Answers

Chapter 1

1.1 SI Measurement, pages 15 to 21

1. a) Example: Use a fingernail width as a referent for 1 cm.
   i) 18 fingernail widths (18 cm)
   ii) 23 fingernail widths (23 cm)
b) Example:
   i) 18.6 cm
   ii) 25 cm. It is not necessary to measure all sides. Opposite sides are equal, and subtraction can be used to calculate some of the smaller sides.

2. a) i) Example: Using a fingernail width as a referent for 10 mm, the curve of the S could be about $2\frac{1}{2}$ fingernail widths.
   ii) Example: Using a hand width as a referent for 10 cm, the curve of the S could be about 2 hand widths.
b) Use a piece of string and lay it down along the shape of the letter, and then measure the string.

3. a) 72 mm; 7.2 cm **b)** 18.4 mm; 1.84 cm
c) 34.4 mm; 3.44 cm

4. a) 105 m **b)** 300 cm or 3 m

5. a) No. Mountain heights are usually reported in metres. 5959 m
b) No. Centimetres are commonly used for distances about as wide as a hand. 6.4 cm
c) No. Metres would be more appropriate for something about twice the height of a person. 4.2 m
d) No. Metres or centimetres are commonly used for distances about the height of a person. 1.95 m or 195 cm

6. a) 384 cm **b)** 611 mm
c) Example: 643 mm

7. Examples: Measuring tape, ruler, laser ruler, car odometer, metre stick, trundle wheel, caliper, transit. To use a measuring tape for shorter distances, place the "0" end at one end of the object you want to measure and then read the length at the other end; for longer distances, count several convenient lengths (for example, 25 m) and then measure the last portion as explained for shorter distances.

8. Example: 159 mm

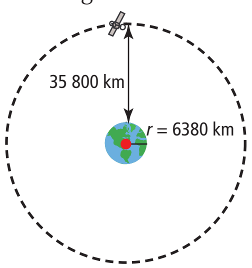
9. No. The ratio of the lengths is 8 cm : 5 cm or 8 : 5. The ratio of the heights is 5 cm : 2.5 cm or 10 : 5. The ratios are not the same, so the reduction would not be proportional.

10. 1.4 m

11. a) dime: 17.79 mm
   quarter: 23.59 mm
b) 17.79 : 23.59 ≈ 1 : 1.3
c) Example: 31.28 mm. The actual diameter of a loonie is 26.5 mm. The ratio does not apply. Also, the penny and nickel are bigger in size than the dime yet worth less. The size of the coin does not indicate its value.

12. a) 1 : 6 250 000
b) 475 km
c) Example: from Virginia Falls: 250 km; from Rabbitkettle Lake: 338 km. The distance is 88 km greater from Rabbitkettle Lake.

13. a)



b) 40 086.7 km
c) 265 024.8 km **d)** 9372.4 km/h faster

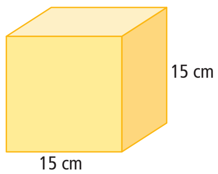
14. a) Example: Use a fingernail width as a referent for 1 cm: 10 cm by 1.5 cm by 5 cm
b) front face: 22.4 cm; side face: 12.2 cm; top face: 28.6 cm. Three perimeters were calculated because opposite faces are the same. There are six faces in total.
c) 293 mm

15. 230 m

16. a) 442.5 m
b) Example: The route affects the total distance because if you finish cutting the last portion of grass far away from your starting point, you will then have to walk across grass you have already cut to get back to A. By using a route that allows you to finish the last part of cutting near your starting point, you minimize the amount you walk over any part twice.

17. 15.9 cm

18. a) about 1 m or 100 cm
c) Example: The bandage will stretch more if pulled tight, and as well, there will be some overlapping of the bandage.

19. a) Example: Estimate that the tubes are 10 mm in diameter; about $(15)(15) = 225$ tubes would fit inside. But tubes are $\frac{4}{5}$ of 10 mm. So, about $\left(\frac{4}{5}\right)(225) \approx 280$ tubes would fit inside.
b)


c) Example: 360 tubes, if each tube settles between the two tubes below it. To check, you could draw a 15-cm by 15-cm square on a piece of paper and cut an 8-mm circular hole in another piece of paper. Then, trace as many circles as possible inside the square.

20. a) Example: Measuring down the inside of a pan, across the bottom, and up the other side gives 36.8 cm. Inside surface area is 338.56π cm^2; measuring according to the formula gives $d = 30$ cm and $h = 6.0$ cm. $S = 405\pi$ cm^2; the factory formula yields a surface area that is too large, since the formula does not take into account the curved nature of most frying pans.
b) No. Since d is the diameter of the entire pan, including the distance the sloping side adds to the flat bottom dimension, the formula will produce an area that is too large unless the side of the pan is perfectly vertical.

21. **Step 2:** Examples: A student may cut the corners. A student may slow down for the corners. A student may take smaller steps in order to make the corner.

1.2 Imperial Measurement, pages 29 to 35

1. a) $\frac{1}{16}$ in.
b) $\frac{1}{40}$ in.; 0.025 in.
c) $\frac{1}{1000}$ in.; 0.001 in.

2. a) $13\frac{1}{2}$ in.
b) $\frac{3}{4}$ yd
c) 76 mi
d) 15 840 ft

3. Example:
a) $1\frac{7}{8}$ in.; length of an eraser
b) 3.154 in.; width of a calculator
c) 0.593 in.; diameter of a penny

4. Example:
a) a caliper; $\frac{5}{16}$ in.
b) a string; 1 in.
c) a ruler; $5\frac{7}{8}$ in.

5. Example:
a) $4\frac{3}{4}$ small paper clips; $5\frac{1}{4}$ in.
b) $6\frac{3}{4}$ paper clips; 7 in.

6. a) Example: Use one large step as a referent for 3 ft.
b) Example: Use the length of your calculator as a referent for 6 in.

7. a) 6.25 mph
b) 9.6 min

8. 183.4 in.

9. a) Determine the circumference of the drive wheels and the caster wheels. Then, divide the first value by the second. 1:8
b) about 119
c) about 1261

10. a) 1:2
b) about $3\frac{7}{8}$ in.

11. a) Example: No. Gail calculated $(7.5)(5) = 37.5$ ft^2, but $0.5 \text{ ft}^2 \neq 5 \text{ in}^2$. $1 \text{ ft}^2 = (12 \text{ in.})(12 \text{ in.}) = 144 \text{ in.}^2$, so $0.5 \text{ ft}^2 = 72 \text{ in.}^2$.
b) 75 tiles

12. a) $4\frac{11}{16}$ in.
b) $\left(4\frac{1}{4} \text{ in.}\right)\left(\frac{5}{8} \text{ in.}\right)\left(2\frac{3}{4} \text{ in.}\right)$
c) Example: 10 in.

13. a) Example: about 1000 yd. The direct distance on the map from the captain to the cache is about $2\frac{1}{2}$ in. The distance on the map along the route taken is about 5 in.
b) 950 yd or 2850 ft. The actual distance is farther since the paths between the red dots are not straight.

14. a) 19 ft 1 in.
b) 62 ft: 19 ft 9 in.; 65 ft: 20 ft 8 in.; 70 ft: 22 ft 3 in.
c) The 62 ft length would add approximately 4 in. all around the circumference of the pool.

15. a) Comet Hyakutake: 9 462 909 mi; Comet Hale-Bopp: 122 236 992 mi
b) 112 774 083 mi

16. a) Any pairs of corresponding sides.

$AC:DF = \frac{3}{4}:1\frac{3}{8} = 1:1.8;$

$BC:EF = \frac{3}{8}:\frac{11}{16} = 1:1.8;$

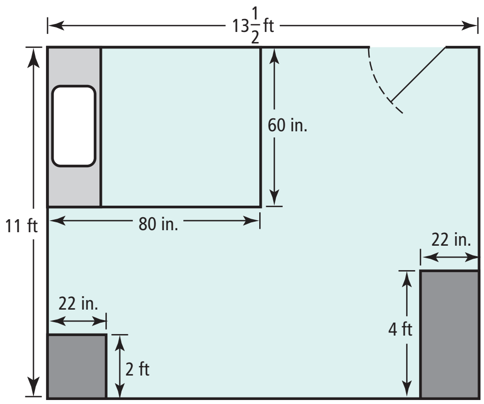
$AB:DE = \frac{9}{16}:1 = 1:1.8$

b) Similar triangles have the same shape but are larger or smaller by a scale factor.

c) Look for a figure enlarged by a factor of 3. Check that the lines drawn from the point to the enlargement are three times as long as the ones drawn from the point to the original figure.

17. a) double bed: 54 in. by 75 in.; queen-size bed: 60 in. by 80 in.

b) Example:



c) Example: Sam could buy either bed, as each size fits with his current furniture. The queen-size bed is larger and would be the better purchase.

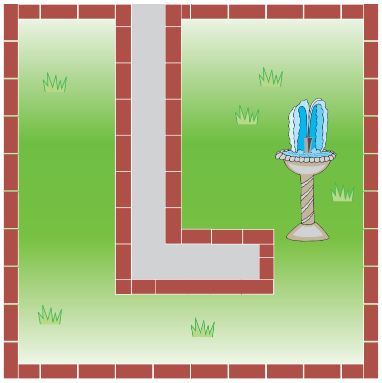
18. a) 14 ft

b) small turbine: 41.77 mph; large turbine: 46.77 mph

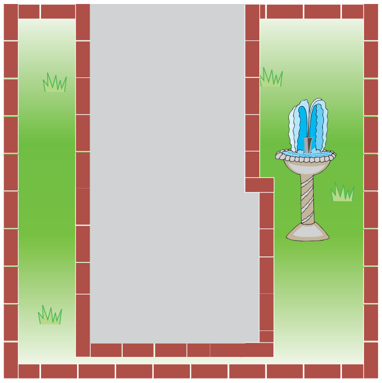
19. a) Example: 15 in. Each side looks to be about 2.5 in. and the border around the pathway looks to be about the same as the length of two sides.

b) 11.75 in.; Estimate overstated perimeter by 3.25 in.

c) Perimeter is 11.75 in.



d) Example: As the width of the pathway increases, the perimeter of the border remains the same.



1.3 Converting Between SI and Imperial Systems, pages 42 to 47

1. a) $2\frac{3}{8}$ in. **b)** 83 mm

c) $\frac{7}{8}$ in. or 22 mm

2. a) 0.03 mm **b)** 16 ft

c) 42.19 km **d)** 9.84 cm

3. a) Example: 8 in. or 20 cm

b) Example: 5 hand spans

c) Example: 24 in. or 60 cm

d) Example: about 2650 paces to walk a mile; about 1700 paces to walk a kilometre

e) Example: SI is easier because the units are multiples of powers of 10.

4. a) about 1.4 m **b)** 1:150

c) 1.5 m **d)** 9.2 ft by 12.8 ft

5. Maximum depth is 399 yd; Mount Columbia is 12 287 ft (2.33 mi) high; Mount Athabasca is 11 453 ft (2.17 mi) high; Average snow fall is 3.28 ft (39.4 in.).

6. a) 63 mm; $2\frac{1}{2}$ in.   b) $2\frac{5}{16}$ in.; 5.87 cm
   c) 1.536 in.; 3.901 cm   d) 4.78 cm; 1.9 in.
7. a) $45\frac{1}{2}$ ft or 45 ft 6 in.
   b) 13.87 m. Usually, measurements greater than 200 or 300 cm are reported using metres.
8. 175 km
9. a) metres to kilometres: divide by 1000; metres to centimetres: multiply by 100; yards to miles: divide by 1760
   b) In a length conversion, if the unit gets larger, the number must get smaller. Therefore, divide by the conversion factor to get a smaller number of the larger units. This works in either system, because a smaller number of larger units are required for the equivalent length.
   c) If the units get smaller, the number must get larger. Therefore, multiply by the conversion factor to get more of the smaller units.
10. Multiply the number of kilometres by $\frac{5}{8}$.
    Since 164 km ≈ 103 mi, Penny travelled a greater distance.
11. Lake Baikal: 1636 m; Great Slave Lake: 614 m; Great Slave Lake is 108 m deeper than Quesnel Lake
12. about 3951 mi
13. a) $41\frac{3}{4}$ in.
    b) Example: Using the SI measurements given, calculate the perimeter taking advantage of equal distances, then convert to inches. This way, you only have to do one conversion instead of many, which would make your answer less accurate.
14. a) 1667 LPs. Example: $\frac{20\ 000}{10} = 2000$ LPs
    b) 185.2 in. or 15 ft $5\frac{3}{16}$ in.; 9400 : 183 or 51.4 : 1
15. a) 24 blocks
    b) 63 in. by $47\frac{1}{4}$ in. by $15\frac{3}{4}$ in.
    c) 32 extra blocks. Example: Each length and each width will be increased by 2 units. So, 1 extra block is needed on each side. $(2)(4) = 8$ more blocks than for the inside wall. $24 + 8 = 32$
16. a) Example: 234 m^2
    b) This formula will work for imperial units, as long as the imperial units are converted to decimals. For example, 6 ft 6 in. = 6.5 ft.
17. a) Example: SI: distances between towns, distances in Olympic events, thickness of plastic sheeting. Imperial: dimensions of building materials, distances between towns in the United States, dimensions of paper
    b) Approximate: distances between towns, distances between towns in the United States. Exact: distances in Olympic events, thickness of plastic sheeting, dimensions of building materials, dimensions of paper stock
18. Example: 144 in.: $144 \text{ in.}\left(\frac{1 \text{ yd}}{36 \text{ in.}}\right) = 4$ yd;
    $4 \text{ yd}\left(\frac{0.9144 \text{ m}}{1 \text{ yd}}\right) = 3.6576$ m

Chapter 1 Review, pages 48 to 50

1. Example: Use a string to follow the curve of the object or, if possible, roll the object across a surface one rotation and measure the distance travelled.
2. 5.7 cm
3. 2.46 cm
4. 62.8 cm; 285.8 cm^2
5. Example: 46.7 cm
6. b) Use a string to trace out the S shape, then measure the length of the string.
7. $D = 6\frac{3}{4}$ in.; distance from C to D is $2\frac{9}{16}$ in.
   You could count by $\frac{1}{16}$ or subtract the reading at C from the reading at D.
8. a) 5.356 in.
   b) 5.121 in. The perimeter of the triangle is smaller because the triangle can be drawn inside the quarter circle. The shortest distance between two points is a straight line, not a curve.
9. a) $2\frac{1}{4}$ in. by $4\frac{1}{2}$ in.
   b) Scale factor is 1.78 to fit the height. The width will need to be cropped, as the scale factor for the width is smaller than that of the height.
10. a) 256 mi   b) 83 ft
11. Approximation, because 8 ft $11\frac{1}{10}$ in. = 2.72034 m. The stated height of 2.7 m is shorter by a little more than 2 cm.
12. Example: About 2.6 times as tall with head down. About 63.75 in. tall with head up. This could be stated as 5 ft $3\frac{3}{4}$ in. Most heights are given this way.

13. a) 1 cm = 8.8 km **b)** 1 in. ≈ 13.9 mi
c) about 30 mi **d)** Faust

Chapter 1 Practice Test, pages 51 to 53

1. D
2. B
3. C
4. C
5. C
6. a) Example: Use a natural step as a referent for 2 ft. Use an exaggerated step as a referent for 1 m; feet, yards, metres
b) inches and centimetres; 1 in. = 2.54 cm
7. 7 cm by 15 cm
8. 7, 8, and 9 mm
9. Example: 29 ft 10 in.
10. a) Assuming their first line was 5 yd from an end wall, they drew 8 lines.
b) 3.76 yd
c) 404 yd. They will run twice the distance from the wall to each line and then the length of the gym.
d) 320 m (about 350 yd, 54 yd less). Yes. Using yards, they had to make an extra round trip almost the full length of the gym.

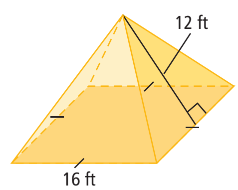
Chapter 2

2.1 Units of Area and Volume, pages 61 to 65

1. a) 1 500 000 m^2 **b)** 82.8 km^2
c) 2258.1 cm^2 **d)** 97.5 m^2
2. a) 75 000 mm^2 **b)** 0.005 16 m^2
c) 27 870.9 cm^2
3. 194 yd^2
4. a) 3540 cm^3 **b)** 39 329 cm^3
5. 1.3 m^3
6. 58.8 ft^2, 5.46 m^2
7. a) The bedroom in the new house is bigger by 3.9%.
b) $177.23
8. 51 km^2
9. a) 2604 in.^{2} **b)** 180 tiles
10. a) The locker from the double stack has more volume.
b) It has 0.158 m^3 more space.
11. Example: When converting from a smaller unit to a larger unit, divide by a power of 10. The conversion factor for SI units of volume is found by raising the conversion factor from the smaller unit to the larger unit, to the power of 3. This result is the power of 10 to be used when dividing. The same method is used when converting from larger to smaller units, except for multiplying by the power of 10.
a) 1 000 000 cm^3
b) 0.000 355 m^3
c) 2 500 000 000 mm^3
12. a) 80 586 ft^2
b) 7487 m^2
c) 0.7487 ha
14. Example: architect, draftsperson, mechanic, carpenter, electrician, grocer, tile layer, plumber, engineer
16. Example: There may be a need for conversions in the meat, deli, and produce department. Some customers may still think in imperial measurements when purchasing a mass of meat, cheese, vegetables, or fruit.

2.2 Surface Area, pages 74 to 79

1. a) 13.6 m^2 **b)** 4775.2 in.^{2}
c) 275.7 cm^2 **d)** 237 in.^{2}
e) 162.9 cm^2
2. 640 ft^2



3. a) 43.1 cm **b)** 11.0 m **c)** 2.7 m
4. 6 in.
5. 734.3 cm^2
6. Example: There are no computational errors in Austin's work. But, he does not need to paint the ends of the pillars if they will be standing upright. I would just paint the lateral surface area which is 50.24 ft^2 for each pillar.
7. 182.46 m^2
8. a) 664 cm^2 **b)** 414.34 cm^2
9. I assumed there were two bases. 96.9 cm
10. 58 307 960 mi^2
11. 314 in^2
12. 1841 m^2
13. 380 mm^2
14. 5 m^2

15. a) Minimum: 4902 mm^2;
Maximum: 5153 mm^2

b) Minimum: 39.5 mm by 39.5 mm by 39.5 mm;
Maximum: 40.5 mm by 40.5 mm by 40.5 mm

16. 192.3 cm^2

17. 1353.2 mm^2

18. a)

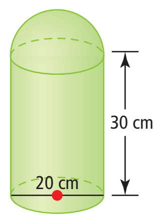
Investigating Changes in Dimensions of a Sphere			
Stretch Ratio	Radius	Surface Area	Ratio of New SA to Original SA
1	2	50.265	1
2	4	201.06	4
3	6	452.385	9
4	8	804.24	16
5	10	1256.625	25
6	12	1809.54	36

b) It is the square of the stretch ratio.

c) 1809.54 square units

d) Example: The stretch ratio causes the area to change by the square of the stretch ratio.

19. Example: The surface area is 2826 cm^2. To convert to square inches, divide 2826 by 6.45. So, the surface area in imperial units is 438.14 $in.^2$



20. Example: Surface area is the sum of the areas of the faces of a three-dimensional object. Area is measured in square units, so surface area is also measured in square units.

2.3 Volume, pages 86 to 91

1. a) 192 666.7 cm^3 or 0.2 m^3

b) 578 000 cm^3 or 0.6 m^3

c) 1005.3 ft^3

d) 335.1 ft^3

e) 2 226 094.9 mm^3

2. a) 48 $in.^3$ **b)** 754 cm^3

3. 0.1 m^3

4. a) Erin is correct. Example: Janine is incorrect because she divided the volume of the entire object by 3.

b) Example: Erin's method.

5. a) 8.4 cm **b)** 12 in.

c) 6.0 cm **d)** 1.8 yd

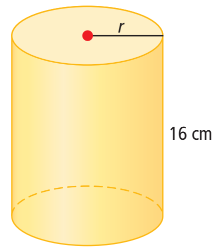
6. 801 599.64 m^3

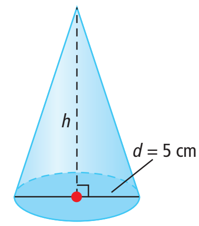
7. 6 in. by 6 in. by 6 in.

8. 18 cm^3

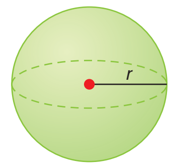
9. 160 cm^3

10. a) $r = 3.2$ cm **b)** $h = 3.1$ cm





c) $r = 2.3$ cm



11. 5.1 m^3

12. 12 ft

13. a) 45 ft^3 **b)** Example: 35 ft^3

c) 33.75 ft^3; The volume decreased by $\frac{1}{4}$.

14. 81.5 cm^3

15. Example: 70 $in.^3$

16. 621.12 songs/cm^3 on the MP3;
0.06 songs/cm^3 on the vinyl record

17. Example: If a cone and a sphere have the same radius and the height of the cone is the same measurement as the radius of the cone, then the volume of the sphere is 4 times the volume of the cone.

18. 11.2 cm^3

19. a)

Investigating Changes in Radius of a Sphere			
Stretch Ratio	Radius	Volume	Ratio of New Volume to Original Volume
1	3	113.1	1
2	6	904.8	8
3	9	3053.7	27
4	12	7238.4	64
5	15	14137.5	125
6	18	24429.6	216

b) Example: The stretch ratio is cubed.

c) Example: The ratio will be 6 cubed or 216.

d) Example: The volume is increased by the cube of the stretch ratio or the radius.

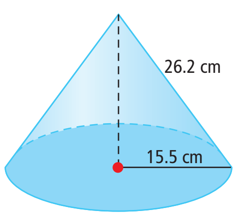
20. Example:

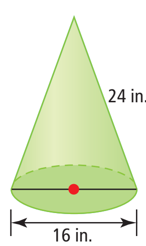
Investigating Changes in Dimensions of a Square Pyramid				Ratio of New Volume to Original Volume
Stretch Ratio	Side	Height	Volume	
1	2	2	2.67	1
2	4	4	21.33	8
3	6	6	72.00	27
4	8	8	170.67	64
5	10	10	333.33	125
6	12	12	576.00	216

21. Example: stereo cabinet
a) Estimate the volume to be 0.5 m^3 in SI units and 0.5 yd^3 in imperial units.
b) In imperial units it is actually 0.4703 yd^3 and in SI units it is 0.35958 m^3.
c) The estimate was closer to the imperial units. My personal referent for imperial units is more accurate.

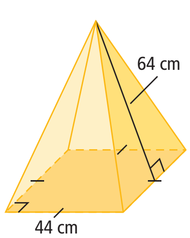
Chapter 2 Review, pages 92 to 94

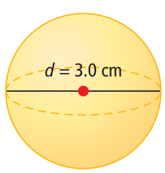
1. a) 8100 cm^2 **b)** 0.54 $in.^2$
2. a) 423.84 ft^3 **b)** 1029.63 cm^3
3. Example: For 1 cm^2, my referent is the area of my little finger nail. For 1 $in.^2$, my referent is the area of a 25¢ coin. For 1 m^2, my referent is the front of the square bookshelf in my bedroom.
4. 25.84 lb
5. a) 2030.57 cm^2 **b)** 804.25 in^2





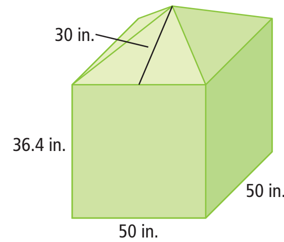
c) 7568 cm^2 **d)** 28.27 cm^2





6. a) $s = 1.64$ m **b)** $s = 40$ cm
c) $r = 5.54$ cm
7. 2 m^2, assuming the tire is a cylinder and the cover will enclose the total surface

8. a) 50 in. by 50 in. by 36.4 in.
b) 28 in. by 28 in. The dog should be able to walk in without crouching down.
c)



d) 12 780 $in.^2$
9. 1.77%
10. a) 21 205.75 ft^3 **b)** 74.22 cm^3
c) 1008 ft^3 **d)** 288.70 cm^3
11. a) 0.73 m **b)** 4.66 cm
c) 4.20 m **d)** 8.38 cm
12. a) 4300 m^3 **b)** 239 truckloads
13. a) 6 283 185 mm^3 **b)** 5 497 787 mm^3

Chapter 2 Practice Test, pages 95 to 97

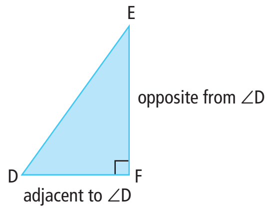
1. A
2. A
3. D
4. A
5. B
6. $SA = 2463$ cm^2; $V = 11\ 494$ cm^3
7. 24 572.5 mm^3
8. 58.24 m^2
9. The small size should be the container with radius 7 cm and height 18 cm since its volume is 2770.88 cm^3. The large size should be the container with the radius of 8 cm and height of 16 cm since its volume is 3216.99 cm^3.
10. a) 760.7 cm^3 **b)** 1051.3 cm^3
11. $SA = 72.2$ in^2; $V = 39.65$ in^3
12. a) 100 000 000 m^3, assuming the kimberlite is a cylindrical shape with a height of 2 km and base area of 50 000 m^2
13. a) 3.9 ft
b) The prism has a surface area of 94 ft^2. The cylinder has a surface area of 85.15 ft^2. Therefore, the cylinder's surface area is the least.

Chapter 3

3.1 The Tangent Ratio, pages 107 to 113

1. a) hypotenuse: XZ; opposite: ZY; adjacent: XY
b) hypotenuse: ST; opposite: SR; adjacent: RT
c) hypotenuse: LM; opposite: MN; adjacent: LN

2. a)

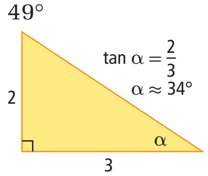


b) $\tan D = \frac{EF}{DF}$

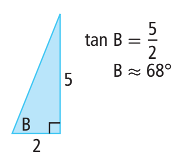
3. a) 3.4874 **b)** 1 **c)** 1.7321
d) 57.2900 **e)** 0.7536 **f)** 0.3249

4. a) 35° **b)** 60° **c)** 29°
d) 49°

5. a)



b)



6. a) $x \approx 19.8$ m **b)** $\theta \approx 3.6°$

7. a) 45° **b)** 17 ft

8. approximately 33.8° and 56.2°

9. a) 29 ft
b) The ratio 1:12 is the tangent of the angle of the ramp. For a safe ramp, the angle of inclination would have to be less than or equal to 4.8°. The ramp shown is not safe.

10. T1: 11.7 km; T2: 37.0 km; T3: 49.2 km

11. approximately 0.5°

12. 1592 ft

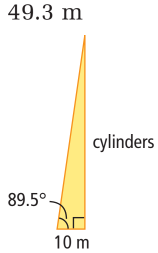
13. a) approximately 35°
b) approximately 260.19 m

14. a) approximately 304.3 m
b) approximately 783.24 m

15. a) approximately 6.11 ft
b) approximately 16.75 ft

16. a) 49.3 m **b)** 50.0 m

17. a)

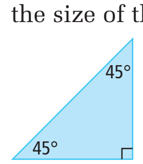


b) 1145.89 m **c)** 11 459 cylinders

18. Example: Ratio: A ratio is the proportion of one number to another. The tangent ratio is the proportion of the length of the side opposite the subject angle in relation to the length of the side (that is not the hypotenuse) adjacent to the subject angle.
$\theta = 63°$: The symbol θ is generally used to indicate the size of an angle. If $\theta = 63°$, the proportion of the lengths of the opposite and adjacent sides is approximately 1.96.
tan 42°: The value of tan 42° is approximately 0.9, so the length of the side opposite the angle measuring 42° is approximately 0.9 times the length of the side that is not the hypotenuse, but that is adjacent to the angle measuring 42°.
$\tan \theta = 1.428$: The value of θ is approximately 55°, so the proportion of the length of a side in a right triangle opposite an angle measuring 55° compared to the length of the side that is not the hypotenuse, but that is adjacent to the angle measuring 55° is approximately 1.428.
$\tan \theta = \frac{3}{4}$: The value of θ is approximately 36.87°.

Opposite Side: You can determine the length of the side opposite the subject angle in a right triangle by using the tangent ratio if the length of the side that is not the hypotenuse, but that is adjacent to the subject angle is known, as well as the size of the subject angle.
Adjacent Side: You can determine the length of the side that is not the hypotenuse, but that is adjacent to the subject angle in a right triangle by using the tangent ratio if the length of the side opposite the subject angle is known, as well as the size of the subject angle.

19.



The triangle is isosceles with both acute angles measuring 45°.

20. In the small triangle, both the lengths of the opposite side of the angle and the side adjacent to the angle are known, so Devin could input $\tan^{-1}(2 \div 1.1)$ into his calculator to find that the angle is approximately 61.2°.

21. **Step 2:** Sight through the straw on the transit to the object. Record the angle the straw makes with the protractor on the transit. Use the tangent ratio with this angle and the baseline distance, AB, to determine the distance from point B to the object.
Step 3: Example:

Object	Length of Baseline AB	Measure of ∠A	Distance to the Object (to the nearest tenth of a metre)
Goal posts	30 m	60°	52.0 m
Back stop	25 m	35°	17.5 m

3.2 The Sine and Cosine Ratios, pages 120 to 124

1. **a)** 0.8290 **b)** 0.5534 **c)** 0.8902
d) 0.3355 **e)** 1 **f)** 0.1736

2. **a)** $\frac{12}{13}$ **b)** $\frac{5}{13}$ **c)** $\frac{12}{13}$
d) $\frac{21}{29}$ **e)** $\frac{21}{29}$ **f)** $\frac{20}{29}$

3. **a)** 62° **b)** 47°
c) 34° **d)** No such angle exists.
e) 30° **f)** 41°

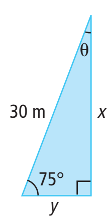
4. **a)** 15.3 **b)** 22.7

5. **a)** 33.2° **b)** 36.9°

6. **a)** $\theta \approx 44.4°$ **b)** $x \approx 14.2$ ft
c) $\theta \approx 40.7°$ **d)** $x \approx 226.5$ m

7. 10.1 m

8. **a)**

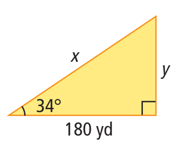


b) 29.0 m

9. 39.8 m

10. 8485.3 m

11. **a)**

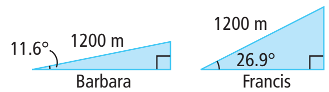


b) 217 yd
c) approximately 84 yd shorter

12. 17°

13. **a)** Because two sides are known, the Pythagorean relationship could be used to determine the height.
b) The lengths of the adjacent side and the hypotenuse are known, so the cosine ratio could be used to determine the angle.

14. **a)**

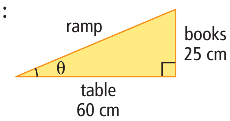


Comparing triangles representing the two situations shows that Barbara will cover a greater horizontal distance.
b) 105.3 m

15. $x \approx 6.01$ m; $y \approx 10.23$ m; $\theta \approx 35.6°$

16. approximately 173.2 cm

17. **Step 1:** Example:



$\theta \approx 22.6°$
Step 4:
a) As the launch angle of the ramp increases, the distance the marble travels increases. This change in distance travelled occurs because at higher angles, the marble will stay in the air longer and travel farther horizontally.
b) Yes. Making the angle of the ramp larger would increase the speed at which the marble leaves the ramp, so it would increase the horizontal distance travelled when the ramp curves up at the end.

3.3 Solving Right Triangles, pages 131 to 135

1. **a)** $\angle = 60°$; $x \approx 8.7$; $y = 5$
b) $\angle = 45°$; $x = 7$; $y \approx 9.9$
c) $\angle B \approx 30.3°$; $\angle C \approx 59.7°$; $BC \approx 13.9$
d) $\angle J = 29°$; $MD \approx 1.7$; $MJ \approx 3.4$

2. **a)** 14.2 cm **b)** 12.4 cm

3. 75°

4. **a)** angle of depression **b)** angle of elevation
c) angle of depression **d)** angle of elevation

5. **a)** approximately 16.17°
b) approximately 38.66°
c) approximately 65.06°
d) approximately 21.80°
e) approximately 37.95°

6. 1079 m

7. The boat is not safe, because it is approximately 51.2 m from the cliff.

8. 504 ft

9. **a)** maximum distance: approximately 204.9 m; minimum distance: approximately 192.2 m
b) maximum angle: approximately 87.6°; minimum angle: approximately 69.5°

10. approximately 165.1 m

11. **a)** approximately 6.2 mi
b) approximately 7.9 mi

12. a) The boat on the left is closer to the helicopter, because the larger the angle of depression, the closer the object is to the base of where the object is sighted.

b) 1601 m

13. 32.3 m

14. a) 123 m

b) The truck is travelling at approximately 12.3 m/s, which is equivalent to approximately 44 km/h, so the truck driver is speeding.

15. approximately 3524 cm^3

16. a) Richard is incorrect. The angle of depression sighting down will equal the angle of elevation sighting up.

b) Because $\alpha = \theta$, knowing the angle of depression (α) gives the angle of elevation (θ). If we know the height of the window and the horizontal distance, the tangent ratio can be used to determine the value of θ. If we know the height of the window and the length of the line of sight, the sine ratio can be used to determine the value of θ. If we know the length of the line of sight and the horizontal distance, the cosine ratio can be used to determine the value of θ.

Chapter 3 Review, pages 136 to 137

1. BC = 4; AC ≈ 2.6; XZ ≈ 7.9

2. a) $x \approx 17.3$ **b)** $\theta \approx 54.0°$ **c)** $y \approx 2.3$

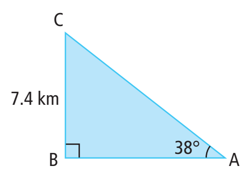
3. 52°

4. a) $x \approx 9.8$ **b)** $x \approx 11.0$ **c)** $\theta \approx 56.4°$

5. 41.0°

6. 12.6 ft

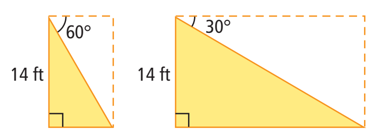
7. a)



b) ∠C = 52°; AB ≈ 9.5 km; AC ≈ 12.0 km

8. approximately 208.4 m

9. The swimmer is moving away from the lifeguard, because as the angle of depression decreases, the distance from the base of the position of sighting increases.



The swimmer has travelled approximately 16.2 ft.

Chapter 3 Practice Test, pages 138 to 139

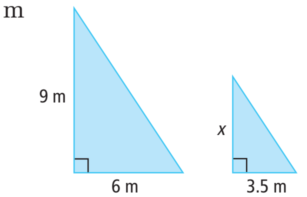
1. C

2. B

3. A

4. D

5. 5.3 m



6. a) 0.3057 **b)** 0.9272 **c)** 0.9205

7. a) 15° **b)** 80° **c)** 42°

8. The second ratio should be cos 18° not sin 18°. The cosine ratio is used in conjunction with the angle's adjacent side and hypotenuse.

9. a) 9.5°

b) No. The puck will be approximately 51 in. high when it reaches the net, which is only 48 in. high.

Unit 1 Review, pages 140 to 143

1. Example: millimetre: thickness of one sheet of Bristo board; centimetre: width of small finger; metre: length of a large step; inch: width of adult male thumb at base of nail; foot: distance from elbow to wrist; yard: length of a large step

2. a) 2.5 cm, because two fingers would total 1 in., which is equal to approximately 2.54 cm.

b) 38.1 cm, because 5 hand widths total 15 in., and (15)(2.54) = 38.1.

c) 6.4 m, because 14 steps total 7 yd, which is equal to 252 in. There are approximately 39.37 in. in 1 m. 252 ÷ 39.37 = 6.4

3. a) 350 cm **b)** 42 in.

c) 8.723 km **d)** 1.2954 m

e) approximately 26.4 in.

f) approximately 8.7 mi

4. 19 ft 2 in.

5. 5 ft $1\frac{1}{2}$ in.

6. a) 4.5 m^2 **b)** 49 561 600 yd^2

7. a) 1728 cm^2 **b)** 1200 cm^2

8. a) 5 cm

b) approximately 5.89 cm^3

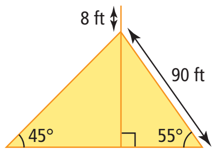
9. approximately 11 879 $in.^3$

10. a) $x \approx 17.7$ cm; $\theta \approx 43°$

b) $x \approx 26.1$ cm; $\theta \approx 32°$

11. 29.7 m

12. a)



b) 82 ft

c) The wire with the unknown length is likely longer than the other wire, because the angle of depression for that wire is less than the angle of depression for the wire that is 90 ft long. The length of the wire is 104.5 ft.

d) 125.5 ft

13. approximately 21.7 m

14. 897.8 m

Unit 1 Test, pages 144 to 145

1. A

2. B

3. C

4. B

5. 8

6. 44

7. 8.0

8. a) 15 cm **b)** 720 cm^3

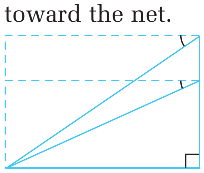
c) The box must have sides that are at least 12 cm by 12 cm by 15 cm in order for the purse to fit, so the volume needs to be at least 2160 cm^3. The larger size box (2200 cm^3) would fit the purse, providing that the sides are 12 cm by 12 cm by 15 cm.

9. a) Example: $\sin 40° = \frac{5}{\text{length of AC}}$

b) 7.8 cm **c)** 4 cm

10. a) approximately 14.0°

b) The angle of depression will decrease because he will not be looking downward as steeply toward the net.



Chapter 4

4.1 Square Roots and Cube Roots, pages 158 to 161

1. a) 49 **b)** −2500 **c)** 9

d) $\frac{16}{5}$ **e)** $\frac{3}{4}$ **f)** $\frac{9}{16}$

2. a) 8 **b)** −64 **c)** −125

d) 2 **e)** $\frac{1}{72}$ **f)** $\frac{8}{27}$

3. a) 7 **b)** 13 **c)** 10

d) 2 **e)** 2 **f)** $3x$

4. a) 1 **b)** 6 **c)** 20

d) 2 **e)** $\frac{3}{5}$ **f)** $4a$

5. a) both; (1)(1) = 1, (1)(1)(1) = 1

b) perfect cube; (10)(10)(10) = 1000

c) perfect square; (9)(9) = 81

d) perfect square; (13)(13) = 169

e) perfect cube; (6)(6)(6) = 216

f) perfect square; (32)(32) = 1024

6. a) perfect square **b)** perfect cube

c) perfect square **d)** perfect square

e) both **f)** both

7. Find all prime factors of the radicand. Group the prime factors into two equal groups. Calculate the value of one group.

a) 10 **b)** 2 **c)** 9 **d)** 3 **e)** 12 **f)** 24

8. a) 14 **b)** 16 **c)** 21 **d)** 15 **e)** 31 **f)** 17

9. 20 m

10. 7 ft

11. a) 40 **b)** 38 ft

c) Example: My answer is 2 ft less than my estimate.

12. 1 m by 1 m or 2 m by 2 m or 3 m by 3 m

13. a) 120 squares **b)** Designs may vary.

c) Example: The length of the diagonal of each square is the square root of the sum of two sides squared.

14. 36 in.

15. a) 17 in.

b) Example: It is a 17 by 17 by 17 cube, so 17 represents the cube root of the volume.

16. 1000 mm^3

17. a) 22.2 km **b)** 6.3 h

18. 26 cm

19. a) 2880 cm^2

b) 13 824 cm^3; 24 cm by 24 cm by 24 cm

20. a)

Number	0	1	2	3	4	5	6	7	8
Number Squared	0	1	4	9	16	25	36	49	64

b) vertical axis: number squared; horizontal axis: number

c) 0.2; 2

d) Find 5 on the horizontal axis, slide up to the curve, and left to the vertical axis.

e) Find 49 on the vertical axis, slide right to the curve, and down to the horizontal axis.

f) $4.2^2 = 17.64$ **g)** 39

21. a) Example: What is the square root of $\frac{4}{9}$?

b) Example: What is the cube root of $\frac{8}{27}$?

4.2 Integral Exponents, pages 169 to 173

1. a) A positive exponent would be used for calculating population in future years, n being the number of years past 2005. A negative exponent would be used to calculate the population in years before 2005.

b) A positive exponent would be used for calculating the amount of radioactive substance a number of periods, n, after the sample was measured. A negative exponent would be used to calculate the amount of radioactive substance a number of periods before the sample was measured.

c) A positive exponent would be used for calculating the number of bacteria a number of periods, n, after the initial number in the culture was counted. A negative exponent would be used to calculate the number of bacteria in the culture a number of periods before the count was done.

2. a) $\frac{1}{b^3}$ **b)** $\frac{x}{y^4}$ **c)** $\frac{2}{x^2}$ **d)** $\frac{2x^2}{y}$ **e)** $\frac{-4}{x^5}$ **f)** $\frac{-2}{x^3y^4}$

3. Yes. A negative exponent in the numerator is a positive exponent in the denominator.

4. a) $\frac{1}{4^2}$ **b)** $\frac{1}{3^2}$ **c)** $\frac{1}{12^4}$ **d)** $\frac{1}{8^3}$ **e)** $\frac{1}{5^8}$ **f)** $\frac{3^6}{2^{15}}$ **g)** $\frac{4^2}{5^2}$ **h)** 3.2^6 **i)** $4(2^3)$

5. a) $\frac{t^6}{s^2}$ **b)** $\frac{1}{h^{10}}$ **c)** $8t^4$ **d)** $\frac{8}{x^{12}}$ **e)** $\frac{1}{n^{24}}$ **f)** x^6y^{24}

6. a) $2^6 = 64$ **b)** $\left(\frac{3}{2}\right)^9 = 38.4434$ **c)** $5^{-4} = 0.0016$ **d)** $(6^0)^{-3} = 1$ **e)** $8^8 = 16\ 777\ 216$ **f)** $\left(\frac{3}{4}\right)^6 = 0.1780$

7. a) 1250; 78 **b)** 80 000

8. \$593 979.4

9. 1000

10. a) i) 8000 **ii)** 256 000 **iii)** 500

b) the beginning of the time period

11. 1.298×10^{19} miles

12. 250 000 mm

13. a) 405 **b)** 328

14. 3.2×10^{24}

15. 4.1 volts

16. 2 weeks ago

17. a) the doubling approach **b)** \$40.96

18. 20 days

19. a) 14 164 **b)** 17 284

20. a) $\frac{2}{3}$ **b)** -4 **c)** -3 **d)** -2

21. 4

22. a) $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}, \frac{1}{64}$

b) \$32 000, \$16 000, \$8000, \$4000, \$2000, \$1000

c) \$1000 **d)** 9 agencies

23. a) 1200 **b)** 768 **c)** 491.5

24. a) 100 **b)** starting time

c) times before the starting time

25. Example: A power with a negative exponent moves from the numerator to the denominator, while a power with a positive exponent remains in the numerator. For example, $2^{-2} = \frac{1}{2^2}$, $2^2 = \frac{2^2}{1}$.

26. Example: In the half-life of a chemical substance, a negative exponent means the value decreases by a certain proportion over time.

27. a) 3^5 is larger. The greater the exponent, the greater the result will be if the base is the same.

b) The greater the base, the greater the result will be when the exponent is the same.

c) 6^{222}, 2^{666}, 5^{333}, 3^{555}, 4^{444}

4.3 Rational Exponents, pages 180 to 183

1. a) $x^{\frac{16}{3}}$ **b)** b^2 **c)** a^3 **d)** $k^{7.8}$ **e)** 2 **f)** $\frac{-2a^2}{3}$ **g)** $-8x^2$ **h)** $27x^3$ **i)** $5x$

2. a) $x^{\frac{7}{3}}$ **b)** $\frac{1}{3^3}$ **c)** $\frac{1}{m^{\frac{10}{3}}}$ **d)** $\frac{1}{3p^{\frac{5}{2}}}$ **e)** $\frac{1}{x^9y^6}$ **f)** $\frac{243x^5}{32y^{10}}$

3. a) 2 **b)** $\frac{5}{4}$ **c)** $\frac{1}{2}$ **d)** $\frac{1}{4}$ **e)** $\frac{1}{2}$ **f)** 3

4. a) 4 **b)** 2 **c)** -81 **d)** 3 **e)** $\frac{216}{125}$ **f)** $\frac{1}{6}$

5. a) 0.0370 **b)** 6208.3751 **c)** 0.6905 **d)** 0.25 **e)** 77.5305 **f)** 0.1768

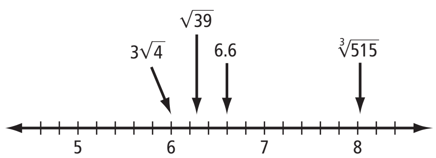
6. a) 402 **b)** 383 **c)** 207 **d)** 179

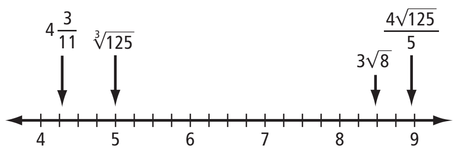
7. a) $t^{1.7}$ **b)** $4x$

8. a) 3-year term deposit at 1.5%
b) $5.28
9. a) the starting population, in millions
b) 1 255 286 **c)** 1 138 950
10. a) 12; 24; 48; $6(2)^m$ **b)** 543
c) No, tank size and increased pollution of the tank would limit population growth.
11. a) $5111.33 **b)** $15 642.66
12. a) 7.6 times larger **b)** 8 times
13. a) $\frac{2}{5}$ **b)** $\frac{3}{4}$
14. a) 4 °C **b)** 1.3 °C
15. 5.80×10^{10} m
16. 7 folds
17. a) 14 mg/mL
b) Answers may range from 1.5 h to 1.75 h. Example: 1.66 h
18. Example: Rational exponents can be used to model the decrease in value of a car that you own. For example, consider a $10 000 car that decreases in value at a rate of 15% per year. You can model this situation using the equation $V = 10\,000(0.85)^n$, where V represents the value of the car and n is the number of years.
19. Example: A common error is multiplying the exponents instead of adding them when multiplying powers with the same base. You could rewrite the rational exponents in the margin and add them separately to help avoid multiplying them.

4.4 Irrational Numbers, pages 192 to 195

1. a) $(\sqrt{4})^3$ **b)** $\sqrt[5]{32}$ **c)** $\sqrt{64}$
d) $\sqrt[4]{\frac{1}{100}}$ **e)** $\sqrt[3]{\frac{y^4}{x^3}}$ **f)** $\sqrt{m^{3n}}$
2. a) $(12p)^{\frac{3}{2}}$ **b)** $5^{\frac{3}{5}}$ **c)** $x^{\frac{3}{4}}$
d) $\left(\frac{s^3}{t^5}\right)^{\frac{1}{3}}$ or $\frac{s}{t^{\frac{5}{3}}}$ **e)** $y^{\frac{5}{6}}$ **f)** $8^{\frac{1}{n}}$
3. a) 0.6 **b)** 3
c) 16.4924 **d)** 16.1662
e) 1.4071 **f)** 2.2678
4. a) $\sqrt{99}$ **b)** $\sqrt{98}$ **c)** $\sqrt{45}$
d) $\sqrt{28}$ **e)** $\sqrt{27}$ **f)** $\sqrt{600}$
5. a) $\sqrt[3]{56}$ **b)** $\sqrt[3]{81}$ **c)** $\sqrt[3]{5000}$
d) $\sqrt[3]{128}$ **e)** $\sqrt[4]{162}$ **f)** $\sqrt[4]{80}$
6. a) $2\sqrt{3}$ **b)** $5\sqrt{2}$ **c)** $4\sqrt{3}$
d) $6\sqrt{2}$ **e)** $3\sqrt{5}$ **f)** $10\sqrt{5}$
7. a) $2\sqrt[3]{3}$ **b)** $3\sqrt[3]{2}$ **c)** $3\sqrt[3]{9}$
d) $2\sqrt[3]{5}$ **e)** $2\sqrt[4]{2}$ **f)** $3\sqrt[4]{3}$

8. a) $\sqrt{0.25}$, $\frac{5}{8}$, $0.\bar{6}$, $\sqrt[3]{0.84}$; $\sqrt[3]{0.84}$ is an irrational number.
b) $\sqrt[4]{625}$, $\sqrt{225}$, $15\frac{4}{5}$, $3\sqrt{28}$; $3\sqrt{28}$ is an irrational number.
9. a)


$\sqrt{39}$ and $\sqrt[3]{515}$ are irrational numbers.
b)


$\frac{4\sqrt{125}}{5}$ and $3\sqrt{8}$ are irrational numbers.
10. 3.375 cm
11. 1.35 m
12. 40 mph
13. a) 37.08 cm **b)** 2224.8 cm²
14. a) 85 min **b)** 35 800 km
15. 3.24 ft
16. $0.862 \approx \sqrt[3]{8P}$
$0.862 \approx 2\sqrt[3]{P}$
$0.431 \approx \sqrt[3]{P}$
$P \approx (0.431)^3$
$P \approx 0.08$
The store should offer an 8% discount.
17. 6.3 A
18. 2
19. a) $2^{\frac{1}{5}}$ **b)** $256^{\frac{1}{8}}$
20. Sometimes true. Not true when $x < 0$.
21. a) 8
b) Rational numbers: 1 by 1, 2 by 2, 3 by 3, 4 by 4. Irrational numbers: $\sqrt{2}$ by $\sqrt{2}$, $2\sqrt{2}$ by $2\sqrt{2}$, $\sqrt{5}$ by $\sqrt{5}$, $\sqrt{10}$ by $\sqrt{10}$
c) 1, 2, 4, 5, 8, 9, 10
22. The denominator is the root and the numerator is the power: $\sqrt[m]{x^n} = x^{\frac{n}{m}}$.

Chapter 4 Review, pages 196 to 198

1. a) perfect square **b)** both
c) perfect cube **d)** perfect square
e) both **f)** perfect square
2. 144 = (2)(2)(2)(2)(3)(3); square root: (2)(2)(3) = 12
3. a) 11 **b)** 6 **c)** 20
4. 11 cm by 11 cm by 11 cm
5. $540

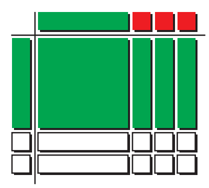
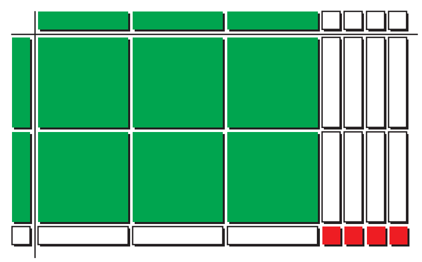
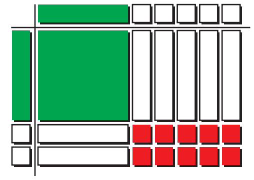
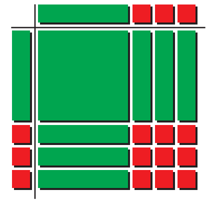
6. a) $\frac{1}{x^8}$ b) s^6
c) $(-2.6)^6$ d) $(4k)^5$
7. a) 81 b) 0.0370
c) 0.4823 d) $\frac{x^2}{1\ 048\ 576}$
8. a) 1.03 m b) 5 bounces
9. a) 15.625 g b) 8000 g
10. a) 1470; 1543; 1620; $1400(1.05)^n$
b) 3369 c) 1209
11. a) $\left(\frac{1}{x}\right)^{\frac{1}{3}}$ b) 4
c) $\frac{1}{8g^6}$ d) $8t^7$
12. a) $(3)(3) = 9$
b) Example: A negative exponent in the numerator is a positive exponent in the denominator.
13. a) 7.3004 b) 0.1111
c) 0.001 d) 45.2548
14. $27^{\frac{2}{3}} = 9$, not 18; $9x^{\frac{8}{3}}$
15. \$7785.51
16. 0.166 km
17. \$465 658.88
18. a) $\sqrt[5]{x^3}$ b) $\sqrt[3]{(27t^2)^2}$ c) $\sqrt{\frac{g^3}{18}}$
19. a) $(xp)^{\frac{5}{2}}$ b) $2^{\frac{5}{3}}$ c) $3\left(x^{\frac{4}{5}}\right)$
20. a) $\sqrt{108}$ b) $\sqrt{40}$
c) $\sqrt[3]{320}$ d) $\sqrt[3]{-16}$
21. a) $6\sqrt{5}$ b) $8\sqrt{3}$
c) $4\sqrt[3]{2}$ d) $2\sqrt[4]{3}$
22. a) Irrational numbers: $\frac{\pi}{3}$, $\sqrt{0.9}$, $\sqrt[5]{96}$;
Order: $\sqrt[5]{96}$, $\frac{\pi}{3}$, $\sqrt{0.9}$, $0.\overline{24}$
b) Irrational number: $18^{\frac{1}{2}}$;
Order: $6.\overline{2}$, $2\sqrt[3]{27}$, $\sqrt{36}$, $18^{\frac{1}{2}}$
24. a) 9.8 cm b) 452.4 cm²

Chapter 4 Practice Test, pages 199 to 201

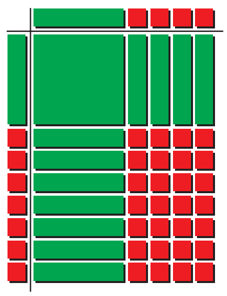
1. D
2. A
3. D
4. C
5. A
6. A
7. B
8. a) $(2)(2)(2) = 8$ while $(3)(3)(3) = 27$, so the cube root of 10.648 is closer to 2.
b) 2.2 m by 2.2 m by 2.2 m
9. Example: An irrational number cannot be made into a ratio or fraction, so it cannot be rational.
10. a) 13 cm by 13 cm b) 4.3 cm
11. Subtract the exponents in step 2; $\frac{1}{2}$
12. 31.25 g
13. 224.8 km
14. a) 1580 b) 1758
15. a) Convert the numbers to decimals and order on the number line.
b) Change all mixed radicals to entire radicals and compare.
c) $6\sqrt{3}$, $4\sqrt{12}$, $3\sqrt{27}$, $3\sqrt{48}$

Chapter 5

5.1 Multiplying Polynomials, pages 209 to 213

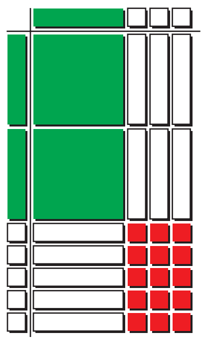
1. a)

$x^2 + x - 6$
b)

$6x^2 - 11x + 4$
c)

$x^2 - 7x + 10$
d)

$x^2 + 6x + 9$

e)



$x^2 + 11x + 28$

f)



$2x^2 - 11x + 15$

2. a) $2x^2 + 3x - 2$ **b)** $2x - 1$ by $x + 2$

3. a) $x^2 + 3x - 10$ **b)** $x^2 - 6x + 9$

c) $c^2 - d^2$ **d)** $4x^2 + 5xy + y^2$

e) $y^2 + 6y + 9$ **f)** $24j^2 - 6k^2$

4. a) $3x^3 - 5x^2 + 8x$ **b)** $7ab^2 + ab - a$

c) $6x^3 - 22x^2 + 36$ **d)** $10x^3 + 3x^2 - 14x + 5$

e) $12s^4 - 5s^3 + 22s^2 + 6s$

f) $2y^4 + 11y^3 + 21y^2 + 11y - 5$

5. a) B **b)** H **c)** F **d)** D

e) J **f)** E **g)** A **h)** G

6. a) $6n^2 - 9n + 8$ **b)** $-7f^2 + 4f - 29$

c) $9b^2 - 8bd + 7d^2$ **d)** $40x^2 - 90x - 50$

e) $14a^2 - 35ac - 28c^2$

f) $4y^4 - 14y^3 - 53y^2 - 41y - 6$

7. $A = (x + 4)(x + 4)$; $A = x^2 + 8x + 16$

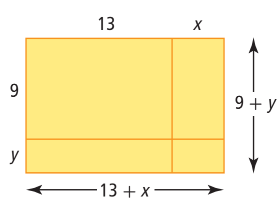
10. $A = (x - 7)(x - 4)$; $A = x^2 - 11x + 28$

11. $A = \pi(3x + 2)^2$; $A = 9\pi x^2 + 12\pi x + 4\pi$

12. a) No. Step 3 is incorrect.

b) Example: $p = 1$, $-5 \neq -15$

13. a)



b) $A = (y + 9)(x + 13)$ **c)** 154 m^2

14. a) $x + 2$ by $x - 1$ **b)** $A = (x + 2)(x - 1)$

c) The new rug has the greater area by 1 ft^2.

15. a) $A = (3x + 8)(2x + 4) = 6x^2 + 28x + 32$

b) 1232 cm^2

16. a) In the check, the left side does not equal the right side.

b) In step 1, André multiplied −4 and 5 to get +20. This is actually equal to −20.

17. a) As the price of a burger increases, the average number of burgers sold decreases.

b) $p = \dfrac{550 - b}{100}$ **c)** $R = \dfrac{550n - bn}{100}$

18. a) The product of the first and last numbers is 2 less than the product of the middle numbers.

b) $n + 1$, $n + 2$, $n + 3$

c) Example: The first and last product is $n^2 + 3n$; the middle product is $n^2 + 3n + 2$. I noticed that the product of the middle values is 2 more than the product of the first and last values.

19. a) $3t + 4$ **b)** 1530

5.2 Common Factors, pages 220 to 223

1. a) 20: 1, 2, 4, 5, 10, 20; 30: 1, 2, 3, 5, 6, 10, 15, 30; GCF: 10

b) 28: 1, 2, 4, 7, 14, 28; 40: 1, 2, 4, 5, 8, 10, 20, 40; GCF: 4

c) 30: 1, 2, 3, 5, 6, 10, 15, 30; 48: 1, 2, 3, 4, 6, 8, 12, 16, 24, 48; GCF: 6

d) 36: 1, 2, 3, 4, 6, 9, 12, 18, 36; 27: 1, 3, 9, 27; GCF: 9

2. a) 12 **b)** 48 **c)** 27

d) 2 **e)** 25

3. a) 48 **b)** 60 **c)** 90

d) 150 **e)** 132

4. a) $3ab$ **b)** $27m^2n$ **c)** $8x^2y^2$

d) $4a^2c$ **e)** p^3q^3

5. a) $5(x + 3)$ **b)** $y(3y - 5)$

c) $w^2(x + y - z)$ **d)** $6ab(a^2 - 3b)$

e) $3x(3x^2 - 4x + 2)$

6. a) $3ab$ **b)** $s^2 - 5$ **c)** $d - 7$

d) $8x - 1$ **e)** $4xy$

7. a) $(y - 2)(3y + 4)$ **b)** $(a - 4)(5a - 2)$

c) $(c - 4)(2x + 7)$ **d)** $(x - 3)(3x - 8)$

e) $(2y + 1)(y^3 - 5)$

8. 36 cm

9. Example: When you list the factors of a number, you list all the numbers that divide evenly into the number. When you list the multiples of a number, you list the products of the number and all natural numbers.

10. **a)** $3x + 9$; 3 by $x + 3$; $3(x + 3)$
b) $2x^2 + 3x$; x by $2x + 3$; $x(2x + 3)$

11. Example:
a) $6x^2 + 18x$ **b)** $8a^2b - 4ab$
c) $4m^4n^2 + 6m^3n^3 - 10m^3n^2$

12. **a)** Incorrect: $3x \div 3x \neq 0$;
Correct: $3x(5x - 1)$
b) Incorrect: $(x - 2) \div (x - 2) \neq 0$;
Correct: $(x - 2)(5x - 1)$
c) Incorrect: GCF $\neq 9ab$;
Correct: $9a^2b^2(b - 3 + 9ab)$
d) Incorrect: factoring incomplete;
Correct: $2(x + 4)(2f + 1)$
e) Incorrect: expression not simplified;
Correct: $2(p^2 - 7p - 5)$

13. 6

14. $4r^2(4 - \pi)$

15. 6 in. by 6 in.

16. Example: $15x$ by $x + 2$

17. 3484, 5226

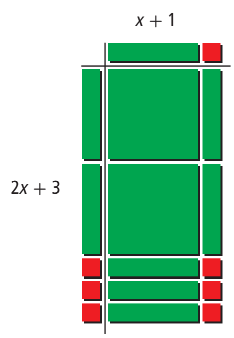
18. **a)** $(2x + 5)^2 + (2x + 2)^2 + (2x - 1)^2$
b) $12x^2 + 24x + 30$ **c)** $6(2x^2 + 4x + 5)$

19. **a)** $SA = b(b + 2s)$ **b)** 65 cm^2
c) Example: The surface areas are the same, but the equations used to calculate them are different.
d) Example: It is less complicated to find the surface area using the factored form.

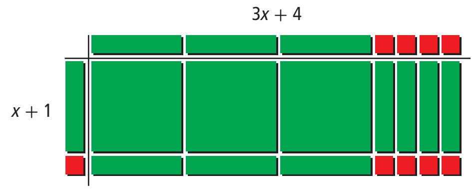
5.3 Factoring Trinomials, pages 234 to 237

1. **a)** $x^2 + 4x + 3$; $(x + 1)(x + 3)$
b) $x^2 + 2x + 1$; $(x + 1)(x + 1)$
c) $x^2 + x - 2$; $(x + 2)(x - 1)$
d) $x^2 + 5x + 4$; $(x + 4)(x + 1)$

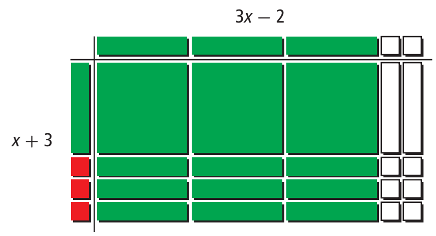
2. **a)** $(2x + 3)(x + 1)$



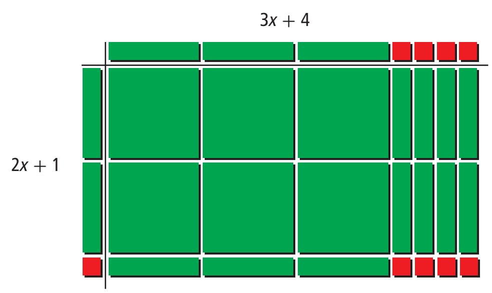
b) $(3x + 4)(x + 1)$



c) $(3x - 2)(x + 3)$



d) $(3x + 4)(2x + 1)$



3. **a)** 5 and 9 **b)** -2 and -3
c) 5 and -2 **d)** -10 and 2

4. **a)** $(x + 2)(x + 5)$ **b)** $(j + 3)(j + 9)$
c) $(k + 4)(k + 1)$ **d)** not factorable
e) $(d + 6)(d + 4)$ **f)** not factorable

5. **a)** $(m - 5)(m - 2)$ **b)** $(s + 5)(s - 2)$
c) $(f - 6)(f - 1)$ **d)** $(g - 7)(g + 2)$
e) $(b - 4)(b + 1)$ **f)** $2(r - 3s)(r - 4s)$

6. **a)** $(2x + 5)(x + 1)$ **b)** $(3y + 8)(2y + 1)$
c) $(3m + 4)(m + 2)$ **d)** not factorable
e) $(4q + 3)(3q + 2)$ **f)** $(3x + y)(x + 2y)$

7. **a)** $(4x - 3)(x - 2)$ **b)** not factorable
c) $(x - 2)(x - 3)$ **d)** $(2m - 3)(m + 3)$
e) $3(2x + y)(x - y)$ **f)** $(4y - 1)(3y + 1)$
g) $(6c - 5d)(c + 2d)$ **h)** $(k + 3)(4k + 3)$
i) $(a + 3b)(a + 8b)$ **j)** $(6m + n)(m + 2n)$

8. **a)** $x + 10$ and $x + 8$; 25 cm by 23 cm
b) $3x + 8$ and $2x - 1$; 53 cm by 29 cm

9. Example:
a) 7, 8 **b)** 4, 5
c) 2, 7 **d)** 3, 9

10. Example:
a) 8, 9 **b)** 9, 20 **c)** $-2, -3$ **d)** 8, 15

11. Example:
a) $\pm 8, \pm 17$ **b)** $\pm 20, \pm 28$ **c)** $\pm 13, \pm 23$

12. Example:
a) $k = 2$ **b)** $k = 2$ **c)** $k = 2$

13. Example:
a) $5x^2 + x + 16$
b) No two numbers multiply to 80 and add to 1.

15. $h = -(t - 5)(5t + 2)$; 34 m

16. $(40 - 2x)$; $(18 + x)$

17. any three of the following values: $-16, -11, -8, 8, 11, 16$

18. $12x + 20y$. Factor the expression and then multiply the length of a single side (factor) by 4.

19. First factor out 3. Then, factor the new expression $10x^2 - 13xy - 3y^2$; $3(5x + y)(2x - 3y)$

20. **a)** rectangle **b)** $2x - 1$ by $4x + 7$

21. Example: For factorable trinomials, the operations of factoring the trinomial and multiplying the resulting binomials are opposite operations. For example, the product of $(x + 5)(x - 3)$ results in the trinomial $x^2 + 2x - 15$, and the result of factoring the trinomial $x^2 + 2x - 15$ is $(x + 5)(x - 3)$.

5.4 Factoring Special Trinomials, pages 246 to 251

1. **a)** $(x + 2)(x - 2)$ **b)** $(2x + 3)(2x - 3)$
c) $(x + 4)(x + 4)$ **d)** $(x - 3)(x - 3)$

2. **a)** $x^2 - 64$ **b)** $4x^2 - 25$
c) $9a^2 - 4b^2$ **d)** $3t^2 - 75$

3. **a)** $x^2 + 6x + 9$ **b)** $25a^2 - 30ab + 9b^2$
c) $4h^2 + 12h + 9$ **d)** $5x^2 - 20xy + 20y^2$

4. **a)** $m^2 - y^2 = (m - y)(m + y)$
b) $16r^6 - 81 = (4r^3 - 9)(4r^3 + 9)$
c) $x^2 - 12x + 36 = (x - 6)^2$
d) $4x^2 + 20x + 25 = (2x + 5)^2$
e) $25x^2 + 70x + 49 = (5x + 7)(5x + 7)$

5. **a)** $(x + 4)(x - 4)$ **b)** $(b + 11)(b - 11)$
c) not factorable **d)** $(3a + 4b)(3a - 4b)$
e) $(6c + 7d)(6c - 7d)$ **f)** not factorable
g) not factorable **h)** $(10 + 3t)(10 - 3t)$

6. **a)** $(x + 6)(x + 6)$ **b)** $(x + 5)(x + 5)$
c) not factorable **d)** $(m - 13)(m - 13)$
e) $(4k - 1)(4k - 1)$ **f)** $(7 - m)(7 - m)$
g) not factorable **h)** $(6a + 7)(6a + 7)$

7. **a)** $5(t^2 - 20)$ **b)** $10xy(x + 3)(x - 3)$
c) $4(x^2 - 12x + 9)$ **d)** $2x(3x + 2)(3x + 2)$
e) $(x^2 + 4)(x + 2)(x - 2)$ **f)** $(x + 3)^2(x - 3)^2$

8. **a)** ± 10; $(x + 5)^2$; $(x - 5)^2$
b) ± 20; $(a + 10)^2$; $(a - 10)^2$
c) ± 70; $(5b + 7)^2$; $(5b - 7)^2$
d) ± 132; $(6t + 11)^2$; $(6t - 11)^2$

9. **a)** $-16b$ is not a perfect square term.
b) There are no pairs of integers that have a product of -12 and a sum of -7.
c) The trinomial is not of the form $(ax)^2 - 2abx + b^2$.
d) $49t^2 + 100$ is not a difference of squares.

11. **a)** 280 **b)** 460 **c)** 600 **d)** -600

13. $(x + y)(x - y)$

14. **a)** $\pi(r + 4)^2 - \pi r^2$ **b)** $8\pi(r + 2)$
c) $201.1\ \text{cm}^2$

15. **a)** $[3(2x - 3)]^2 - (2x - 3)^2$
$= [3(2x - 3) - (2x - 3)][3(2x - 3) + (2x - 3)]$, or $[4x - 6][8x - 12]$
b) $32x^2 - 96x + 72$
c) Example: $x = 1$; $8 = 8$

16. Example: The top striped rectangle has an area of $x(x - y)$. The bottom striped rectangle has an area of $y(x - y)$. Adding these areas gives the difference between the areas of the larger and smaller squares. The difference of squares is $x^2 - y^2 = (x - y(x + y)$.

17. $28 - 8x$

18. $6x + 10$

19. **a)** Never true. $(-b)^2 \neq -b^2$
b) Sometimes true. It is true if $a = 0$ or $b = 0$.
c) Sometimes true. When $b = 0$,
$a^2 - 0^2 = a^2 - 2a(0) + 0^2$
$a^2 = a^2$
d) Always true. $(a + b)^2 = a^2 + 2ab + b^2$.

20. Rahim is correct; $4(4x^2 + y^2)$ cannot be factored further.

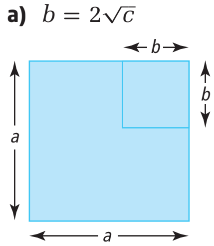
21. $x + 3y$ by $x - 3y$ by $xy - 7$

22. $16x^2 - 52x + 36$

23. **a)** $x^2 - y^2 = x + y$
Factor as a difference of squares to get $x - y = 1$.
b) any pair of consecutive integers from 11 to 20, for example 11 and 12, 12 and 13, and so on

24. **a)** $b = 2\sqrt{c}$ **b)** $b = 2\sqrt{ac}$

25.



$(a - b)(a + b) = a^2 - ab + ab - b^2 = a^2 - b^2$

26. $x^2 + 2bx + b^2$ has factors $(x + b)^2$ and $x^2 - 2bx + b^2$ has factors $(x - b)^2$.

27. $30^2 - 1 = 899$; $60^2 - 1 = 3599$

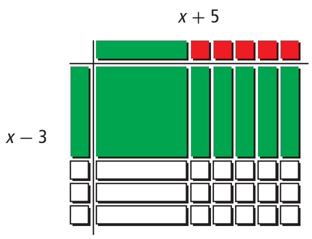
a) Example: $a^2 - b^2 = (a + b)(a - b)$ represents a difference of squares and also the product of two numbers that differ by 2. In this case, the average of a and b represents half the difference between the numbers. Since the two numbers differ by 2, adding 1 to the average gives the larger number and subtracting 1 gives the smaller number.

b) Square the average of the two numbers and subtract 9.

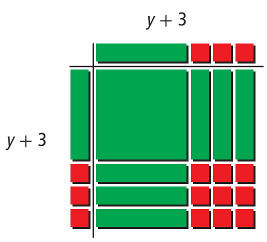
c) (average − 3)(average + 3)

Chapter 5 Review, pages 252 to 253

1. **a)**



b)



2. **a)** $x^2 + 10x + 21$ **b)** $b^2 - 81$
c) $y^2 - 121$ **d)** $15a^2 + 58ab + 48b^2$
e) $-20x^2 - 100xb - 125b^2$
f) $36b^2 - a^2$

3. **a)** $a^3 + 3a^2 - 16a - 6$ **b)** $19b^3 + 2b^2 - 16b$

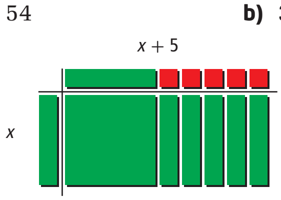
4. $x(x - 3) + 2(9)$; $x^2 - 3x + 18$

5. $10x^2 + 100x + 250$

6. **a)** 16 **b)** 27 **c)** 6
d) $2x$ **e)** 10 **f)** x

7. **a)** 54 **b)** 375

8. **a)**



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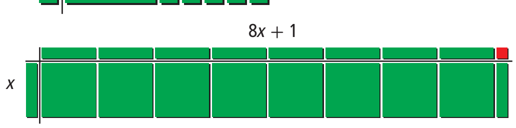
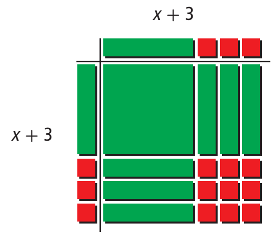
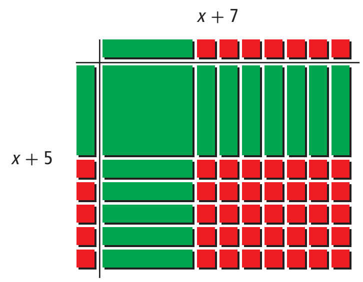


9. $xy(2x + 5)$

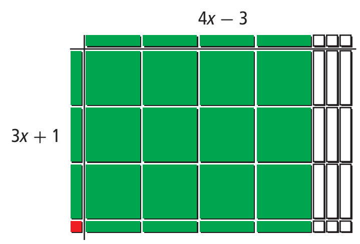
10. **a)**



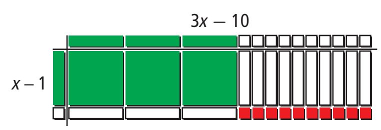
b)



c)



d)



11. **a)** $(x - 6)(x + 2)$ **b)** $(x - 3)(x - 4)$
c) $3(5x + 4)(2x - 1)$ **d)** $-2(x + 6)(3x - 1)$
e) $-2(x - 3)(x - 5)$ **f)** $x(x + 7)(x - 4)$

12. $(x - 9)$ and $(x - 10)$; 2 cm by 1 cm

13. **a)** $(x + 10)(x - 10)$ **b)** $(c + 5)(c - 5)$
c) $(3x + 4)(3x - 4)$ **d)** $2(8 + 3x)(8 - 3x)$
e) $(1 + 15y)(1 - 15y)$ **f)** $-3(x + 3y)(x - 3y)$

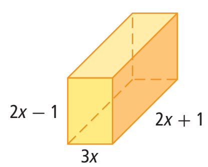
14. **a)** $(y + 8)^2$ **b)** $(x - 10)^2$
c) $9(5 - y)^2$ **d)** $(11c + 14d)^2$

15. **a)** x by $2x + 3$ by $2x + 3$
b) a rectangular prism with a square base with sides $2x + 3$ and height x
c) 270 cm^2

16. $x^2 + y^2 + 4x + 4y + 8$

Chapter 5 Practice Test, pages 254 to 255

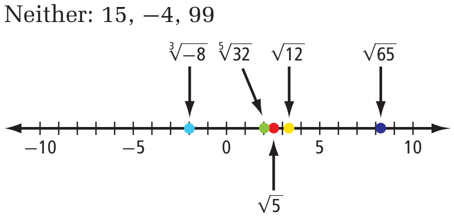
1. A
2. B
3. A
4. C
5. GCF: 4; LCM: 15 960
6. a) $x^2 - 12x + 27$ **b)** $4x^2 + 4x - 3$
c) $-x^2 + 24x - 66$ **d)** $11c^2 + 4cd + d^2$
e) $-10x^2 - 2x + 9$
f) $c^2 + 9d^2 + 12cd - 6c - 3$
7. a) $6x^4 + 17x^3 + 5x^2$ **b)** 252 cm^3
8. a) $(x + 5)^2$ **b)** $(5r - 2s)^2$
c) $5(x + 1)(x - 1)$ **d)** $(1 + 7m)(1 - 7m)$
e) $(m + 3)(5m + 2)$ **f)** $(m - 7n)(m - 2n)$
9. a) $y(3y - 1)(y - 2)$ **b)** $4(m^2 + 4)$
c) $(2y + 1)(3y - 1)$ **d)** $(x - 4)(m - 2)$
e) $(x + y)(2 + y)$ **f)** $t(3 - 2t)(3 + 2t)$
10. a) $(2x + 5)(5x - 8)$ **b)** 69 mm by 152 mm
11. $A = \pi(2x + 3)^2$ m; $A = \pi(4x^2 + 12x + 9)$ m
12. No. The expression $4y^2 - 6y - 9$ cannot be factored over the integers. The correct answer should be $2(4y^2 - 6y - 9)$.
13. a) $3x(2x + 1)(2x - 1)$
b)



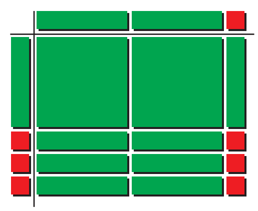
c) 11 cm by 13 cm by 18 cm

Unit 2 Review, pages 256 to 259

1. B
2. D
3. C
4. A
5. Perfect squares: 16, $\sqrt{16} = 4$; 169, $\sqrt{169} = 13$.
Perfect cubes: −8, $\sqrt[3]{-8} = -2$; 27, $\sqrt[3]{27} = 3$; 125, $\sqrt[3]{125} = 5$; 1000, $\sqrt[3]{1000} = 10$.
Neither: 15, −4, 99
6.

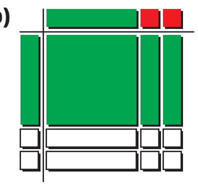


7. 81 $in.^2$
8. 9 cm^2
9. a) $2\sqrt{3}$ **b)** $9\sqrt{2}$ **c)** $2\sqrt[3]{2}$
10. a) $\sqrt{20}$ **b)** $\sqrt{75}$ **c)** $\sqrt[3]{40}$
11. a) $\sqrt[5]{7^4}$ **b)** $\sqrt[3]{\frac{27}{8}}$ **c)** $\sqrt[4]{6x^2}$
12. a) $\frac{m^{\frac{3}{2}}}{n}$ **b)** $6^{\frac{3}{4}}$ **c)** $2s^{\frac{4}{3}}$
13. a) $\left(\frac{1}{3}\right)^{\frac{11}{2}}$ **b)** $\frac{1}{y^3}$ **c)** $\frac{1}{3}$
14. a) $\frac{125}{8}$ **b)** 150 **c)** 100
15. a)



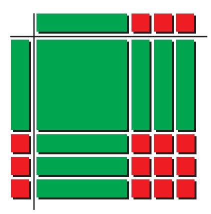
$2x^2 + 7x + 3$

b)



$x^2 - 4$

c)



$x^2 + 6x + 9$

16. a) $a^2 + 3a - 28$ **b)** $10x^2 + 19x + 6$
c) $-x^2 + 25$ **d)** $9y^2 + 24y + 16$
e) $4a^2 - 13ab + 3b^2$ **f)** $2v^3 - 6v^2 - 5v + 9$
17. Example:
a) $k = 7$ **b)** $k = 2$
18. a) $161 \neq 12$
b) No. $4x(11x) = 44x^2$ not $44x$; $4x(-7) = -28x$ not $-24x$; $-1(-7) = 7$ not 6.
Correct: $8x^3 + 42x^2 - 39x + 7$
19. a) not factorable **b)** $2(5x - 3y)^2$
c) not factorable
20. k is an integer that is divisible by 2.
21. a) $7x$ **b)** $5x^2$ **c)** $3ab(a - 1)$
22. a) not factorable **b)** $(v + 3)(2v - 3)$
c) $-2(x + 5)(x - 2)$ **d)** $(2y + 5)(2y - 5)$
e) $(x - 20)(x - 1)$ **f)** $-(3x - 2)(5x + 3)$
23. a) Julio divided the first and last terms by 2, but subtracted 2 from the middle term instead of dividing by 2.
b) $2(x + 3)(x + 3)$
24. a) $(4a + 6)(4a - 6)$ **b)** $16a^2 - 36$
c) 36 $units^2$
25. $r = 7n + 8$

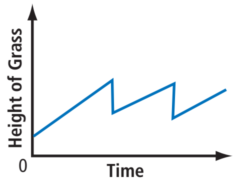
Unit 2 Test, pages 260 to 261

1. D
2. C
3. A
4. D
5. A
6. 12
7. 5
8. 19
9. 4
10. $\frac{1}{20^{\frac{1}{6}}}$
11. **a)** $2x^2 + 9xy - 5y^2$ **b)** $6a^3 - 5a^2 - 20a + 21$
    c) $3x^3 - 7x^2 + 7x + 1$
12. **a)** $(x - 9)(x - 1)$ **b)** $(a - 2)(4a + 3)$
    c) $(4x + y)(4x - y)$
13. **a)** $x^2 - 1$ **b)** $14x^2 + 17x - 3$

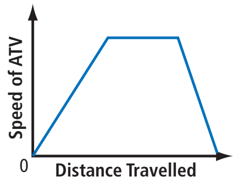
Chapter 6

6.1 Graphs of Relations, pages 274 to 278

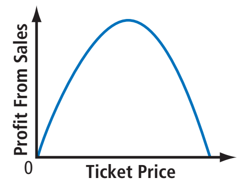
1. AB: There is a constant slow decrease of Quantity B. The segment is falling and shallow.
   BC: Quantity B is not changing, the segment is horizontal.
   CD: Quantity B is decreasing, but not at a constant rate. The curve is initially steep and falling, then becomes less steep as it gradually approaches horizontal.
   DE: Quantity B is increasing, but not at a constant rate. The curve is initially horizontal, then gradually begins to increase until it rises steeply.
   EF: Quantity B is decreasing quickly at a constant rate. The segment is falling and steep.
   FG: There is a constant increase of Quantity B. The segment is rising at approximately 45°.
2. **a)** **i)** A **ii)** C **iii)** D
   b) Example: Graph B: the number of people in a building as they enter the building, watch a concert, and exit the building
3. **a)**



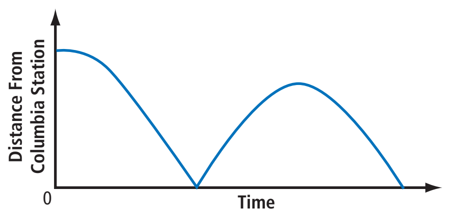
b)



c)

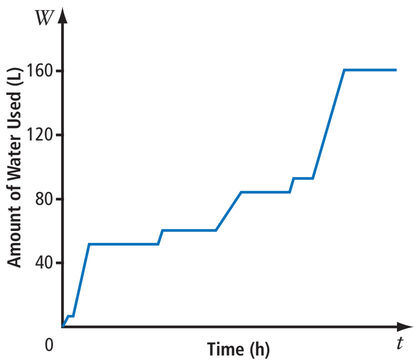


4. Examples:
   a) A jogger jogs home, and then leaves his house walking. The vertical axis is the distance from home, and the horizontal axis is time.
   b) A car slows down to a stop at a stop sign, and then accelerates to a constant speed. The vertical axis is speed, and the horizontal axis is time.
   c) A ball is thrown up and left to bounce on the floor. The vertical axis is height, and the horizontal axis is time.
5. Example:



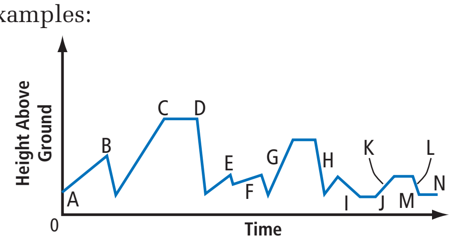
6. Examples: The blue line represents vinyl albums. It is the oldest format, so many units were sold many years ago, but few have been sold for a number of recent years. The red line represents cassette tapes. This format is newer than vinyl albums and was very popular for a while, but in the last few years it has no longer been a viable option. The green line represents compact discs. This format quickly became popular, but has been declining rapidly in popularity. The yellow line represents digital downloads. It is the most recently developed format, and has rapidly become the most popular format.
7. Example: Uriash initially travelled on flat ground at a constant speed. He went up and down a number of slopes travelling away from home. Then, he travelled at a constant speed on flat terrain. Next, he travelled back toward home going up and down slopes. Finally, he returned home on flat terrain at a constant speed.

8. Example: I flushed the toilet and washed my hands. I took a shower. I flushed the toilet and washed my hands. I ran the dishwasher. I flushed the toilet and took a bath.

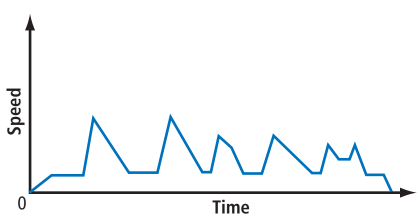


9. Examples:

a)

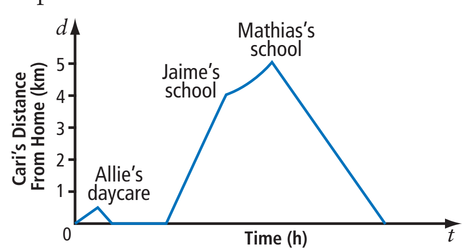


b)

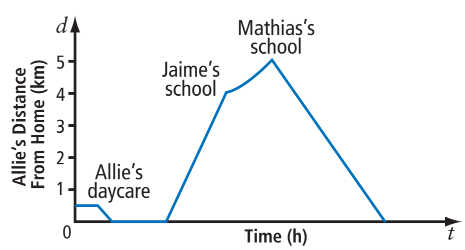


10. Examples:

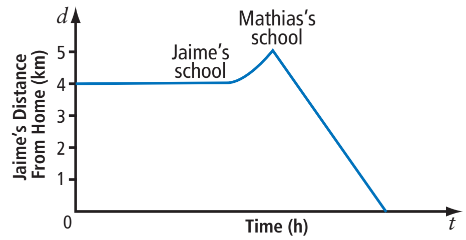
a)



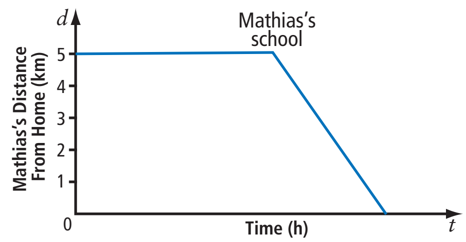
b)



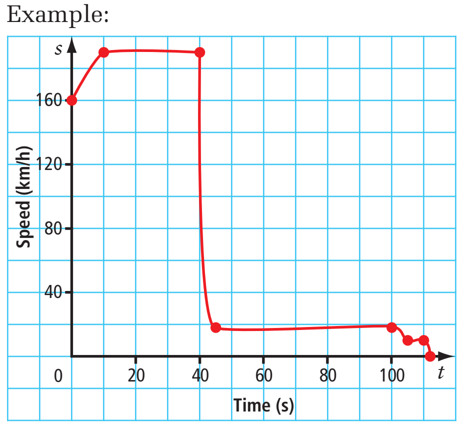
c)



d)



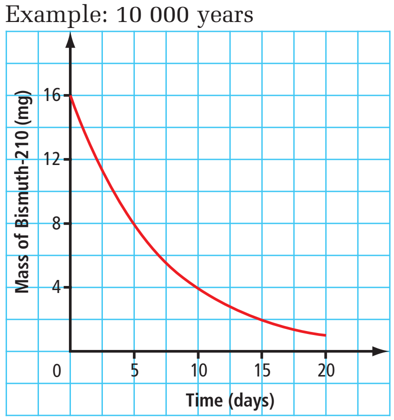
11. Example:



12. Example: Stage 1: The birth and mortality rates are similar, so the total population remains constant. Stage 2: The mortality rate declines rapidly while the birth rate remains nearly constant, so the total population rises at a constant rate. Stage 3: This stage is similar to stage 2. The birth rate is greater than the mortality rate, although the mortality rate begins to approach the birth rate, so the total population increase begins to taper off. Stage 4: The birth and mortality rates become similar, so the total population increase continues to taper off. Stage 5: The mortality rate is greater than the birth rate, so the total population begins to decline.

13. a) Example: 10 000 years

b)



14. The cost is constant up to a certain quantity of time. Example: The cost is $1 for the first hour, $2 for between one and two hours, and $3 for between two and three hours.

15. Examples:

a) Total time passed cannot be taken away.

b) Distance already travelled cannot be taken away.

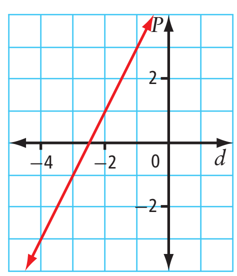
6.2 Linear Relations, pages 287 to 291

1. a) (−2, 5), (−1, 6), (0, 7), (1, 8), (2, 9), (3, 10), (4, 22)

b)

x	*y*
0	0
1	1 and −1
2	2 and −2
3	3 and −3

c)



d) Each child ate one orange.

2. a) linear; Each integral change in *r* results in a constant change of 2π in *C*.

b) non-linear; The degree is 2.

c) linear; An integral change in *x* results in a constant change in *y*.

d) non-linear; The values of *x* increase by greater and greater amounts but the values of *y* are increasing by the same constant.

e) linear; Each increase of 5 in the value of *x* results in an increase of 10 in the value of *y*.

f) linear; Each integral change in the value of *x* results in a constant change in the value of *y*.

g) linear; As the values of *x* increase, the values of *y* stay the same.

h) non-linear; The relation does not form a straight line.

3. a) dependent variable: *A*, independent variable: *r*

b) dependent variable: *V*, independent variable: *t*

c) dependent variable: *A*, independent variable: *n*

d) dependent variable: profit, independent variable: year

e) dependent variable: *e*, independent variable: *c*

4. Graph B. The relation does not have a degree of 1, so it cannot be linear. Only Graph B is non-linear.

5. a) linear; For each additional bushel of wheat sold, the amount of money received goes up by $6.

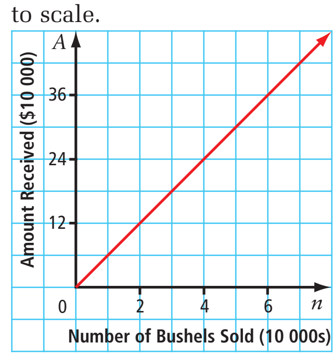
b) The amount of money received, *A*, is the dependent variable, and the number of bushels sold, *n*, is the independent variable.

c)

Number of Bushels Sold, *n*	Amount Received, *A* ($)
0	0
10 000	60 000
20 000	120 000
30 000	180 000
40 000	240 000
50 000	300 000

d) discrete; The farmer would not get paid for parts of bushels. However, because a single bushel is such a small unit compared to 10 000 bushel units, the relation would appear to be continuous on a graph drawn to scale.

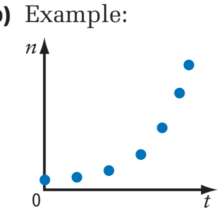
e)



6. a) Example:

x	*y*
0	0
1	−2
2	2
3	−4
4	4

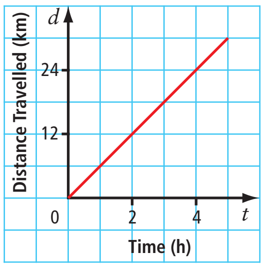
b) Example:



c) Example: $n = 4m + 1$

7. a) linear; The degree is 1.
b) dependent variable: D, independent variable: d
c) 1.5 m
d) Yes. The apparent depth is 2.1 m. The relation is continuous, because fractions of metres are feasible.

8. a) The dependent variable, d, represents the distance travelled, in kilometres. The independent variable, t, represents time, in hours.
b) (0, 0), (1, 6), (2, 12), (3, 18), (4, 24), and (5, 30)
c) continuous; The whale can swim for a fraction of an hour or cover a distance that is a fraction of a kilometre.
d)



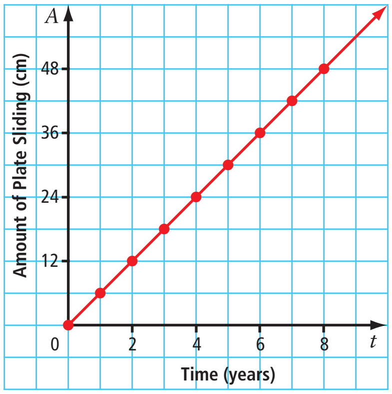
e) linear; The change in the distance travelled is constant with a constant change in the time.

9. a)

t	A
0	9.0
1	8.2
2	7.4
3	6.6
4	5.8
5	5.0
6	4.2
7	3.4
8	2.6
9	1.8
10	1.0
11	0.2
12	0.0

b) 12 years

10. a) non-linear; As the magnitude changes by one, the difference in size changes by ten times, so the difference in size of the earthquake is not constant.
b) (0, 0), (1, 6), (2, 12), (3, 18), (4, 24), (5, 30), (6, 36), (7, 42), and (8, 48)
c)



Example: Yes, the points should be connected, because fractions of years and fractions of centimetres are logical.

11. a) linear; As the values of x increase by two, the values of y increase by k.
b) linear; As the values of x increase by one, the values of y increase by $3n$.

12. a) Graph A is linear and Graph B is non-linear. In Graph A, the difference between values on the vertical axis is constant. In Graph B, the difference between values on the vertical axis is increasing.
b) For simple interest, the interest calculation is a certain percent of the original amount, so the amount added each year is the same, as shown in Graph A. For compound interest, the interest is added to the amount each year, so the interest earned each year gets larger, as shown in Graph B.

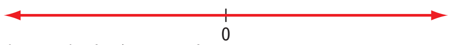
13. Example: I prefer an equation, because it is easy to see whether or not the relation is linear.

14. Example: research on the Internet or interviewing people

6.3 Domain and Range, pages 301 to 304

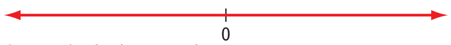
1. a) the real numbers between −8 and 30 inclusive, $[-8, 30]$, $\{n \mid -8 \leq n \leq 30, n \in R\}$
b) the real numbers less than or equal to 0, $(\infty, 0]$, $\{n \mid n \leq 0, n \in R\}$
c) all real numbers greater than or equal to −2, $[-2, \infty)$, $\{n \mid n \geq -2, n \in R\}$
d) the real numbers greater than 50 and less than or equal to 100, $(50, 100]$, $\{n \mid 50 < n \leq 100, n \in R\}$

2. a) domain: all real numbers



(∞, ∞), $\{x \mid x \in R\}$

range: all real numbers



(∞, ∞), $\{y \mid y \in R\}$

b) domain: all real numbers from 2 to 8, inclusive

[2, 8], $\{x \mid 2 \le x \le 8, x \in R\}$

range: all real numbers from 1 to 7, inclusive

[1, 7], $\{y \mid 1 \le y \le 7, y \in R\}$

c) domain: all real numbers greater than or equal to −4

[−4, ∞), $\{x \mid x \ge -4, x \in R\}$

range: all real numbers greater than or equal to 0

[0, ∞), $\{y \mid y \ge 0, y \in R\}$

d) domain: all real numbers from −2 to 2, inclusive

[−2, 2], $\{x \mid -2 \le x \le 2, x \in R\}$

range: all real numbers from −5 to −1, inclusive

[−5, −1], $\{y \mid -5 \le y \le -1, y \in R\}$

e) domain: all real numbers

(∞, ∞), $\{x \mid x \in R\}$

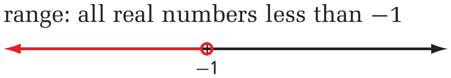
range: all real numbers less than and including 7

(∞, 7], $\{y \mid y \le 7, y \in R\}$

f) domain: all real numbers less than 1

(∞, 1), $\{x \mid x < 1, x \in R\}$

range: all real numbers less than −1



(∞, −1), $\{y \mid y < -1, y \in R\}$

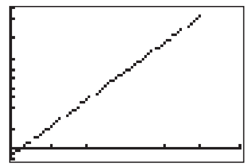
3. a) domain: {−4, 0, 1, 2, 3}, range: {−1, 0, 1, 4, 5, 6, 7}

b) domain: {−4, −2, 0, 2, 4, 6}, range: {5, 7, 9}

c) domain: {50, 100, 150, 200}, range: {10, 20, 30, 40}

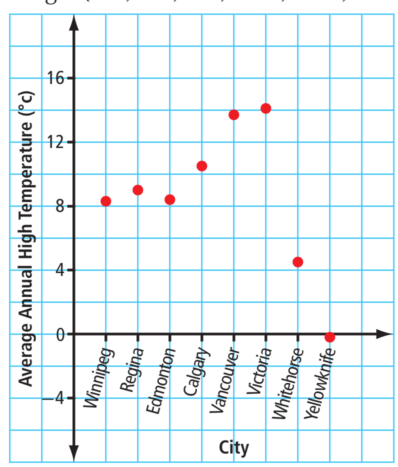
4. a) [−3.5, 66.5]

b) Example: Window values: Xmin = 0, Xmax = 30, Ymin = −5, Ymax = 70



5. a) domain: {Winnipeg, Regina, Edmonton, Calgary, Vancouver, Victoria, Whitehorse, Yellowknife}, range: {8.3, 9.1, 8.5, 10.5, 13.7, 14.1, 4.5, −0.2}

b)

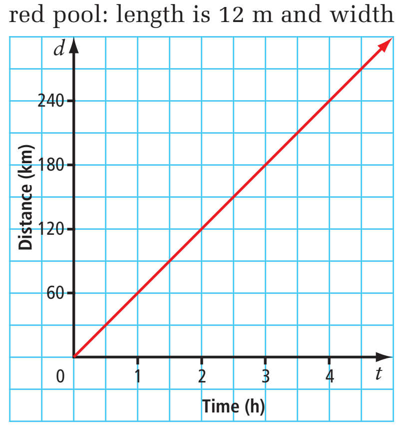


6. a) domain: [2.5, 11.5], range: [0, 6]

b) domain: $\{x \mid 1 \le x \le 13, x \in R\}$, range: $\{y \mid 0 \le y \le 6, y \in R\}$

c) blue pool: length is 9 m and width is 6 m; red pool: length is 12 m and width is 6 m

7. a)



b) Examples: domain: the times between 0 h and approximately 3.22 h, [0, 3.22]; range: the distances between 0 km and 193 km inclusive, [0, 193]

8. a) dependent variable axis label: Water Depth (ft), d;
independent variable axis label: Time (h), t

b) Point A represents the high-tide water depth of 15.9 ft at 12:00 a.m. (0 h) at the beginning of the period, at 12:00 p.m. (12 h) at the middle of the period, and at 12:00 a.m. (24 h) at the end of the period. Point B represents the low-tide water depth of 4.5 ft at 6:00 a.m. (6 h) and at 6:00 p.m. (18 h). Point C is the origin, at the beginning of the time period (0 h). Point D is the end of the period (24 h).

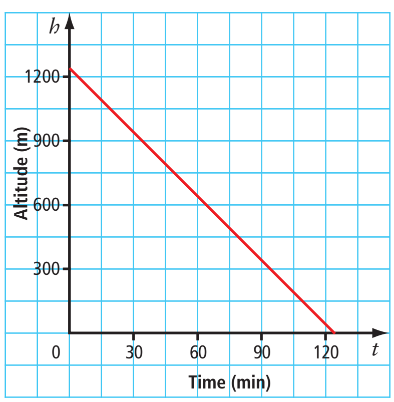
c) domain: the times between 0 h and 24 h, inclusive

$[0, 24]$, $\{t \mid 0 \le t \le 24, t \in \mathrm{R}\}$
range: the water depths between 4.5 ft and 15.9 ft, inclusive

$[4.5, 15.9]$, $\{d \mid 4.5 \le d \le 15.9, d \in \mathrm{R}\}$

9. a) 123.6 min

b)



c) Example: No. Once the balloon has landed, the situation of the model changes, causing a restriction on the domain and range.

d) The domain represents the times from when the balloon is at its highest until the balloon reaches the ground. The range represents the heights of the balloon from its highest point to ground level.

e) domain: the times between 0 min and 123.6 min, inclusive

$[0, 123.6]$, $\{t \mid 0 \le t \le 123.6, t \in \mathrm{R}\}$
range: the altitudes between 0 m and 1236 m, inclusive

$[0, 1236]$, $\{h \mid 0 \le h \le 1236, h \in \mathrm{R}\}$

10. $m = 2$ and $k = 14$

11. domain: [0, 7997.5]; range: [0, 2285]

12. Example: Given pairs of numbers that are related in some way, the domain is all of the possible first numbers of the relation, and the range is all of the possible second numbers of the relation.

13. Example: Hockey teams: The number of teams is the independent variable and the total number of players is the dependent variable. The restrictions are in place because there must be a limited number of teams, and each team has a limit on the number of players it can have.

6.4 Functions, pages 311 to 314

1. a) function; Each value of x has one value of y.
b) function; Each value of x has one value of y.
c) function; Each value of x has one value of y.
d) not a function; The values of x of 1 and 4 each have more than one value of y.
e) function; Each name has one age.
f) function; The graph passes the vertical line test.
g) not a function; There are two values of y associated with $x = -2$.

2. $A(r) = 4\pi r^2$

3. $C = 3n + 50$

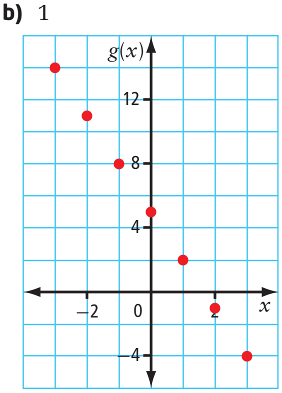
4. a) 12 **b)** −38 **c)** 5

5. a) 7 **b)** −1 **c)** −12

6. a) 2 **b)** 1

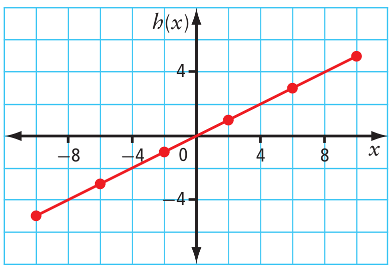
7. a)

x	$g(x)$
−3	14
−2	11
−1	8
0	5
1	2
2	−1
3	−4



b) Example:

x	$h(x)$
−10	−5
−6	−3
−2	−1
2	1
6	3
10	5



8. a) The variable w represents the number of weeks.

b) $M(w)$ is the function that shows the amount that Mike saves each week. $A(w)$ is the function that shows the amount that Ali spends each week.

c) $M(4) = 280$ and $A(4) = 120$; After four weeks, Mike has $280 and Ali has $120.

d) $w = 10$; After 10 weeks, Ali will have spent all of her money.

9. a) 177.523 cm

b) 174.636 cm; The function $h(36.87)$ represents the height of a female whose humerus measures 36.87 cm.

c) Example: [100, 230]; It is unlikely that either a man or woman would be shorter than 100 cm or taller than 230 cm.

d) Example: For $h(100)$, the radius bone for men measures approximately 4.1 cm. For $h(230)$, it measures approximately 43.5 cm. So, the domain is [4.1, 43.5]. For women, the radius bone measures approximately 5.7 cm and 45.1 cm. So, the domain is [5.7, 45.1]

e) Example: A male with a radius measuring 29 cm should have a height of 182.1 cm. If his height is 180 cm, the prediction is relatively accurate.

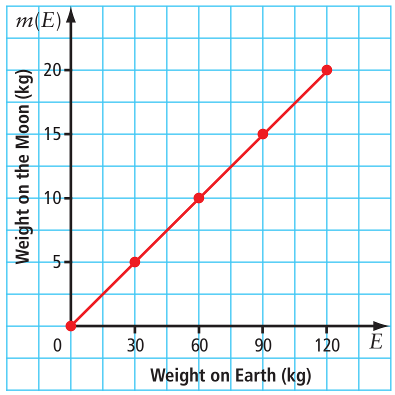
10. a) You would be lighter on the moon, because you divide your Earth weight by six to calculate your weight on the moon.

b) approximately 13.3 kg

c) Example: A person who weighs 90 kg on Earth would weigh 15 kg on the moon.

d) Example: [0, 120]

Weight on Earth (kg)	Weight on the Moon (kg)
0	0
30	5
60	10
90	15
120	20



11. a) 1236 km/h

b) 1071 km/h

c) $M(V) = \frac{V}{1236}$ and $M(V) = \frac{V}{1071}$

d) approximately 1.68

12. a) $f(x) = 3x + 2$

b) Example: $f(x) = 5x - 2$; $f(1) = 3$, $f(-1) = -7$, $f(2) = 8$, and $f(-2) = -12$

13. a) Yes. Each percent of carbon-14 value is paired with only one age value.

b) Example: approximately 90 years; This is the age of the bison bone.

c) Example: These bison bones would have about 50% of their carbon-14 remaining.

14. a) Yes. No value of x has more than one value of y.

b) $f(-4) = 0.5$; $f(1) = 0.5$; $f(3) = 4$; $f(5) = 6$

15. a) $h(4x) = 8x - 5$

b) $h(2x + 3) = 4x + 1$

c) $h\left(\frac{x}{2} - 1\right) = x - 7$

16. Example: Relations are pairs of numbers that are related to each other in some way. Functions are also pairs of numbers that are related, but they cannot be related in such a way that any value of x has more than one value of y (the first number cannot be paired with more than one second number).

17. Example: The expression $f(2)$ means that the value of x is 2. The expression $f(x) = 2$ means that the function value, or value of y, is 2.

18. Examples:

a) Jean-Marie is applying the distributive property. He thinks that f is being multiplied by the variable and the constant in the brackets.

b) The expression $f(x + 2)$ means that for any function $f(x)$, substitute $(x + 2)$ for x.

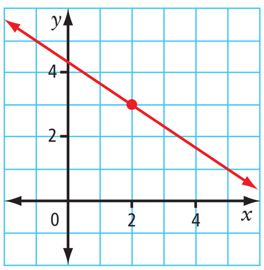
6.5 Slope, pages 325 to 329

1. a) negative **b)** positive **c)** positive **d)** zero **e)** negative

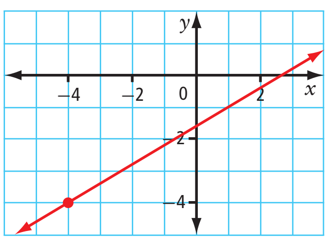
2. a) $\frac{2}{3}$ **b)** -1

3. a) $\frac{4}{7}$ **b)** 0 **c)** $-\frac{2}{3}$ **d)** 3 **e)** undefined **f)** $\frac{1}{2}$

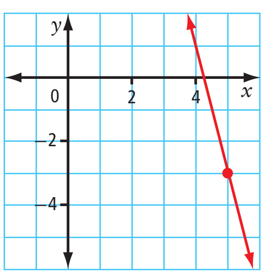
4. a)



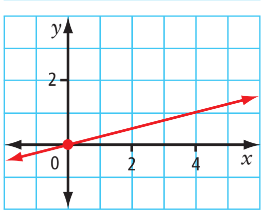
b)



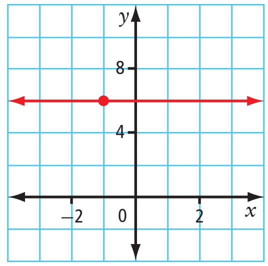
c)



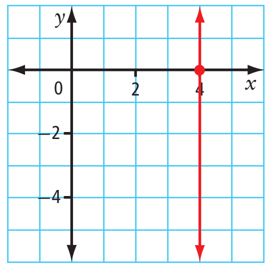
d)



e)



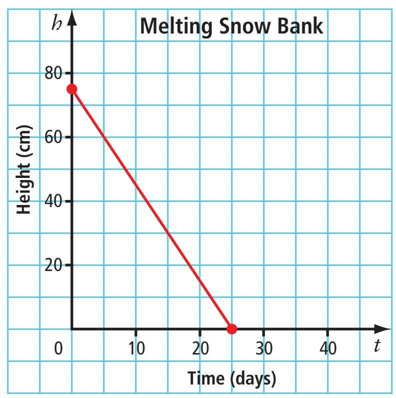
f)



5. -6.5 °C/km

6. approximately -8.3 m/s

7. a)



b) the height of the snow bank after the number of days defined by that point

c) The segment ends at (25, 0). After 25 days, the snow bank has completely melted.

d) The slope represents the rate at which the snow bank is losing height, which is 3 cm per day.

8. a) 216 in. or 18 ft

b) approximately $216\frac{3}{4}$ in. or 18 ft $\frac{3}{4}$ in.

c) approximately 24 ft 1 in.

9. a) $\frac{8}{100}$ or 8 : 100

b) Example: For every 100 units forward, the height of the road drops 8 units.

10. -3 ft/yr

11. a) The wood bison population diminished at a rate of approximately 1804 wood bison per year.
b) The wood bison population increased at a rate of approximately 47 wood bison per year.

12. a) 933 000 trees/yr
b) This rate of change represents the average increase per year in the number of trees in Alberta infested with the pine beetle from 2004 to 2007.
c) Example: If the same rate of increase continues, then in 2012 the number of trees infested with pine beetles will be 7 465 000, or almost 7.5 million infested trees.

13. a) 341 m/s
b) the speed of sound
c) approximately 10 221 m, or approximately 10 km

14. approximately 0.72

15. a) before heating: 125 cm^3, after heating: approximately 125.75 cm^3
b) 75.1501

16. $\frac{2x}{3}$

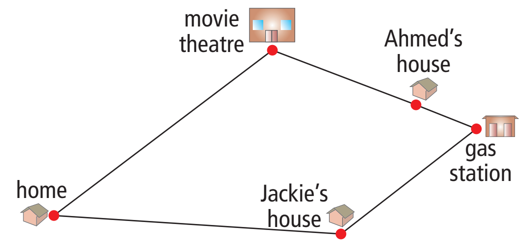
17. Example: The ratio of the rise versus the run remains the same (or constant) between any two points on the line.

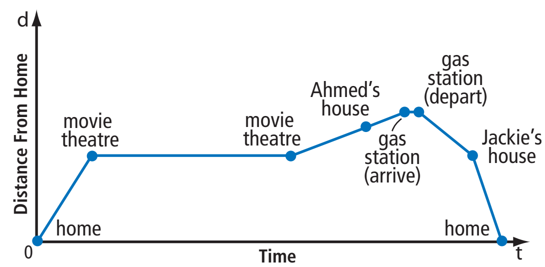
18. a) Example: The tangent ratio is equal to the ratio of the length of the side opposite the angle (or rise), to the length of the side adjacent to the angle (or run). So, the measure of the angle is $\tan^{-1}\left(\frac{1}{16}\right)$.
b) approximately 3.6°

19. **Step 1:** 2900 m, 2720 m, and 2640 m
Step 2: The highest peak, 2900 m, closest to the bottom left corner, is Big Sister.
Step 3: Example: Calculate the slope between the lowest point on the mountain and the point that represents the peak.
Step 4: Example: AB: 5, BC: 0.1, CD: 1.1, DE: 2.6, FG: 0.6; Sections CD and FG pose an avalanche risk.
Step 5: Example: The slope is either too flat for the snow to easily fall, or too steep to hold any snow.

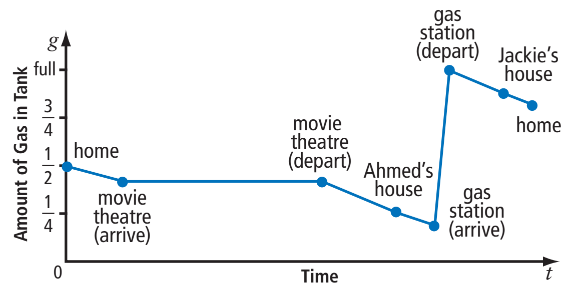
Chapter 6 Review, pages 330 to 334

1. Examples:
a)





b)



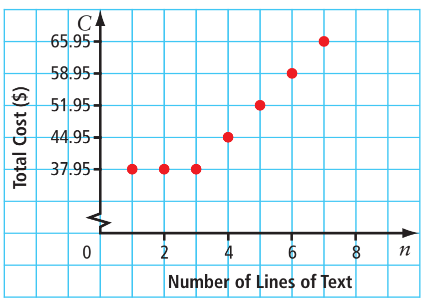
2. Example: The green line represents televisions. As people age, they tend to go out less and use more home entertainment devices such as television. The red line represents cell phones. Older generations were not raised with access to cell phones. The blue line represents computers. The younger groups are more comfortable with and dependent on this device because they were raised with it.

3. Example: Container 1: Graph A; The container would fill up at a constant, gradual rate.
Container 2: Graph D; The container would fill up quickly at a constant rate.
Container 3: Graph B; The lower portion of the container would fill up more slowly than the upper part.
Container 4: Graph C; The container would fill up more quickly at the bottom and slower at the top.

4. a) non-linear; The distance from the sun would not increase or decrease at a constant rate, and there would be times when the distances would repeat.
b) linear; The values of x are increasing by five each time, and the corresponding values of y are changing at a constant rate.
c) non-linear; The degree is 2.
d) non-linear; The values of x are increasing at a constant rate, but the values of y are not.
e) non-linear; The graph is not a single straight line.

5. B and D

6. a) No. There is no change in the cost for the first three lines of text.
b) dependent variable: total cost; independent variable: number of lines of text
c) (3, 37.95), (4, 44.95), (5, 51.95), (6, 58.95), (7, 65.95)
d) discrete
e)



7. a) domain: $\{-9, -5, 0, 2\}$, range: $\{5, 8\}$
b) domain: $\{-1, 0, 1, 2, 3\}$, range: $\{-3, -1, 1, 3, 5\}$

8. a) domain:

$(-5, 5)$, $\{x \mid -5 < x < 5, x \in \mathrm{R}\}$
range:

$(1, 5)$, $\{y \mid 1 < y < 5, y \in \mathrm{R}\}$
b) domain:

$(\infty, 4]$, $\{x \mid x \leq 4, x \in \mathrm{R}\}$
range:

(∞, ∞), $\{y \mid y \in \mathrm{R}\}$

9. $C = \pi d$

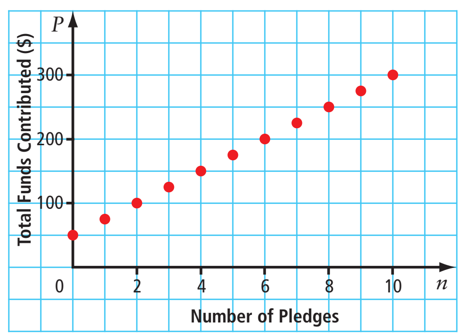
10. $V(r) = r^3$

11. a) function; Each value of x has only one value of y.
b) not a function; It fails the vertical line test.
c) not a function; Black hair colour has one male and one female.
d) not a function; The value of x of 8.6 has more than one value of y.

12. a) approximately 24.4 kg
b) 37.8 kg

13. a)

Number of Pledges	Total Funds Contributed ($)
0	50
1	75
2	100
3	125
4	150
5	175
6	200
7	225
8	250
9	275
10	300



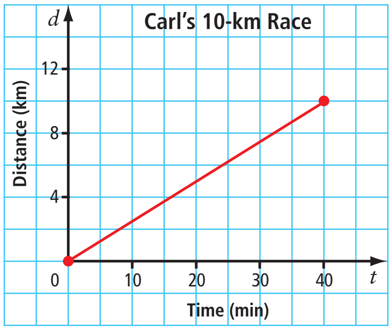
b) \$250; If Amber has eight pledges, she will have \$250 to donate.
c) more than 25 pledges
d) Example: For each number of pledges, there is only one possible total for the amount raised.

14. a) $\frac{3}{5}$
b) undefined
c) 0
d) -4

15. (450, 0) and (−450, 0)

16. a) $\frac{1}{4}$
b) -2

17. a)



b) Carl's distance covered and the time he has taken to cover that distance

c) (40, 10); This point represents the end of the 10-km race, 40 min after Carl started.

d) his speed, 0.25 km/min

18. a) approximately 1155 people per year

b) This number represents the average rate of increase per year of people aged 12 or older who have asthma in Manitoba.

c) approximately 87 292 people

Chapter 6 Practice Test, pages 335 to 337

1. C

2. D

3. B

4. C

5. D

6. a) 1

b) Examples: (2, 1), (3, 2), and (4, 3)

7. a) approximately 5.4 m/s

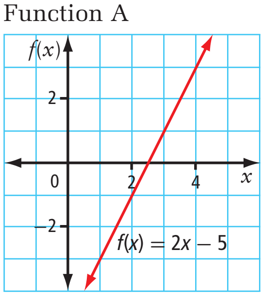
b) This rate represents his actual speed, which combines his speed from rowing and the current speed.

8. a) the boat's speed, in metres per second, after accelerating for 6 s

b) 20 m/s

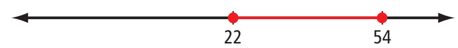
c) 7.2 s

9. Function A



10. a) the time, in hours, beginning at 24:00, and lasting for 3 days

b) Example:

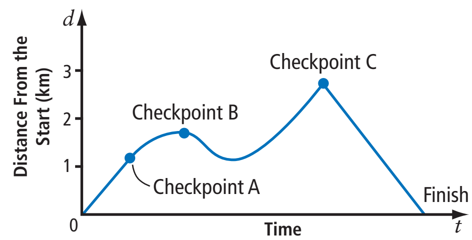


c) Example: [30, 39]

d) Example: $\{t \mid 34 \le t \le 37, t \in R\}$

e) Example: The temperatures are more stable at the deeper depths.

11.



Chapter 7

7.1 Slope-Intercept Form, pages 349 to 356

1. a) $m = -5$, y-intercept: (0, 4)

b) $m = \frac{3}{4}$, y-intercept: (0, 1)

c) $m = 1$, y-intercept: (0, −7)

d) $m = -4$, y-intercept: (0, 0)

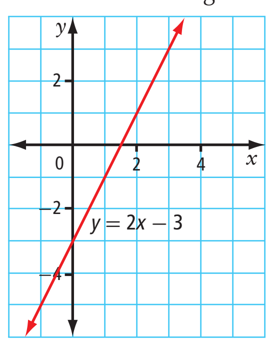
e) $m = 0$, y-intercept: (0, −3)

f) $m = 0.5$, y-intercept: (0, −1.25)

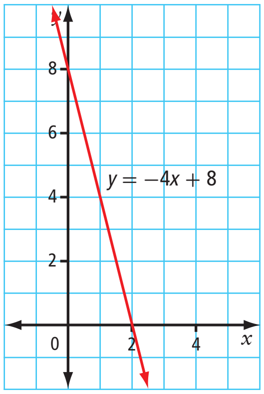
2. a) $m = -3$, y-intercept: (0, 2)

b) Example: Plot the point (0, 2). From the point (0, 2), go 3 units down and 1 unit to the right. Draw a line through the two points given.

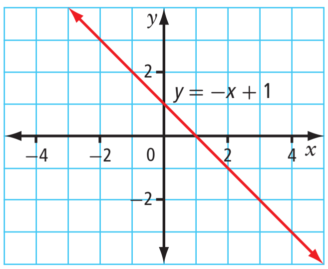
3. a)



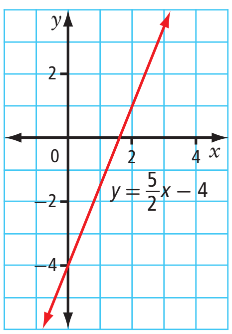
b)



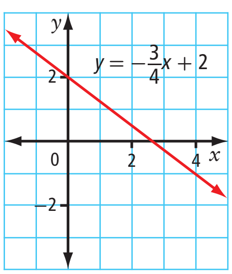
c)



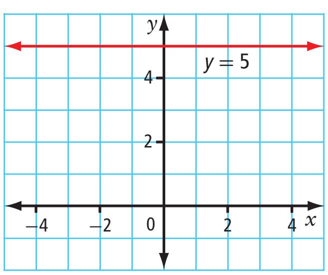
d)



e)



f)



4. a) step 3

b) $y = \frac{3}{2}x - 4$; The slope of the line is $\frac{3}{2}$ and the y-intercept is -4.

5. a) $y = -2x + 6$; $m = -2$, y-intercept: $(0, 6)$

b) $y = -3x - 9$; $m = -3$, y-intercept: $(0, -9)$

c) $y = -\frac{5}{6}x + \frac{4}{3}$; $m = -\frac{5}{6}$, y-intercept: $\left(0, \frac{4}{3}\right)$

d) $y = 6x - 4$; $m = 6$, y-intercept: $(0, -4)$

e) $y = 7x + 9$; $m = 7$, y-intercept: $(0, 9)$

f) $y = 2x - \frac{3}{4}$; $m = 2$, y-intercept: $\left(0, -\frac{3}{4}\right)$

6. a) $y = -3x + 2$ **b)** $y = \frac{5}{6}x - 4$

c) $y = -0.75x - 5$ **d)** $y = x - 7$

e) $y = -x$ **f)** $y = \frac{1}{3}$

7. a) A and C; The slopes are positive.

b) B and D; The slopes are negative.

c) C, B, D, A

d) D

8. a) $m = 4$, y-intercept: $(0, 4)$; $y = 4x + 4$

b) $m = -\frac{1}{2}$, y-intercept: $(0, -1)$; $y = -\frac{1}{2}x - 1$

c) $m = -2$, y-intercept: $(0, 6)$; $y = -2x + 6$

d) $m = \frac{2}{3}$, y-intercept: $(0, 4)$; $y = \frac{2}{3}x + 4$

e) $m = 0$, y-intercept: $(0, -2.5)$; $y = -2.5$

f) $m = \frac{2}{5}$, y-intercept: $(0, 4)$; $y = \frac{2}{5}x + 4$

9. a) -3 **b)** 18 **c)** -11 **d)** -5

10. a) 1 **b)** -5 **c)** $-\frac{3}{2}$ **d)** $-\frac{1}{6}$

11. Examples: $y = \frac{13}{5}x + 64$ and $y = -\frac{13}{5}x + 64$

12. a) $m = -2$, y-intercept: $(0, 3)$; Graph C

b) $m = 2$, y-intercept: $(0, -3)$; Graph D

c) $m = \frac{1}{2}$, y-intercept: $(0, -3)$; Graph B

d) $m = -\frac{1}{2}$, y-intercept: $(0, 3)$; Graph A

13. a) $C = 300 + 6.25n$

b) $T = 3.60 + 1.48x$

c) $D = 1024 + 54t$

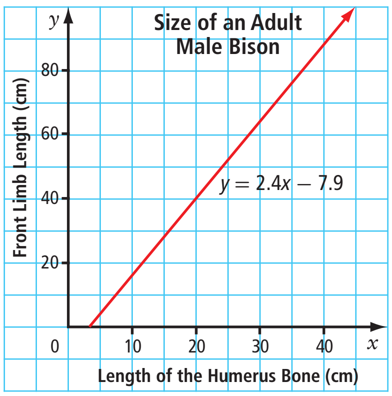
d) $L = 2500 - 120t$

14. $y_1 = \frac{10}{3}x + 10$, $y_2 = -\frac{10}{3}x + 10$, $y_3 = -\frac{10}{3}x - 10$, $y_4 = \frac{10}{3}x - 10$, $y_5 = -x$, $y_6 = x$, $y_7 = -\frac{3}{10}x + 3$, $y_8 = \frac{3}{10}x + 3$, $y_9 = -\frac{3}{10}x - 3$, $y_{10} = \frac{3}{10}x - 3$

15. a) spring 1: $L = \frac{3}{2}x + 8$, spring 2: $L = -\frac{3}{2}x + 24$

b) Example: The mass is sitting on top of the spring instead of being suspended from it. The length of spring 2 compresses by 1.5 cm per gram.

16. a)

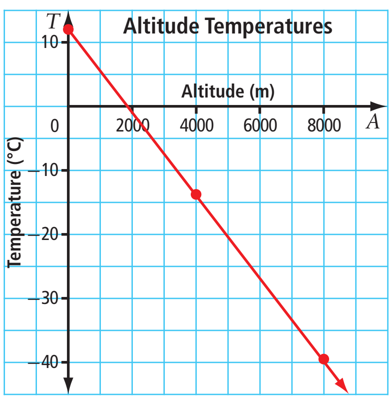


b) 89 cm, 70 cm

c) 26%

17. $y = -3x + 7$

18. a)



b) $m = -\frac{4}{625}$; The temperature drops 4 °C for every 625 m increase in altitude.

c) y-intercept: (0, 12); The temperature at ground level is 12 °C.

d) $T = -\frac{4}{625}A + 12$

e) −26.1 °C

f) above 5000 m

19. $y = -\frac{1}{4}x + 4$

20. −20

21. −9

22. $y = x + 3$

23. 99 points

24. a) Example: To determine the slope, apply the slope formula using two of the points from the table. To determine the y-intercept, look for the corresponding y-coordinate when the x-coordinate is 0.

b) Example: To determine the slope, find two points on the graph and apply the slope formula. To determine the y-intercept, read the value of y when $x = 0$ from the graph.

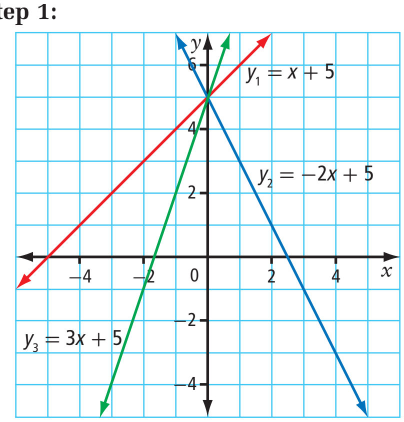
c) Example: The slope is the value of m, and the y-intercept is the value of b.

25. a) Example: Write the equation of the line in the form $y = mx + b$, where m is the slope and b is the y-intercept.

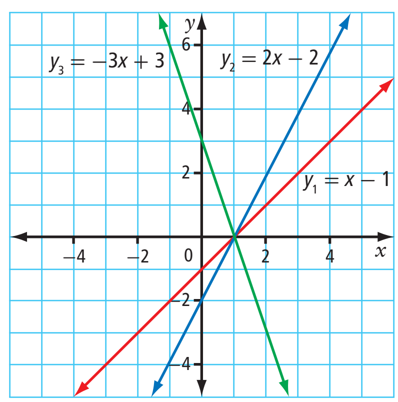
b) Example: Start with the y-intercept and then use the slope to determine a second point. Draw the line passing through the two points.

26. Step 1:

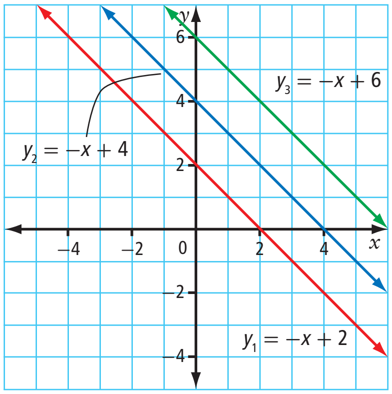
a)



b)



c)



Step 2: Examples:

a) same y-intercept but different slopes

b) same x-intercept but different slopes

c) same slope but different y-intercepts; parallel lines

Step 3: Examples:

a) $y = -x + 5$

b) $y = -x + 1$

c) $y = -x - 2$

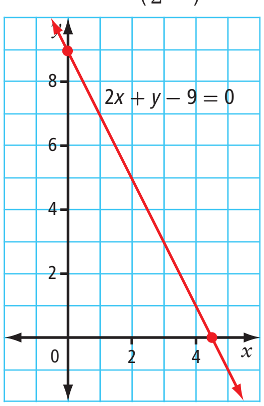
Step 4: Example: $y_1 = 2x$, $y_2 = -x$, $y_3 = 3x$; All lines pass through the origin, (0, 0).

7.2 General Form, pages 365 to 369

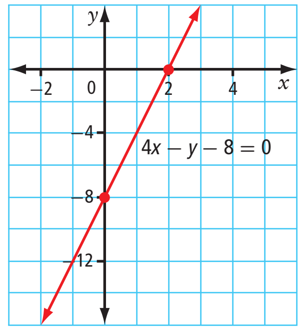
1. Jasmine forgot to multiply 4 by 2. $3x + 2y - 8 = 0$

2. a) $7x - y - 5 = 0$ **b)** $x + y - 8 = 0$
c) $3x - 2y + 8 = 0$ **d)** $3x + 5y + 10 = 0$
e) $5x - 20y - 6 = 0$ **f)** $20x + 8y - 1 = 0$

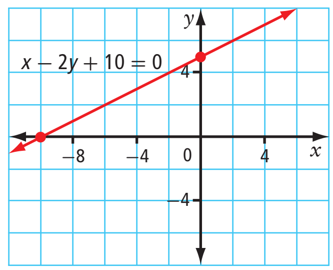
3. a) x-intercept: $\left(\frac{9}{2}, 0\right)$, y-intercept: $(0, 9)$



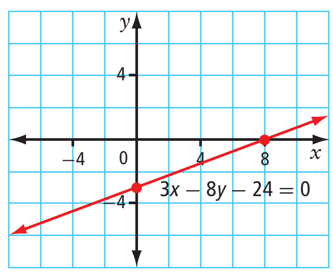
b) x-intercept: $(2, 0)$, y-intercept: $(0, -8)$



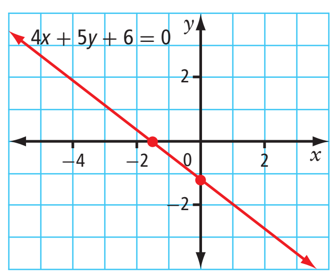
c) x-intercept: $(-10, 0)$, y-intercept: $(0, 5)$



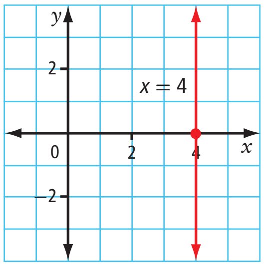
d) x-intercept: $(8, 0)$, y-intercept: $(0, -3)$



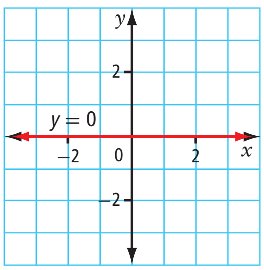
e) x-intercept: $\left(-\frac{3}{2}, 0\right)$, y-intercept: $\left(0, -\frac{6}{5}\right)$



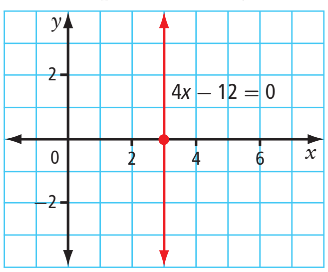
f) x-intercept: (4, 0), no y-intercept



g) $\{x \mid x \in \mathrm{R}\}$, y-intercept: (0, 0)



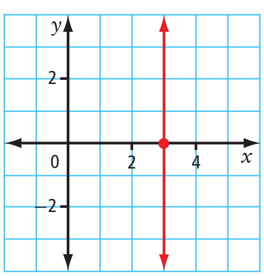
h) x-intercept: (3, 0), no y-intercept



4. a) domain: $\{x \in \mathrm{R}\}$, range: $\{2\}$, no x-intercept, y-intercept: (0, 2), $m = 0$; $y - 2 = 0$

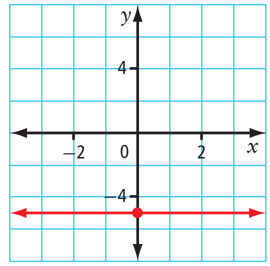
b) domain: $\{-3\}$, range: $\{y \in \mathrm{R}\}$, no y-intercept, x-intercept: $(-3, 0)$, slope is undefined; $x + 3 = 0$

5. a)



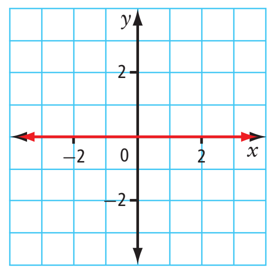
$x - 3 = 0$

b)



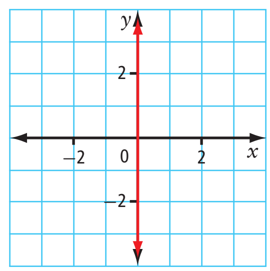
$y + 5 = 0$

c)



$y = 0$

d)



$x = 0$

6. a) 2 **b)** 4 **c)** 8 **d)** 5
e) 3 **f)** 6 **g)** 7 **h)** 1

7. a) $x - 3 = 0$ **b)** $y - 6 = 0$
c) $y = 0$ **d)** $x = 0$

8. $x - 3 = 0$

9. Let g represent the number of 125-mL servings of green peas. Let b represent the number of 125-mL servings of baked beans. Let B represent the number of 125-mL servings of bran buds.
$4g + 16B - 21 = 0$ or $7b + 16B - 21 = 0$;
green peas: 157 mL; baked beans: 90 mL
Note that answers were rounded up to ensure the desired amount of each vegetable was consumed. If the answers had been rounded down, the desired amounts would not have been achieved.

10. a) y-intercept: (0, 1200); The distance between Saskatoon and Vancouver is 1200 km. x-intercept: (2.0, 0); It takes 2 h to fly from Saskatoon to Vancouver.

b) domain: $\{x \mid 0 \le x \le 2, x \in \mathrm{R}\}$, range: $\{y \mid 0 \le y \le 1200, y \in \mathrm{R}\}$

c) $m = -600$; The speed of the plane is 600 km/h.

d) $600x + y - 1200 = 0$

e) 1 h 40 min

f) 750 km

11. a) $8x + 11y = 440$

b) x-intercept: (55, 0); Luc needs to swim backstroke for 55 min in order to burn 440 cal. y-intercept: (0, 40); Luc needs to swim butterfly for 40 min in order to burn 440 cal.

c) 33 min

12. a) $1200x + 1800y = 10\ 000$

b) approximately 0.50 m^3

c) approximately 6%

13. a) $8a + 12d - 1120 = 0$

b) Example: Find the a-intercept and the d-intercept and draw the line passing through these two points.

c) 80 advance tickets, 40 tickets at the door

14. a) $\frac{4}{3}$ **b)** 3 **c)** -10

15. a) (6, 6) **b)** (12, 4) **c)** (3, 7)

16. -4

17. a) 25 square units

b) 49 square units

18. a) Example: I prefer the slope-intercept form, because it is easy to find two points on the graph.

b) Example: Use the general form to find the x-intercept.

19. a) Example: Substitute $y = 0$ in the equation and solve for x.

b) Example: Substitute $x = 0$ into the equation and solve for y, or rewrite the equation in slope-intercept form.

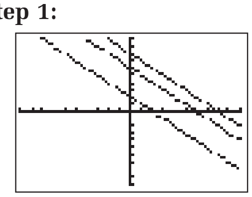
20. a) vertical

b) horizontal

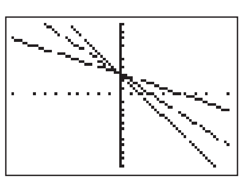
c) oblique

21. Step 1:

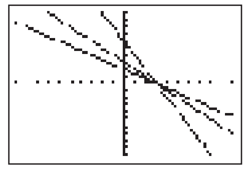
a)



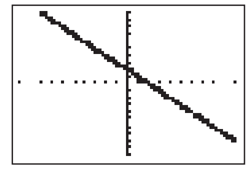
b)



c)



d)



Step 2:

a) parameter C; If only parameter C is changed, the graphs of the equations will have the same slope but different x-intercepts and y-intercepts.

b) parameter A; If only parameter A is changed, the graphs of the equations will have the same y-intercept but different slopes and x-intercepts.

c) parameter B; If only parameter B is changed, the graphs of the equations will have the same x-intercept but different slopes and y-intercepts.

d) All parameters have changed so that the second and third equations are multiples of the first equation. When parameters A, B, and C of one equation are multiples of those of another equation, the graphs represent the same line.

Step 3: Example: Parameters A and B influence the slope of the line, while parameter C influences the x-intercept and y-intercept.

7.3 Slope-Point Form, pages 377 to 382

1. a) $y = x - 8$, $x - y - 8 = 0$

b) $y = 2x + 2$, $2x - y + 2 = 0$

c) $y = 4x + 10$, $4x - y + 10 = 0$

d) $y = -5x - 17$, $5x + y + 17 = 0$

e) $y = -\frac{1}{2}x - 1$, $x + 2y + 2 = 0$

f) $y = -\frac{2}{3}x - 5$, $2x + 3y + 15 = 0$

2. a) $y - 2 = 2(x - 3)$

b) $y + 3 = -\frac{3}{2}(x - 1)$

c) $y + 2 = \frac{1}{2}(x + 4)$

d) $y - 2 = -\frac{1}{3}(x + 4)$

3. a) $y + 2 = 6(x - 5)$, $y = 6x - 32$, $6x - y - 32 = 0$

b) $y + 5 = -2(x + 3)$, $y = -2x - 11$, $2x + y + 11 = 0$

c) $y - 3 = \frac{1}{2}(x + 8)$, $y = \frac{1}{2}x + 7$, $x - 2y + 14 = 0$

d) $y + 6 = -\frac{2}{3}(x - 12)$, $y = -\frac{2}{3}x + 2$, $2x + 3y - 6 = 0$

4. a) $m = \frac{2}{3}$, $(6, 1)$

b) Example: From the point (6, 1), go 2 units up and 3 units right to find the second point. Draw the line passing through the two points.

5. Examples:

a) $y - 1 = 4(x - 1)$

b) $y + 2 = -3(x + 1)$

c) $y - 2 = -\frac{1}{2}(x + 2)$

d) $y + 1 = \frac{2}{3}(x - 0)$

6. a) $y - 1 = 4(x - 5)$, $y = 4x - 19$, $4x - y - 19 = 0$

b) $y + 8 = -3(x - 5)$, $y = -3x + 7$, $3x + y - 7 = 0$

c) $y - 5 = -\frac{1}{2}(x - 4)$, $y = -\frac{1}{2}x + 7$, $x + 2y - 14 = 0$

d) $y + 3 = \frac{3}{4}(x - 8)$, $y = \frac{3}{4}x - 9$, $3x - 4y - 36 = 0$

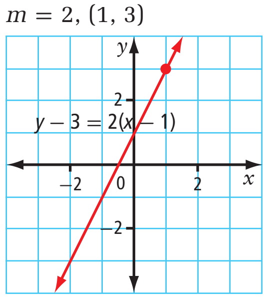
e) $y + 1 = \frac{3}{2}(x - 5)$, $y = \frac{3}{2}x - \frac{17}{2}$, $3x - 2y - 17 = 0$

f) $y - 6 = \frac{3}{2}(x - 3)$, $y = \frac{3}{2}x + \frac{3}{2}$, $3x - 2y + 3 = 0$

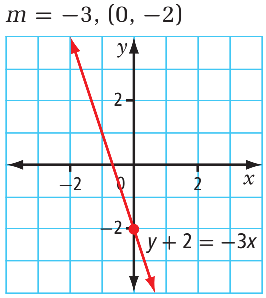
7. a) Example: Compare the graphs of the equations using slope-point form, or rewrite the equations in slope-intercept form and compare the equations.

b) 1 and 4, 2 and 3; In slope-intercept form, the equations in each pair are the same.

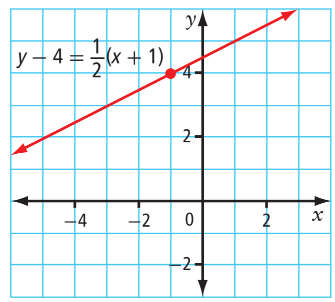
8. a) $m = 2$, $(1, 3)$



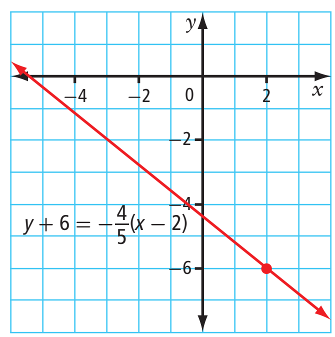
b) $m = -3$, $(0, -2)$



c) $m = \frac{1}{2}$, $(-1, 4)$



d) $m = -\frac{4}{5}$, $(2, -6)$



9. a) Example: Find the slope and use one of the points in slope-point form or in slope-intercept form of the equation. Plot the two points and draw the line that passes through them. Read the *y*-intercept from the graph.

b) 10

10. a) $y = 2x + 1$

b) Example: $y - 7 = 2(x - 3)$

c) same graph

11. a) $y + 5 = 0(x - 4)$, $y = -5$

b) $y - 4 = -3(x + 2)$, $y = -3x - 2$

c) $y - 0 = \frac{1}{2}(x - 8)$, $y = \frac{1}{2}x - 4$

d) $y + 4 = -2(x - 3)$, $y = -2x + 2$

12. a) $y - 0 = 3(x - 4)$, $3x - y - 12 = 0$

b) $y + 1 = -4(x - 2)$, $4x + y - 7 = 0$

c) $y - 2 = -\frac{1}{2}(x - 0)$, $x + 2y - 4 = 0$

d) $y + 6 = 3(x - 0)$, $3x - y - 6 = 0$

13. a) $V - 29 = 1.2(t - 24)$

b) 129 h

c) No. The tank contained 0.2 m^3 before it started filling.

14\. a) $\frac{3}{5}$
b) 0.6 m/s/°C
c) $V - 335 = \frac{3}{5}(t - 6)$
d) 352.4 m/s
e) approximately 28 °C

15\. -2

16\. -3

17\. a) (1, 30) and (9, 33.7)
b) $m = 0.4625$
c) 462 500 people/year
d) $p - 30 = 0.4625(t - 1)$
e) 37.4 million people

18\. a) Example: $p - 30 = \frac{3}{5}(n - 0)$, where p represents the number of grams of protein in the dinner and n represents the number of yellow potatoes that are eaten.
b) $m = \frac{3}{5}$; It represents 0.6 g protein per yellow potato.
c) p-intercept = 30; The steak contains 30 g of protein.
d) Example: domain: $\{n \mid 0 \leq n \leq 5, n \in W\}$, range: $\{p \mid 0 \leq p \leq 33, p \in R\}$

19\. $y = m(x - n)$

20\. $y + 4 = \frac{1}{2}(x + 4)$

21\. Substitute the coordinates of the y-intercept, $(0, b)$.

22\. Example: two points, slope and one point, relationships with other lines

23\. Example: $y = mx + b$ for questions about slope or y-intercept; $y - y_1 = m(x - x_1)$ for questions involving two points or a point and slope

24\. **Step 1:** Example:

Length of Humerus Bone (cm)	Person's Height (cm)
36	176
40	177

Step 3: The equation of the line passing through these two points is $y = 0.25x + 167$.
Step 4: Example: For a measurement of 37 cm, the predicted height of the teacher is 176.25 cm or approximately 176 cm.

7.4 Parallel and Perpendicular Lines, pages 390 to 395

1\. a) $m = 5$; $m = -\frac{1}{5}$
b) $m = -7$; $m = \frac{1}{7}$
c) $m = -\frac{1}{3}$; $m = 3$
d) $m = \frac{6}{7}$; $m = -\frac{7}{6}$
e) $m = 0.5$; $m = -2$
f) $m = -0.75$; $m = \frac{4}{3}$
g) $m = 0$, m is undefined
h) m is undefined, $m = 0$

2\. a) $m = \frac{3}{7}$, $m = -\frac{7}{3}$
b) $m = -1$, $m = 1$
c) $m = -3$, $m = \frac{1}{3}$
d) $m = -2$, $m = \frac{1}{2}$
e) $m = \frac{3}{2}$, $m = -\frac{2}{3}$
f) $m = -\frac{5}{4}$, $m = \frac{4}{5}$
g) $m = 0$, m is undefined
h) m is undefined, $m = 0$

3\. a) $m = -2$ b) $m = \frac{1}{2}$

4\. a) $n = 20$; $n = -5$
b) $n = -72$; $n = 8$
c) $n = \frac{27}{2}$; $n = -6$
d) $n = -\frac{6}{7}$; $n = \frac{21}{2}$

5\. a) neither; The slopes are neither equal nor negative reciprocals.
b) perpendicular; The slopes are negative reciprocals.
c) parallel; The slopes are equal.
d) perpendicular; The slopes are negative reciprocals.
e) neither; The slopes are neither equal nor negative reciprocals.
f) perpendicular; The slopes are negative reciprocals.

6\. a) $y = 2x - 8$ b) $y = -3x - 1$
c) $y = -5x + 7$ d) $y = 3x - 14$
e) $y = 4$ f) $x = -1$

7. a) $y = -\frac{1}{3}x + 8$ **b)** $y = \frac{1}{4}x - 4$

c) $y = 3x - 24$ **d)** $y = -\frac{3}{4}x - \frac{5}{2}$

e) $y = 7$ **f)** $x = 4$

8. a) Example: No. You have to prove it mathematically.

b) Example: Calculate and compare the slopes of the two lines. If the slopes are equal, then the lines are parallel.

c) No. Since $m_{AB} = \frac{1}{3}$ and $m_{CD} = \frac{1}{2}$, the two line segments are not parallel.

9. Yes. Example: Since $m_{AB} = m_{CD} = -\frac{2}{7}$, side AB is parallel to side CD. Since $m_{AD} = m_{BC} = -3$, side AD is parallel to side BC. Therefore, ABCD is a parallelogram, because opposite sides are parallel.

10. a) $y - 5 = 0$ **b)** $x - 7 = 0$

11. a) $n = -8$ **b)** $n = 5$

12. Example: $m_{AB} = \frac{2}{7}$ and $m_{AC} = -\frac{7}{2}$. Since the slopes of sides AB and AC are negative reciprocals, AB and AC are perpendicular to each other, and △ABC is a right triangle.

13. a) $y = -5x - 6$

b) $y = 5x - 3$

c) $y = \frac{4}{5}x - 4$

14. $y = 2x - 1$

15. $n = -8$

16. $y = -3x + 16$

17. Example: No. The slopes of the two graphs are not equal.

18. Example: $y_1 = \frac{14}{23}x + \frac{42}{23}$, $y_2 = \frac{14}{23}x$, $y_3 = \frac{14}{23}x - 2$; Note: The slope of the middle line is parallel to the other two lines.

19. $n = -10$

20. $n = 3$

21. $\frac{\sqrt{5}}{5}$ units; It is the perpendicular distance between the lines.

22. (1, 0) and (4, 0)

23. $n = 6$, $n = -6$

24. $n = 0$

25. Example: Sometimes true. Vertical and horizontal lines are perpendicular to each other. However, their slopes are not negative reciprocals. For oblique lines, it is always true.

26. Example: I would prefer to use the slope-intercept or slope-point form, because it is easy to compare the slopes.

Chapter 7 Review, pages 396 to 398

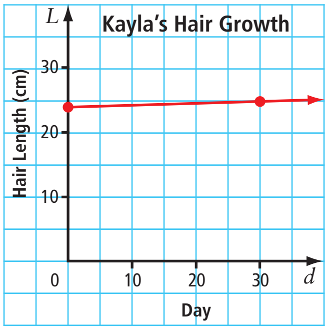
1. a) $m = -5$, y-intercept: (0, 6)

b) $m = \frac{5}{6}$, y-intercept: (0, 2)

2. a) Substitute $-\frac{4}{5}$ for m and 6 for b in $y = mx + b$. $y = -\frac{4}{5}x + 6$

b) Substitute 0 for m and −8 for b in $y = mx + b$. $y = -8$

3. a)



b) $m = 0.04$; Kayla's hair grows 0.04 cm per day.

c) y-intercept: (0, 24); Kayla's starting hair length is 24 cm.

d) $L = 0.04d + 24$

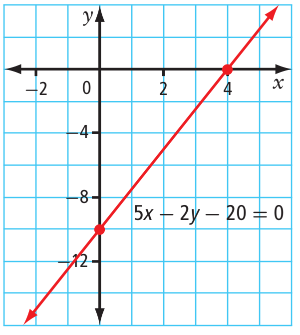
e) 53.2 cm

4. Example: Express the equation in slope-intercept form. Start from the y-intercept, 4, on the y-axis. Locate another point by moving 2 units down and 5 units to the right, since the slope is $-\frac{2}{5}$. Draw a line through the points, (0, 4) and (5, 2).

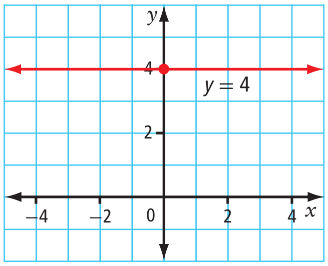
5. a) (0, 6), (−2, 0); $3x - y + 6 = 0$

b) (3, 0), no y-intercept; $x - 3 = 0$

6. a) x-intercept: (4, 0), y-intercept: (0, −10)



b) no x-intercept, y-intercept: $(0, 4)$



7. a) Let b represent the number of bannock wheels sold. Let c represent the number of buffalo burgers sold. $2b + 3c - 600 = 0$

b) b-intercept $= 300$; If they sold only bannock wheels, they would have sold 300. c-intercept $= 200$; If they sold only buffalo burgers, they would have sold 200.

c) domain: $\{b \mid 0 \le b \le 300, b \in W\}$, range: $\{c \mid 0 \le c \le 200, c \in W\}$

d) 110 buffalo burgers

8. a) $y - 1 = -4(x + 2)$, $y = -4x - 7$, $4x + y + 7 = 0$

b) $y + 3 = \frac{1}{2}(x - 8)$, $y = \frac{1}{2}x - 7$, $x - 2y - 14 = 0$

9. Example: Find the slope using the two points: $m = -4$. Write the equation in slope-point form using the slope and one of the points: $y - 2 = -4(x - 3)$. $y = -4x + 14$ or $4x + y - 14 = 0$

10. a) $m = -0.0035$; The temperature at which water boils decreases by 0.0035 °C for every metre increase in altitude.

b) $T = -0.0035d + 100$

c) 86 °C

11. a) $m = \frac{5}{2}$ **b)** $m = -\frac{2}{5}$

12. a) $n = -12$ **b)** $n = 27$

13. a) A and D, A and E, D and E; The slopes are equal but the intercepts are different.

b) B and A, B and D, B and E; The slopes are negative reciprocals.

c) D and E; The equations of the lines are the same.

14. $y = 2$; Example: The slope of $y = -7$ is 0 and the graph is a horizontal line. Therefore, the equation of a horizontal line through $(-1, 2)$ is $y = 2$.

15. $4x - 3y + 45 = 0$; Example: Determine the slope of the given line. Then, substitute the negative reciprocal of that slope and the coordinates of the given point into the slope-point form. Express in general form.

16. Example: First, determine that the slope of $2x + 5y + 10 = 0$ is $-\frac{2}{5}$. The slope of a line perpendicular to this one is $\frac{5}{2}$. Next, determine that the x-intercept of $3x - 2y = 12$ is 4. Then, use $m = \frac{5}{2}$ and $(4, 0)$ to write the equation of the line in slope-point form. Express it in general form. $5x - 2y - 20 = 0$

17. $y = -\frac{4}{3}x + 18$

Chapter 7 Practice Test, pages 399 to 401

1. C

2. B

3. B

4. C

5. A

6. A

7. a) The product of their slopes is -1.

b) $n = 9$

8. $x - 2 = 0$

9. a) Let a represent the number of adult tickets sold. Let s represent the number of student tickets sold. $10a + 6s = 2900$

b) 125 adult tickets

10. A, C, and D; Once expressed in slope-intercept form, they all have the same equation.

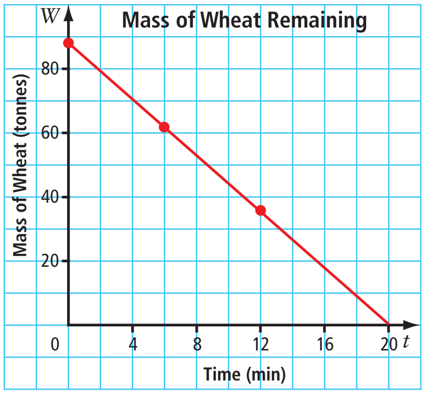
11. a) D-intercept: $(0, 30)$; This represents the total length of the trail: 30 km.

b) Example: The equations of the two scenarios represent parallel lines, since they will have the same slope. Parallel lines never intersect. Therefore, Felicia will never catch up to Jacob.

12. $5x + y - 14 = 0$; Example: First, determine that the slope of $5x + y - 1 = 0$ is -5. A parallel line will have the same slope. Use $m = -5$ and $(3, -1)$ to write an equation in slope-point form, and then express it in general form.

13. Example: 1) Plot the point $(-3, 4)$ and use the slope of -2 to locate another point. Draw a line through the two points. 2) Express the equation in slope-intercept form. Then, use the slope of -2 and the y-intercept of -2 to draw the graph of the line. 3) Express the equation in general form. Then, find the intercepts and use these to draw the graph of the line.

14. a)



b) $W = -4.4t + 88$

c) t-intercept = 20; After 20 min, the car is empty. W-intercept = 88.0; Before unloading, there is 88.0 tonnes of grain in the railway car.

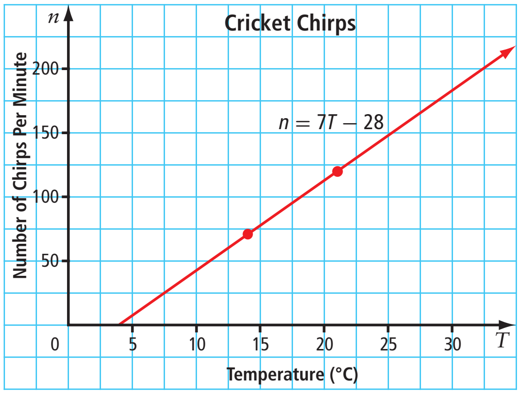
d) $m = -4.4$; The railway car is unloaded at a rate of 4.4 tonnes per minute.

e) domain: $\{t \mid 0 \leq t \leq 20,\ t \in R\}$, range: $\{W \mid 0 \leq W \leq 88.0,\ W \in R\}$

f) 10 min

15. a) $n = 7T - 28$

b) Example: Plot the two points (14, 70) and (21, 119) and draw a line through them.

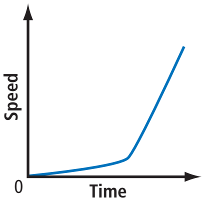


c) 28 °C

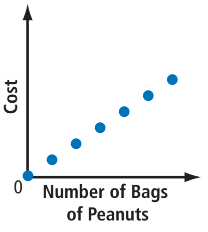
Unit 3 Review, pages 406 to 407

1. Examples:

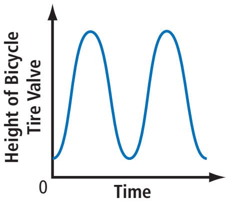
a) Time is greater than or equal to zero and stops when the rider is at the bottom of the hill. The relation is continuous.



b) The number of bags of peanuts bought must be a whole number. The relation is discrete.



c) Time is greater than or equal to zero. The relation is continuous.



2. Examples:

a) The height of a plant over time.

b) After coming home from school, Timmy visited his friend and returned home again.

3. a)

Weeks Worked	Earnings ($)
0	0
1	875
2	1750
3	2625
4	3500
5	4375

b) This relation is a function. Each domain value occurs only once.

c) The relation is discrete, since Rachel is only paid daily.

d) Let E represent Rachel's weekly earnings, in dollars. Let n represent the number of weeks worked. $E = 875n$

4. a) function **b)** function
c) function **d)** not a function

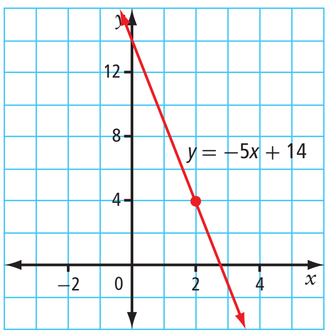
5. a) independent variable: time, dependent variable: litres of blood
b) $m = 5$
c) A human heart can pump 5 L of blood per minute.

6. a) function **b)** non-function

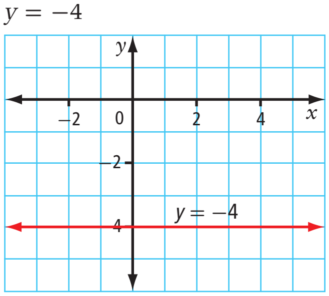
7. $\frac{5}{7}$, 2, 0

8. a) $m = \frac{1}{2}$, y-intercept: (0, 6)
b) $m = -\frac{3}{5}$, y-intercept: (0, 2)
c) $m = \frac{1}{3}$, y-intercept: (0, 0)
d) $m = 0$, y-intercept: (0, −1)

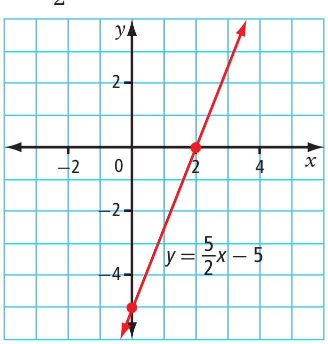
9. a) $y = -5x + 14$



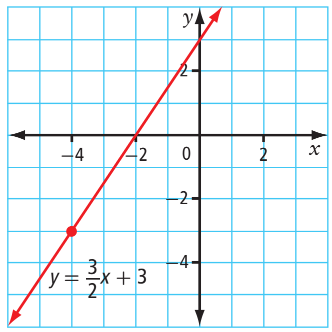
b) $y = -4$



c) $y = \frac{5}{2}x - 5$



d) $y = \frac{3}{2}x + 3$



10. a) (0, 6) and (4, 0); $3x + 2y - 12 = 0$
b) (0, 3) and (−2, 0); $3x - 2y + 6 = 0$

11. a) $x - 1 = 0$
b) $3x + 5y + 21 = 0$

Unit 3 Test, pages 408 to 409

1. C
2. D
3. B
4. D
5. A
6. 3
7. 2

8. a) $\{n \mid 0 \le n \le 8.5, n \in \mathrm{R}\}$, where n represents the number of hours you study.

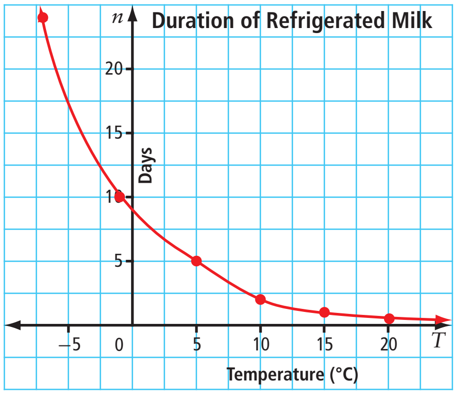
b)

Number of Hours of Study	Mark (%)
0	32
1	40
2	48
3	56
4	64

c) $M = 8n + 32$, where n represents the number of hours you study and M represents the predicted mark as a percent.
d) 8.5 h
e) Example: No, a linear model is not a valid model because there are many factors that can affect performance on an exam other than hours of study.

9. $2x + y + 6 = 0$

10. a)



b) 8 days

11. a) Example: The equation contains two variables and is of degree one. For each domain value there will be only one range value.

b) discrete; The cost for the lessons is based on half hour increments.

c) Example: (0, 25), (0.5, 40), (1, 55), (1.5, 70), (2, 85)

d) 3.5 h

Chapter 8

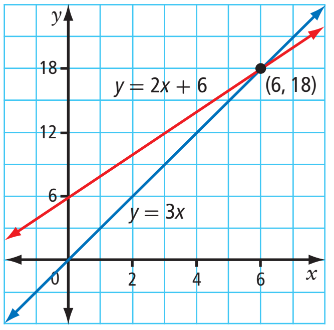
8.1 Systems of Linear Equations and Graphs, pages 426 to 431

1. Yes. Example: The table of values shows that at $x = 1$, both outputs are 3. The graph shows that the point of intersection is (1, 3).

2. No. Example: The calculator screen shows that (5.2, 3) is a solution to $7x - 2y = 30.4$ because the left side equals the right side. However, it is not a solution to $4x + y = 25.1$ because (5.2, 3) produced 23.8 and not 25.1.

3. a)

x	$y = 2x + 6$	$y = 3x$
0	6	0
1	8	3
2	10	6
3	12	9
4	14	12
5	16	15
6	18	18
7	20	21



b) Example: The solution is (6, 18). From the table of values, both values of y are 18 when $x = 6$. From the graph, the point of intersection is (6, 18).

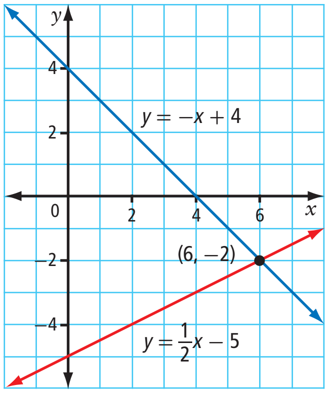
c) Since $2(6) + 6 = 18$ and $3(6) = 18$, the ordered pair (6, 18) satisfies both equations and is the solution.

4. a) Example:

x	$y = -x + 4$	$y = \frac{1}{2}x - 5$
0	4	−5
2	2	−4
4	0	−3
6	−2	−2
8	−4	−1
10	−6	0

The table of values shows that when $x = 6$, $y = -2$ in each of the equations. Therefore, (6, −2) is the solution.

b)



c) Example: The solution is the ordered pair common to both equations and the point of intersection of the two linear graphs.

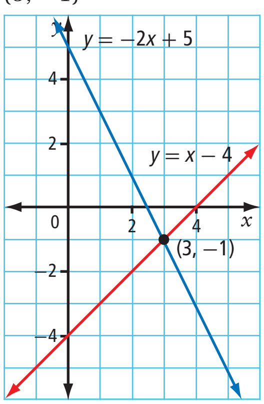
5. a) Yes. Example: The point with coordinates (4, 7) satisfies both equations. (4, 7) is the solution to the linear system.

b) No. Example: The point with coordinates (−1, 3) satisfies the equation $4x + 3y = 5$, but not the equation $x + 4y = 13$. (−1, 3) is not a solution to the linear system.

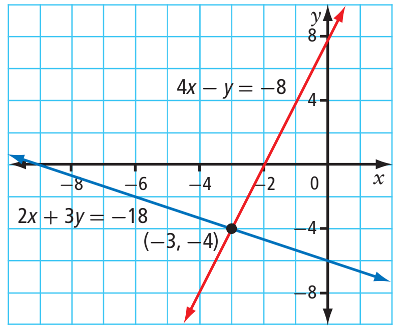
c) Yes. Example: The point with coordinates (−6, −10) satisfies both equations. (−6, −10) is the solution to the linear system.

d) No. Example: The point with coordinates (1.2, 2.4) satisfies the equation $y = 4.5x - 3$, but not the equation $12x - 3y = 7$. (1.2, 2.4) is not a solution to the linear system.

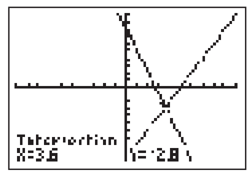
6. a) (3, −1)



b) (−3, −4)

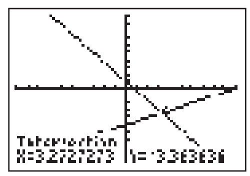


7. a)



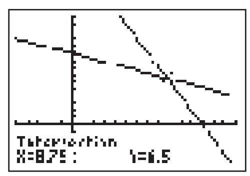
(3.6, −2.8)

b)



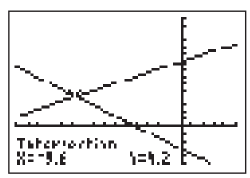
$\left(\frac{36}{11}, -\frac{37}{11}\right)$ or about (3.27, −3.36)

c)



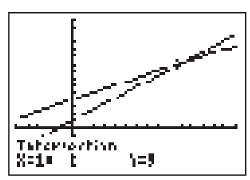
(8.75, 6.5)

d)



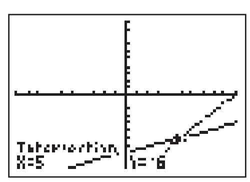
(−9.6, 4.2)

8. a)



(10, 9)

b)



(5, −6)

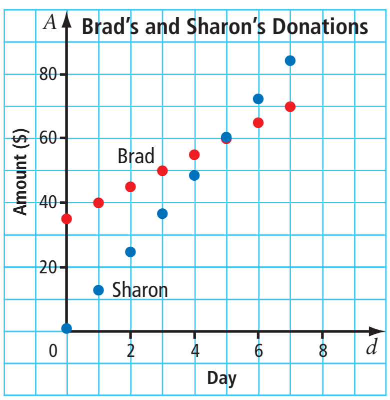
9. a) No. Example: The point (2, 5) lies on the graph of $x + 4y = 22$ but not on the graph of $3x - y = 2$. It is not a solution to the linear system.

b) Yes. Example: The point $(-3, -2)$ lies on the graph of both lines as the point of intersection. It is the solution to the linear system.

10. a)

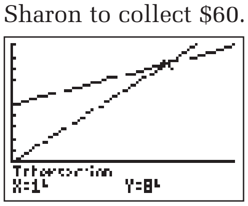
Brad	
Day	**Amount ($)**
0	35
1	40
2	45
3	50
4	55
5	60
6	65
7	70

Sharon	
Day	**Amount ($)**
0	0
1	12
2	24
3	36
4	48
5	60
6	72
7	84



b) (5, 60); It would take 5 days for both Brad and Sharon to collect $60.

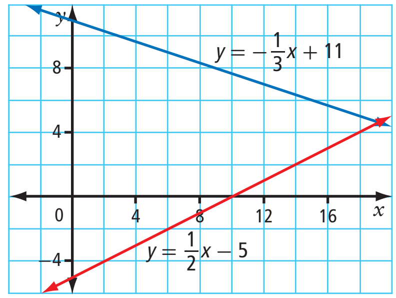
11. a)



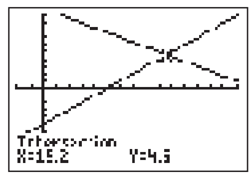
b) 14 necklaces

c) From the graph, the cost for 20 necklaces is $99 and the revenue is $120. The profit is $120 − $99, or $21. This is the vertical gap between the graphs of the two lines at 20 necklaces.

12. a) (19.2, 4.6)



b)

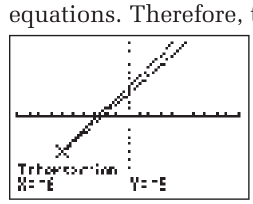


(19.2, 4.6)

c) Example: Technology can give you a more accurate answer if the numbers are not integers, and is usually faster. However, sometimes you need to adjust the viewing window to find the solution. Alternatively, the x-intercept and y-intercept method may be easier to graph manually than manipulating the equations into the form $y = mx + b$ for the graphing calculator.

13. Example: Yes. While the table of values does not show the same value of $f(x)$ for a given value of x, the pattern of changes shows that (4.5, 32) would be halfway between 4 and 5 for both equations. Therefore, this is the solution.

14.



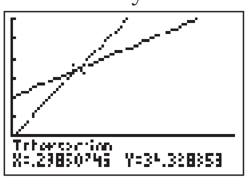
The coordinates of the point $(-6, -5)$ satisfy both equations, $3x - 2y = -8$ and $4x - 3y = -9$. Example: The two equations are almost coincident, so your pencil lines would need to be very accurate to distinguish where the point of intersection is. A graphing calculator does not have this problem.

15. a) Example: Brendan began with a 400-m head start but ran more slowly than Malcolm did. He took 9 min to complete 2800 m. Malcolm made up the difference by running 3200 m in 8 min. He passed Brendan 4.5 min into the run, around 1800 m from the start of the timing.

b) Example: Since each person is running at a constant speed during this portion of the run, the graph represents a system of linear equations.

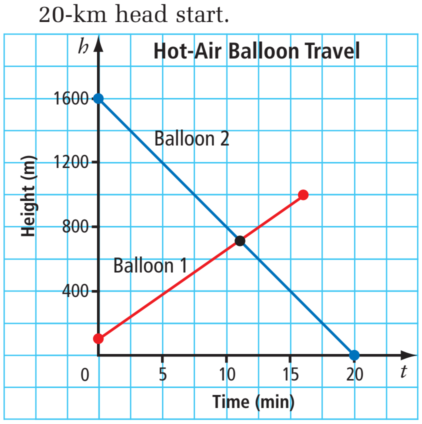
16. a) 20 km

b) At $t = 0$, the canvasback ducks have not started to fly, while the green-winged teals have already flown 20 km.



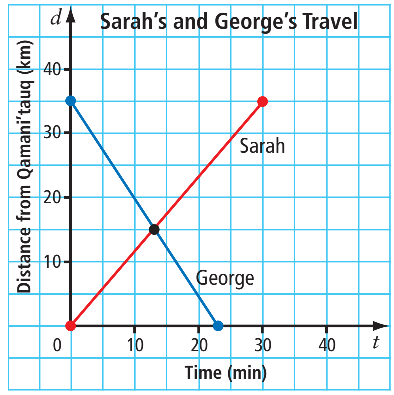
c) Example: It took the canvasback ducks about 0.3 h, or 18 min, to catch up to and pass the green-winged teals. Both types of duck were just over 34 km into the flight and 16 km from the water source. The canvasbacks arrived about 11 min before the teals despite the 20-km head start.

17.



At approximately 11 min, the two balloons pass one another, just over 719 m in the air.

18.

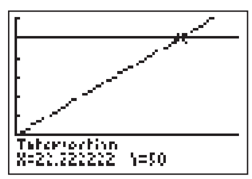


At approximately 13 min, Sarah and George pass one another, about 15 km from Qamani'tauq.

19. Example: If a person talks for over 300 min per month, that person would save money with Plan C. If a person talks for over 100 min per month but less than 300 min per month, Plan B is the least expensive. If a person talks for less than 100 min per month, Plan A is the least expensive.

20. 6.25 s

21. Example: I need to make a decision on transit passes. Do I pay \$2.25 per trip or spend \$50 per month for a pass? How many trips per month would I need to take to save money with a pass?



I would need to take over 22 trips a month to make a pass worthwhile.

22. Example: Solving a system of linear equations determines the coordinates of the point of intersection of the graphs of the equations. Verifying a solution to a system of linear equations is testing a point to see if it satisfies each equation. For example, the point of intersection of the graphs of $y = -2x + 2$ and $y = x - 7$ is the solution, $(3, -4)$. Substituting the coordinates of the point $(3, -4)$ into each equation results in a true statement.

23. a) The lines will be parallel, since the slopes are equal but the y-intercepts are different. There is no solution to this system of linear equations.

b) The lines will be perpendicular to one another, since the slopes are negative reciprocals. There is one solution to this system of linear equations.
c) The lines will intersect on the *y*-axis, since the slopes are different but the *y*-intercepts are the same. There is one solution to this system of linear equations.
d) The lines will be coincident, since the slopes and *y*-intercepts are the same. There are an infinite number of solutions to this system of linear equations.

8.2 Modelling and Solving Linear Systems, pages 440 to 445

1. a) Let C represent the cost, in dollars. Let s represent the number of songs downloaded. $C = 0.99s$ and $C = 0.79s + 11$
b) Let h represent the height above the ground, in metres. Let t represent time, in minutes. $h = 800 - 55t$ and $h = 80t$
c) Let R represent the material sorted, in tonnes. Let t represent time, in hours. $R = 100 + 20t$ and $R = 40t$

2. a) Let J represent Jamal's age, in years. Let M represent Maria's age, in years. $J = 3M$ and $J + 7 = 2(M + 7)$
b) Let C represent the temperature, in degrees Celsius. Let t represent time, in hours. $C = 2 - 2t$ and $C = -8 + 4t$

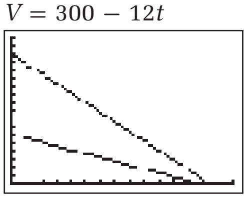
3. Let G represent the number of goals. Let A represent the number of assists. $G + A = 32$ and $A = 3G$

4. a) $d + q = 50$ and $0.1d + 0.25q = 6.80$
b)

Type of Coin	Value of One Coin (¢)	Number of Coins	Value of Coins (¢)
Dime	10	d	$10d$
Quarter	25	q	$25q$

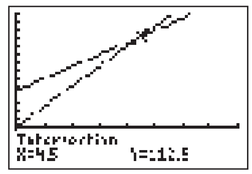
$d + q = 50$ and $10d + 25q = 680$

5. a) Let V represent the volume of water remaining in each tank, in cubic metres. Let t represent time, in minutes. $V = 800 - 30t$ and $V = 300 - 12t$
b)



c) Example: The larger tank starts with more water and drains in about 27 min. The smaller tank drains more slowly but starts with less water. It is empty in 25 min. The two graphs do not intersect until after 27 min, so they never contain the same amount of water until they are both empty.

6. a) Let L represent the length of sash woven, in centimetres. Let t represent time, in hours. $L = 45 + 15t$ and $L = 25t$
b)

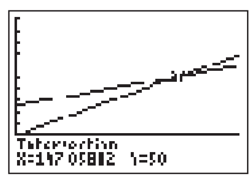


c) Example: At 4 h 30 min (4.5 h), Kianna and Naomi both have 112.5 cm of sash woven. From this point on, Naomi's sash will be increasingly longer than Kianna's sash.

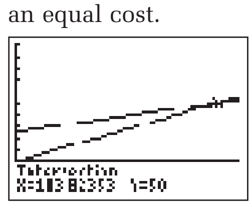
7. In 75 days, both oil wells will have produced 2625 m^3 of oil.

8. Example: If Megan is planning on driving less than 196 km in the day, she should go with the first option. If she will be driving over 196 km, then the flat rate would be more cost effective.

9. a) $C = 0.002(170n)$
b) $C = 0.34n$ and $C = 25 + 0.17n$
c)



d) (147, 50); At about 147 showers, the cost of showering with either type of shower head is \$50.
e) Example: It will take more showers to reach an equal cost.

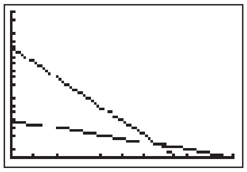


It would take almost 184 showers for the cost of showering with either type of shower head to be \$50.

10. approximately 22.7 km

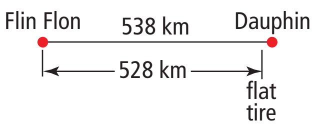
11. Yes. Example: The solution to the system of linear equations $d = 0.4 + 7.5t$ and $d = 10t$ is (0.16, 1.6). In 9.6 min (0.16 h), they will both be 1.6 km up the hill.

12. a) Let n represent the population of a species remaining. Let t represent time, in years. $n = 100 - 5t$ and $n = 300 - 20t$



b) Yes. In 13 years 4 months, there will be fewer than 34 of each species. This is the point where the graphs of the two linear equations intersect.

13. Let f represent the time driven at 90 km/h. Let s represent the time driven at 75 km/h. $f + s = 6$ and $90f + 75s = 538$; 528 km



14. They finish painting the fence in about 5.7 h, or 5 h 42 min. Chris paints almost $51\frac{1}{2}$ ft and Robert a little more than $68\frac{1}{2}$ ft.

15. In about 67 days, both trees will be approximately 153.3 cm tall.

16. Yes; about 22.9 kg

17. a) Let h represent the height above the ground, in metres. Let t represent time, in seconds. $h = 500 - 4t$ and $h = 200 + 5t$

b) In about 33.3 s, they will be approximately 366.7 m above the ground.

18. Let A represent the number of grapes that Andrea has. Let H represent the number of grapes that Hunter has. $A = 3H$ and $A = 2H + 6$; Hunter: 6 grapes, Andrea: 18 grapes

19. 51 years old

20. Let s represent the average speed of the swimmer, in metres per minute. Let c represent the average speed of the current, in metres per minute. $200 = 3(s - c)$ and $150 = 0.75(s + c)$; swimming speed: about 133.3 m/min, current speed: about 66.7 m/min

21. Let s represent the mass of sterling silver, in grams. Let p represent the mass of pure silver, in grams. $0.925s + 1p = 0.94(100)$ and $s + p = 100$

22. Let C represent the cost, in dollars. Let n represent the number of visits.

Option A: $C = 22 + 6n$, Option B: $C = 16.50\left(\frac{n}{2}\right)$;

Example: Eunji needs to decide how many times she will visit the amusement park. If she makes at least ten visits to the amusement park, the season's pass is a better deal.

23. a) Example:

Person	Time (h)	Speed (km/h)	Distance Travelled (km)
Gavin	t	110	$110t$
James	$t - 0.75$	240	$240(t - 0.75)$

b) Example: Graph $d = 110t$ and $d = 240t - 180$ and find the point of intersection. If the d-coordinate of this point is less than 300, then James will catch up to Gavin.

24. a) Example: Determine the slope of the line using points (0, 0) and (5, 70).

b) $C = 14t$ and $C = 50 + 4t$

c) Example: The point of intersection is (5, 70), so Bikes-to-Go is a better deal for more than 5 h. Spokz is a better deal if you're renting for less than 5 h.

8.3 Number of Solutions for Systems of Linear Equations, pages 454 to 459

1. a) A and B, A and C, A and D, B and D, C and D

b) B and C

2. a) infinite number of solutions; Example: Since the equations have the same slope and the same y-intercept, the graph will result in coincident lines. Therefore, this system has an infinite number of solutions.

b) one solution; Example: The equations have different slopes. So, the graph will result in two lines that intersect at one point. Therefore, this system has one solution.

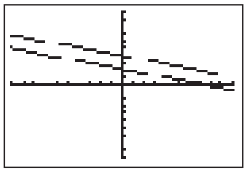
c) no solution; Example: Since the equations have the same slope and different y-intercepts, the graph will result in parallel lines. Therefore, this system has no solution.

3. a) no solution; Example: Since the equations will have the same slope and different y-intercepts, the graph will result in parallel lines.

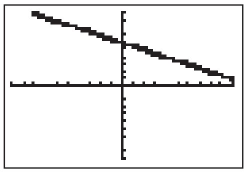
b) one solution; Example: The equations will have different slopes. So, the graph will result in two lines that intersect at one point.

c) one solution; Example: The equations will have different slopes. So, the graph will result in two lines that intersect at one point.

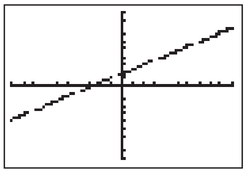
4. a) parallel lines
   b) lines with different slopes that intersect at one point
   c) only one line shown on the graph
5. a) Example: Since the x-coefficient and y-coefficient are the same, the equations have the same slope. However, the constant values are different. Therefore, the graph will be a pair of parallel lines. The linear system has no solution.



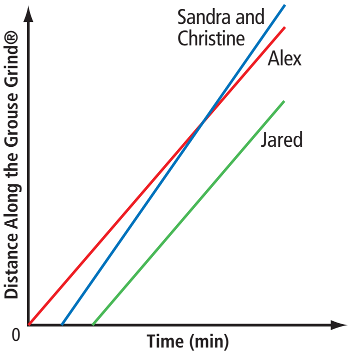
   b) Example: Double the first equation creates the same equation as the second one. So, the graph of the lines will be coincident. The linear system has an infinite number of solutions.



6. Examples:
   a) $2x - y + 1 = 0$
   b) $3x - y + 5 = 0$
   c) $4x - 2y + 10 = 0$
7. Let E represent an employee's earnings, in dollars. Let s represent the number of subscriptions sold.
   a) $E = 360 + 8.25s$ and $E = 360 + 8.25s$; infinite number of solutions; Brian and Charlie will always have the same earnings.
   b) $E = 472 + 7s$ and $E = 360 + 8.25s$; one solution; Brian will catch and pass Alyssa in earnings.
   c) $E = 360 + 8.25s$ and $E = 413 + 8.25s$; no solution; Dena will always have earned \$53 more than Charlie.
8. a) Compare the slopes of the two equations. Since they are different, there should be one solution.
   b)



Example: Anton is correct because the equations have different slopes so there is one solution. Jeff was fooled because the graphs looked coincident on the screen.
9. a) Example: Stephanie doesn't see a point of intersection on the screen.
   b) She is incorrect. The lines have different slopes and will intersect somewhere to the left of the current screen.
10. a) Example:



   b) Alex and Jared: no solution; Sandra and Christine: an infinite number of solutions; Sandra or Christine and Alex: one solution; Sandra or Christine and Jared: no solution; Sandra and Christine will catch and pass Alex, but they will always be ahead of Jared and will steadily increase their lead. Jared is always the same distance behind Alex.
11. False. Example: Any point on one line is also on the other line. Not all points in the coordinate plane are on the lines.
12. a) No. The lines could be parallel with no solution or coincident with an infinite number of solutions.
   b) No. The lines could be coincident or have one solution (at the y-intercept).
   c) Yes. The lines will be coincident with an infinite number of solutions.

13. a) Let P represent the napkins manufactured, in kilograms. Let w represent the number of weeks. $P = 5000 + 350w$ and $P = 28\ 000 + 350w$

b) Example: Since the graphs of the lines are parallel, there is no solution to the system. Northern Paper will always have produced 23 000 kg more napkins than PaperWest.

14. a) $C = 24$

b) Any value except 24 will yield no solution ($C \neq 24$).

15. a) $y = 20x + 6$ and $y = 20x$

b) There are no solutions, because both taxis have the same fuel economy but stated in different ways. The second taxi will never catch the other taxi based on fuel used.

16. a) With the domain restricted, there is no solution. The lines do not intersect within these limits.

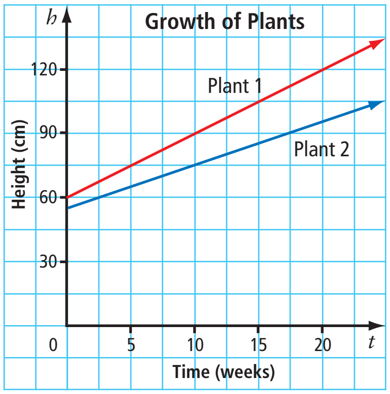
b) one solution

c) Example: Only parallel and coincident situations will be predictable. Graphs of lines with different slopes might not intersect in the window defined by the restricted domain and range.

17. a) $W = 6$ or $W = -6$

b) Another number will yield one solution. Example: $5x + 3y = 10$ and $12x + 5y = 24$ have two different slopes, $-\frac{5}{3}$ and $-\frac{12}{5}$, so the system will have one solution.

18. Wendy. Example: The shorter plant is growing slower so it will never catch up. The two equations have different slopes, but the intersection would be before the time starts.



19. Example: No. The graph of the *straight* lines would have to curve. On a globe, a line of latitude will meet a line of longitude at two points, one on either side of Earth.

20. Example: Yes, as long as there are no restrictions on the domain. With restrictions, you cannot be sure (like the plants in #18).

21. Examples:

a) In a race, a head start is given to one runner. If the two runners are running at the same speed, there will be no solution. $d = 5t$ and $d = 5t - 15$

b) In a race, a head start is given to one runner, and the second runner is faster. There will be one solution. $d = 5t$ and $d = 7t - 14$

c) In a race, the runners start at the same time and run at the same speed. They will always be beside one another (infinite number of solutions). $d = 5t$ and $d = 5t$

22. Step 1: Example: A: $2x + y = 4$ and $6x + 3y = 12$, B: $2x + y = 4$ and $2x + y = 10$, C: $2x + y = 4$ and $2x + y + 5 = 9$, D: $2x + y = 4$ and $4x + 2y = 4$

Step 2: Example: A: an infinite number of solutions, B: no solution, C: an infinite number of solutions, D: no solution

Step 3: One equation as a multiple of another produces coincident equations. If two equations have identical x-coefficients and y-coefficients but different constants, then they are parallel lines and there will be no solution.

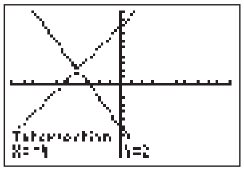
Step 4: Example: Any equation of the form $Ax + By = C$ has a slope of $-\frac{A}{B}$. Any other equation whose value of $-\frac{A}{B}$ is not the same will have one solution with the first equation, since the slopes will be different.

Chapter 8 Review, pages 460 to 462

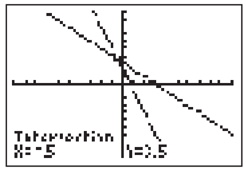
1. a) Example: Substitute $x = -7$ and $y = 4$ into each equation. Evaluate each side to determine whether the values satisfy both equations. The point $(-7, 4)$ is the solution to the linear system.

b) Example: Substitute $x = 3$ and $y = -5$ into each equation. Evaluate each side to determine whether the values satisfy both equations. The point $(3, -5)$ is not the solution to the linear system.

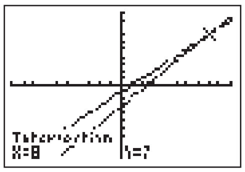
2. a) (−4, 2)



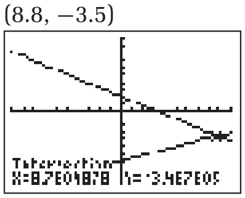
b) (−0.5, 3.5)



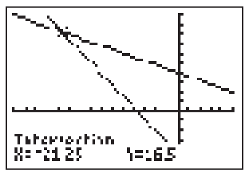
c) (8, 7)



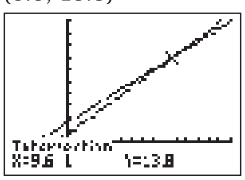
3. a) approximately (8.8, −3.5)



b) (−21.25, 16.5)

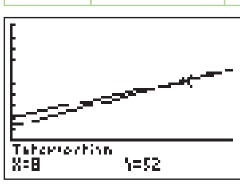


c) (9.6, 13.8)



4. a) Example:

t	$d = 4t + 20$	$d = 5t + 12$
0	20	12
1	24	17
2	28	22
3	32	27
4	36	32
5	40	37
6	44	42
7	48	47
8	52	52



b) Example: In the table of values, the solution occurs when the values of d are equal for the same value of t. On the graph, the solution is the point of intersection.

c) (8, 52); At 8 s, both boats are at a distance of 52 m.

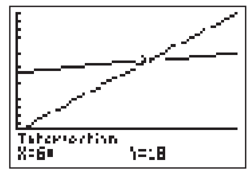
5. a) Let C represent the cost of a gym membership. Let m represent the number of months as a member. $C = 85 + 30m$ and $C = 35m$

b) Let G represent the amount of grain, in cubic metres. Let t represent time, in minutes. $G = 5 + 2.5t$ and $G = 5t$

c) Let D represent the length of road left to resurface, in metres. Let t represent time, in hours. $D = 3000 - 200t$ and $D = 4000 - 250t$

6. a) Let P represent the cost of the cell phone plan. Let m represent the number of minutes used. $P = 15 + 0.05m$ and $P = 0.3m$

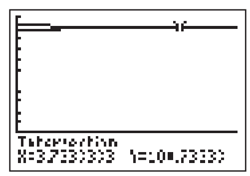
b)



c) Example: The point of intersection shows that 60 min costs $18 on both plans. If a person would use more than 60 min per month, then the better choice is Plan #1. If a person would use less than 60 min per month, then the better choice is Plan #2.

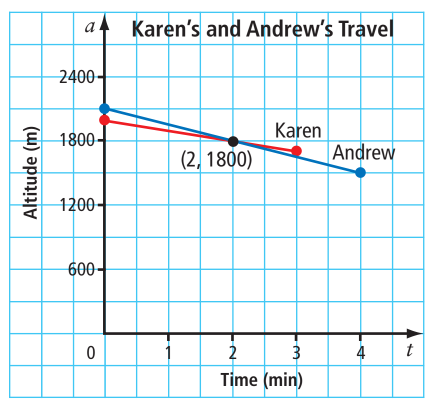
7. a) Let P represent the atmospheric pressure, in kilopascals. Let t represent time, in hours. $P = 102.6 - 0.5t$ and $P = 99.8 + 0.25t$

b)



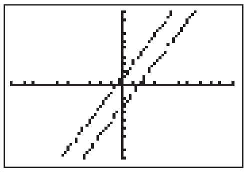
In 3 h 44 min, both cities will have the same pressure of about 100.7 kPa.

8. Andrew will pass Karen 2 min into the skiing, at 1800 m.

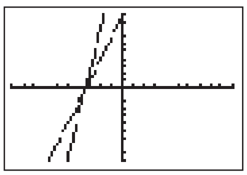


9. a) parallel lines
b) intersecting lines
c) coincident lines

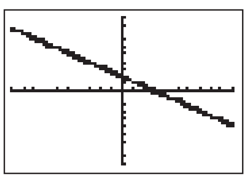
10. a) no solution; Example: Since the equations have the same slope and different *y*-intercepts, the graph will result in parallel lines.



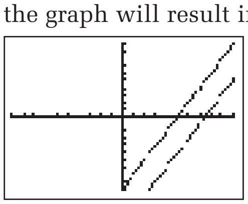
b) one solution; Example: The equations have different slopes. So, the graph will result in two lines that intersect at one point.



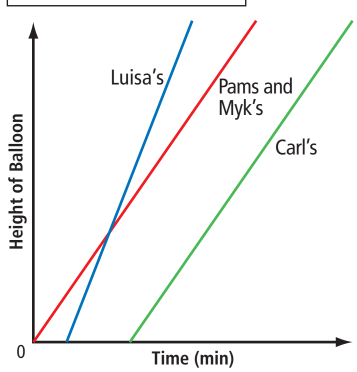
c) infinite number of solutions; Example: Since 7 times the first equation equals the second equation, the graph will result in coincident lines.



d) no solution; Example: Since the equations will have the same slope and different *y*-intercepts, the graph will result in parallel lines.



11. a)



b) Example: Zero solutions would be for Pam's and Carl's or Myk's and Carl's, as the graphs of their balloons are parallel. Luisa's and Carl's balloons will also never cross, because Luisa's had a head start and rises faster. One solution for Pam's and Luisa's or for Myk's and Luisa's, because their balloons have different slopes and Luisa's balloon will pass the other two. There are an infinite number of solutions for Pam's and Myk's, because their balloons are always side by side.

12. a) Let P represent the production of sports beverages, in litres. Let h represent the number of production hours. $P = 150 + 300h$ and $P = 600 + 300h$

b) There are no solutions to this system. Both companies have the same rate of production. Company B will always have 450 L more in production.

13. a) one solution

b) Example: One solution is not possible, as they are earning interest at the same rate (slope). They either started with the same amount of money (principal) and always have the same amount, or they began with different principals and will always be the same amount apart.

Chapter 8 Practice Test, pages 463 to 465

1. D
2. C
3. D
4. B
5. D

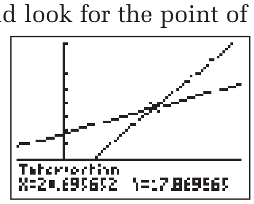
6. a) No. Example: The point (5, 2) does not lie on the graph of $x + y = 10$ or the graph of $2x - y = 3$.

b) Yes. Example: The point $(-1, 4)$ lies on the graphs of both lines as the point of intersection.

c) No. Example: The point $(8, -3)$ lies on the graph of $x + 4y + 4 = 0$ but not on the graph of $2x - 3y = 27$.

7. Example: Graph the equations on the same grid and look for the point of intersection.

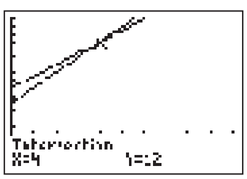
8. a)



b) (20.70, 17.87)
c) Example: Store the x-value and y-value after finding the point of intersection on your graphing calculator. Check that $5x - 4y$ is 32 and $3x - 7y$ is -63. Use the full decimal strings and not the rounded off values for best results.

9. a) Example: Since the x-coefficients and y-coefficients are the same, the equations have the same slope. However, the constant values are different. Therefore, the graph will be a pair of parallel lines. The linear system has no solution.
b) Example: Since the equations have the same slope and the same y-intercept, the graph will result in coincident lines. Therefore, this system has an infinite number of solutions.

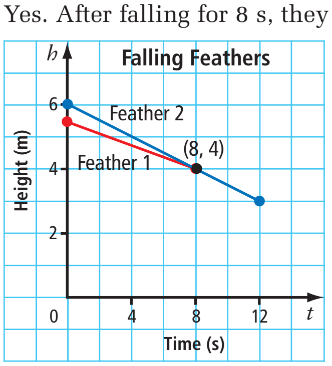
10. $B = 10$

11. a) Let L represent the height of the grass, in centimetres. Let w represent the number of weeks. $L = 6 + 1.5w$ and $L = 4 + 2w$
b)


One grass starts higher but grows more slowly. The shorter grass will grow quickly and pass the first grass in 4 weeks, when they are both 12 cm high.

12. Example: Paige had to walk 5 km to get to school, while Quinn had to walk only 3.5 km. Even though Paige had further to walk to get to school, she walked faster (0.125 km/min) than Quinn did (0.05 km/min) and arrived earlier. Paige passed Quinn 2.5 km from school and 20 min into the walk.

13. Yes. After falling for 8 s, they are both at 4 m.



14. Let d represent distance, in miles. Let t represent time, in hours.
a) $d = 11.8 + 7.2t$ and $d = 11.8 + 7.2t$; Donna and Marcus are always beside each other and thus have an infinite number of times that they are at the same point in the river.
b) $d = 12.6 + 7.0t$ and $d = 11.8 + 7.2t$; There is one solution. Donna catches Taj at 4 h and 40.6 km into the race.
c) $d = 11.8 + 7.2t$ and $d = 11.2 + 7.2t$; There is no solution. Marcus stays ahead of Rose a consistent 0.6 km throughout the race.

Chapter 9

9.1 Solving Systems of Linear Equations by Substitution, pages 474 to 479

1. a) $x = 3$ and $y = 11$
b) $x = -6$ and $y = 18$
c) $x = 12$ and $y = 5$

2. a) $x = 2$ and $y = -2$
b) $j = 2$ and $m = 16$
c) $k = 1.5$ and $n = -1$

3. a) $x = 7$ and $y = -2.9$; Example: Isolating y makes for easier calculations.
b) $x = 21\frac{3}{7}$ and $y = -37\frac{1}{7}$; Example: Isolating y makes for easier calculations.
c) $x = 4$ and $y = 3$; Example: Isolating x makes for easier calculations.

4. a) $x = 12\frac{6}{7}$ and $y = -\frac{5}{7}$
b) $x = -2$ and $y = 8$
c) $x = 17\frac{3}{4}$ and $y = -3\frac{5}{6}$

5. a) $x = 6$ and $y = 2$
b) Example: Helen's method is preferred. Although it requires two steps to isolate the variable x, the solution does not involve operations involving fractions. Jaret's method involves operations on fractions with a denominator of 2.

6. Let x and y be the two numbers. $x + y = 20$ and $2x = 4y + 4$; $x = 14$ and $y = 6$

7. a) approximately (0.3, 3.7)
b) $\left(\frac{1}{3}, 3\frac{2}{3}\right)$
c) The algebraic approach gives exact answers.

8. a), **b)**, and **c)** $x = 6.5$ and $y = 4.5$
  d) Example: The method in part b) eliminates the decimals and leaves numbers that are easy to use.

9. 32 m and 50 m

10. Vancouver: 48 cm, Whitehorse: 144 cm

11. 12 days

12. 13 h

13. 7 years

14. Rory: 16 years old,
Rory's grandmother: 74 years old

15. Let b represent the cost of one bush and t represent the cost of one tree, both in dollars. $40b + 12t = 1484$ and $25b + 18t = 1421$; One bush costs \$23 and one tree costs \$47.

16. a) 12 more dimes than quarters; 23 more quarters than nickels
  b) Example: The question deals only with the quantity of each type of coin, not the value of the coins.

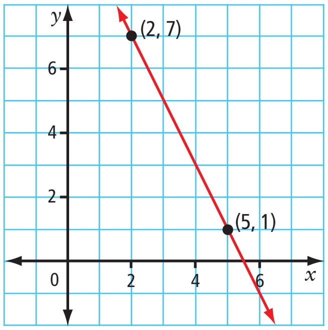
17. 6 students in each van and 44 students in each bus

18. whole-wheat bread: 28 L; white bread: 40 L

19. a) The answer must be a whole number but the ratio $\frac{7593}{24}$ is not a whole number.
  b) In step 2, he needs to multiply the expression $1.00(132 - q)$ by 100 also. Then, it becomes $100(132 - q)$.
  c) 73 quarters and 59 loonies

20. a) $x = -1\frac{3}{32}$ and $y = -2\frac{5}{32}$
  b) $x = \frac{2}{5}$ and $y = \frac{3}{4}$

21. $m = -2$ and $b = 11$



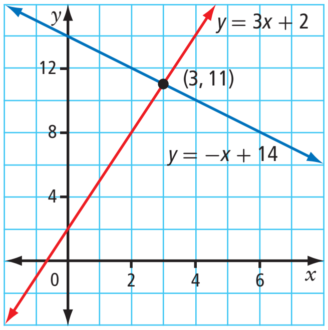
22. 0.5 km

23. $P = I^2R$

24. Example: Substitution results in the statement $10 = -15$, which is not true. So, the system cannot have a solution.

25. Examples:
  a) Both methods may use algebra to rearrange an equation. Both methods produce the same solution.
  b) Substitution involves working algebraically with equations, variables, and mathematical operations, while solving graphically involves drawing two graphs and finding their point of intersection.

26. Example: $y = 3x + 2$ and $x + y = 14$
  a) $x = 3$ and $y = 11$



  b) Example: The substitution method is simple. For the graphical approach, the second equation needs to be rewritten in $y = mx + b$ form.

9.2 Solving Systems of Linear Equations by Elimination, pages 488 to 491

1. a) $x = 7$ and $y = 3$
  b) $x = 9\frac{2}{3}$ and $y = 1\frac{2}{3}$
  c) $x = 4$ and $y = 4$

2. a) $-3x + y = 11$ and $x - y = -5$
  b) $x - y = -7$ and $2x + y = -8$
  c) $x + 3y = 4$ and $x - y = 16$

3. $s + a = 430$ and $10s + 13a = 4804$
  a) 168 tickets
  b) 262 tickets

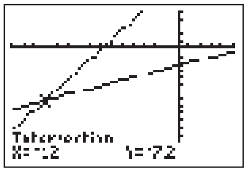
4. a) $x = 1$ and $y = 2$
  b) $x = 3$ and $y = -1$
  c) $x = -5$ and $y = -11$

5. a) $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$
  b) $x = 2\frac{8}{15}$ and $y = \frac{11}{45}$
  c) $x = 4\frac{1}{2}$ and $y = 1$

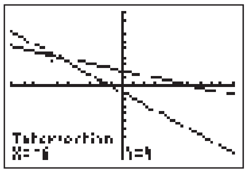
6. The system has no solution. Example: A graph of these equations would result in two parallel lines with no point of intersection.
7. 20 bicycles; 10 tricycles
8. tulip bulbs: \$14; iris bulbs: \$20
9. bagel: \$1.75; juice: \$1.25
10. 175 dogs
11. 40 trucks and 560 passenger vehicles
12. 6.75 km on the flat terrain and 1.8 km on the mountainous terrain
13. 72 min playing basketball and 18 min cycling
14. **a)** Let n represent the number of loads of laundry each sister does per week. Let V represent the number of litres of water used per week. $V = 225n$ and $V = 95n + 260$
    b) 2 loads of laundry
    c) Sharon uses 1800 L and Bev uses 1020 L. So, Sharon uses 780 L more if they both do eight loads of laundry.
15. **a)** $x = -3$ and $y = 2$
    b) $x = 1\frac{7}{25}$ and $y = \frac{56}{75}$
16. \$1750
17. 53.3 L of the 3.25% MF and 6.7 L of the 1% MF
18. $k = 12$
19. $a = -9$ and $b = 9$; There is only one solution. Example: The value of y (which equals a) can be determined from substituting 9 for x in the first equation. The value of b is determined by substituting $x = 9$ and $y = -9$ into the second equation.
20. **a)** Example: $3x + 2y = 10$ and $2x - y = 4$; $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$
    b) It is easy to isolate y in the second equation to substitute into the first equation.
    c) Example: Any equations in which none of the coefficients of x or y in either equation is equal to one. When you must divide each term in an equation, you may have to substitute fractional expressions early in the solution.
21. Example: If it is easy to isolate either x or y in either equation without producing fractions, then substitution will be a good method. Example: $x + 5y = 7$ and $4x - 3y = -20$ For any other system, elimination is a better method.

9.3 Solving Problems Using Systems of Linear Equations, pages 498 to 501

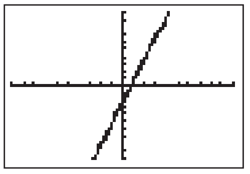
1. **a)** $x = -12$ and $y = -7.2$



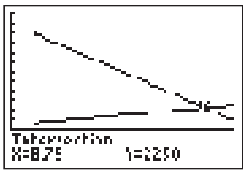
   b) $x = -6$ and $y = 4$



   c) There are an infinite number of solutions.



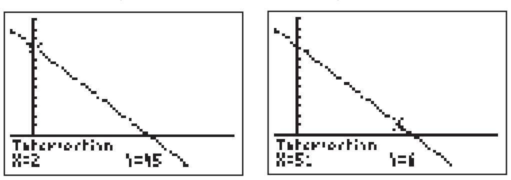
2. **a)** $x = 2$ and $y = -6.5$
   b) $m = 12.6$ and $n = 10.4$
   c) $x = \frac{1}{3}$ and $y = -\frac{2}{3}$
3. Calgary: −2.8 °C; Winnipeg: −12.7 °C
4. 6.4%
5. **a)** The equation $C = 0.3m + 16$ represents the total cost, in dollars, of the fundraiser. The equation $C = 0.75m$ represents the income, in dollars, from the sale of the muffins.
   b) 36 muffins
6. approximately 602 h
7. 85 adults and 45 students
8. If Jason drives exactly 520 km, the rental cost is the same for both companies. If he drives less than 520 km, Easy 4 U is cheaper. If he drives more than 520 km, Speed-E-Car is less expensive.

9. a) The population of fish is decreasing by 1000 each year while the number of fish eaten by osprey is increasing by 200 each year.
b) Example: Let F represent the number of fish. Let x represent the year number. $F = -1000x + 11\ 000$ and $F = 200x + 500$
c) 
The solution is (8.75, 2250). This point indicates that after 8.75 years, the number of fish in the lake will equal the number of fish that are being eaten by the osprey.
d) Example: As the number of fish decreases, the osprey population will also decrease, because there will not be enough fish to keep feeding the osprey population.

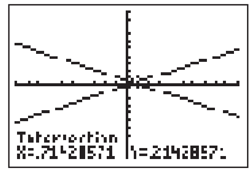
10. Let x represent the depth, in metres, and let y represent the number of minutes the diver can remain at that depth. $60 = 60m + b$ and $90 = 30m + b$; $y = -x + 120$

11. 81.25 min cross-country skiing and 18.75 min playing squash

12. 36.75 square units

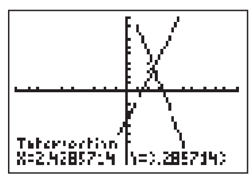
13. a) The constant in the second equation of the second pair is one larger than the constant of the second equation in the first pair.
b) $x = 2$ and $y = 45$; $x = 51$ and $y = 6$
c) 
d) The large numbers make the graphing difficult for both solving for y and finding a good viewing window. The larger numbers make solving the system algebraically (elimination) tedious.

14. a) Example: $3x - y = 5$ and $2x + 7y = 57$ has the solution $x = 4$ and $y = 7$.
b) Example: If it is relatively easy to isolate y in both equations, solving graphically might be preferred. If it is relatively easy to isolate either x or y in only one of the equations, substitution would be recommended. Otherwise, elimination would be preferred.

15. a) Example: $7x - 14y = 2$ and $7x + 14y = 8$ has a solution $x = \frac{5}{7}$ and $y = \frac{3}{14}$.

b) Example: This system is difficult to solve graphically, because isolating y in both equations creates equations with fractions as coefficients and/or constants. The solution can only be approximated from the graphs. Solving by elimination is easy, because the coefficients of x are equal and the coefficients of y add to zero.

Chapter 9 Review, pages 502 to 503

1. a) $x = 3$ and $y = 8$
b) $x = 0$ and $y = -2$
c) $x = \frac{2}{9}$ and $y = -\frac{4}{3}$

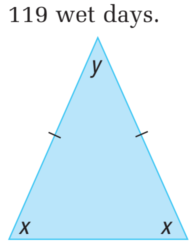
2. 
$x = 2\frac{3}{7}$ and $y = 3\frac{2}{7}$; Solving algebraically is preferred, because the solution is exact. Graphical solving gives only an approximate solution.

3. 32 000 km

4. \$1.40 for one song and \$4.20 for one game

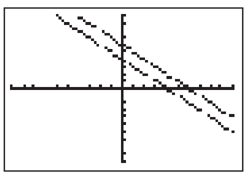
5. a) $x = 4$ and $y = -13$
b) $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$
c) $x = \frac{3}{2}$ and $y = 0$

6. Vancouver has 166 wet days and Yellowknife has 119 wet days.

7. 

The two base angles are each 46.5° and the third angle is 87°.

8. Danika ate 121.875 g of grapes and 203.125 g of oranges.
9. washing machine: $800; shower head: $25
10. **a)** $34 per day; $0.15 per km
  b) Example: The elimination method is easiest, because graphing and substitution are more complicated due to the coefficients of the variables.
11. **a)** 19 acres for developed sites and 38 acres for basic sites
  b) 76 developed campsites and 57 basic campsites
12. 1 h 40 min
13. **a)** no solution

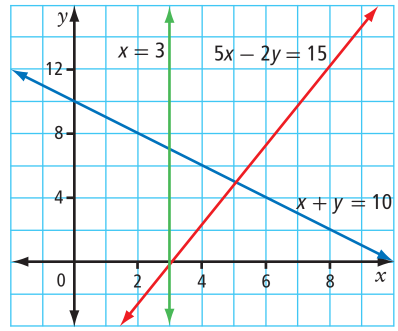


  b) The two lines are parallel, so there is no point of intersection and thus no solution.

Chapter 9 Practice Test, pages 504 to 505

1. D
2. C
3. C
4. C
5. **a)** $x = 4\frac{1}{4}$ and $y = 5\frac{3}{4}$
  b) $x = -1.5$ and $y = 20.5$
  c) $x = 4.5$ and $y = -3.5$
6. The length is 4 m and the width is 1.4 m.
7. 187.5 g of peanuts and 112.5 g of almonds
8. 17 nickels and 32 quarters
9. The green fee is $22 per game and the annual fee is $150.
10. 667 students and 29 teachers
11. **a)** Edmonton to Saskatoon took approximately 6.21 h. Saskatoon to Regina took approximately 3.64 h.
  b) The distance from Edmonton to Saskatoon is approximately 546.89 km. Example: Multiply the number of hours to drive from Edmonton to Saskatoon (approximately 6.21 h) by the speed (88 km/h) Mallory travelled.

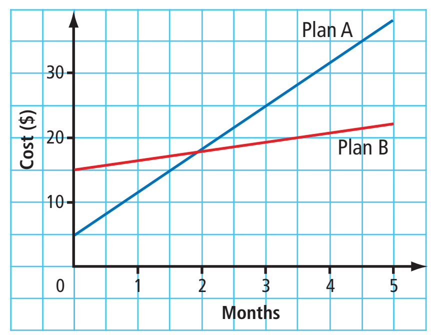
12. **a)**



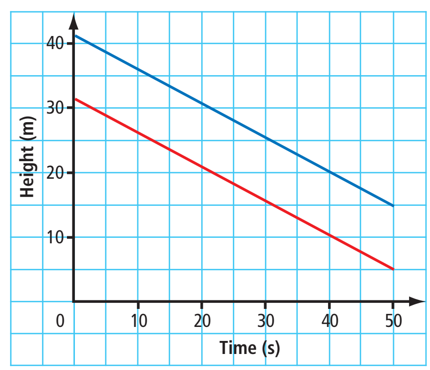
  b) (3, 0), (5, 5), and (3, 7)

Unit 4 Review, pages 507 to 509

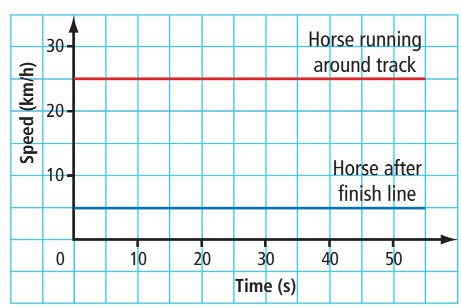
1. **a)**



  b)



  c)

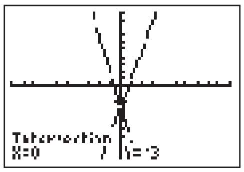


2. i) B **ii)** A **iii)** C

3. a) The point is the solution to the system of linear equations and the point of intersection of the graphs of the two lines.

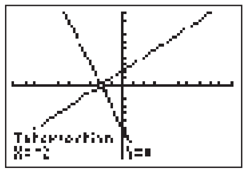
b) The point is the *y*-intercept of the graph of $y = -x + 3$, but the point is not on the graph of $y = \frac{3}{2}x + 2$.

4. a)



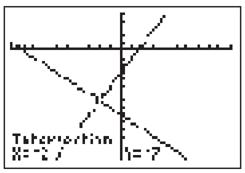
(0, −3)

b)



(−2, 0)

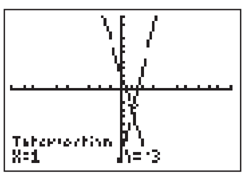
c)



(−2, −7)

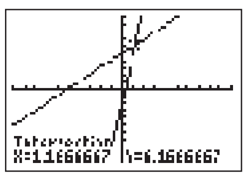
5. D

6. a)



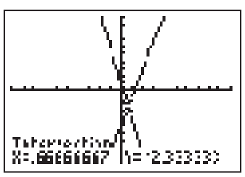
(1, −3)

b)



(1.2, 6.2)

c)



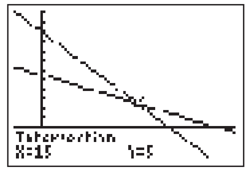
(0.7, −2.3)

7. This point indicates that if she rented a car for 7 days, the cost of renting from each company would be $580.

8. a) Let d represent the number of dimes. Let q represent the number of quarters. $d + q = 20$ and $0.10d + 0.25q = 2.75$

b) $d + q = 20$ written as a function is $q(d) = 20 - d$.
Domain: $\{d \mid 0 \le d \le 20, d \in W\}$
Range: $\{q \mid 0 \le q \le 20, q \in W\}$
$0.10d + 0.25q = 2.75$ written as a function is $q(d) = -0.4d + 11$ or $q(d) = -\frac{2}{5}d + 11$.
Domain: {0, 5, 10, 15, 20, 25}
Range: {1, 3, 5, 7, 9, 11}

c)



15 dimes and 5 quarters

9. a) one solution

b) no solution

c) infinite number of solutions

10. Let a represent the number of assists. Let g represent the number of goals. $a + 2g = 23$ and $2g = a + 1$

11. a) Example: Use the substitution method, because the first equation is already solved for y.

b) Example: Use the elimination method, because substitution would involve rational expressions.

c) Example: Use the elimination method, because multiplying the first equation by 2 and adding the two equations would eliminate y.

d) Example: Use the substitution method, because it is easy to isolate x in the first equation.

12. a) $x = -1$ and $y = 5$

b) $x = 2$ and $y = 1$

c) $x = 2$ and $y = -1$

13. a) $x = 5$ and $y = 3$. Example: Use the elimination method, because adding the two equations eliminates y.

b) $x = 0$ and $y = -2$. Example: Use the elimination method, because multiplying the second equation by −3 and adding the two equations eliminates y.

c) $x = -2$ and $y = 1$. Example: Use the elimination method, because substitution would involve equations with fractions as coefficients and/or constants.

14. a) Let p represent their paddling speed, in kilometres per hour. Let c represent the speed of the current, in kilometres per hour.
$\frac{1}{3}(p + c) = 3$ and $\frac{3}{5}(p - c) = 3$

b) Their paddling speed was 7 km/h and the speed of the current was 2 km/h.

Unit 4 Test, pages 510 to 511

1. A
2. C
3. A
4. D
5. 10
6. 38
7. $x = 4$ and $y = -6$. Example: I used the elimination method, because after multiplying the first equation by 6 and the second equation by 12 to make integral coefficients, adding the two equations will eliminate y.
8. **a)** Let r represent the cost of one red bead. Let g represent the cost of one green bead. $25r + 15g = 2.75$ and $7r + 13g = 1.65$
   b) red bead: \$0.05, green bead: \$0.10
   c) \$1.00
9. 56 km/h