{h} \times 35\ \text{h} = \$287.35$

Calculate the difference between her total pay and her wages.

$\$408.65 - \$287.35 = \$121.30$

Rosita earned $121.30 in tips.

PRACTISE YOUR NEW SKILLS, p. 104

1. Calculate Parminder's isolation pay for 8 months.

$\$780.00/\text{month} \times 8\ \text{months} = \$6240.00$

Calculate her total annual pay, including her salary and isolation pay.

$\$45\,650.00 + \$6240.00 = \$51\,890.00$

Parminder's annual income will be $51 890.00.

2. Calculate Hilda's pay for her regular hours.

$\$11.25/\text{h} \times 40\ \text{h} = \$450.00$

Calculate Hilda's bonus pay per hour.

$\$11.25/\text{h} + \$8.50/\text{h} = \$19.75/\text{h}$

Calculate how many hours Hilda worked overtime.

$57.5 - 40 = 17.5\ \text{h}$

Calculate Hilda's total bonus pay.

$\$19.75/\text{h} \times 17.5\ \text{h} = \$345.63$

Calculate Hilda's total pay for the week by adding her pay for regular hours and her total bonus pay.

$\$450.00 + \$345.63 = \$795.63$

Hilda earned $795.63 for the week.

3. a) Calculate the total amount of tips for the restaurant.

$\$40\,568.00 \times 0.15 = \$6085.20$

Divide this by 3 to calculate the amount each waiter would receive.

$\$6085.20 \div 3 = \$2028.40$

Each waiter would receive $2028.40 in tips for the month.

b) Each waiter would receive 75% of the tips calculated in part a.

$\$2028.40 \times 0.75 = \$1521.30$

Each waiter would make $1521.30.

4. Calculate Franco's hourly rate for a split shift.

   $17.23/h + $2.65/h = $19.88/h

   Calculate Franco's hourly overtime rate.

   $17.23/h × 1.5 = $25.85/h

   Calculate the number of hours Franco worked overtime.

   43.5 – 38.5 = 5 h

   Calculate for how many hours Franco was paid his regular rate.

   43.5 – 5 – 18 = 20.5 h

   Calculate Franco's income from regular hours.

   $17.23/h × 20.5 h = $353.22

   Calculate Franco's income from overtime hours.

   $25.85/h × 5 h = $129.23

   Calculate Franco's income from split shift hours.

   $19.88/h × 18 h = $357.84

   Add to determine Franco's total income.

   $353.22 + $129.23 + $357.84 = $840.29

   Franco earned $840.29 for the week.

5. Calculate Horace's reimbursement for his driving.

   $0.45/km × 2354 km = $1059.30

   Calculate his commission.

   $47 854.00 × 0.08 = $3828.32

   Calculate his total paycheque.

   $1059.30 + $3828.32 = $4887.62

   His paycheque would be for $4887.62.

2.4 Deductions and Net Pay

BUILD YOUR SKILLS, p. 107

1. Convert 15% to a decimal.

   $15 \div 100 = 0.15$

   Multiply by your gross pay.

   $\$750.00 \times 0.15 = \$112.50$

   $112.50 would be deducted from you paycheque for federal tax.

2. Convert 0.5% to a decimal.

   $0.5 \div 100 = 0.005$

   Calculate 5% of $300.00.

   $300.00 \times 0.005 = \$1.50$

   Your short-term disability insurance deduction per paycheque is $1.50.

3. Convert 4.95% to a decimal (0.0495) and multiply by your salary.

   $\$1578.00 \times 0.0495 = \$78.11$

   You would pay $78.11 into CPP every two weeks.

   (Note: There is a maximum annual payment into CPP; for 2010, it is $2163.15. Once that amount is reached, you do not continue to make CPP payments for the year.)

4. Determine what percent $757.24 is of $3276.54.

   $757.24 \div 3276.54 \approx 0.23$

   $0.23 \times 100 = 23\%$

   Samara paid about 23% of her taxable income.

5. a) Determine Patricia's taxable income.

   $\$700.00 - \$75.47 = \$624.53$

   Calculate what percent $93.68 is of $624.53.

   $93.68 \div 624.53 \approx 0.15$

   $0.15 \times 100 = 15\%$

   Patricia's federal tax rate is about 15%.

   b) Calculate what percent $36.85 is of $624.53.

   $36.85 \div 624.53 \approx 0.059$

   $0.059 \times 100 = 5.9$

   Patricia's territorial tax rate is 5.9%.

6. Determine what percent $37.51 is of $2168.21.

   $37.51 \div 2168.21 \approx 0.017$

   $0.017 \times 100 = 1.7\%$

   Hans's EI rate is about 1.7%.

7. For each of Randy's jobs, calculate his total deductions and net income.

   Job #1:

   Calculate total deductions.

   $56.67 + $13.12 + $16.09 + $4.14 = $90.02

   Calculate net income.

   $325.00 − $90.02 = $234.98

   Job #2:

   Calculate total deductions.

   $79.42 + $16.82 + $18.12 = $114.36

   Calculate net income.

   $567.00 − $114.36 = $452.64

   Calculate total net income from both jobs.

   $234.98 + $452.64 = $687.62

   Randy's net income will be $687.62.

   ALTERNATIVE SOLUTION

   Calculate Randy's total gross income from both jobs.

   $325.00 + $567.00 = $892.00

   Calculate his total deductions from both jobs.

   $56.67 + $13.12 + $16.09 + $4.14 + $79.42 + $16.82 + $18.12 = $204.38

   Subtract deductions from gross income.

   $892.00 − $204.38 = $687.62

   Randy's net income will be $687.62.

8. Calculate Kathy's short-term disability deduction.

   $3654.75 × 0.005 ≈ $18.27

   Calculate Kathy's union fee deduction.

   $3654.75 × 0.031 ≈ $113.30

   Calculate Kathy's pension deduction.

   $3654.75 × 0.04 = $146.19

   Determine Kathy's taxable income by subtracting before-tax deductions from gross income.

   $3654.75 − $18.27 − $113.30 − $146.19 = $3376.99

   Calculate Kathy's federal tax deduction.

   $3376.99 × 0.185 ≈ $624.74

   Calculate Kathy's provincial tax deduction.

   $3376.99 × 0.062 = $209.37

   Calculate Kathy's CPP deduction.

   $3376.99 × 0.0495 ≈ $167.16

   Calculate Kathy's EI deduction.

   $3376.99 × 0.022 ≈ $74.29

   Calculate Kathy's net income by subtracting her after-tax deductions from the taxable income.

   $3376.99 − $624.74 − $209.37 − $167.16 − $74.29 = $2301.43

   Kathy's net income is $2301.43.

9. a) Hank's gross weekly income is $575.00.

   b) Subtract Hank's deductions (federal, provincial, CPP, EI) from his gross income.

   $$\$575.00 - \$104.73 = \$470.27$$

   Hank's net income is $470.27.

   c) Hank paid $48.01 in federal taxes. Calculate what percent $48.01 is of $575.00.

   $$48.01 \div 575.00 \approx 0.083$$

   $$0.083 \times 100 = 8.3\%$$

   Hank paid 8.3% of his taxable income in federal taxes.

PRACTISE YOUR NEW SKILLS, p. 113

1. a) Calculate 2.4% of $45 785.00.

   $$0.024 \times \$45\,785.00 = \$1098.84$$

   Juliana pays $1098.84 in union dues.

   b) Calculate 4.95% of $44 686.16.

   $$\$44\,686.16 \times 0.0495 = \$2211.96$$

   She pays $2211.96 in CPP deductions.

2. Calculate what percent $685.74 is of $2981.52.

   $$\$685.74 \div \$2981.52 \approx 0.230$$

   $$0.230 \times 100 = 23.0\%$$

   Mario's tax rate is 23%.

3. Calculate the total deductions.

   $$\$105.30 + \$23.76 + \$48.61 + \$14.12 = \$191.79$$

   Subtract the deductions from your gross pay.

   $$\$982.00 - \$191.79 = \$790.21$$

   Your net pay will be $790.21.

CHAPTER TEST, p. 114

1. Calculate 3.2% of $12.15.

$$3.2 \div 100 = 0.032$$

$$\$12.15 \times 0.032 = \$0.39$$

Add to Brenda's original hourly rate.

$$\$12.15/h + \$0.39/h = \$12.54/h$$

Brenda will earn $12.54 per hour.

ALTERNATIVE SOLUTION

Calculate 103.2% of $12.15.

$$1.032 \times \$12.15 = \$12.54$$

Brenda will earn $12.54 per hour.

2. There are 52 weeks in a year; divide by 2 to calculate how many times you will be paid.

$$52 \div 2 = 26$$

You will be paid 26 times.

Multiply by your biweekly pay.

$$26 \times \$750.00 = \$19\,500.00$$

You will be paid $19 500.00 for the year.

3. There are 12 months per year, so your annual salary will be 12 times your monthly salary.

$$12 \times \$3568.00 = \$42\,816.00$$

Your annual salary will be $42 816.00.

4. Stephanie's annual income for job #1 would be $53 000.00.

Calculate what her annual income would be at job #2.

$$\frac{\$25.50}{\text{h}} \times \frac{40\text{ h}}{\text{week}} \times 52\text{ weeks} = \$53\,040.00/\text{year}$$

Calculate the difference in pay between job #1 and job #2.

$$\$53\,040.00 - \$53\,000.000 = \$40.00$$

Job #2 would pay $40.00 more per year.

5. Calculate what percent $20.55 is of $685.00.

$$\$20.55 \div \$685.00 = 0.03$$

$$0.03 \times 100 = 3\%$$

Tommy's commission rate is 3%.

6. Calculate the dealer's after-cost profit on the sale of the car.

$$\$12\,795.00 - \$9280.00 = \$3515.00$$

Calculate 8% of the profit.

$$8 \div 100 = 0.08$$

$$0.08 \times \$3515.00 = \$281.20$$

Von earns a commission of $281.20.

7. Calculate Jenny's pay rate on a statutory holiday.

$$\$12.42/h \times 2.5 = \$31.05/h$$

Calculate how much Jenny earned in 6 hours.

$$\$31.05/h \times 6\text{ h} = \$186.30$$

Jenny earned $186.30 on the statutory holiday.

8. Calculate how much Harold earned in regular pay.

   $\$18.25/h \times 40\ h = \$730.00$

   Calculate Harold's overtime pay per hour.

   $\$18.25/h \times 1.5 = \$27.38/h$

   Calculate how much Harold earned in overtime pay.

   $\$27.38/h \times 5.25\ h = \$143.75$

   Calculate Harold's total pay for the week.

   $\$730.00 + \$143.75 = \$873.75$

   Harold earned $873.75.

9. Calculate Nanette's profit per scarf.

   $\$15.95 - \$7.52 = \$8.43$

   Calculate Nanette's profit for 9 scarves.

   $9 \times \$8.43 = \$75.87$

   If Nanette sells 9 scarves, she will make $75.87.

10. Calculate the cost of labour.

    $$\frac{\$12.50}{h} \times \frac{8\ h}{day} \times 2\ days \times 4\ men = \$800.00$$

    Calculate the cost of labour plus materials.

    $\$1675.84 + \$800.00 = \$2475.84$

    Calculate Cho's profits by subtracting his labour and materials expenses from the amount of the contract.

    $\$5750.00 - \$2475.84 = \$3274.16$

    Cho earns $3274.16.

11. Calculate 4.95% of $782.45.

    $4.95 \div 100 = 0.0495$

    $0.0495 \times \$782.45 = \$38.73$

    $38.73 will be deducted from your pay for CPP.

12. a) Calculate Padma's regular pay for a 40-hour week.

    $\$21.52/h \times 40\ h = \$860.80$

    Add her bonus isolation pay.

    $\$860.80 + \$125.00 = \$985.80$

    Padma will earn $985.80 in a 40-hour work week.

    b) If she makes $985.80, divide this by 40 hours.

    $\$985.80 \div 40 \approx \$24.65$

    She earns $24.65 per hour.

ALTERNATIVE SOLUTION

Divide Padma's isolation pay for the week by 40 hours.

$\$125.00/week \div 40\ h/week = \$3.13/h$

Add this to her regular hourly wage.

$\$21.52/h + \$3.13/h = \$24.65/h$

Padma earns $24.65 per hour.

Chapter 3

Length, Area, and Volume

3.1 Systems of Measurement

BUILD YOUR SKILLS, p. 120

1. Calculate the sum of the side lengths to determine the perimeter.

   a) $P = 2\ell + 2w$

   $P = 2(18.3) + 2(8.5)$

   $P = 36.6 + 17$

   $P = 53.6$ cm

   b) $P = 9.6 + 12.3 + 6.2 + 5.1 + 10.4$

   $P = 43.6$ cm

   c) $P = 2(2.3) + 1.2 + 2(0.9)$

   $P = 4.6 + 1.2 + 1.8$

   $P = 7.6$ m

2. Calculate the perimeter of the tablecloth.

   $P = 2\ell + 2w$

   $P = 2(210) + 2(180)$

   $P = 420 + 360$

   $P = 780$ cm

   Darma will need 780 cm of lace.

3. Calculate the perimeter of the pasture.

   $P = 2\ell + 2w$

   $P = 2(15) + 2(25)$

   $P = 30 + 50$

   $P = 80$ m

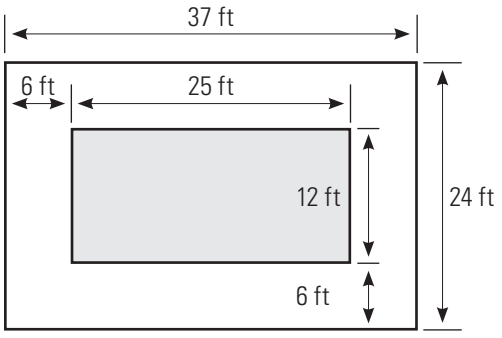
   Garry needs 3 rows of wire, so multiply the perimeter by 3.

   $\text{length of wire} = 3 \times P$

   $\text{length of wire} = 3 \times 80$

   $\text{length of wire} = 240 \text{ m}$

   Garry will need 240 m of barbed wire.

4. 

   Length of fence = length of pool + 2(width of walkway)

   Length of fence = 25 + 2(6)

   Length of fence = 25 + 12

Length of fence = 37 ft

Width of fence = width of pool + 2(width of walkway)

Width of fence = 12 + 2(6)

Width of fence = 12 + 12

Width of fence = 24 ft

Calculate the perimeter of the fenced area.

$P = 2\ell + 2w$

$P = 2(37) + 2(24)$

$P = 74 + 48$

$P = 122$ ft

Chantal will need 122 ft of fencing.

5. Use the formula for the circumference of a circle.

$C = 2\pi r$

$C = 2\pi(5.3)$

$C \approx 33.3$ m

The circumference of the fountain is about 33.3 m.

6. Johnny will need to put lights long both long edges of his roof and the peak, three times the length of 28 m. He will need to put lights along the two short edges on the front of the house and the two short edges on the back of the house, four times the length of 5 m.

$P = 3\ell + 4w$

$P = 3(28) + 4(5)$

$P = 84 + 20$

$P = 104$ m

Johnny will need 104 m of Christmas lights.

7. Calculate the circumference of one circle.

$C = 2\pi r$

$C = 2\pi(35)$

$C \approx 219.9$ cm

The length of wire Hershy needs is 5 times the circumference of one circle.

$\text{length of wire} = 5 \times C$

$\text{length of wire} = 5 \times 219.9$

$\text{length of wire} = 1099.5$ cm

Hershy needs 1099.5 cm of wire.

8. Calculate how much of the 2 by 4 lumber Bernard needs. He needs 3 pieces that are $4\frac{1}{2}$ ft long. Calculate the total length.

$\ell = 3 \times 4\frac{1}{2}$

$\ell = 3 \times 4.5$

$\ell = 13.5 \text{ or } 13\frac{1}{2}$ ft

Calculate how much of the 2 by 2 lumber Bernard needs. He needs 10 pieces that are $5\frac{1}{4}$ ft long. Calculate the total length.

$\ell = 10 \times 5\frac{1}{4}$

$\ell = 10 \times 5.25$

$\ell = 52.5 \text{ or } 52\frac{1}{2}$ ft

Bernard needs $13\frac{1}{2}$ ft of 2 by 4 lumber and $52\frac{1}{2}$ ft of 2 by 2 lumber.

9. To find the total length of pipe Benjie needs, add together the lengths of each of the pieces of pipe, plus the one inch lost in cutting.

   total length = (piece #1) + (piece #2) + (piece #3) +1″

   Add feet to feet and inches to inches.

   total length = 2′ + 5′7″ + 4′ + 1″

   total length = 11′8″

   He needs 11 ft 8 in of pipe, but can only buy in even numbers of feet, so he will have to buy 12 feet of pipe.

10. Find the perimeter of the playground.

    $P = 2\ell + 2w$

    $P = 2(125) + 2(60)$

    $P = 250 + 120$

    $P = 370$ ft

    The perimeter is 370 ft. Since each board is 6 in, or $\frac{1}{2}$ ft, wide, José will need 2 boards per foot of fence.

    $2 \times 370 = 740$

    José will need 740 boards.

11. Calculate the total width of all the cages.

    width = 5(cage # 1) + 3(cage # 2) + 2(cage # 3)

    width = 5(2′8″) + 3(4′6″) + 2(1′8″)

    width = 10′40″ + 12′18″ + 2′16″

    width = 24′74″

    Convert 74″ to feet and inches.

    $74 \div 12 = 6$, remainder 2

    74″ = 6′2″

    Substitute this into the width measurement.

    width = 24′74″

    width = 24′ + 6′2″

    width = 30′2″

    The cages will not fit along a 30′ wall. They are 2″ too wide.

12. Convert the measurement of the diameter in feet and inches to feet.

    $6'4'' = 6' + \frac{4}{12}'$

    $6'4'' = 6' + \frac{1}{3}'$

    $6'4'' = 6\frac{1}{3}'$

    $6'4'' = \frac{19}{3}'$

    Calculate the circumference of the flower garden.

    $C = \pi d$

    $C = \pi\left(\frac{19}{3}\right)$

    $C \approx 19.9'$

    The garden circumference is about 20 feet, so Gordon will need 20 geraniums.

13. Calculate how much space the pipe will take from the height of the ceiling.

    space for pipe = (size of pipe) + (space between pipe and drywall)

    space for pipe = 6″ + 1″

    space for pipe = 7″

    Subtract this from the height of the ceiling to determine the height under the pipe.

height = (height of ceiling) − (space for pipe)

height = 7′2″ − 7″

height = 86″ − 7″

height = 79″ or 6′7″

The height of the pipe is 6′7″. Craig is 6′6″, so he will be able to walk under the finished pipe.

PRACTISE YOUR NEW SKILLS, p. 129

1. a) Convert 42 inches to feet.

$$12\overline{)42}\quad 3$$

$$36$$

$$6$$

$42 \div 12 = 3$, remainder 6

$42 \div 12 = 3\frac{6}{12}$

$42 \div 12 = 3\frac{1}{2}$

42 inches equals $3\frac{1}{2}$ feet.

b) Convert 16 inches to feet and inches.

$$12\overline{)16}\quad 1$$

$$12$$

$$4$$

$16 \div 12 = 1$, remainder 4

16 inches equals 1 foot 4 inches.

c) Convert 96 inches to yards.

36 inches = 1 yard

$$36\overline{)96}\quad 2$$

$$72$$

$$24$$

$96 \text{ in} = 2\frac{24}{36}$ yd

$96 \text{ in} = 2\frac{2}{3}$ yd

d) Convert 5 miles to yards.

1 mi = 1760 yd

5 mi = 5 × 1760

5 mi = 8800 yd

2. Calculate the perimeter of the vegetable garden.

$P = 2\ell + 2w$

$P = 2(12'8'') + 2(4'6'')$

$P = 24'16'' + 8'12''$

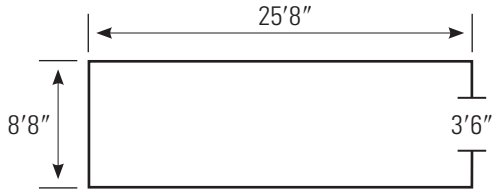
$P = 24'16'' + 8' + 1'$

$P = 33'16''$

$P = 33' + (12'' + 4'')$

$P = 34'4''$

You will need 34′4″ of fencing.

3. 

Calculate the perimeter of the dog run, minus the width of the opening.

$P = 2\ell + 2w$ – (opening)

$P = 2(25'8'') + 2(8'8'') - 3'6''$

$P = 50'16'' + 16'16'' - 3'6''$

$P = 63'26''$

$P = 63' + (24'' + 2'')$

$P = 65'2''$

Marjorie will need 65′2″ of fencing.

4. Change all measurements to inches.

shelf height = 1′5″

shelf height = 12″ + 5″

shelf height = 17″

shelf length = 2 yd

shelf length = 2(36″)

shelf length = 72″

To calculate how many packages could fit the height of the shelf, divide the shelf height by the height of one package.

$17'' \div 2'' = 8.5$

Round down to the nearest number of packages. Klaus can stack 8 packages on a shelf.

To calculate how many packages could fit the length of the shelf, divide the shelf length by the length of one package.

$72'' \div 8.5'' \approx 8.5$

Round down to the nearest number of packages. Klaus line 8 packages along the length of a shelf.

Klaus can stack paper to a height of 8 packages and a length of 8 packages.

$8 \times 8 = 64$

He can fit 64 packages on a shelf.

5. Convert 5 miles to inches.

$$5 \text{ mi} = 5 \text{ mi} \times \frac{5280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}}$$

$5 \text{ mi} = 316\,800 \text{ in}$

Divide by the number of inches per step.

$316\,800'' \div 18'' = 17\,600$

If 1 block equals 1550 steps, then divide the number of steps in 5 mi by the number of steps per block.

$17\,600 \div 1550 \approx 11.4$

Jennine would have to walk 11.4 blocks.

ALTERNATIVE SOLUTION

Convert 1 block to inches.

$$1\text{ block} = 1550\text{ steps} \times \frac{18''}{1\text{ step}}$$

$$1\text{ block} = 27\,900''$$

Convert inches to feet.

$$1\text{ block} = 27\,900''$$

$$1\text{ block} = 27\,900'' \times \frac{1'}{12''}$$

$$1\text{ block} = 2325'$$

Convert 5 mi to feet.

$$5\text{ mi} = 5\text{ mi} \times \frac{5280'}{1\text{ mi}}$$

$$5\text{ mi} = 26\,400'$$

Divide this number by the number of feet in 1 block.

$$26\,400' \div 2325' \approx 11.4$$

Jennine would have to walk 11.4 blocks.

3.2 Converting Measurements

BUILD YOUR SKILLS, p. 132

1. Calculate the area of the yard using the formula for the area of a rectangle.

   $A = \ell w$

   $A = (38)(20)$

   $A = 760$ sq ft

   Ina's yard is 760 sq ft.

2. Calculate the radius of the rug using the formula for the area of a circle.

   $$A = \pi r^2$$
   $$4.9 = \pi r^2$$
   $$\frac{4.9}{\pi} = r^2$$
   $$\sqrt{\frac{4.9}{\pi}} = r$$
   $$1.2 \approx r$$

   The radius of the rug is about 1.2 m. The diameter is twice the radius, or 2.4 m. This is less than the dimensions of the space Travis wants to cover, so the rug will fit into the space.

3. The length of the label is equal to the circumference of the can.

   $C = \pi d$

   $C = \pi(9)$

   $C \approx 28.3$ cm

   The label is 28.3 cm long.

4. Convert 8 inches to centimetres.

   $1 \text{ in} \approx 2.54 \text{ cm}$

   $8 \text{ in} = 8 \times 2.54 \text{ cm}$

   $8 \text{ in} \approx 20.3 \text{ cm}$

   Convert 4 inches to centimetres.

   $1 \text{ in} \approx 2.54 \text{ cm}$

   $4 \text{ in} = 4 \times 2.54 \text{ cm}$

   $4 \text{ in} \approx 10.2 \text{ cm}$

   The dimensions of the tiles are about 20.3 cm by 10.2 cm.

5. Convert the distance Benjamin drove, 1546 mi, to kilometres.

   $1 \text{ mi} \approx 1.6 \text{ km}$

   $1564 \text{ mi} \approx 1564 \times 1.6 \text{ km}$

   $1564 \text{ mi} \approx 2502.4 \text{ km}$

   Multiply this by Benjamin's reimbursement rate of \$0.89/km.

   $\$0.89/\text{km} \times 2502.4 \text{ km} = \$2227.14$

   Benjamin would be reimbursed \$2227.14 for the use of his truck.

6. a) Calculate the cost of hallway runners per linear foot.

   $$1 \text{ yd} = 3 \text{ ft}$$
   $$\frac{\$9.52}{\text{linear ft}} \times \frac{3 \text{ linear ft}}{1 \text{ linear yd}} = \$28.56/\text{linear yd}$$

   The hallway runners cost \$28.56 per linear yard.

b) Calculate the cost per linear metre.

$$1 \text{ ft} \approx 0.3 \text{ m}$$

$$\frac{\$9.52}{\text{linear ft}} \times \frac{1 \text{ linear ft}}{0.3 \text{ linear m}} \approx \$31.73/\text{linear m}$$

The hallway runners cost $31.73 per linear metre.

c) Calculate the total cost of the hallway runner using the cost per linear metre calculated in part b.

$$\frac{\$31.73}{1 \text{ linear m}} \times 3.9 \text{ linear m} = \$123.75$$

The hallway runner will cost Ralph $123.75.

7. Sod costs $0.28/sq ft. Convert to cost per m^2.

$$1 \text{ ft} \approx 0.3 \text{ m}$$

$$(1 \text{ ft})^2 \approx (0.3 \text{ m})^2$$

$$1 \text{ sq ft} \approx 0.09 \text{ m}^2$$

Sod costs $0.28 for 0.09 m^2. Calculate the cost of 1 m^2.

$$\$0.28 \div 0.09 = \$3.11$$

Sod costs $3.11/$m^2$.

Calculate the area of Rebecca's backyard in metres.

$A = \ell w$

$A = (18.2)(9.8)$

$A \approx 178.4 \text{ m}^2$

Multiply by the cost of sod per square metre.

$$\$3.11/\text{m}^2 \times 178.4 \text{ m}^2 = \$554.82$$

It will cost approximately $554.82 to sod Rebecca's backyard.

This answer is not exactly the same as the answer for Example 2, due to rounding.

8. a) Convert the measurements of the floor to inches.

Length:

$$4.2 \text{ m} = 420 \text{ cm}$$

$$2.54 \text{ cm} \approx 1 \text{ in}$$

$$420 \text{ cm} = 420 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}}$$

$$420 \text{ cm} \approx 165.4 \text{ in}$$

Each tile is 9 in wide. Calculate how many tiles would be needed to cover the length of the floor.

$$165.4 \div 9 \approx 18.4$$

Round up to the number of tiles needed. 19 tiles would be needed for this length.

Width:

$$3.8 \text{ m} = 380 \text{ cm}$$

$$380 \text{ cm} \approx 380 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}}$$

$$380 \text{ cm} \approx 149.6 \text{ in}$$

The floor is 149.6 in wide. Calculate how many tiles would be needed to cover this width.

$$149.6 \div 9 \approx 16.6$$

17 tiles would be needed to cover this width.

Multiply the number of tiles needed for the length by the number needed for the width to calculate the total number of tiles needed.

$$19 \times 17 = 323$$

323 tiles are needed.

Each box contains 12 tiles. Calculate how many boxes are needed.

$323 \div 12 \approx 26.9$

Round up. 27 boxes of tiles are needed.

b) Calculate the cost of tiles.

$\$18.95/\text{box} \times 27 \text{ boxes} = \$511.65$

The tiles will cost $511.65.

9. Calculate the area of the bottom and side of the pond. The bottom is a circle.

$A_{bottom} = \pi r^2$

$A_{bottom} = \pi(3)^2$

$A_{bottom} = \pi(9)$

$A_{bottom} \approx 28.3 \text{ sq ft}$

The side of the pond is a rectangle whose width equals the depth of the pond and whose length equals the circumference of the pond.

Calculate the circumference of the pond.

$C = 2\pi r$

$C = 2\pi(3)$

$C = 6\pi$

$C \approx 18.8 \text{ sq ft}$

Calculate the area of the side of the pond.

$A_{side} = \ell w$

$A_{side} \approx (18.8)(2)$

$A_{side} \approx 37.6 \text{ sq ft}$

Calculate the total area to be cemented.

$A = A_{bottom} + A_{side}$

$A = 28.3 + 37.6$

$A = 65.9 \text{ sq ft}$

The finishing will cost $175.85 per m^2. Convert this to cost per sq ft.

$1 \text{ m} \approx 3.28 \text{ ft}$

$(1 \text{ m})^2 \approx (3.28 \text{ ft})^2$

$1 \text{ m}^2 \approx 10.8 \text{ sq ft}$

The cost is $175.85/10.8 sq ft. Calculate the cost per sq ft.

$\$175.85 \div 10.8 = \$16.28$

Calculate the cost of finishing the pond.

$\$16.28/\text{sq ft} \times 65.9 \text{ sq ft} = \$1072.85$

The cost to finish the pond is about $1072.85.

ALTERNATIVE SOLUTION

Calculate the area to be finished in m^2.

Convert the measurement of the radius to metres.

$r = 3 \text{ ft}$

$r \approx 3 \text{ ft} \times \frac{0.3 \text{ m}}{\text{ft}}$

$r \approx 0.9 \text{ m}$

Convert the measurement of the depth to metres.

$\text{depth} = 2 \text{ ft}$

$\text{depth} \approx 2 \text{ ft} \times \frac{0.3 \text{ m}}{\text{ft}}$

$\text{depth} \approx 0.6 \text{ m}$

Calculate the area of the bottom and side of the pond.

$A_{bottom} = \pi r^2$

$A_{bottom} = \pi(0.9)^2$

$A_{bottom} = \pi(0.81)$

$A_{bottom} \approx 2.5 \text{ m}^2$

The side of the pond is a rectangle whose width equals the depth of the pond and whose length equals the circumference of the pond.

Calculate the circumference of the pond.

$C = 2\pi r$

$C = 2\pi(0.9)$

$C \approx 5.7 \text{ m}^2$

Calculate the area of the side of the pond.

$A_{side} = \ell w$

$A_{side} \approx (5.7)(0.6)$

$A_{side} \approx 3.4 \text{ m}^2$

Calculate the total area to be cemented.

$A = A_{bottom} + A_{side}$

$A = 2.5 + 3.4$

$A = 5.9 \text{ m}^2$

The finishing will cost \$175.85 per m^2. Calculate the cost of finishing the pond.

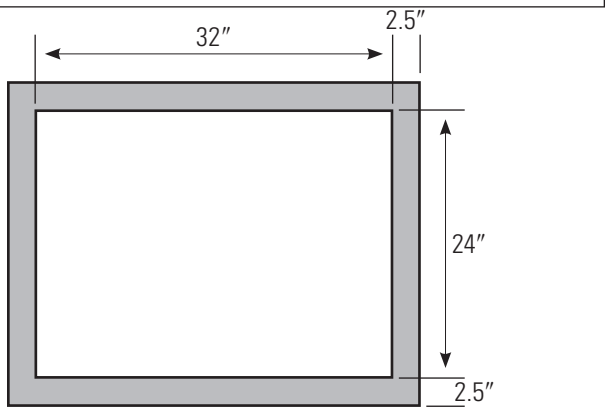
$\$175.85/\text{m}^2 \times 5.9 \text{ m}^2 = \$1037.52$

The cost to finish the pond is about \$1037.52.

This answer is different from the first solution due to rounding.

PRACTISE YOUR NEW SKILLS, p. 139

1.



a) The length of the framed picture is equal to the length of the picture plus two times the width of the frame.

ℓ = (length of picture) + 2(width of frame)

$\ell = 32 + 2(2.5)$

$\ell = 32 + 5$

$\ell = 37$ inches

The width of the framed picture will be equal to the width of the picture plus two times the width of the frame.

w = (width of picture) + 2(width of frame)

$w = 24 + 2(2.5)$

$w = 24 + 5$

$w = 29$ inches

Calculate the perimeter of the framed picture.

$P = 2\ell + 2w$

$P = 2(37) + 2(29)$

$P = 74 + 58$

$P = 132$ inches

The perimeter of the framed picture is 132 inches.

b) Convert 132 inches to inches and feet.

12 in = 1 ft

132 in = 132 in ÷ 12 in/ft

132 in = 11 ft

The perimeter of the framed picture is 11 ft.

c) Convert 11 ft to yards.

3 ft = 1 yd

11 ft = 11 ft ÷ 3 ft/yd

$11 \text{ ft} = 3\frac{2}{3} \text{ yd}$

$\frac{2}{3} \text{ yd} = \frac{2}{3} \text{ yd} \times \frac{3 \text{ ft}}{\text{yd}}$

$\frac{2}{3} \text{ yd} = 2 \text{ ft}$

The perimeter of the framed picture is 3 yd 2 ft.

2. Convert 620 km to miles.

$1.6 \text{ km} \approx 1 \text{ mi}$

$1 \text{ km} \approx \frac{1}{1.6} \text{ mi}$

$620 \text{ km} \approx 620 \times \frac{1}{1.6}$

$620 \text{ km} \approx 387.5 \text{ mi}$

The distance is approximately 387.5 mi.

3. Convert the dimensions of the field from feet to metres.

$1 \text{ ft} \approx 0.3 \text{ m}$

$150 \text{ ft} \approx 150 \times 0.3$

$150 \text{ ft} \approx 45 \text{ m}$

$85 \text{ ft} \approx 85 \times 0.3$

$85 \text{ ft} \approx 25.5 \text{ m}$

The field will be 45 m by 25.5 m.

4. Convert the height of the truck, 3.2 m, to feet and inches.

$0.3 \text{ m} \approx 1 \text{ ft}$

$1 \text{ m} \approx \frac{1}{0.3} \text{ ft}$

$3.2 \text{ m} \approx 3.2 \times \frac{1}{0.3}$

$3.2 \text{ m} \approx 10.7 \text{ ft}$

Convert 0.7 ft to inches.

$0.7 \times 12 = 8.4 \text{ in}$

The height of the truck is 10 ft 8.4 in. It will not fit through the tunnel, which is 10 ft 6 in high.

ALTERNATIVE SOLUTION

Convert the height of the tunnel, 10 ft 6 in, to metres.

10’ 6” = 10.5 ft

0.3 m ≈ 1 ft

10.5 ft = 10.5 × 0.3 m

10.5 ft = 3.15 m

The height of the truck is 3.2 m and the height of the tunnel is 3.15 m. The truck will not fit through the tunnel.

5. Convert the length of cloth Carla needs from metres to yards.

$0.9 \text{ m} \approx 1 \text{ yd}$

$1 \text{ m} \approx \frac{1}{0.9} \text{ yd}$

$3.5 \text{ m} \approx 3.5 \times \frac{1}{0.9}$

$3.5 \text{ m} \approx 3.9 \text{ yd}$

Carla needs 3.9 yards of cloth.

Calculate the cost of the cloth.

$3.9 \text{ yd} \times \$9.78/\text{yd} = \$38.14$

The cloth would cost $38.14.

6. Convert the dimensions of the garden from metres to feet.

$$1 \text{ m} \approx \frac{1}{0.3} \text{ ft}$$

$$150 \text{ m} \approx 150 \times \frac{1}{0.3}$$

$$15 \text{ m} \approx 500 \text{ ft}$$

$$210 \text{ m} \approx 210 \times \frac{1}{0.3}$$

$$21 \text{ m} \approx 700 \text{ ft}$$

Calculate the area that is to be seeded, in square feet.

$A = \ell w$

$A = (500)(700)$

$A = 350\,000 \text{ sq ft}$

Calculate how many pounds of seed are needed.

$3 \text{ lb} \div 100\,000 \text{ sq ft} \times 350\,000 \text{ sq ft} = 10.5 \text{ lb}$

Ari will need 10.5 lb of seed.

7. Convert dimensions of room from feet and inches to feet.

$$12'8'' = 12' + \frac{8}{12}''$$

$$12'8'' = 12\frac{2}{3}'$$

$$10'9'' = 10' + \frac{9}{12}''$$

$$10'9'' = 10\frac{3}{4}'$$

Calculate the area of the room.

$$A = \ell w$$

$$A = (12\frac{2}{3})(10\frac{3}{4})$$

$$A = \left(\frac{39}{3}\right)\left(\frac{43}{4}\right)$$

$$A = \frac{1677}{12}$$

$$A = 139.75 \text{ sq ft}$$

Add 10% to the area of the room.

$139.75 \times 1.1 \approx 153.7 \text{ sq ft}$

Convert from square feet to square metres.

$$1 \text{ ft} \approx 0.3 \text{ m}$$

$$(1 \text{ ft})^2 \approx (0.3 \text{ m})^2$$

$$1 \text{ sq ft} \approx 0.09 \text{ m}^2$$

$$153.7 \text{ sq ft} \approx 153.7 \times 0.09$$

$$153.7 \text{ sq ft} \approx 13.8 \text{ m}^2$$

He will need 14 m^2 of carpeting.
Calculate the cost.

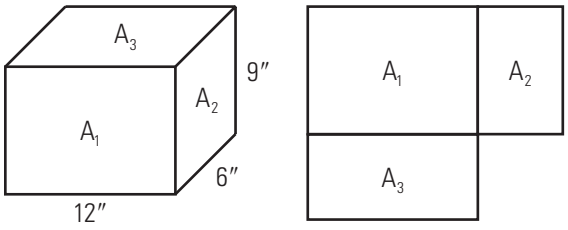
$14 \text{ m}^2 \times \$45.98/\text{m}^2 = \$643.72$

The carpeting will cost $643.72.

3.3 Surface Area

BUILD YOUR SKILLS, p. 145

1.



Calculate the surface area of the rectangular prism. There will be 2 of each of the rectangles shown.

$A_1 = \ell w$

$A_1 = (12)(9)$

$A_1 = 108$ sq in

$A_2 = \ell w$

$A_2 = (6)(9)$

$A_2 = 54$ sq in

$A_3 = \ell w$

$A_3 = (12)(6)$

$A_3 = 72$ sq in

$SA = 2(A_1) + 2(A_2) + 2(A_3)$

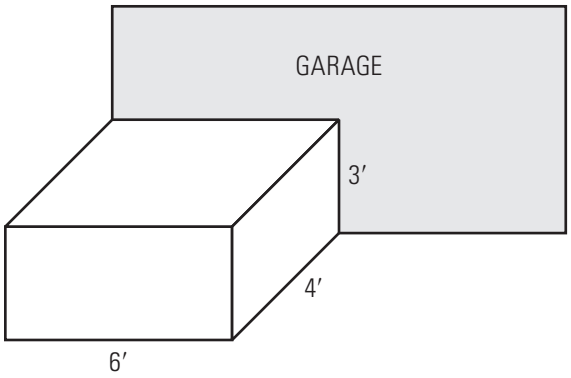
$SA = 2(108) + 2(54) + 2(72)$

$SA = 216 + 108 + 144$

$SA = 468$ sq in

Jim will need 468 sq in of veneer.

2.



There will be two sides of the greenhouse that are 4 ft by 3 ft (the two ends).

The top will be 6 ft by 4 ft.

The front will be 6 ft by 3 ft.

Calculate the areas of each of these pieces.

$A_{sides} = 2 \times \ell w$

$A_{sides} = 2(4)(3)$

$A_{sides} = 24$ sq ft

$A_{top} = \ell w$

$A_{top} = (6)(4)$

$A_{top} = 24$ sq ft

$A_{front} = \ell w$

$A_{front} = (6)(3)$

$A_{front} = 18$ sq ft

$SA = A_{sides} + A_{top} + A_{front}$

$SA = 24 + 24 + 18$

$SA = 66$ sq ft

Anita will need 66 sq ft of glass.

3. Tiles will cover three walls that are each 35 in by 8 ft. Tiles will also cover the floor, which is 35 in by 35 in. Calculate the surface area in square inches.

Convert the height, 8 ft, to inches.

$8 \text{ ft} = 8 \times 12 \text{ in}$

$8 \text{ ft} = 96 \text{ in}$

$A_{walls} = \ell w$

$A_{walls} = (35)(96)$

$A_{walls} = 3360 \text{ sq in}$

$A_{floor} = \ell w$

$A_{floor} = (35)(35)$

$A_{floor} = 1225 \text{ sq in}$

$SA = 3(A_{walls}) + A_{floor}$

$SA = 3(3360) + (1225)$

$SA = 10\,080 + 1225$

$SA = 11\,305 \text{ sq in}$

Vicki will need 11 305 sq in of tiles.

4. a) The shipping tube has 3 surfaces: the top and bottom, which are circles with a diameter of 6 inches, and the side of the tube with a length of 48 inches and width equal to the circumference of the cylinder.

Calculate the circumference.

$C = \pi d$

$C = \pi(6)$

$C \approx 18.8 \text{ in}$

Calculate the area of the circular surface.

$A_{circle} = \pi r^2$

$A_{circle} = \pi \left(\frac{6}{2}\right)^2$

$A_{circle} \approx 28.3 \text{ sq in}$

Calculate the area of the rectangular surface, where the length is equal to the circumference calculated above.

$A_{rectangle} = \ell w$

$A_{rectangle} = (48)(18.8)$

$A_{rectangle} = 902.4 \text{ sq in}$

Calculate the total surface area.

$SA = 2(A_{circle}) + A_{rectangle}$

$SA = 2(28.3) + 902.4$

$SA = 56.6 + 902.4$

$SA = 959 \text{ sq in}$

The surface area is 959 sq in.

b) Convert the surface area in square inches to square feet.

$12 \text{ in} = 1 \text{ ft}$

$(12 \text{ in})^2 = (1 \text{ ft})^2$

$144 \text{ sq in} = 1 \text{ sq ft}$

$959 \text{ sq in} = 959 \div 144$

$959 \text{ sq in} \approx 6.7 \text{ sq ft}$

The surface area is about 6.7 square feet.

5. The total height of the cylinder will be 4 times the diameter of one tennis ball.

$h = 4d$

$h = 4(3.25)$

$h = 13 \text{ in}$

The box is made up of 3 surfaces: the top and bottom, which are circles with a diameter of 3.25 inches, and the side of the tube, which is a rectangle with a length of 13 inches (the height of the box) and width equal to the circumference of the cylinder.

Calculate the area of the end of the cylinder.

$A_{end} = \pi r^2$

$A_{end} = \pi \left(\frac{3.25}{2}\right)^2$

$A_{end} \approx 8.3$ sq in

Calculate the circumference of the circle.

$C = \pi d$

$C = \pi(3.25)$

$C \approx 10.2$ in

Calculate the area of the side.

$A_{side} = C \times h$

$A_{side} = 10.2 \times 13$

$A_{side} = 132.6$ sq in

Calculate the total surface area.

$SA = 2(A_{end}) + A_{side}$

$SA = 2(8.3) + 132.6$

$SA = 16.6 + 132.6$

$SA = 149.2$ sq in

The total surface area is approximately 149.2 square inches.

6. Use the formula for calculating the area of the surface of a cone to calculate surface area in square inches, then convert the measurement to square feet.

Note: The question provides the height of the funnel (9 inches), but you do not need this information to solve the problem.

$A = \pi rs$

$A = \pi(5.8)(10.7)$

$A \approx 194.9$ sq in

1 ft = 12 in

$(1 \text{ ft})^2 = (12 \text{ in})^2$

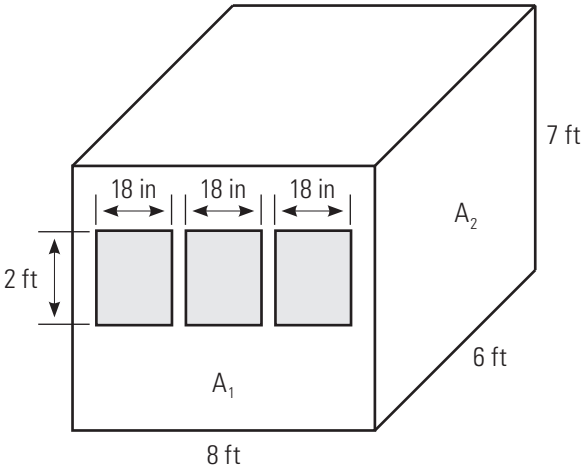
1 sq ft = 144 sq in

194.9 sq in = 194.9 ÷ 144

194.9 sq in ≈ 1.4 sq ft

The surface area of the funnel is 1.4 square feet.

7.



Calculate the area of the walls.

There are two walls that are 8 ft by 7 ft.

$A_1 = \ell w$

$A_1 = (8)(7)$

$A_1 = 56$ sq ft

There are two walls that are 6 ft by 7 ft.

$A_2 = \ell w$

$A_2 = (6)(7)$

$A_2 = 42$ sq ft

Calculate the total surface area, ignoring the windows.

$SA = 2A_1 + 2A_2$

$SA = 2(56) + 2(42)$

$SA = 112 + 84$

$SA = 196$ sq ft

Convert the width of the window, 18 inches, to feet.

$18 \div 12 = 1.5$ ft

Calculate the total area of the 3 windows.

$A_{windows} = 3 \times \ell w$

$A_{windows} = (3)(2)(1.5)$

$A_{windows} = 9$ sq ft

Calculate the area to be painted.

$A = SA - A_{windows}$

$A = 196 - 9$

$A = 187$ sq ft

The walls are to receive two coats of paint, so multiply the area by 2.

Area to be painted = 2(187)

Area to be painted = 374 sq ft

The total area to be painted is 374 square feet.

8. The surface are of the canister is equal to 2 times the area of the circular end, plus the area of the side, which is a rectangle with a length equal to the circumference of the canister.

$A_{end} = \pi r^2$

$A_{end} = \pi \left(\frac{4}{2}\right)^2$

$A_{end} \approx 12.6$ sq in

$C = \pi d$

$C = \pi(4)$

$C \approx 12.6$ in

Convert the length of the canister from feet and inches to inches.

1 ft 3 in = 12 in + 3 in

1 ft 3 in = 15 in

$A_{side} = C \times \ell$

$A_{side} = 12.6 \times 15$

$A_{side} = 189$ sq in

Calculate the total surface area.

$SA = 2(A_{end}) + A_{side}$

$SA = 2(12.6) + 189$

$SA = 25.2 + 189$

$SA = 214.2$ sq in

The total surface area is 214.2 square inches.

9. The inside surface area of the of the hot tub is equal to the area of each of the walls plus the area of the floor, ignoring the bench.

There are two walls of 5′6″ by 3′, two walls of 6′11″ by 3′, and the floor is 6′11″by 5′6″.

Convert the dimensions to feet.

$$5'6'' = 5' + \frac{6}{12}'$$

$$5'6'' = 5.5'$$

$$6'11'' = 6' + \frac{11}{12}'$$

$$6'11'' \approx 6.92'$$

Calculate the area of each of the surfaces.

$$A_1 = \ell w$$
$$A_1 = (5.5)(3)$$
$$A_1 = 16.5 \text{ sq ft}$$

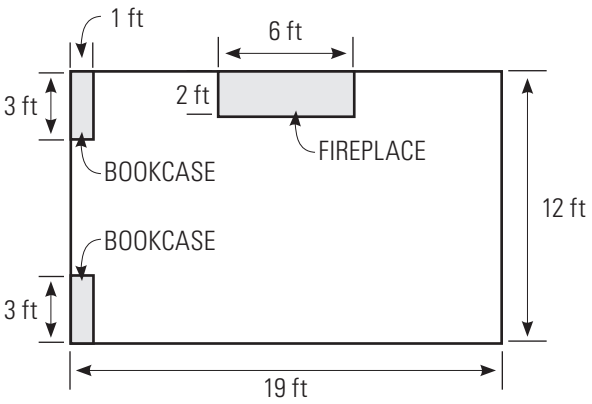
$$A_2 = \ell w$$
$$A_2 = (6.92)(3)$$
$$A_2 \approx 20.8 \text{ sq ft}$$

$$A_3 = \ell w$$
$$A_3 = (6.92)(5.5)$$
$$A_3 \approx 38.1$$

$$SA = 2A_1 + 2A_2 + A_3$$
$$SA = 2(16.5) + 2(20.8) + 38.1$$
$$SA = 33 + 41.6 + 38.1$$
$$SA = 112.7 \text{ sq ft}$$

The total surface area is 112.7 sq ft. Jerg will need 112.7 sq ft of finishing material.

10.



Calculate the area of the floor ignoring the area of the fireplace and bookcases.

$$A_{room} = \ell w$$
$$A_{room} = 19 \times 12$$
$$A_{room} = 228 \text{ sq ft}$$

Calculate the area of one bookcase.

$$A_{bookcase} = \ell w$$
$$A_{bookcase} = 3 \times 1$$
$$A_{bookcase} = 3 \text{ sq ft}$$

Calculate the area of the fireplace.

$$A_{fireplace} = \ell w$$
$$A_{fireplace} = 6 \times 2$$
$$A_{fireplace} = 12 \text{ sq ft}$$

Calculate the area that will require flooring.

$$A_{floor} = A_{room} - 2A_{bookcase} - A_{fireplace}$$
$$A_{floor} = 228 - 2(3) - 12$$
$$A_{floor} = 228 - 6 - 12$$
$$A_{floor} = 210 \text{ sq ft}$$

Add 12% to the area.

$$210 \times 1.12 = 235.2 \text{ sq ft}$$

Randi needs to order 235.2 sq ft of flooring.

Calculate the cost of the flooring.

$$235.2 \text{ sq ft} \times \$5.25/\text{sq ft} = \$1234.80$$

The flooring will cost $1234.80.

11. Use the formula for calculating the surface area of a cone.

$A = \pi rs$

$A = \pi(2.2)(3.5)$

$A \approx 24.2$ sq yd

The roof will require 24.2 sq yd of sheet metal.

Calculate the cost of the sheet material.

24.2 sq yd × \$54.25/sq yd = \$1312.85

The cost of the sheet metal will be \$1312.85.

12. Calculate the total area of the walls, ignoring the window and door.

There are two walls that measure 10 ft by 9.5 ft.

$A_1 = \ell w$

$A_1 = (10)(9.5)$

$A_1 = 95$ sq ft

There are two walls that measure 8 ft by 9.5 ft.

$A_2 = \ell w$

$A_2 = (8)(9.5)$

$A_2 = 76$ sq ft

Calculate the total area of the walls.

$A_{walls} = 2A_1 + 2A_2$

$A_{walls} = 2(95) + 2(76)$

$A_{walls} = 190 + 152$

$A_{walls} = 342$ sq ft

Next, calculate the area that will not be wallpapered.

Calculate the area of the door.

$A_3 = \ell w$

$A_3 = (7)(3)$

$A_3 = 21$ sq ft

Calculate the area of the window

$A_4 = \ell w$

$A_4 = (3)(4)$

$A_4 = 12$ sq ft

Calculate the total area that needs papering.

$A = A_{walls} - A_3 - A_4$

$A = 342 - 21 - 12$

$A = 309$ sq ft

The total area to be wallpapered is 309 sq ft.

Calculate how many rolls of paper will be needed.

$309 \div 56 \approx 5.5$

Rolls must be bought in whole numbers, so 6 rolls of wallpaper will be needed.

Calculate the cost.

6 rolls × \$29.95/roll = \$179.70

The total cost for the wallpaper is \$179.70.

PRACTISE YOUR NEW SKILLS, p. 155

1. The storage bin has 6 sides. Four sides are 114 cm by 56 cm. Two sides that are 56 cm by 56 cm. Calculate the area of each of the sides.

$A_1 = \ell w$

$A_1 = (114)(56)$

$A_1 = 6384 \text{ cm}^2$

$A_2 = \ell w$

$A_2 = (56)(56)$

$A_2 = 3136 \text{ cm}^2$

$SA = 4A_1 + 2A_2$

$SA = 4(6384) + 2(3136)$

$SA = 25\,536 + 6272$

$SA = 31\,808 \text{ cm}^2$

Convert the area from cm^2 to square feet.

$1 \text{ ft} \approx 0.3 \text{ m}$

$1 \text{ ft} \approx 30 \text{ cm}$

$(1 \text{ ft})^2 \approx (30 \text{ cm})^2$

$1 \text{ sq ft} \approx 900 \text{ cm}^2$

$31\,808 \text{ cm}^2 = 9520 \text{ cm}^2 \times \dfrac{1 \text{ sq ft}}{900 \text{ cm}^2}$

$31\,808 \text{ cm}^2 \approx 35.3 \text{ sq ft}$

The surface area of the storage bin is about 35.3 square feet.

2. There will be 6 panes that are each 4 ft by 1.5 ft. Calculate the area of one pane, then multiply by 6 to find how much glass will be needed.

$A = \ell w$

$A = (4)(1.5)$

$A = 6 \text{ sq ft}$

$A_{total} = 6A$

$A_{total} = 6 \times 6$

$A_{total} = 36 \text{ sq ft}$

36 sq feet of glass will be needed to construct the fish tank.

3. Calculate the area of the patio in cm^2.

$A = \ell w$

$A = (300)(250)$

$A = 75\,000 \text{ cm}^2$

Calculate the area of each of the tiles.

$A_{tile\ 1} = \ell w$

$A_{tile\ 1} = (39)(39)$

$A_{tile\ 1} = 1521 \text{ cm}^2$

$A_{tile\ 2} = \ell w$

$A_{tile\ 2} = (18)(27)$

$A_{tile\ 2} = 486 \text{ cm}^2$

Calculate how many tiles would be needed of each type to cover the area of the patio.

Tile 1:

$75\,000 \div 1521 \approx 49.3$

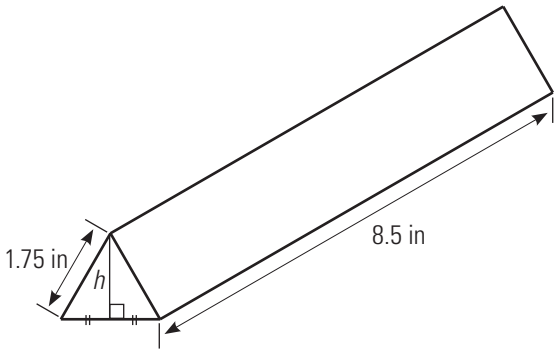
50 of the 39 cm by 39 cm tiles would be needed.

Tile 2:

$75\,000 \div 486 \approx 154.3$

155 of the 18 cm by 27 cm tiles would be needed.

4.



The box is made up of three rectangles 8.5 in long and 1.75 in wide, and two equilateral triangles with sides of 1.75 in. Find the height of the equilateral triangles using the Pythagorean theorem.

$$a^2 + b^2 = c^2$$

$$\left(\frac{\text{side length}}{2}\right)^2 + h = (\text{side length})^2$$

$$\left(\frac{1.75}{2}\right)^2 + h^2 = (1.75)^2$$

$$h^2 = (1.75)^2 - \left(\frac{1.75}{2}\right)^2$$

$$h = \sqrt{(1.75)^2 - \left(\frac{1.75}{2}\right)^2}$$

$$h \approx 1.5 \text{ in}$$

Find the area of the triangle ends.

$$A_{end} = \frac{1}{2}bh$$

$$A_{end} = \frac{1}{2}(1.75)(1.5)$$

$$A_{end} \approx 1.3 \text{ sq in}$$

Find the area of the side pieces.

$$A_{side} = \ell w$$

$$A_{side} = (8.5)(1.75)$$

$$A_{side} \approx 14.9 \text{ sq in}$$

Calculate the surface area.

$$SA = 2(A_{end}) + 3(A_{side})$$

$$SA = 2(1.3) + 3(14.9)$$

$$SA = 2.6 + 44.7$$

$$SA = 47.3 \text{ sq in}$$

The total surface area of the box is 47.3 sq in.

5. The label on the water bottle will be a rectangle with width equal to the circumference of the cylinder and length equal to the height of the bottle.

Calculate the circumference.

$$C = \pi d$$

$$C = \pi(3.75)$$

$$C = 11.8 \text{ in}$$

The label will have dimensions of 11.8 in by 7.5 in.

Calculate the area of the label.

$A = \ell w$

$A = (11.8)(7.5)$

$A = 88.5$ sq in

The label can be a maximum of 88.5 square inches.

6. Convert the slant height measurement to a decimal.

$$3\frac{1}{8}' = 3 + (1 \div 8)$$

$$3\frac{1}{8}' = 3.125'$$

Calculate the surface area of the cone.

$$A = \pi rs$$

$$A = \pi\left(\frac{3}{2}\right)(3.125)$$

$$A \approx 14.7 \text{ sq in}$$

14.7 sq in of paper are needed to make the cup.

7. The pyramid is made up of 4 triangles, each with a base of 756 ft and a height of 610 ft. Calculate the area of one triangle.

$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2}(756)(610)$$

$$A = 230\,580 \text{ sq ft}$$

The surface area of the pyramid is 4 times the area of one triangle.

$$SA = 4A$$

$$SA = 4(230\,580)$$

$$SA = 922\,320 \text{ sq ft}$$

The surface area of the Great Pyramid of Giza was 922 320 sq ft.

3.4 Volume

BUILD YOUR SKILLS, p. 159

1. a) Calculate the volume of the tank using the formula for the volume of a rectangular prism.

$V = \ell wh$

$V = (30)(24)(18)$

$V = 12\,960 \text{ in}^3$

The fish tank will hold $12\,960 \text{ in}^3$ of water.

b) Convert the volume of the tank from part a) to cubic feet.

$$12 \text{ in} = 1 \text{ ft}$$
$$(12 \text{ in})^3 = (1 \text{ ft})^3$$
$$1728 \text{ in}^3 = 1 \text{ ft}^3$$
$$12\,960 \div 1728 = 7.5 \text{ ft}^3$$

The fish tank will hold 7.5 ft^3 of water.

2. Calculate the volume of one box.

$V = \ell wh$

$V = (3)(2.5)(1.5)$

$V = 11.25 \text{ ft}^3$

Each box is 11.25 ft^3.

3. Calculate the volume of the first box.

$V = \ell wh$

$V = (3)(4)(6)$

$V = 72 \text{ in}^3$

Calculate the volume of the cube.

$V = s^3$

$V = 43$

$V = 64 \text{ in}^3$

The contents of the box will not fit in the cube.

4. Calculate the volume of soil needed. (Convert the depth of the soil from inches to feet.)

$V = \ell wh$

$V = (4)(3)(0.5)$

$V = 6 \text{ ft}^3$

6 ft^3 of soil are needed.

Divide by the number of cubic feet per bag of soil.

$6 \div 2 = 3$

3 bags of soil are needed to cover the garden.

5. Calculate the volume of one bale of hay.

   $V = \ell wh$

   $V = (15)(24)(36)$

   $V = 12\,960 \text{ in}^3$

   Multiply the volume of one bale of hay by 250 to find the total volume.

   $12\,960 \times 250 = 3\,240\,000 \text{ in}^3$

   Convert to cubic feet.

   $$12 \text{ in} = 1 \text{ ft}$$
   $$(12 \text{ in})^3 = (1 \text{ ft})^3$$
   $$1728 \text{ in}^3 = 1 \text{ ft}^3$$
   $$3\,240\,000 \div 1728 = 1875 \text{ ft}^3$$

   Karl needs 1875 cubic feet of hay.

6. To calculate the volume of the packed box, add 1.5 inches twice to each of the dimensions of the computer.

   The box measures 12 inches by 19 inches by 19.5 inches.

   Calculate the volume.

   $V = \ell wh$

   $V = (12)(19)(19.5)$

   $V = 4446 \text{ in}^3$

   The volume of the packed box is 4446 in^3.

7. a) Convert the gas tank capacity from litres to US gallons.

   $1 \text{ US gal} = 3.8 \text{ L}$

   $$1 \text{ L} = \frac{1}{3.8} \text{ US gal}$$
   $$55 \text{ L} = 55 \times \frac{1}{3.8}$$
   $$55 \text{ L} \approx 14.5 \text{ US gal}$$

   The gas tank of Serina's car has a capacity of 14.5 US gallons.

   b) Calculate cost of filling the tank.

   $14.5 \text{ US gal} \times \$2.99/\text{US gal} = \$43.36$

   It will cost Serina $43.36 to fill her gas tank.

   c) Calculate the gas tank's capacity in British gallons.

   $1 \text{ British gal} \approx 4.5 \text{ L}$

   $$1 \text{ L} \approx \frac{1}{4.5} \text{ British gal}$$
   $$55 \text{ L} = 55 \times \frac{1}{4.5}$$
   $$55 \text{ L} \approx 12.2 \text{ British gal}$$

   Calculate the cost to fill the tank.

   $12.2 \text{ British gal} \times \$9.86/\text{British gal} = \$120.29$

   It will cost $120.29 to fill the tank in London.

8. Convert the dimensions of the cube van from feet and inches to feet.

length:

20 feet

width:

$$10 \text{ ft } 8 \text{ in} = 10\frac{8}{12} \text{ ft}$$

$$10 \text{ ft } 8 \text{ in} \approx 10.7 \text{ ft}$$

height:

$$12 \text{ ft } 6 \text{ in} = 12\frac{6}{12} \text{ ft}$$

$$12 \text{ ft } 6 \text{ in} = 12.5 \text{ ft}$$

Calculate the volume.

$V = \ell wh$

$V = (20)(10.7)(12.5)$

$V = 2675 \text{ ft}^3$

The volume of Jakob's cube van is 2675 cubic feet.

9. Convert the dimensions of the first bin to feet.

$$12 \text{ ft } 8 \text{ in} = 12\frac{8}{12} \text{ ft}$$

$$12 \text{ ft } 8 \text{ in} \approx 12.7 \text{ ft}$$

$$8 \text{ ft } 9 \text{ in} = 8\frac{9}{12} \text{ ft}$$

$$8 \text{ ft } 9 \text{ in} = 8.75 \text{ ft}$$

$$4 \text{ ft } 6 \text{ in} = 4\frac{6}{12} \text{ ft}$$

$$4 \text{ ft } 6 \text{ in} = 4.5 \text{ ft}$$

Calculate the volume of grain in the first bin.

$V = \ell wh$

$V = (12.7)(8.75)(4.5)$

$V \approx 500 \text{ ft}^3$

You are given the length and width of the second bin. Use the volume calculated for the first bin so solve for the height.

$$V = \ell wh$$

$$500 = (9)(9)h$$

$$500 = 81h$$

$$\frac{500}{81} = h$$

$$6.2 \text{ ft} \approx h$$

The height of the grain in the second bin will be approximately 6.2 feet.

PRACTISE YOUR NEW SKILLS, p. 166

1. a) Calculate the volume of the storage container, which is a rectangular prism.

$V = \ell wh$

$V = (6)(3)(4)$

$V = 72 \text{ ft}^3$

The volume is 72 cubic feet.

b) Convert the volume from part a) to cubic yards.

$$1 \text{ yd} = 3 \text{ ft}$$

$$(1 \text{ yd})^3 = (3 \text{ ft})^3$$

$$1 \text{ yd}^3 = 27 \text{ ft}^3$$

$$72 \text{ ft}^3 = 72 \div 27 \text{ yd}^3$$

$$72 \text{ ft}^3 \approx 2.7 \text{ yd}^3$$

The volume is approximately 2.7 cubic yards.

2. Convert the measurement of milk in cups to millilitres.

$1 \text{ cup} = 250 \text{ mL}$

$2\frac{3}{4} \text{ cups} = 2.75 \times 250 \text{ mL}$

$2\frac{3}{4} \text{ cups} = 687.5 \text{ mL}$

The recipe requires 687.5 mL of milk.

3. Convert 5 fl oz to mL.

$1 \text{ fl oz} = 30 \text{ mL}$

$5 \text{ fl oz} = 5 \times 30 \text{ mL}$

$5 \text{ fl oz} = 150 \text{ mL}$

The capacity of the jar is 150 mL.

4. Calculate how many litres of fuel you will need for 450 km.

$$450 \text{ km} \times \frac{8.8 \text{ L}}{100 \text{ km}} = 39.6 \text{ L}$$

You will need 39.6 L of fuel. Convert this to US gallons.

$1 \text{ US gal} = 3.8 \text{ L}$

$39.6 \text{ L} = 39.6 \div 3.8 \text{ US gal}$

$39.6 \text{ L} \approx 10.4 \text{ US gal}$

You will need about 10.4 US gallons of fuel for a 450-km trip.

5. Calculate how many fluid ounces of fertilizer are need.

$10.5 \text{ fl oz/tree} \times 15 \text{ trees} = 157.5 \text{ fl oz}$

Convert this to millilitres.

$1 \text{ fl oz} = 30 \text{ mL}$

$157.5 \text{ fl oz} = (157.5 \times 30) \text{ mL}$

$157.5 \text{ fl oz} = 4725 \text{ mL}$

Convert to litres.

$4725 \div 1000 = 4.725$

4.7 L of fertilizer will be needed, so two bottles will need to be purchased.

6. To find the volume of concrete needed, calculate the volume using the outer dimensions and subtract the volume using the inner dimensions.

Volume using outer dimensions:

$V = \ell wh$

$V = (10)(8)(4)$

$V = 320 \text{ ft}^3$

To find the dimensions of the interior, subtract 6 inches (0.5 ft) from each side; you will have to subtract 6 inches twice from the length and the width. Because there is no lid, you will only have to subtract 6 inches once from the height.

$\ell = 10 \text{ ft} - 0.5 \text{ ft} - 0.5 \text{ ft}$

$\ell = 9 \text{ ft}$

$w = 8 \text{ ft} - 0.5 \text{ ft} - 0.5 \text{ ft}$

$w = 7 \text{ ft}$

$h = 4 \text{ ft} - 0.5 \text{ ft}$

$h = 3.5 \text{ ft}$

Volume using inner dimensions:

$V = \ell wh$

$V = (9)(7)(3.5)$

$V = 220.5 \text{ ft}^3$

Calculate the volume of concrete needed.

$$V = V_{outer} - V_{inner}$$
$$V = 320 - 220.5$$
$$V = 99.5 \text{ ft}^3$$

Convert the volume to cubic yards.

$$1 \text{ yd} = 3 \text{ ft}$$
$$(1 \text{ yd})^3 = (3 \text{ ft})^3$$
$$1 \text{ yd}^3 = 27 \text{ ft}^3$$
$$99.5 \text{ ft}^3 = 99.5 \div 27 \text{ yd}^3$$
$$99.5 \text{ ft}^3 \approx 3.7 \text{ yd}^3$$

About 3.7 cubic yards of concrete will be needed.

Calculate the cost of the concrete.

$$3.7 \text{ yd}^3 \times \$98.95/\text{yd}^3 = \$366.12$$

The cost of the concrete will be $366.12.

CHAPTER TEST, p. 169

1. a) Calculate the difference in their heights, subtracting feet from feet and inches from inches.

$$\begin{array}{r} 8'11.1'' \\ -\,2'4.7'' \\ \hline 6'6.4'' \end{array}$$

The difference in their heights is 6 feet 6.4 inches.

b) Calculate the men's heights in metres.

Robert Pershing Wadlow:

Convert his height in feet and inches to feet.

$$8'11.1'' = 8 + \frac{11.1'}{12}$$
$$8'11.1'' = 8.925'$$

Convert to metres.

$$1 \text{ ft} \approx 0.3 \text{ m}$$
$$8.925 \text{ ft} \approx 8.925 \times 0.3 \text{ m}$$
$$8.925 \text{ ft} \approx 2.7 \text{ m}$$

Robert Pershing Wadlow was about 2.7 m tall.

He Pingping:

Convert his height in feet and inches to feet.

$$2'4.7'' = 2' + \frac{4.7'}{12}$$
$$2'4.7'' \approx 2.4'$$

Convert to metres.

$$1 \text{ ft} \approx 0.3 \text{ m}$$
$$2.4 \text{ ft} \approx 2.4 \times 0.3 \text{ m}$$
$$2.4 \text{ ft} \approx 0.7 \text{ m}$$

He Pingping was 0.7 m tall.

c) Subtract He Pingping's height from Robert Pershing Wadlow's height.

$2.7 - 0.7 = 2$ m

The difference in their heights is about 2 m.

2. Convert the height of the tunnel, 10 ft 6 in, to metres.

$10 \text{ ft } 6 \text{ in} = 10.5 \text{ ft}$

$$1 \text{ ft} \approx 0.3 \text{ m}$$
$$10.5 \text{ ft} \approx 10.5 \times 0.3 \text{ m}$$
$$10.5 \text{ ft} \approx 3.15 \text{ m}$$

Franklin's truck is more than 3.15 m high, so it will not fit through the tunnel.

3. The wainscotting will be installed so that the 4-ft dimension is the height. Because it is being installed to a height of 4 ft, you only need to consider the length.

Calculate the perimeter of the room including the doors and windows.

$P = 2\ell + 2w$

$P = 2(19) + 2(13)$

$P = 38 + 26$

$P = 64$ ft

The doors are each 30 inches wide, for a total of 60 inches (5 feet). Subtract this from the perimeter.

$64 - 5 = 59$ feet

Consider the window. Under it, a panel of 2 feet by 12 feet will not be needed. Cut in half height-wise; this is equal to 4 feet by 6 feet. Subtract the length (6 feet) from the perimeter.

$59 - 6 = 53$ feet

53 feet of wainscotting will be needed.

Divide this by 8 feet (the length of one panel of wainscotting) to determine how many panels will be needed.

$53 \div 8 \approx 6.6$ panels

Rachelle will need to purchase 7 panels of wainscotting.

4. a) Divide the space into two sections: one that is 12 ft 8 in by 9 ft 4 in, and one that is 3 ft 4 in by 3 ft 4 in. Convert these measures to feet.

$$12 \text{ ft } 8 \text{ in} = 12\frac{8}{12} \text{ ft}$$
$$12 \text{ ft } 8 \text{ in} \approx 12.7 \text{ ft}$$

$$9 \text{ ft } 4 \text{ in} = 9\frac{4}{12} \text{ ft}$$
$$9 \text{ ft } 4 \text{ in} \approx 9.3 \text{ ft}$$

$$3 \text{ ft } 4 \text{ in} = 3\frac{4}{12} \text{ ft}$$
$$3 \text{ ft } 4 \text{ in} \approx 3.3 \text{ ft}$$

Calculate the area of the patio, in two sections.

$$A_1 = \ell w$$
$$A_1 = (12.7)(9.3)$$
$$A_1 \approx 118.1 \text{ sq ft}$$

$$A_2 = \ell w$$
$$A_2 = (3.3)(3.3)$$
$$A_2 \approx 10.9 \text{ sq ft}$$

$$A = A_1 + A_2$$
$$A = 118.1 + 10.9$$
$$A = 129 \text{ sq ft}$$

One tile is 12 in (1 ft) by 12 in (1 ft), so the area of one tile is 1 sq ft.

Mario will need 129 tiles to cover his patio.

b) Calculate the perimeter of the patio, minus the entrance.

$$P = 3.3 + (12.7 - 3.3) + 9.3 + 12.7 + 9.3 + 3.3$$
$$P = 47.3 \text{ ft}$$

If geraniums are planted 1 foot apart, Mario will need 47 geraniums.

5. Calculate the surface area of the side of the cylinder (the ends will not be painted). The side is a rectangle with a length equal to the height of the granary and width equal to the circumference.

$$C = \pi d$$
$$C = \pi(14)$$
$$C \approx 44 \text{ ft}$$

$$A = C \times h$$
$$A = 44 \times 10$$
$$A = 440 \text{ sq ft}$$

The surface area of the granary is 440 sq ft. Louise will be giving it two coats of paint, so multiply the surface area by two.

(440)(2) = 880 sq ft

Divide this by the number of square feet per gallon of paint.

880 sq ft ÷ 375 sq ft/gal ≈ 2.3 gal

Louise will need to buy 2.3 gallons (likely rounded up to 3 gallons) of paint.

6. The storage unit will have the following surfaces:

2 rectangles that are 7 ft 6 in by 8 ft 2 in

2 rectangles that are 9 ft 8 in by 8 ft 2 in

1 rectangle that is 7 ft 6 in by 9 ft 8 in

Convert the dimensions to feet.

7 ft 6 in = 7.5 ft

8 ft 2 in ≈ 8.2 ft

9 ft 8 in ≈ 9.7 ft

Calculate the areas.

$A_1 = \ell w$

$A_1 = (7.5)(8.2)$

$A_1 = 61.5$ sq ft

$A_2 = \ell w$

$A_2 = (9.7)(8.2)$

$A_2 \approx 79.5$ sq ft

$A_3 = \ell w$

$A_3 = (7.5)(9.7)$

$A_3 \approx 72.8$ sq ft

$SA = (2 \times A_1) + (2 \times A_2) + A_3$

$SA = (2 \times 61.5) + (2 \times 79.5) + 72.8$

$SA = 123 + 159 + 72.8$

$SA = 354.8$

The surface area is 354.8 sq ft.

7. Convert the dimensions in metres to yards.

1 m = 1.09 yd

109 m = 109 × 1.09 yd

109 m ≈ 118.8 yd

73 m = 73 × 1.09 yd

73 m = 79.6 yd

The field fits within the league's specifications.

8. Calculate the volume of the fish tank using the formula for the volume of a rectangular prism.

$V = \ell wh$

$V = (90)(55)(32)$

$V = 158\ 400\ \text{cm}^3$

The fish tank's volume is 158 400 cm^3.

9. Calculate the volume of gravel in cubic feet, then convert to cubic yards.

Convert the depth of gravel, 2 inches, to feet.

2 ÷ 12 ≈ 0.2 ft

Calculate the volume of gravel in cubic feet.

$V = \ell wh$

$V = (36)(10)(0.2)$

$V = 72\ \text{ft}^3$

Convert to cubic yards.

$1\ \text{yd} = 3\ \text{ft}$

$(1\ \text{yd})^3 = (3\ \text{ft})^3$

$1\ \text{yd}^3 = 27\ \text{ft}^3$

$72\ \text{ft}^3 = 72 \div 27\ \text{yd}^3$

$72\ \text{ft}^3 \approx 2.7\ \text{yd}^3$

2.7 cubic yards of gravel will be needed to cover the driveway.

ALTERNATIVE SOLUTION

Convert the dimensions of the gravel cover to yards before calculating volume.

Convert 36 feet to yards.

$36 \div 3 = 12$ yd

Convert 10 ft to yards.

$10 \div 3 \approx 3.3$ yd

Convert 2 in to yards.

$(2 \div 12) \div 3 = 0.06$ yd

Calculate the volume.

$V = \ell wh$

$V = (12)(3.3)(0.06)$

$V = 2.4 \text{ yd}^3$

2.4 cubic yards of gravel will be needed to cover the driveway. This answer is different from the first solution due to rounding.

10. Convert the sizes of milk jugs from imperial units to SI units.

$1 \text{ US gal} = 3.8 \text{ L}$

$1 \text{ US gal} = (3.8 \times 1000) \text{ mL}$

$1 \text{ US gal} = 3800 \text{ mL}$

$0.5 \text{ US gal} = (3800 \text{ mL}) \div 2$

$0.5 \text{ US gal} = 1900 \text{ mL}$

$4 \text{ quarts} = 1 \text{ US gal}$

$4 \text{ quarts} = 3800 \text{ mL}$

$1 \text{ quart} = (3800 \div 4) \text{ mL}$

$1 \text{ quart} = 950 \text{ mL}$

$2 \text{ pints} = 1 \text{ quart}$

$2 \text{ pints} = 950 \text{ mL}$

$\frac{1}{2} \text{ pint} = (950 \div 4) \text{ mL}$

$\frac{1}{2} \text{ pint} = 237.5 \text{ mL}$

The equivalent measurements in millilitres are 3800 mL, 1900 mL, 950 mL, and 237.5 mL.

11. a) Convert the measurement of evaporated milk from US fluid ounces to cups.

$1 \text{ cup} = 8 \text{ US fl oz}$

$5 \text{ US fl oz} = \frac{5}{8} \text{ cup}$

$5 \text{ US fl oz} = 0.625 \text{ cup}$

b) Convert the measurement of evaporated milk from US fluid ounces to millilitres.

$1 \text{ cup} = 250 \text{ mL}$

$\frac{1}{2} \text{ cup} = 250 \div 2 \text{ mL}$

$\frac{1}{2} \text{ cup} = 125 \text{ mL}$

Chapter 4

Mass, Temperature, and Volume

4.1 Temperature Conversions

BUILD YOUR SKILLS, p. 177

1. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$$C = \frac{5}{9}(F - 32)$$

$$C = \frac{5}{9}(350 - 32)$$

$$C = \frac{5}{9}(318)$$

$$C \approx 176.7$$

Set the oven at 176.7°C.

2. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$$C = \frac{5}{9}(F - 32)$$

$$C = \frac{5}{9}(238 - 32)$$

$$C = \frac{5}{9}(206)$$

$$C \approx 114.4$$

The mixture needs to reach 114.4°C.

3. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$$C = \frac{5}{9}(F - 32)$$

$$C = \frac{5}{9}(2190 - 32)$$

$$C = \frac{5}{9}(2158)$$

$$C \approx 1198.9$$

The flame is 1198.9°C.

4. Use the formula for converting from degrees Celsius to degrees Fahrenheit.

$$F = \frac{9}{5}C + 32$$

$$F = \frac{9}{5}(40) + 32$$

$$F = 72 + 32$$

$$F = 104$$

Ashley's dog has a temperature of 104°F. This is outside (higher than) the normal range.

5. Use the formula for converting from degrees Celsius to degrees Fahrenheit.

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(9) + 32$

$F = 16.2 + 32$

$F = 48.2$

The temperature is 48°F. The paint can be safely applied.

6. a) Calculate the change in temperature by subtraction.

$49 - (-54) = 49 + 54$

$49 - (-54) = 103$

The change in temperature was 103°F.

b) Use the formula for converting from degrees Fahrenheit to degrees Celsius.

Minimum temperature:

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(-54 - 32)$

$C = \frac{5}{9}(-86)$

$C \approx -47.8$

The minimum temperature was −47.8°C.

Maximum temperature:

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(49 - 32)$

$C = \frac{5}{9}(17)$

$C \approx 9.4$

The maximum temperature was 9.4°C.

c) Calculate the change in temperature by subtraction.

$9.4 - (-47.8) = 9.4 + 47.8$

$9.4 - (-47.8) = 57.2$

The change in temperature was 57.2°C.

PRACTISE YOUR NEW SKILLS, p. 179

1. Use the formula for converting from degrees Celsius to degrees Fahrenheit.

a) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(35) + 32$

$F = 63 + 32$

$F = 95$

35°C = 95°F

b) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(-8) + 32$

$F = -14.4 + 32$

$F = 17.6$

−8°C = 17.6°F

c) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(165) + 32$

$F = 297 + 32$

$F = 329$

165°C = 329°F

d) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(21) + 32$

$F = 37.8 + 32$

$F = 69.8$

21°C = 69.8°F

e) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(-40) + 32$

$F = -72 + 32$

$F = -40$

−40°C = −40°F

f) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(202) + 32$

$F = 363.6 + 32$

$F = 395.6$

202°C = 395.6°F

2. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

a) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(-20 - 32)$

$C = \frac{5}{9}(-52)$

$C \approx -28.9$

−20°F = −28.9°C

b) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(80 - 32)$

$C = \frac{5}{9}(48)$

$C \approx 26.7$

80°F = 26.7°C

c) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(375 - 32)$

$C = \frac{5}{9}(343)$

$C \approx 190.6$

375°F = 190.6°C

d) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(2 - 32)$

$C = \frac{5}{9}(-30)$

$C \approx -16.7$

2°F = −16.7°C

e) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(0 - 32)$

$C = \frac{5}{9}(-32)$

$C \approx -17.8$

0°F = −17.8°C

f) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(-2 - 32)$

$C = \frac{5}{9}(-34)$

$C \approx -18.9$

−2°F = −18.9°C

3. Convert the temperature of the blowtorch flame to degrees Fahrenheit.

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(1300) + 32$

$F = 2340 + 32$

$F = 2372$

The blowtorch flame is 2372°F. This is hotter than the candle flame.

Calculate the difference in temperatures, in degrees Fahrenheit.

$2372 - 1830 = 542$

The blowtorch flame is hotter by 542°F.

Convert the temperature of the candle flame to degrees Celsius.

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(1830 - 32)$

$C = \frac{5}{9}(1798)$

$C \approx 998.9$

The candle flame is 998.9°C.

Calculate the difference in temperatures, in degrees Celsius.

$1300 - 998.9 = 301.1°C$

The blowtorch flame is hotter by 301.1°C.

4. Use the formula for converting from degrees Fahrenheit to degrees Celsius for each of the different materials.

a) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(200 - 32)$

$C = \frac{5}{9}(168)$

$C \approx 93.3$

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(260 - 32)$

$C = \frac{5}{9}(228)$

$C \approx 126.7$

The bituminous material must be between 93.3°C and 126.7°C.

b) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(65 - 32)$

$C = \frac{5}{9}(33)$

$C \approx 18.3$

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(100 - 32)$

$C = \frac{5}{9}(68)$

$C \approx 37.8$

The water solution must be between 18.3°C and 37.8°C.

c) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(160 - 32)$

$C = \frac{5}{9}(128)$

$C \approx 71.1$

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(210 - 32)$

$C = \frac{5}{9}(178)$

$C \approx 98.9$

The mixing gel must be between 71.1°C and 98.9°C.

5. Use the formula for converting from degrees Celsius to degrees Fahrenheit.

Minimum temperature:

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(-19) + 32$

$F = -34.2 + 32$

$F = -2.2$

Maximum temperature:

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(22) + 32$

$F = 39.6 + 32$

$F = 71.6$

The temperature rose from –2.2°F to 71.6°F.

6. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(41 - 32)$

$C = \frac{5}{9}(9)$

$C = 5$

The temperature of a medical emergency is 5°C.

7. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(-106.6 - 32)$

$C = \frac{5}{9}(-138.6)$

$C = -77$

The temperature on Mount Logan was –77°C.

8. Use the formula for converting from degrees Fahrenheit to degrees Celsius.

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(2300 - 32)$

$C = \frac{5}{9}(2268)$

$C = 1260$

The space shuttle tiles can withstand temperatures of 1260°C.

4.2 Mass in the Imperial System

BUILD YOUR SKILLS, p. 185

1. Calculate the total weight of the twins by adding pounds to pounds, and ounces to ounces.

$$\begin{array}{r} 6 \text{ lb } 5 \text{ oz} \\ +\ 5 \text{ lb } 14 \text{ oz} \\ \hline 11 \text{ lb } 19 \text{ oz} \end{array}$$

Convert 19 oz to pounds and ounces. Since 1 lb equals 16 oz, 19 oz equals 1 lb 3 oz.

Total weight = 11 lb 19 oz

Total weight = 11 lb + lb 3 oz

Total weight = 12 lb 3 oz

The babies' combined weight was 12 lb 3 oz.

2. Given the weight of 1 L of water, calculate how much 8 L of water will weigh. Multiply the weight of 1 L by 8.

Weight of 8 L of water = 8(2 lb 3 oz)

Weight of 8 L of water = 16 lb 24 oz

Weight of 8 L of water = 16 lb + (16 + 8) oz

Weight of 8 L of water = 16 lb + 1 lb + 8 oz

Weight of 8 L of water = 17 lb 8 oz

8 litres of water weigh 17 lb 8 oz.

3. Calculate how many ounces of raspberries are needed.

$4 \text{ lb} = (4 \times 16) \text{ oz}$

$4 \text{ lb} = 64 \text{ oz}$

You need 64 oz of berries. Divide by the weight of one basket of raspberries to determine how many baskets are needed.

$64 \div 12 = 5.333$

You would need approximately 5.3 baskets of raspberries, but since you cannot buy partial baskets, you would have to round up to 6.

4. Calculate the total weight of the tiles.

$65 \times 42 = 2730 \text{ lb}$

Calculate the weight of the men.

$195 + 210 = 405 \text{ lb}$

Calculate the total weight of the load by adding the weight of the tiles plus the weight of the men.

$2730 + 405 = 3135 \text{ lb}$

The total load of the elevator is 3135 lb. Convert to tons.

2000 lb = 1 tn

$3135 \div 2000 = 1.5675 \text{ tn}$

The weight of the load is about 1.6 tons, so it is unsafe and over the acceptable limit of 1.5 tons.

5. Convert the weight of truck to tons.

   $1300 \div 2000 = 0.65$ tn

   Calculate the maximum weight of slabs, in tons, that can be loaded onto truck.

   $2.75 - 0.65 = 2.1$ tn

   Convert the maximum weight of the slabs to pounds.

   $2.1 \times 2000 = 4200$ lb

   Divide by 150 to determine the number of slabs that can be loaded onto the truck.

   $4200 \div 150 = 28$

   28 slabs can be loaded onto the truck.

6. Calculate how many pounds of wheat Kurt will need.

   $320 \times 90 = 2880$ lb

   Convert the weight to tons.

   $2880 \div 2000 = 14.4$ tn

   Kurt will use 14.4 tons of wheat.

7. Calculate the cost per ounce for each of the jars of peanut butter.

   Jar 1:

   $\$3.29 \div 18 = \$0.18277/oz$

   Jar 2:

   $\$4.79 \div 28 = \$0.17107/oz$

   Jar 3:

   First convert the weight from pounds to ounces, then calculate the cost per ounce.

   $2.5 \times 16 = 40$ oz

   $\$5.99 \div 40 = \$0.14975/oz$

   \$5.99 for a 2.5-lb jar is the best buy.

8. Calculate the number of skeins of yarn needed to make 1 pound (16 ounces) of yarn.

   $16 \text{ oz} \div 3 \text{ oz/skein} \approx 5.3$

   You would need 5.3 skeins of yarn, but since you cannot buy partial skeins, you would need to round up to 6 skeins.

   Calculate the cost for 6 skeins.

   $\$6.24 \times 6 = \$37.44$

   It will cost \$37.44 to knit the sweater.

9. Calculate how many pounds of chocolate are made from one bag of beans.

   $88\,000 \div 200 = 440$ lb

   Convert to ounces.

   $440 \times 16 = 7040$ oz

   Divide the total weight in ounces by the weight of one bar.

   $7040 \div 1.5 \approx 4693$

   Approximately 4693 bars can be made from one bag of cocoa beans.

10. Zara paid \$1.98/0.9 lb, since 10% of strawberries were waste.

    $1.98 \div 0.9 = 2.20$

    The true cost is \$2.20/lb.

11. Calculate the cost of 8 bags of sand.

$\$1.68 \times 8 = \$13.44$

Calculate the amount of sand, in pounds, in 7 bags.

$7 \times 25 = 175$ lb

To calculate the true cost, divide the cost of 8 bags by the weight in pounds.

$\$13.44 \div 175 = \$0.0768$

The true cost of the sand is \$0.08/lb.

12. Divide the total cost of coffee beans by the actual weight.

$\$28.45 \div 22 \approx \$1.29$

The true cost was about \$1.29/oz.

PRACTISE YOUR NEW SKILLS, p. 192

1. Calculate the conversions between ounces, pounds, and tons.

a) 1 lb = 16 oz

24 oz = (24 ÷ 16) lb

24 oz = 1.5 lb

b) 1 tn = 2000 lb

7890 lb = (7890 ÷ 2000) tn

7890 lb = 3.945 tn

c) 1 lb = 16 oz

54 oz = (54 ÷ 16) lb

54 oz = $3\frac{6}{16}$ lb

54 oz = 3 lb 6 oz

d) 1 lb = 16 oz

6 lb 2 oz = ((6 × 16) + 2) oz

6 lb 2 oz = 96 + 2 oz

6 lb 2 oz = 98 oz

e) 1 tn = 2000 lb

4.54 tn = (4.54 × 2000) lb

4.54 tn = 9080 lb

f) 1 lb = 16 oz

654 oz = (654 ÷16) lb

654 oz = $40\frac{14}{16}$ lb

654 oz = 40 lb 14 oz

2. Calculate the total weight by first adding pounds to pound, and ounces to ounces, then converting the total ounces to pounds.

Total weight = 12 oz + 1 lb 7 oz + 1 lb 2 oz + 15 oz + 9 oz + 1 lb 3 oz

Total weight = 3 lb 48 oz

Total weight = 3 lb + (48 ÷ 16) lb

Total weight = 3 lb + 3 lb

Total weight = 6 lb

The total weight of the books is 6 lb.

3. Calculate how many ounces of flour are needed for 9 dozen cookies.

1 lb 4 oz = (1 × 16) oz + 4 oz

1 lb 4 oz = 20 oz

3 dozen cookies is equal to $\frac{1}{3}$ of the yield of the original recipe. Multiply the weight of the flour by $\frac{1}{3}$.

$\frac{1}{3} \times 20 = 6\frac{2}{3}$

You will need $6\frac{2}{3}$ ounces of flour.

4. Calculate the total weight of the slabs of concrete.

$5 \times 46 = 230$ lb

Kris's weight: 195 lb

Calculate the truck weight, in pounds.

$1 \text{ tn} = 2000$ lb

$1.5 \times 2000 = 3000$ lb

Add the weight of the slabs, Kris, and the truck.

$230 + 195 + 3000 = 3425$

The total weight of the loaded truck is 3425 lb.

5. Calculate the weight of paint when wet.

$9 \text{ lb/gal} \times 1.5 \text{ gal} = 13.5$ lb

The paint will weigh 13.5 lb, so Harinder can safely paint the structure.

6. a) Divide the cost of the 12-lb box of blueberries by 12.

$\$20.00 \div 12 \approx \$1.67$

One pound will cost about $1.67.

b) Convert 12 ounces to pounds.

$12 \div 16 = \frac{3}{4}$ lb

Multiply the weight by the cost per pound.

$\frac{3}{4} \times \$1.67 \approx \$1.25$

It would cost about $1.25 for 12 ounces.

7. Calculate the weight of the non-mouldy oranges.

$\frac{3}{4} \times 10 = 7.5$ lb

The non-moldy oranges weigh 7.5 lb.

Calculate the true cost per pound by dividing the total cost by the weight of non-mouldy oranges.

$\$12.99 \div 7.5 \approx \$1.73$

The oranges cost about $1.73/lb.

4.3 Mass in the Système International

BUILD YOUR SKILLS, p. 196

1. Calculate the weight of 15 skids of boxes in kilograms.

   $15 \times 210 \text{ kg} = 3150 \text{ kg}$

   Convert to tonnes.

   $1 \text{ t} = 1000 \text{ kg}$

   $3150 \div 1000 = 3.15 \text{ t}$

   Add the weight of the skids to the weight of the truck.

   $3.15 + 2.6 = 5.75 \text{ t}$

   The total weight of the loaded truck is 5.75 tonnes.

2. Calculate the weight of the tomatoes Irène has already purchased, in grams.

   $256 + 452 + 158 + 320 = 1186 \text{ g}$

   Convert the total amount needed to grams.

   $1 \text{ kg} = 1000 \text{ g}$

   $1.6 \times 1000 = 1600 \text{ g}$

   Subtract the weight already purchased from the total weight needed.

   $1600 - 1186 = 414$

   Irène needs 414 g more tomatoes.

3. a) Calculate the cost of 1 g of salami.

   $\$1.79 \div 100 = \$0.0179$

   Multiply by 350 g.

   $350 \text{ g} \times \$0.0179/\text{g} = \$6.27$

   350 g costs about $6.27.

   b) Convert the cost per 100 g to cost per kg.

   $1 \text{ kg} = 1000 \text{ g}$

   $1 \text{ kg} = 10 \times 100 \text{ g}$

   The cost of 1 kg is equal to 10 times the cost per 100 g.

   $\$1.79 \times 10 = \$17.90$

   One kilogram costs $17.90.

4. Determine the conversion between grams and ounces.

   $1 \text{ kg} = 2.2 \text{ lb}$

   $1000 \text{ g} = 2.2 \text{ lb}$

   $1000 \text{ g} = 2.2 \text{ lb} \times 16 \text{ oz/lb}$

   $1000 \text{ g} = 35.2 \text{ oz}$

   $1 \text{ g} = (35.2 \div 1000) \text{ oz}$

   $1 \text{ g} = 0.0352 \text{ oz}$

   Use this figure to convert 180 g to ounces.

   $180 \text{ g} = 180 \times 0.0352$

   $180 \text{ g} \approx 6.3 \text{ oz}$

   180 g equals about 6.3 oz.

5. Calculate the number of grams in 1 lb.

$$1 \text{ kg} = 2.2 \text{ lb}$$
$$1000 \text{ g} = 2.2 \text{ lb}$$
$$(1000 \div 2.2) \text{ g} = (2.2 \div 2.2) \text{ lb}$$
$$454.5 \text{ g} \approx 1 \text{ lb}$$

Convert the baby's weight in pounds and ounces to pounds.

$$7 \text{ lb } 12 \text{ oz} = \left(7 + \frac{12}{16}\right) \text{ lb}$$
$$7 \text{ lb } 12 \text{ oz} = 7.75 \text{ lb}$$

Multiply by the number of grams per pound.

$$7.75 \text{ lb} \times 454.5 \text{ g/lb} \approx 3522.4 \text{ g}$$

The baby weighed about 3522.4 g.

6. Convert Chen's weight in kilograms to pounds.

$$1 \text{ kg} = 2.2 \text{ lb}$$
$$68 \text{ kg} = (68 \times 2.2) \text{ lb}$$
$$68 \text{ kg} = 149.6 \text{ lb}$$

Chen weighs 149.6 pounds.

7. Convert the cost per kg to cost per pound.

$$1 \text{ kg} = 2.2 \text{ lb}$$
$$\$9.74 \div 2.2 \approx \$4.43$$

One pound costs about $4.43.

8. Calculate the cost of 1 kg at $3.85/200 g.

$$1 \text{ kg} = 5 \times (200 \text{ g})$$
$$5 \times \$3.85 = \$19.25$$

Calculate the cost of 1 kg at $9.60/lb.

$$1 \text{ kg} = 2.2 \text{ lb}$$
$$2.2 \text{ lb} \times \$9.60/\text{lb} = \$21.12$$

200 grams at $3.85 is the better buy.

9. a) Convert Tom's weight to kilograms.

$$1 \text{ lb} = \frac{1}{2.2 \text{ kg}}$$
$$185 \times \frac{1}{2.2} \approx 84$$

Tom weighs about 84 kg.

Multiply Tom's weight by the dosage of medicine per kilogram.

$$0.05 \times 84 = 4.2$$

Tom should receive 4.2 mg of medicine.

b) Multiply the amount of medicine Tom needs, in mg, by the cost per mg.

$$4.2 \times \$1.95 = \$8.19$$

The medicine will cost $8.19.

PRACTISE YOUR NEW SKILLS, p. 200

1. Convert the weights between SI units.

a) $1 \text{ t} = 1000 \text{ kg}$
$2.5 \text{ t} = (2.5 \times 1000) \text{ kg}$
$2.5 \text{ t} = 2500 \text{ kg}$

b) $1 \text{ kg} = 1000 \text{ g}$
$2.8 \text{ kg} = (2.8 \times 1000) \text{ g}$
$2.8 \text{ kg} = 2800 \text{ g}$

c) $1 \text{ kg} = 1000 \text{ g}$
$1 \text{ g} = \frac{1}{1000} \text{ kg}$
$125 \text{ g} = \left(125 \times \frac{1}{1000}\right) \text{ kg}$
$125 \text{ g} = 0.125 \text{ kg}$

d) $1 \text{ g} = 0.001 \text{ kg}$
$2.4 \text{ g} = (2.4 \times 0.001) \text{ kg}$
$2.4 \text{ g} = 0.0024 \text{ kg}$

e) $1\text{ t} = 1000\text{ kg}$

$1\text{ kg} = 2.2\text{ lb}$

$1\text{ t} = (1000 \times 2.2)\text{ lb}$

$1\text{ t} = 2200\text{ lb}$

f) $1\text{ tn} = 2000\text{ lb}$

$1\text{ lb} = \frac{1}{2.2}\text{ kg}$

$1\text{ tn} = \left(2000 \times \frac{1}{2.2}\right)\text{ kg}$

$1\text{ tn} \approx 909\text{ kg}$

$3.6\text{ tn} \approx (3.6 \times 909)\text{ kg}$

$3.6\text{ tn} \approx 3272.4\text{ kg}$

2. Convert 1 tonne to tons.

$1\text{ tn} = 2000\text{ lb}$

$1\text{ lb} = \frac{1}{2.2}\text{ kg}$

$1\text{ tn} = \left(2000 \times \frac{1}{2.2}\right)\text{ kg}$

$1\text{ tn} = 909\text{ kg}$

$1\text{ t} = 1000\text{ kg}$

$1\text{ t} = \frac{1000}{909}\text{ tn}$

$1\text{ t} = 1.1\text{ tn}$

3. Convert the weights of the packages to grams.

$1.2 \times 1000 = 1200$

$0.75 \times 1000 = 750$

$1.5 \times 1000 = 1500$

Calculate the sum of the weights.

$1200 + 750 + 1500 = 3450\text{ g}$

The total weight of the packages of nuts is 3450 grams.

4. Calculate the total weight of the books, in kilograms.

$5\text{ boxes} \times 9.8\text{ kg/box} = 49.0\text{ kg}$

Calculate the weight of the truck, in kilograms.

$1.9\text{ t} \times 1000\text{ kg/t} = 1900\text{ kg}$

Add the weights of Win, his dog, the truck, and the books.

$78 + 18 + 1900 + 49 = 2045\text{ kg}$

The total weight of the loaded truck is 2045 kg.

5. Calculate the weight of 8 potatoes, in grams.

$8 \times 375 = 3000$

The potatoes weigh 3000 grams, or 3 kilograms.

Convert to pounds.

$1\text{ kg} = 2.2\text{ lb}$

$3\text{ kg} \times 2.2\text{ lb/kg} = 6.6\text{ lb}$

Karen will need 6.6 pounds of potatoes.

6. Calculate the cost of grass seed per pound.

$\$75.45 \div 10 \approx \$7.55$

To calculate the cost per kilogram, multiply by the number of pounds per kilogram.

$1\text{ kg} = 2.2\text{ lb}$

$2.2 \times \$7.55 = \$16.61$

One kilogram of grass seed will cost about $16.61.

7. Convert the weight of the ground beef to pounds.

$1.9\text{ kg} \times 2.2\text{ lb/kg} = 4.18\text{ lb}$

Divide by the weight of one hamburger, 0.25 lb.

$4.18 \div 0.25 = 16.72$

You can make about 16 quarter-pound hamburgers.

4.4 Making Conversions

BUILD YOUR SKILLS, p. 204

1. a) Divide the number of bushels by the conversion factor to determine the weight in tonnes.

$5 \div 73.487 \approx 0.0679 \text{ t}$

Convert to kilograms.

$1 \text{ t} = 1000 \text{ kg}$

$0.0679 \times 1000 \approx 67.9 \text{ kg}$

The weight is about 67.9 kilograms.

b) Convert the weight in kilograms to pounds.

$1 \text{ kg} = 2.2 \text{ lb}$

$67.9 \text{ kg} = (67.9 \times 2.2) \text{ lb}$

$67.9 \text{ kg} \approx 149.4 \text{ lb}$

The weight is about 149 pounds.

2. Calculate the number of units of weight per 1 bushel.

White beans:

$1 \div 36.744 \approx 0.0272$

1 bushel of white beans weighs 0.0272 units of weight.

Corn:

$1 \div 39.368 \approx 0.0254$

1 bushel of corn weighs 0.0254 units of weight.

White beans weigh more per unit of volume (bushel).

3. Multiply the earning per tonne by the conversion factor of 1 tonne/36.744 bushels.

$\$195.76/\text{t} \times \frac{1 \text{ t}}{36.744 \text{ bu}} \approx \$5.33/\text{bu}$

Jore earns $5.33/bu.

4. Convert the dimensions of the pile from feet to inches.

$8 \times 12 = 96$

$6 \times 12 = 72$

$5 \times 12 = 60$

Calculate the volume of the pile in cubic inches.

$96 \times 72 \times 60 = 414\,720 \text{ in}^3$

Divide the volume of the pile by the number of cubic inches per bushel to find the number of bushels.

$414\,720 \div 2220 \approx 187$

There are approximately 187 bushels in the pile.

5. Divide the number of bushels by the number of bushels per tonne.

$900 \text{ bu} \div 39.368 \text{ bu/t} \approx 22.9 \text{ t}$

The weight of rye is about 22.9 tonnes.

6. Calculate the weight of one bushel of wheat and of sunflower seeds.

   Wheat:

   $1 \text{ bu} \div 36.744 \text{ bu/t} \approx 0.0272 \text{ t}$

   One bushel of wheat weighs about 0.0272 tonnes.

   Sunflower seeds:

   $1 \text{ bu} \div 73.487 \text{ bu/t} \approx 0.0136 \text{ t}$

   One bushel of sunflower seeds weighs about 0.0136 tonnes.

   Wheat is approximately twice as heavy as sunflower seeds, per volume unit.

7. Calculate how many ounces of chicken Alphonse needs.

   $7 \text{ oz} \times 14 = 98 \text{ oz}$

   Convert the weight in ounces to grams.

   $1 \text{ oz} \approx 28.3 \text{ g}$

   $98 \text{ oz} \approx (98 \times 28.3) \text{ g}$

   $98 \text{ oz} \approx 2773.4 \text{ g}$

   Convert grams to kilograms.

   $2773.4 \div 1000 = 2.7734 \text{ kg}$

   Alphonse will need to buy about 2.8 kg of chicken.

8. Calculate the total weight of the sandstone in pounds.

   $$70 \text{ cu ft} \times \frac{150 \text{ lb}}{\text{cu ft}} = 10\,500 \text{ lb}$$

   Convert the weight of the sandstone to tonnes.

   $$1 \text{ t} \approx 2200 \text{ lb}$$

   $$10\,500 \text{ lb} \approx (10\,500 \div 2200) \text{ t}$$

   $$10\,500 \text{ lb} \approx 4.8 \text{ t}$$

   The sandstone weighs about 4.8 t, which is less than the 5 t lifting limit of the crane. Yes, the crane can be used to load the container onto the train.

9. Convert the weight of the maple syrup to kilograms.

   $$1 \text{ lb} = \frac{1}{2.2} \text{ kg}$$

   $$3 \text{ lb} = \left(3 \times \frac{1}{2.2}\right) \text{ kg}$$

   $$3 \text{ lb} \approx 1.4 \text{ kg}$$

   Calculate the total weight of the packages of salmon.

   $3 \times 100 = 300 \text{ g}$

   Convert to kilograms.

   $300 \div 1000 = 0.3 \text{ kg}$

   Calculate the total weight of the package.

   $0.3 + 1.4 = 1.7 \text{ kg}$

   The total weight of the package is 1.7 kg, which is less than the 2 kg limit. Therefore, yes, Josephine will be able to send her package for the cheaper rate.

PRACTISE YOUR NEW SKILLS, p. 207

1. Convert the dimensions of the bin from feet to inches.

   $8 \times 12 = 96$

   $4 \times 12 = 48$

   Calculate the volume of the bin in cubic inches.

   $96 \times 96 \times 48 = 442\,368 \text{ cu in}$

   Divide the volume of the bin by the number of cubic inches per bushel to find the number of bushels.

   $442\,368 \div 2220 \approx 199.3$

   There are approximately 199 bushels of grain in the bin.

2. Calculate the weight of the canola.

   $230 \text{ bu} \times \frac{1 \text{ t}}{44.092 \text{ bu}} \approx 5.216 \text{ t}$

   Convert to kilograms.

   $5.216 \times 1000 = 5216 \text{ kg}$

   The canola weighs about 5216 kg.

   This is over the limit of 5000 kg, so the load cannot be safely carried.

3. Convert 1 ton (tn) to kilograms.

   $1 \text{ tn} \approx 2000 \text{ lb}$

   $1 \text{ lb} \approx \frac{1}{2.2} \text{ kg}$

   $1 \text{ tn} \approx \left(2000 \times \frac{1}{2.2}\right) \text{ kg}$

   $1 \text{ tn} \approx 909.1 \text{ kg}$

   There are approximately 909 kg in 1 ton.

4. Convert the average weight of 1 adult to pounds.

   $1 \text{ kg} = 2.2 \text{ lb}$

   $80 \text{ kg} = (2.2 \times 80) \text{ lb}$

   $80 \text{ kg} = 176 \text{ lb}$

   Divide the capacity of the elevator by the average weight of one adult.

   $1400 \div 176 \approx 7.955$

   The elevator can safely carry about 8 adults.

5. Calculate the volume of the box in cm^3.

   $V = \ell wh$

   $V = (10)(5)(3)$

   $V = 150 \text{ cm}^3$

   Calculate the number of mL in the box.

   $1000 \text{ cm}^3 = 1 \text{ L}$

   $1000 \text{ cm}^3 = 1000 \text{ mL}$

   $150 \text{ cm}^3 = 150 \text{ mL}$

   There are 150 mL in the box.

6. Calculate the area of the field in square metres.

   $A = \ell w$

   $A = (620)(380)$

   $A = 235\,600 \text{ m}^2$

   Convert the area from square metres to hectares.

   $235\,600 \div 10\,000 = 23.56$

   The field is approximately 23.6 ha.

CHAPTER TEST, p. 210

1. Use the formulas for converting between degrees Fahrenheit and degrees Celsius.

a) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(25) + 32$

$F = 45 + 32$

$F = 77$

25°C = 77°F

b) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(25 - 32)$

$C = \frac{5}{9}(-7)$

$C \approx -3.9$

25°F = –3.9°C

c) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(-40) + 32$

$F = -72 + 32$

$F = -40$

–40°C = –40°F

d) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(-25 - 32)$

$C = \frac{5}{9}(-57)$

$C \approx -31.7$

–25°F = –31.7°C

e) $C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(405 - 32)$

$C = \frac{5}{9}(373)$

$C \approx 207.2$

405°F = 207.2°C

f) $F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(45) + 32$

$F = 81 + 32$

$F = 113$

45°C = 113°F

2. Use the formula for converting from degrees Celsius to degrees Fahrenheit.

Lower temperature limit:

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(500) + 32$

$F = 900 + 32$

$F = 932$

500°C = 932°F

Upper temperature limit:

$F = \frac{9}{5}C + 32$

$F = \frac{9}{5}(20\,000) + 32$

$F = 36\,000 + 32$

$F = 36\,032$

The temperature ranges from 932°F to 36 032° F.

3. Convert between imperial units.

a) 1 lb = 16 oz

12 lb 4 oz = ((12 × 16) + 4) oz

12 lb 4 oz = (192 + 4) oz

12 lb 4 oz = 196 oz

b) 1 tn = 2000 lb

2.3 tn = (2.3 × 2000) lb

2.3 tn = 4600 lb

c) 1 tn = 2000 lb

5284 lb = (4000 + 1284) lb

5284 lb = 2 tn 1284 lb

d) $1 \text{ lb} = 16 \text{ oz}$

$3\frac{3}{4} \text{ lb} = (3.75 \times 16) \text{ oz}$

$3\frac{3}{4} \text{ lb} = 60 \text{ oz}$

e) $16 \text{ oz} = 1 \text{ lb}$

$165 \text{ oz} = (165 \div 16) \text{ lb}$

$165 \text{ oz} \approx 10.3 \text{ lb}$

f) $1000 \text{ g} = 2.2 \text{ lb}$

$1 \text{ g} = 0.0022 \text{ lb}$

$454 \text{ g} = (454 \times 0.0022) \text{ lb}$

$454 \text{ g} \approx 1 \text{ lb}$

4. Multiply the number of tons of paper saved by the number of trees saved per ton.

$8254 \text{ tn} \times 17 \text{ trees/tn} = 140\,318 \text{ trees}$

140 318 trees are saved.

5. Calculate the weight of the trout before the waste was removed. Add pounds to pounds, and ounces to ounces.

$3 \text{ lb } 5 \text{ oz} + 2 \text{ lb } 12 \text{ oz} + 3 \text{ lb } 8 \text{ oz} = 8 \text{ lb } 25 \text{ oz}$

Convert 25 ounces to pounds and ounces.

$25 \text{ oz} = (16 + 9) \text{ oz}$

$25 \text{ oz} = 1 \text{ lb } 9 \text{ oz}$

Original weight of trout = 8 lb 25 oz

Original weight of trout = 8 lb + 1 lb 9 oz

Original weight of trout = 9 lb 9 oz

The original weight of the trout was 9 lb 9 oz.

Subtract the weight of usable trout from the original weight.

$9 \text{ lb } 9 \text{ oz} - 8 \text{ lb } 2 \text{ oz} = 1 \text{ lb } 7 \text{ oz}$

About 1 lb 7 oz was waste.

6. Calculate the weight of the raw silk that Katharine bought.

$12.5 \text{ yd} \times \frac{38 \text{ lb}}{100 \text{ yd}} = 4.75 \text{ lb}$

Calculate the weight of the Habutai silk that Katharine bought.

$12.5 \text{ yd} \times \frac{12 \text{ lb}}{100 \text{ yd}} = 1.5 \text{ lb}$

Add the weights of the two types of silk.

$1.5 + 4.75 = 6.25 \text{ lb}$

$6.25 \text{ lb} = 6 \text{ lb} + (0.25 \times 16) \text{ oz}$

$6.25 \text{ lb} = 6 \text{ lb } 4 \text{ oz}$

The total weight is 6 lb 4 oz.

7. Divide 1 kg (1000 g) by the weight of 1 egg.

$1000 \div 70 \approx 14.3$

Approximately 14 eggs are needed.

8. Calculate the total weight of the tiles in pounds.

$12 \times 288 = 3456 \text{ lb}$

Convert to kilograms.

$1 \text{ lb} = \frac{1}{2.2} \text{ kg}$

$3456 \text{ lb} = \left(3456 \times \frac{1}{2.2}\right) \text{ kg}$

$3456 \text{ lb} \approx 1570.9$

The weight is about 1571 kg.

9. Multiply the number of bushels by 1 t/36.744 bu.

$45 \text{ bu} \times \frac{1 \text{ t}}{36.744 \text{ bu}} \approx 1.2 \text{ t}$

The weight is approximately 1.2 tonnes.

Chapter 5

Angles and Parallel Lines

5.1 Measuring, Drawing, and Estimating Angles

BUILD YOUR SKILLS, p. 215

1. a) An angle of 68° is angle because it is between 0° and 90°.

   b) An angle of 215° is reflex because it is between 180° and 360°.

   c) An angle of 91° is obtuse because it is between 90° and 180°.

   d) An angle of 32° is acute because it is between 0° and 90°.

   e) An angle of 180° is straight.

   f) An angle of 99° is obtuse because it is between 90° and 180°.

   g) An angle of 195° is reflex because it is between 180° and 360°.

   h) An angle of 265° is reflex because it is between 180° and 360°.

2. ∠A measures about 40°.

   ∠B measures about 75°.

   ∠C measures about 65°.

   ∠D measures about 10°.

3. The angle is about 20°.

4. ∠A measures about 140° or 150°.

   ∠B measures about 230° or 240°.

   ∠C measures about 170°.

   ∠D measures about 330°.

5. The angle between the buildings is larger than 90° and smaller than 180°. It is about 10° larger than a right angle, so it is about 100°.

6. To find the complement, subtract the angle from 90°. If the angle is greater than 90°, it does not have a complement.

   To find the supplement, subtract the angle from 180°. If the angle is greater than 180°, it does not have a supplement.

ANGLE COMPLEMENTS AND SUPPLEMENTS

Angle	*Complement*	*Supplement*
45°	90° – 45° = 45°	180° – 45° = 135°
78°	90° – 78° = 12°	180° – 78° = 102°
112°	Does not exist, because angle is greater than 90°.	180° – 112° = 68°
160°	Does not exist, because angle is greater than 90°.	180° – 160° = 20°
220°	Does not exist, because angle is greater than 90°.	Does not exist, because angle is greater than 180°.

7. a) Complementary angles add up to 90°. Calculate what size of angle is complementary to 58°.

$$58° + x = 90°$$
$$x = 90° - 58°$$
$$x = 32°$$

The angle is 32°.

b) Supplementary angles add up to 180°. Calculate what size of angle is supplementary to 32°.

$$180° - 32° = 148°$$

The supplement of the angle is 148°.

8. a) Calculate what size of angle is complementary to 0°.

$$90° - x = 0$$
$$90° = x$$

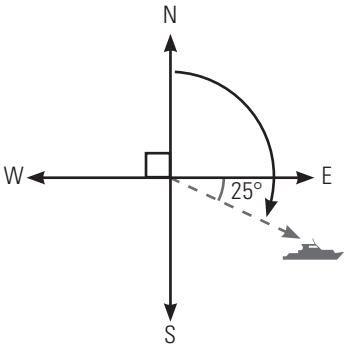
The angle is 90°.

b) Calculate what size of angle is supplementary to 90°.

$$180° - 90° = 90°$$

The supplement of the angle is 90°.

9.

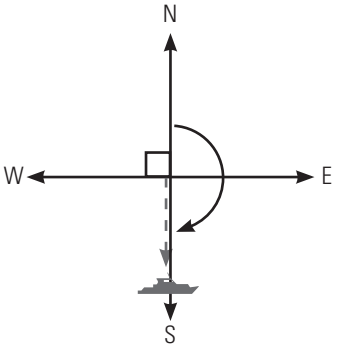


To calculate the true bearing, measure the angle from the vertical.

$$90° + 25° = 115°$$

The true bearing of the boat is 115°.

10.

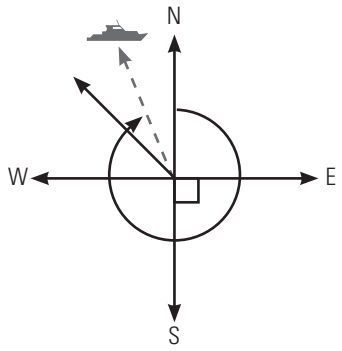


To calculate the true bearing, measure the angle from the vertical.

$$90° + 90° = 180°$$

The true bearing of the boat is 180°.

11.



The true bearing of the boat can be calculated by breaking the angle into parts. First, calculate the bearing of directly northwest.

$270° + 45° = 315°$

The remaining angle is half of a 45° angle.

$\frac{1}{2} \times 45° = 22.5°$

Add to calculate the true bearing of the boat.

$315° + 22.5° = 337.5°$

The true bearing is 337.5°.

PRACTISE YOUR NEW SKILLS, p. 222

1. a) 56° is an acute angle.

   b) 91° is an obtuse angle.

   c) 270° is a reflex angle.

   d) 170° is an obtuse angle.

   e) 43° is an acute angle.

   f) 192° is a reflex angle.

2. a) The angle is slightly greater than 60°, about 65°.

   b) The angle is slightly greater 50°.

   c) The angle is about 45°.

   d) Angle x is about 120°, and angle y is about 60°.

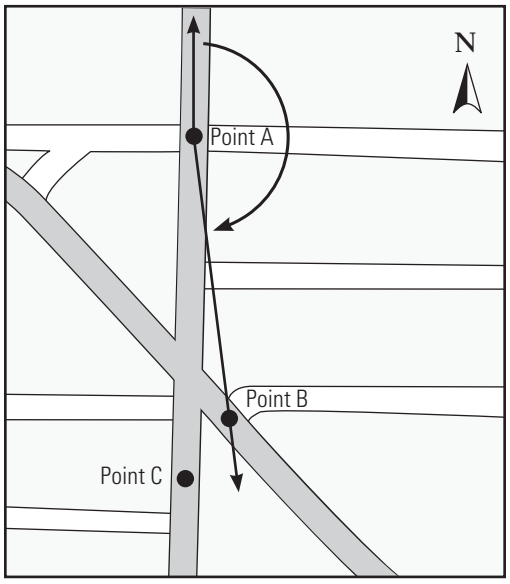
3. When a rectangle is cut diagonally, two identical triangles are formed. In each triangle, the sum of the angles is 180°, one of the angles is a right angle, and the other angle is 65°.

   $180° - 90° - 65° = 25°$

   The other acute angle is 25°.

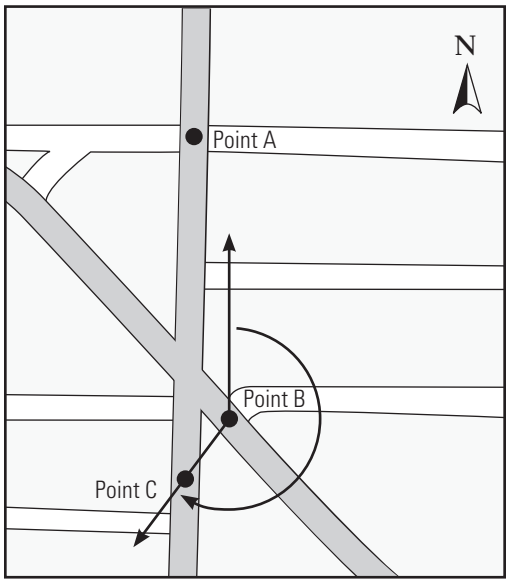
4. ∠A is more than 90°; it is about 110°.

5. a)



Draw a vertical line from Point A, and a line connecting Points A and B. Measure the angle formed (clockwise) by these two lines. The true bearing from Point A to Point B is 175°.

b)



Draw a vertical line from Point B, and a line connecting Points B and C. Measure the angle formed (clockwise) by the two lines. The true bearing from Point B to Point C is 220°.

5.2 Angle Bisectors and Perpendicular Lines

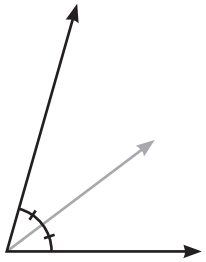
BUILD YOUR SKILLS, p. 226

1. To calculate the measure of the resulting angles after one angle is bisected, divide the measure of the angle by 2.

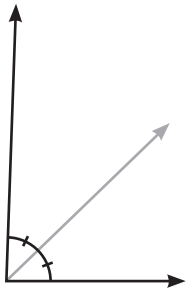
   $90° \div 2 = 45°$

   Each angle is 45°.

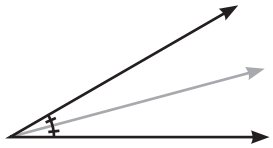
2. a)



   b)



   c)



3. The original angle will be the sum of the resulting angles.

   $78° + 78° = 156°$

   The original angle was 156°.

4. Let the original angle be x.

$$\frac{x}{2} = 180 - x$$

$$2\left(\frac{x}{2}\right) = 2(180 - x)$$

$$x = 360 - 2x$$

$$3x = 360$$

$$x = 120$$

   The original angle was 120°.

5. Find the complement of the angle.

   $90° - 86.7° = 3.3°$

   The carpenter must move the leg by 3.3°.

6. Use a protractor to measure the angle.

   The angle measure is approximately 35°.

7. *a*: $180° - 60° - 75° = 45°$

   b: $180° - 75° - 55° = 50°$

   c: $180° - 50° - 75° = 55°$

   d: $180° - 75° - 75° = 30°$

PRACTISE YOUR NEW SKILLS, p. 229

1. a) The angles formed are not quite 90°, so the lines are not perpendicular.

   b) The angle is about 110°, so the lines are not perpendicular.

   c) The angles formed are 90°, so the lines are perpendicular.

   d) The angles is 90°, so the lines are perpendicular.

2. To find the complement, subtract the angle from 90°. If the angle is greater than 90°, it does not have a complement.

   To find the supplement, subtract the angle from 180°. If the angle is greater than 180°, it does not have a supplement.

   To find the resulting angle measure after the angle is bisected, divide the angle by 2.

ANGLE CALCULATIONS

Angle	*Complement*	*Supplement*	*Resulting angle measure after the angle is bisected*
73°	17°	107°	36.5°
78°	12°	102°	39°
15°	75°	165°	7.5°
48°	42°	132°	24°
90°	0°	90°	45°
68°	22°	112°	34°
41°	49°	139°	20.5°
136°	n/a	44°	68°
80°	10°	100°	40°
254°	n/a	n/a	127°

3. A complete circle is 360°. The inner vertex has the following angles:

$$135° + 90° + 90° + y + y = 360°$$
$$315° + 2y = 360°$$
$$2y = 360° - 315°$$
$$2y = 45°$$
$$y = 22.5°$$

The sum of the angles in a triangle is 180°. Therefore:

$$x = 180° - 90° - 22.5°$$
$$x = 67.5°$$

4. a) y is the supplement of 70°.

$$y = 180° - 70°$$
$$y = 110°$$

x is vertically opposite the 70° angle, and so is equal to it.

$x = 70°$

x and y are supplementary.

   b) Angle x is the measure of the resulting angles after the 144° angle has been bisected.

$$x = \frac{1}{2} \times 144°$$
$$x = 72°$$

   c) x is the supplement of 81°.

$$180° - 81° = 99°$$

   d) Angle x and the 115° angle form a circle.

$$x = 360° - 115°$$
$$x = 245°$$

5. The king post bisects the angle at the peak of the roof. The measure of the angle formed by the rafter and the king post is the resulting measure after the 135° angle has been bisected.

   $135° \div 2 = 67.5°$

   The angle formed by the rafter and the king post is 67.5°.

5.3 Non-Parallel Lines and Transversals

BUILD YOUR SKILLS, p. 233

1. a) ∠7 and ∠8 are alternate interior angles.

   b) ∠2 and ∠7 are corresponding angles.

   c) ∠19 and ∠6 are exterior angles on the same side of the transversal.

   d) ∠5 and ∠7 are interior angles on the same side of the transversal.

2. a) ∠6 is the alternate exterior angle to ∠2.

   b) ∠3 is an interior angle on the same side of the transversal to ∠7.

   c) ∠3 is an alternate interior angle to ∠4.

   d) ∠3 is a corresponding angle to ∠5.

3. a) Angles corresponding to ∠1:

   ∠7, using lines ℓ_3 and ℓ_4 with transversal ℓ_1

   ∠3, using lines ℓ_1 and ℓ_2 with transversal ℓ_3

   b) Interior angle on the same side of the transversal as ∠10:

   ∠4, using lines ℓ_3 and ℓ_4 with transversal ℓ_2

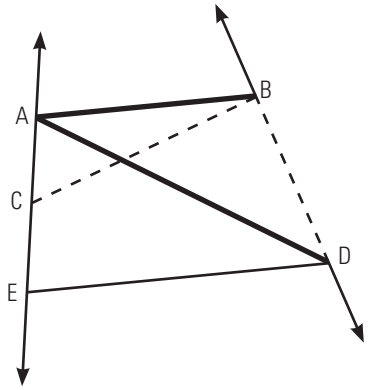
   c) Alternate interior angle to ∠5:

   ∠10, using lines ℓ_3 and ℓ_4 with transversal ℓ_2

   d) Two interior angles on the same side of the transversal as ∠8:

   ∠5, using lines ℓ_3 and ℓ_4 with transversal ℓ_2

   ∠7, using lines ℓ_1 and ℓ_2 with transversal ℓ_4

4. 

   CB and BD intersect AB and AD, because they each intersect AB and AD at two different points.

   AE cannot be a transversal of both AB and AD, because it intersects both lines at the same place, point A.

   ED cannot be a transversal of both AB and AD, because it intersects both lines at the same place, point D.

5. Line t cannot be a transversal because it does not pass through two distinct points. It is concurrent to ℓ_1 and ℓ_2 because they all pass through the same point.

6. t and ℓ_3 are intersected by ℓ_1 and ℓ_2.

PRACTISE YOUR NEW SKILLS, p. 236

1. a) Alternate interior angles:

   ∠3 and ∠5

   ∠2 and ∠8

   b) Corresponding angles:

   ∠1 and ∠5

   ∠2 and ∠6

   ∠3 and ∠7

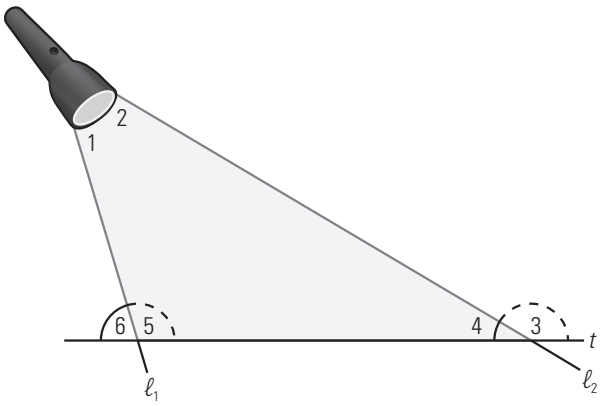
   ∠4 and ∠8

   c) Interior angles on the same side of the transversal:

   ∠2 and ∠5

   ∠3 and ∠8

2.



There are two pairs of corresponding angles: ∠3 and ∠5, and ∠4 and ∠6.

3. a) ℓ_3 is the transversal that makes ∠1 and ∠2 corresponding angles for ℓ_1 and ℓ_2.

   b) ℓ_4 is the transversal that makes ∠3 and ∠4 alternate interior angles for ℓ_1 and ℓ_2.

4. ∠3 and the 85° angle are supplementary.

   180° − 85° = 95°

   ∠4 and the 112° angle are supplementary.

   180° − 112° = 68°

   ∠5 and ∠4 are supplementary.

   180° − 68° = 112°

   Other angles:

   Sum of all interior angles:

   interior angles = 85° + ∠3 + ∠4 + ∠5

   interior angles = 85° + 95° + 68° + 112°

   interior angles = 360°

   Note:

   ∠1: 180° − 85° = 95°

   ∠2: 85°

   ∠6: 180° − 112° = 68°

5. $\angle 1$ is supplementary to the 120° angle.

   $\angle 1 = 180° - 120°$

   $\angle 1 = 60°$

   $\angle 2$ is vertically opposite the 120° angle, and so is equal to it.

   $\angle 2 = 120°$

   $\angle 3$ is supplementary to the 120° angle. It is also vertically opposite $\angle 1$, and so is equal to it.

   $\angle 3 = \angle 1$

   $\angle 3 = 60°$

   $\angle 4$ is supplementary to the 70° angle.

   $\angle 4 = 180° - 70°$

   $\angle 4 = 110°$

   $\angle 5$ is vertically opposite the 70° angle, and so is equal to it.

   $\angle 5 = 70°$

   $\angle 6$ is supplementary to the 70° angle. It is also vertically opposite $\angle 4$, and so is equal to it.

   $\angle 6 = \angle 4$

   $\angle 6 = 110°$

5.4 Parallel Lines and Transversals

BUILD YOUR SKILLS, p. 240

1. ∠1 is supplementary to the 71° angle, because interior angles on the same side of the transversal are supplementary.

   ∠1 = 180° – 71°

   ∠1 = 109°

   ∠2 is supplementary to the 118° angle.

   ∠2 = 180° – 118°

   ∠2 = 62°

   ∠3 corresponds to the 118° angle, and so is equal to it.

   ∠3 = 118°

   ∠4 corresponds to ∠2, and so is equal to it. It is also supplementary to ∠3.

   ∠4 = 180° – 118°

   ∠4 = 62°

2. ∠1 is supplementary to the 68° angle.

   ∠1 = 180° – 68°

   ∠1 = 112°

   ∠2 is an alternate interior angle to the 68° angle, and so is equal to it.

   ∠2 = 68°

   ∠3 is equal to ∠2, based on the properties of isosceles trapezoids.

   ∠3 = 68°

   ∠4 is equal to ∠1, based on the properties of isosceles trapezoids.

   ∠4 = 112°

3. To solve for ∠A, consider the parallel lines BC and AD, intersected by the transversal AB. ∠A is an interior angle on the same side of the transversal as ∠B, and so is supplementary to it.

   ∠A = 180° – ∠B

   ∠A = 180° – 74°

   ∠A = 106°

   To solve for ∠C, consider parallel lines AB and CD, intersected by the transversal BC. ∠C is an interior angle on the same side of the transversal as ∠B, and so is supplementary to it.

   ∠C = 180° – ∠B

   ∠C = 180° – 74°

   ∠C = 106°

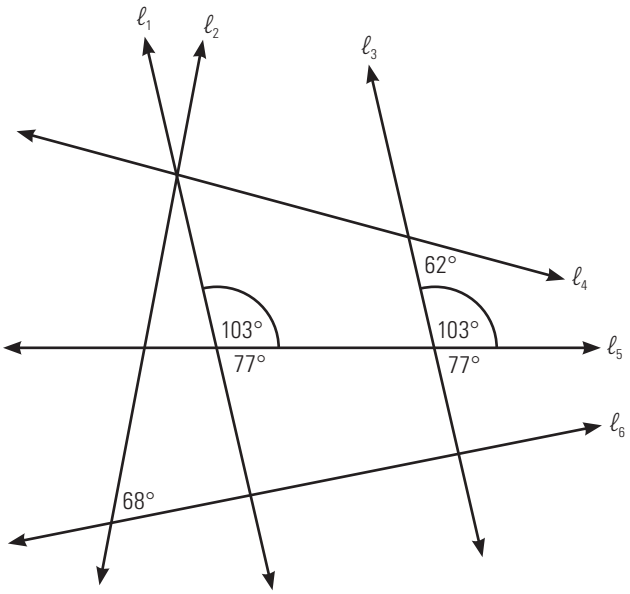
   To solve for ∠D, consider parallel lines AB and CD, intersected by the transversal AD. ∠D is an interior angle on the same side of the transversal as ∠A, and so is supplementary to it.

   ∠D = 180° – ∠A

   ∠D = 180° – 106°

   ∠D = 74°

4. Consider lines ℓ_1 and ℓ_3, and the transversal ℓ_5. The angle formed by ℓ_3 and ℓ_5 that corresponds to the marked 103° angle is also 103°, because it is supplementary to the marked 77° angle. Since corresponding angles are equal, ℓ_1 and ℓ_3 are parallel.



5. For ℓ_1 and ℓ_3 to be parallel, the angle vertically opposite ∠1—and therefore also ∠1—must be supplementary to the 123° angle.

   ∠1 = 180° – 123°

   ∠1 = 57°

6. For the two pipes to be parallel, the interior angles (currently marked as 106° and 78°) must be supplementary. If the angle formed by Pipe 1 is correct at 106°, then calculate what angle must be formed by Pipe 2.

   180° – 106° = 74°

   Pipe 2 must form a 74° angle with the dotted line, so it needs to be moved by 4°.

7. **SOLVING ANGLE MEASURES**

Angle measure	*Reason*
∠1 = 54°	It is vertically opposite the 54° angle.
∠2 = 54°	It is an alternate interior angle to ∠1.
∠3 = 97°	It is supplementary to the 83° angle.
∠4 = 83°	It is an interior angle on the same side of the transversal as ∠3, so is supplementary to it. Also, it is vertically opposite 83°.

8. ∠1 is an interior angle on the same side of the transversal (the shed roof) as the 58° angle, and so is supplementary to it.

   ∠1 = 180° – 58°

   ∠1 = 122°

   ∠2 is an interior angle on the same side of the transversal (the ground) as the 90° angle, and so is supplementary to it.

   ∠2 = 180° – 90°

   ∠2 = 90°

9. ∠1 and ∠2 are interior angles on the same side of the transversal, and so they must be supplementary.

   ∠2 = ∠180° – ∠1

   ∠2 = 180° – 53°

   ∠2 = 127°

PRACTISE YOUR NEW SKILLS, p. 246

1. ∠1 is supplementary to the 112° angle.

   ∠1 = 180° – 112°

   ∠1 = 68°

   ∠2 is supplementary to the 112° angle.

   ∠2 = 180° – 112°

   ∠2 = 68°

   (∠2 is also vertically opposite ∠1, and so is equal to it.)

   ∠3 is an interior angle on the same side of the transversal as 112°, so it is supplementary to it.

   ∠3 = 180° – 112°

   ∠3 = 68°

   (∠3 is also an alternate interior angle to ∠2, and so is equal to it.)

   ∠4 is supplementary to the 60° angle.

   ∠4 = 180° – 60°

   ∠4 = 120°

   ∠5 is vertically opposite ∠3, and so is equal to it.

   ∠5 = 68°

2. ∠1 is an alternate interior angle to the 57° angle, and so it equal to it.

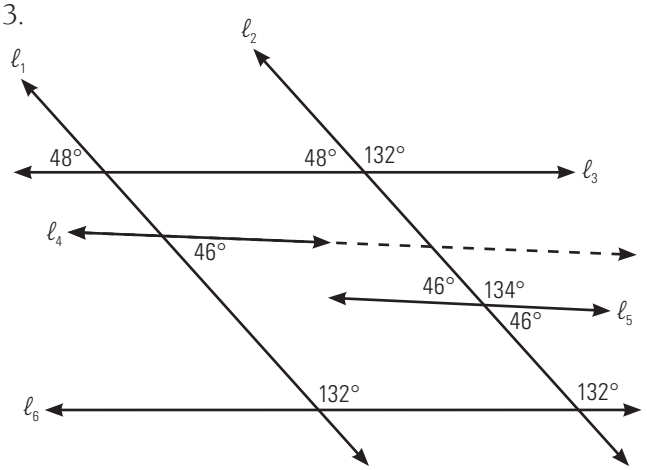
   ∠1 = 57°

   ∠2 is complementary to ∠1.

   ∠2 = 90° – 57°

   ∠2 = 33°

3.



   ℓ_1 is parallel to ℓ_2 because, with transversal ℓ_3, the corresponding angles are equal. (132° and 48° are supplementary.)

   ℓ_3 is parallel to ℓ_6 because, with transversal ℓ_2, two corresponding angles are 132°.

   ℓ_4 is parallel to ℓ_5 because, with transversals ℓ_1 and ℓ_2, the corresponding angles are equal.

4. The top of stud A must be moved 1° to the right, to change the 89° angle to 90°.

   The top of stud B must be moved 1° to the left, to change the 91° angle to 90°.

   The top of stud D must be moved 1° to the left, to change the 134° angle to 135°.

CHAPTER TEST, p. 248

1. a) The angle is obtuse.

   b) The angle is acute.

   c) The angle is reflex.

   d) The angle is straight.

   e) The angle is right.

   f) The angle is obtuse.

2. **ANGLE CALCULATIONS**

Angle	*Complement*	*Supplement*	*Resulting angle measure after the angle is bisected*
58°	32°	122°	29°
94°	Does not exist, because angle is greater than 90°.	86°	47°
87°	Does not exist, because angle is greater than 90°.	93°	43.5°
153°	Does not exist, because angle is greater than 90°.	27°	76.5°
65°	25°	115°	32.5°

3. a) ∠3 and ∠5 are alternate interior angles.

   b) ∠4 and ∠5 are interior angles on the same side of the transversal.

   c) ∠1 and ∠3 are vertically opposite angles.

   d) ∠2 and ∠6 are corresponding angles.

4. ∠2 is supplementary to the 62° angle.

   ∠2 = 180° – 62°

   ∠2 = 118°

   ∠4 is vertically opposite the 62° angle.

   ∠4 = 62°

   (∠4 is also supplementary to ∠2.)

   ∠3 is an alternate interior angle to the 62° angle.

   ∠3 = 62°

   (∠3 is also supplementary to ∠2 because it is an interior angle on the same side of the transversal.)

   ∠1 is an interior angle on the same side of the transversal as the 67° angle, so is supplementary to it.

   ∠1 = 180° – 67°

   ∠1 = 113°

5. ∠1 is an interior angle on the same side of the transversal (line AD) as ∠D (68°), so is supplementary to it.

   ∠1 = 180° – 68°

   ∠1 = 112°

   ∠2 is the corresponding angle to ∠C (75°), given transversal AC.

   ∠2 = 75°

6. The sum of the angles of triangle PQS must be equal to 180°. Use this to calculate ∠1.

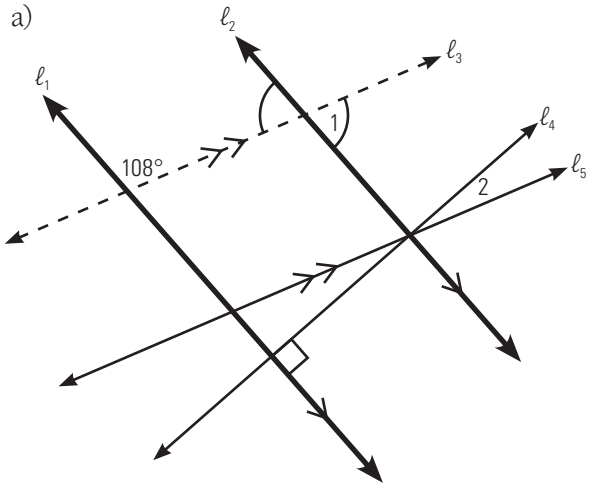
   ∠1 = 180° – 133° – 24°

   ∠1 = 23°

   ∠ 2 is an alternate interior angle to ∠1 (using transversal QS). Therefore, ∠2 must be equal to ∠1.

   ∠2 = 23°

7. a)

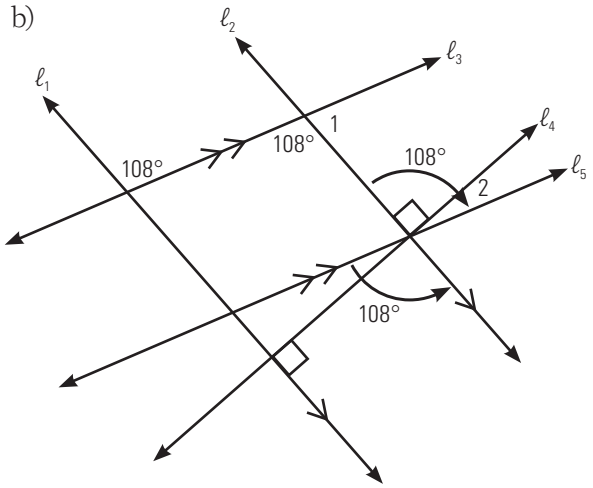


Using lines ℓ_1 and ℓ_2, and transversal ℓ_3, the angle vertically opposite $\angle 1$ is complementary to the 108° angle, because they are interior angles on the same side of the transversal. Therefore, $\angle 1$ is also complementary to 108°.

$\angle 1 = 180° - 108°$

$\angle 1 = 72°$

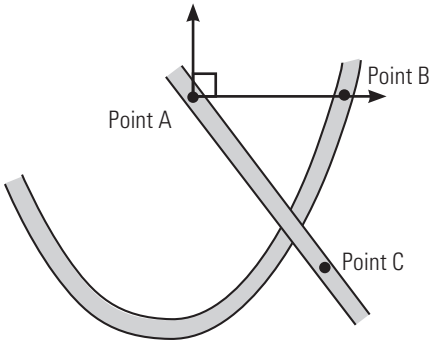
b)



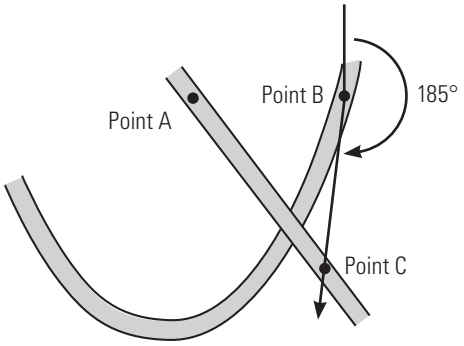
$\angle 2 = 108° - 90°$

$\angle 2 = 18°$

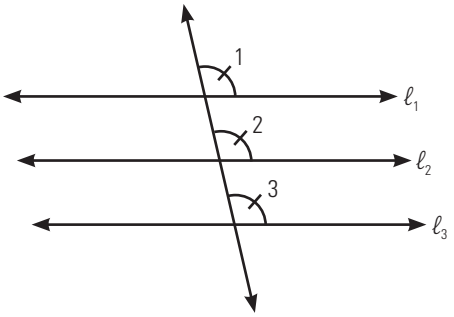
8. a) To determine the true bearing from point A to point B, draw a vertical line from point A, and a line connecting points A and B. Measure the angle formed (clockwise) by the two lines using a protractor. The true bearing from point A to point B is 90°.



b) To determine the true bearing from point B to point C, first draw a vertical line from point B, and a line connecting points B and C. Measure the angle formed (clockwise) by the two lines using a protractor. The true bearing from point B to point C is about 185°.



9.



Fred is correct. $\angle 1$ is equal to $\angle 2$ and ℓ_1 is parallel to ℓ_3 since the corresponding angles are equal.

10. $\angle 2 = \angle 7$

Using ℓ_1 and ℓ_2, and transversal t_1, $\angle 2$ and $\angle 7$ are alternate interior angles.

$\angle 5 = \angle 7$

Using ℓ_1 and ℓ_2, and transversal t_1, $\angle 5$ and $\angle 7$ are corresponding angles.

$\angle 4 = \angle 7$

Using ℓ_1 and ℓ_3, and transversal t_1, $\angle 4$ and $\angle 7$ are alternate interior angles.

Chapter 6
Similarity of Figures

6.1 Similar Polygons

BUILD YOUR SKILLS, p. 257

1. If the figures are similar, the proportions between the side lengths must be equal.

$$\frac{LP}{AE} = \frac{LM}{AB}$$

$$\frac{LP}{21} = \frac{5}{15}$$

$$15 \times \cancel{21} \times \frac{LP}{\cancel{21}} = \frac{5}{\cancel{15}} \times 21 \times \cancel{15}$$

$$15 \times LP = 5 \times 21$$

$$\frac{15 \times LP}{15} = \frac{105}{15}$$

$$LP = 7 \text{ cm}$$

$$\frac{OP}{DE} = \frac{LM}{AB}$$

$$\frac{OP}{18} = \frac{5}{15}$$

$$15 \times \cancel{18} \times \frac{OP}{\cancel{18}} = \frac{5}{\cancel{15}} \times 18 \times \cancel{15}$$

$$15 \times OP = 5 \times 18$$

$$\frac{15 \times OP}{15} = \frac{90}{15}$$

$$OP = 6 \text{ cm}$$

$$\frac{ON}{DC} = \frac{LM}{AB}$$

$$\frac{ON}{12} = \frac{5}{15}$$

$$15 \times \cancel{12} \times \frac{ON}{\cancel{12}} = \frac{5}{\cancel{15}} \times 12 \times \cancel{15}$$

$$15 \times ON = 5 \times 12$$

$$\frac{15 \times ON}{15} = \frac{60}{15}$$

$$ON = 4 \text{ cm}$$

Since BC is equal to DE, MN will be equal to OP. Therefore, MN is 6 cm.

ALTERNATIVE SOLUTION

Since LM is equal to $\frac{1}{3}$ AB, then each side of the second figure will be $\frac{1}{3}$ the length of the corresponding side of the first figure.

$$LP = \frac{1}{3} AE$$

$$LP = \frac{1}{3} \times 21$$

$$LP = 7 \text{ cm}$$

$$OP = \frac{1}{3} DE$$

$$OP = \frac{1}{3} \times 18$$

$$OP = 6 \text{ cm}$$

$$ON = \frac{1}{3}CD$$

$$ON = \frac{1}{3} \times 12$$

$$ON = 4 \text{ cm}$$

$$MN = \frac{1}{3}BC$$

$$MN = \frac{1}{3} \times 18$$

$$MN = 6 \text{ cm}$$

2. The scale on the blueprint is 1 inch:8 feet. To calculate the dimensions of the room, multiply each measurement on the blueprint by 8 and change the units from inches to feet.

$$2.75'' : (2.75 \times 8)'$$

$$2.75'' : 22'$$

$$1.5'' : (1.5 \times 8)'$$

$$1.5'' : 12'$$

The room is 22 feet by 12 feet.

3. Similar polygons must have sides in the same proportion.

ABCD is similar to QRST. The corresponding sides are in the same proportion.

$$\frac{AB}{QR} = \frac{BC}{RS} = \frac{CD}{ST} = \frac{DA}{TQ}$$

EFGH is similar to LKJI. The corresponding sides are in the same proportion.

$$\frac{EF}{LK} = \frac{FG}{KJ} = \frac{GH}{JI} = \frac{HE}{IL}$$

4. If ABCDEF is similar to GHIJKL, then the following angles are corresponding.

$\angle A = \angle G$

$\angle B = \angle H$

$\angle C = \angle I$

$\angle D = \angle J$

$\angle E = \angle K$

$\angle F = \angle L$

From the measures given, the following angles can be determined.

$\angle D = \angle J = 73°$

$\angle H = \angle B = 21°$

$\angle E = \angle K = 40°$

5. Given $\Delta ABC \sim \Delta XYZ$, the following angles correspond.

$\angle A = \angle X$

$\angle B = \angle Y$

$\angle C = \angle Z$

Given the known angle measures, the other angles are as follows.

$\angle B = \angle Y = 100°$

$\angle X = \angle A = 32°$

$\angle Z = \angle C = 48°$

6. Given than trapezoid PQRS is similar to trapezoid LMNO, the following angles correspond.

$\angle P = \angle L$

$\angle Q = \angle M$

$\angle R = \angle N$

$\angle S = \angle O$

Solve for *w*.

$w = \angle R$

$\angle R = \angle N$

$\angle N = 42°$

Therefore, *w* is 42°.

Solve for *y*.

$y = \angle M$

$\angle M = \angle Q$

$\angle Q = 70°$

Therefore, *y* is 70°.

Set up proportions to solve for sides *x* and *z*.

$$\frac{SP}{OL} = \frac{QR}{MN}$$
$$\frac{40}{20} = \frac{90}{x}$$
$$x = 45 \text{ cm}$$
$$\frac{SP}{OL} = \frac{PQ}{LM}$$
$$\frac{40}{20} = \frac{35}{z}$$
$$z = 17.5 \text{ cm}$$

7. If 5 cm:2 m, then 2.5 cm:1 m is the unit conversion. 1 m is 2.5 cm on the model.

Length:

$6.5 \text{ m} : (6.5 \times 2.5) \text{ cm}$

$6.5 \text{ m} : 16.25 \text{ cm}$

Width:

$4.8 \text{ m} : (4.8 \times 2.5) \text{ cm}$

$4.8 \text{ m} : 12 \text{ cm}$

Height:

$2.8 \text{ m} : (2.8 \times 2.5) \text{ cm}$

$2.8 \text{ m} : 7 \text{ cm}$

In the model, the room will have a length of 16.25 cm, a width of 12 cm, and a height of 7 cm.

8. Use the scale of 1 ft : $\frac{1}{2}$ in to calculate the dimensions of the model.

$40 \text{ ft} : \left(40 \times \frac{1}{2}\right) \text{ in}$

$40 \text{ ft} : 20 \text{ in}$

$35 \text{ ft} : \left(35 \times \frac{1}{2}\right) \text{ in}$

$35 \text{ ft} : 17.5 \text{ in}$

$27 \text{ ft} : \left(27 \times \frac{1}{2}\right) \text{ in}$

$27 \text{ ft} : 13.5 \text{ in}$

The length of the model of the house will be 20 in, the width will be 17.5 in, and the roof height will be 13.5 in.

9. If each box is scaled down by $\frac{1}{4}$, the sides of the smaller box will be $\frac{3}{4}$ the length of the larger box.

Box 1:

$\ell = \frac{3}{4} \times 12$

$\ell = 9$ cm

$w = \frac{3}{4} \times 8$

$w = 6$ cm

$h = \frac{3}{4} \times 4$

$h = 3$ cm

The dimensions are 9 cm by 6 cm by 3 cm.

Box 2:

$\ell = \frac{3}{4} \times 9$

$\ell = 6.75$ cm

$w = \frac{3}{4} \times 6$

$w = 4.5$ cm

$h = \frac{3}{4} \times 3$

$h = 2.25$ cm

The dimensions are 6.75 cm by 4.5 cm by 2.25 cm.

Box 3:

$\ell = \frac{3}{4} \times 6.75$

$\ell \approx 5.1$ cm

$w = \frac{3}{4} \times 4.5$

$w \approx 3.4$ cm

$h = \frac{3}{4} \times 2.25$

$h \approx 1.7$ cm

The dimensions are about 5.1 cm by 3.4 cm by 1.7 cm.

PRACTISE YOUR NEW SKILLS, p. 262

1. Set up a proportion to solve for x, the length of the actual airplane.

$$\frac{2}{45} = \frac{38}{x}$$

$$\cancel{45} \times x \times \frac{2}{\cancel{45}} = \frac{38}{\cancel{x}} \times \cancel{x} \times 45$$

$$2x = 38 \times 45$$

$$2x = 1710$$

$$\frac{2x}{2} = \frac{1710}{2}$$

$$x = 855$$

The actual airplane is 855 cm (or 8.55 m) long.

2. The ratio of sides of the larger triangle to the smaller triangle is 8:5.

Let the other two sides of the smaller triangle be x and y.

$$\frac{8}{5} = \frac{5}{x}$$

$$x \times \cancel{5} \times \frac{8}{\cancel{5}} = \frac{5}{\cancel{x}} \times 5 \times \cancel{x}$$

$$8x = 25$$

$$\frac{8x}{8} = \frac{25}{8}$$

$$x \approx 3.1 \text{ m}$$

$$\frac{8}{5} = \frac{6}{y}$$

$$y \times \cancel{5} \times \frac{8}{\cancel{5}} = \frac{6}{\cancel{y}} \times 5 \times \cancel{y}$$

$$8y = 30$$

$$\frac{8y}{8} = \frac{30}{8}$$

$$y = 3.75 \text{ m}$$

The lengths of the other two sides of the smaller triangle are about 3.1 m and 3.75 m.

3. The angles in similar polygons are the same: 108°, 204°, 63°, 120°, and 45°. When the lengths of the sides of the polygon are doubled, the angles will remain the same.

4. At the lower end, the microscope will enlarge an object by 40 times. Multiply the dimensions of the object by 40.

   $1.2 \times 40 = 48$ mm

   $0.5 \times 40 = 20$ mm

   The object will appear to be 48 mm by 20 mm.

   At the upper end, the microscope will enlarge an object by 1600 times. Multiply the dimensions of the object by 1600.

   $1.2 \times 1600 = 1920$ mm

   $0.5 \times 1600 = 800$ mm

   The object will appear to be 1920 mm by 800 mm.

5. Funnel 1:

   The ratio of the top diameter of the largest funnel to the second-largest funnel is 12:10. Therefore, every dimension of the smaller funnel will be $\frac{10}{12}$ or $\frac{5}{6}$ times the length of the original.

   $\text{height} = \frac{5}{6} \times 16$

   $\text{height} \approx 13.3$ cm

   $\text{spout length} = \frac{5}{6} \times 10$

   $\text{spout length} \approx 8.3$ cm

   $\text{spout diameter} = \frac{5}{6} \times 2$

   $\text{spout diameter} \approx 1.7$ cm

   Funnel 2:

   The ratio of the top diameter of the largest funnel to the third-largest funnel is 12:8. Therefore, every dimension of the smaller funnel will be $\frac{8}{12}$ or $\frac{2}{3}$ times the length of the original.

   $\text{height} = \frac{2}{3} \times 16$

   $\text{height} \approx 10.7$ cm

   $\text{spout length} = \frac{2}{3} \times 10$

   $\text{spout length} \approx 6.7$ cm

   $\text{spout diameter} = \frac{2}{3} \times 2$

   $\text{spout diameter} \approx 1.3$ cm

   Funnel 3:

   The ratio of the top diameter of the largest funnel to the smallest funnel is 12:6. Therefore, every dimension of the smaller funnel will be $\frac{6}{12}$ or $\frac{1}{2}$ times the length of the original.

   $\text{height} = \frac{1}{2} \times 16$

   $\text{height} = 8$ cm

   $\text{spout length} = \frac{1}{2} \times 10$

   $\text{spout length} = 5$ cm

   $\text{spout diameter} = \frac{1}{2} \times 2$

   $\text{spout diameter} = 1$ cm

6.2 Determining if Two Polygons are Similar

BUILD YOUR SKILLS, p. 266

1. Yes, the two hexagons are similar. If a hexagon is regular, all of the angles are congruent and all sides are congruent. Therefore, the two hexagons Pierre drew will have congruent corresponding angles and are similar.

2. The picture and poster are similar if the ratios of length to width are the same for each.

$$\frac{4}{6} = \frac{2}{3} \text{ or } 0.\overline{6}$$

$$\frac{1}{1.5} = \frac{2}{3} \text{ or } 0.\overline{6}$$

The picture and the poster are similar.

3. To determine if two rectangles are similar, you must compare corresponding sides.

Zora is correct if she is comparing rectangle ABCD to rectangle PQRS. But if Zora compares the longer sides of the two rectangles, and the shorter sides of the two rectangles, she will find that they are similar. She can compare rectangle ABCD to rectangle QRSP. Since $\frac{100}{50}$ is equal to $\frac{60}{30}$, Zora can say that rectangle ABCD is similar to rectangle QRSP.

4. Yes, it is true that if you increase or decrease the side lengths of a figure by the same factor, the resulting figure will be similar to the original. If you multiply or divide by the same number, you are keeping the same proportion.

For example, consider a right triangle with side lengths of 3 cm, 4 cm, and 5 cm. If you double the lengths to 6 cm, 8 cm, and 10 cm or multiply by 10 to 30 cm, 40 cm, and 50 cm, the resulting triangle is still similar because the sides are proportional and the angles are the same.

5. Find the dimensions of the framed picture.

$24 + 4 + 4 = 32$ inches

$34 + 4 + 4 = 44$ inches

Check to see if the same ratio can be used to convert the dimensions.

$$\frac{44}{36} = 1.\overline{2}$$

$$\frac{32}{24} = 1.\overline{3}$$

Since the proportions are not the same, the framed picture is not similar to the original.

6. Calculate the proportions of the dimensions of the smaller cylinder to the larger.

$$\frac{25}{30} \approx 0.83$$

$$\frac{35}{40} \approx 0.88$$

$$\frac{25}{30} \neq \frac{35}{40}$$

Since the proportions are not the same, the two cylinders are not similar.

PRACTISE YOUR NEW SKILLS, p. 269

1. a) Set up a proportion to solve for the distance represented by 12.5 cm on the map. Let x represent the actual distance.

$$\frac{2.5}{500} = \frac{12.5}{x}$$

$$\cancel{500} \times x \times \frac{2.5}{\cancel{500}} = \frac{12.5}{\cancel{x}} \times \cancel{x} \times 500$$

$$2.5x = 500 \times 12.5$$

$$2.5x = 6250$$

$$\frac{2.5x}{2.5} = \frac{6250}{2.5}$$

$$x = 2500$$

A 12.5 cm segment on the map represents 2500 m.

b) Let y be the length of the line on the map. Set up a proportion to solve for y, the segment on the map. In the proportion, convert 1.5 km to 1500 m.

$$\frac{2.5}{500} = \frac{y}{1500}$$

$$1500 \times \cancel{500} \times \frac{2.5}{\cancel{500}} = \frac{y}{\cancel{1500}} \times 500 \times \cancel{1500}$$

$$1500 \times 2.5 = 500y$$

$$3750 = 500y$$

$$\frac{3750}{500} = \frac{500y}{500}$$

$$7.5 = y$$

1.5 km would be represented by a line 7.5 cm long on the map.

ALTERNATIVE SOLUTION

Since 1.5 km, or 1500 m, is 3 times the 500 m of part a), the segment would be 3 times 2.5 cm, or 7.5 cm.

2. Calculate whether the ratios between the side lengths of the two rectangular prisms are equal.

$$\frac{6}{4} = 1.5$$

$$\frac{10}{7} \approx 1.4$$

$$\frac{8}{5} = 1.6$$

The ratios are not equal, therefore the prisms are not similar.

3. Colin is correct as there is enough information given to determine that corresponding sides are proportional and all the angles are right angles. The proportions between the corresponding sides are all the same.

$$\frac{8}{4} = \frac{8}{4} = \frac{10}{5} = \frac{18}{9} = \frac{18}{9} = \frac{10}{5}$$

4. Calculate the ratios of the sides of the dog mats and compare.

Mat 1 and Mat 2:

$$\frac{36}{27} = 1.\overline{3}$$

$$\frac{28}{21} = 1.\overline{3}$$

Mats 1 and 2 are similar.

Mat 1 and Mat 3:

$$\frac{36}{24} = 1.5$$

$$\frac{28}{18} = 1.\overline{5}$$

The sides are not proportional, so mats 1 and 3 are not similar. Since mats 1 and 2 are similar and 1 and 3 are not similar, 2 and 3 are not similar.

5. Consider two rectangles, one with sides ℓ and w, and the other with sides double the length, 2ℓ and 2w. Their areas will be as follows.

$$A_1 = \ell w$$

$$A_2 = 2\ell \times 2w$$

$$A_2 = 4\ell w$$

The area of the second rectangle is 4 times the area of the first; this is not the same proportion as the sides.

More generally, let the lengths of the sides of a third rectangle be k times those of the first. Then its area will be:

$$A_3 = k\ell \times kw$$

$$A_3 = k^2 \ell w$$

6.3 Drawing Similar Polygons

BUILD YOUR SKILLS, p. 272

1. Calculate the width of the second rectangle using proportional reasoning.

$$\frac{8}{20} = \frac{w}{10}$$

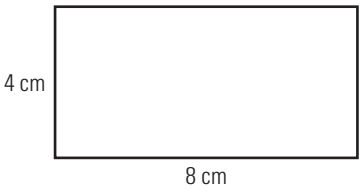
$$\cancel{20} \times \frac{8}{\cancel{20}} = \frac{w}{10} \times 20$$

$$8 = 2w$$

$$\frac{8}{2} = \frac{2w}{2}$$

$$4 = w$$

The width of the drawing must be 4 cm.



ALTERNATIVE SOLUTION

The width of the given rectangle is $\frac{1}{2}$ its length, so the width of the new rectangle must be half its length.

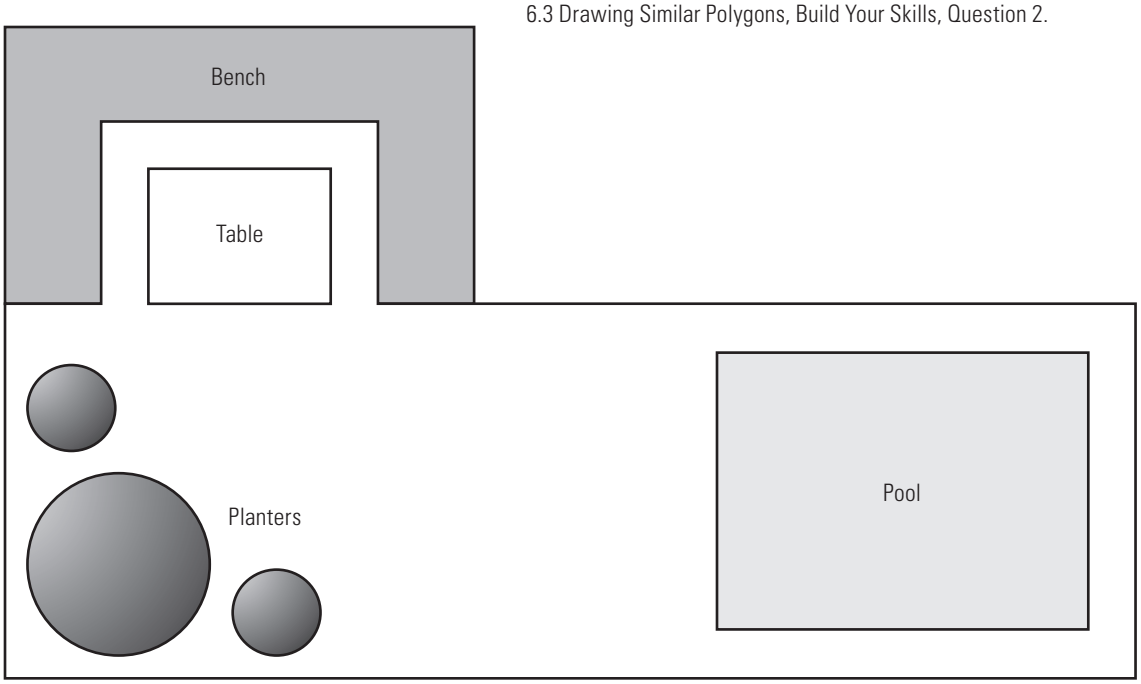
$$\text{width} = \frac{1}{2} \times 8$$

$$\text{width} = 4 \text{ cm}$$

2. Multiply the dimensions of the diagram by 2.5.

See below.

6.3 Drawing Similar Polygons, Build Your Skills, Question 2.



3. Calculate the scale of the drawing by dividing the width on the drawing by the width of the actual house.

$$\frac{10 \text{ in}}{55 \text{ ft}} = \frac{(10 \div 10) \text{ in}}{(55 \div 10) \text{ in}}$$

$$\frac{10 \text{ in}}{55 \text{ ft}} = \frac{1 \text{ in}}{5.5 \text{ ft}}$$

The scale used on the drawing was 1 in:5.5 ft.

4. Pick two corresponding dimensions to calculate the scale factor.

Using the front edge of the table:

$$\frac{25}{20} = \frac{25 \div 5}{20 \div 5}$$

$$\frac{25}{20} = \frac{5}{4}$$

$$\frac{5}{4} = 1.25$$

The scale factor used to construct the larger table was 1.25.

You can check your answer using the other dimensions of the tables.

Leg length:

$$18.5 \text{ in} \times 1.25 = 22.5 \text{ in}$$

Table length:

$$30 \text{ in} \times 1.25 = 37.5 \text{ in}$$

5. Multiply each dimension of the smaller box by 1.3 to calculate the dimensions of the larger box.

$$20 \text{ cm} \times 1.3 = 26 \text{ cm}$$

$$12 \text{ cm} \times 1.3 = 15.6 \text{ cm}$$

$$5 \text{ cm} \times 1.3 = 6.5 \text{ cm}$$

The larger box is 26 cm by 15.6 cm by 6.5 cm.

6. The ratio of the new tail to the old tail is 49:28. Calculate the scale factor.

$$\frac{49}{28} = 1.75$$

Use the scale factor of 1.75 to calculate the other dimensions of the kite.

Length of new kite:

$$40 \text{ cm} \times 1.75 = 70 \text{ cm}$$

Upper portion of new kite:

$$8 \text{ cm} \times 1.75 = 14 \text{ cm}$$

Half-width of new kite:

$$20 \text{ cm} \times 1.75 = 35 \text{ cm}$$

PRACTISE YOUR NEW SKILLS, p. 275

1. Use proportional reasoning to solve for the measure of the original.

$$\frac{3}{5} = \frac{45}{x}$$

$$x \times \cancel{5} \times \frac{3}{\cancel{5}} = \frac{45}{\cancel{x}} \times 5 \times \cancel{x}$$

$$3x = 45 \times 5$$

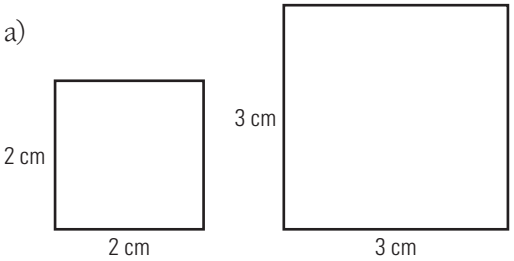
$$3x = 225$$

$$\frac{3x}{3} = \frac{225}{3}$$

$$x = 75$$

The original measures 75 mm.

2. a)



b) Yes, the squares are similar because the sides are proportional.

$$\frac{2}{3} = \frac{2}{3}$$

c) No, the two rectangles will not be similar. For two rectangles to be similar, their sides must be in the same proportion.

Rectangle 1 has a width of 5 cm and a length of 8 cm.

Rectangle 2 has a width of 8 cm and a length of 11 cm.

Calculate whether the proportions between their widths and lengths are the same.

$$\frac{w_1}{w_2} = \frac{5}{8}$$

$$\frac{w_1}{w_2} = 0.625$$

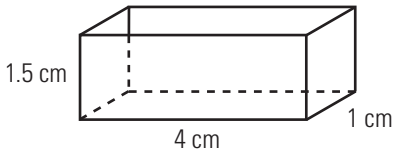
$$\frac{\ell_1}{\ell_2} = \frac{8}{11}$$

$$\frac{\ell_1}{\ell_2} \approx 0.727$$

$$\frac{w_1}{w_2} \neq \frac{\ell_1}{\ell_2}$$

The sides are not proportional, so the rectangles are not similar.

3.



4. a) The ratio between the photograph and the actual cruise ship is 1.2:310. Calculate the scale factor by dividing 1.2 by 310.

$$\frac{1.2}{310} \approx 0.0039$$

The scale factor is approximately 0.0039.

b) Convert the actual height of the person to centimetres.

1.8 m = 180 cm

Multiply by the scale factor to calculate the height of the person in the photograph.

$$180 \text{ cm} \times 0.0039 \approx 0.7 \text{ cm}$$

The person is 0.7 cm tall in the photograph.

5. a) Let x be the width of the miniature tent. Set up a proportion to solve for x.

$$\frac{12}{1.5} = \frac{10}{x}$$

$$\cancel{1.5} \times x \times \frac{12}{\cancel{1.5}} = \frac{10}{\cancel{x}} \times \cancel{x} \times 1.5$$

$$12x = 10 \times 1.5$$

$$12x = 15$$

$$\frac{12x}{12} = \frac{15}{12}$$

$$x = 1.25$$

The width of the miniature tent is 1.25 feet.

b) The length of the miniature is $1\frac{1}{2}$ ft and the length of the actual tent is 10 ft, so the scale ratio is $1\frac{1}{2} : 12$. Change this to whole numbers and simplify.

$$1\frac{1}{2} : 12 = 1.5 : 12$$

$$1.5 : 12 = 15 : 120$$

$$15 : 120 = (15 \div 15) : (120 \div 15)$$

$$15 : 120 = 1 : 8$$

The scale ratio is 1:8.

6.4 Similar Triangles

BUILD YOUR SKILLS, p. 278

1. a) Set up proportions to solve for the unknown sides.

$$\frac{AB}{XY} = \frac{BC}{YZ}$$

$$\frac{6.1}{4.5} = \frac{5.3}{x}$$

$$\cancel{4.5} \times x \times \frac{6.1}{\cancel{4.5}} = \frac{5.3}{\cancel{x}} \times \cancel{x} \times 4.5$$

$$6.1x = 5.3 \times 4.5$$

$$\frac{6.1x}{6.1} = \frac{5.3 \times 4.5}{6.1}$$

$$x \approx 3.9 \text{ cm}$$

b)

$$\frac{BC}{YZ} = \frac{AC}{XZ}$$

$$\frac{18.8}{8.2} = \frac{x}{12.7}$$

$$\cancel{8.2} \times 12.7 \times \frac{18.8}{\cancel{8.2}} = \frac{x}{\cancel{12.7}} \times \cancel{12.7} \times 8.2$$

$$12.7 \times 18.8 = 8.2x$$

$$\frac{12.7 \times 18.8}{8.2} = \frac{8.2x}{8.2}$$

$$29.1 \text{ ft} \approx x$$

c) Calculate the length of z (side XY) using the Pythagorean theorem.

$$y^2 = x^2 + z^2$$

$$(25)^2 = (16)^2 + z^2$$

$$625 = 256 + z^2$$

$$625 - 256 = z^2$$

$$369 = z^2$$

$$\sqrt{369} = z$$

$$19.2 \text{ m} \approx z$$

Set up a proportion to solve for c. Use the square root of 369 instead of 19.2, to avoid rounding errors.

$$\frac{YZ}{BC} = \frac{XY}{AB}$$

$$\frac{16}{4} = \frac{\sqrt{369}}{c}$$

$$c \times \cancel{4} \times \frac{16}{\cancel{4}} = \frac{\sqrt{369}}{\cancel{c}} \times 4 \times \cancel{c}$$

$$16c = \sqrt{369} \times 4$$

$$c = \frac{\sqrt{369} \times 4}{16}$$

$$c \approx 4.8 \text{ m}$$

ALTERNATIVE SOLUTION

Since 4 is $\frac{1}{4}$ times 16, multiply the square root of 369 by $\frac{1}{4}$.

$$c = \frac{1}{4} \times \sqrt{369}$$

$$c \approx 4.8 \text{ m}$$

2. Set up a proportion to solve for side ST.

$$\frac{AB}{RS} = \frac{BC}{ST}$$

$$\frac{6}{8} = \frac{5}{ST}$$

$$ST \times \cancel{8} \times \frac{6}{\cancel{8}} = \frac{5}{\cancel{ST}} \times 8 \times \cancel{ST}$$

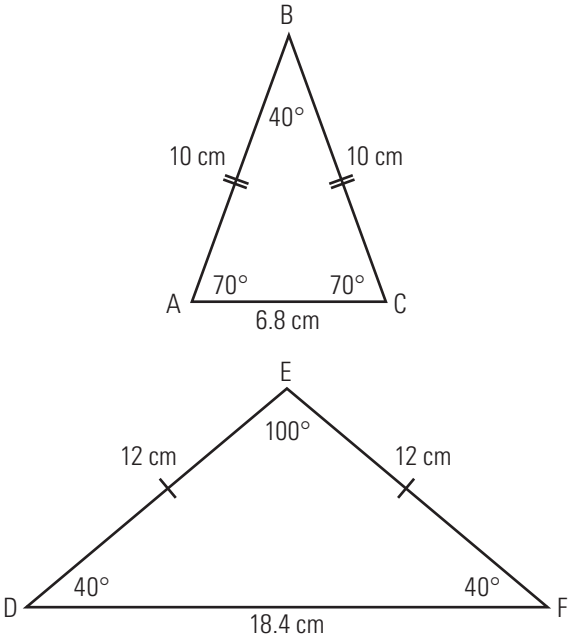
$$6(ST) = 40$$

$$ST = \frac{40}{6}$$

$$ST \approx 6.7 \text{ cm}$$

You are not given enough information to find the length of the third side, TR.

3. Not all isosceles triangles are similar.



ΔABC is not similar to ΔDEF because the base angles are not the same and the sides are not proportional.

4. Let h be the height of the hill. Set up a proportion to solve for h.

$$\frac{4.2}{100} = \frac{h}{250}$$

$$250 \times \cancel{100} \times \frac{4.2}{\cancel{100}} = \frac{h}{\cancel{250}} \times 100 \times \cancel{250}$$

$$250 \times 4.2 = 100h$$

$$1050 = 100h$$

$$\frac{1050}{100} = \frac{100h}{100}$$

$$10.5 = h$$

If you walk 250 m up the hill along the slope, you will be 10.5 m higher.

5. The sketch is drawn to a scale of 1:8, so each part on the quilt will be 8 times longer than on the sketch.

$2.2 \text{ cm} \times 8 = 17.6 \text{ cm}$

$4.6 \text{ cm} \times 8 = 36.8 \text{ cm}$

The legs of the triangle on the quilt will be 17.6 cm and 36.8 cm.

∠ACD = ∠DCB

∠ADC = ∠CDB

Therefore: ∠CAD = ∠CBD

Each of the three triangles has one 90° angle and two 45° angles. Therefore:

ΔABC ~ ΔACD ~ ΔCBD

PRACTISE YOUR NEW SKILLS, p. 282

1. Set up a proportion to solve for ED.

$$\Delta ABC \sim \Delta EDC$$

$$\frac{AC}{CE} = \frac{AB}{ED}$$

$$\frac{12}{7} = \frac{8}{ED}$$

$$ED \times \cancel{7} \times \frac{12}{\cancel{7}} = \frac{8}{\cancel{ED}} \times 7 \times \cancel{ED}$$

$$12(ED) = 56$$

$$ED = \frac{56}{12}$$

$$ED \approx 4.7 \text{ m}$$

2. No, the triangular blocks of wood are not similar. While the triangular faces are similar, both blocks are 2 inches thick. In order for the blocks to be similar, their thicknesses would have to be proportional.

3. Given that ΔFGH is similar to ΔXYZ, the following angles are equal and sides are proportional.

$\angle F = \angle X$

$\angle G = \angle Y$

$\angle H = \angle Z$

$FG \sim XY$

$GH \sim YZ$

$FH \sim XZ$

4. Because the angles of the two triangles are the same, the triangles are similar. Use proportional reasoning to solve for the height of the statue.

Convert 5 ft 8 in to feet.

$$5 \text{ ft } 8 \text{ in} = 5\frac{8}{12} \text{ ft}$$

$$5 \text{ ft } 8 \text{ in} \approx 5.7 \text{ ft}$$

$$\frac{2}{8} = \frac{5.7}{(x + 6)}$$

$$(x + 6) \times \cancel{8} \times \frac{2}{\cancel{8}} = \frac{5.7}{\cancel{(x + 6)}} \times \cancel{(x + 6)} \times 8$$

$$2(x + 6) = 5.7 \times 8$$

$$2x + 12 = 45.6$$

$$2x = 45.6 - 12$$

$$2x = 33.6$$

$$x = 16.8 \text{ ft}$$

The statue of Louis Riel is about 17 ft high.

CHAPTER TEST, p. 284

1. Calculate the scale factor used to make the larger pentagon by dividing the given side length by the shortest side length of the smaller pentagon.

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

Each side of the larger pentagon is 2.5 times longer than the corresponding side of the smaller pentagon.

$$6'' \times 2.5 = 15''$$
$$10'' \times 2.5 = 25''$$
$$14'' \times 2.5 = 35''$$
$$24'' \times 2.5 = 60''$$

The side lengths of the larger pentagon are 5 in, 15 in, 25 in, 35 in, and 60 in.

2. Set up proportions to solve for x and y.

$$\frac{6}{2.5} = \frac{x}{3}$$
$$\cancel{2.5} \times 3 \times \frac{6}{\cancel{2.5}} = \frac{x}{\cancel{3}} \times \cancel{3} \times 2.5$$
$$18 = 2.5x$$
$$\frac{18}{2.5} = x$$
$$7.2 \text{ m} = x$$

$$\frac{6}{2.5} = \frac{8.5}{y}$$
$$\cancel{2.5} \times y \times \frac{6}{\cancel{2.5}} = \frac{8.5}{\cancel{y}} \times \cancel{y} \times 2.5$$
$$6y = 8.5 \times 2.5$$
$$\frac{6y}{6} = \frac{8.5 \times 2.5}{6}$$
$$y \approx 3.5 \text{ m}$$

3. Set up a proportion to solve for AB, the distance across the river.

$$\frac{32}{18} = \frac{AB}{24}$$
$$24 \times \cancel{18} \times \frac{32}{\cancel{18}} = \frac{AB}{\cancel{24}} \times 18 \times \cancel{24}$$
$$24 \times 32 = 18(AB)$$
$$768 = 18(AB)$$
$$\frac{768}{18} = \frac{18(AB)}{18}$$
$$42.7 \approx (AB)$$

The river is about 42.7 m wide.

4. Set up a proportion to solve for x, the man's height.

$$\frac{3.8}{15} = \frac{x}{8}$$
$$8 \times \cancel{15} \times \frac{3.8}{\cancel{15}} = \frac{x}{\cancel{8}} \times 15 \times \cancel{8}$$
$$8 \times 3.8 = 15x$$
$$30.4 = 15x$$
$$\frac{30.4}{15} = \frac{15x}{15}$$
$$2.03 \approx x$$

The man is approximately 2 m tall.

5. Let the length and width of the first rectangle be ℓ and w. The dimensions of the larger rectangle are 2ℓ and $2w$.

Areas of the rectangles:

$$A_1 = \ell w$$
$$A_2 = (2\ell)(2w)$$
$$A_2 = 4\ell w$$

When the side lengths of a rectangle are doubled, the area is quadrupled.

6. Calculate the ratios of the corresponding sides.

$$\frac{7}{4} = 1.75$$

$$\frac{4.8}{2.75} \approx 1.75$$

$$\frac{9.2}{5.25} \approx 1.75$$

When the ratios are rounded to 2 decimal places, the shapes are similar.

7. a) True, all equilateral triangles are similar. In equilateral triangles, the angles are always 60° and the ratios of the sides will always be equal.

   b) False, all isosceles triangles are not similar. The angles do not need to be equal, nor do the sides have to be proportional.

   c) True, congruent triangles are similar. The corresponding angles are equal and the ratios of sides will be 1:1.

8. Convert the dimensions of the projected image from feet and inches to inches.

$$4'2'' = ((4 \times 12) + 2)''$$

$$4'2'' = (48 + 2)''$$

$$4'2'' = 50''$$

Calculate the scale factor by dividing the width of the projected image by the width of the original diagram.

$$\frac{50}{6} \approx 8.3$$

The scale factor of the projection is about 8.3.

9. On the drawing, the main area is 6 inches, or 0.5 feet, wide. In the actual space, the width is 13 feet. Therefore, the scale ratio of model:actual is 0.5:13, or 1:26. This can be rewritten as a fraction, $\frac{1}{26}$. Calculate the other dimensions of the drawing using this scale factor.

$$\frac{1}{26} \times 17 \approx 0.65'$$

$$0.65' \times 12'' \approx 7.8''$$

$$\frac{1}{26} \times 6 \approx 0.23'$$

$$0.23' \times 12'' \approx 2.8''$$

$$5'2'' = \left(5\frac{2}{12}\right)'$$

$$5'2'' \approx 5.17'$$

$$\frac{1}{26} \times 5.17 \approx 0.2'$$

$$0.2' \times 12'' = 2.4''$$

$$7'2'' = \left(7\frac{2}{12}\right)'$$

$$7'2'' \approx 7.17'$$

$$\frac{1}{26} \times 7.17 \approx 0.28'$$

$$0.28' \times 12'' = 3.4''$$

On the drawing:

17′ is represented by 7.8″.

6′ is represented by 2.8″.

5′2″ is represented by 2.4″.

7′2″ is represented by 3.4″.

10. Multiply the dimensions of the photograph by the scale factor of 6.25.

$5'' \times 6.25 = 31.25''$

$7'' \times 6.25 = 43.75''$

The painting will be 31.25 inches by 43.75 inches.

11. Multiply the dimensions of the original blanket by 0.55.

$174 \text{ cm} \times 0.55 = 95.7 \text{ cm}$

$230 \text{ cm} \times 0.55 = 126.5 \text{ cm}$

The smaller blanket will be 95.7 cm by 126.5 cm.

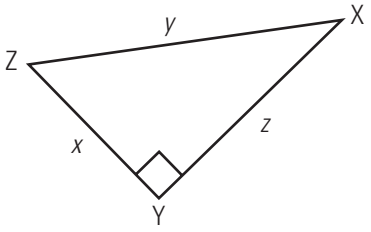
Chapter 7

Trigonometry of Right Triangles

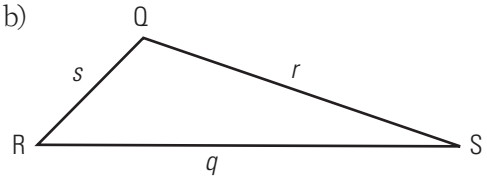
7.1 The Pythagorean Theorem

BUILD YOUR SKILLS, p. 290

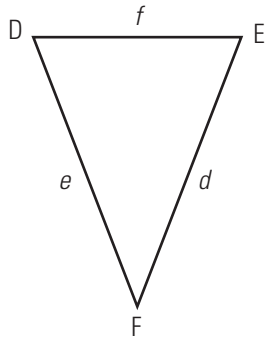
1. a)



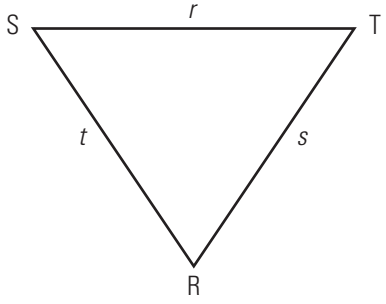
b)



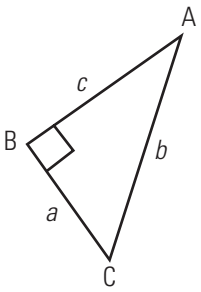
c)



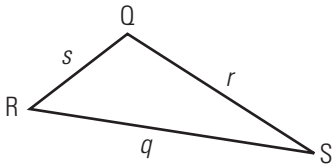
d)



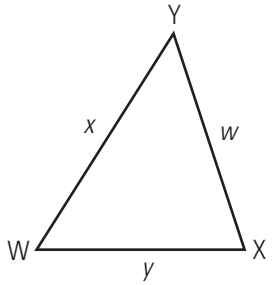
2. a)



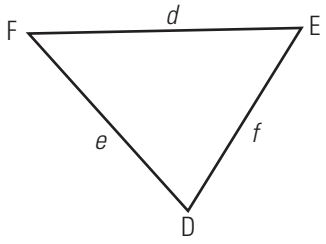
b)



c)



d)



3. Consider ΔABC. The right angle is ∠B.

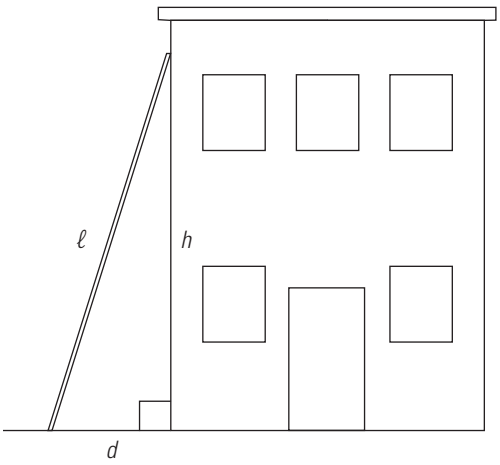
   $a^2 + c^2 = (x + y)^2$

   Consider ΔABD. The right angle is ∠D.

   $x^2 + z^2 = c^2$

   Consider ΔBDC. The right angle is ∠D.

   $z^2 + y^2 = a^2$

4. 

   The distance from the base of the house, *d*, and the side of the house, *h*, form the legs of the triangle. The ladder, ℓ, forms the hypotenuse. The relationship between the sides can be expressed as follows.

   $h^2 + d^2 = \ell^2$

5. Rearrange the equation to solve for *x*.

$$x^2 + y^2 = z^2$$
$$x^2 = z^2 - y^2$$
$$x = \sqrt{z^2 - y^2}$$

   Note: Generally when you take the square root of a number, there are two possible solutions (e.g., $x^2 = 4$, $x = \pm 2$). In this case, since *x* is a length, you do not need to consider the negative solution.

   Next, rearrange the equation to solve for *y*.

$$x^2 + y^2 = z^2$$
$$y^2 = z^2 - x^2$$
$$y = \sqrt{z^2 - x^2}$$

6. First consider the bottom triangle, with legs of 4.2 cm and 6.8 cm and hypotenuse *x*.

$$c^2 = a^2 + b^2$$
$$x^2 = 4.2^2 + 6.8^2$$
$$x^2 = 17.64 + 46.24$$
$$x^2 = 63.88$$
$$x = \sqrt{63.88}$$
$$x \approx 8.0 \text{ cm}$$

   Next, consider the upper triangle, with legs *x* and *y*, and a hypotenuse of 10.4 cm.

$$a^2 + b^2 = c^2$$
$$y^2 + x^2 = 10.4^2$$
$$y^2 + (\sqrt{63.88})^2 = 108.16$$
$$y^2 + 63.88 = 108.16$$
$$y^2 = 108.16 - 63.88$$
$$y^2 = 44.28$$
$$y = \sqrt{44.28}$$
$$y \approx 6.7 \text{ cm}$$

7. Let the length of the ladder be ℓ, the height of the ladder be h, and distance from the base of the house be d.

$$h^2 + d^2 = \ell^2$$
$$38^2 + d^2 = 40^2$$
$$d^2 = 40^2 - 38^2$$
$$d = \sqrt{40^2 - 38^2}$$
$$d = \sqrt{1600 - 1444}$$
$$d = \sqrt{156}$$
$$d \approx 12.5 \text{ ft}$$

The foot of the ladder is approximately 12.5 feet from the base of the house.

8. Calculate the diagonal distance across the field.

$$\ell^2 + w^2 = d^2$$
$$180^2 + 120^2 = d^2$$
$$\sqrt{180^2 + 120^2} = d$$
$$\sqrt{32\,400 - 14\,400} = d$$
$$\sqrt{46\,800} = d$$
$$216.3 \approx d$$

If you walked diagonally across the field, your route would be about 216.3 m long.

Calculate the distance you would travel if you walked around the edge of the field.

$$d_{edge} = \ell + w$$
$$d_{edge} = 180 + 120$$
$$d_{edge} = 300 \text{ m}$$

Calculate the difference in route lengths.

$300 - 216.3 = 83.7$ m

Your route would be about 83.7 m shorter by walking diagonally across the field.

PRACTISE YOUR NEW SKILLS, p. 295

1. Convert the dimensions of the stairway from feet and inches to inches.

$$6'4'' = [(6 \times 12) + 4]''$$
$$6'4'' = (72 + 4)''$$
$$6'4'' = 76''$$
$$8'6'' = [(8 \times 12) + 6]''$$
$$8'6'' = (96 + 6)''$$
$$8'6'' = 102''$$

Let the diagonal length of the stairway be s, the rise be r, and the horizontal distance be h.

$$s^2 = r^2 + h^2$$
$$s^2 = 76^2 + 102^2$$
$$s = \sqrt{76^2 + 102^2}$$
$$s = \sqrt{5776 + 10\,404}$$
$$s = \sqrt{16\,180}$$
$$s \approx 127.2 \text{ in}$$

The diagonal length of the stairway is about 127.2 inches.

Convert to feet and inches.

$$127.2 \div 12 = 10.6 \text{ ft}$$
$$10.6 \text{ ft} = 10 \text{ ft } (0.6 \times 12) \text{ in}$$
$$10.6 \text{ ft} = 10 \text{ ft } 7.2 \text{ in}$$

The diagonal length of the stairway is about 10 ft 7.2 in.

ALTERNATIVE SOLUTION

Convert the measurements to feet.

$$6'4'' = \left(6\frac{4}{12}\right)'$$
$$6'4'' \approx 6.3'$$

$$8'6'' = \left(8\frac{6}{12}\right)'$$
$$8'6'' = 8.5'$$

$$s^2 = r^2 + h^2$$
$$s^2 = 6.3^2 + 8.5^2$$
$$s = \sqrt{6.3^2 + 8.5^2}$$
$$s = \sqrt{39.69 + 72.25}$$
$$s = \sqrt{111.94}$$
$$s \approx 10.6 \text{ ft}$$

The diagonal length of the stairway is about 10.6 ft.

Convert to feet and inches.

$$127.2 \div 12 = 10.6 \text{ ft}$$
$$10.6 \text{ ft} = 10 \text{ ft } (0.6 \times 12) \text{ in}$$
$$10.6 \text{ ft} = 10 \text{ ft } 7.2 \text{ in}$$

The diagonal length of the stairway is about 10 ft 7.2 in.

2. Let the length of the guy wire be g, the height of the tower be t, and the distance from the base of the tower be d.

$$d^2 + t^2 = g^2$$
$$d^2 + 24^2 = 28^2$$
$$d^2 = 28^2 - 24^2$$
$$d = \sqrt{28^2 - 24^2}$$
$$d = \sqrt{784 - 576}$$
$$d = \sqrt{208}$$
$$d \approx 14.4 \text{ m}$$

The guy wire is attached to the ground about 14.4 m from the base of the tower.

3. Let the rise of the ramp be h, the run be r, and the length of the ramp be ℓ.

$$\ell^2 = h^2 + r^2$$
$$\ell^2 = 3.5^2 + 10.5^2$$
$$\ell = \sqrt{3.5^2 + 10.5^2}$$
$$\ell = \sqrt{12.25 + 110.25}$$
$$\ell = \sqrt{122.5}$$
$$\ell \approx 11.1 \text{ m}$$

The ramp is approximately 11.1 m long.

4. Let the height of the TV be h, the width be w, and the diagonal distance between opposite corners be d.

$$h^2 + w^2 = d^2$$
$$32^2 + w^2 = 52^2$$
$$w^2 = 52^2 - 32^2$$
$$w = \sqrt{52^2 - 32^2}$$
$$w = \sqrt{2704 - 1024}$$
$$w = \sqrt{1680}$$
$$w \approx 41.0 \text{ in}$$

The TV is about 41 inches wide.

5. Calculate how far north the boat sailed.

$$3 \text{ h} \times 12 \text{ km/h} = 36 \text{ km}$$

Calculate how far east the boat sailed.

$$2 \text{ h} \times 18 \text{ km/h} = 36 \text{ km}$$

Let n be the distance travelled north, e be the distance travelled east, and d be the distance from the starting point.

$$d^2 = n^2 + e^2$$
$$d^2 = 36^2 + 36^2$$
$$d = \sqrt{36^2 + 36^2}$$
$$d = \sqrt{1296 + 1296}$$
$$d = \sqrt{2592}$$
$$d \approx 50.9 \text{ km}$$

The boat is about 50.9 km from its starting point.

7.2 The Sine Ratio

BUILD YOUR SKILLS, p. 298

1. a) Use the sine ratio to solve for sin A.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin A = \frac{4.3}{6.9}$$

$$\sin A \approx 0.62$$

b) $$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin A = \frac{5.2}{9.6}$$

$$\sin A \approx 0.54$$

2. Use a calculator to calculate the sine ratio.

a) sin 10° = 0.1736

b) sin 48° = 0.7431

c) sin 62° = 0.8829

d) sin 77° = 0.9744

3. sin 90° = 1

Possible reasons for this answer include:

- 90° is not an acute angle of a right triangle, so you cannot draw a triangle to represent this situation.
- As the acute angle gets larger, the sine also gets larger but does not get to 1 because the hypotenuse is the longest side and sine is equal to $\frac{\text{opp}}{\text{hyp}}$.

4. a) Use the sine ratio to calculate the length of the side opposite the indicated angle.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 58° = \frac{a}{9.7}$$

$$9.7 \sin 58° = a$$

$$8.2 \approx a$$

Side a is about 8.2 cm.

b) $$\sin X = \frac{\text{opp}}{\text{hyp}}$$

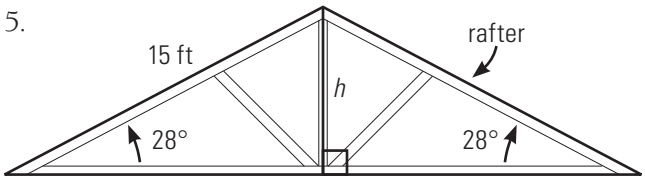
$$\sin 23° = \frac{x}{9.7}$$

$$9.7 \sin 23° = x$$

$$3.8 \approx x$$

Side x is about 3.8 cm.

5.



Use the sine ratio to solve for h, the height of the rafter's peak.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 28° = \frac{h}{15}$$

$$15 \sin 28° = h$$

$$7.0 \approx h$$

The rafter's peak is about 7 feet high.

6. Use the sine ratio to solve for h, the height of the weather balloon.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 35^\circ = \frac{h}{15}$$
$$15 \sin 35^\circ = h$$
$$8.6 \approx h$$

The balloon is about 8.6 m above the ground.

7. Use the sine ratio to solve for h, the hypotenuse.

a)
$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 33^\circ = \frac{7.8}{h}$$
$$h \sin 33^\circ = 7.8$$
$$h = \frac{7.8}{\sin 33^\circ}$$
$$h \approx 14.3$$

The hypotenuse is approximately 14.3 mm.

b)
$$\sin X = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 70^\circ = \frac{12.1}{h}$$
$$h \sin 70^\circ = 12.1$$
$$h = \frac{12.1}{\sin 70^\circ}$$
$$h \approx 12.9$$

The hypotenuse is approximately 12.9 cm.

8. Use the sine ratio to solve for g, the length of the guy wire.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 52^\circ = \frac{4.2}{g}$$
$$g \sin 52^\circ = 4.2$$
$$g = \frac{4.2}{\sin 52^\circ}$$
$$g \approx 5.3$$

The guy wire is approximately 5.3 m long.

9. Use the sine ratio to solve for t, the distance travelled by the boat.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 43^\circ = \frac{15}{t}$$
$$t \sin 43^\circ = 15$$
$$t = \frac{15}{\sin 43^\circ}$$
$$t \approx 22.0$$

The boat travels about 22 m before reaching the opposite shore.

10. Use the sine ratio to solve for d, the distance between George and the house.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 18^\circ = \frac{125}{d}$$
$$d \sin 18^\circ = 125$$
$$d = \frac{125}{\sin 18^\circ}$$
$$d \approx 404.5$$

George is about 404.5 m from the house.

11. Use the sine ratio to solve for ℓ, the length of the road.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 4.5^\circ = \frac{16}{\ell}$$
$$\ell \sin 4.5^\circ = 16$$
$$\ell = \frac{16}{\sin 4.5^\circ}$$
$$\ell \approx 203.9$$

The length of the road is about 203.9 m.

12. Use the sine ratio to solve for h, the height of the slide.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 32^\circ = \frac{h}{3.6}$$
$$3.6 \sin 32^\circ = h$$
$$1.9 \approx h$$

The top of the slide is 1.9 m above the ground.

PRACTISE YOUR NEW SKILLS, p. 306

1. a) Use the sine ratio to solve for sin A.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin A = \frac{7.9}{12.4}$$
$$\sin A \approx 0.6371$$

b) First find side b using the Pythagorean theorem.

$$a^2 + b^2 = c^2$$
$$6.2^2 + b^2 = 8.9^2$$
$$b^2 = 8.9^2 - 6.2^2$$
$$b = \sqrt{8.9^2 - 6.2^2}$$
$$b = \sqrt{79.21 - 38.44}$$
$$b = \sqrt{40.77}$$
$$b \approx 6.4$$

Use side b and the sine ratio to solve for sin B.

$$\sin B = \frac{\text{opp}}{\text{hyp}}$$
$$\sin B = \frac{6.4}{8.9}$$
$$\sin B \approx 0.7191$$

2. Use the sine ratio to calculate the length of the indicated side.

a)
$$\sin X = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 68^\circ = \frac{x}{19.3}$$
$$19.3 \sin 68^\circ = x$$
$$17.9 \approx x$$

Side x is about 17.9 cm.

$$\sin X = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 79^\circ = \frac{12.3}{y}$$
$$y \sin 79^\circ = 12.3$$
$$y = \frac{12.3}{\sin 79^\circ}$$
$$y \approx 12.5$$

Side y is about 12.5 m.

3. Use the sine ratio to solve for h, the height of the ramp.

$$\sin E = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 15^\circ = \frac{h}{21.2}$$

$$21.2 \sin 15^\circ = h$$

$$5.5 \approx h$$

The ramp reaches about 5.5 m in height.

4. Use the sine ratio to solve for h, the height of the waterslide.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 20^\circ = \frac{h}{25}$$

$$25 \sin 20^\circ = h$$

$$8.6 \approx h$$

The platform is about 8.6 m high.

5. Use the sine ratio to solve for n, the man's distance north.

$$\sin X = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 68^\circ = \frac{n}{45}$$

$$45 \sin 68^\circ = n$$

$$41.7 \approx n$$

The man is about 41.7 m north of his starting point.

7.3 The Cosine Ratio

BUILD YOUR SKILLS, p. 310

1. Use a calculator to find the ratios.

a) $\cos 23° = 0.9205$

$\sin 67° = 0.9205$

b) $\cos 83° = 0.1219$

$\sin 7° = 0.1219$

c) $\cos 45° = 0.7071$

$\sin 45° = 0.7071$

d) $\cos 37° = 0.7986$

$\sin 53° = 0.7986$

The cosine of one angle and the sine of the supplementary angle are equal.

2. Use the cosine ratio to calculate the length of the indicated side.

a)
$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 12° = \frac{x}{8.4}$$
$$8.4 \cos 12° = x$$
$$8.2 \approx x$$

Side x is about 8.2 cm.

b)
$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 78° = \frac{x}{8.4}$$
$$8.4 \cos 78° = x$$
$$1.7 \approx x$$

Side x is about 1.7 cm.

c)
$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 45° = \frac{6.1}{x}$$
$$x \cos 45° = 6.1$$
$$x = \frac{6.1}{\cos 45°}$$
$$x \approx 8.6$$

Side x is about 8.6 cm.

d)
$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 60° = \frac{6.1}{x}$$
$$x \cos 60° = 6.1$$
$$x = \frac{6.1}{\cos 60°}$$
$$x = 12.2$$

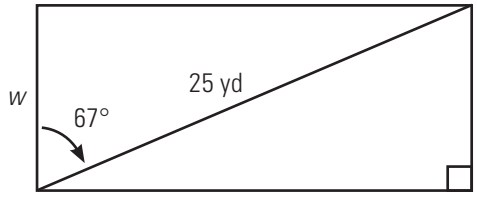
Side x is 12.2 cm.

3. Use the cosine ratio to solve for d, the distance between the base of the flagpole and the point at which the guy wire is fixed.

$$\cos G = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 63° = \frac{d}{12}$$
$$12 \cos 63° = d$$
$$5.4 \approx d$$

The guy wire must be fixed about 5.4 m from the base of the flagpole.

4.



Use the cosine ratio to solve for *w,* the width of the field.

$$\cos R = \frac{\text{adj}}{\text{hyp}}$$

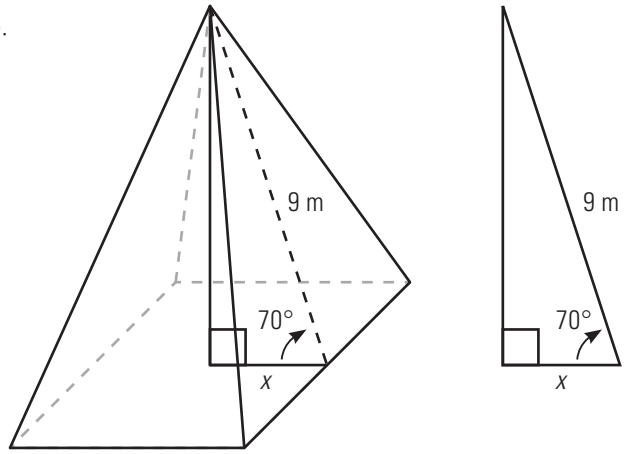
$$\cos 67^\circ = \frac{w}{25}$$

$$25 \cos 67^\circ = w$$

$$9.8 \approx w$$

The width of the field is 9.8 yards.

5.



Redraw the triangle under consideration.

x is equal to half the length of a side of the pyramid. Use the cosine ratio to solve for *x*.

$$\cos P = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 70^\circ = \frac{x}{9}$$

$$9 \cos 70^\circ = x$$

$$3.1 \approx x$$

The side of the pyramid is twice this length.

$2(3.1) = 6.2$

The side of the pyramid is about 6.2 m long.

6. Use the cosine ratio to solve for *c*, the length of the bridge line.

$$\cos B = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 67^\circ = \frac{5.5}{c}$$

$$c \times \cos 67^\circ = 5.5$$

$$c = \frac{5.5}{\cos 67^\circ}$$

$$c \approx 14.1$$

The length of the bridge line is about 14.1 m.

7. Use the cosine ratio to solve for ℓ, the length of the rafter.

$$\cos R = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 35^\circ = \frac{9.5}{\ell}$$

$$\ell \cos 35^\circ = 9.5$$

$$\ell = \frac{9.5}{\cos 35^\circ}$$

$$\ell \approx 11.6$$

The rafter is about 11.6 m long.

8. Use the cosine ratio to solve for *d*, the distance the airplane will travel before landing.

$$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 5^\circ = \frac{500}{d}$$

$$d \cos 5^\circ = 500$$

$$d = \frac{500}{\cos 5^\circ}$$

$$d \approx 501.9$$

The plane travels about 502 km.

PRACTISE YOUR NEW SKILLS, p. 315

1. Use the cosine ratio to solve for the length of the indicated side.

a) $$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 52^\circ = \frac{x}{5.9}$$

$$5.9 \cos 52^\circ = x$$

$$3.6 \approx x$$

Side x is about 3.6 cm.

b) $$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 67^\circ = \frac{a}{12.3}$$

$$12.3 \cos 67^\circ = a$$

$$4.8 \approx a$$

Side a is about 4.8 m.

c) $$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 12^\circ = \frac{9.3}{r}$$

$$r \cos 12^\circ = 9.3$$

$$r = \frac{9.3}{\cos 12^\circ}$$

$$r \approx 9.5$$

Side r is about 9.5 cm.

d) $$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 61^\circ = \frac{1.5}{\ell}$$

$$\ell \cos 61^\circ = 1.5$$

$$\ell = \frac{1.5}{\cos 61^\circ}$$

$$\ell \approx 3.1$$

Side ℓ is about 3.1 m.

2. Use the cosine ratio to solve for d, the distance between the base of the barn and the base of the screw conveyor.

$$\cos C = \frac{\text{adj}}{\text{hyp}}$$

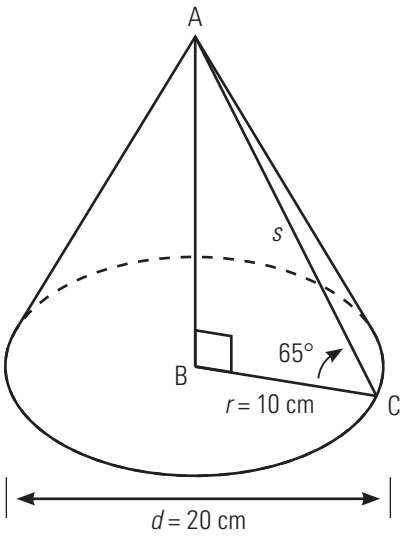
$$\cos 30^\circ = \frac{d}{20}$$

$$20 \cos 30^\circ = d$$

$$17.3 \approx d$$

The conveyor must be placed about 17.3 m from the base of the barn.

3.



The radius of the base of the cone is half the diameter, 10 cm.

Consider ΔABC. Use the cosine ratio to solve for the slant height (side AC).

$$\cos C = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 65^\circ = \frac{10}{s}$$

$$s \cos 65^\circ = 10$$

$$s = \frac{10}{\cos 65^\circ}$$

$$s \approx 23.7$$

The slant height is about 23.7 m.

4. Use the cosine ratio to solve for d, the distance travelled by the balloon.

$$\cos S = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 15^\circ = \frac{1.2}{d}$$
$$d \cos 15^\circ = 1.2$$
$$d = \frac{1.2}{\cos 15^\circ}$$
$$d \approx 1.24$$

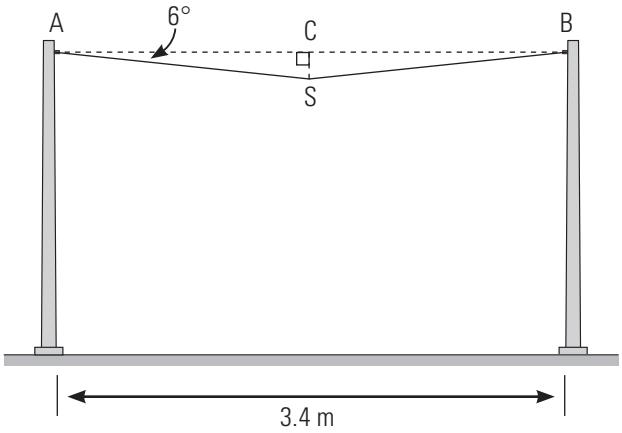
The hot air balloon travelled about 1.24 km.

5. Use the cosine ratio to solve for h, the horizontal distance travelled by the car.

$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 3.2^\circ = \frac{h}{8.5}$$
$$8.5 \cos 3.2^\circ = h$$
$$8.49 \approx h$$

The car travelled about 8.49 km.

6. Assume the clothesline sags evenly from both ends.



Distance AB is 3.4 m, and AC is half that distance, or 1.7 m.

$$\cos A = \frac{\text{adj}}{\text{hyp}}$$
$$\cos 6^\circ = \frac{AC}{AS}$$
$$\cos 6^\circ = \frac{1.7}{c}$$
$$c \cos 6^\circ = 1.7$$
$$c = \frac{1.7}{\cos 6^\circ}$$
$$c \approx 1.71$$

The length of the clothesline is twice the length of c.

$2(1.71) = 3.42$

The clothesline is about 3.42 m long.

7.4 The Tangent Ratio

BUILD YOUR SKILLS, p. 320

1. Use the tangent ratio to solve for the length of the indicated side.

a) $\tan X = \frac{\text{opp}}{\text{adj}}$

$\tan 38° = \frac{x}{12.1}$

$12.1 \tan 38° = x$

$9.5 \approx x$

Side x is 9.5 m long.

b) $\tan A = \frac{\text{opp}}{\text{adj}}$

$\tan 75° = \frac{a}{6}$

$6 \tan 75° = a$

$22.4 \approx a$

Side a is 22.4 in long.

c) $\tan S = \frac{\text{opp}}{\text{adj}}$

$\tan 40° = \frac{2}{r}$

$r \tan 40° = 2$

$r = \frac{2}{\tan 40°}$

$r \approx 2.4$

Side r is 2.4 m long.

d) $\tan R = \frac{\text{opp}}{\text{adj}}$

$\tan 50° = \frac{9.4}{p}$

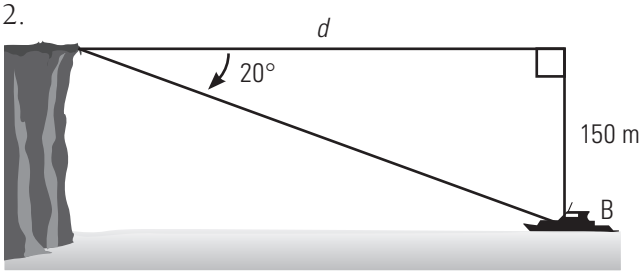
$p \tan 50° = 9.4$

$p = \frac{9.4}{\tan 50°}$

$p \approx 7.9$

Side p is 7.9 ft long.

2.



Use the tangent ratio to solve for d, the distance between the boat and the base of the cliff.

$\tan \theta = \frac{\text{opp}}{\text{adj}}$

$\tan 20° = \frac{150}{d}$

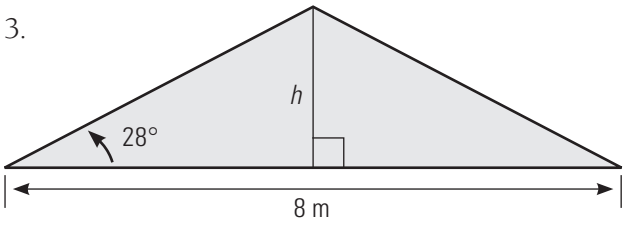
$d \tan 20° = 150$

$d = \frac{150}{\tan 20°}$

$d \approx 412.1$

The boat is about 412 m from the cliff.

3.



$$\tan R = \frac{\text{opp}}{\text{adj}}$$

$$\tan 28° = \frac{h}{4}$$

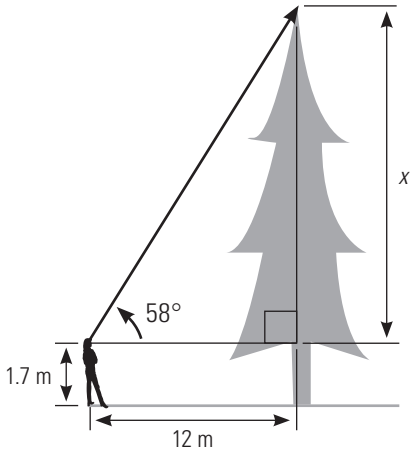
$$4 \tan 28° = h$$

$$2.1 \approx h$$

The sand pile has a height of about 2.1 m.

PRACTISE YOUR NEW SKILLS, p. 321

1.



Use the tangent ratio to solve for x.

$$\tan X = \frac{\text{opp}}{\text{adj}}$$

$$\tan 58° = \frac{x}{12}$$

$$12 \tan 58° = x$$

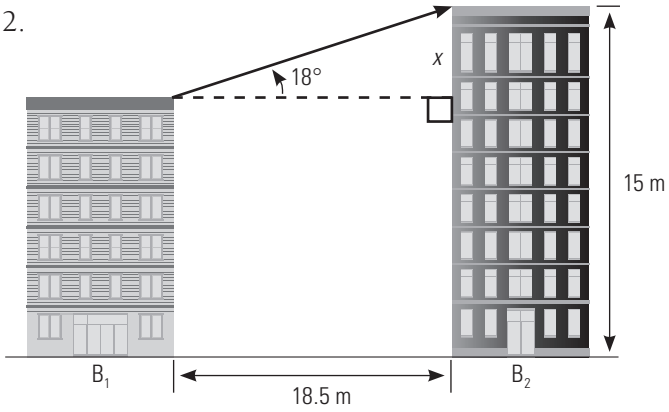
$$19.2 \approx x$$

Add height x to the height of the man to calculate the height of the tree.

$19.2 + 1.7 = 20.9$

The tree is about 21 m tall.

2.



Let the difference in heights of the buildings be x. Use the tangent ratio.

$$\tan X = \frac{\text{opp}}{\text{adj}}$$

$$\tan 18° = \frac{x}{18.5}$$

$$18.5 \tan 18° = x$$

$$6.0 \approx x$$

Subtract the difference in heights from the height of the taller building.

$15 - 6 = 9$

The smaller building is about 9 m tall.

3. Let d be the distance between the base of the house and the base of the ladder. Use the tangent ratio.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$

$$\tan 70° = \frac{15}{d}$$

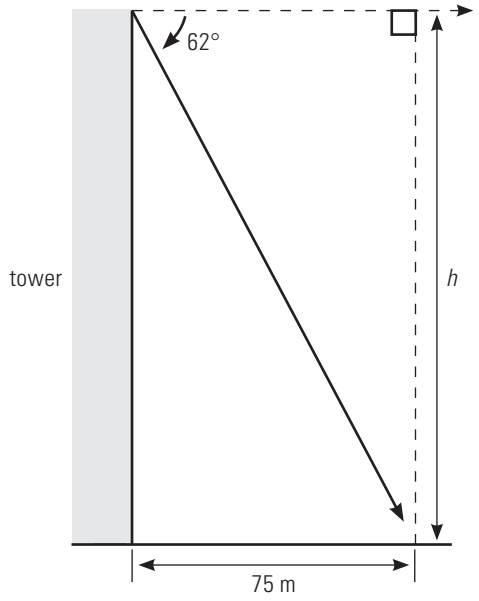
$$d \tan 70° = 15$$

$$d = \frac{15}{\tan 70°}$$

$$d \approx 5.5$$

The foot of the ladder is about 5.5 ft from the house.

4.



Use the tangent ratio to solve for h, the height of the tower.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$

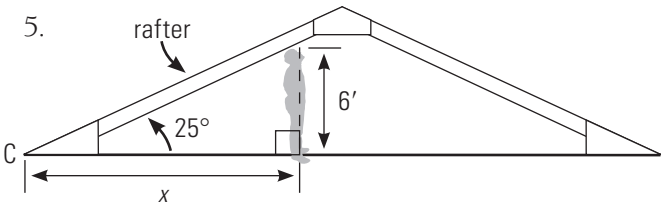
$$\tan 62° = \frac{h}{75}$$

$$75 \tan 62° = h$$

$$141.1 \approx h$$

The tower is about 141.1 m tall.

5.



Use the tangent ratio to solve for x, the distance between the man and the corner.

$$\tan C = \frac{\text{opp}}{\text{adj}}$$

$$\tan 25° = \frac{6}{x}$$

$$x \tan 25° = 6$$

$$x = \frac{6}{\tan 25°}$$

$$x \approx 12.9$$

A 6-foot tall man could stand about 12.9 ft from the corner.

6. Use the tangent ratio to solve for distance AB, the width of the river.

$$\tan C = \frac{\text{opp}}{\text{adj}}$$

$$\tan 75° = \frac{\text{AB}}{100}$$

$$100 \tan 75° = \text{AB}$$

$$373.2 \approx \text{AB}$$

The river is about 373 m wide.

7.5 Finding Angles and Solving Right Triangles

BUILD YOUR SKILLS, p. 325

1. Use the inverse operation of your calculator to solve for the angle meansure.

   a) $\sin D = 0.5491$

   $D = \sin^{-1}(0.5491)$

   $D \approx 33°$

   b) $\cos F = 0.8964$

   $F = \cos^{-1}(0.8964)$

   $F \approx 26°$

   c) $\tan G = 2.3548$

   $G = \tan^{-1}(2.3548)$

   $G \approx 67°$

   d) $\sin H = 0.9998$

   $H = \sin^{-1}(0.9998)$

   $H \approx 89°$

2. The ratio of opposite to hypotenuse is the sine ratio. Use the inverse sine function to solve for the angle.

$$\sin X = \frac{\text{opp}}{\text{hyp}}$$

$$\sin X = \frac{7}{8}$$

$$X = \sin^{-1}\left(\frac{7}{8}\right)$$

$$X \approx 61°$$

$\angle X$ is about 61°.

3. The ratio of opposite to adjacent is the tangent ratio. Use the inverse tangent function to solve for the angle.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

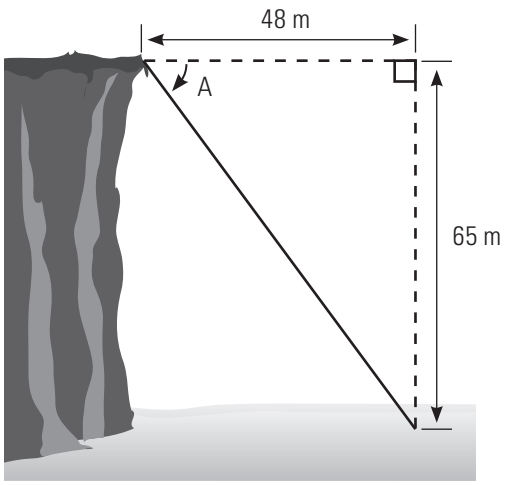
$$\tan A = \frac{15}{8}$$

$$A = \tan^{-1}\left(\frac{15}{8}\right)$$

$$A \approx 62°$$

The angle measure is about 62°.

4.



Let A represent the angle of depression.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\tan A = \frac{65}{48}$$

$$A = \tan^{-1}\left(\frac{65}{48}\right)$$

$$A \approx 54°$$

The angle of depression is about 54°.

5. Use sine ratio to solve for the angle.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin A = \frac{4.2}{6.8}$$

$$A = \sin^{-1}\left(\frac{4.2}{6.8}\right)$$

$$A \approx 38°$$

The angle must measure approximately 38°.

6. Use the cosine ratio to solve for ∠H.

$$\cos H = \frac{\text{adj}}{\text{hyp}}$$

$$\cos H = \frac{5}{8}$$

$$H = \cos^{-1}\left(\frac{5}{8}\right)$$

$$H \approx 51°$$

The angle is about 51°.

7. Use the sine ratio to solve for side *r*.

$$\sin P = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 48° = \frac{5.4}{r}$$

$$r \sin 48° = 5.4$$

$$r = \frac{5.4}{\sin 48°}$$

$$r \approx 7.3$$

The measure of *r* is about 7.3 m.

Use the tangent ratio to solve for *q*.

Note: Do not use cos P to find *q*, because *r* is a rounded value so the answer would be less accurate.

$$\tan P = \frac{\text{opp}}{\text{adj}}$$

$$\tan 48° = \frac{5.4}{q}$$

$$q \tan 48° = 5.4$$

$$q = \frac{5.4}{\tan 48°}$$

$$q \approx 4.9$$

The measure of *q* is about 4.9 m.

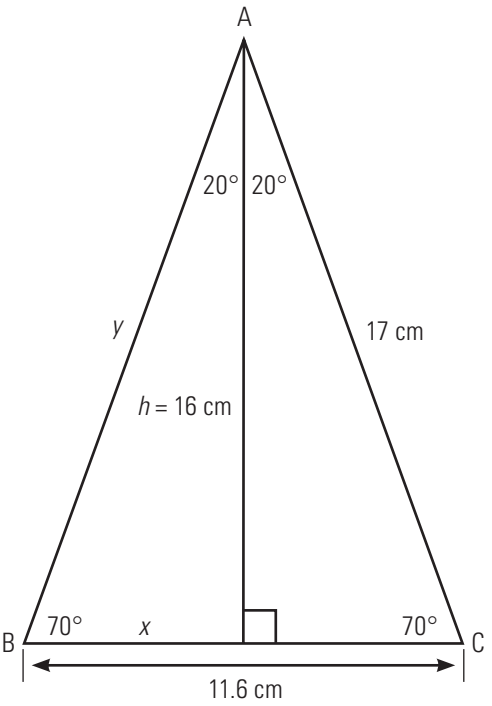
∠P and ∠Q must add up to 90°.

∠Q = 90° − 48°

∠Q = 42°

You could have used tan Q to find *q*. You could also have used cos Q to find *r*.

8.



Calculate ∠BAC.

∠BAC = 180° − 70° − 70°

∠BAC = 40°

Use the tangent ratio to calculate x.

$$\tan B = \frac{\text{opp}}{\text{adj}}$$

$$\tan 70° = \frac{16}{x}$$

$$x \tan 70° = 16$$

$$x = \frac{16}{\tan 70°}$$

$$x \approx 5.82$$

Multiply by 2 to determine BC.

$$2 \times 5.82 = 11.64$$

The base of the triangle measures about 11.6 cm.

Use the sine ratio to find the measure of y.

$$\sin B = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 70° = \frac{16}{y}$$

$$y \sin 70° = 16$$

$$y = \frac{16}{\sin 70°}$$

$$y \approx 17.0$$

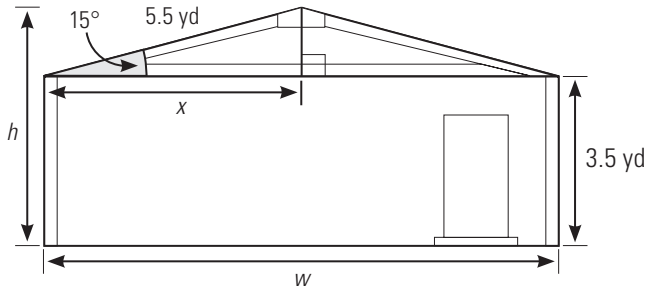
The equal sides are each about 17 cm long.

Calculate the third angle of the triangle.

$180° - 140° = 40°$

The third angle measures 40°.

9.



Calculate the half-width of the building, x.

$$\cos H = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 15° = \frac{x}{5.5}$$

$$5.5 \cos 15° = x$$

$$5.3 \approx x$$

The width of the building is twice the length of x.

$2(5.3) = 10.6$

The width of the building is about 10.6 yards.

Calculate the height of peak section.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 15° = \frac{h}{5.5}$$

$$5.5 \sin 15° = h$$

$$1.4 \approx h$$

The peak of the roof is about 1.4 yd high.

The total height of the building is the height of the peak section plus the height of the walls.

$3.5 + 1.4 = 4.9$

The total height of the building is about 4.9 yards.

10. a) Use the tangent ratio to find ∠R.

$$\tan R = \frac{\text{opp}}{\text{adj}}$$

$$\tan R = \frac{1.5}{2.8}$$

$$R = \tan^{-1}\left(\frac{1.5}{2.8}\right)$$

$$R \approx 28°$$

Subtract to find ∠S.

$$\angle S = 90° - 28°$$

$$\angle S = 62°$$

Use the Pythagorean theorem to find t.

$$t^2 = s^2 + r^2$$

$$t^2 = 2.8^2 + 1.5^2$$

$$t = \sqrt{7.84 + 2.25}$$

$$t = \sqrt{10.09}$$

$$t \approx 3.2$$

Side t measures about 3.2 m.

If you find t first, do not use it to determine R or S, because this would introduce rounding errors.

b) Find ℓ using the Pythagorean theorem.

$$\ell^2 + m^2 = n^2$$

$$\ell^2 + 6.8^2 = 9.5^2$$

$$\ell^2 = 9.5^2 - 6.8^2$$

$$\ell^2 = \sqrt{9.5^2 - 6.8^2}$$

$$\ell = \sqrt{44.01}$$

$$\ell \approx 6.6$$

Side ℓ is about 6.6 cm long.

Use the sine ratio to find ∠M.

$$\sin M = \frac{\text{opp}}{\text{hyp}}$$

$$\sin M = \frac{6.8}{9.6}$$

$$M = \sin^{-1}\left(\frac{6.8}{9.6}\right)$$

$$M \approx 45°$$

∠M measures about 45°.

Subtract to find ∠L.

$$\angle L = 90° - 45°$$

$$\angle L = 45°$$

∠L measures about 45°.

Note: Do not use your approximated values to determine parts of the triangle.

11. Calculate the height of the pole using the sine ratio.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 25° = \frac{h}{18}$$

$$18 \sin 25° = h$$

$$7.6 \approx h$$

The height of the pole is about 8 m.

Calculate the distance from the cable to the pole using the cosine ratio.

$$\cos H = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 25° = \frac{x}{18}$$

$$18 \cos 25° = x$$

$$16.3 \approx x$$

The cable is attached about 16 m away from the pole.

12. Use the tangent ratio to find b.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$
$$\tan 40° = \frac{15}{b}$$
$$b \tan 40° = 15$$
$$b = \frac{15}{\tan 40°}$$
$$b \approx 17.8$$

The measure of b is approximately 18 cm.

Use the cosine ratio to find a.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 40° = \frac{15}{a}$$
$$a \sin 40° = 15$$
$$a = \frac{15}{\sin 40°}$$
$$a \approx 23.3$$

The measure of a is approximately 23 cm.

Let b plus d equal x. Use the tangent ratio to find x.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$
$$\tan 40° = \frac{25}{x}$$
$$x \tan 40° = 25$$
$$x = \frac{25}{\tan 40°}$$
$$x \approx 30$$

Subtract to find d.

$x = b + d$

$d = x - b$

$d = 30 - 18$

$d = 12$

The measure of d is approximately 12 cm.

Let a plus c equal y. Use the sine ratio to find y.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 40° = \frac{25}{y}$$
$$y \sin 40° = 25$$
$$y = \frac{25}{\sin 40°}$$
$$y \approx 39$$

Subtract to find c.

$y = a + c$

$c = y - a$

$c = 39 - 23$

$c = 16$

The measure of c is approximately 16 cm.

PRACTISE YOUR NEW SKILLS, p. 333

1. a) Use the sine ratio and inverse sine function to solve.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$
$$\sin A = \frac{175}{340}$$
$$A = \sin^{-1}\left(\frac{175}{340}\right)$$
$$A \approx 31°$$

$\angle A$ measures about 31°.

b) Use the cosine ratio and inverse cosine function to solve.

$$\cos B = \frac{\text{adj}}{\text{hyp}}$$

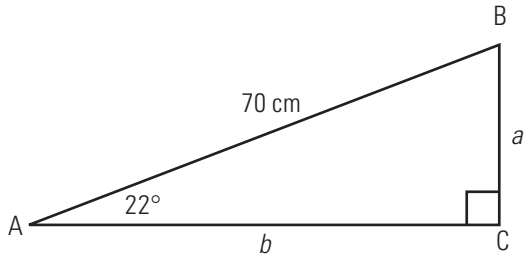
$$\cos B = \frac{135}{200}$$

$$B = \cos^{-1}\left(\frac{135}{200}\right)$$

$$B \approx 48°$$

$\angle B$ measures about 48°.

2.



Subtract to find $\angle B$.

$\angle B = 180° - 90° - 22°$

$\angle B = 68°$

Use the sine ratio to find one leg. Let the leg be a.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 22° = \frac{a}{70}$$

$$70 \sin 22° = a$$

$$26.2 \approx a$$

The measure of the first leg is about 26 cm.

Use the cosine ratio to find the second leg, b.

$$\cos A = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 22° = \frac{b}{70}$$

$$70 \cos 22° = b$$

$$64.9 \approx b$$

The measure of the second leg is about 65 cm.

3. Use the tangent ratio and inverse tangent function to solve.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

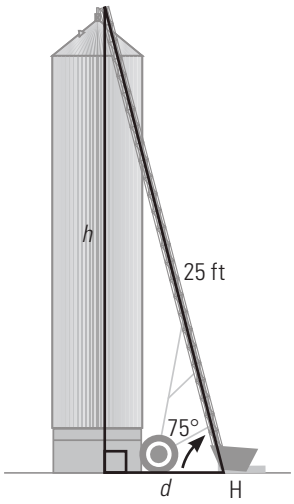
$$\tan A = \frac{1}{3}$$

$$A = \tan^{-1}\left(\frac{1}{3}\right)$$

$$A \approx 18.4$$

The angle of elevation is about 18.4°.

4.



Use the sine ratio to find h.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 75° = \frac{h}{25}$$

$$25 \sin 75° = h$$

$$24.1 \approx h$$

The maximum height the auger reaches to is about 24.1 ft.

Use the cosine ratio to find d.

$$\cos H = \frac{\text{adj}}{\text{hyp}}$$

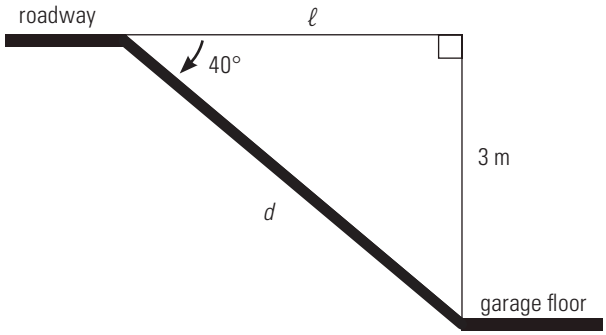
$$\cos 75° = \frac{d}{25}$$

$$25 \cos 75° = d$$

$$6.5 \approx d$$

The auger will be about 6.5 feet from the granary.

5.



Use the sine ratio to find d.

$$\sin A = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 40° = \frac{3}{d}$$

$$d \sin 40° = 3$$

$$d = \frac{3}{\sin 40°}$$

$$d \approx 4.7$$

The driveway is about 4.7 m long.

Use the tangent ratio to find ℓ.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\tan 40° = \frac{3}{\ell}$$

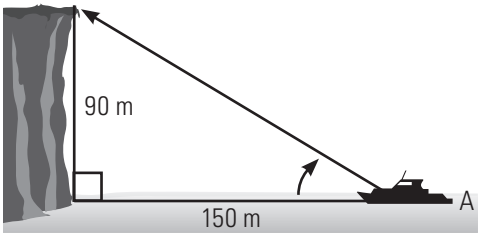
$$\ell \tan 40° = 3$$

$$\ell = \frac{3}{\tan 40°}$$

$$\ell \approx 3.6$$

The garage entrance is about 3.6 m into the lot.

6.



Use the tangent ratio and inverse tangent function to find the angle of elevation.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\tan A = \frac{90}{150}$$

$$A = \tan^{-1}\left(\frac{90}{150}\right)$$

$$A \approx 31.0°$$

The angle of elevation is about 31°.

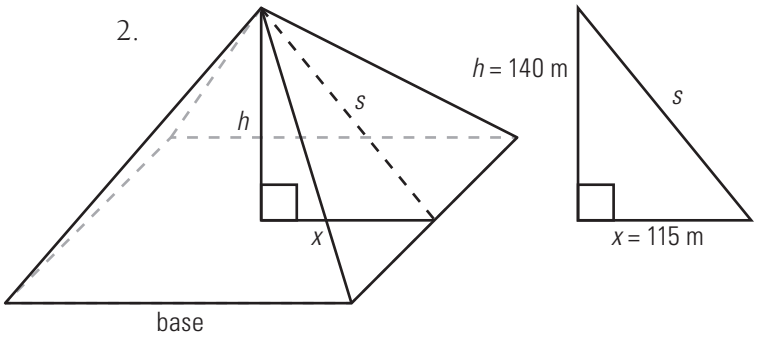
CHAPTER TEST, p. 336

1. Use the Pythagorean theorem to solve.

$$a^2 + b^2 = d^2$$
$$120^2 + 50^2 = d^2$$
$$\sqrt{120^2 + 50^2} = d$$
$$\sqrt{16\,900} = d$$
$$130 = d$$

The diagonal brace is 130 cm long.

2.



Consider the triangle formed by the vertical height, the slant height, and half of the base. Use the Pythagorean theorem to solve.

x = half the length of the base

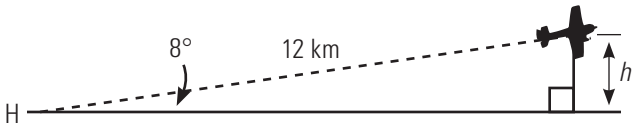
$x = 230 \div 2$

$x = 115$ m

$$s^2 = h^2 + x^2$$
$$s^2 = 140^2 + 115^2$$
$$s = \sqrt{140^2 + 115^2}$$
$$s = \sqrt{32\,825}$$
$$s \approx 181$$

The slant height is about 181 m.

3.

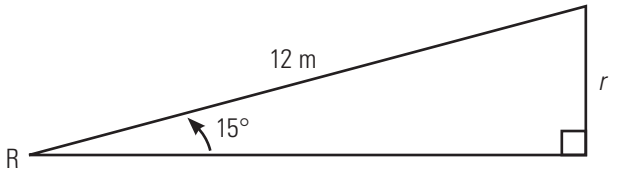


Use the sine ratio to solve.

$$\sin H = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 8° = \frac{h}{12}$$
$$12 \sin 8° = h$$
$$1.67 \approx h$$

The plane climbed about 1.67 km.

4.



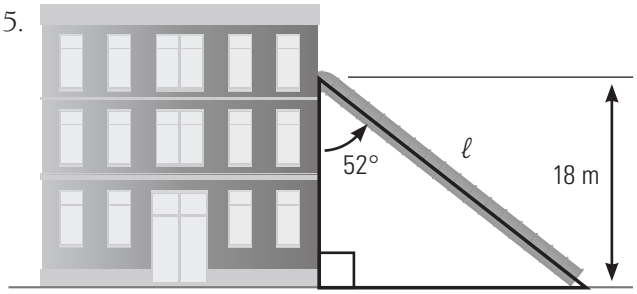
Use the sine ratio to solve.

$$\sin R = \frac{\text{opp}}{\text{hyp}}$$
$$\sin 15° = \frac{r}{12}$$
$$12 \sin 15° = r$$
$$3.1 \approx r$$

The ramp rose about 3.1 m.

Because of similarity of triangles, a 24-m ramp would rise double that of a 12-m ramp, or about 6.2 m.

5.



Use the cosine ratio to solve.

$$\cos W = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 52° = \frac{18}{\ell}$$

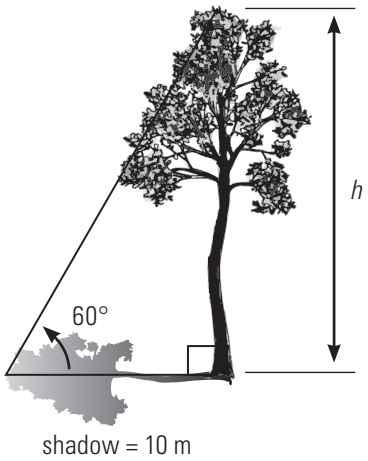
$$\ell \cos 52° = 18$$

$$\ell = \frac{18}{\cos 52°}$$

$$\ell \approx 29.2$$

The chute is about 29.2 m long.

6.



Use the tangent ratio to solve.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$

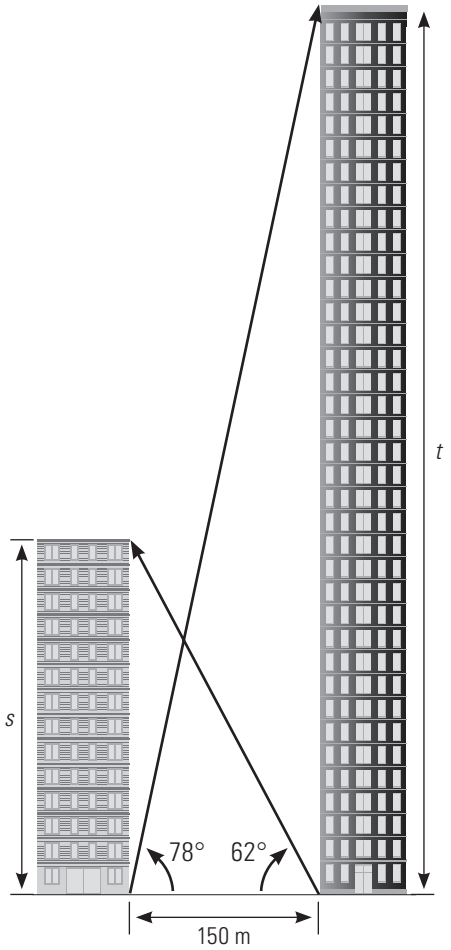
$$\tan 60° = \frac{h}{10}$$

$$10 \tan 60° = h$$

$$17.3 \approx h$$

The tree is about 17.3 m tall.

7.



Use the 78° triangle and the tangent ratio to find the height, t, of the taller building.

$$\tan T = \frac{\text{opp}}{\text{adj}}$$

$$\tan 78° = \frac{t}{150}$$

$$150 \tan 78° = t$$

$$705.7 \approx t$$

The taller building is about 705.7 m tall.

Use the 62° triangle and the tangent ratio to find the height, s, of the shorter building.

$$\tan S = \frac{\text{opp}}{\text{adj}}$$

$$\tan 62° = \frac{s}{150}$$

$$150 \tan 62° = s$$

$$282.1 \approx s$$

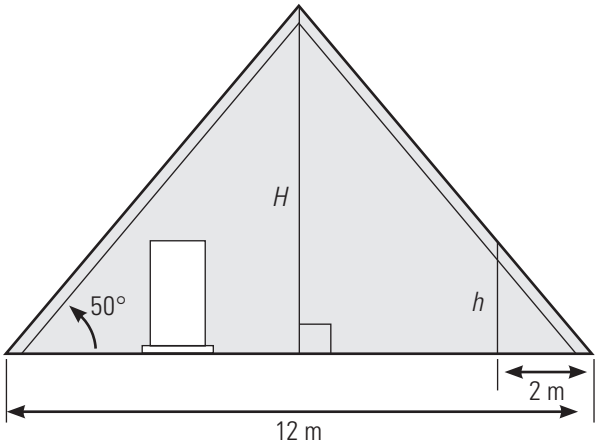
The shorter building is about 282.1 m tall.

Calculate the difference in their heights.

$705.7 - 282.1 = 423.6$

The taller building is 423.6 m taller than the shorter building.

8.



a) Use the tangent ratio to solve for H, the height of the building at its centre.

$$\tan\theta = \frac{\text{opp}}{\text{adj}}$$

$$\tan 50° = \frac{H}{6}$$

$$6\tan 50° = H$$

$$7.2 \approx h$$

The building is about 7.2 m high at its centre.

b) Use the tangent ratio to solve for x.

$$\tan\theta = \frac{\text{opp}}{\text{adj}}$$

$$\tan 50° = \frac{x}{2}$$

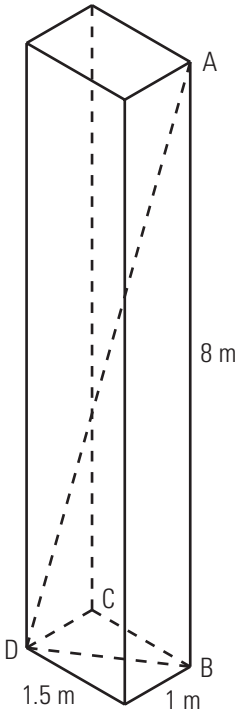
$$2\tan 50° = x$$

$$2.4 \approx x$$

The measure of x is about 2.4 m.

Note: Since 2 m is $\frac{1}{3}$ of 6 m, and because of similarity of triangles, x will measure approximately $\frac{1}{3}$ of 7.2.

9.



The longest object that can fit into the box will be from one vertex to the opposite, A to D.

Find AC, the diagonal of the longest side, using the Pythagorean theorem.

$$a^2 + b^2 = c^2$$

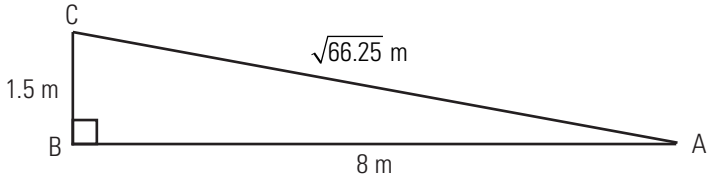
$$BC^2 + AB^2 = AC^2$$

$$1.5^2 + 8^2 = AC^2$$

$$\sqrt{1.5^2 + 8^2} = AC$$

$$\sqrt{66.25} = AC$$

$$8.14 \approx AC$$



In the next step, use the square root of 66.25 instead of 8.14 to avoid rounding errors.

Use right triangle ACD and the Pythagorean theorem to solve for AD.

$$a^2 + b^2 = c^2$$

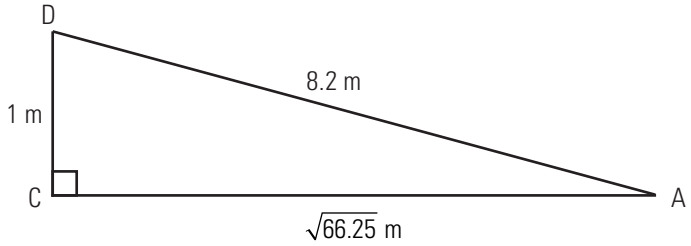
$$AC^2 + CD^2 = AD^2$$

$$(\sqrt{66.25})^2 + 1^2 = AD^2$$

$$\sqrt{66.25 + 1} = AD$$

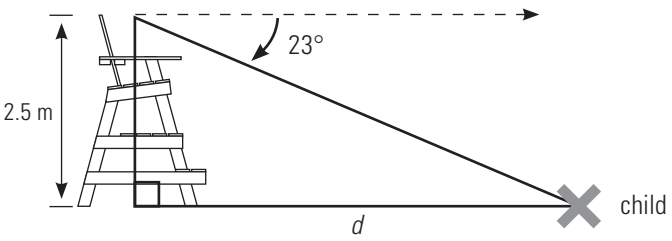
$$\sqrt{67.25} = AD$$

$$8.2 \approx AD$$



The longest object that can fit into the box measures about 8.2 m.

10.



Use the tangent ratio to solve.

$$\tan H = \frac{\text{opp}}{\text{adj}}$$

$$\tan 23° = \frac{2.5}{d}$$

$$d \tan 23° = 2.5$$

$$d = \frac{2.5}{\tan 23°}$$

$$d \approx 5.9$$

The child is about 6 m out from the lifeguard's chair.

11. Use the tangent ratio and the inverse tangent function to solve.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\tan A = \frac{1.2}{2.6}$$

$$A = \tan^{-1}\left(\frac{1.2}{2.6}\right)$$

$$A \approx 24.8°$$

The angle of elevation of the playground slide is about 25°.