Answers

Chapter 1 Measurement, page 2

1.1 Imperial Measures of Length, page 11

3. Answers may vary. For example:
a) Foot **b)** Inch
c) Foot **d)** Inch
e) Mile
4. a) Inch
5. Answers may vary. For example:
a) Foot
7. a) 36 in. **b)** 189 ft.
c) 4 ft.
8. a) 10 560 ft. **b)** 15 yd. 2 ft. 10 in.
c) 1 mi. 703 yd. 1 ft.
9. 165 in. = 4 yd. 1 ft. 9 in.
10. a) 52 ft. = 17 yd. 1 ft. **b)** $197.82
11. a) 24 mats
12. No; 21 ft. 9 in. = 7 yd. 9 in.
13. 10 in.
14. a) 39 ft. 2 in. **b)** 4 rolls
c) $49.96
15. a) $119.99 **b)** $18.59
16. 1062 ft.
17. 62 mi.
18. 27 tulip bulbs
19. 2 mi. 80 yd.
20. 1:2 349 000
21. a) $351 000
22. $158 400 000

1.2 Math Lab: Measuring Length and Distance, page 15

3. Calipers require a steady hand to ensure an accurate reading. Calipers cannot be used for large measures.

1.3 Relating SI and Imperial Units, page 22

Answers will vary depending on the conversion ratios used.

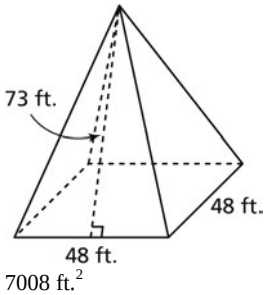
4. a) 40.6 cm **b)** 1.2 m
c) 4.6 m **d)** 1.5 km
e) 9.7 km **f)** 50.8 mm
5. a) 1 in. **b)** 8 ft.
c) 11 yd. **d)** 93 mi.
6. a) 55.9 cm **b)** 256.5 cm
c) 9.6 m
7. a) **i)** 2 ft. 6 in. **ii)** 3 yd.
iii) 6 mi.
8. 100.6 m by 54.9 m
9. Tennessee River
10. The odometer is accurate; 142 km is close to 87 mi.
11. a) The warehouse
12. a) Michael
13. a) CN Tower: approximately 1815 ft.;
Willis Tower: approximately 442.3 m
b) CN Tower **c)** 111 m; 364 ft.
14. 144 sections of casing
15. 28 in.
16. Yes; approximately 8 cm
17. 7 homes
18. a) Approximately 65 hectares
b) Approximately 259 hectares

Chapter 1: Checkpoint 1, page 25

3. a) 26 yd. 2 ft. **b)** 5280 yd.
c) 84 in.
4. Sidney
7. Answers will vary depending on the conversion ratios used.
a) 14 yd. 1 ft. **b)** 122 cm
c) 1 mi. 427 yd. **d)** 273 yd. 1 ft. 3 in.
e) 330.2 m **f)** 5 ft. 9 in.
8. 10 ft. of laminate

1.4 Surface Areas of Right Pyramids and Right Cones, page 34

4. a) 132 $in.^2$ **b)** 220 cm^2
5. a) 168 $in.^2$ **b)** 294 cm^2
6. a) 101 $in.^2$ **b)** 1649 cm^2
7. a) 151 $in.^2$ **b)** 2356 cm^2
8. a) 896 cm^2 **b)** 628 $yd.^2$
9. a)



b) 7008 $ft.^2$

10. 923 285 ft.^{2}

11. **a)** 2261.9 cm^2

b) $11.94

12. 1520 cm^2

13. **a)** 87 m^2

b) 176 ft.^{2}

14. 2.0 m^2; I assumed the hides had equal areas.

15. 188 ft.^{2}

16. **a)** 69.0 mm

b) 7.6 m

17. **a)** Right square pyramid and right cone

b) Right rectangular prism

18. The Louvre

19. **a)** 193.7 cm^2

b) 34.9 m^2

20. 61 ft.^{2}

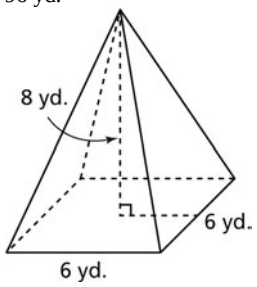
21. 16.0 cm

1.5 Volumes of Right Pyramids and Right Cones, page 42

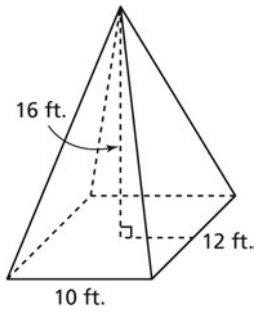
4. **a)** 288 yd.^{3}

b) 1920 ft.^{3}

5. **a)** 96 yd.^{3}



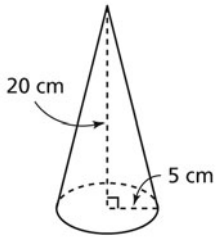
b) 640 ft.^{3}



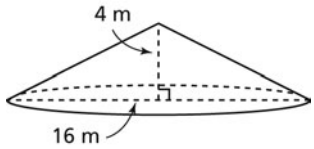
6. **a)** 1571 cm^3

b) 804 m^3

7. **a)** 524 cm^3



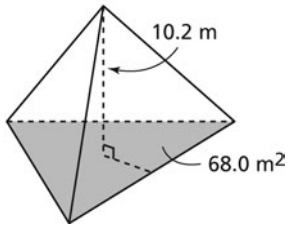
b) 268 m^3



8. **a)** 18 m^3 **b)** 168 yd.^{3}

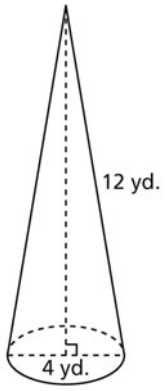
9. **a)** 37.7 m^3 **b)** 2948.9 cm^3

10. **a)**



b) 231.2 m^3

11. **a)**



b) 50 yd.^{3}

12. 0.3 m^3

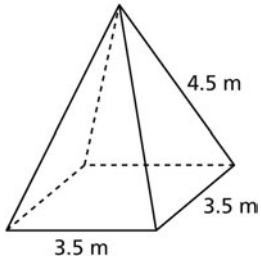
13. **b)** 441.2 cm^3

14. **a)** 5 in.^{3}

b) $3.33

c) Approximately 7 in.^{3}

15. a)



b) 3.8 m **c)** 15.3 m^3

16. 401 $ft.^3$

17. a) 15 cm^2 **b)** 23 cm^3

c) No, there is also some air inside the tea bag.

18. a) 4.7 cm **b)** 10.5 m

c) 3.3 m **d)** 7.4 cm

19. b) 8.0 cm

20. a) 22.9 kL **b)** Approximately 16.4 kL

21. 10 yd.

22. 49.6 m^3

1.6 Surface Area and Volume of a Sphere, page 51

3. a) 314 cm^2 **b)** 32 m^2

c) 201 $ft.^2$ **d)** 99 cm^2

4. a) 524 cm^3 **b)** 17 m^3

c) 268 $ft.^3$ **d)** 92 cm^3

5. a) 339 m^2, 452 m^3 **b)** 191 $yd.^2$, 191 $yd.^3$

7. 886.7 m, 2482.7 m^3

8. 3.2 cm

9. 12 in.

10. a) 2.1 L **b)** 8 cups

11. a) Hemisphere **b)** Hemisphere

12. a) 784 m^2 **b)** 2065 kL

13. a) 511 185 933 km^2

b) 357 830 153 km^2

c) 1 086 781 293 000 km^3

d) 1 078 037 876 000 km^3

14. Approximately 1 082 696 932 000 km^3; approximately 1 093 440 264 000 km^3

15. 239 spheres

16. a) 11 cm; 5 in. **b)** 1387 cm^2; 277 $in.^2$

c) 4855 cm^3; 434 $in.^3$ **d)** Basketball

17. a) 16.4 m^3 **b)** 1.0 m^2

18. 529.6 m^2; 882.2 m^3

19. 42 pumps

20. 45 cookies

21. a) Approximately 69%

b) Assumptions: Ball is created from one solid piece and has greatest possible diameter.

22. $SA = \pi d^2$; $V = \frac{1}{6}\pi d^3$

23. Approximately 5 in.

24. a) Inflated balloon's circumference is 3 times greater

b) Inflated balloon's surface area is 9 times greater

c) Inflated balloon's volume is 27 times greater

Chapter 1: Checkpoint 2, page 54

1. a) 80 $ft.^2$ **b)** 21 m^2

c) 1127 m^2

2. 425 m^2

3. 183 $in.^2$

4. a) 41 $ft.^3$ **b)** 6 m^3

c) 1947 m^3

5. a) 9.5 cm **b)** 2.7 m

c) 17.4 cm

6. a) 973.1 km^2, 2854.5 km^3

b) 109.0 cm^2, 82.3 cm^3

7. 7946 cm^2

1.7 Solving Problems Involving Objects, page 59

3. a) 170 cm^2 **b)** 1040 $ft.^2$

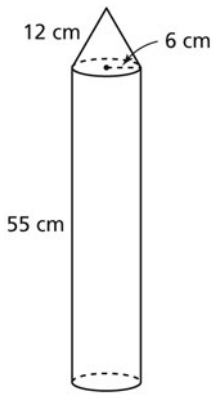
c) 95 $in.^2$ **d)** 314 $in.^2$

4. a) Object in part c **b)** Approximately 38 $in.^3$

5. a) 273.3 cm^2, 353.4 cm^3 **b)** 12.0 m^2, 2.5 m^3

6. a) $5\frac{4}{5}$ in. **b)** 6.7 cm

7. a)



b) 2413 cm^2 **c)** 6612 cm^3

d) Approximately 2204 cm^3, or 2204 mL

8. 93 cm^3

9. a) Circular-based bin

b) Square-based bin

10. a) 1300.0 cm^3 **b)** 6.2 m^3

11. a) 856.2 cm^2 **b)** 24.2 m^2

12. Approximately 26.4 m^2

13. a) 1060 $in.^3$ **b)** 15 in. by 15 in. by 12 in.

c) 1820 $in.^3$

Chapter 1: Review, page 64

1. Answers may vary. For example:

a) Inch **b)** Foot

c) Yard

3. a) 42 ft. **b)** 8800 yd.

c) 75 in. **d)** 3 yd. 1 ft. 3 in.

4. 320 in., or 8 yd. 2 ft. 8 in.

6. Answers will vary depending on the conversion ratios used.

a) 8 ft. 7 in. **b)** 136 yd. 2 ft. 1 in.

c) 3 mi. 1282 yd. **d)** 1 ft. 2 in.

7. Answers will vary depending on the conversion ratios used.

a) 12.5 m **b)** 6.8 km

c) 48.3 cm **d)** 215.9 mm

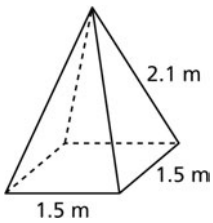
8. Answers will vary depending on the conversion ratio used. 670 750 strides

9. a) 75 $ft.^2$ **b)** 85 cm^2

c) 898 mm^2 **d)** 192 m^2

10. 160 $yd.^2$

11. a)



b) 2.0 m

c) 6 m^2

12. a) $8\frac{7}{10}$ in. **b)** 173 $in.^2$

13. 125.8 cm^2

14. 5810 $ft.^2$

15. a) 11 m^3 **b)** 8822 $in.^3$

c) 7 $ft.^3$ **d)** 221 mm^3

16. No; approximately 132.7 cm^3

17. 12 cm

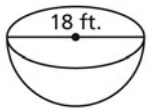
18. a) 24 $in.^3$ **b)** 6 in.

19. a) 2.1 m **b)** 2.3 cm

20. a) 254 $in.^2$, 382 $in.^3$

b) 133 m^2, 144 m^3

21.



a) 763 $ft.^2$ **b)** 1527 $ft.^3$

22. $4\frac{3}{5}$ in.

23. Approximately 98 cm^3

24. 523 $in.^3$

25. a) 480 cm^2, 595 cm^3 **b)** 108 $ft.^2$, 84 $ft.^3$

26. a) 113 981 cm^3 **b)** 11 878 cm^2

27. a) 8 cm **b)** 10 mm

Chapter 1: Practice Test, page 67

1. B

2. C

3. The volume of the right cylinder is 3 times the volume of the right cone.

4. a) 69.3 cm^2, 28.3 cm^3

b) 647.2 m^2, 1215.8 m^3

5. a) A ruler with inches marked

6. 5.8 cm

Chapter 2 Trigonometry, page 68

2.1 The Tangent Ratio, page 75

3. a) $\tan A = \frac{6}{7}$; $\tan C = \frac{7}{6}$

b) $\tan D = \frac{3}{2}$; $\tan F = \frac{2}{3}$

c) $\tan H = \frac{5}{4}$; $\tan J = \frac{4}{5}$

d) $\tan K = \frac{5}{7}$; $\tan M = \frac{7}{5}$

4. a) 14° **b)** 51°

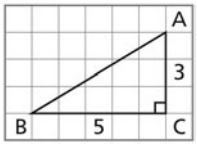
c) 68° **d)** 87°

5. a) 27° **b)** 45°

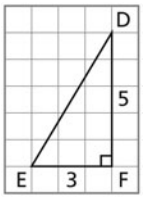
c) 61° **d)** 69°

6. Sketches will vary. For example:

a)



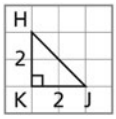
b)



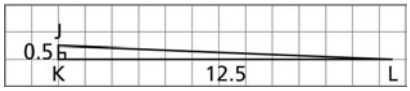
c)

d)

e)



f)



7. a) tan 60° > 1 **b)** tan 30° < 1

8. a) 36.4° **b)** 68.0°

9. b) i) ∠A ≐ 26.6°; ∠B ≐ 63.4°

ii) ∠D ≐ 63.4°; ∠F ≐ 26.6°

iii) ∠G ≐ 63.4°; ∠H ≐ 26.6°

c) No

10. a) 36.0° **b)** 49.1°

c) 20.3° **d)** 82.4°

11. a) 11° **b)** 14°

c) 6° **d)** 9°

12. Whitehorse

13. ∠P = ∠RQS ≐ 67.4°, ∠R = ∠PQS ≐ 22.6°

14. 22°

15. 20.6°; 69.4°

16. The side opposite the acute angle has the same length as the side adjacent to the angle.

17. 25°

18. 22°

19. 146°

20. 76°

21. ∠X ≐ 50.1°, ∠Y = ∠Z ≐ 64.9°

22. a) There is no least possible value; the tangent can be arbitrarily close to zero.

b) There is no greatest possible value; the tangent can be arbitrarily large.

23. a) 1; $\frac{1}{\sqrt{2}}$; $\frac{1}{\sqrt{3}}$; $\frac{1}{\sqrt{4}}$, or $\frac{1}{2}$; $\frac{1}{\sqrt{5}}$

b) $\frac{1}{\sqrt{100}}$, or $\frac{1}{10}$

2.2 Using the Tangent Ratio to Calculate Lengths, page 82

3. a) 2.5 cm **b)** 1.4 cm

c) 5.0 cm **d)** 7.5 cm

4. a) 2.2 cm **b)** 2.8 cm

c) 2.8 cm

5. a) 5.6 cm **b)** 4.1 cm

c) 3.8 cm

6. 22.8 m

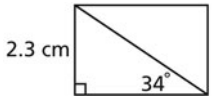
7. 3.8 m

8. 187 m

9. a) 3.6 cm **b)** 10.0 cm

10. Approximately 30 m

11. a)



b) 3.4 cm

12. 40.3 cm^2

13. Approximately 60 m

14. Approximately 58 m, assuming the balloon is directly over the store

15. ∠QRT = ∠SRT = 26.5°, ∠QRS = 53.0°,
∠QPT = ∠SPT = 56.3°, ∠QPS = 112.6°,
∠RQT = ∠RST = 63.5°,
∠PQT = ∠PST = 33.7°,
∠PQR = ∠PSR = 97.2°,
∠PTQ = ∠PTS = ∠QTR = ∠RTS = 90.0°
PQ = PS ≐ 3.6 cm, QR = SR ≐ 6.7 cm

16. a) Approximately 38.7°

b) Approximately 63.4°

2.3 Math Lab: Measuring an Inaccessible Height, page 86

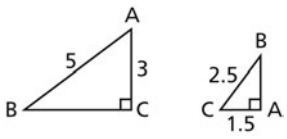
1. The sum of the angle shown on the protractor and the angle of inclination is 90°.
2. 13.5 m
3. 25 m

Chapter 2: Checkpoint 1, page 88

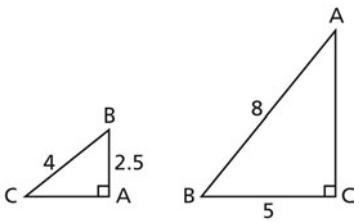
1. a) 14° **b)** 56°
c) 53°
3. 11.5°
4. a) 11.2 cm **b)** 7.3 cm
c) 11.7 cm
5. Approximately 23.7 m

2.4 The Sine and Cosine Ratios, page 95

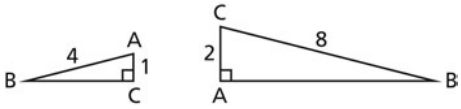
4. a) i) Opposite: GH; adjacent: AG; hypotenuse: AH
ii) Opposite: TK; adjacent: AK; hypotenuse: AT
b) i) sin A = 0.60; cos A = 0.80
ii) sin A = 0.28; cos A = 0.96
5. a) sin 57° ≐ 0.84; cos 57° ≐ 0.54
b) sin 5° ≐ 0.09; cos 5° ≐ 1.00
c) sin 19° ≐ 0.33; cos 19° ≐ 0.95
d) sin 81° ≐ 0.99; cos 81° ≐ 0.16
6. a) 14° **b)** 50°
c) 33° **d)** 39°
7. a) 34° **b)** 35°
c) 39° **d)** 33°
8. a) 41° **b)** 78°
c) 26° **d)** 66°
9. Sketches will vary. For example:
a)



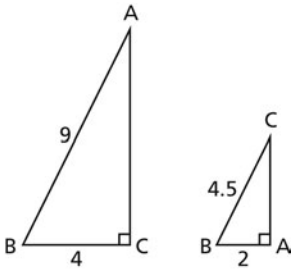
b)



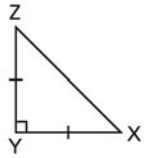
c)



d)



10. a) ∠C ≐ 16.3°, ∠D ≐ 73.7°
b) ∠F ≐ 63.9°, ∠H ≐ 26.1°
c) ∠J ≐ 38.0°, ∠K ≐ 52.0°
d) ∠P ≐ 49.3°, ∠Q ≐ 40.7°
11. 1.3°
12. 79.4°
13. 61°
14. 31°
15. a) i) 0.1736… **ii)** 0.3420…
iii) 0.6427… **iv)** 0.7660…
v) 0.8660… **vi)** 0.9848…
16.



The opposite and adjacent sides of an acute angle have the same length, so $\frac{\text{opposite}}{\text{hypotenuse}} = \frac{\text{adjacent}}{\text{hypotenuse}}$.

17. 40°
18. a) i) 1 **ii)** 0
iii) 0 **iv)** 1

2.5 Using the Sine and Cosine Ratios to Calculate Lengths, page 101

3. a) 3.1 cm **b)** 1.5 cm
c) 1.5 cm **d)** 3.7 cm
4. a) 1.7 cm **b)** 3.2 cm
c) 5.4 cm **d)** 7.9 cm
5. a) 25.3 cm **b)** 8.0 cm
c) 7.7 cm **d)** 12.4 cm

6. 29.7 m

7. a) 48.3 m

b) The surveyor could use the tangent ratio or the Pythagorean Theorem.

8. 4.0 km

9. 2813 m

10. 18.3 cm by 4.6 cm

11. a) 423 cm **b)** 272 cm

12. a) i) 21.0 cm **ii)** 15.1 cm

13. 186 mm

14. a) Approximately 139 ft.

b) 17 407 ft.^{2}

Chapter 2: Checkpoint 2, page 104

1. a) 30° **b)** 48°

c) 56°

2. 13°

3. a) i) 0.9848… **ii)** 0.9396…

iii) 0.8660… **iv)** 0.7660…

v) 0.6427… **vi)** 0.5

vii) 0.3420… **viii)** 0.1736…

4. a) 4.2 cm **b)** 2.7 cm

c) 14.0 cm

5. Approximately 3.2 km

2.6 Applying the Trigonometric Ratios, page 111

3. a) Sine **b)** Tangent

c) Cosine **d)** Tangent

4. a) 4.6 cm; cosine **b)** 4.7 cm; tangent

c) 11.8 cm; sine **d)** 14.5 cm; cosine

5. a) Pythagorean Theorem **b)** Sine ratio

c) Pythagorean Theorem **d)** Pythagorean Theorem

6. a) $\angle T = 57°$, TU $\doteq$ 23.0 cm, VU $\doteq$ 19.2 cm

b) $\angle Y = 43°$, WY $\doteq$ 8.7 cm, XY $\doteq$ 6.3 cm

c) ZB $\doteq$ 11.3 cm, $\angle B \doteq 60.3°$, $\angle Z \doteq 29.7°$

d) $\angle E = 61°$, CD $\doteq$ 12.0 cm, CE $\doteq$ 6.6 cm

7. a) 1147 cm **b)** 1144 cm

8. 173 ft.

9. a) 68 km **b)** 31°

10. a) 4° **b)** 15.0 m

11. a) 31° **b)** 118°

12. a) 13.5 cm; 7.8 cm^2 **b)** 28.9 cm; 47.5 cm^2

13. 7.3 cm

14. a) 3 in.^{2} **b)** 15 in.^{3}

15. 36 cm

16. 15.6 cm; 11.6 cm^2

2.7 Solving Problems Involving More than One Right Triangle, page 118

3. a) 6.0 cm **b)** 6.0 cm

c) 4.3 cm **d)** 3.6 cm

4. a) 5.7 cm **b)** 4.9 cm

c) 5.7 cm

5. a) 93.2° **b)** 123.7°

c) 11.1° **d)** 15.0°

6. 15 m, 19 m

7. 51°, 65°, 65°

8. a) 19 ft. **b)** 21 ft.

9. 35 m, 58 m

10. Approximately 126°, approximately 54°

11. 4.5 m

12. a) 53 m **b)** 29 m

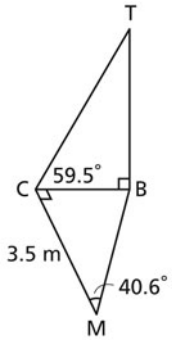
c) 50 m

13. a) 5.0 m **b)** 51.3°

c) 2.4 m

14. a) 23 m **b)** 20 m

16. a)

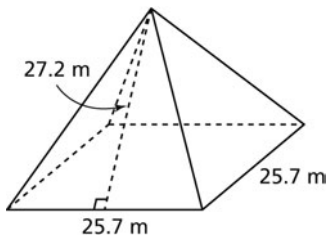


b) 5.1 m

17. a) 98.1°, 51.7°, 105.1°, 105.1°

b) 100 mm

18. a)



b) 24.0 m

19. a) 5.4 cm **b)** 33.9°

20. Approximately 8.3 m

21. Approximately 18 in.

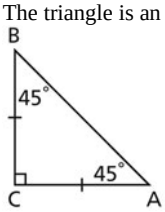
Chapter 2: Review, page 124

1. **a)** 35° **b)** 65°

2. **a)** $\tan 20° < 1$ **b)** $\tan 70° > 1$

3. 6°

4. The triangle is an isosceles right triangle.



5. **a)** **i)** 3.7 cm
ii) 3.0 cm
b) Could also use trigonometric ratios
i) Approximately 4.2 cm
ii) Approximately 4.0 cm

6. 327 m

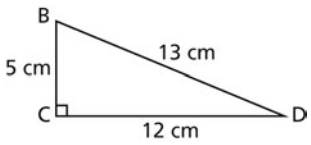
7. **a)** 11.7 cm **b)** 13.0 cm

8. 17.5 m

9. 30 m

11. **a)** 73°; cosine **b)** 28°; sine

12.



a) **i)** $\frac{5}{13}$ **ii)** $\frac{12}{13}$
iii) $\frac{5}{13}$ **iv)** $\frac{12}{13}$

b) $\sin D = \cos B$; $\sin B = \cos D$

13. 64.2°

14. 36.9°

15. **a)** 3.9 cm; cosine
b) 4.4 cm; sine
c) 4.7 cm; sine
d) 4.5 cm; cosine

16. 6.0 km

17. 1.6 cm by 2.8 cm

18. **a)** CE ≐ 5.0 cm, ∠E ≐ 57.3°, ∠C ≐ 32.7°
b) ∠H = 52°, GH ≐ 2.7 cm, FH ≐ 4.3 cm
c) ∠K = 63°, JM ≐ 3.9 cm, KM ≐ 2.0 cm

19. 85.9°

20. **a)** 35.5 cm; 52.1 cm^2
b) 13.0 cm; 10.2 cm^2

21. **a)** 3.2 m **b)** 8.2 m

22. **a)** 13.6 cm **b)** 11.3 cm
c) 21.0°

23. 2316 ft.

Chapter 2: Practice Test, page 127

1. B

2. C

4. ∠D = 27.0°, DE ≐ 6.9 cm, EF ≐ 3.5 cm

5. 203 cm

6. 75.5 m

Cumulative Review Chapters 1 and 2, page 130

1. **a)** 23 yd. 1 ft. **b)** $59.76

2. 276 km

4. Answers will vary depending on the conversion ratios used.
a) 823 cm **b)** 279 400 m
c) 3 mi. **d)** 5 ft. 3 in.

5. Answers will vary depending on the conversion ratio used. The road above The Narrows is higher by approximately 5 ft., or 1.5 m.

6. **a)** 342 m^2 **b)** 208 $ft.^2$

7. 192 $ft.^3$

8. Approximately 6 yd.

9. No

10. **a)** Hemisphere; 138 $in.^2$
b) Sphere; 3824 $in.^3$

11. 191 m^2, 170 m^3

12. 4478 $in.^2$

13. 222.1 mm^2, 239.6 mm^3

14. **a)** 31.0° **b)** 62.5°

15. 26 yd.

16. 201 ft.

17. **a)** 61.9° **b)** 68.4°

18. 22°

19. 50 ft. by 94 ft.

20. **a)** ∠S = 24.0°, RT ≐ 6.4 m, RS ≐ 14.4 m
b) ∠M = 46.0°, MN ≐ 7.1 cm, MP ≐ 10.3 cm

21. 59°

22. x = 20.0 cm; y ≐ 40.0 cm;
∠PRQ = 46.4°; ∠PRS = 133.6°;
∠PSR = 31.7°; ∠QPR = 43.6°;
∠QPS = 58.3°; ∠QRS = 180.0°;
∠RPS = 14.7°

Chapter 3 Factors and Products, page 132

3.1 Factors and Multiples of Whole Numbers, page 140

3. **a)** 6, 12, 18, 24, 30, 36
b) 13, 26, 39, 52, 65, 78
c) 22, 44, 66, 88, 110, 132
d) 31, 62, 93, 124, 155, 186
e) 45, 90, 135, 180, 225, 270
f) 27, 54, 81, 108, 135, 162

4. **a)** 2, 5 **b)** 3, 5
c) 3 **d)** 2, 3, 5
e) 2, 5, 7 **f)** 2, 3

5. **a)** $3 \cdot 3 \cdot 5$, or $3^2 \cdot 5$
b) $2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$, or $2^4 \cdot 5$
c) $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$, or $2^5 \cdot 3$
d) $2 \cdot 61$
e) $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$, or $2^5 \cdot 5$
f) $3 \cdot 5 \cdot 13$

6. **a)** $2^3 \cdot 3 \cdot 5^2$ **b)** $2 \cdot 5^2 \cdot 23$
c) $2 \cdot 7 \cdot 73$ **d)** $2 \cdot 3^2 \cdot 5^3$
e) $2^2 \cdot 3^2 \cdot 5^3$ **f)** $5^3 \cdot 7^2$

8. **a)** 2 **b)** 2^3, or 8
c) 3^3, or 27 **d)** 2^2, or 4
e) 2^5, or 32 **f)** $2^2 \cdot 5$, or 20

9. **a)** 5 **b)** $2^3 \cdot 5$, or 40
c) $2 \cdot 3 \cdot 7$, or 42 **d)** 2^2, or 4

10. **a)** $2^2 \cdot 3 \cdot 7$, or 84 **b)** $3^2 \cdot 5 \cdot 7$, or 315
c) $2^2 \cdot 3^2 \cdot 5$, or 180 **d)** $2 \cdot 3 \cdot 7 \cdot 19$, or 798
e) $2^5 \cdot 3^2 \cdot 5$, or 1440 **f)** $2^2 \cdot 7 \cdot 13$, or 364

11. **a)** $2^2 \cdot 3^2 \cdot 5 \cdot 19$, or 3420
b) $2^5 \cdot 3 \cdot 5 \cdot 11$, or 5280
c) $2^2 \cdot 3^2 \cdot 5^2$, or 900
d) $2^3 \cdot 3^3 \cdot 5$, or 1080

12. Greatest common factor: 2;
least common multiple: $2^2 \cdot 3 \cdot 7$, or 84

13. $2 \cdot 3$, or 6

14. The greatest common factor of the two numbers is 1.

15. **a)** $\frac{37}{65}$ **b)** $\frac{17}{19}$
c) $\frac{13}{18}$ **d)** $\frac{42}{61}$
e) $\frac{49}{110}$ **f)** $\frac{33}{17}$

16. **a)** $\frac{149}{112}$ **b)** $\frac{65}{60}$, or $\frac{13}{12}$
c) $\frac{43}{264}$ **d)** $\frac{304}{210}$, or $\frac{152}{105}$
e) $\frac{121}{600}$ **f)** $\frac{239}{90}$
g) $\frac{27}{20}$ **h)** $\frac{77}{12}$

17. 800 m

18. No; 1 does not have any prime factors.

19. **a)** 72 cm by 72 cm **b)** Yes

20. **a)** Yes **b)** Yes
c) 660 feet

21. Yes

22. 30 cm

3.2 Perfect Squares, Perfect Cubes, and Their Roots, page 146

4. **a)** 14 **b)** 16
c) 19 **d)** 17
e) 21

5. **a)** 7 **b)** 8
c) 10 **d)** 11
e) 15

6. **a)** Perfect square
b) Perfect square and perfect cube
c) Neither
d) Perfect square
e) Perfect square and perfect cube
f) Perfect cube

7. **a)** 22 mm **b)** 42 yd.

8. **a)** 18 in. **b)** 25 ft.

9. 96 $ft.^2$

10. 35 937 $ft.^3$

11. No; 2000 is not a perfect cube.

12. These answers assume that the endpoints of each range are included in the range.
a) Perfect squares: 324, 361; perfect cube: 343
b) Perfect squares: 676, 729; perfect cube: 729
c) Perfect squares: 841, 900
d) Perfect squares: 1225, 1296; perfect cube: 1331

13. The first 5 are: 0, 1, 64, 729, 4096

14. 12 ft.

15. **a)** $\frac{45x^2}{8}$ **b)** $x = 4$

16. Edge length: 6 units

17. a) $11x^2y$ **b)** $4x^2y$

18. $1^3 + 12^3$, $9^3 + 10^3$

Chapter 3: Checkpoint 1, page 149

1. a) $2^2 \cdot 3^2 \cdot 5 \cdot 7$ **b)** $2^7 \cdot 3 \cdot 11$
c) $2^3 \cdot 3^2 \cdot 5 \cdot 17$ **d)** $5 \cdot 11 \cdot 19$
e) $2^4 \cdot 3^3 \cdot 7$ **f)** $3 \cdot 5^2 \cdot 7^2$

2. a) 2^3, or 8 **b)** $2^2 \cdot 3$, or 12
c) 5 **d)** 2^4, or 16
e) 2^3, or 8 **f)** 5^2, or 25

3. a) $2^2 \cdot 3 \cdot 5 \cdot 7$, or 420
b) $2^5 \cdot 3 \cdot 5$, or 480
c) $2^3 \cdot 3^2 \cdot 5$, or 360
d) $2^5 \cdot 3 \cdot 5$, or 480
e) $2^6 \cdot 7^2$, or 3136
f) $2 \cdot 3 \cdot 5^2 \cdot 11$, or 1650

4. a) $\frac{103}{33}$ **b)** $\frac{71}{35}$
c) $\frac{27}{70}$

5. 18 980 days; 52 years

6. a) 20 **b)** 28
c) 24 **d)** 33
e) 39 **f)** 55

7. a) 12 **b)** 15
c) 20 **d)** 18
e) 22 **f)** 21

8. a) Neither
b) Perfect square
c) Perfect square and perfect cube
d) Perfect square
e) Perfect cube
f) Neither

9. a) Perfect squares: 400, 441, 484
b) Perfect squares: 900, 961; perfect cube: 1000
c) Perfect square: 1156

10. 26 cans

3.3 Common Factors of a Polynomial, page 155

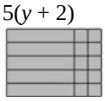
Gray algebra tiles represent positive tiles and black tiles represent negative algebra tiles.

4. a) $3x + 12$; 3, $x + 4$
b) $4x^2 + 10x$; $2x$, $2x + 5$
c) $12x^2 - 8x + 16$; 4, $3x^2 - 2x + 4$

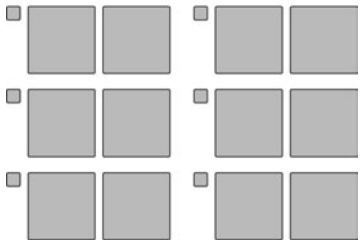
5. a) 3 **b)** m

6. a) **i)** $3(2 + 5n)$ **ii)** $3(2 - 5n)$
iii) $3(5n - 2)$ **iv)** $3(-5n + 2)$
b) **i)** $m(4 + m)$ **ii)** $m(m + 4)$
iii) $m(4 - m)$ **iv)** $m(m - 4)$

7. a) $5(y + 2)$

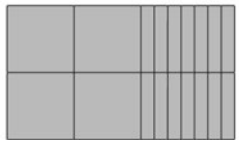


b) $6(1 + 2x^2)$



c) $3(3k + 2)$

d) $2s(2s + 7)$

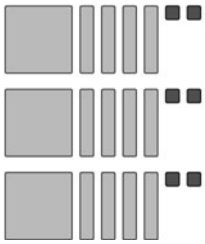


e) $y(1 + y)$

f) $h(3 + 7h)$

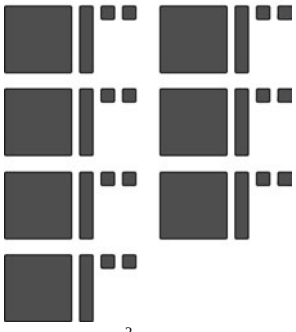
8. a) $3b^2(3 - 4b)$ **b)** $12(4s^3 - 1)$
c) $-a^2(1 + a)$ **d)** $3x^2(1 + 2x^2)$
e) $4y(2y^2 - 3)$ **f)** $-7d(1 + 2d^3)$

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

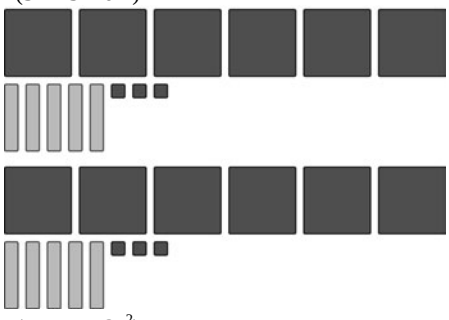


b) $2(2 - 3y - 4y^2)$

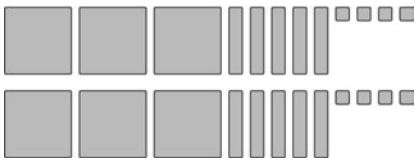
c) $-7(m + m^2 + 2)$



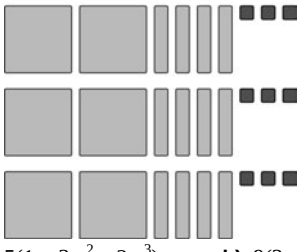
d) $2(5n - 3 - 6n^2)$



e) $2(4 + 5x + 3x^2)$



f) $-3(3 - 4b - 2b^2)$



10. a) $5(1 + 3m^2 - 2m^3)$ **b)** $9(3n + 4 - 2n^3)$

c) $v(6v^3 + 7 - 8v^2)$ **d)** $-c^2(3 + 13c^2 + 12c)$

e) $6x(4 + 5x - 2x^3)$ **f)** $s(s^3 + s - 4)$

11. a) $-12x^2 + 20x$

b) $4x$ and $(-3x + 5)$

c) The factors are the dimensions of the rectangle.

12. a) i) $3m(m + 3m^2 - 1)$

ii) $-4(4 - 2n + n^3)$

b) Expanded his solutions

13. The monomial is 1 when the term is the common factor. The monomial is –1 when the term has the opposite sign of the common factor.

14. a) $4x - 4 = 4(x - 1)$

b) $16m^2 - 24m - 16 = 8(2m^2 - 3m - 2)$

c) $-8n^3 - 6n^2 - 10n = -2n(4n^2 + 3n + 5)$

15. a) i) $2 \cdot 2 \cdot s \cdot t \cdot t$, or $4st^2$

ii) $a \cdot a \cdot b$, or a^2b

iii) $2 \cdot 2 \cdot 3 \cdot x \cdot x \cdot y \cdot y$, or $12x^2y^2$

b) i) $4st^2(s + 3st + 9)$

ii) $4st^2(3st - s - 9)$

iii) $-a^2b(3a + 9a^2 - 8)$

iv) $a^2b(9a^2 + 3a - 8)$

v) $12x^2y^2(3y^2 + x + x^2y)$

vi) $-12x^2y^2(3y^2 + x^2y + x)$

16. a) $5x(5y + 3x - 6xy^2)$

b) $3mn(17m + 13n - 24)$

c) $3p^2q^2(3p^2 - 2pq + 4q^2)$

d) $a^2b^2(10a + 12b^2 - 5)$

e) $4cd(3d - 2 - 5c)$

f) $7rs^2(r^2s + 2r - 3)$

17. a) $SA = 2\pi r(r + h)$

b) Approximately 2639 cm^2

18. a) $SA = \pi r(r + s)$

b) Approximately 679 cm^2

19. a) Assume the area of the base of the silo is not included in the surface area. $SA = 2\pi rh + 2\pi r^2$; $SA = 2\pi r(h + r)$; approximately 603 m^2

b) $V = \pi r^2 h + \frac{2}{3}\pi r^3$; $V = \pi r^2\left(h + \frac{2}{3}r\right)$; approximately 1583 m^3

20. Yes

21. a) $\frac{2\pi rh}{2\pi r^2 + 2\pi rh}$ **b)** $\frac{h}{r + h}$

22. a) 2; 3

b) $n - 3$

c) $\frac{n^2}{2} - \frac{3n}{2} = \frac{n}{2}(n - 3)$

3.4 Math Lab: Modelling Trinomials as Binomial Products, page 158

1. a) Can be represented

b) Can be represented

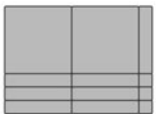
c) Cannot be represented

d) Cannot be represented

e) Cannot be represented

f) Cannot be represented

2. a) Can be represented



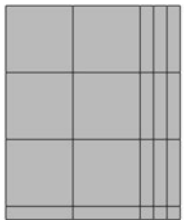
b) Can be represented

c) Cannot be represented

d) Cannot be represented

e) Cannot be represented

f) Can be represented



3. 7, 8, 13

4. 4, 7, 9, 10

3.5 Polynomials of the Form $x^2 + bx + c$, page 166

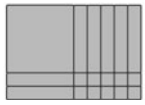
4. a) $(x + 1)(x + 3) = x^2 + 4x + 3$

b) $(x + 2)(x + 4) = x^2 + 6x + 8$

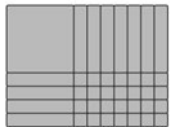
c) $(x + 5)(x + 5) = x^2 + 10x + 25$

d) $(x + 3)(x + 6) = x^2 + 9x + 18$

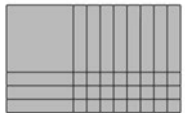
5. a) $b^2 + 7b + 10$



b) $n^2 + 11n + 28$



c) $h^2 + 11h + 24$



d) $k^2 + 7k + 6$

6. a) i) $x^2 + 4x + 4$

ii)

iii) $(x + 2)(x + 2)$

b) i) $x^2 + 5x + 4$

ii)

iii) $(x + 1)(x + 4)$

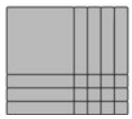
c) i) $x^2 + 6x + 8$

ii)

iii) $(x + 2)(x + 4)$

d) i) $x^2 + 7x + 12$

ii)



iii) $(x + 3)(x + 4)$

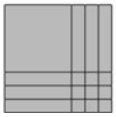
7. a) **i)** 1, 2 **ii)** 2, 3
iii) 1, 9 **iv)** 2, 5
v) 3, 4 **vi)** 3, 5

b) **i)** $(v + 1)(v + 2)$ **ii)** $(w + 2)(w + 3)$
iii) $(s + 1)(s + 9)$ **iv)** $(t + 2)(t + 5)$
v) $(y + 3)(y + 4)$ **vi)** $(h + 3)(h + 5)$

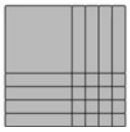
8. a) **i)** $(v + 1)(v + 1)$

ii) $(v + 2)(v + 2)$

iii) $(v + 3)(v + 3)$



iv) $(v + 4)(v + 4)$



b) The rectangles are squares; the binomial factors are the same.

c) $v^2 + 10v + 25 = (v + 5)(v + 5)$;
$v^2 + 12v + 36 = (v + 6)(v + 6)$;
$v^2 + 14v + 49 = (v + 7)(v + 7)$

9. Area models and/or rectangle diagrams may vary.
For example:

a) $m^2 + 13m + 40$

	m	8
m	$(m)(m) = m^2$	$(m)(8) = 8m$
5	$(5)(m) = 5m$	$(5)(8) = 40$

b) $y^2 + 12y + 27$

	y	3
y	$(y)(y) = y^2$	$(y)(3) = 3y$
9	$(9)(y) = 9y$	$(9)(3) = 27$

c) $w^2 + 18w + 32$

	w	16
w	$(w)(w) = w^2$	$(w)(16) = 16w$
2	$(2)(w) = 2w$	$(2)(16) = 32$

d) $k^2 + 14k + 13$

	k	1
k	$(k)(k) = k^2$	$(k)(1) = k$
13	$(13)(k) = 13k$	$(13)(1) = 13$

10. a) $(w + 3)(w + 2) = w^2 + 5w + 6$
b) $(x + 5)(x + 2) = x^2 + 7x + 10$
c) $(y + 10)(y + 2) = y^2 + 12y + 20$

11. a) $(x + 4)(x + 6)$ **b)** $(m + 2)(m + 8)$
c) $(p + 1)(p + 12)$ **d)** $(s + 2)(s + 10)$
e) $(n + 1)(n + 11)$ **f)** $(h + 2)(h + 6)$
g) $(q + 1)(q + 6)$ **h)** $(b + 2)(b + 9)$

12. a) $g^2 + 4g - 21$

	g	7
g	$(g)(g) = g^2$	$(g)(7) = 7g$
-3	$(-3)(g) = -3g$	$(-3)(7) = -21$

b) $h^2 - 5h - 14$

	h	-7
h	$(h)(h) = h^2$	$(h)(-7) = -7h$
2	$(2)(h) = 2h$	$(2)(-7) = -14$

c) $22 - 13j + j^2$

	2	$-j$
11	$(11)(2) = 22$	$(11)(-j) = -11j$
$-j$	$(-j)(2) = -2j$	$(-j)(-j) = j^2$

d) $k^2 + 8k - 33$

	k	11
k	$(k)(k) = k^2$	$(k)(11) = 11k$
-3	$(-3)(k) = -3k$	$(-3)(11) = -33$

e) $84 - 5h - h^2$

	7	$-h$
12	$(12)(7) = 84$	$(12)(-h) = -12h$
h	$(h)(7) = 7h$	$(h)(-h) = -h^2$

f) $m^2 - 81$

	m	9
m	$(m)(m) = m^2$	$(m)(9) = 9m$
-9	$(-9)(m) = -9m$	$(-9)(9) = -81$

g) $n^2 - 18n + 56$

	n	-4
n	$(n)(n) = n^2$	$(n)(-4) = -4n$
-14	$(-14)(n) = -14n$	$(-14)(-4) = 56$

h) $p^2 - 11p - 102$

	p	-17
p	$(p)(p) = p^2$	$(p)(-17) = -17p$
6	$(6)(p) = 6p$	$(6)(-17) = -102$

13. a) $r^2 - 9r - 52$

b) $s^2 - 20s + 75$

14. a) $(b - 1)(b + 20)$ **b)** $(t - 3)(t + 18)$

c) $(x - 2)(x + 14)$ **d)** $(n + 3)(n - 8)$

e) $(a + 4)(a - 5)$ **f)** $(y + 6)(y - 8)$

g) $(m - 5)(m - 10)$ **h)** $(a - 6)(a - 6)$

15. a) $(1 + k)(12 + k)$ **b)** $(2 + g)(-8 + g)$

c) $(5 + y)(12 + y)$ **d)** $(9 + z)(8 - z)$

16. a) i) $x^2 + 3x + 2$; 132

ii) $x^2 + 4x + 3$; 143

b) The coefficients of the terms of the polynomial are the digits in the product of integers.

17. a) $(m + 5)(m - 12)$

b) $(w - 5)(w - 9)$

c) $(b - 3)(b + 12)$

18. a) i) $t^2 + 11t + 28$ **ii)** $t^2 - 11t + 28$

iii) $t^2 + 3t - 28$ **iv)** $t^2 - 3t - 28$

b) i) Because the constant terms in the binomials have the same sign

ii) Because the constant terms in the binomials have opposite signs

iii) Add the constant terms in the binomials

19. a) ±7, ±11; 4 integers

b) 0, ±8; 3 integers

c) ±6, ±9; 4 integers

d) ±1, ±4, ±11; 6 integers

e) ±9, ±11, ±19; 6 integers

f) 0, ±6, ±15; 5 integers

20. Infinitely many integers are possible. For example:

a) 0, –2, –6, –12, –20, –30, …

b) 0, –2, –6, –12, –20, –30, …

c) 1, 0, –3, –8, –15, –24, –35, …

d) 1, 0, –3, –8, –15, –24, –35, …

e) 2, 0, –4, –10, –18, –28, –40, …

f) 2, 0, –4, –10, –18, –28, –40, …

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

c) $4(x - 3)(x + 4)$ **d)** $10(x + 2)(x + 6)$

e) $-5(n - 1)(n - 7)$ **f)** $7(c - 2)(c - 3)$

23. a) i) $(h + 2)(h - 12)$ **ii)** $(h - 2)(h + 12)$

iii) $(h - 4)(h - 6)$ **iv)** $(h + 4)(h + 6)$

b) The first 6 are:

$h^2 \pm 13h \pm 30$, $h^2 \pm 15h \pm 54$, $h^2 \pm 17h \pm 60$,

$h^2 \pm 25h \pm 84$, $h^2 \pm 20h \pm 96$, $h^2 \pm 26h \pm 120$

3.6 Polynomials of the Form $ax^2 + bx + c$, page 177

5. a) $(2m + 1)(m + 3) = 2m^2 + 7m + 3$

b) $(3p + 2)(p + 4) = 3p^2 + 14p + 8$

c) $(3w + 1)(2w + 1) = 6w^2 + 5w + 1$

d) $(4v + 3)(3v + 2) = 12v^2 + 17v + 6$

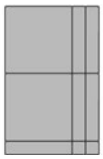
6. a) $2v^2 + 7v + 6$ **b)** $3r^2 + 13r + 4$

c) $6g^2 + 13g + 6$ **d)** $8z^2 + 26z + 15$

e) $9t^2 + 24t + 16$ **f)** $4r^2 + 12r + 9$

7. a) i) $2x^2 + 5x + 2$

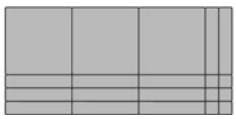
ii)



iii) $(2x + 1)(x + 2)$

b) i) $3x^2 + 11x + 6$

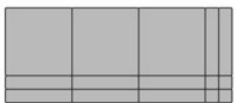
ii)



iii) $(x + 3)(3x + 2)$

c) i) $3x^2 + 8x + 4$

ii)



iii) $(x + 2)(3x + 2)$

d) i) $4x^2 + 9x + 2$

ii)

iii) $(x + 2)(4x + 1)$

8. a) $(2w + 1)(w + 6) = 2w^2 + 13w + 6$

b) $(2g - 5)(3g - 3) = 6g^2 - 21g + 15$

c) $(-4v - 3)(-2v - 7) = 8v^2 + 34v + 21$

9. a) $15 + 23f + 4f^2$ **b)** $15 - 29t + 12t^2$

c) $90 + 11r - 2r^2$ **d)** $36 - 24m + 4m^2$

e) $-24 + 50x + 14x^2$ **f)** $-36 + 60n - 25n^2$

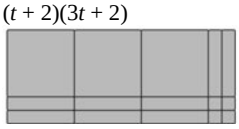
10. a) $6c^2 + 23c + 20$ **b)** $-21t^2 - 32t + 5$

c) $32r^2 + 48r - 14$ **d)** $5t^2 + 46t + 9$

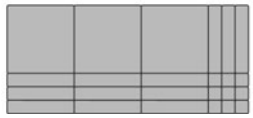
e) $35h^2 + 29h - 30$ **f)** $-36y^2 + 84y - 49$

11. a) i) $(t + 1)(3t + 1)$

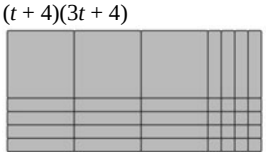
ii) $(t + 2)(3t + 2)$



iii) $(t + 3)(3t + 3)$



iv) $(t + 4)(3t + 4)$



b) The side lengths increase by 1 each time; the constant terms in the binomial factors increase by 1 each time.

c) $3t^2 + 20t + 25 = (t + 5)(3t + 5)$;

$3t^2 + 24t + 36 = (t + 6)(3t + 6)$;

$3t^2 + 28t + 49 = (t + 7)(3t + 7)$

12. a) i) $(n + 6)(2n + 1)$ **ii)** $(n - 6)(2n - 1)$

b) i) $(n + 6)(2n - 1)$ **ii)** $(n - 6)(2n + 1)$

c) i) $(n + 2)(2n + 3)$ **ii)** $(n - 2)(2n - 3)$

The trinomials in each pair have middle terms with the same value, but opposite signs. The constant terms in the binomial factors have opposite signs.

13. **a)** $(y + 2)(2y + 1)$ **b)** $(a + 4)(2a + 3)$
c) $(k + 5)(2k + 3)$ **d)** $(m - 4)(2m - 3)$
e) $(k - 3)(2k - 5)$ **f)** $(m + 7)(2m + 1)$
g) $(g + 6)(2g + 3)$ **h)** $(n + 6)(2n - 3)$

14. **a)** **i)** 1, 15 **ii)** 2, 12
iii) 3, 5 **iv)** 3, 4
v) 1, 12 **vi)** 3, 8
b) **i)** $(v + 5)(3v + 1)$
ii) $(m + 4)(3m + 2)$
iii) $(b + 1)(3b + 5)$
iv) $(a + 1)(4a + 3)$
v) $(d + 3)(4d + 1)$
vi) $(v + 2)(4v + 3)$

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

16. **a)** $(2u + 7)(3u - 2)$
b) $(3k - 10)(k + 3)$
c) $(4v - 5)(v - 4)$

17. $(3g + 7)(5g - 6)$

18. **a)** $10(r + 2)(2r + 3)$ **b)** $5(a - 4)(3a - 1)$
c) $3(2h + 3)(3h - 2)$ **d)** $6(2u - 3)(2u - 3)$
e) $4(m - 5)(3m + 2)$ **f)** $2(3g + 5)(4g - 7)$

19. **a)** $(2y - 1)(7y - 3)$ **b)** $(p - 2)(10p + 3)$
c) $(2r - 7)(5r + 1)$ **d)** $(3g + 1)(5g - 2)$
e) $(2x - 3)(2x + 5)$ **f)** $(3d - 4)(3d - 4)$
g) $(3t + 2)(3t + 2)$ **h)** $(5y + 2)(8y - 3)$
i) $(2c + 3)(12c - 5)$ **j)** $(2x + 5)(4x - 3)$

20. These answers do not include cases where there is a common constant factor among the terms of the polynomial.
a) ±7, ±8, ±13; 6 integers
b) ±20, ±25, ±29, ±52, ±101; 10 integers
c) ±3, ±15, ±25, ±53; 8 integers
d) ±22, ±23, ±26, ±29, ±34, ±43, ±62, ±121; 16 integers
e) ±6, ±10; 4 integers
f) ±1; 2 integers

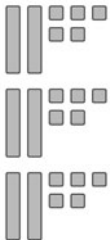
21. **a)** **i)** $(r + 1)(4r - 5)$
ii) Cannot be factored
iii) Cannot be factored
iv) $(w - 2)(2w - 1)$
v) $(h - 3)(3h + 1)$
vi) Cannot be factored

22. **a)** **i)** $(n + 2)(3n + 5)$ **ii)** $(n - 2)(3n - 5)$
iii) $(n + 1)(3n + 10)$ **iv)** $(n - 1)(3n - 10)$
v) $(n + 5)(3n + 2)$ **vi)** $(n - 5)(3n - 2)$
b) Yes; $3n^2 + 31n + 10$ and $3n^2 - 31n + 10$

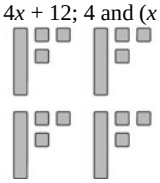
23. $9m^2 \pm 24m + 16$, $9m^2 \pm 25m + 16$, $9m^2 \pm 26m + 16$, $9m^2 \pm 30m + 16$, $9m^2 \pm 40m + 16$, $9m^2 \pm 51m + 16$, $9m^2 \pm 74m + 16$, $9m^2 \pm 145m + 16$

Chapter 3: Checkpoint 2, page 180

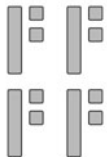
1. **a)** $6x + 15$; 3 and $(2x + 5)$



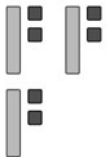
b) $4x + 12$; 4 and $(x + 3)$



2. **a)** **i)** $4(a + 2)$

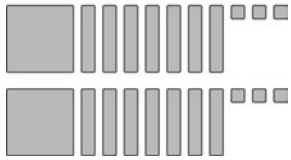


ii) $3(c - 2)$

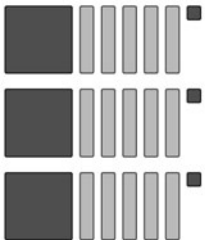


iii) $-v(2v + 5)$

iv) $2(x^2 + 7x + 3)$

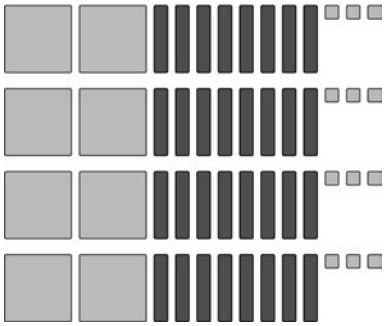


v) $-3(r^2 - 5r + 1)$



vi) $3a(5a^2 - ab - 2b^2)$

vii) $4(3 - 8x + 2x^2)$

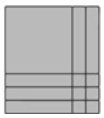


viii) $4y(3x^2 - 2x - 4)$

b) The polynomials in part vi and part viii

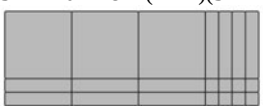
3. Answers will vary. For example:

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



4. Answers will vary. For example:

$3x^2 + 10x + 8 = (x + 2)(3x + 4)$



5. Area models and rectangle diagrams may vary. For example:

a) $x^2 + 5x + 4$

	x	4
x	$(x)(x) = x^2$	$(x)(4) = 4x$
1	$(1)(x) = x$	$(1)(4) = 4$

b) $d^2 + d - 6$

	d	3
d	$(d)(d) = d^2$	$(d)(3) = 3d$
-2	$(-2)(d) = -2d$	$(-2)(3) = -6$

c) $x^2 - 6x + 8$

	x	-2
x	$(x)(x) = x^2$	$(x)(-2) = -2x$
-4	$(-4)(x) = -4x$	$(-4)(-2) = 8$

d) $30 - r - r^2$

	6	r
5	$(5)(6) = 30$	$(5)(r) = 5r$
$-r$	$(-r)(6) = -6r$	$(-r)(r) = -r^2$

e) $g^2 + 4g - 5$

	g	-1
g	$(g)(g) = g^2$	$(g)(-1) = -g$
5	$(5)(g) = 5g$	$(5)(-1) = -5$

f) $20 - 12t + t^2$

	10	$-t$
2	$(2)(10) = 20$	$(2)(-t) = -2t$
$-t$	$(-t)(10) = -10t$	$(-t)(-t) = t^2$

6. a) $(s + 5)(s + 6)$ **b)** $(n + 5)(n - 6)$

c) $(4 - b)(5 - b)$ **d)** $-(1 + t)(11 - t)$

e) $(z + 3)(z + 10)$ **f)** $-(k - 3)(k - 6)$

7. a) $3(x - 2)(x + 7)$ **b)** $-2(y - 3)(y - 8)$

c) $-(3 + m)(8 + m)$ **d)** $(2 - y)(25 + y)$

8. a) $2c^2 + 7c + 3$ **b)** $-4m^2 + 21m - 5$

c) $9f^2 - 9f - 4$ **d)** $12z^2 - 20z + 3$

e) $30 - 8r - 6r^2$ **f)** $8 + 20h + 8h^2$

9. a) $(j + 4)(2j + 5)$ **b)** $(v + 2)(3v - 5)$

c) $(k - 4)(5k - 3)$ **d)** $(3h + 2)(3h + 4)$

e) $(2y - 1)(4y + 1)$ **f)** $(3 - 4u)(2 - 5u)$

3.7 Multiplying Polynomials, page 186

4. a) $g^3 + 3g^2 + 5g + 3$
b) $2 + 7t + 6t^2 + 4t^3 + t^4$
c) $2w^3 + 11w^2 + 26w + 21$
d) $12 + 29n + 22n^2 + 8n^3 + n^4$

5. a) $6z^2 + 5zy + y^2$
b) $12f^2 + 4f - 25fg - 3g + 12g^2$
c) $8a^2 + 22ab + 15b^2$
d) $12a^2 + 4a - 31ab - 5b + 20b^2$
e) $4r^2 + 4rs + s^2$
f) $9t^2 - 12tu + 4u^2$

6. a) i) $4x^2 + 4xy + y^2$
ii) $25r^2 + 20rs + 4s^2$
iii) $36c^2 + 60cd + 25d^2$
iv) $25v^2 + 70vw + 49w^2$
v) $4x^2 - 4xy + y^2$
vi) $25r^2 - 20rs + 4s^2$
vii) $36c^2 - 60cd + 25d^2$
viii) $25v^2 - 70vw + 49w^2$
b) i) $p^2 + 6pq + 9q^2$
ii) $4s^2 - 28st + 49t^2$
iii) $25g^2 + 40gh + 16h^2$
iv) $100h^2 - 140hk + 49k^2$

7. a) i) $x^2 - 4y^2$ **ii)** $9r^2 - 16s^2$
iii) $25c^2 - 9d^2$ **iv)** $4v^2 - 49w^2$
b) i) $121g^2 - 25h^2$ **ii)** $625m^2 - 49n^2$

8. a) $3y^3 + y^2 - 26y + 16$
b) $4r^3 - 7r^2 - 14r - 3$
c) $2b^3 + 17b^2 - 13b + 2$
d) $3x^3 + 11x^2 - 39x - 7$

9. a) $x^2 + 3x + 2xy + 3y + y^2$
b) $x^2 + 3x + xy + 2y + 2$
c) $a^2 + 2ab + b^2 + ac + bc$
d) $3s + st + 5t + t^2 + 6$

10. a) $x^2 - x - 2y - 4y^2$
b) $2c^2 + 2c - cd - 3d - 3d^2$
c) $a^2 - 4a - 3ab + 20b - 10b^2$
d) $p^2 + 2pq - 8q^2 - pr + 2qr$

11. $2r^2 - 13rs + 12r + 15s^2 - 18s$

12. $x^3 + 10x^2 + 23x + 14$

13. a) $4r^4 + 13r^3 + 12r^2 + 5r + 2$
b) $2d^4 + 14d^3 + 19d^2 + 12d + 3$
c) $-4c^4 + 26c^3 - c^2 - 22c - 6$
d) $8n^4 - 18n^3 - 7n^2 + 16n - 3$

14. $-3g^4 - 7g^3 + 10g^2 + 18g - 8$

15. a) $9s^2 + 41s + 52$
b) $13x^2 + 4x + 40$
c) $18m^2 - 2m - 42mn - 4n$
d) 0
e) $3x^2 - 28x + 10$
f) $7a^2 + 2a - 7$

16. a) $20 - 2x$
b) $10 - 2x$
c) $4x^2 - 60x + 200$
d) $4x^3 - 60x^2 + 200x$

17. a) $27x^2 + 43x + 16$
b) $x^2 + 2x - 2$

18. a) $x^3 - 6x^2 + 12x - 8$
b) $8y^3 + 60y^2 + 150y + 125$
c) $64a^3 - 144a^2b + 108ab^2 - 27b^3$
d) $c^3 + 3c^2d + 3cd^2 + d^3$

19. a) $12a^3 + 2a^2 - 4a$
b) $-6r^3 + 3r^2 + 3r$
c) $40x^4 - 50x^3 + 15x^2$
d) $-8x^3y - 10x^2y + 25xy$
e) $4b^3 + 2b^2c - 2bc^2$
f) $y^6 - y^2$

20. a) $(2x + 3)^3 = 8x^3 + 36x^2 + 54x + 27$
b) $6(2x + 3)^2 = 24x^2 + 72x + 54$

21. a) $6x^3 + 2x^2 - 128x - 160$
b) $3b^3 - b^2 - 172b + 224$
c) $18x^3 + 3x^2 - 88x - 80$
d) $50a^3 - 235a^2 + 228a - 63$
e) $8k^3 + 12k^2 - 18k - 27$

22. a) $x^3 + 3x^2y + 3xy^2 + y^3 + 3x^2 + 6xy + 3y^2 + 3x + 3y + 1$
b) $x^3 - 3x^2y + 3xy^2 - y^3 - 3x^2 + 6xy - 3y^2 + 3x - 3y - 1$
c) $x^3 + 3x^2y + 3xy^2 + y^3 + 3x^2z + 6xyz + 3y^2z + 3xz^2 + 3yz^2 + z^3$
d) $x^3 - 3x^2y + 3xy^2 - y^3 - 3x^2z + 6xyz - 3y^2z + 3xz^2 - 3yz^2 - z^3$

3.8 Factoring Special Polynomials, page 194

4. a) $x^2 + 4x + 4$ **b)** $9 - 6y + y^2$
c) $25 + 10d + d^2$ **d)** $49 - 14f + f^2$
e) $x^2 - 4$ **f)** $9 - y^2$
g) $25 - d^2$ **h)** $49 - f^2$

5. a) Difference of squares
b) Neither
c) Neither
d) Perfect square trinomial

6. a) $(x + 7)(x - 7)$ **b)** $(b + 11)(b - 11)$
c) $(1 + q)(1 - q)$ **d)** $(6 + c)(6 - c)$

7. a) i) $(a + 5)^2$ **ii)** $(b - 6)^2$
iii) $(c + 7)^2$ **iv)** $(d - 8)^2$
v) $(e + 9)^2$ **vi)** $(f - 10)^2$
b) $g^2 + 22g + 121 = (g + 11)^2$;
$h^2 - 24h + 144 = (h - 12)^2$;
$i^2 + 26i + 169 = (i + 13)^2$;
$j^2 - 28j + 196 = (j - 14)^2$

8. a) $(2x - 3)^2$ **b)** $(3 + 5n)^2$
c) $(9 - 2v)^2$ **d)** $(5 + 4h)^2$
e) $(3g + 8)^2$ **f)** $(7r - 2)^2$

9. a) x^2; y^2; $x^2 - y^2$
b) $(x - y)$ and $(x - y)$; $(x - y)(x - y)$

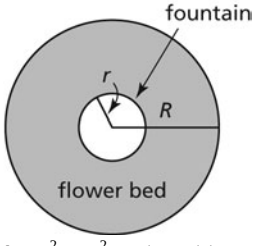
10. a) $(3d + 4f)(3d - 4f)$
b) $(5s + 8t)(5s - 8t)$
c) $(12a + 3b)(12a - 3b)$, or $9(4a + b)(4a - b)$
d) $(11m + n)(11m - n)$
e) $(9k + 7m)(9k - 7m)$
f) $(10y + 9z)(10y - 9z)$
g) $(v + 6t)(v - 6t)$
h) $(2j + 15h)(2j - 15h)$

11. a) $(y + 2z)(y + 5z)$ **b)** $(2w + 3x)(2w - 7x)$
c) $(3s - u)(4s - u)$ **d)** $(t - v)(3t - 4v)$
e) $(2r + 3s)(5r - 3s)$ **f)** $(2p + 7q)(4p - 5q)$

12. Trinomials in parts a, c, and d are perfect squares.
a) $(2x + 7y)^2$ **b)** $(3m - n)(5m + 4n)$
c) $(4r + t)^2$ **d)** $(3a - 7b)^2$
e) $(3h + 4k)(4h + 3k)$ **f)** $(3f - 5g)(5f - 2g)$

13. a) $8(m + 3n)(m - 3n)$
b) $2(2z + y)^2$
c) $3(2x + 3y)(2x - 3y)$
d) $2(2p + 5q)^2$
e) $-3(2u - v)(4u + 3v)$
f) $-2(3b + 8c)(3b - 8c)$

14. a)



b) $\pi R^2 - \pi r^2 = \pi(R + r)(R - r)$
c) Approximately 314 159 cm^2

15. a) i) ±14 **ii)** 25
iii) 9
b) i) 2 integers **ii)** 1 integer
iii) 1 integer

16. –2, –1, 0; –1, 0, 1; 2 possibilities

17. 39 999

18. $5x^2 + 34x + 24$

19. a) i) Neither
ii) Difference of squares
iii) Difference of squares
iv) Perfect square trinomial
b) ii) $(-10 + r)(10 + r)$
iii) $(9ab + 1)(9ab - 1)$
iv) $(4s^2 + 1)^2$

20. a) $(x + 2)(x - 2)(x + 3)(x - 3)$
b) $(a + 1)(a - 1)(a + 4)(a - 4)$
c) $(y + 1)(y - 1)(y + 2)(y - 2)$

21. a) $8(d + 2e)(d - 2e)$
b) $\frac{1}{4}(10m + n)(10m - n)$, or $\left(5m + \frac{1}{2}n\right)\left(5m - \frac{1}{2}n\right)$
c) $2y^2(3x + 5y)(3x - 5y)$
d) Cannot be factored
e) Cannot be factored
f) $\frac{1}{196}(7x + 2y)(7x - 2y)$, or $\left(\frac{x}{4} + \frac{y}{7}\right)\left(\frac{x}{4} - \frac{y}{7}\right)$

Chapter 3: Review, page 198

1. a) 2, 3, 11; $2 \cdot 3^3 \cdot 11$
b) 2, 3, 5, 7; $2^2 \cdot 3 \cdot 5^2 \cdot 7$
c) 3, 5, 13; $3 \cdot 5^3 \cdot 13$
d) 3, 7, 11, 13; $3^2 \cdot 7 \cdot 11 \cdot 13$

2. a) $2^2 \cdot 5$, or 20 **b)** $5 \cdot 7$, or 35
c) 2^4, or 16 **d)** 2^2, or 4

3. a) $2^2 \cdot 3^2 \cdot 5 \cdot 7$, or 1260
b) $2^3 \cdot 3 \cdot 5 \cdot 13 \cdot 103$, or 160 680
c) $2^3 \cdot 5^3$, or 1000
d) $2^4 \cdot 3^2 \cdot 5 \cdot 17$, or 12 240

4. 61 beads

5. a) $\frac{7}{9}$ **b)** $\frac{11}{17}$
c) $\frac{13}{15}$ **d)** $\frac{247}{576}$
e) $\frac{20}{27}$ **f)** $\frac{23}{160}$

6. a) 28 in. **b)** 32 cm

7. a) 12 cm **b)** 14 ft.

8. a) Perfect square; $\sqrt{256} = 16$

b) Perfect square; $\sqrt{324} = 18$

c) Perfect square and perfect cube; $\sqrt{729} = 27$; $\sqrt[3]{729} = 9$

d) Neither

e) Perfect square; $\sqrt{1936} = 44$

f) Perfect cube; $\sqrt[3]{9261} = 21$

9. 540 ft.

10. 44 cm

11. a) $4m(2 - m)$ **b)** $-3(1 - 3g^2)$

c) $7a^2(4 - a)$ **d)** $3a^2b^2c(2b - 5c)$

e) $-6mn(4m + n)$ **f)** $7b^2(2bc^2 - 3a^3)$

Algebra tiles could be used to factor the binomials in parts a and b

12. a) $3(4 + 2g - g^2)$ **b)** $d(3c^2 - 10c - 2)$

c) $4mn(2n - 3 - 4m)$ **d)** $y(y^2 - 12y + 24)$

e) $10x^2y(3 - 2y + xy)$ **f)** $-4b(2b^2 - 5b + 1)$

13. a) $4x(2x - 3)$ **b)** $3y(y^2 - 4y + 5)$

c) $2b(2b^2 - 1 - 3b)$ **d)** $6m(m^2 - 2 - 4m)$

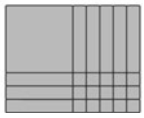
14. a) $5q(3p^2 + 5pq - 7q^2)$ **b)** $-3(4mn - 5m^2 - 6n^2)$

15. a)

b)

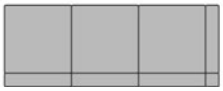
c) Cannot be arranged as a rectangle

d)



16. a) Cannot be arranged as a rectangle

b)



c)

d) Cannot be arranged as a rectangle

17. 6 x-tiles

18. a) $g^2 + g - 20$

	g	-4
g	$(g)(g) = g^2$	$(g)(-4) = -4g$
5	$(5)(g) = 5g$	$(5)(-4) = -20$

b) $h^2 + 14h + 49$

	h	7
h	$(h)(h) = h^2$	$(h)(7) = 7h$
7	$(7)(h) = 7h$	$(7)(7) = 49$

c) $k^2 + 7k - 44$

	k	11
k	$(k)(k) = k^2$	$(k)(11) = 11k$
-4	$(-4)(k) = -4k$	$(-4)(11) = -44$

d) $81 - s^2$

	9	$-s$
9	$(9)(9) = 81$	$(9)(-s) = -9s$
s	$(s)(9) = 9s$	$(s)(-s) = -s^2$

e) $144 - 24t + t^2$

	12	$-t$
12	$(12)(12) = 144$	$(12)(-t) = -12t$
$-t$	$(-t)(12) = -12t$	$(-t)(-t) = t^2$

f) $42 - r - r^2$

	6	$-r$
7	$(7)(6) = 42$	$(7)(-r) = -7r$
r	$(r)(6) = 6r$	$(r)(-r) = -r^2$

g) $y^2 - 14y + 33$

	y	-11
y	$(y)(y) = y^2$	$(y)(-11) = -11y$
-3	$(-3)(y) = -3y$	$(-3)(-11) = 33$

h) $x^2 - 25$

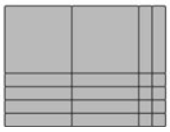
	x	5
x	$(x)(x) = x^2$	$(x)(5) = 5x$
-5	$(-5)(x) = -5x$	$(-5)(5) = -25$

19. a) $(q + 2)(q + 4)$ **b)** $(n + 5)(n - 9)$
c) $(6 - s)(9 - s)$ **d)** $(k + 6)(k - 15)$
e) $(x + 4)(x - 5)$ **f)** $(3 - y)(4 - y)$

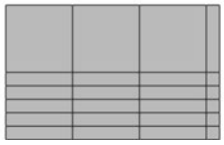
20. a) i) $(m + 3)(m + 4)$ **ii)** $(m + 2)(m + 6)$
iii) $(m + 1)(m + 12)$ **iv)** $(m - 3)(m - 4)$
v) $(m - 2)(m - 6)$ **vi)** $(m - 1)(m - 12)$
b) No

21. a) $(u - 3)(u - 9)$ **b)** $(v + 4)(v - 5)$
c) $(w - 2)(w + 12)$

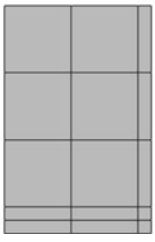
22. a) $2h^2 + 10h + 8$



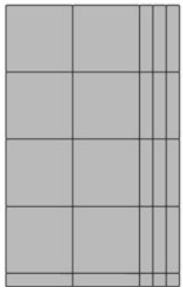
b) $3j^2 + 16j + 5$



c) $6k^2 + 7k + 2$



d) $8m^2 + 14m + 3$



23. a) i) $2x^2 + 5x + 3$

ii)

iii) $(x + 1)(2x + 3)$

b) i) $3x^2 + 10x + 8$

ii)

iii) $(x + 2)(3x + 4)$

24. a) $6r^2 + 31r + 35$

	$3r$	5
$2r$	$(2r)(3r) = 6r^2$	$(2r)(5) = 10r$
7	$(7)(3r) = 21r$	$(7)(5) = 35$

b) $9y^2 - 80y - 9$

	y	-9
$9y$	$(9y)(y) = 9y^2$	$(9y)(-9) = -81y$
1	$(1)(y) = y$	$(1)(-9) = -9$

c) $4a^2 - 26a + 42$

	$2a$	-6
$2a$	$(2a)(2a) = 4a^2$	$(2a)(-6) = -12a$
-7	$(-7)(2a) = -14a$	$(-7)(-6) = 42$

d) $9w^2 - 9w + 2$

	$3w$	-1
$3w$	$(3w)(3w) = 9w^2$	$(3w)(-1) = -3w$
-2	$(-2)(3w) = -6w$	$(-2)(-1) = 2$

e) $16p^2 + 40p + 25$

	$4p$	5
$4p$	$(4p)(4p) = 16p^2$	$(4p)(5) = 20p$
5	$(5)(4p) = 20p$	$(5)(5) = 25$

f) $3y^2 - 2y - 1$

	$-3y$	-1
$-y$	$(-y)(-3y) = 3y^2$	$(-y)(-1) = y$
1	$(1)(-3y) = -3y$	$(1)(-1) = -1$

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

26. a) $(2m - 3)(3m + 7)$
b) $(4n + 1)(3n - 5)$
c) $(4p - 5)(5p + 4)$

27. a) $c^3 + 4c^2 + 5c + 2$
b) $8r^3 - 22r^2 - 9r + 30$
c) $-2j^3 - 5j^2 + 35j + 11$
d) $6x^3 + 5x^2 - 17x - 6$

28. a) $16m^2 - 8mp + p^2$
b) $9g^2 - 24gh + 16h^2$
c) $y^2 - yz - 2z^2 - 2y + 4z$
d) $-18c^2 + 39cd - 20d^2 + 21c - 28d$

29. a) $2m^4 + 7m^3 + 12m^2 + 17m + 10$
b) $5 - 11x - 3x^2 + 11x^3 - 2x^4$
c) $-6k^4 + 25k^3 + 10k^2 - 33k - 18$
d) $3 + 2h - 10h^2 - 3h^3 + 2h^4$

30. a) $22a^2 + 3a + 7$
b) $23c^2 - 10c - 53$

31. a) $n + 2$, $n + 4$
b) $n(n + 2)(n + 4) = n^3 + 6n^2 + 8n$

32. a) $(9 + 2b)(9 - 2b)$
b) $(4v + 7)(4v - 7)$
c) $16(2g + h)(2g - h)$
d) $2(3m + n)(3m - n)$

33. a) $(m - 7)^2$ **b)** $(n + 5)^2$
c) $(2p + 3)^2$ **d)** $(4 - 5q)^2$
e) $(2r + 7)^2$ **f)** $(6 - 11s)^2$

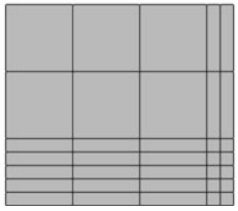
34. a) $(g + 3h)^2$ **b)** $(4j - 3k)^2$
c) $(5t + 2u)^2$ **d)** $(3v - 8w)^2$

35. $3x^2 + 14x + 16$

Chapter 3: Practice Test, page 201

1. A
2. C
3. 900; 5
4. a) i) 20: 5, 20, 45, 80, 125, …
45: 5, 20, 45, 80, 125, …
50: 2, 8, 18, 32, 50, …
ii) 20: 50, 400, 1350, 3200, 6250, …
45: 75, 600, 2025, 4800, 9375, …
50: 20, 160, 540, 1280, 2500, …

5. a) $6c^2 + 19c + 10$



b) $72 + 86r + 24r^2$

	8	$6r$
9	$(9)(8) = 72$	$(9)(6r) = 54r$
$4r$	$(4r)(8) = 32r$	$(4r)(6r) = 24r^2$

c) $12t^2 + 13t - 35$

	$3t$	7
$4t$	$(4t)(3t) = 12t^2$	$(4t)(7) = 28t$
-5	$(-5)(3t) = -15t$	$(-5)(7) = -35$

6. a) $2p^3 + 3p^2 - 16p + 7$
b) $3e^3 + 6e^2f + 2ef^2 + 4f^3 + 5ef + 10f^2$
c) $-7y^2 + 60yz - 16z^2$

7. a) $(f + 1)(f + 16)$
b) $(c - 2)(c - 11)$
c) $(t + 4)(4t - 7)$
d) $(2r + 5s)^2$
e) $(2x - 5y)(3x - y)$
f) $(h + 5j)(h - 5j)$

8. $6r^3 + 11r^2 + 6r + 1$

9. $8t^2 \pm 25t + 3$; $8t^2 \pm 14t + 3$; $8t^2 \pm 11t + 3$; $8t^2 \pm 10t + 3$

Chapter 4 Roots and Powers, page 202

4.1 Math Lab: Estimating Roots, page 206

1. Answers will vary. For example:
a) $\sqrt{25}$, $\sqrt[3]{19}$, $\sqrt[4]{37}$, $\sqrt[5]{3}$
b) For $\sqrt{25}$, the radicand is 25 and the index is 2.
For $\sqrt[3]{19}$, the radicand is 19 and the index is 3.
For $\sqrt[4]{37}$, the radicand is 37 and the index is 4.
For $\sqrt[5]{3}$, the radicand is 3 and the index is 5.
c) The index tells which root to take.

2. a) 6; $36 = (6)(6)$
b) 2; $8 = (2)(2)(2)$
c) 10; $1000 = (10)(10)(10)(10)$
d) -2; $(-2)(-2)(-2)(-2)(-2) = -32$
d) $\frac{3}{5}$; $\left(\frac{3}{5}\right)\left(\frac{3}{5}\right)\left(\frac{3}{5}\right) = \frac{27}{125}$
e) 1.5; $(1.5)(1.5) = 2.25$
f) 0.5; $(0.5)(0.5)(0.5) = 0.125$
g) 5; $(5)(5)(5)(5) = 625$

3. a) 2.8 **b)** 2.1
c) 1.8 **d)** 3.6
e) 2.5 **f)** 2.0
g) 4.4 **h)** 2.7

4. a) The calculator returns an error message; the square of a real number will always be positive.
b) Any non-zero even index
c) i) Any odd index
ii) Any even index

5. a) i) $\sqrt{4}$ **ii)** $\sqrt[3]{8}$
iii) $\sqrt[4]{16}$
b) i) $\sqrt{9}$ **ii)** $\sqrt[3]{27}$
iii) $\sqrt[4]{81}$
c) i) $\sqrt{16}$ **ii)** $\sqrt[3]{64}$
iii) $\sqrt[4]{256}$
d) i) $\sqrt{100}$ **ii)** $\sqrt[3]{1000}$
iii) $\sqrt[4]{10\,000}$
e) i) $\sqrt{0.81}$ **ii)** $\sqrt[3]{0.729}$
iii) $\sqrt[4]{0.6561}$
f) i) $\sqrt{0.04}$ **ii)** $\sqrt[3]{0.008}$
iii) $\sqrt[4]{0.0016}$

6. Answers will vary. For example:
a) $\sqrt[3]{216} = 6$ **b)** $\sqrt[3]{-343} = -7$
c) $\sqrt[4]{\frac{81}{16}} = \frac{3}{2}$ **d)** $\sqrt{17} \doteq 4.1$

4.2 Irrational Numbers, page 211

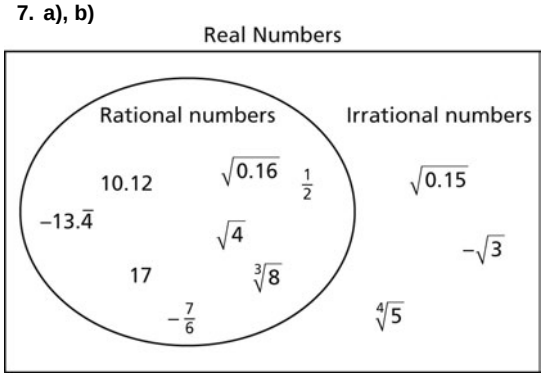
3. a) Irrational
b) Rational
c) Irrational
d) Rational
e) Irrational
f) Rational

4. a) 7, $\sqrt[3]{27}$
b) -5, 7, $\sqrt[3]{27}$
c) $\frac{4}{3}$, $0.3\overline{4}$, -5, -2.1538, $\sqrt[3]{27}$, 7
d) $\sqrt[4]{9}$

5. a) $\sqrt{49} = 7$; $\sqrt[4]{16} = 2$
b) $\sqrt{21}$ and $\sqrt[3]{36}$ cannot be written as a terminating or repeating decimals.

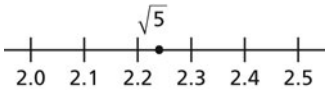
6. a) Rational
b) Irrational

7. a), b)

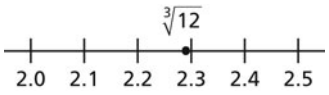


8. The cubes roots of the numbers in parts c and d will be irrational.

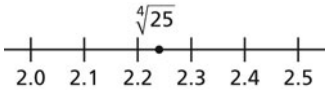
9. a)



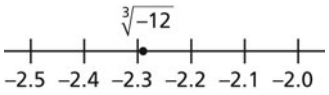
b)



c)



d)



10. a) $\sqrt[3]{400}$, $\sqrt{50}$, $\sqrt[3]{70}$, $\sqrt[4]{100}$

b) $\sqrt{89}$, $\sqrt[3]{150}$, $\sqrt[4]{250}$, $\sqrt[3]{-150}$

11. $\sqrt[3]{98}$, $\sqrt{40}$, $\sqrt[3]{300}$, $\sqrt[3]{500}$, $\sqrt{75}$, $\sqrt{98}$

12. $\frac{-14}{5}$, $\sqrt[3]{-10}$, –2, $\frac{123}{99}$, $\sqrt{4}$;

irrational: $\sqrt[3]{-10}$; rational: $\frac{-14}{5}$, –2, $\frac{123}{99}$, $\sqrt{4}$

13. $\sqrt{5^2+3^2} = \sqrt{34}$, which is an irrational number.

14. a) **i)** True **ii)** True
iii) False **iv)** False
v) True

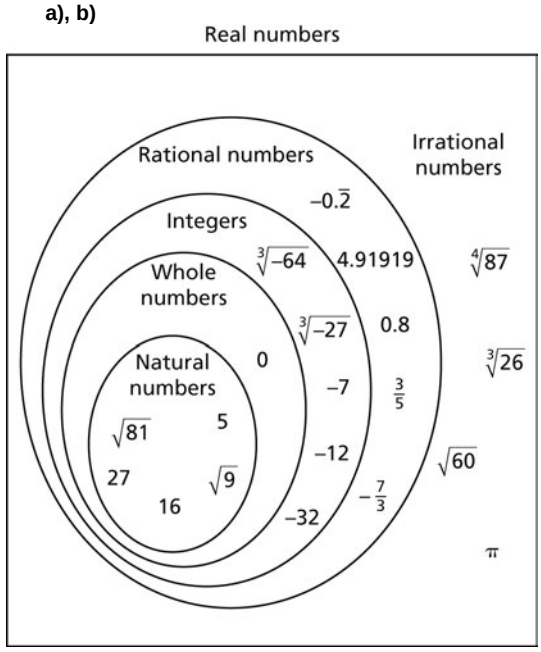
b) **iii)** 0 **iv)** π

15. Answers will vary. For example:

a) **i)** 0.75 **ii)** 0
iii) $\sqrt{7}$

16. Additional numbers may vary. For example:

a), b)

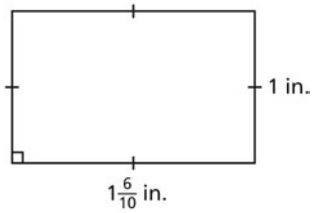


17. Answers may vary. For example:

a) 21 **b)** 125

18. a) 1.6

b)



19. 755:481 is approximately equivalent to 1.6:1, and $\frac{1+\sqrt{5}}{2}$ is approximately 1.6.

20. a) Irrational number

b) Rational number

21. Each prime factor occurs a multiple of *n* times.

22. Triangles will vary. For example:

a) Side lengths: 3 units, 4 units, 5 units

b) Side lengths: 1 unit, $\sqrt{3}$ units, 2 units

c) Side lengths: 1 unit, $\sqrt{2}$ units, $\sqrt{3}$ units

d) Side lengths: $\sqrt{2}$ units, $\sqrt{3}$ units, $\sqrt{5}$ units

23. a) Yes **b)** No

24. Take rational numbers to the 12th power.

4.3 Mixed and Entire Radicals, page 218

3.

Perfect square	Square root
1	1
4	2
9	3
16	4
25	5
36	6
49	7
64	8
81	9
100	10
121	11
144	12
169	13
196	14
225	15
256	16
289	17
324	18
361	18
400	20

4. a) $2\sqrt{2}$ **b)** $2\sqrt{3}$
c) $4\sqrt{2}$ **d)** $5\sqrt{2}$
e) $3\sqrt{2}$ **f)** $3\sqrt{3}$
g) $4\sqrt{3}$ **h)** $5\sqrt{3}$

5. a) $\sqrt{50}$ **b)** $\sqrt{72}$
c) $\sqrt{98}$ **d)** $\sqrt{128}$
e) $\sqrt{75}$ **f)** $\sqrt{108}$
g) $\sqrt{147}$ **h)** $\sqrt{192}$

6. a)

Perfect cube	Cube root
1	1
8	2
27	3
64	4
125	5
216	6
343	7
512	8
729	9
1000	10

b)

Perfect fourth power	Fourth root
1	1
16	2
81	3
256	4
625	5

9. 25 is a perfect square, but neither 10 nor 5 is a perfect square.

10. a) $3\sqrt{10}$ **b)** Cannot be simplified
c) $6\sqrt{3}$ **d)** $10\sqrt{6}$
e) $3\sqrt{6}$ **f)** Cannot be simplified
g) $2\sqrt{7}$ **h)** Cannot be simplified
i) $4\sqrt{7}$

11. a) $2\sqrt[3]{2}$ **b)** $3\sqrt[3]{3}$
c) $4\sqrt[3]{4}$ **d)** $4\sqrt[3]{2}$
e) Cannot be simplified **f)** $4\sqrt[3]{3}$
g) $3\sqrt[3]{5}$ **h)** Cannot be simplified
i) $5\sqrt[3]{4}$ **j)** $5\sqrt[3]{3}$

12. a) $\sqrt{18}$ **b)** $\sqrt{32}$
c) $\sqrt{180}$ **d)** $\sqrt{150}$
e) $\sqrt{343}$ **f)** $\sqrt[3]{16}$
g) $\sqrt[3]{81}$ **h)** $\sqrt[3]{192}$
i) $\sqrt[3]{250}$ **j)** $\sqrt[3]{72}$

13. a) Yes
b) No

14. $6\sqrt{7}$ ft.

15. $2\sqrt[3]{25}$ cm

16. $12\sqrt{6}$ in.

17. a) $2\sqrt[4]{3}$ **b)** $3\sqrt[4]{5}$
c) $5\sqrt[4]{2}$ **d)** $2\sqrt[4]{11}$

18. a) $\sqrt[4]{3888}$ **b)** $\sqrt[4]{4802}$
c) $\sqrt[5]{972}$ **d)** $\sqrt[5]{3072}$

19. a) $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$, $\sqrt{6}$, $\sqrt{7}$, $\sqrt{8}$, $\sqrt{9}$, $\sqrt{10}$, $\sqrt{11}$, $\sqrt{12}$, $\sqrt{13}$, $\sqrt{14}$
b) i) The radicands start at 2 and increase by 1 each time.
ii) $\sqrt{51}$
iii) 30

20. $\sqrt[3]{1024}$

21. $4\sqrt{6}$

22. a) $8\sqrt{3}$, $9\sqrt{2}$, $4\sqrt{5}$, $6\sqrt{2}$, $2\sqrt{6}$
b) $8\sqrt{3}$, $6\sqrt{5}$, $4\sqrt{7}$, $2\sqrt{13}$
c) $9\sqrt{2}$, $3\sqrt{17}$, $5\sqrt{6}$, $7\sqrt{3}$, $\sqrt{103}$

23. a) 2, 20, 200;
$\sqrt{4\,000\,000}$, $\sqrt{400\,000\,000}$
b) 3, 30, 300;
$\sqrt{27\,000\,000\,000}$, $\sqrt{27\,000\,000\,000\,000}$
c) $2\sqrt{2}$, $20\sqrt{2}$, $200\sqrt{2}$;
$\sqrt{8\,000\,000}$, $\sqrt{800\,000\,000}$
d) $2\sqrt[3]{3}$, $20\sqrt[3]{3}$, $200\sqrt[3]{3}$;
$\sqrt[3]{24\,000\,000\,000}$, $\sqrt[3]{24\,000\,000\,000\,000}$

24. $4\sqrt{2}$ cm, 32 cm^2; 4 cm, 16 cm^2

25. a) i) 14.142
ii) 141.42
b) i) 2.8284
ii) 4.2426
iii) 5.6568
iv) 7.071

Chapter 4: Checkpoint 1, page 221

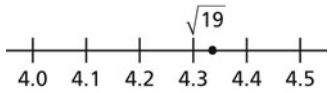
1. a) 9 **b)** –5
c) 4 **d)** 3

2. a) 3.16 **b)** 2.47
c) 1.73 **d)** 1.87

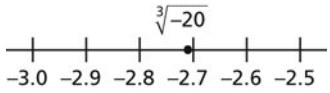
3. Neither

4. a) Irrational **b)** Irrational
c) Irrational **d)** Rational
e) Rational **f)** Irrational

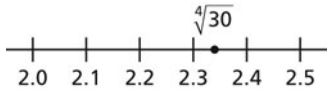
5. a)



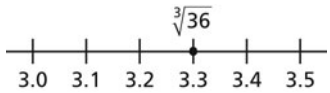
b)



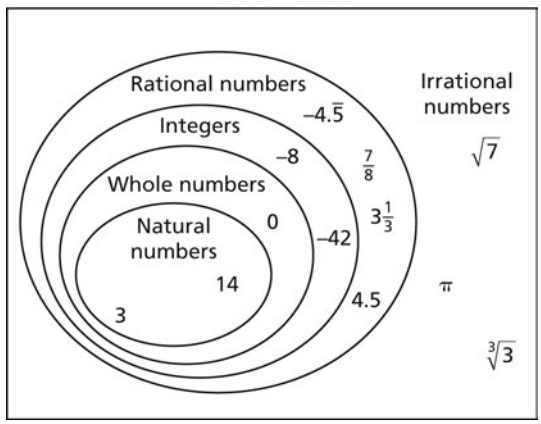
c)



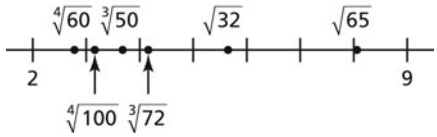
d)



6. a), b) Additional numbers may vary. For example:



7. a)



b) $\sqrt{65}$, $\sqrt{32}$, $\sqrt[3]{72}$, $\sqrt[3]{50}$, $\sqrt[4]{100}$, $\sqrt[4]{60}$

8. Areas of squares may vary. For example:

a)

b)

9. a) $3\sqrt{5}$ **b)** $2\sqrt[3]{12}$

c) Cannot be simplified **d)** $2\sqrt[4]{3}$

e) $2\sqrt[3]{10}$ **f)** Cannot be simplified

11. a) $\sqrt{63}$ **b)** $\sqrt[3]{32}$

c) $\sqrt{147}$ **d)** $\sqrt[4]{192}$

e) $\sqrt[3]{270}$ **f)** $\sqrt{396}$

4.4 Fractional Exponents and Radicals, page 227

3. a) 4 **b)** 6

c) 4 **d)** 2

e) –3 **f)** –10

4. a) 10 **b)** 3

c) 4 **d)** –2

5. a) $\sqrt[3]{36}$ **b)** $\sqrt{48}$

c) $\sqrt[5]{-30}$

6. a) $39^{\frac{1}{2}}$ **b)** $90^{\frac{1}{4}}$

c) $29^{\frac{1}{3}}$ **d)** $100^{\frac{1}{5}}$

7. a) 1 **b)** 2

c) 4 **d)** 8

e) 16 **f)** 32

8. a) $\sqrt[3]{4^2}$, or $\left(\sqrt[3]{4}\right)^2$

b) $\sqrt[5]{(-10)^3}$, or $\left(\sqrt[5]{-10}\right)^3$

c) $\sqrt{2.3^3}$, or $\left(\sqrt{2.3}\right)^3$

9. $\sqrt[3]{350}$ cm, $350^{\frac{1}{3}}$ cm

10. a) $\sqrt[3]{48^2}$, or $\left(\sqrt[3]{48}\right)^2$

b) $\sqrt[3]{(-1.8)^5}$, or $\left(\sqrt[3]{-1.8}\right)^5$

c) $\sqrt{\left(\frac{3}{8}\right)^5}$, or $\left(\sqrt{\frac{3}{8}}\right)^5$

d) $\sqrt[4]{0.75^3}$, or $\left(\sqrt[4]{0.75}\right)^3$

e) $\sqrt[5]{\left(-\frac{5}{9}\right)^2}$, or $\left(\sqrt[5]{-\frac{5}{9}}\right)^2$

f) $\sqrt{1.25^3}$, or $\left(\sqrt{1.25}\right)^3$

11. a) $3.8^{\frac{3}{2}}$, or $3.8^{1.5}$ **b)** $(-1.5)^{\frac{2}{3}}$

c) $\left(\frac{9}{5}\right)^{\frac{5}{4}}$, or $\left(\frac{9}{5}\right)^{1.25}$ **d)** $\left(\frac{3}{8}\right)^{\frac{4}{3}}$

e) $\left(\frac{5}{4}\right)^{\frac{3}{2}}$, or $\left(\frac{5}{4}\right)^{1.5}$ **f)** $(-2.5)^{\frac{3}{5}}$, or $(-2.5)^{0.6}$

12. a) 27 **b)** $\frac{9}{4}$

c) 9 **d)** 0.216

e) 16 **f)** $\frac{8}{125}$

13. a) $4^{\frac{1}{2}}$, $\sqrt{4}$ **b)** $16^{\frac{1}{2}}$, $\sqrt{16}$

c) $100^{\frac{1}{2}}$, $\sqrt{100}$ **d)** $9^{\frac{1}{2}}$, $\sqrt{9}$

e) $25^{\frac{1}{2}}$, $\sqrt{25}$

14. a) $(-1)^{\frac{1}{3}}$, $\sqrt[3]{-1}$ **b)** $8^{\frac{1}{3}}$, $\sqrt[3]{8}$

c) $27^{\frac{1}{3}}$, $\sqrt[3]{27}$ **d)** $(-64)^{\frac{1}{3}}$, $\sqrt[3]{-64}$

e) $64^{\frac{1}{3}}$, $\sqrt[3]{64}$

15. $\left(\frac{1}{4}\right)^{\frac{3}{2}}$, $\sqrt[3]{4}$, $4^{\frac{3}{2}}$, 4^2

16. a) **i)** 64 **ii)** 27

iii) 16 **iv)** 5.9160…

v) 1.331 **vi)** 0.8414…

b) i, ii, iii, v

17. Approximately 76 m

18. 2.744

19. Approximately 1.3 m^2

20. a) Approximately 93%
b) Approximately 81%
c) 5 h

21. Mars; period of Earth: approximately 363.8 Earth days; period of Mars: approximately 688.5 Earth days

22. Karen

4.5 Negative Exponents and Reciprocals, page 233

3. a) $\frac{1}{5^4} = 5^{-4}$ **b)** $\left(-\frac{1}{2}\right)^{-3} = (-2)^3$

c) $\frac{1}{3^{-2}} = 3^2$ **d)** $\frac{1}{4^{-2}} = 4^2$

4. a) 16, $\frac{1}{16}$ **b)** 16, $\frac{1}{16}$

c) 6, $\frac{1}{6}$ **d)** 64, $\frac{1}{64}$

5. $\frac{1}{1024}$

6. a) $\frac{1}{2^3}$

b) $\frac{1}{3^5}$

c) $\frac{1}{(-7)^2}$, or $\frac{1}{7^2}$

7. a) 2^2

b) $\left(\frac{3}{2}\right)^3$

c) $\left(-\frac{5}{6}\right)^4$, or $\left(\frac{5}{6}\right)^4$

8. a) $\frac{1}{9}$ **b)** $\frac{1}{16}$

c) $-\frac{1}{32}$ **d)** 27

e) $\frac{9}{4}$ **f)** 125

9. a) $\frac{1}{2}$ **b)** $\frac{10}{3}$

c) $\frac{1}{3}$ **d)** $-\frac{1}{4}$

e) $\frac{100}{9}$ **f)** $\frac{1}{4}$

g) $\frac{1}{27}$ **h)** 125

10. Answers may vary. For example:
a) 3^{-2}
b) $25^{-\frac{1}{2}}$
c) $\left(\frac{1}{2}\right)^{-2}$
d) $\left(\frac{1}{-27}\right)^{\frac{1}{3}}$

11. \$2651.56

12. $-\frac{3125}{1024}$

13. a) $\frac{1}{81}$ **b)** $\frac{1}{64}$

c) $\frac{1}{4}$ **d)** $\frac{9}{4}$

e) $\frac{8}{27}$ **f)** $\frac{32}{243}$

14. \$1266.57

15. Approximately 19%

16. 5^{-2}; $\frac{1}{25} > \frac{1}{32}$

17. a) The numbers at the left are divided by 2 each time. The exponents in the powers at the right decrease by 1 each time.
b) $2 = 2^1$; $1 = 2^0$; $\frac{1}{2} = 2^{-1}$; $\frac{1}{4} = 2^{-2}$; $\frac{1}{8} = 2^{-3}$

18. 3^8, or 6561 times as great

19. a) The exponent is positive.
b) The exponent is negative.
c) The exponent is 0.

20. No; if the base is between 0 and 1, the power will be greater than 1. For example: $\left(\frac{1}{2}\right)^{-1} = 2$

21. a) Approximately 2.0×10^{20} N
b) Answers may vary depending on researched values. For example: approximately 1.9×10^{20} N

Chapter 4: Checkpoint 2, page 236

1. a) 2 **b)** 7

c) 16 **d)** $\frac{343}{27}$

e) –32

2. a) **i)** $\sqrt[3]{35^2}$, or $\left(\sqrt[3]{35}\right)^2$

ii) $\sqrt{32^3}$, or $\left(\sqrt{32}\right)^3$

iii) $\sqrt[5]{(-32)^2}$, or $\left(\sqrt[5]{-32}\right)^2$

iv) $\sqrt{400^3}$, or $\left(\sqrt{400}\right)^3$

v) $\sqrt[3]{-125}$

vi) $\sqrt[3]{\left(\frac{8}{125}\right)^2}$, or $\left(\sqrt[3]{\frac{8}{125}}\right)^2$

b) iii) 4 **iv)** 8000

v) –5 **vi)** $\frac{4}{25}$

3. a) $4^{\frac{1}{3}}$

b) $9^{\frac{1}{2}}$, or $9^{0.5}$

c) $18^{\frac{1}{4}}$, or $18^{0.25}$

d) $10^{\frac{3}{2}}$, or $10^{1.5}$

e) $(-10)^{\frac{2}{3}}$

4. Approximately 53 s

5. $\sqrt[3]{3}$, $3^{\frac{2}{3}}$, $\left(\sqrt[3]{3}\right)^4$, $3^{\frac{3}{2}}$, $\left(\sqrt{3}\right)^5$

6. $\sqrt[3]{421\,875}$ mm, $421\,875^{\frac{1}{3}}$ mm, 75 mm

7. a) $\frac{81}{16}$ **b)** 4

c) $\frac{1}{100}$ **d)** 2

e) 100 **f)** 625

8. $4589.06

4.6 Applying the Exponent Laws, page 241

3. a) x^7 **b)** $\frac{1}{a^3}$

c) b^2 **d)** $\frac{1}{m}$

4. a) 0.5^5 **b)** 0.5^{-1}

c) 0.5^{-1} **d)** 0.5^5

5. a) x^2 **b)** $\frac{1}{x^3}$

c) n **d)** $\frac{1}{a^4}$

6. a) n^6 **b)** $\frac{1}{z^6}$

c) n^{12} **d)** $\frac{1}{c^4}$

7. a) $\left(\frac{3}{5}\right)^{12}$ **b)** $\left(\frac{3}{5}\right)^{-12}$

c) $\left(\frac{3}{5}\right)^{12}$ **d)** $\left(-\frac{3}{5}\right)^{12}$

8. a) $\frac{a^2}{b^2}$ **b)** $\frac{n^6}{m^3}$

c) $\frac{d^8}{c^8}$ **d)** $\frac{4b^2}{25c^2}$

e) a^2b^2 **f)** n^6m^3

g) $\frac{1}{c^{12}d^8}$ **h)** $\frac{x^3}{y^3}$

9. a) x; product of powers law

b) a^{-5}; product of powers law

c) b^3; product of powers law

d) 1; product of powers law

e) $\frac{1}{x^7}$; quotient of powers law

f) s^{10}; quotient of powers law

g) $\frac{1}{b^5}$; quotient of powers law

h) 1; quotient of powers law

10. a) 2.25 **b)** $\frac{9}{16}$

c) 0.36 **d)** 1

e) $\frac{5}{3}$ **f)** $-\frac{3}{8}$

g) $\frac{1000}{343}$ **h)** $\frac{3}{10}$

11. a) x^3y^6 **b)** $\frac{a^4}{4b^4}$

c) $\frac{1}{64m^6n^9}$ **d)** $\frac{16m^8n^{12}}{81}$

12. 10.6 cm

13. 251 ft.^{2}

14. a) $\frac{a^5}{b}$ **b)** $\frac{d^4}{c^2}$

15. a) –32 **b)** $-\frac{1}{8}$

c) $-\frac{1}{32}$ **d)** $\frac{1}{1024}$

16. a) m^2 **b)** $\frac{1}{x^{\frac{5}{4}}}$

c) $-\frac{3b^{\frac{1}{2}}}{a^6}$ **d)** $-\frac{4c^2b^{\frac{1}{6}}}{a^3}$

17. a) $\frac{x^{\frac{5}{2}}}{y^4}$ **b)** $\frac{b}{25a^4}$

19. a) $\frac{m^8}{n^2}$ **b)** $\frac{r^{\frac{1}{2}}}{s^{\frac{5}{4}}}$

20. a) **i)** Dimensions, in millimetres: $\frac{1000}{2^{\frac{7}{4}}}$ by $\frac{1000}{2^{\frac{5}{4}}}$;

297 mm by 420 mm

ii) Dimensions, in millimetres: $\frac{1000}{2^{\frac{9}{4}}}$ by $\frac{1000}{2^{\frac{7}{4}}}$;

210 mm by 297 mm

iii) Dimensions, in millimetres: $\frac{1000}{2^{\frac{11}{4}}}$ by $\frac{1000}{2^{\frac{9}{4}}}$;

149 mm by 210 mm

b) **i)** Dimensions, in millimetres: $\frac{1000}{2^{\frac{9}{4}}}$ by $\frac{1000}{2^{\frac{7}{4}}}$

ii) Dimensions, in millimetres: $\frac{1000}{2^{\frac{11}{4}}}$ by $\frac{1000}{2^{\frac{9}{4}}}$

iii) Dimensions, in millimetres: $\frac{1000}{2^{\frac{13}{4}}}$ by $\frac{1000}{2^{\frac{11}{4}}}$

c) A piece of A4 paper has the same dimensions as a folded piece of A3 paper; a piece of A5 paper has the same dimensions as a folded piece of A4 paper.

21. a) $\frac{a^{16}c^3}{b^7}$ **b)** $\frac{c^{14}}{64a^2b^{10}}$

22. a) $\frac{1}{a^{\frac{10}{9}}}$ **b)** $\frac{1}{a^{\frac{7}{2}}}$

23. For example:

a) $x^1 \cdot x^{\frac{1}{2}}$, $x^{\frac{3}{4}} \cdot x^{\frac{3}{4}}$, $x^2 \cdot x^{-\frac{1}{2}}$

b) $x^2 \div x^{\frac{1}{2}}$, $x^{\frac{5}{2}} \div x^1$, $x^{-1} \div x^{-\frac{5}{2}}$

c) $\left(x^{\frac{1}{2}}\right)^3$, $\left(x^6\right)^{\frac{1}{4}}$, $\left(x^{-\frac{1}{3}}\right)^{-\frac{9}{2}}$

24. $\frac{1}{2}\left(\frac{3}{2}\right)^{\frac{1}{2}}$ cm, or approximately 0.6 cm

Chapter 4: Review, page 246

1. a) 10 **b)** 0.9

c) 2 **d)** $\frac{3}{5}$

2. The index tells which root to take.

3. a) 3.3 **b)** –2.3

c) 2.0

4. a) 25 **b)** 216

c) 2401

5. Neither

6. a) Rational **b)** Rational

c) Rational **d)** Irrational

e) Rational **f)** Rational

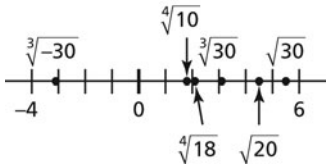
g) Rational **h)** Irrational

i) Irrational

7. Approximately 4.8 cm

8. a) Rational **b)** Irrational

9. $\sqrt[3]{-30}$, $\sqrt[4]{10}$, $\sqrt[4]{18}$, $\sqrt[3]{30}$, $\sqrt{20}$, $\sqrt{30}$



10. 1 s

11. a) $5\sqrt{6}$ **b)** $3\sqrt[3]{5}$

c) $4\sqrt{7}$ **d)** $3\sqrt[4]{2}$

12. a) $\sqrt{180}$ **b)** $\sqrt{126}$

c) $\sqrt[3]{192}$ **d)** $\sqrt[4]{32}$

13. Approximately 1.0 cm

15. $6\sqrt{2}$, $3\sqrt{6}$, $5\sqrt{2}$, $4\sqrt{3}$, $2\sqrt{7}$

17. a) $\sqrt[4]{12}$ **b)** $\sqrt[3]{(-50)^5}$, or $\left(\sqrt[3]{-50}\right)^5$

c) $\sqrt{1.2}$ **d)** $\sqrt[3]{\frac{3}{8}}$

18. a) $1.4^{\frac{1}{2}}$ **b)** $13^{\frac{2}{3}}$

c) $2.5^{\frac{4}{5}}$ **d)** $\left(\frac{2}{5}\right)^{\frac{3}{4}}$

19. a) 2 **b)** 1.2

c) –32 **d)** $\frac{27}{64}$

20. Approximately 35%

21. $\left(\sqrt{5}\right)^3$, $5^{\frac{3}{4}}$, $5^{\frac{2}{3}}$, $\sqrt[3]{5}$, $\sqrt[4]{5}$

22. a) Approximately 7122 Calories/day

b) Approximately 4 Calories/day

23. a) The numbers at the left are divided by 3 each time; the exponents in the powers at the right decrease by 1 each time.

b) $3 = 3^1$; $1 = 3^0$; $\frac{1}{3} = 3^{-1}$; $\frac{1}{9} = 3^{-2}$; $\frac{1}{27} = 3^{-3}$

24. a) $\frac{1}{4}$ **b)** $\frac{27}{8}$

c) $\frac{125}{8}$

25. $908.51

26. 18.0 cm

27. 262 Hz

28. a) $9m^8n^2$ **b)** $\frac{1}{x^4y^6}$

c) $\frac{1}{4ab^3}$ **d)** $\frac{1}{r^{\frac{10}{3}}s^{\frac{2}{3}}}$

29. a) a^2b^5 **b)** $\frac{x^2}{y}$

c) $\frac{1}{a^5}$ **d)** $x^{\frac{3}{2}}y^3$

30. a) $\frac{9}{4}$ **b)** 30.25

c) $\frac{144}{25}$ **d)** 0.4

31. Approximately 6.4 cm

32. a) $s^3t^{\frac{10}{3}}$

b) $\frac{d^9}{64c}$

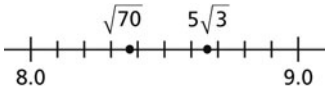
Chapter 4: Practice Test, page 249

1. B

2. A

3. a) $5\sqrt{3}$; $5\sqrt{3} = \sqrt{75}$

b)



4. a) $\frac{4}{3}$ **b)** $\frac{1}{16}$

c) 0.729 **d)** $\frac{1}{4}$

5. $2\sqrt{11}$

6. $\frac{y^5}{x^2}$

7. a) $\frac{1}{p^2q}$ **b)** $\frac{1}{cd^{\frac{1}{3}}}$

8. Approximately 29 L

Cumulative Review Chapters 1–4, page 252

1. 117 m^2

2. 236 $in.^3$

3 a) 5.2 cm **b)** 1 in.

4. 28 ft.

5. 64.2°

6. a) $9\frac{7}{10}$ in. **b)** 4 $in.^2$

7. a) 9; 585

b) 14; 924

c) 3; 3150

d) 2; 4620

8. 8214 $in.^2$

9. a) 1, 4, 9, 16, 25, 36, 49, 64, 81, 100

b) 1, 8, 27, 64, 125, 216, 343, 512, 729, 1000

c) 1, 64, 729

10. a) $3a(5a - 9)$ **b)** $2p(2 + 6p^2 - 3p)$

c) $-2d(4d^3 + 7)$ **d)** $7(3w - 4 + 2w^2)$

e) $2x^2y^2(9x^2 - 2xy + 5y^2)$ **f)** $11np^2(3n^3p + n - 11p^2)$

11. The trinomials that can be represented as a rectangle of algebra tiles can be factored.

a) Can be represented **b)** Cannot be represented

c) Cannot be represented **d)** Can be represented

12. a) $d^2 + 2d - 15$

	d	-3
d	$(d)(d) = d^2$	$(d)(-3) = -3d$
5	$(5)(d) = 5d$	$(5)(-3) = -15$

b) $45 - 14s + s^2$

	9	$-s$
5	$(5)(9) = 45$	$(5)(-s) = -5s$
$-s$	$(-s)(9) = -9s$	$(-s)(-s) = s^2$

c) $-49 + 16g^2$

	7	4g
–7	(–7)(7) = –49	(–7)(4g) = –28g
4g	(4g)(7) = 28g	(4g)(4g) = $16g^2$

d) $6k^2 + 13k - 63$

	2k	9
3k	(3k)(2k) = $6k^2$	(3k)(9) = 27k
–7	(–7)(2k) = –14k	(–7)(9) = –63

13. Answers may vary. For example, one of these:

a) 15, –15, 9, –9

b) 6, 4, 0, –6, –14, –24, –36, …

c) 17, –17, 7, –7, 3, –3

d) 4, 3, 0, –5, –12, –21, –28, …

14. a) $(n + 11)(n - 2)$

b) $(4 - m)(15 - m)$

c) $(2r + 5)(3r + 4)$

d) $(2n + 1)(5n - 2)$

15. a) $3(c - 10)(c + 2)$

b) $-5(h + 7)(h - 3)$

c) $3(8c + 3)(c - 4)$

d) $5(4 - 3a)(5 - 4a)$

e) $4(t - 6)^2$

f) $2(4 + w)(8 - w)$

g) $3(6r - 7s)(6r + 7s)$

h) $-2(5x - 3y)(7x + 2y)$

16. a) $2x^3 + 3x^2 - 19x + 15$

b) $2a^2 - ab - 6a - 10b^2 - 12b$

c) $12 - t - t^2 + 9s - 3st$

d) $2n^4 + 3n^3 - 8n^2 - 7n + 4$

17. a) $5c^2 + 23c - 42$

b) $-2t^2 - 33t + 30$

c) $-4w^2 + 53w + 46$

d) $3d^2 + 12d - 25$

18. a) $(5n + 4)^2$

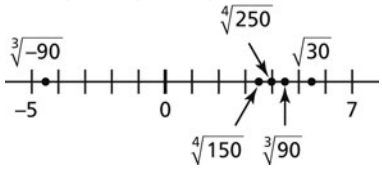
b) $(6v - w)(4v + 3w)$

c) $(9c - 13d)(9c + 13d)$

d) $(3a - 5b)^2$

19. 3.42

20. $\sqrt[3]{-90}$, $\sqrt[4]{150}$, $\sqrt[4]{250}$, $\sqrt[3]{90}$, $\sqrt{30}$



21. a) **i)** $4\sqrt{6}$ **ii)** $3\sqrt[3]{4}$

iii) $2\sqrt[4]{9}$ **iv)** $5\sqrt{17}$

v) $6\sqrt[3]{3}$ **vi)** $2\sqrt[4]{22}$

b) **i)** $\sqrt{75}$ **ii)** $\sqrt[3]{40}$

iii) $\sqrt[4]{29\ 282}$ **iv)** $\sqrt{63}$

v) $\sqrt[3]{2916}$ **vi)** $\sqrt[5]{96}$

22. a) **i)** $\sqrt[4]{50^3}$, or $\left(\sqrt[4]{50}\right)^3$

ii) $\sqrt[3]{(-2.5)^2}$, or $\left(\sqrt[3]{-2.5}\right)^2$

iii) $\sqrt[5]{\left(\frac{3}{4}\right)^8}$, or $\left(\sqrt[5]{\frac{3}{4}}\right)^8$

b) **i)** $8.9^{\frac{2}{3}}$ **ii)** $\left(\frac{7}{4}\right)^{\frac{3}{4}}$

iii) $(-4.8)^{\frac{6}{5}}$

23. a) 27 **b)** $\frac{216}{343}$

c) –0.002 43 **d)** $\frac{81}{16}$

e) $\frac{1}{8}$ **f)** $\frac{512}{125}$

g) 27 **h)** $\frac{25}{4}$, or 6.25

i) $\frac{1331}{343}$

24. $24 895.92

25. a) $\frac{4}{25}$ **b)** 0.25

c) $\frac{5}{3}$ **d)** $-\frac{1}{2}$

26. a) a^3b^2 **b)** $\frac{16x^{24}}{y^8}$

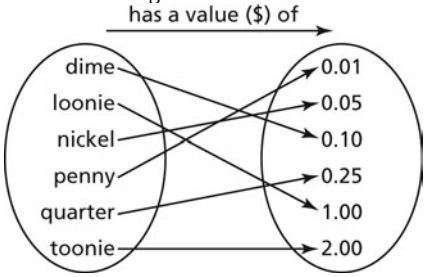
c) $\frac{-3b^{\frac{5}{2}}}{a^{\frac{3}{2}}}$ **d)** $\frac{-5z}{x^2y^3}$

Chapter 5 Relations and Functions, page 254

5.1 Representing Relations, page 262

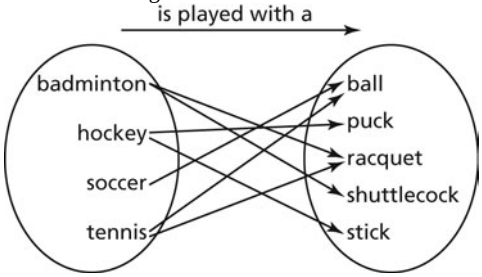
3. a) i) The relation shows the association "has a value, in dollars, of" from a set of coins to a set of numbers.

ii) As a set of ordered pairs:
{(penny, 0.01), (nickel, 0.05), (dime, 0.10), (quarter, 0.25), (loonie, 1.00), (toonie, 2.00)}
As an arrow diagram:



b) i) The relation shows the association "is played with a" from a set of sports to a set of equipment.

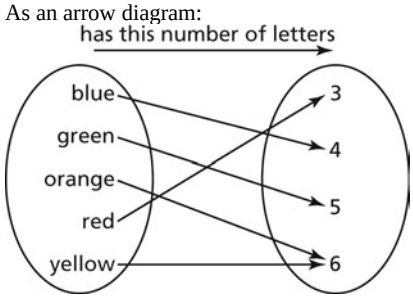
ii) As a set of ordered pairs:
{(badminton, racquet), (badminton, shuttlecock), (hockey, puck), (hockey, stick), (tennis, ball), (tennis, racquet), (soccer, ball)}
As an arrow diagram:



4. a) As a table:

Word	Number of Letters
blue	4
green	5
orange	6
red	3
yellow	6

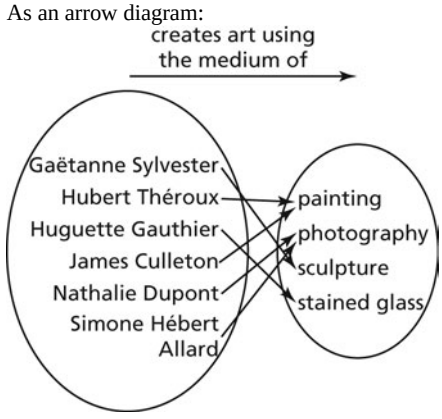
b) As an arrow diagram:



5. a) The relation shows the association "creates art using the medium of" from a set of francophone artists from Manitoba to a set of artistic mediums.

b) i) As a set of ordered pairs:
{(Gaëtanne Sylvester, sculpture),
(Hubert Théroux, painting),
(Huguette Gauthier, stained glass),
(James Culleton, painting),
(Nathalie Dupont, photography),
(Simone Hébert Allard, photography)}

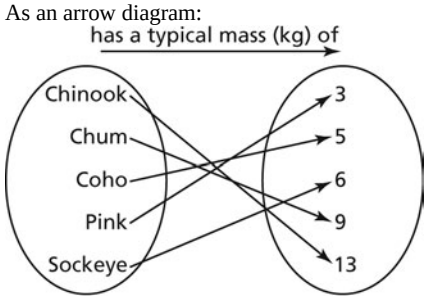
ii) As an arrow diagram:



6. a) The relation shows the association "has a typical mass, in kilograms, of" from a set of salmon species to a set of masses.

b) As a set of ordered pairs:
{(Chinook, 13), (Chum, 9), (Coho, 5), (Pink, 3), (Sockeye, 6)}

c) As an arrow diagram:

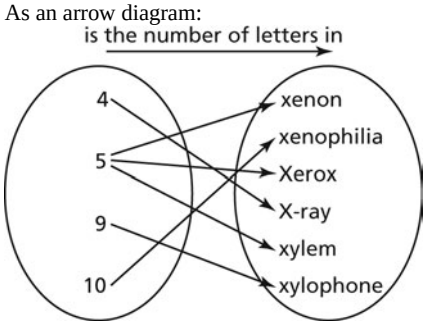


7. a) The arrow diagram shows a relation with the association "is the number of letters in" from a set of numbers to a set of words beginning with the letter Z.

b) As a set of ordered pairs:
{(3, Zen), (4, zany), (4, zero), (5, zebra), (6, zombie), (7, Zamboni), (8, zeppelin)}
As a table:

Number	Word beginning with Z
3	Zen
4	zany
4	zero
5	zebra
6	zombie
7	Zamboni
8	zeppelin

c) Chosen words and representations may vary. For example:
As an arrow diagram:



As a set of ordered pairs:
{(4, X-ray), (5, xenon), (5, Xerox), (5, xylem), (9, xylophone), (10, xenophilia)}
As a table:

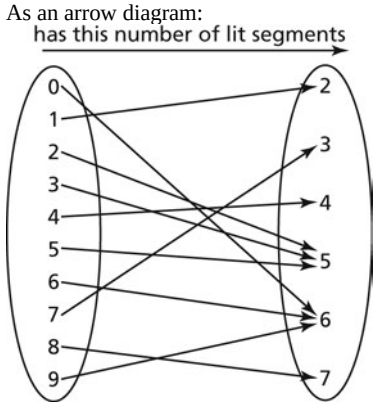
Number	Word beginning with X
4	X-ray
5	xenon
5	Xerox
5	xylem
9	xylophone
10	xenophilia

8. a) The diagram shows a relation with the association "translates to" from the set of French words to the set of English words.

b) Answers may vary. For example: Two ordered pairs that satisfy the relation are: (oui, yes) and (et, and)

9. a) {(0, 6), (1, 2), (2, 5), (3, 5), (4, 4), (5, 5), (6, 6), (7, 3), (8, 7), (9, 6)} Some digital clocks may show the number 9 with 5 line segments.

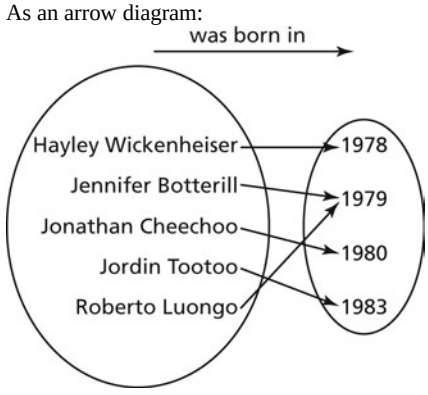
b) Representations may vary. For example:
As an arrow diagram:



As a table of values:

Digit	Number of lit segments
0	6
1	2
2	5
3	5
4	4
5	5
6	6
7	3
8	7
9	6

10. a) As an arrow diagram:

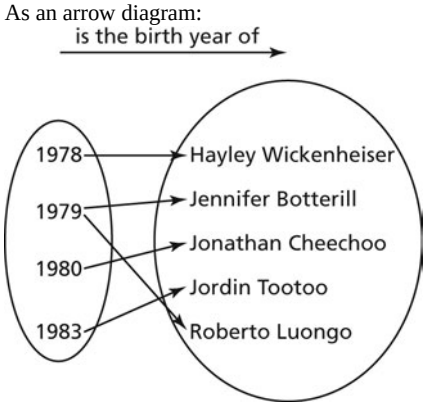


As a set of ordered pairs:
{(Hayley Wickenheiser, 1978),
(Jennifer Botterill, 1979),
(Jonathan Cheechoo, 1980),
(Jordin Tootoo, 1983),
(Roberto Luongo, 1979)}

As a table:

Hockey Player	Birth Year
Hayley Wickenheiser	1978
Jennifer Botterill	1979
Jonathan Cheechoo	1980
Jordin Tootoo	1983
Roberto Luongo	1979

b) As an arrow diagram:



As a set of ordered pairs:
{(1978, Hayley Wickenheiser),
(1979, Jennifer Botterill),
(1979, Roberto Luongo),
(1980, Jonathan Cheechoo),
(1983, Jordin Tootoo)}

As a table:

Birth Year	Hockey Player
1978	Hayley Wickenheiser
1979	Jennifer Botterill
1979	Roberto Luongo
1980	Jonathan Cheechoo
1983	Jordin Tootoo

11. Answers may vary. For example:

a) Ordered pairs should be in the form: (older person, younger person)

b) Other associations include: "is taller than" "is involved in more school groups than" "usually wakes up earlier than"

12. a) i) {(1, 1), (1, 3), (1, 5), (2, 2), (2, 4), (2, 6), (3, 1), (3, 3), (3, 5), (4, 2), (4, 4), (4, 6), (5, 1), (5, 3), (5, 5), (6, 2), (6, 4), (6, 6)}

ii) {(1, 3), (1, 4), (1, 6), (2, 4), (2, 5), (3, 1), (3, 5), (3, 6), (4, 1), (4, 2), (4, 6), (5, 2), (5, 3), (6, 1), (6, 3), (6, 4)}

b) No

13. a) 6 children **b)** 4 parents
c) 2 grandparents

14. a) 2 females **b)** 3 males

5.2 Properties of Functions, page 270

4. a) Function
b) Not a function
c) Function

5. a) Function; domain: {1, 2, 3, 4}; range: {3, 6, 9, 12}
b) Not a function; domain: {–1, 0, 1}; range: {–1, 0, 1}
c) Function; domain: {2, 4, 6, 8}; range: {3, 5, 7, 9}
d) Not a function; domain: {0, 1, 2}; range: {1, 2, 3}

6. a) $C(n) = 20n + 8$ **b)** $P(n) = n - 3$
c) $t(d) = 5d$ **d)** $f(x) = -x$

7. a) $d = 3t - 5$ **b)** $y = -6x + 4$
c) $C = 5n$ **d)** $P = 2n - 7$

8. a) Function; domain: {1, 2, 3, 4}; range: {1, 8, 27, 64}
b) Not a function; domain: {3}; range: {4, 5, 6, 7}

9. a) i) Function
ii) Dependent variable: C; independent variable: n
iii) Domain: {1, 2, 3, 4, 5, 6, …};
range: {2.39, 4.00, 6.39, 8.00, 10.39, 12.00, …}

b) i) Function
ii) Dependent variable: T; independent variable: A
iii) Domain: {610, 1220, 1830, 2440, 3050, 3660, …};
range: {15.0, 11.1, 7.1, 3.1, –0.8, –4.8, …}

10. a) Not a function **b)** Function
c) Part a: domain: {3, 4, 5, 6}; range: { equilateral triangle, hexagon, isosceles triangle, parallelogram, pentagon, rectangle, rhombus, right triangle, scalene triangle, square, trapezoid}
Part b: domain: {equilateral triangle, hexagon, isosceles triangle, parallelogram, pentagon, rectangle, rhombus, right triangle, scalene triangle, square, trapezoid}; range: {3, 4, 5, 6}

11. Answers may vary. For example:

a) Functions:

Name	From
Marie	Edmonton
Gabriel	Falher
Élise	Bonnyville
Christophe	Calgary
Jean	Edmonton
Mélanie	Edmonton
Nicole	Red Deer
Marc	Légal

Name	Age
Marie	13
Gabriel	16
Élise	14
Christophe	13
Jean	15
Mélanie	15
Nicole	17
Marc	13

b) Not functions:

Age	Name
13	Marie
16	Gabriel
14	Élise
13	Christophe
15	Jean
15	Mélanie
17	Nicole
13	Marc

From	Age
Edmonton	13
Falher	16
Bonnyville	14
Calgary	13
Edmonton	15
Edmonton	15
Red Deer	17
Légal	13

12. The statement in part a is true.

13. a)

Letter	Number
A	1
D	2
F	4
G	2
M	3
Q	10
T	1
X	8
Z	10

Number	Letter
1	A
1	T
2	D
2	G
3	M
4	F
8	X
10	Q
10	Z

b) The first table represents a function.

14. a) $f(1) = 6$

b) $f(-3) = 26$

c) $f(0) = 11$

d) $f(1.2) = 5$

15. a) i) $n = 9$

ii) $n = \frac{1}{2}$, or 0.5

b) i) $x = -8$

ii) $x = \frac{17}{5}$, or 3.4

16. a) $C = 2.54i$

b) $C(12) = 30.48$; a length of 12 in. is equal to a length of 30.48 cm.

c) $i = 39.3700\ldots$; a length of 100 cm is approximately equal to a length of 39 in.

17. a) $D(t) = -80t + 300$

b) 300 km

18. a) i) $f(15) = 112.785$; a female whose humerus is 15 cm long will be approximately 113 cm tall.

ii) $m(20) = 128.521$; a male whose humerus is 20 cm long will be approximately 129 cm tall.

b) i) $l = 25.6082\ldots$; a female who is 142 cm tall will have a humerus length of approximately 26 cm.

ii) $l = 42.6257\ldots$; a male who is 194 cm tall will have a humerus length of approximately 43 cm.

19. a) i) $C(50) = 10$

ii) $C(-13) = -25$

b) i) $f = 68$

ii) $f = -31$

c) i) $C(32) = 0$

ii) $C(212) = 100$

iii) $C(356) = 180$

20. Variables may differ. Let c represent a temperature in degrees Celsius. Let F represent the same temperature in degrees Fahrenheit. $F(c) = \frac{9}{5}c + 32$

21. $P(l) = 2l + \frac{18}{l}$

22. $l(w) = 6 - w$; domain: $0 < w < 6$; range: $0 < l < 6$

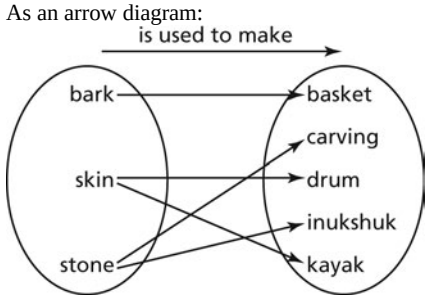
23. $t(s) = 11 - 2s$; domain: $1.5 < s < 3$; range: $5 < t < 8$

Chapter 5: Checkpoint 1, page 275

1. a) In words:

This relation shows the association "is used to make" from a set of materials to a set of objects.

As an arrow diagram:



As a table:

Material	Object
bark	basket
skin	drum
skin	kayak
stone	carving
stone	inukshuk

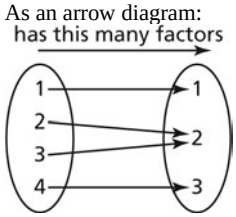
b) In words:

This relation shows the association "has this many factors" from the natural numbers from 1 to 4 to a set of natural numbers.

As a set of ordered pairs:

{(1, 1), (2, 2), (3, 2), (4, 3)}

As an arrow diagram:



c) In words:

This relation shows the association "is usually coloured" from a set of objects to a set of colours.

As a set of ordered pairs:

{(grass, green), (sea, blue), (sky, blue), (snow, white)}

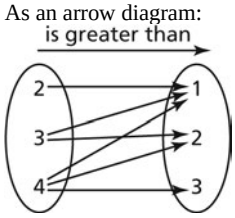
As a table:

Object	Colour
grass	green
sea	blue
sky	blue
snow	white

d) As a set of ordered pairs:

{(2, 1), (3, 1), (3, 2), (4, 1), (4, 2), (4, 3)}

As an arrow diagram:



As a table:

Number	Number
2	1
3	1
3	2
4	1
4	2
4	3

2. a) The relations in parts b and c are functions.

b) Part b: domain: {1, 2, 3, 4}; range: {1, 2, 3}

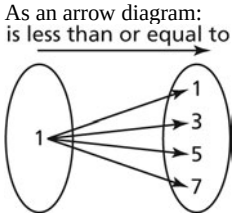
Part c: domain: {grass, sea, sky, snow}; range: {blue, green, white}

3. Answers may vary. For example:

a) i) {(1, 1), (1, 3), (1, 5), (1, 7)}

ii) {(1, 1), (3, 3), (5, 5), (7, 7)}

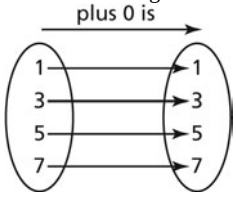
b) i) As an arrow diagram:



As a table of values:

Number	Number
1	1
1	3
1	5
1	7

ii) As an arrow diagram:



As a table of values:

Number	Number
1	1
3	3
5	5
7	7

4. a) Dependent variable: T; independent variable: d

b) $T = 10d + 20$

c) $T(5) = 70$; At a depth of 5 km below Earth's surface, the temperature is 70°C.

d) $d = 3$; A temperature of 50°C occurs at a depth of 3 km below Earth's surface.

5.3 Interpreting and Sketching Graphs, page 281

3. a) Bear F; approximately 650 kg

b) Bear A; approximately 0.7 m

c) Bears D and E; 400 kg

d) Bears D and H; approximately 2.25 m

4. a) 8 m; 06:00 and 18:00

b) 2 m; 00:00 (midnight), 12:00 (noon), and 24:00 (midnight)

c) Approximately 6.5 m

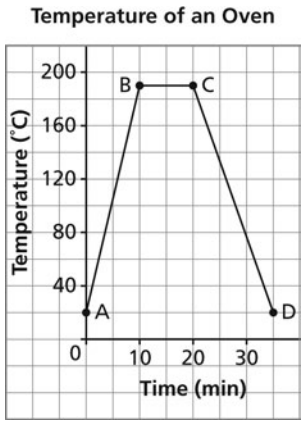
d) At approximately 02:20, 09:40, 14:20, and 21:40

5. Graph B

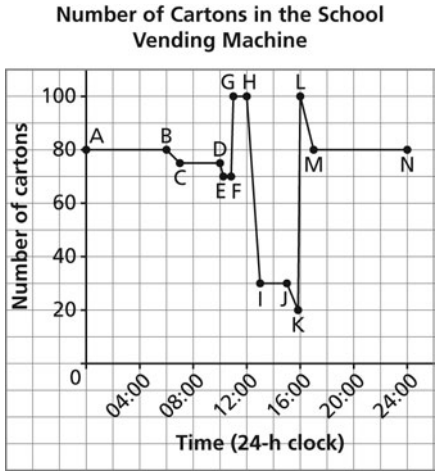
8. **a)** True **b)** False
c) True **d)** False
e) False

9. **b)** 25 L; no

10.



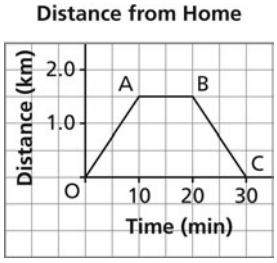
12.



13. From 3 min to 4 min, the volume should be below 40 because Jonah turns the volume down.
At 9 min, the graph should be a vertical line from 80 to 0 because the mute button immediately silences the television.

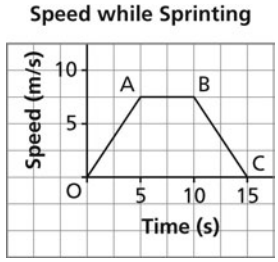
14. Answers may vary. For example:

a)



Situation: A person walks from home to a park 1.5 km away in 10 min. He sits on a park bench and reads for 10 min. Then he walks home.

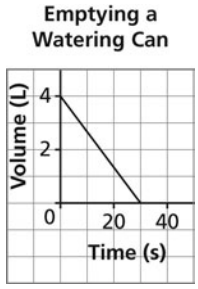
b)



Situation: A person sprints down a street starting from a standstill. It takes the person 5 s to reach a speed of 7.5 m/s. After 5 s of running at 7.5 m/s, the person slows down and stops in 5 s.

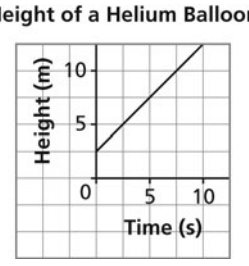
15. Answers may vary. For example:

a)



Situation: A watering can contains 4 L of water. The water is poured at a steady rate so the watering can is empty after 30 s.

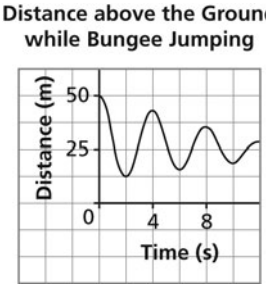
b)



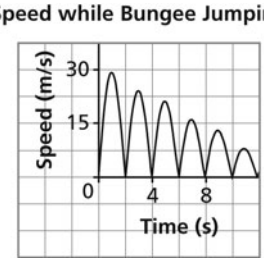
Situation: A person lets go of a helium balloon. The balloon starts at a height of 2.5 m above the ground. After 10 s, it is at a height of 15 m above the ground.

16. Answers may vary. For example:

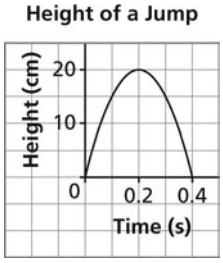
a) **i)**



ii)



17. a)

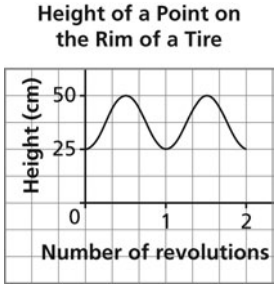


Situation: The height of a grasshopper during one hop. It takes 0.2 s for a grasshopper to jump 20 cm high, and another 0.2 s for it to return to the ground.

b)

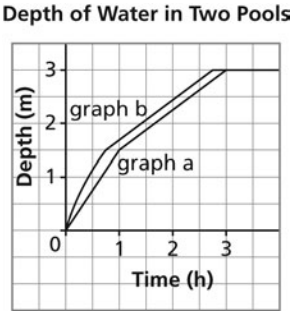
Situation: The cost of parking in a parking garage. It costs $1 to park for up to 30 min, $2 to park from 30 min to 60 min, and $3 to park from 60 min to 90 min.

c)



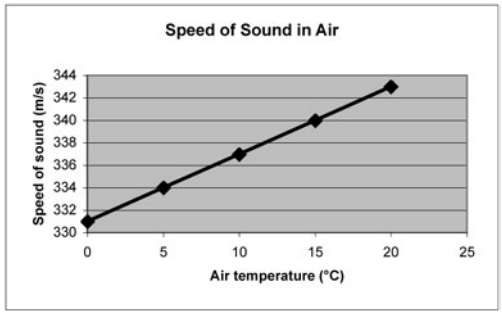
Situation: The height of a point on the rim of a tire on a truck over time. The point starts at the lowest point on the rim, 25 cm above the ground.
As the wheel goes around, the point moves up to a maximum height of 50 cm, then down, then up again.

18.



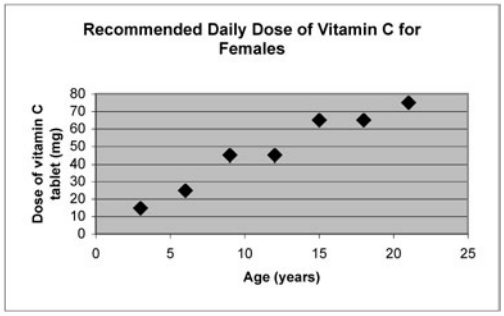
5.4 Math Lab: Graphing Data, page 286

1. a) i) The points are joined because air temperature and speed can have any numerical value between those indicated by the points on the graph.



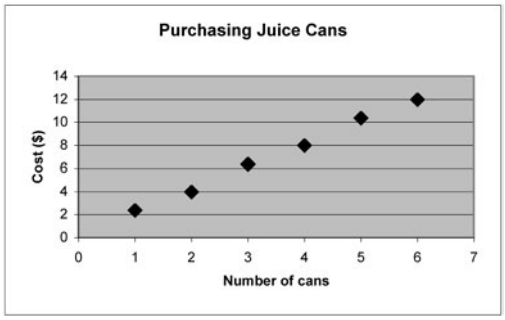
ii) Yes

b) i) The points are not joined because the data are only valid for whole numbers of years.



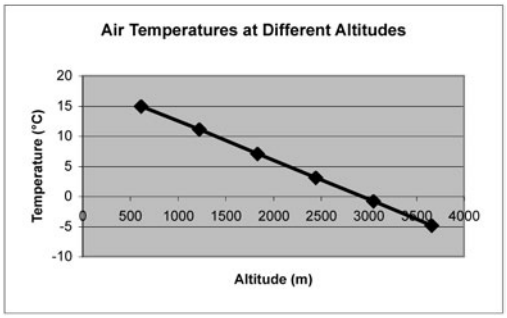
ii) Yes

2. a) The points are not joined because only whole numbers are permissible for the number of juice cans purchased.



The relation is a function because there is only one cost for each number of cans.

b) The points are joined because all values of altitude and temperature are permissible between those plotted.



The relation is a function because there is only one value of temperature for each altitude.

5.5 Graphs of Relations and Functions, page 294

4. a) Domain: {–2, –1, 0, 1, 2}; range: {–4, –2, 0, 2, 4}

b) Domain: {–3, –1, 0, 2, 3}; range: {–2, 0, 1, 2, 3}

c) Domain: {–3, –2, –1, 0, 1, 2, 3}; range: {2}

5. A vertical line drawn on each graph intersects the graph at 0 points or 1 point.

6. a) Yes; each point on the line has a different x-coordinate.

b) No; each point on the line has the same x-coordinate, 1.

7. a) iv **b)** i

c) ii **d)** iii

8. a) Function; domain: all real numbers; range: $1 \le y \le 3$

b) Not a function; domain: $-3 \le x \le 1$; range: $y \ge -1$

c) Not a function; domain: {1, 2, 3, 4, 5}; range: {2, 3, 4, 5}

d) Function; domain: $x \ge -2$; range: $2 \le y \le 4$

e) Not a function; domain: $x \le 2$; range: $1 \le y \le 5$

9. a) Domain: all real numbers; range: $y \ge 1$

b) Domain: $-3 \le x \le 3$; range: $0 \le y \le 3$

c) Domain: $-3 \le x \le 3$; range: $-3 \le y \le 0$

d) Domain: $-1 \le x \le 2$; range: $0 \le y \le 3$

10. a) The points on the graph should not be connected.

b) The points on the graph should be connected.

c) The points on the graph should be connected.

d) The points on the graph should be connected.

11. a) i) The distance of a school bus from the school from 8:00 to 9:00.

ii) The number of students on a school bus from 8:00 to 9:00.

b) i) Independent variable: time; dependent variable: distance from the school

ii) Independent variable: time; dependent variable: number of students

c) Graph A: points are connected because all values of time and distance are permissible between the indicated plotted points.
Graph B: points are not connected because it is impossible to have only part of a student on a bus.

12. a) The points on the graph are connected because the car's speed and skid length can be any positive number of kilometres per hour and metres, respectively, between the plotted points.

b) Exact numbers for the range may vary. For example: domain: $40 \le s \le 120$; range: $16 \le d \le 144$
Restrictions: the domain and range cannot contain negative numbers because it is impossible to have a negative skid distance or a negative speed.
The domain is also restricted because the relationship shown on the graph may not be true for speeds less than 40 km/h and greater than 120 km/h.

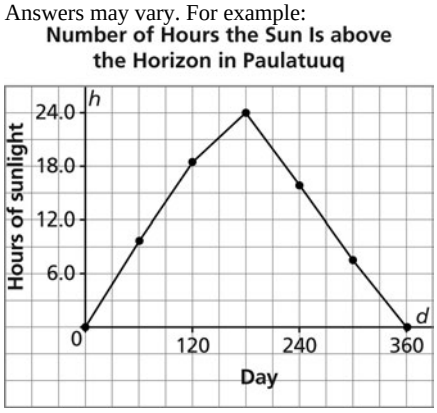
13. a) Independent variable: t; dependent variable: n

b) The points are not connected because it is impossible to have part of a car in a parking lot.

c) Exact numbers for the range may vary. For example: domain: {8:00, 10:00, 12:00, 14:00, 16:00}; range: {4, 25, 31, 64, 65}
Restrictions: the domain can be any time between 00:00 and 24:00, all the possible times in one day. The range can be any whole number up to the number of parking spaces in the lot.

14. a) Independent variable: number of days after January 1; dependent variable: number of hours the sun is above the horizon, h

b) Answers may vary. For example:



I connected the points because the relationship shown on the graph is true for days represented by points between the ones plotted.

The data are discrete, but the scale is so small that if all the points were plotted, they would make a line segment.

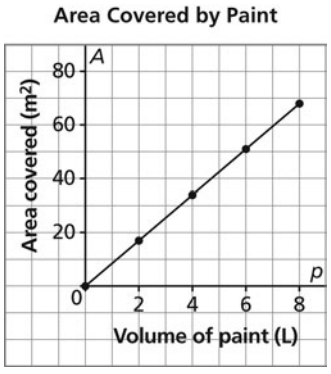
c) From the table: the relation is a function because each number in the first column is different.

From the graph: the relation is a function because a vertical line drawn on the graph would intersect the graph in only 1 point.

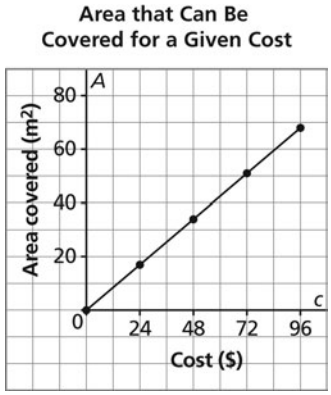
15. a)

Volume of Paint, *p* (L)	0	2	4	6	8
Cost, *c* ($)	0	24	48	72	96
Area Covered, *A* (m^2)	0	17	34	51	68

b)



c)



d) Part b: domain: $0 \le p \le 8$; range: $0 \le A \le 68$

Part c: domain: $0 \le c \le 96$; range: $0 \le A \le 68$

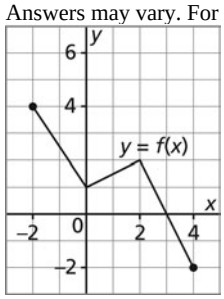
16. a) –1

b) 3

17. a) 5

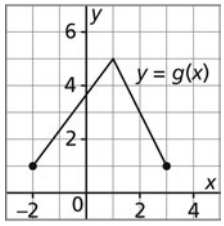
b) 3

18. Answers may vary. For example:

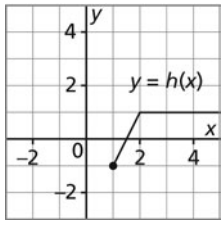


Domain: $-2 \le x \le 4$; range: $-2 \le y \le 4$

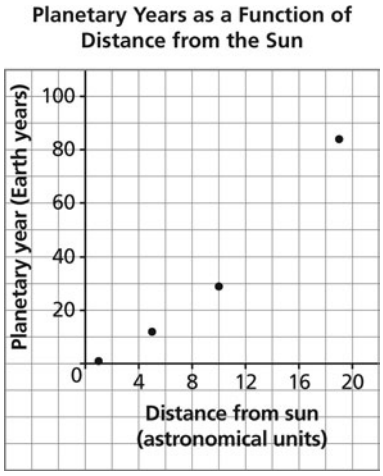
19. a)



b)



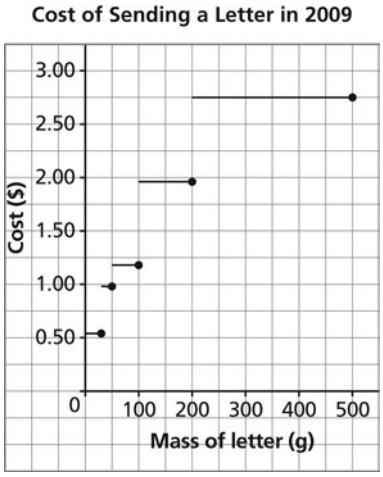
20. a)



The points are not joined because each point represents a planet and their number is limited.

b) Domain: {1, 5, 10, 19}; range: {1, 12, 29, 84}

21. a)



b) Domain: all real numbers greater than 0 and less than or equal to 500; range: {0.54, 0.98, 1.18, 1.96, 2.75}

22. Yes

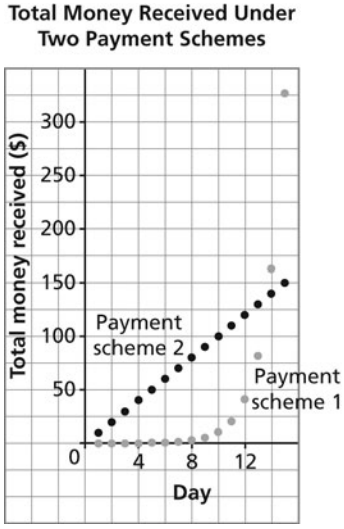
23. The statement is false.

24. a)

Payment Scheme 1	
Day	**Total money received ($)**
1	0.01
2	0.03
3	0.07
4	0.15
5	0.31
6	0.63
7	1.27
8	2.55
9	5.11
10	10.23
11	20.47
12	40.95
13	81.91
14	163.83
15	327.67

Payment Scheme 2	
Day	**Total money received ($)**
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100
11	110
12	120
13	130
14	140
15	150

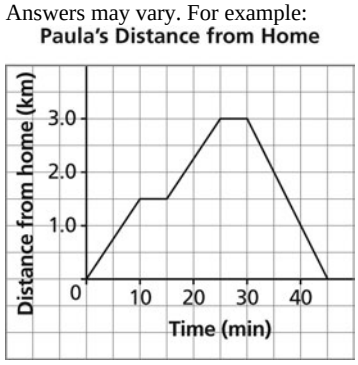
b)



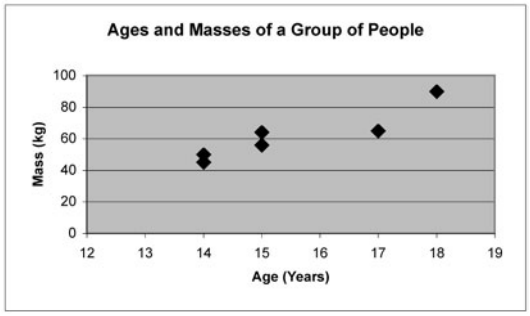
c) I would choose Payment Scheme 1 because after 13 days, the money received is greater and increases at a faster rate.

Chapter 5: Checkpoint 2, page 299

1. Answers may vary. For example:



2. a)



b) No

c) Domain: {14, 15, 17, 18};
range: {45, 50, 56, 64, 65, 90}

3. a) Not a function; domain: $0 \le x \le 2$; range: $1 \le y \le 5$

b) Function; domain: $x \ge -3$; range: $y \ge 0$

c) Function; domain: $-2 \le x \le 2$; range: $-8 \le y \le 8$

5.6 Properties of Linear Relations, page 308

3. a) Linear relation **b)** Not a linear relation

c) Linear relation **d)** Not a linear relation

4. a) Linear relation **b)** Not a linear relation

c) Not a linear relation

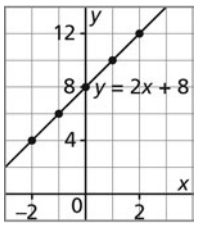
5. a) Linear relation **b)** Linear relation

c) Not a linear relation **d)** Not a linear relation

6. a) Tables of values may vary. For example:

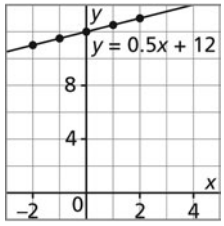
i)

x	y
–2	4
–1	6
0	8
1	10
2	12



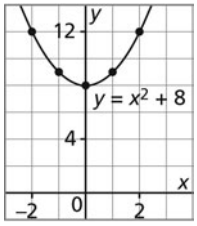
ii)

x	y
–2	11
–1	11.5
0	12
1	12.5
2	13



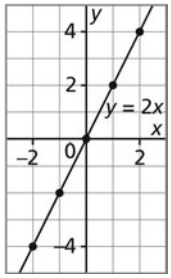
iii)

x	y
–2	12
–1	9
0	8
1	9
2	12

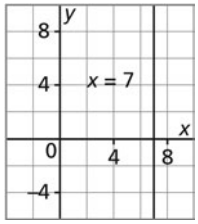


iv)

x	y
–2	–4
–1	–2
0	0
1	2
2	4

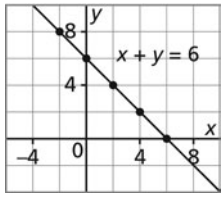


v)



vi)

x	y
–2	8
0	6
2	4
4	2
6	0



b) The relations in part a, i, ii, iv, v, and vi are straight lines, so they are linear relations.

7. a) **i)** Independent variable: s; dependent variable: d

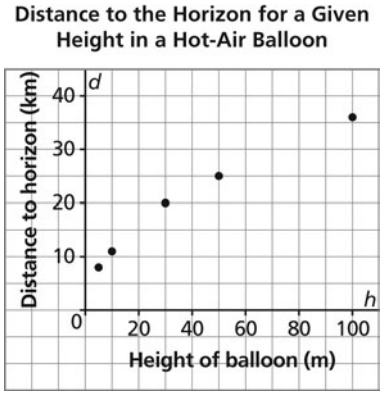
ii) Not linear

b) **i)** Independent variable: t; dependent variable: a

ii) Linear

iii) –200 m/min

8. a)



b) The relation is not linear because the points on the graph do not lie on a straight line.

9. Answers may vary. For example:
I could examine the change in the first and second coordinates. If both changes are constant, the relation is linear.
I could also graph the ordered pairs. If the points lie on a straight line, the relation is linear.

10. Yes

11. The first set of ordered pairs does not represent a linear relation. The second set of ordered pairs represents a linear relation.

12. a) Answers may vary. For example: The equation relates the dependent variable, C, to the rate of change, 15, times the independent variable, n, plus a constant, 550.

b) 15; cost per guest

13. Answers may vary. For example:
Create a table of values for the relation. Then, either check the differences in the numbers in each column or plot the points. If the differences are constant or the points lie along a line, the relation is linear. Otherwise, it is not linear.

14. a) Independent variable: t; dependent variable: C

b) \$0.08/min; every minute, the cost of the phone call increases by \$0.08.

15. –\$0.80/booth; at every toll booth, Kashala pays \$0.80.

16. a) Equation 3 and Set B

b) Equation 1 and Set C

c) Equation 2 and Set A

17. a) i) Linear **ii)** Not linear
iii) Linear **iv)** Linear
v) Not linear

b) i) Independent variable: time since the hang glider started her descent; dependent variable: hang glider's altitude; rate of change: –50 m/min; every minute, the hang glider's altitude decreases by 50 m.

iii) Independent variable: distance travelled; dependent variable: taxi fee; rate of change: \$2/km; every kilometre, the fee increases by \$2.

iv) Independent variable: number of yearbooks to be printed; dependent variable: fee; rate of change: \$5/yearbook; for every yearbook to be printed, the fee increases by \$5.

18. a) Linear

b) Not linear

c) Not linear

d) Linear

e) Not linear

19. a) The equation $V = 24\,000 - 2000n$ is linear.
The equation $V = 24\,000(0.2^n)$ is not linear.

b) –\$2000/year; every year, the value of the truck depreciates by \$2000

20. Yes; the relation is linear.

21. No; the relation is not linear.

22. a) True

b) True

c) False

d) True

e) False

5.7 Interpreting Graphs of Linear Functions, page 319

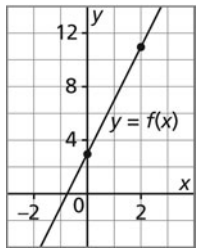
4. a) i) Vertical intercept: 0; horizontal intercept: 0; (0, 0); (0, 0)
ii) 40 km/h
iii) Domain: $0 \le t \le 3$; range: $0 \le d \le 120$

b) i) Vertical intercept: 100; horizontal intercept: 4; (0, 100); (4, 0)
ii) –25 km/h
iii) Domain: $0 \le t \le 4$; range: $0 \le d \le 100$

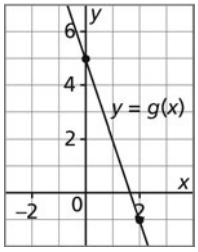
5. a) i) 400; (0, 400)
ii) 100 ft./min
iii) Domain: $0 \le t \le 8$; range: $400 \le A \le 1200$

b) i) 1000; (0, 1000)
ii) –50 ft./min
iii) Domain: $0 \le t \le 8$; range: $600 \le A \le 1000$

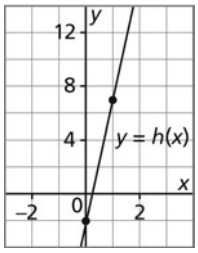
6. a)



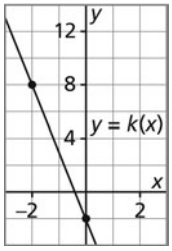
b)



c)



d)



7. a) 9 m^2/L; every litre of paint covers an area of 9 m^2.

b) 54 m^2

c) 5 L

8. a) ii

b) iii

9. a) Vertical intercept: 0; horizontal intercept: 0; (0, 0); the cost of running the backhoe for 0 h is $0.

b) $80/h; each hour that the backhoe is run increases the cost by $80.

c) Domain: $0 \le t \le 10$; range: $0 \le C \le 800$

d) $560

e) 4.5 h

10. a) $1.50/km; every kilometre driven costs an additional $1.50.

b) $14

c) 4 km

11. Estimates may vary. Smart car: approximately 0.06 L/km; SUV: approximately 0.128 L/km; the Smart car uses less fuel per kilometre.

12. a) 2.5 h, or 2 h 30 min

b) 24 km/h

c) 60 km

d) $1\frac{2}{3}$ h, or 1 h 40 min

13. a) It takes longer to fill the empty tank.

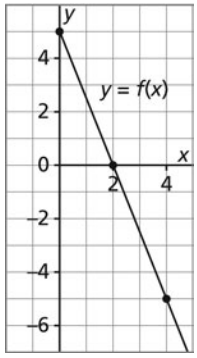
b) 25 m^3 of fuel

14. a) Answers may vary. For example:
The scale on the axes is so small that it would be impossible to distinguish every point on the graph.

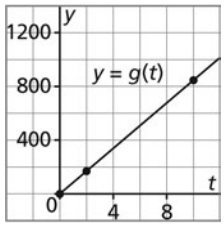
b) i) Approximately 33 sweatshirts

ii) $15

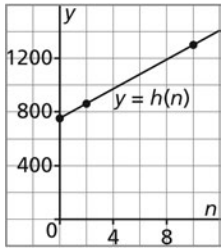
15. a)



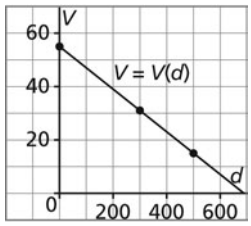
b)



c)



d)



16. a) $0.80 per bar sold

b) Vertical intercept: –40; it represents the loss when 0 bars are sold: $40; horizontal intercept: 50; it represents the number of bars that must be sold to reach the break-even point, when no profit is made and there is no loss: 50 bars

c) Domain: $0 \le n \le 300$, where n is a whole number; range: all multiples of 0.80 from –40 to 200; I wouldn't want to list all the values in the range because there are 301 of them.

17. a) Answers may vary. For example:
There are no intercepts on the graph because the relation does not apply to people less than 10 years of age and older than 90 years of age.

b) Approximately –0.8 (beats/min)/year; for every additional year of age, the recommended maximum heart rate decreases by approximately 1 beat/min.

c) Approximately 77 years of age

d) Approximately 126 beats/min

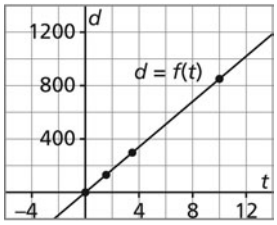
18. a) i) x-intercept: 5; y-intercept: 5

ii) $x + y = 5$

b) i) x-intercept: 5; y-intercept: –5

ii) $x - y = 5$

19. a)



b) $f(5) = 425$

c) $t = 2.5$

d) Contexts may vary. For example: A car's distance from home as it travels away at an average speed of 85 km/h. In this context, only the 1st quadrant of the graph is relevant.

20. a) The vertical intercept represents the person's distance from Duke Point when starting the journey at Parksville.
The horizontal intercept represents the person's distance from Parksville after completing the journey at Duke Point.
The distance between the two locations doesn't change, so the intercepts have the same value.

b) –1; for every 1 km the car moves away from Parksville, it moves 1 km closer to Duke Point.

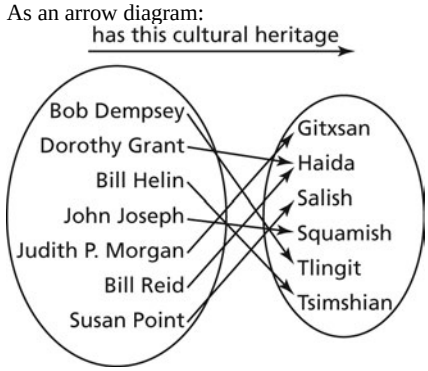
c) Interchanging the dependent and independent variables would interchange the labels on the axes, but the line on the graph would stay the same.

Chapter 5: Review, page 326

1. a) The table shows a relation with the association "has this cultural heritage" from a set of artists to a set of First Nations heritages.

b) i) As a set of ordered pairs:
{(Bob Dempsey, Tlingit), (Dorothy Grant, Haida), (Bill Helin, Tsimshian), (John Joseph, Squamish), (Judith P. Morgan, Gitxsan), (Bill Reid, Haida), (Susan Point, Salish)}

ii) As an arrow diagram:

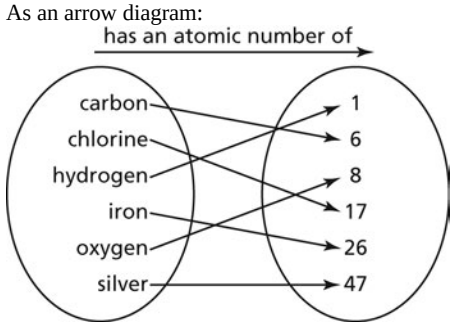


2. Representations may vary. For example:

a) As a table:

Element	Atomic Number
carbon	6
chlorine	17
hydrogen	1
iron	26
oxygen	8
silver	47

As an arrow diagram:

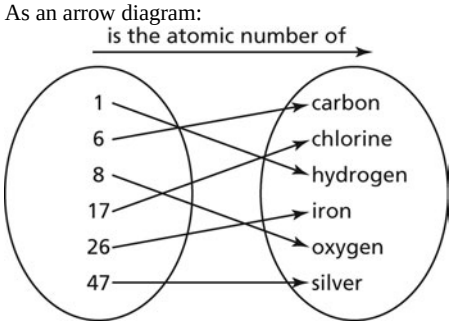


As a set of ordered pairs:
{(carbon, 6), (chlorine, 17), (hydrogen, 1), (iron, 26), (oxygen, 8), (silver, 47)}

b) As a table:

Atomic Number	Element
1	hydrogen
6	carbon
8	oxygen
17	chlorine
26	iron
47	silver

As an arrow diagram:



As a set of ordered pairs:
{(1, hydrogen), (6, carbon), (8, oxygen), (17, chlorine), (26, iron), (47, silver)}

3. a) Not a function
b) Function
c) Function
d) Not a function

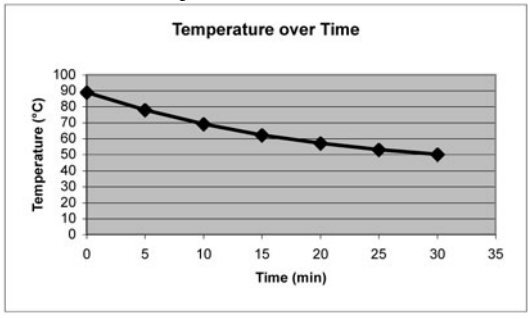
4. a) $f(x) = -4x + 9$
b) $C(n) = 12n + 75$
c) $D(t) = -20t + 150$
d) $P(s) = 4s$

5. a) $P = 5n - 300$
b) Independent variable: n; dependent variable: P
c) $P(150) = 450$; if 150 students attend the dance, the profit is \$450.
d) $n = 200$; the profit is \$700 when 200 students attend the dance.

6. a) Graph A
b) Answers may vary. For example:
Graph D could represent Laura's journey to school to pick up her bike. She walks to school, then picks up her bicycle and rides home.

7. b) 2 times
c) 2.0 L of water
d) Dependent variable: volume of water in Liam's flask; independent variable: distance Liam hikes

8. a) I joined the points because all times between 0 min and 30 min are permissible and all temperatures between 50°C and 89°C are permissible.



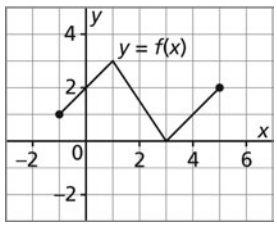
b) The graph represents a function because a vertical line drawn on the graph passes through one point.

9. Estimates may vary.
a) Not a function; domain: {13, 14, 15, 16, 17}; range: {159, 161, 165, 168, 170, 174, 176}
b) Function; domain: {08:00, 10:00, 12:00, 14:00, 16:00, 18:00}; range: {2, 5, 10, 20, 25}

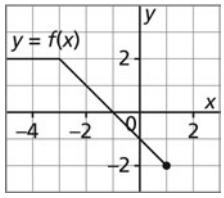
10. a) i) Graph A represents the volume of a jar, in cubic centimetres, as a linear function of its height, in centimetres.
ii) Graph B represents the number of marbles in a jar as a linear function of the jar's height, in centimetres.
b) i) Independent variable: height of the jar, h; dependent variable: volume of the jar, V
ii) Independent variable: height of the jar, h; dependent variable: number of marbles in the jar, n
c) i) Estimates may vary. For example: Domain: $5 \le h \le 20$; range: approximately $400 \le V \le 1575$
ii) Domain: {5, 10, 15, 20}; range: {14, 28, 42, 56}
d) The points are joined in Graph A because it is possible for a jar to have any height between 5 cm and 20 cm and any volume between 400 cm^3 and 1575 cm^3.
The points are not joined in Graph B because only whole numbers of marbles are permissible.

11. a) –2
b) –1

12. Graphs may vary. For example:
a)

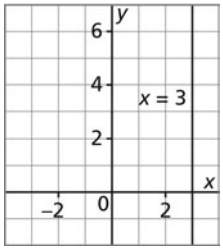


b)



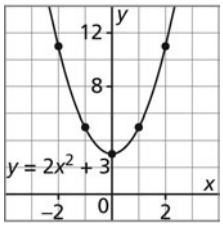
13. a) Linear relation **b)** Linear relation
c) Not a linear relation

14. Tables of values may vary. For example:
a) i)



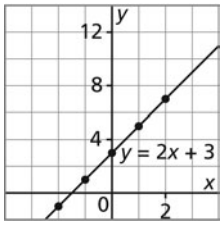
ii) Table:

x	y
–2	11
–1	5
0	3
1	5
2	11

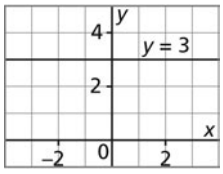


iii)

x	y
–2	–1
–1	1
0	3
1	5
2	7

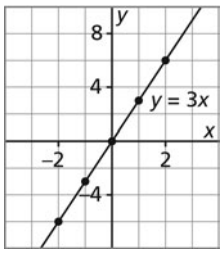


iv)



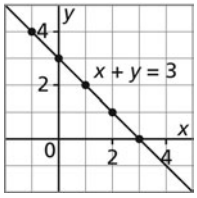
v)

x	y
–2	–6
–1	–3
0	0
1	3
2	6



vi)

x	y
–1	4
0	3
1	2
2	1
3	0



b) i, iii, iv, v, vi

15. a) The equation represents a linear relation because, when g changes by 1, N changes by $\frac{1}{15}$.

b) $\frac{1}{15}$; For every 1 g of carbohydrate that Isabelle consumes, she gives herself $\frac{1}{15}$ of a unit of insulin.

16. a) 6000 m, or 6 km

b) Domain: $0 \le n \le 2800$; range: $0 \le d \le 6000$

c) Approximately 2.1 m/revolution; in one revolution of the wheel, the bicycle covers a distance of approximately 2 m.

d) Approximately 0.68 m, or 68 cm

17. a) ii

b) iii

c) i

18. a) 201 caps

b) $4

c) i) 350 caps

ii) 500 caps

d) The profit depends on the sale of caps and the initial cost of $800 to buy or make the caps. So, doubling the number of caps does not double the profit.

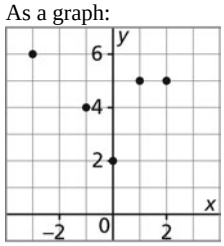
Chapter 5: Practice Test, page 329

1. B

2. C

3. a) i) Function

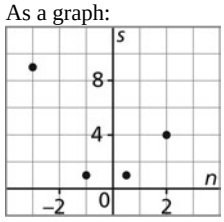
ii) Representations may vary. For example:
Domain: {–3, –1, 0, 1, 2}; range: {2, 4, 5, 6}
As a graph:



The function is not linear because the points on the graph do not lie on a line.

b) i) Function

ii) Representations may vary. For example:
Domain: {–3, –1, 1, 2, …}; range: {1, 4, 9, …}
As a graph:



The function is not linear because the points on the graph do not lie on a line.

c) i) Function

ii) Representations may vary. For example:
Domain: $-2 \le x \le 8$; range: $-1 \le y \le 4$

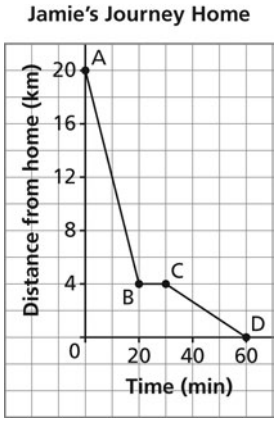
As an equation:

$y = -\frac{1}{2}x + 3$, for $-2 \le x \le 8$

The function is linear because the graph is a non-vertical line.

iii) Independent variable: x; dependent variable: y; rate of change: $-\frac{1}{2}$

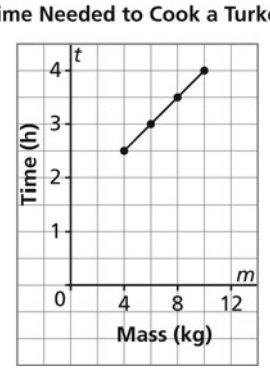
4. Situation: Jamie's school is 20 km from her home. Jamie rides her friend's bike from school to her friend's home, which is 4 km from her own home. She arrives at her friend's home 20 min after she left school. She talks to her friend for 10 min, then walks the remaining 4 km home in 30 min.



5. a) The relation is a function because no number is repeated in the first column.

b) Dependent variable: time; independent variable: mass

c)



I connected the points because both time and mass are not discrete data.

d) Domain: $4 \le m \le 10$; range: $2.5 \le t \le 4.0$

e) 0.25 h/kg; for every additional kilogram, the time needed to cook the turkey increases by 0.25 h.

f) 3.25 h or 3 h 15 min

Chapter 6 Linear Functions, page 330

6.1 Slope of a Line, page 339

4. a) $\frac{2}{11}$ **b)** $\frac{2}{7}$

5. a) Negative

b) Positive

c) Not defined

d) Zero

6. a) Rise: 3; run: 6; slope: $\frac{1}{2}$

b) Rise: –2; run: 8; slope: $-\frac{1}{4}$

c) Rise: 3; run: 4; slope: $\frac{3}{4}$

d) Rise: –6; run: 2; slope: –3

7. a) 3

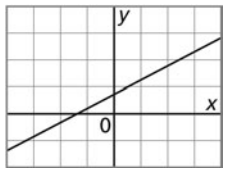
b) $-\frac{7}{2}$

c) $\frac{1}{2}$

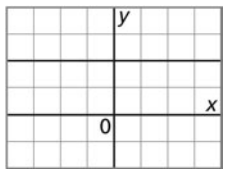
d) $-\frac{1}{2}$

8. Sketches may vary. The lines may be in different positions on the grid but they should have the same orientations as those shown.

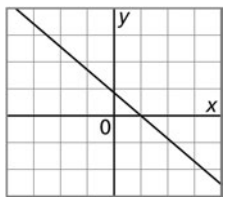
a)



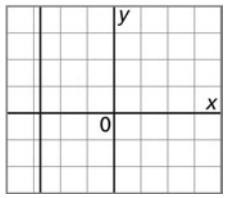
b)



c)

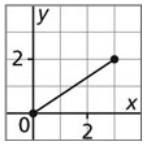


d)

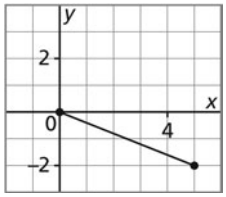


9. Sketches may vary. The line segments may have different lengths but they should have the same orientations as those shown.

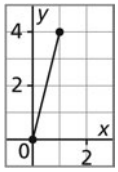
a)



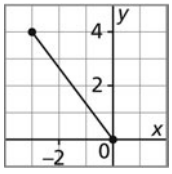
b)



c)



d)



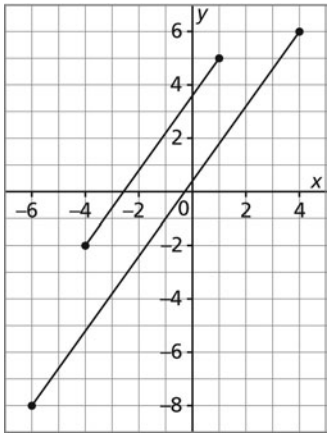
11. a) $\frac{1}{2}$

b) $\frac{1}{2}$

c) The slopes in parts a and b are equal.

12. Diagrams may vary. For example:

a)



b) Similarities: the line segments have the same slope; differences: they pass through different points

13. a) i) 2 **ii)** $\frac{1}{2}$

iii) –3 **iv)** $\frac{1}{3}$

b) i) As x increases by 1, y increases by 2.

ii) As x increases by 2, y increases by 1.

iii) As x increases by 1, y decreases by 3.

iv) As x increases by 3, y increases by 1.

14. a) Diagrams may vary.

b) i) The slopes of the segments are equal; all segments on the same line have the same slope.

15. a) $\frac{1}{15}$, or $0.0\overline{6}$

b) $13\frac{1}{2}$ in.

16. a) $-\frac{1}{48}$

b) 312 in., or 26 ft.

c) $4\frac{1}{2}$ in.

17. a) Line iv

b) Line iii

c) Line ii

d) Line i

18. a) i) $-\frac{3}{5}$

ii) $\frac{3}{5}$

iii) $-\frac{3}{5}$

iv) $\frac{3}{5}$

b) The slopes of BC and ED are equal. The slopes of BE and CD are equal. The two different slopes are opposites.

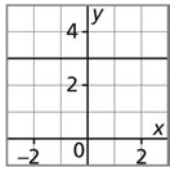
19. a) The slope of a horizontal line is 0 because its rise is 0, and the quotient of 0 and any number is zero.

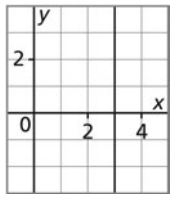
b) The slope of a vertical line is undefined because its run is 0, and the quotient of any number and 0 is undefined; that is, I cannot divide by 0.

20. a) $\frac{1}{3}$

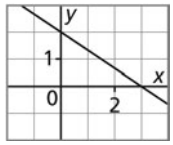
21. Positions of lines on the grid may vary. For example:

a) i)

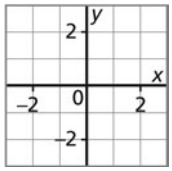




ii)



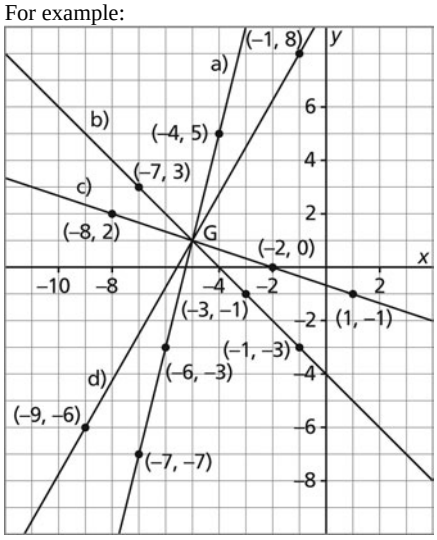
iii)



22. 840 cm, or 8.4 m

23. Coordinates may vary.

For example:



a) (–4, 5), (–6, –3), (–7, –7)

b) (–7, 3), (–3, –1), (–1, –3)

c) (–8, 2), (–2, 0), (1, –1)

d) (–1, 8), (–9, –6), (–13, –13)

24. a) i) Positive

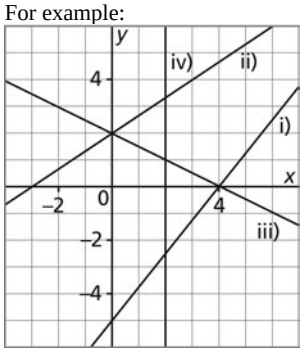
ii) Positive

iii) Negative

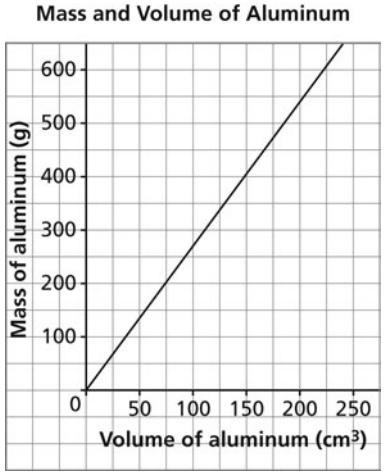
iv) Not defined

b) Sketches may vary.

For example:



25. a)



b) 2.7 g/cm^3

c) The slope shows that for every 1 cm^3 increase in the volume of an aluminum cube, the mass of the cube increases by 2.7 g.

d) i) 135 g **ii)** 742.5 g

e) i) Approximately 37 cm^3

ii) Approximately 167 cm^3

26. a) The number of text messages is restricted to whole numbers.

b) \$0.15, or 15¢ **c)** \$4.95

d) 48 text messages

e) Assumptions may vary. For example: I assumed that all messages cost the same.

27. a) \$45/month **b)** \$505

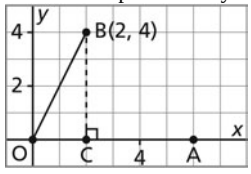
c) \$55

d) Assumptions may vary. For example: I assumed that Charin continues to save the same amount each month after the 5th month and that the savings account did not earn any interest.

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

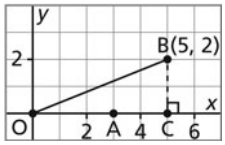
29. No

30. a) Positions of point A may vary. For example:



b) Slope of OB is 2; tan∠AOB = 2

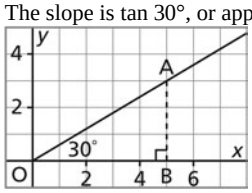
c)



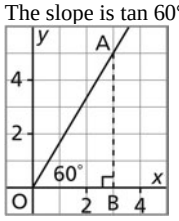
Slope of OB is $\frac{2}{5}$; $\tan\angle AOB = \frac{2}{5}$

d) The slope of a line segment is equal to the tangent of the angle formed by the segment and the positive *x*-axis. Both the slope and the tangent are equal to the quotient of the same two numbers.

31. a) The slope is tan 30°, or approximately 0.6.



b) The slope is tan 60°, or approximately 1.7.



c) No

6.2 Slopes of Parallel and Perpendicular Lines, page 349

3. a) $\frac{4}{5}$

b) $-\frac{4}{3}$

c) 3

d) 0

4. a) $-\frac{6}{7}$

b) $\frac{8}{5}$

c) $-\frac{1}{9}$

d) $\frac{1}{5}$

5. a) Parallel **b)** Neither

c) Neither **d)** Perpendicular

6. a) i) $-\frac{4}{9}$ **ii)** $\frac{9}{4}$

b) i) 5

ii) $-\frac{1}{5}$

c) i) $\frac{7}{3}$

ii) $-\frac{3}{7}$

d) i) –4

ii) $\frac{1}{4}$

7. Yes; the slope of the line through the golfer's club and the slope of the line through the golfer's feet are the same: approximately $-\frac{1}{6}$

8. a) i) A(–5, –2), B(1, 5) and C(–1, –4), D(4, 1)

ii) Neither

b) i) E(–3, 4), F(3, 2) and G(2, 5), H(0, –1)

ii) Perpendicular

c) i) J(–2, 3), K(1, –3) and M(3, 1), N(–4, –2)

ii) Neither

d) i) P(0, 5), Q(6, 2) and R(–4, –1), S(0, –3)

ii) Parallel

9. a) Perpendicular

b) Parallel

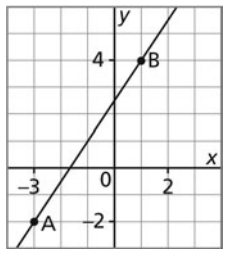
c) Neither

d) Neither

10. a) Both lines have positive slopes, which are reciprocals.

b) Both lines have positive slopes, which are reciprocals.

11. a) Slope of AB is $\frac{3}{2}$, or 1.5.



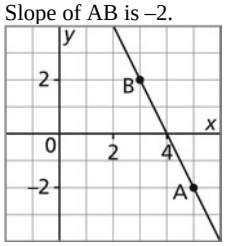
b) Slope of CD is $\frac{3}{2}$, or 1.5.

c) Answers may vary. For example: (1, 2), (3, 5)

d) Slope of AE is $-\frac{2}{3}$.

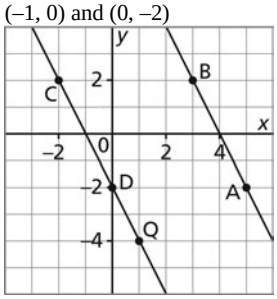
e) Answers may vary. For example: (0, –4), (3, –6)

12. a) Slope of AB is –2.



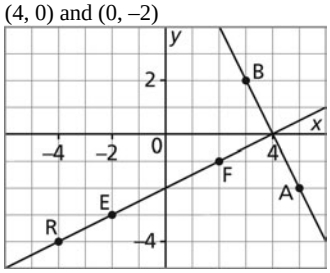
b) Slope of CD is –2.

c) (–1, 0) and (0, –2)



d) Slope of EF is $\frac{1}{2}$, or 0.5.

e) (4, 0) and (0, –2)



13. a) Yes **b)** No

14. Trapezoid

15. No

16. The slopes of BC and AC are negative reciprocals, so BC and AC are perpendicular: slope of BC: –2; slope of AC: $\frac{1}{2}$

17. Yes; The slopes of DE and EF are negative reciprocals, so DE and EF are perpendicular: slope of DE: $\frac{3}{2}$; slope of EF: $-\frac{2}{3}$

18. Triangles may vary.

c) In each case, the line segment that joins the midpoints of two sides of a triangle is parallel to the third side of the triangle.

19. a) No; no pairs of slopes are negative reciprocals.

b) D(–2, –1)

20. Coordinates may vary. For example:
(3, 7), (–9, 1), (6, 1), (–6, –5)

21. Rhombuses may vary. The diagonals intersect at right angles.

22. $c = -2$

23. a) $a = 3\frac{1}{4}$, or 3.25

b) $a = 1\frac{1}{5}$, or 1.2

Chapter 6: Checkpoint 1, page 353

1. Slope of AB: $-\frac{2}{3}$; slope of CD: $\frac{1}{4}$

2. a) $-\frac{15}{4}$

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

3. Answers may vary. For example: The slope of a line is equal to the slope of any segment of the line, so we can use any two points that form that segment to determine the slope of the line.

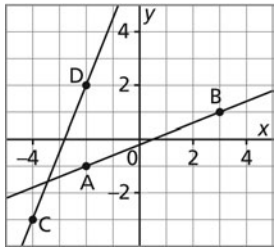
4. a) 25 km/h; Jordan's average speed

b) Approximately 31 km

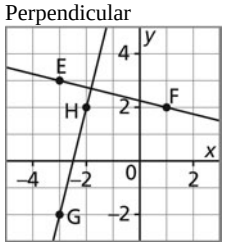
c) 2.6 h, or 2 h 36 min

5. The positions of the lines on the grids and their labels may vary. For example:

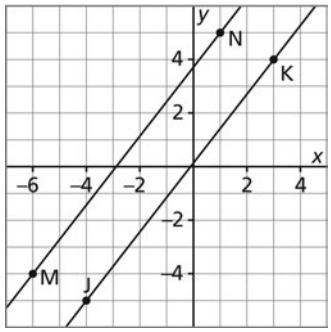
a) Neither



b) Perpendicular



c) Parallel



6. Coordinates may vary. For example:

a) (2, –2), (6, 1)

b) (5, –2), (2, 2)

7. No, no two of the three slopes of the sides of the triangle are negative reciprocals.

8. Answers may vary. For example: (–12, 0), (0, –5)

6.3 Math Lab: Investigating Graphs of Linear Functions, page 356

1. a) From top to bottom:

$y = \frac{1}{2}x + 4$, $y = \frac{1}{2}x + 2$, $y = \frac{1}{2}x - 1$,

$y = \frac{1}{2}x - 2$, $y = \frac{1}{2}x - 3$

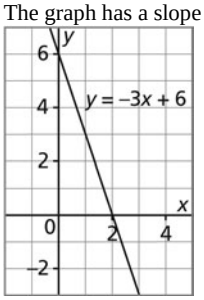
b) From top to bottom:

$y = -\frac{1}{3}x + 4$, $y = -\frac{1}{3}x + 3$, $y = -\frac{1}{3}x + 1$,

$y = -\frac{1}{3}x - 2$, $y = -\frac{1}{3}x - 3$

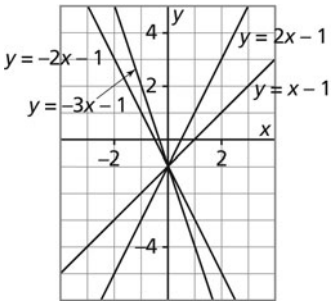
2. m represents the slope and b represents the y-intercept of the line. I could plot the y-intercept, then plot a point using the slope.

3. The graph has a slope of –3 and a y-intercept of 6.



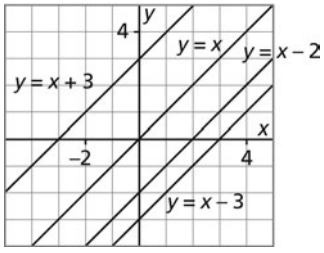
4. a) All the graphs have y-intercept –1.

b)

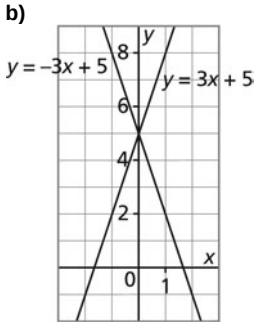


5. a) All the graphs have slope 1.

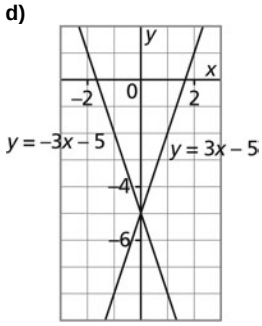
b)



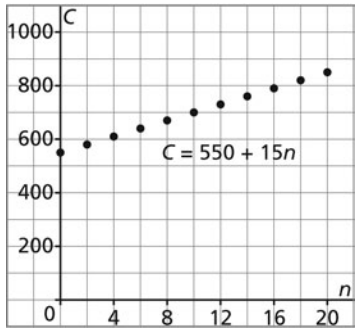
6. a), b)



c), d)



7. a)



b) m represents the slope or rate of change; that is, \$15 per person. b represents the initial cost of \$550 to rent the hall.

6.4 Slope-intercept Form of the Equation for a Linear Function, page 362

4. a) Slope: 4; y-intercept: –7

b) Slope: 1; y-intercept: 12

c) Slope: $-\frac{4}{9}$; y-intercept: 7

d) Slope: 11; y-intercept: $-\frac{3}{8}$

e) Slope: $\frac{1}{5}$; y-intercept: 0

f) Slope: 0; y-intercept: 3

5. a) $y = 7x + 16$

b) $y = -\frac{3}{8}x + 5$

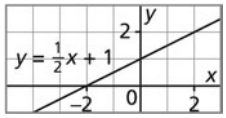
c) $y = \frac{7}{16}x - 3$

d) $y = -\frac{6}{5}x - 8$

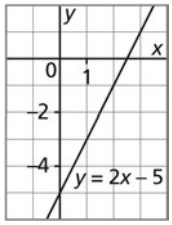
e) $y = -\frac{5}{12}x$

6. Sketches may vary. For example:

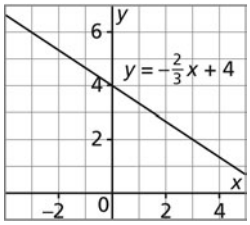
a)



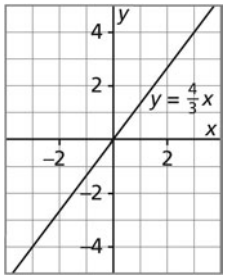
b)



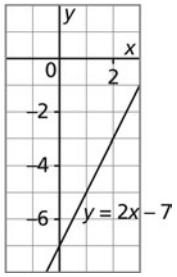
c)



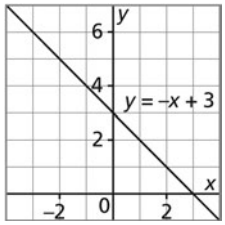
d)



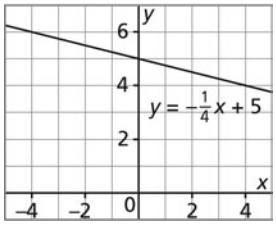
7. a)



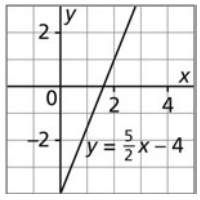
b)



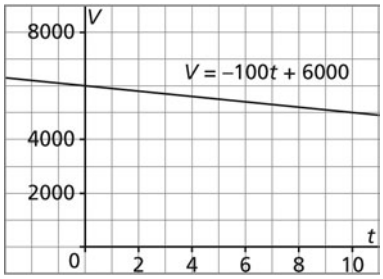
c)



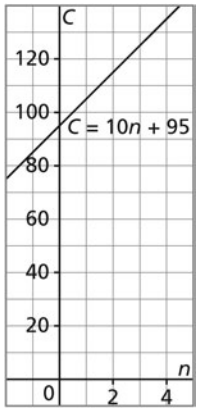
d)



e)



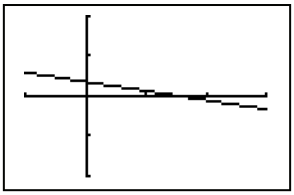
f)



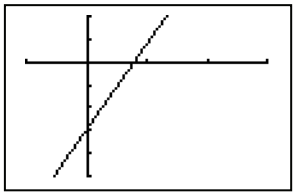
8. a) $C = 50t + 80$ **b)** $C = 40t + 100$

9. $F = 0.02d + 3.50$

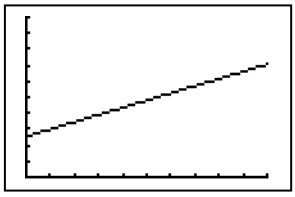
10. a)



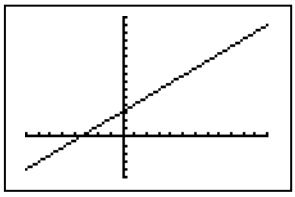
b)



c)



d)



11. a) The student may have confused the values of the slope and the *y*-intercept.

b) $y = 4x - 3$

12. a) **i)** Slope: $-\frac{1}{2}$; *y*-intercept: 2

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

iii) $y = -3$

b) **i)** Slope: 4; *y*-intercept: –6

ii) $y = 4x - 6$

iii) $y = 34$

c) **i)** Slope: $\frac{3}{4}$; *y*-intercept: 1

ii) $y = \frac{3}{4}x + 1$

iii) $y = 8.5$

d) **i)** Slope: $-\frac{1}{3}$; *y*-intercept: –2

ii) $y = -\frac{1}{3}x - 2$

iii) $y = -\frac{16}{3}$, or $-5\frac{1}{3}$

13. a) Slope: –80; the plane is descending at a speed of 80 m/min. *h*-intercept: 900; when the plane begins its descent, it is 900 m above the lake.

b) $h = -80t + 900$

c) 460 m

d) **i)** The graph would be a line joining (0, 700) and (8, 0).

ii) $h = -87.5t + 700$

14. a) $C = 0.80n + 20$

b) \$107.20

c) 125 songs

16. a) $E = 0.05t + 34$

b) \$54

c) \$600

17. a) $y = 4x + 1$

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

c) $y = -\frac{5}{3}x - 7$

18. a) Graph C **b)** Graph A

c) Graph D **d)** Graph B

19. a) Graph C **b)** Graph D

c) Graph B **d)** Graph A

20. a) Graph B **b)** Graph C

c) Graph D **d)** Graph A

21. Parallel lines:

$y = -5x - 7$ and $y = -5x + 13$;

$y = 5x + 15$ and $y = 5x + 24$;

$y = \frac{1}{5}x + 9$ and $y = \frac{1}{5}x + 21$;

$y = -\frac{1}{5}x + 15$ and $y = -\frac{1}{5}x$

Perpendicular lines:

$y = -5x - 7$ and $y = \frac{1}{5}x + 9$;

$y = -5x - 7$ and $y = \frac{1}{5}x + 21$;

$y = -5x + 13$ and $y = \frac{1}{5}x + 9$;

$y = -5x + 13$ and $y = \frac{1}{5}x + 21$;

$y = 5x + 15$ and $y = -\frac{1}{5}x + 15$;

$y = 5x + 15$ and $y = -\frac{1}{5}x$;

$y = 5x + 24$ and $y = -\frac{1}{5}x + 15$;

$y = 5x + 24$ and $y = -\frac{1}{5}x$

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

23. $c = -\frac{38}{3}$, or $-12\frac{2}{3}$

24. $m = -\frac{47}{24}$, or $-1\frac{23}{24}$

6.5 Slope-Point Form of the Equation for a Linear Function, page 372

4. Coordinates may vary. For example:

a) Slope: –4; (1, 5)

b) Slope: 3; (8, –7)

c) Slope: 1; (–15, –11)

d) Slope: 5; (2, 0)

e) Slope: $\frac{4}{7}$; (–3, –6)

f) Slope: $-\frac{8}{5}$; (–16, 21)

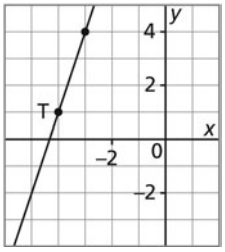
5. a) $y - 2 = -5(x + 4)$

b) $y + 8 = 7(x - 6)$

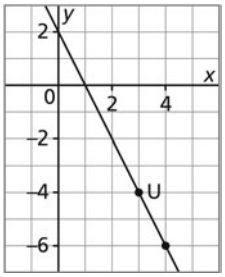
c) $y + 5 = -\frac{3}{4}(x - 7)$

d) $y + 8 = 0$, or $y = -8$

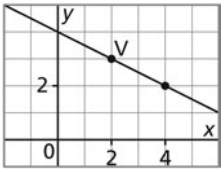
6. a)



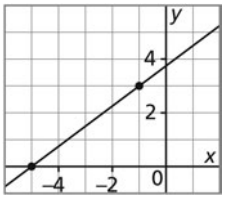
b)



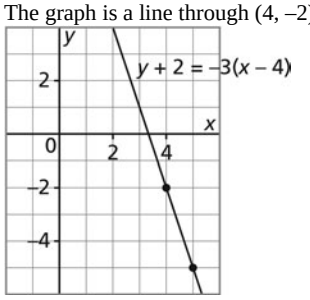
c)



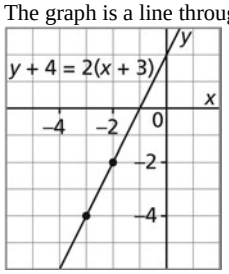
d)



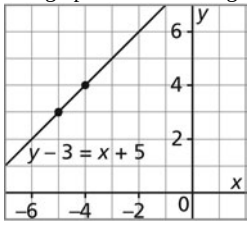
7. a) The graph is a line through (4, –2) with slope –3.



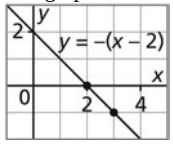
b) The graph is a line through (–3, –4) with slope 2.



c) The graph is a line through (–5, 3) with slope 1.



d) The graph is a line through (2, 0) with slope –1.



9. Equations may be written in different forms.

a) **i)** $y - 4 = -\frac{4}{3}(x + 2)$ **ii)** $y - 3 = \frac{2}{5}(x - 3)$

iii) $y + 2 = \frac{1}{3}(x + 4)$ **iv)** $y + 2 = -\frac{5}{2}(x - 1)$

b) **i)** $y = -\frac{4}{3}x + \frac{4}{3}$; x-intercept: 1; y-intercept: $\frac{4}{3}$

ii) $y = \frac{2}{5}x + \frac{9}{5}$; x-intercept: $-\frac{9}{2}$, or -4.5; y-intercept: $\frac{9}{5}$

iii) $y = \frac{1}{3}x - \frac{2}{3}$; x-intercept: 2; y-intercept: $-\frac{2}{3}$

iv) $y = -\frac{5}{2}x + \frac{1}{2}$; x-intercept: $\frac{1}{5}$, or 0.2; y-intercept: $\frac{1}{2}$, or 0.5

10. Different variables may be used.

a) Let s represent the speed of sound and t represent the air temperature: $s - 337 = 0.6(t - 10)$

b) 331 m/s

11. Slope-point forms of equations may vary. For example:

a) $y - 1 = 2(x - 1)$, or $y + 5 = 2(x + 2)$; $y = 2x - 1$

b) $y + 2 = -(x - 5)$, or $y - 7 = -(x + 4)$; $y = -x + 3$

c) $y - 8 = 3(x - 2)$, or $y + 7 = 3(x + 3)$; $y = 3x + 2$

d) $y + 5 = -2(x + 5)$, or $y + 1 = -2(x + 7)$; $y = -2x - 15$

12. a) Graph C: slope 2 and y-intercept –5

b) Graph A: slope 1 and y-intercept 1

c) Graph B: slope 2 and y-intercept 5

d) Graph D: slope –1 and y-intercept –5

13. The graphs are parallel. The graph of $y - y_1 = m(x - x_1)$ passes through the point $P(x_1, y_1)$, and the graph of $y + y_1 = m(x + x_1)$ passes through the point $Q(-x_1, -y_1)$.

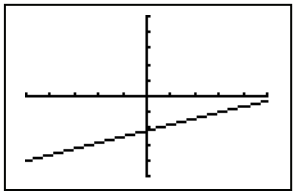
14. a) $y - 2 = 2(x + 1)$

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

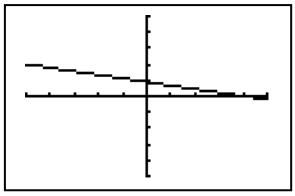
c) $y - 1 = -\frac{2}{3}(x - 2)$

15. Graphs may also be produced on a computer with graphing software. Graphs may show different windows.

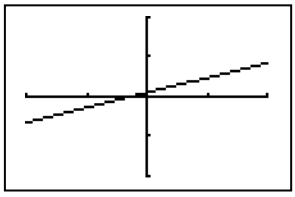
a)



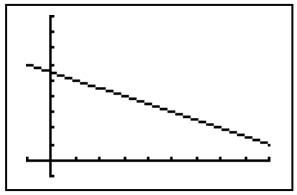
b)



c)



d)



16. a) 1.26 g/mL; For every 1 mL of liquid that is poured into the cylinder, the mass of the cylinder and the liquid increases by 1.26 g.

b) Variables and form of the equation may vary. For example: Let v millilitres represent the volume of the liquid, and M grams represent the mass of the cylinder and liquid; $M - 51.5 = 1.26(v - 20)$

c) 64.1 g

d) 26.3 g

17. a) Variables and form of the equation may vary. For example: Let M represent the mass of potash in millions of tonnes, and t represent the time in years since 2005; $M = 0.6t + 8.2$

b) 11.2 million tonnes; 14.2 million tonnes; Assumption: I assume that the relation continues for times beyond 2007 and remains linear.

18. a) Variables and form of the equation may vary. For example: Let p represent the number of students enrolled in francophone schools, and t represent the time, in years, since 2001; $p - 3470 = 198(t - 2)$

b) Approximately 3866 students

19. a) –2 **b)** $y - 11 = -2(x + 3)$

c) $y + 3 = -2(x - 4)$

20. a) i) $y + 3 = -\frac{4}{3}(x + 5)$

ii) $y + 3 = \frac{3}{4}(x + 5)$

21. a) $y + 2 = 2(x - 1)$ **b)** $y + 2 = -\frac{1}{2}(x - 1)$

22. a) $y - 6 = -\frac{5}{2}(x - 2)$ **b)** $y - 6 = \frac{2}{5}(x - 2)$

23. a) $y = \frac{3}{5}(x - 4)$

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

24. Form of the equation may vary.

$y = -\frac{9}{2}x + \frac{37}{9}$

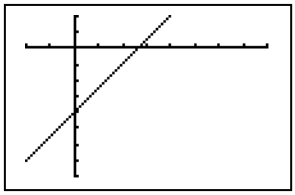
25. Form of the equation may vary.

$y + 5 = \frac{3}{5}(x + 2)$

Chapter 6: Checkpoint 2, page 376

1. Screens may vary.

a)



b) Increase the value of m to get a line with a greater slope. Decrease the value of m to get a line with a lesser slope.

c) Increase the value of b to get a line with a greater y-intercept. Decrease the value of b to get a line with a lesser y-intercept.

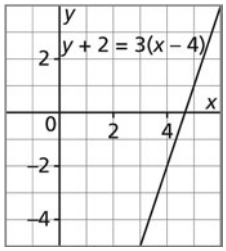
2. a) Slope: 25; d-intercept: 10; 25 km/h is Eric's average speed; d-intercept: 10 km is Eric's distance from home at the start of his ride.

b) $d = 25t + 10$

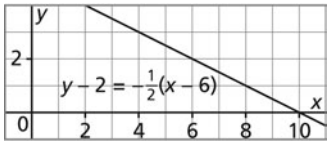
c) **i)** 66.25 km

ii) 1.4 h, or 1 h 24 min

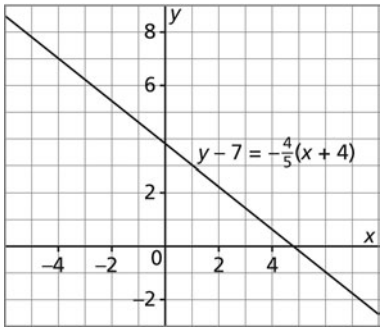
3. a)



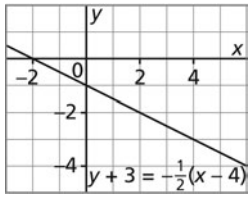
b)



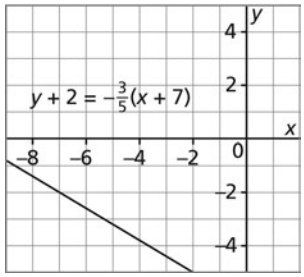
c)



d)



e)



4. a) $y = 2x + 3$

b) Equations may have different forms. For example: $y - 5 = 2(x - 1)$

6.6 General Form of the Equation for a Linear Relation, page 384

4. a) Standard form

b) General form

c) Slope-intercept form

d) Slope-point form

5. a) x-intercept: 3; y-intercept: –8

b) x-intercept: 8; y-intercept: 7

c) x-intercept: 22; y-intercept: –8

d) x-intercept: 13.5; y-intercept: –3

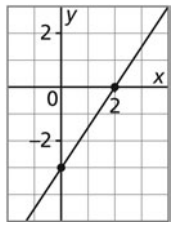
6. a) $4x + 3y - 36 = 0$

b) $2x - y - 7 = 0$

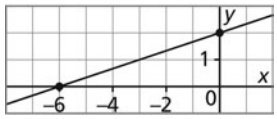
c) $2x + y - 6 = 0$

d) $5x - y - 1 = 0$

7. a)



b)



8. a) **i)** The coefficient of x is negative.

ii) Neither side of the equation is 0.

iii) The coefficient of x is not a whole number.

iv) The x-term should come before the y-term.

b) **i)** $2x - 3y - 42 = 0$

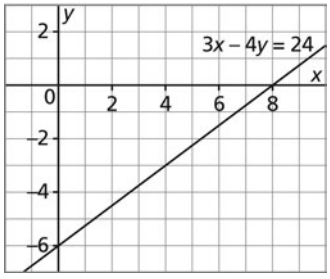
ii) $5x - 4y + 100 = 0$

iii) $x - y + 2 = 0$

iv) $9x + 5y - 20 = 0$

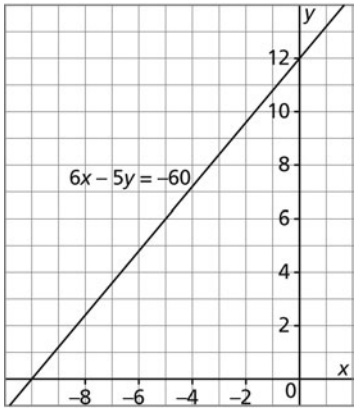
9. a) **i)** x-intercept: 8; y-intercept: –6

ii)



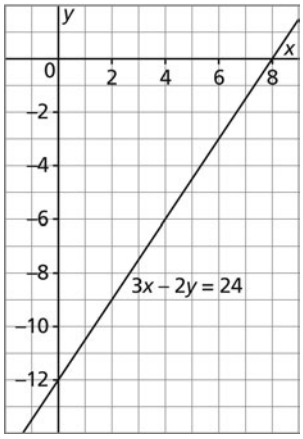
b) **i)** x-intercept: –10; y-intercept: 12

ii)



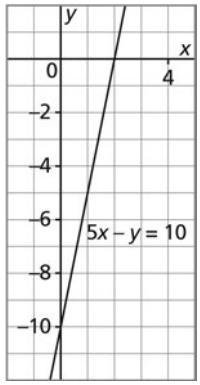
c) **i)** x-intercept: 8; y-intercept: –12

ii)

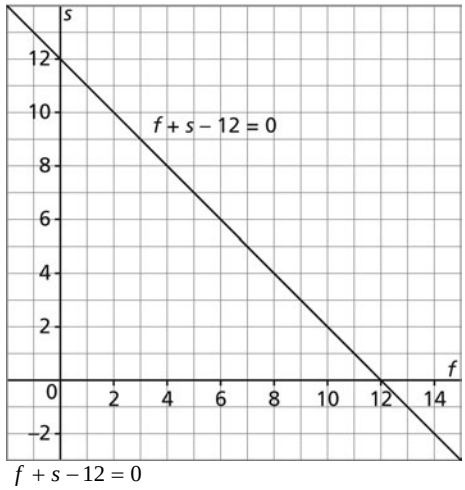


d) **i)** x-intercept: 2; y-intercept: –10

ii)



10. b)



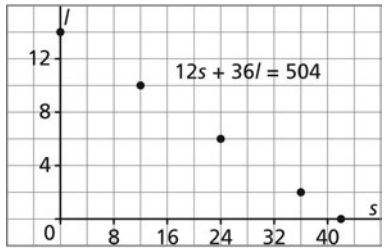
c) $f + s - 12 = 0$

d) Pairs of integers may vary. For example:
0 and 12; 5 and 7; 3 and 9; 13 and –1; 14 and –2; 15 and –3

11. a), b) Letters for the variables may differ.

Let s represent a small pan, and l represent a large pan.

$12s + 36l = 504$



12. a) $y = -\frac{4}{3}x + 8$

b) $y = \frac{3}{8}x + \frac{3}{2}$

c) $y = \frac{2}{5}x - 3$

d) $y = -\frac{7}{3}x - \frac{10}{3}$

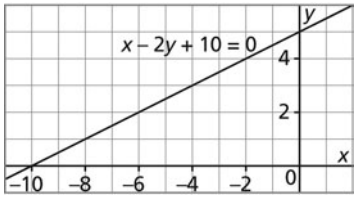
13. a) –4

b) 3

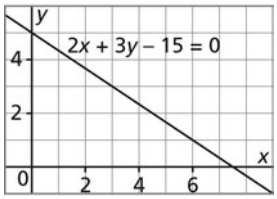
c) 5

d) –5

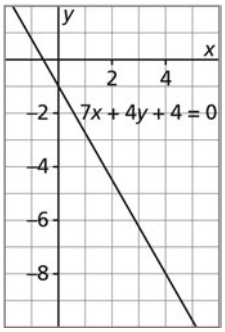
14. a)



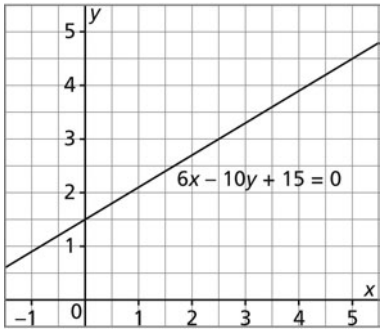
b)



c)



d)



15. a) 9 pieces of 8-ft. pipe

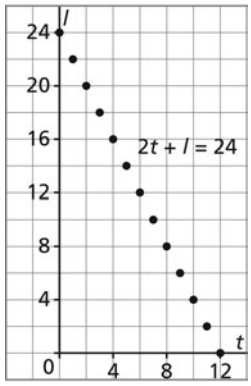
b) 12 pieces of 6-ft. pipe

c) No; 9.75 pieces of 8-ft. pipe would be needed

d) No; $10\frac{2}{3}$ pieces of 6-ft. pipe would be needed

16. Graphs may have variables on different axes; and variables may be different. Let l represent the number of loonies and t represent the number of toonies.

b), c) $2t + l = 24$

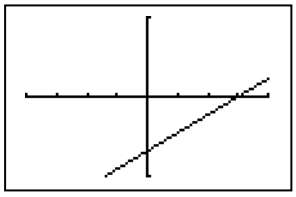


d) i) No

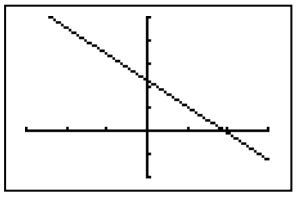
ii) No

17. Screens may vary.

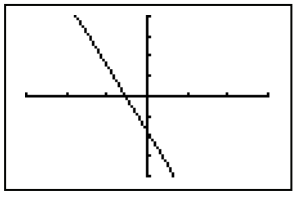
a)



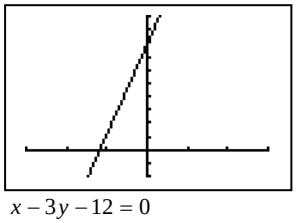
b)



c)



d)



18. a) $x - 3y - 12 = 0$

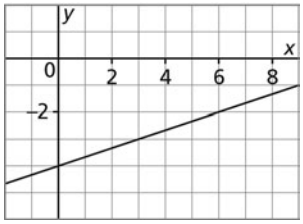
b) $x - 3y + 11 = 0$

c) $x + 4y + 11 = 0$

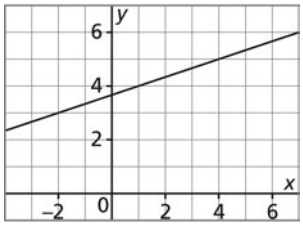
d) $9x + 6y - 8 = 0$

19. Forms of the equations may vary. For example:

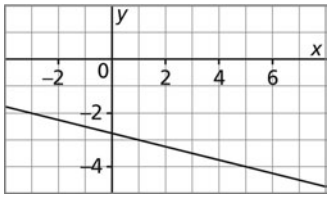
a) $y = \frac{1}{3}x - 4$; $x - 3y - 12 = 0$; $y + 3 = \frac{1}{3}(x - 3)$



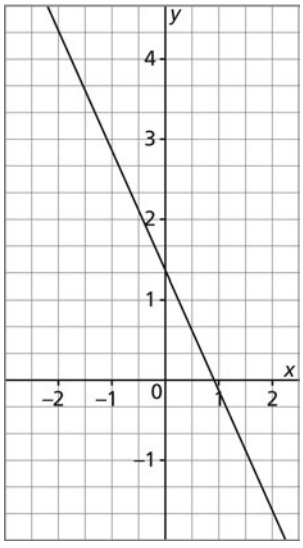
b) $y - 2 = \frac{1}{3}(x + 5)$; $x - 3y + 11 = 0$; $y = \frac{1}{3}x + \frac{11}{3}$



c) $y + 3 = -\frac{1}{4}(x - 1)$; $x + 4y + 11 = 0$; $y = -\frac{1}{4}x - \frac{11}{4}$



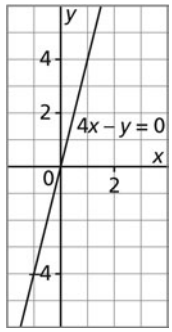
d) $y = -\frac{3}{2}x + \frac{4}{3}$; $9x + 6y - 8 = 0$; $y + \frac{1}{6} = -\frac{3}{2}(x - 1)$



22. a) Graph B

b) Graph A

23. b)



24. Equations in parts b, e, and g are equivalent.
Equations in parts d, f, and h are equivalent.

26. a) $3x + 4y - 12 = 0$; linear function

b) Not a linear function

c) Not a linear function

d) $x - 3y + 8 = 0$; linear function

28. a) $B \neq 0 : -\frac{A}{B}$

b) $B \neq 0 : -\frac{C}{B}$

Chapter 6: Review, page 388

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

b) $\frac{4}{5}$

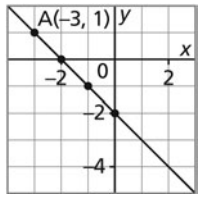
2. a) Negative

b) Negative

c) Zero

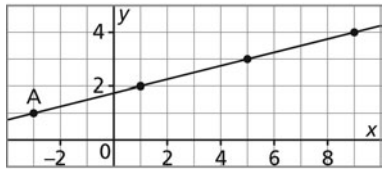
3. Sketches and coordinates may vary.

a) i)



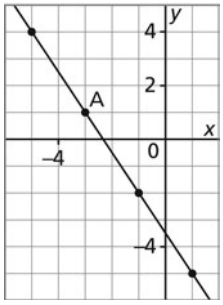
ii) (–2, 0), (–1, –1), (0, –2)

b) i)



ii) (1, 2), (5, 3), (9, 4)

c) **i)**



ii) (–5, 4), (–1, –2), (1, –5)

4. **a)** –2 **b)** $-\frac{3}{2}$

5. **a)** 160; for every 1 min Gabrielle jogs, she covers a distance of 160 m.

b) Slope is equal to the rate of change.

c) **i)** 640 m

ii) 6.25 min, or 6 min 15 s

6. **a)** **i)** 3 **ii)** $-\frac{1}{3}$

b) **i)** $-\frac{6}{5}$ **ii)** $\frac{5}{6}$

c) **i)** $\frac{11}{8}$ **ii)** $-\frac{8}{11}$

d) **i)** 1 **ii)** –1

7. **a)** Perpendicular; slope of JH: 2; slope of KM: $-\frac{1}{2}$

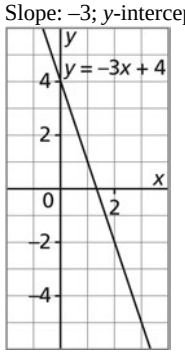
b) Neither; slope of NP: 3; slope of QR: –3

8. No; slope of ST: $-\frac{1}{3}$; slope of TU: 3; slope of UV: $-\frac{4}{9}$; slope of SV: $\frac{5}{2}$

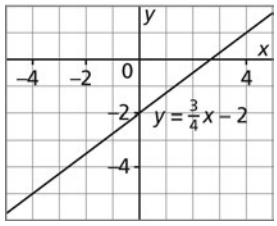
9. Yes; The slopes of AB and BC are negative reciprocals, so AB and BC are perpendicular.

Slope of AB: 2; slope of BC: $-\frac{1}{2}$

11. **a)** Slope: –3; *y*-intercept: 4



b) Slope: $\frac{3}{4}$; *y*-intercept: –2



12. **a)** **i)** Slope: $\frac{5}{3}$; *y*-intercept: 1

ii) $y = \frac{5}{3}x + 1$

b) **i)** Slope: $-\frac{3}{2}$; *y*-intercept: –1

ii) $y = -\frac{3}{2}x - 1$

13. **a)** Graph C

b) Graph D

c) Graph A

d) Graph B

14. **a)** $A = 15w + 40$

b) 21 weeks

c) The slope would represent the amount Mason saved each week: \$15; the vertical intercept would represent the amount in his bank account when he started saving: \$40

15. Equations may vary. For example:

a) $y = \frac{4}{7}x + 1$ and $y = \frac{4}{7}x - 10$

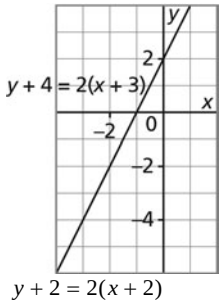
b) $y = -\frac{7}{4}x + 1$ and $y = -\frac{7}{4}x - 10$

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

17. Coordinates and forms of the equation may vary.

a) **i)** 2; (–3, –4)

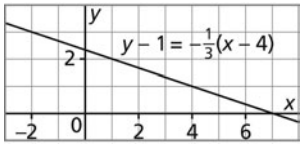
ii)



iii) $y + 2 = 2(x + 2)$

b) **i)** $-\frac{1}{3}$; (4, 1)

ii)



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

18. Forms of the equation may vary. For example:

a) $y = \frac{2}{3}(x - 2)$

b) $y - 2 = -\frac{3}{5}(x + 3)$

19. Forms of the equation may vary.

a) **i)** $y - 5 = 3(x - 1)$ or $y + 7 = 3(x + 3)$

ii) $y + 1 = -\frac{1}{2}(x - 5)$ or $y - 3 = -\frac{1}{2}(x + 3)$

b) Coordinates may vary. For example:

i) (2, 8)

ii) (1, 1)

20. Variables may differ. For example:

a) Let C represent the cost, and p represent the number of people: $C = 44p$

b) $44

c) 6 people

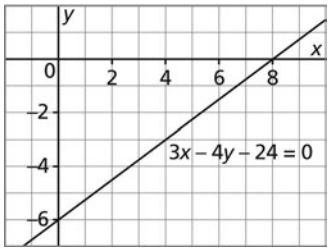
21. b) **i)** $5x - 4y + 40 = 0$

ii) $x + 3y - 12 = 0$

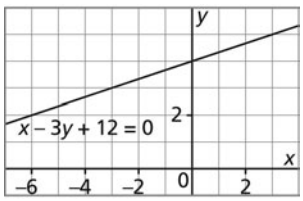
iii) $x - 3y + 10 = 0$

iv) $x - 5y + 15 = 0$

22. a) **i)**

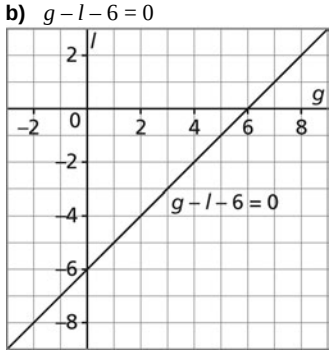


ii)



b) **i)** $\frac{3}{4}$ **ii)** $\frac{1}{3}$

24. a), b) $g - l - 6 = 0$



c) Pairs of integers may vary. For example:
8 and 2; 7 and 1; 6 and 0; 5 and –1; 4 and –2

25. Equations in parts a and d are equivalent. Equations in parts b and e are equivalent.

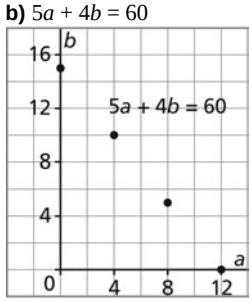
26. a) Graph B

b) Graph C

c) Graph A

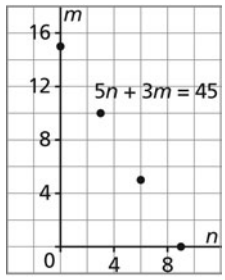
27. Variables may differ. Let a represent the number of hours Max babysits for the first family, and b represent the number of hours he babysits for the second family.

a), b) $5a + 4b = 60$



28. Variables may differ. Let n represent the number of new releases and m represent the number of old movies Kylie rents:

a) $5n + 3m = 45$



b) **i)** No

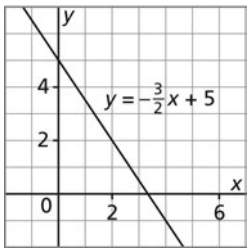
ii) Yes

Chapter 6: Practice Test, page 391

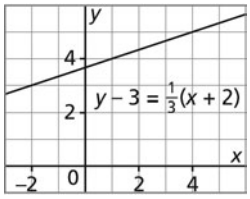
1. C

2. B

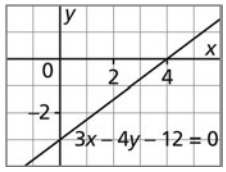
3. a) i)



ii)



iii)



b) $y - 2 = -\frac{3}{2}(x - 6)$

c) $3x + y + 1 = 0$

d) Coordinates and equations may vary. For example:
P(8, 3) and $y = -\frac{2}{7}x + \frac{37}{7}$

4. Answers and forms of equations may vary. For example:

a) Slope-intercept form: $y = -2x - 2$

b) General form: $y + 1 = 0$

c) Slope-point form: $y - 1 = \frac{3}{4}(x - 3)$

5. a) $6570

b) 520 people

Chapter 7 Systems of Linear Equations

7.1 Developing Systems of Linear Equations, page 401

4. d

5. c

6. a) iii; x dollars represents the cost of a jacket and y dollars represents the cost of a sweater.

b) i; x represents the length in feet and y represents the width in feet.

c) ii; x represents the number of chapatti breads sold and y represents the number of naan breads sold.

7. Variables may differ.

a) $2s + 2l = 20$ and $s + 3l = 22$

8. Variables may differ.

a) $2l + s = 24$ and $l - s = 6$

9. a) $3x + y = 17$ and $x = y + 3$

10. $x + 2y = 20$ and $x + y = 13$; Solution B

11. Variables may differ.
$w + j = 60$ and $w - j = 10$; Solution A

15. a) $\frac{C}{B} = \frac{F}{E}$

b) $\frac{C}{A} = \frac{F}{D}$

16. $x + 2y = -8$ and $9x + 10y = 0$

17. a) For example, $3x + 2y = 5$ and $-2x + 3y = 1$

18. b) $x = 3$

7.2 Solving a System of Linear Equations Graphically, page 409

3. a) $x = -4, y = 2$

b) $x = 2, y = 3$

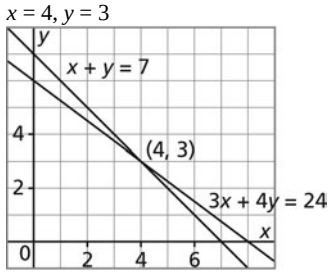
c) $x = 1, y = -3$

d) $x = -2, y = -1$

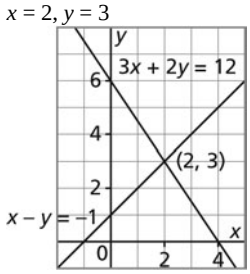
4. a) $x = 9, y = -2$; exact

b) $x = -1\frac{3}{4}, y = 2\frac{3}{4}$; approximate

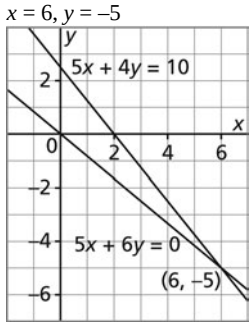
5. a) i) $x = 4, y = 3$



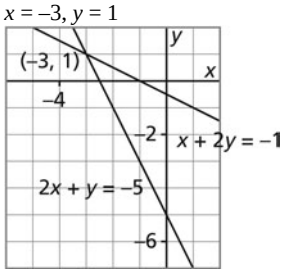
ii) $x = 2, y = 3$



iii) $x = 6, y = -5$



iv) $x = -3, y = 1$

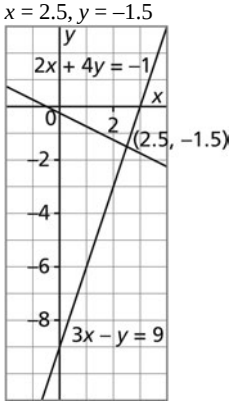


b) The coordinates of the point of intersection represent the solution of the linear system.

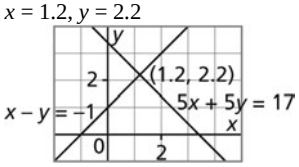
6. Approximate

7. Approximations may vary.

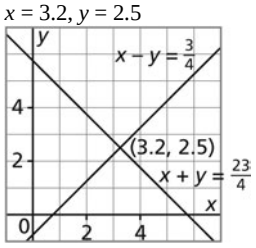
a) $x = 2.5, y = -1.5$



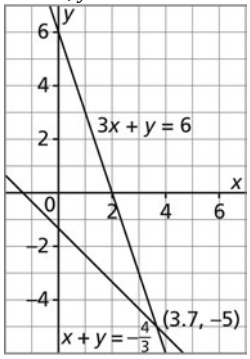
b) $x = 1.2, y = 2.2$



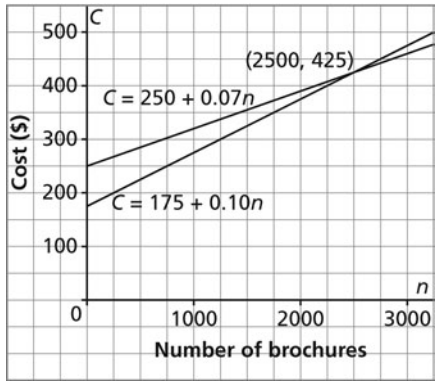
c) $x = 3.2, y = 2.5$



d) $x = 3.7, y = -5$



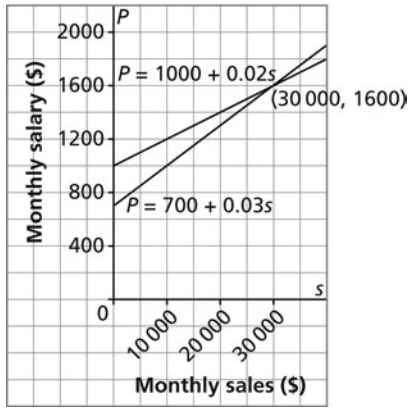
8. a)



b) **i)** 2500 brochures

ii) It is cheaper to use Company A when fewer than 2500 brochures are printed.

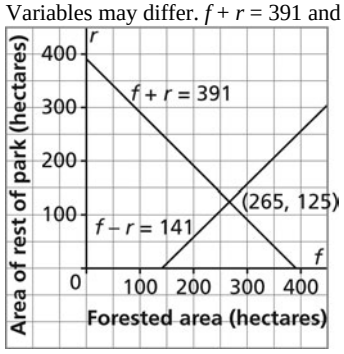
9. a)



b) **i)** $30 000

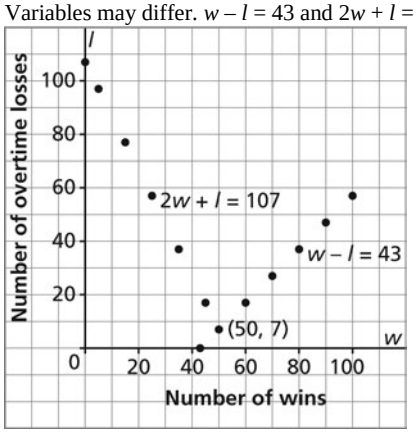
ii) It would be better to choose Plan B when the clerk's monthly sales are less than $30 000.

10. Variables may differ. $f + r = 391$ and $f - r = 141$



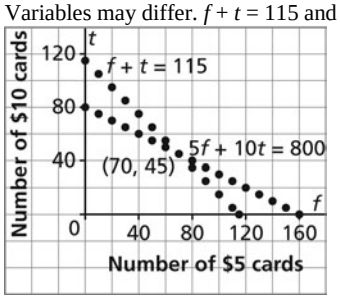
Approximations may vary. For example,
forested area: about 265 hectares;
the rest of the park: about 125 hectares; approximate

11. Variables may differ. $w - l = 43$ and $2w + l = 107$



50 wins and 7 overtime losses; exact

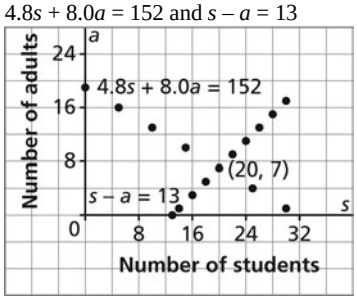
12. Variables may differ. $f + t = 115$ and $5f + 10t = 800$



Seventy $5 gift cards and forty-five $10 gift cards; exact

13. Variables may differ.

$4.8s + 8.0a = 152$ and $s - a = 13$

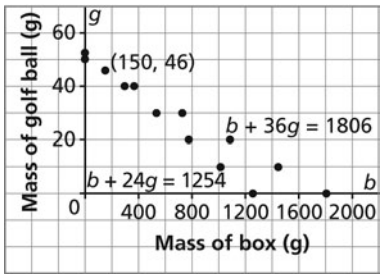


7 adults and 20 students; exact

14. Variables may differ.

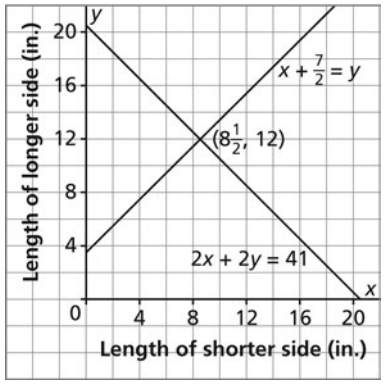
a) $b + 36g = 1806$ and $b + 24g = 1254$

b)

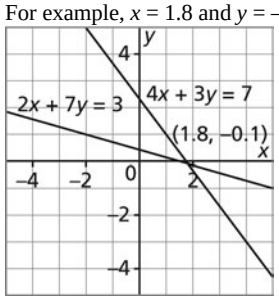


Approximations may vary. For example, mass of box: 150 g; mass of one golf ball: 46 g; approximate

15. $x = 8\frac{1}{2}$ in. and $y = 12$ in.

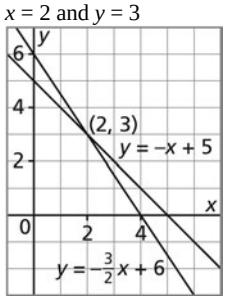


16. **a)** For example, $x = 1.8$ and $y = -0.1$; approximate



17. **a)** For example, $y = -x + 5$ and $y = -\frac{3}{2}x + 6$

b) $x = 2$ and $y = 3$



18. Equations may vary. For example, $y = -2x - 7$

19. **a)** The slopes are negative reciprocals: $-\frac{2}{3}$ and $\frac{3}{2}$

b) Answers may vary. For example,

$y = 4x + 5$ and $y = -\frac{1}{4}x - 2$

7.3 Math Lab: Using Graphing Technology to Solve a System of Linear Equations, page 412

1. **a)** Look for equal values of Y_1 and Y_2, then the corresponding X-value: $x = 4$, $y = 2$

b) Graph each line, then determine the coordinates of the point of intersection of the lines.

2. b) $x = 2.\overline{3}$ and $y = -1.1\overline{6}$

3. 48 cedar tree and 24 spruce tree seedlings

4. a) i) $x = 1$ and $y = 1$

ii) $x = 3$ and $y = 0$

iii) $x = 5$ and $y = -1$

iv) $x = 7$ and $y = -2$

b) $x + 2y = 3$ and $2x - y = 21$

c) $x = 9$ and $y = -3$

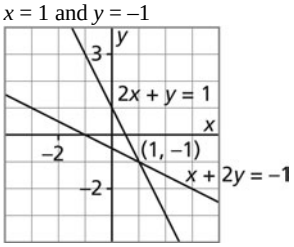
5. No

Chapter 7: Checkpoint 1, page 415

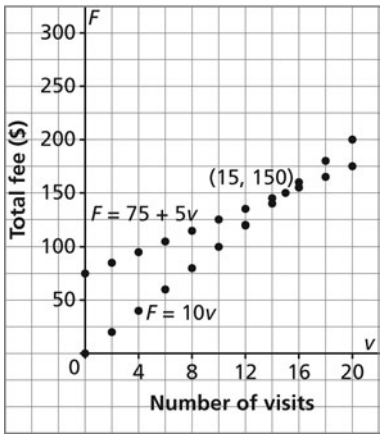
1. Variables may differ.

a) $2l + 2w = 128$ and $l - w = 16$

3. $x = 1$ and $y = -1$



4. a)

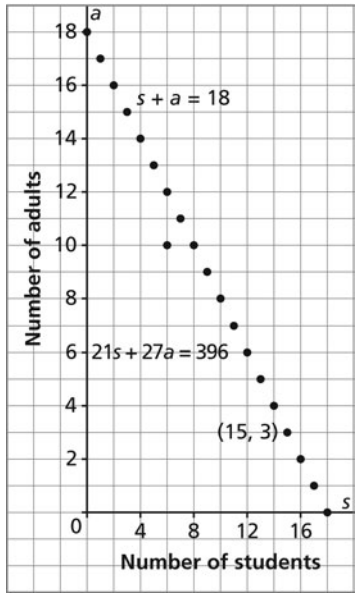


b) Plan A is cheaper when the number of visits is greater than 15.

5. Variables may differ.

a) $21s + 27a = 396$ and $s + a = 18$

b) 15 students and 3 adults



6. Variables may differ.

a) $l + s = 15\,000$ and $1.4l + 0.02s = 7200$

b) 5000 large trees and 10 000 small trees

7.4 Using a Substitution Strategy to Solve a System of Linear Equations, page 425

4. a) $x = 16, y = -7$ **b)** $x = 6, y = 7$

c) $x = -1, y = -8$ **d)** $x = 1, y = 4$

5. a) $x = -2, y = 5$ **b)** $x = -2, y = 3$

c) $x = 3, y = 5$ **d)** $x = 1, y = 4$

6. a) i) $2x$, $4x$; $4x = 2(2x)$

ii) $10y$, $5y$; $10y = 2(5y)$

iii) $6y$, $-2y$; $6y = -3(-2y)$

iv) $-3x$, $9x$; $9x = -3(-3x)$

b) i) $x = -\frac{1}{2}, y = -1$ **ii)** $x = 0, y = 1$

iii) $x = -1, y = 1$ **iv)** $x = 2, y = 3$

7. a) i

b) i) $x = -1, y = 4$ **ii)** $x = -4, y = 1$

iii) $x = 5, y = 1$

8. a) For example, multiply each term in the first equation by 6: $2x - 3y = 12$

For example, multiply each term in the second equation by 12: $10x + 9y = 12$

b) $x = 3, y = -2$

9. a) For example, divide each term in the first equation by 2: $x + y = -2$

For example, divide each term in the second equation by 4: $-3x + y = -6$

b) $x = 1, y = -3$

10. Variables may differ.
$r + n = 186$ and $n - r = 94$
46 bears responded; 140 bears did not respond.

11. Variables may differ.
$2l + 2w = 540$ and $l - w = 90$
Length: 180 cm; width: 90 cm

12. Variables may differ.
$s + a = 45$ and $0.8s + 0.6a = 31$
20 students and 25 adults

13. Variables may differ.
$x + y = 11$ and $4x + 5y = 47$
8 groups of 4 and 3 groups of 5

14. Variables may differ.
$p + a = 85$ and $0.6p + 0.4a = 38$
20 people masks; 65 animal masks

15. Variables may differ.
$0.80A + 0.92B = 63$ and $A + B = 75$
Part A: 50 marks; part B: 25 marks

16. Variables may differ.
$x + y = 5000$ and $0.025x + 0.0375y = 162.50$
Two thousand dollars in the 2.5% bond; $3000 in the 3.75% bond

17. Variables may differ.
$76s + 49d = 474.25$ and $54s + 37d = 346.25$
Single-scoop cone: $3.50; double-scoop cone: $4.25

18. Joel would have to work 15 weekends before he earns the same amount as Sue.

19. **a)** $x = 6, y = -3$ **b)** $x = -1, y = \frac{1}{3}$
c) $x = -\frac{42}{13}, y = -\frac{72}{13}$ **d)** $x = \frac{124}{51}, y = -\frac{16}{17}$

20. **b)** $r = 20, c = 5$

21. $x = 5, y = 22$

22. **a)** For example: $4x - 2y = -8$ and $9x + 6y = 3$
b) $x = -1, y = 2$; the systems have the same solution.

23. **a)** 16 km/h
b) 40 km

24. Mean mass of males: 205.7 g; mean mass of females: 168 g

25. Rate of climb: 200 m/min; rate of descent: –200 m/min

27. $A = 4, B = -3$

7.5 Using an Elimination Strategy to Solve a System of Linear Equations, page 437

3. **a)** $x = -3, y = -1$ **b)** $a = \frac{5}{3}, b = 0$
c) $x = -1, y = -1$ **d)** $x = 4, y = 3$

4. **a)** **i)** $3x - 6y = -18$ and $3x - y = 2$
ii) $x - 2y = -6$ and $6x - 2y = 4$
b) **i)** $15x - 2y = 9$ and $15x + 12y = 51$
ii) $-30x + 4y = -18$ and $5x + 4y = 17$
c) **i)** $35x + 15y = 45$ and $35x + 14y = 49$
ii) $14x + 6y = 18$ and $15x + 6y = 21$
d) **i)** $42x + 45y = 48$ and $42x + 20y = -2$
ii) $28x + 30y = 32$ and $63x + 30y = -3$

5. **a)** $x = 2, y = 4$ **b)** $x = 1, y = 3$
c) $x = 3, y = -4$ **d)** $x = -1, y = 2$

6. **a)** $x = -4, y = 3$ **b)** $m = -\frac{2}{3}, n = -\frac{1}{3}$
c) $s = 0, t = 2$ **d)** $a = 3, b = -2$

7. **a)** $x = \frac{79}{7}, y = \frac{122}{7}$ **b)** $a = -3, b = -7$
c) $a = \frac{1}{2}, b = \frac{1}{3}$ **d)** $x = \frac{5}{2}, y = -3$

8. Variables may differ.
$x + y = 90\,530$ and $y - x = 120$
2006 attendance: 45 205; 2008 attendance: 45 325

9. Variables may differ.
$t + s = 545$ and $t - s = 185$
Talise's dress: 365 cones; her sister's dress: 180 cones

10. Variables may differ.
$10k + 20b = 200$ and $15k + 25b = 270$
1 knife: 8 beaver pelts; 1 blanket: 6 beaver pelts

11. Variables may differ.
$4.5m + 0.5f = 620$ and $f - m = 40$
Moderate tempo: 120 beats/min; fast tempo: 160 beats/min

12. **a)** $a = \frac{4}{5}, b = \frac{9}{5}$ **b)** $x = 20, y = -6$
c) $x = -0.35, y = 0.25$ **d)** $x = 0.5, y = 0.5$

13. 18 Canadian; 7 foreign

14. 36 girls; 40 boys

15. **a)** $3x + y = 17$ and $x + y = 7$
b) From Balance scales 2, the sum of mass x and mass y is 7 kg. The same mass is being removed from each pan. So, the scales will still be balanced.
c) Two x-masses equal 10 kg. So, mass x is 5 kg. Remove mass x from the left side of Balance scales 2 and 5 kg from the right side. Then mass y balances 2 kg.
d) When I remove the x mass, y mass, and 7 kg from Balance scales 1, it is like subtracting the second equation from the first equation to eliminate y.

16. An adult pays $6.75 and a child pays $7. So, a child's ticket is more expensive.

17. 15 kg of green peas; 10 kg of red lentils

18. Problems may vary. $x = 5, y = 3$

19. **b)** $x = 5, y = 2$

20. **a)** For example, multiply equation 1 by –2 and equation 2 by 3, then add to eliminate x.
Multiply equation 1 by 5 and equation 2 by 4, then add to eliminate y.
b) $x = 3, y = 5$

22. $950 in the stock; $450 in the bond

23. **a)** For example, $3x + 6y = 9$; $x = -1, y = 2$

b) The solution to each system is: $x = -1$, $y = 2$

c) The solutions are the same.

24. a) 40 bushels/acre for wheat; 58 bushels/acre for barley

b) No, I could use the solution to part a and proportions to determine the yield in bushels/hectare.

Chapter 7: Checkpoint 2, page 441

1. a) $x = \frac{1}{2}$, $y = \frac{3}{2}$ **b)** $x = 0$, $y = -1$

c) $x = -6$, $y = -1$

2. a) Variables may differ.

$6x + 7y = 494$ and $x - y = 13$

b) 45 replicas with 6 stones; 32 replicas with 7 stones

3. $500 was invested in each bond.

4. a) $x = -6$, $y = -7$ **b)** $x = \frac{1}{2}$, $y = 3$

c) $x = -0.75$, $y = -1.75$ **d)** $x = -\frac{14}{5}$, $y = \frac{2}{5}$

5. Soup: 90 times; a main course: 70 times

6. Larger volume: 1450 mL; smaller volume: 450 mL

7. $x = 55°$; $y = 65°$

7.6 Properties of Systems of Linear Equations, page 448

4. a) **i)** 1 **ii)** –1

iii) 1 **iv)** –1

b) i and iii; ii and iv

c) i and ii; i and iv; ii and iii; iii and iv

5. a) A and C; B and C **b)** A and B

6. a) For example, $x - 3y = 12$ and $5x - 15y = -60$

b) For example, $6x + 3y = 5$ and $2x - 6y = 24$

c) For example, $4x + 2y = 20$ and $2x + y = 10$

7. a) One solution

b) Infinite solutions

c) No solution **d)** No solution

8. a) For example, $y = x + 2$

b) For example, $y = 2x + 2$

c) For example, $-4x + 2y = 2$

9. a) No solution **b)** One solution

c) One solution

10. One solution

11. I need to know whether the y-intercepts are the same or different.

12. For example:

One solution: $-3x - 4y = 12$

No solution: $3x - 4y = 8$

Infinite solutions: $6x - 8y = 24$

13. Infinite solutions

14. One solution

15. Infinite solutions

16. One solution

17. One solution

18. 0 points of intersection: slopes of the lines are equal and their y-intercepts are different.

1 point of intersection: slopes of the lines are different.

Infinite points of intersection: slopes of the lines are equal and their y-intercepts are equal.

19. a) For example: $x + y = 5$ and $2x + 2y = 10$

b) When I try to eliminate one variable, I also eliminate the other variable and the constant.

20. a) For example: $x + y = 4$ and $2x + 2y = 6$

b) When I try to eliminate one variable, I also eliminate the other variable.

22. a) **i)** Infinite solutions

ii) No solution **iii)** One solution

24. a) **i)** $k \neq \frac{3}{4}$ **ii)** $k = \frac{3}{4}$

Chapter 7: Review, page 452

1. a) Variables may differ.

$o + s = 41$ and $o - s = 17$

b) Solution B

2. a) Variables may differ.

$s + l = 25$ and $15s + 25l = 475$

b) Solution B

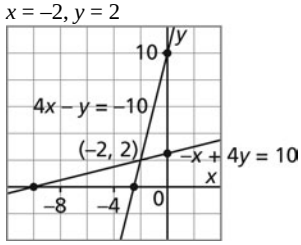
4. a) $3x + y = 11$ and $3x - 5y = -1$

b) $x = 3$, $y = 2$; exact

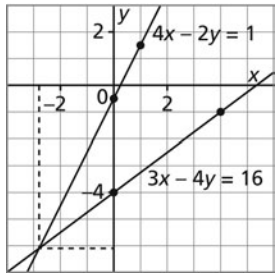
5. a) George: draw a line through each pair of points, then determine the coordinates of the point of intersection.

Sunita: plot each y-intercept, then use the slope to mark another point on each line.

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



7. a)



The graphs appear to intersect at (–2.8, –6.1).

b) Exact; when (–2.8, –6.1) is substituted into each equation, the left side equals the right side.

8. a) Variables may differ.

$2c + 4b = 940$ and $c + 3b = 620$

b) Each line represents one of the equations in the linear system.

c) One bowl of cereal has 170 mg of sodium and 1 slice of bacon has 150 mg of sodium; exact solution.

9. Where necessary, the answers have been written to 3 decimal places.

a) $x \doteq 1.526$, $y \doteq 3.316$ **b)** $x = 12, y = 0$

c) $x = 3.25, y = -1.4$

d) $x \doteq -6.071$, $y \doteq 1.964$

10. a) $x = 0, y = -5$ **b)** $x = 1, y = 3$

c) $x = \frac{19}{7}, y = -\frac{11}{63}$ **d)** $x = -1, y = -2$

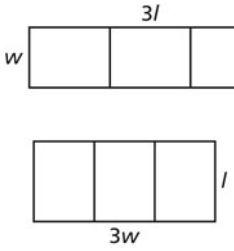
11. c) $x = -1, y = 8$

12. a) Variables may differ.

$\frac{1}{4}x + \frac{2}{3}y = 5\frac{3}{4}$ and $x - y = 1$

b) 7 one-quarter cup measures; 6 two-third cup measures

13. a)



b) Variables may differ.

$60l + 2w = 306$ and $2l + 60w = 190$

c) Width: 3 ft.; length: 5 ft.

14. 35 triangles; 115 squares

15. a) $x = 0, y = -5$ **b)** $x = -\frac{11}{2}, y = -6$

16. c) $x = 2.5, y = -0.25$

17. a) $2l + \left(1 + \frac{1}{2}\pi\right)w = 68\frac{5}{6}$ and $l - w = 7$

b) Length: 19 ft.; width: 12 ft.

18. a) Infinite solutions, for example:

$x + y = -1$ and $2x + 2y = -2$

No solution, for example: $2x + 2y = 5$ and $4x + 4y = -5$

19. a) Clue 1 and Clue 2 **b)** 45 and 12

20. a) No solution

b) Infinite solutions

c) One solution **d)** No solution

Chapter 7: Practice Test, page 455

1. B

2. A

4. b) $s = 6, a = 2$

5. a) **i)** $x = -4, y = \frac{7}{2}$ **ii)** $x = 4, y = 5$

iii) $x = \frac{3}{2}, y = \frac{1}{2}$

b) The solution of a linear system is the coordinates of the point of intersection of the graphs of the lines.

6. a) Variables may differ.

$y + r = 90$ and $25y + 12.5r = 1500$

b) 30 squares and 60 triangles

Cumulative Review Chapters 1–7, page 458

1. Answers may vary. These answers are calculated using exact conversions.

a) 9 ft. 6 in. **b)** 457 cm

c) 4 mi. 1709 yd. **d)** 165 m

e) 269 ft. **f)** 25.75 km

2. a) 384 cm^2; 384 cm^3 **b)** 579 $in.^2$; 924 $in.^3$

c) 254 cm^2; 382 cm^3

3. 56.3°

4. $36\frac{4}{10}$ in.

5. a) $81 + 18s + s^2$ **b)** $6a^2 - 19a + 15$

c) $10n^2 + 7np - 12p^2$ **d)** $64s^2 - t^2$

e) $-2w^3 - w^2 + 20w - 32$

f) $-6x^4 + 5x^3 + 22x^2 + 2x - 8$

6. a) $7(2a^3b^2 - 4b^3c^2 + 3a^2c^3)$

b) $(n - 4)(n + 3)$

c) $4(3r + 4s)(3r - 4s)$ **d)** $(2m + 9)(3m - 2)$

e) $(w - 11x)^2$ **f)** $(5c + 6d)(6c - 5d)$

7. a) **i)** $3\sqrt{5}$ **ii)** $4\sqrt[3]{2}$

iii) $\sqrt[4]{932}$ **iv)** $7\sqrt{11}$

b) **i)** $\sqrt{432}$ **ii)** $\sqrt[3]{189}$

iii) $\sqrt[5]{480}$ **iv)** $\sqrt{425}$

8. a) $\frac{a^2}{b^5}$ **b)** $\frac{c^2}{d^5}$

c) $-\frac{x^5}{4y^3z^4}$ **d)** $-\frac{6}{a^3b^2}$

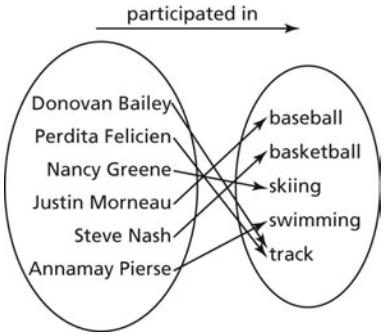
9. a) $\frac{9}{16}$ **b)** 12.25

c) $\frac{25}{36}$ **d)** 2.5

10. a) The relation shows the association "participates in" from a set of athletes to a set of sports.

b) **i)** {Perdita Felicien, track), (Donovan Bailey, track), (Nancy Greene, skiing), (Annamay Pierse, swimming), (Justin Morneau, baseball), (Steve Nash, basketball)}

ii)



11. a) Each number in the first column of the table appears exactly once.

b) Independent variable: v; dependent variable: C

c) Domain: {1, 2, 3, 4, …};
range: {1.09, 2.18, 3.27, 4.36, …}

d) $C(v) = 1.09v$

e) $C(25) = 27.25$; the cost of 25 L of gasoline is \$27.25.

f) $v \doteq 46$; with \$50, approximately 46 L of gasoline can be purchased.

12. a) False **b)** True

c) True **d)** False

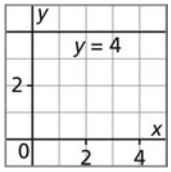
13. a) Graph B

14. a) Domain: $x \leq 3$; range: $y \geq -2$

b) Domain: all real numbers; range: $y \leq 3$

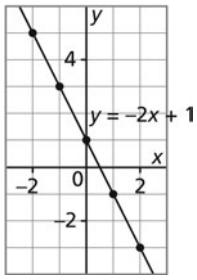
15. a) Tables of values and sketches may vary. For example:

i) A horizontal line that passes through (0, 4)



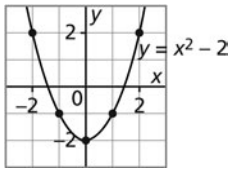
ii)

x	y
–2	5
–1	3
0	1
1	–1
2	–3

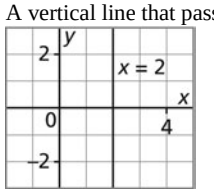


iii)

x	y
–2	2
–1	–1
0	–2
1	–1
2	2

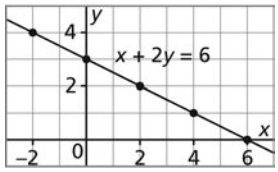


iv) A vertical line that passes through (2, 0)



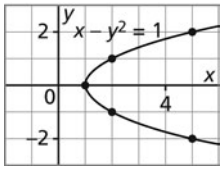
v)

x	y
–2	4
0	3
2	2
4	1
6	0



vi)

x	y
1	0
2	1
2	–1
5	2
5	–2



b) i, ii, iv, and v; the graphs are straight lines.

16. a) 300; (0, 300); the fixed cost of renting the banquet room is \$300.

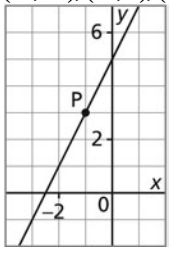
b) \$15/person; for each additional person who attends, the cost increases by \$15.

c) Domain: {0, 1, 2, 3, 4, 5, …};
range: {300, 315, 330, 345, 360, 375, …};
The domain can be any whole number up to the number of people the banquet room can hold.
The range can be any multiple of 15 greater than or equal to 300, up to a number that depends on the maximum capacity of the room.

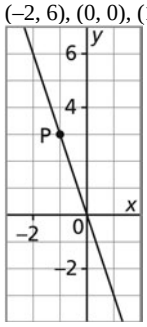
d) \$1050 **e)** 25 people

17. Points and sketches may vary. For example:

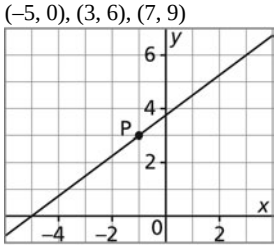
a) (–3, –1), (–2, 1), (0, 5)



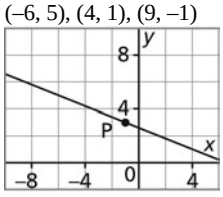
b) (–2, 6), (0, 0), (1, –3)



c) (–5, 0), (3, 6), (7, 9)

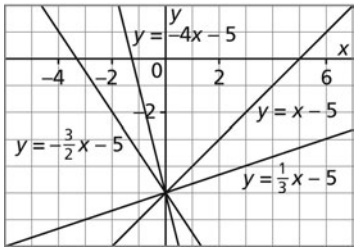


d) (–6, 5), (4, 1), (9, –1)



18. a) Neither **b)** Perpendicular
c) Parallel **d)** Perpendicular

19. a)



b) Changing the value of m changes the steepness of the graph.

20. a) The student wrote the slope as $\frac{1}{2}$ instead of –2, and the y-intercept as –3 instead of 3.

b) $y = -2x + 3$

21. a) Equations may vary. For example:

i) $y - 2 = -\frac{4}{5}(x + 1)$

ii) $y + 3 = 2(x + 2)$

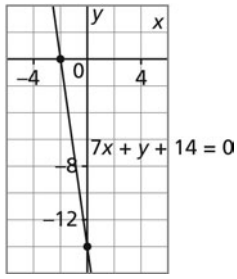
b) i) $y = -\frac{4}{5}x + \frac{6}{5}$; x-intercept: $\frac{3}{2}$; y-intercept: $\frac{6}{5}$

ii) $y = 2x + 1$; x-intercept: $-\frac{1}{2}$; y-intercept: 1

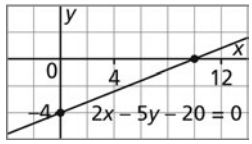
22. a) $d = 14t + 200$ **b)** \$690
c) 37 h **d)** No

23. a) Sketches may vary. For example:

i)



ii)



b) i) –7 **ii)** $\frac{2}{5}$

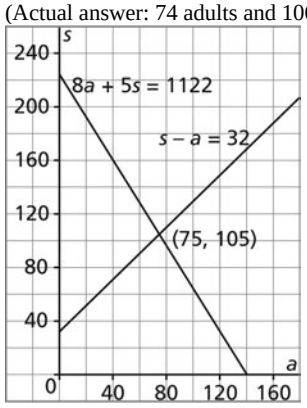
24. a) i) $25x - 20y - 12 = 0$

ii) $2x - 3y - 14 = 0$

25. Variables may differ.
$9.60s + 20.80l = 2206.40$ and $s + l = 140$

26. a) Forms of equations in the system may vary. For example:
$8a + 5s = 1122$ and $s - a = 32$

b) Answers may vary. For example:
75 adults and 105 students; approximate
(Actual answer: 74 adults and 106 students)



27. $x = \frac{8}{3}$; $y = \frac{7}{12}$

28. Part A: 48 marks; Part B: 60 marks

29. a) $x = \frac{53}{26}$, $y = -\frac{8}{13}$

b) $x = -3$, $y = \frac{5}{2}$

30. Equations may vary. For example:
One solution: $x - y = 1$
No solution: $5x + 3y = 1$
Infinite solutions: $10x + 6y = 30$

Glossary

acute angle: an angle measuring less than 90°

acute triangle: a triangle with three acute angles

algebraic expression: a mathematical expression containing a variable: for example, $6x - 4$

angle of depression: the angle between the horizontal through eye level and a line of sight to a point below eye level

angle of elevation: the angle between the horizontal through eye level and a line of sight to a point above eye level

angle of inclination: the acute angle between the horizontal and a line or line segment

apex: the vertex farthest from the base of an object

approximate: a number close to the exact value of an expression; the symbol $\doteq$ means "is approximately equal to"

area: a measure of the number of square units needed to cover a region

arithmetic operations: the operations of addition, subtraction, multiplication, and division

arrow diagram: used to represent a relation; the ovals show the sets, and the arrows associate elements of the first set with elements of the second set

average: a single number that represents a set of numbers (see *mean*)

bar graph: a graph that displays data by using horizontal or vertical bars

bar notation: the use of a horizontal bar over a decimal digit to indicate that it repeats; for example, $1.\overline{3}$ means 1.333 333 …

base: the side of a polygon or the face of an object from which the height is measured

base of a power: see *power*

binomial: a polynomial with two terms; for example, $3x - 8$

calipers: a tool used to measure the diameter or thickness of an object

capacity: the amount a container can hold

central angle: an angle whose arms are radii of a circle

circumference: the distance around a circle, also the perimeter of the circle

clinometer: a tool used to measure an angle above or below the horizontal

coefficient: the numerical factor of a term; for example, in the terms $3x$ and $3x^2$, the coefficient is 3

common factor: a number that divides into each number in a set; for example, 3 is a common factor of 15, 9, and 21. An expression that divides into each term of a given polynomial; for example, $4y$ is a common factor of $8x^2y + 4xy + 12y$

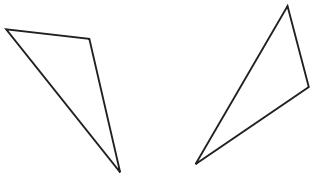
common multiple: a number that is a multiple of each number in a set; for example, 6 is a common multiple of 2 and 3

composite number: a number with three or more factors; for example, 8 is a composite number because its factors are 1, 2, 4, and 8

composite object: the result of combining two or more objects to make a new object

cone: see *right cone*

congruent: shapes that match exactly, but do not necessarily have the same orientation



consecutive numbers: integers that come one after the other without any integers missing; for example, 34, 35, 36 are consecutive numbers, so are -2, -1, 0, and 1

constant term: the term in an expression or equation that does not change; for example, in the expression $4x + 3$, 3 is the constant term

conversion factor: a number used to multiply or divide a quantity to convert from one unit of measure to another

coordinate axes: the horizontal and vertical axes on a grid

coordinates: the numbers in an ordered pair that locate a point on a coordinate grid (see *ordered pair, x-coordinate, y-coordinate*)

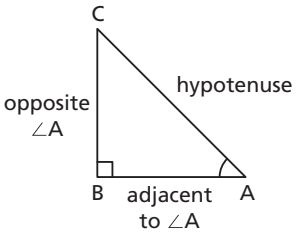
corresponding angles: matching angles in similar polygons

corresponding lengths: matching lengths on an original diagram and its scale diagram

corresponding sides: matching sides of similar polygons

cosine ratio: for an acute ∠A in a right triangle, the ratio of the length of the side adjacent to ∠A to the length of the hypotenuse; written cos A

$$\cos A = \frac{\text{length of side adjacent to } \angle A}{\text{length of hypotenuse}}$$



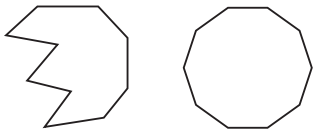
cube: an object with six congruent square faces

cube number: a number that can be written as a power with an integer base and exponent 3; for example, $8 = 2^3$

cube root: a number which, when raised to the exponent 3, results in a given number; for example, 5 is the cube root of 125

cubic units: units that measure volume

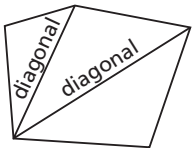
decagon: a polygon with 10 sides



denominator: the term below the line in a fraction

dependent variable: a variable whose value is determined by the value of another (the independent) variable

diagonal: a line segment that joins two vertices of a shape, but is not a side



diameter: the distance across a circle, measured through its centre; or the line segment that joins two points on the circle and passes through its centre

difference of squares: a binomial of the form $a^2 - b^2$; it can be factored as $(a - b)(a + b)$

digit: any of the symbols used to write numerals; for example, 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9

dimensions: measurements such as length, width, and height

direct measurement: a measurement made using a measuring instrument or by counting

displacement: the volume of water moved or displaced by an object put in the water; the volume of the object is equal to the volume of water displaced

distributive property: the property stating that a product can be written as a sum or difference of two products; for example, $a(b + c) = ab + ac$

divisor: the number that divides into another number

domain: the set of first elements of a relation

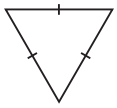
edge: two faces of an object meet at an edge

element: an element of a set is one object in the set

entire radical: a radical sign and the number under it; for example, $\sqrt[5]{32}$

equation: a mathematical statement that two expressions are equal

equilateral triangle: a triangle with 3 equal sides



equivalent: having the same value; for example, $\frac{1}{2}$ and $\frac{2}{4}$; 3:4 and 9:12

estimate: a reasoned guess that is close to the actual value, without calculating it exactly

evaluate: to determine the value of a numerical expression

even integer: a number that has 2 as a factor; for example, 2, 4, 6

expanding an expression: writing a product of polynomial factors as a polynomial

exponent: see *power*

exponent laws: the rules that describe how combinations of powers can be written differently

expression: a mathematical statement made up of numbers and/or variables connected by operations

face: a flat surface of an object

factor: to factor means to write as a product; for example, $20 = 2 \cdot 2 \cdot 5$

factor tree: a branching diagram with a number at the top and its prime factors at the bottom

factored fully: factoring a polynomial so each factor cannot be factored further

factoring a polynomial: writing a polynomial as a product of its factors

factoring by decomposition: factoring a trinomial after writing the middle term as a sum of two terms, then determining a common binomial factor from the two pairs of terms formed

factors: numbers or algebraic expressions that are multiplied to get a product; for example, 3 and 7 are factors of 21, and $x + 1$ and $x + 2$ are factors of $x^2 + 3x + 2$

formula: a rule that is expressed as an equation

fraction: an indicated quotient of two quantities

function: a relation where each element in the first set is associated with exactly one element in the second set

function notation: notation used to show the independent variable in a function; for example, $f(x)$ means that the value of the function f depends on the value of the independent variable x.

general form: the equation of a line in the form $Ax + By + C = 0$, where A is a whole number, and B and C are integers

greatest common factor (GCF): the greatest number that divides into each number in a set; for example, 5 is the greatest common factor of 10 and 15

height: the perpendicular distance from the base of a shape to the opposite side or vertex; the perpendicular distance from the base of an object to the opposite face or vertex

hemisphere: half a sphere

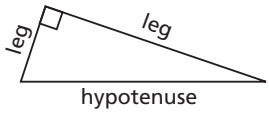
hexagon: a polygon with 6 sides

horizontal axis: see *x-axis*

horizontal intercept: see *x-intercept*

horizontal line: a line parallel to the horizon

hypotenuse: the side opposite the right angle in a right triangle



imperial units: measurement units such as the mile, yard, foot, and inch commonly used in the United States and in some industries in Canada

independent variable: a variable whose value is not determined by the value of another variable, and whose value determines the value of another (the dependent) variable

index: in a radical, the number above the radical symbol that indicates which root is to be taken; for example, 3 is the index in the radical $\sqrt[3]{81}$; if the index is not written, it is assumed to be 2

indirect measurement: a measurement made using a ratio, formula, or other mathematical reasoning

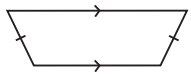
integers: the set of numbers $\ldots -3, -2, -1, 0, 1, 2, 3, \ldots$

inverse operation: an operation that reverses the result of another operation; for example, subtraction is the inverse of addition, and division is the inverse of multiplication

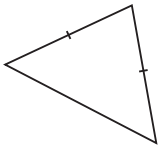
irrational number: a number that *cannot* be written in the form $\frac{m}{n}$, $n \neq 0$, where m and n are integers

isometric: equal measure; on isometric dot paper, the line segments joining 2 adjacent dots in any direction are equal

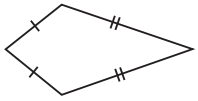
isosceles trapezoid: a trapezoid with 2 equal, non-parallel sides



isosceles triangle: a triangle with 2 equal sides



kite: a quadrilateral with two pairs of adjacent sides equal



lateral area: the surface area of an object, not including the area of its bases

least common multiple (LCM): the least multiple that is the same for two numbers; for example, the least common multiple of 12 and 21 is 84

legs: the sides of a right triangle that form the right angle (see *hypotenuse*)

like terms: terms that have the same variables raised to the same powers; for example, $4x$ and $-3x$ are like terms

line segment: the part of a line between two points on the line

linear function: a linear relation whose graph is not a vertical line

linear relation: a relation that has a straight-line graph

linear system: see *system of linear equations*

mass: the amount of matter in an object

mean: the sum of a set of numbers divided by the number of numbers in the set

midpoint: the point that divides a line segment into two equal parts

mixed radical: a number written as a product of another number and a radical; for example, $3\sqrt{5}$

monomial: a polynomial with one term; for example, 14 and $5x^2$ are monomials

multiple: the product of a given number and a natural number; for example, some multiples of 8 are 8, 16, 24, …

natural numbers: the set of numbers 1, 2, 3, 4, 5, …

negative number: a number less than 0

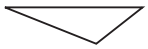
negative reciprocals: two numbers whose product is -1; for example, $-\frac{3}{7}$ and $\frac{7}{3}$

numerator: the term above the line in a fraction

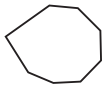
numerical coefficient: see *coefficient*

object: a solid or shell that has 3 dimensions

obtuse triangle: a triangle with one angle greater than 90°



octagon: a polygon with 8 sides



operation: a mathematical process or action such as addition, subtraction, multiplication, division, or raising to a power

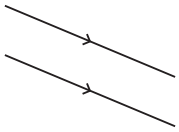
opposites: two numbers with a sum of 0; for example, 2.4 and -2.4 are opposite numbers

order of operations: the rules that are followed when simplifying or evaluating an expression

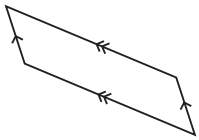
ordered pair: two numbers in order, for example, (2, 4); on a coordinate grid, the first number is the horizontal coordinate of a point, and the second number is the vertical coordinate of the point

origin: the point where the horizontal axis and the vertical axis intersect

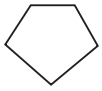
parallel lines: lines on the same flat surface that do not intersect



parallelogram: a quadrilateral with opposite sides parallel and opposite angles equal



pentagon: a polygon with 5 sides



percent: the number of parts per 100; the numerator of a fraction with denominator 100

perfect cube: see *cube number*

perfect square: see *square number*

perfect square trinomial: a trinomial of the form $a^2 + 2ab + b^2$; it can be factored as $(a + b)^2$

perimeter: the distance around a closed shape

perpendicular: lines or line segments that intersect at right angles

pi (π): the ratio of the circumference of a circle to its diameter; $\pi = \dfrac{\text{circumference}}{\text{diameter}}$

point of intersection: the point where two graphs intersect

polygon: a closed shape that consists of line segments; for example, triangles and quadrilaterals are polygons

polyhedron (*plural*, **polyhedra**)**:** an object with faces that are polygons

polynomial: one term or the sum of terms whose variables have whole-number exponents; for example, $x^2 + 3xy - 2y^2 + 5x$

power: an expression of the form a^n, where a is the base and n is the exponent; it represents a product of equal factors; for example, $4 \cdot 4 \cdot 4$ can be written as 4^3

primary trigonometric ratios: three ratios involving sides in right triangles (see *cosine ratio*, *sine ratio*, and *tangent ratio*)

prime factor: a prime number that is a factor of a number; for example, 5 is a prime factor of 30

prime factorization: writing a number as a product of its prime factors; for example, the prime factorization of 20 is $2 \cdot 2 \cdot 5$, or $2^2 \cdot 5$

prime number: a whole number with exactly two factors, itself and 1; for example, 2, 3, 5, 7, 11, 29, 31, and 43

prism: an object with 2 bases (see *right prism*)

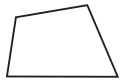
product: the result when two or more numbers are multiplied; or the expression of one number multiplied by another

proportion: a statement that two ratios are equal; for example, $r{:}24 = 3{:}4$

proportional reasoning: the ability to understand and compare quantities that are related multiplicatively

Pythagorean Theorem: the rule that states that, for any right triangle, the area of the square on the hypotenuse is equal to the sum of the areas of the squares on the legs

quadrilateral: a polygon with 4 sides



quotient: the result when one number is divided by another; or the expression of one number divided by another

radical: an expression consisting of a radical sign, a radicand, and an index; for example, $\sqrt[3]{64}$

radicand: the number under a radical sign; for example, 81 is the radicand in $\sqrt{81}$

radius (*plural*, **radii**)**:** the distance or line segment from the centre of a circle to any point on the circle

range: the set of second elements associated with the first elements (domain) of a relation

rate: a comparison of two quantities measured in different units

rate of change: the change in one quantity with respect to the change in another quantity (see *slope*)

ratio: a comparison of two or more quantities with the same unit

rational number: any number that can be written in the form $\dfrac{m}{n}$, $n \neq 0$, where m and n are integers

real number: any number that is a rational number or an irrational number; a member of the set of numbers that have a decimal representation

reciprocals: two numbers whose product is 1; for example, $\dfrac{2}{3}$ and $\dfrac{3}{2}$

rectangle: a quadrilateral that has four right angles

rectangular prism: see *right rectangular prism*

rectangular pyramid: see *right rectangular pyramid*

referent: used to estimate a measure; for example, a referent for a length of 1 mm is the thickness of a dime

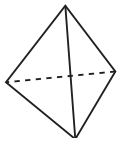
regular polygon: a polygon that has all sides equal and all angles equal

regular polyhedron: a polyhedron with congruent faces, each of which is a regular polygon

regular prism: a prism with regular polygons as bases; for example, a cube

regular pyramid: a pyramid with a regular polygon as its base

regular tetrahedron: an object with four congruent equilateral triangular faces; a regular triangular pyramid



relation: a rule that associates the elements of one set with the elements of another set

repeating decimal: a decimal with a repeating pattern in the digits to the right of the decimal point; it is written with a bar above the repeating digits; for example, $0.\overline{3} = 0.333\,333\,\ldots$

rhombus: a parallelogram with four equal sides

right angle: a 90° angle

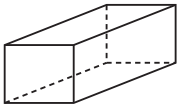
right cone: an object with one circular base and one vertex; the line through the vertex and the centre of the base is perpendicular to the base

right cylinder: an object with two parallel, congruent, circular bases; the line through the centres of the bases is perpendicular to the bases

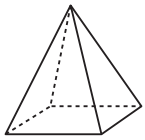
right prism: an object that has two congruent and parallel faces (the *bases*), and other faces that are rectangles

right pyramid: an object that has one face that is a polygon (the *base*), and other faces that are triangles with a common vertex; the line through the vertex and the centre of the base is perpendicular to the base

right rectangular prism: a prism that has rectangular faces



right rectangular pyramid: a pyramid that has a rectangular base; the line through the vertex and the centre of the base is perpendicular to the base



right triangle: a triangle that has one right angle

rise: the vertical distance between two points; see *slope*

run: the horizontal distance between two points; see *slope*

scale: the numbers on the axes of a graph

scale factor: the ratio of corresponding lengths of two similar shapes

set: a collection of distinct objects

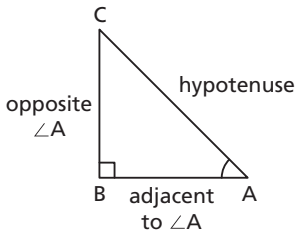
SI system of measures: a system of units based on powers of 10; the fundamental unit: of length is the metre (m); of mass is the kilogram (kg); and of time is the second (s).

similar polygons: polygons with the same shape; one polygon is an enlargement or a reduction of the other polygon

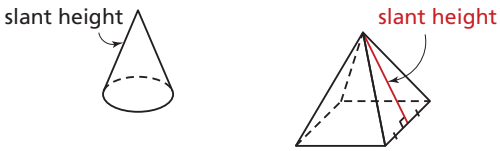
simplest form: a ratio with terms that have no common factors, other than 1; a fraction with numerator and denominator that have no common factors, other than 1

sine ratio: for an acute $\angle A$ in a right triangle, the ratio of the length of the side opposite $\angle A$ to the length of the hypotenuse; written sin A

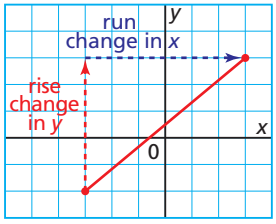
$$\sin A = \frac{\text{length of side opposite } \angle A}{\text{length of hypotenuse}}$$



slant height: the distance from a point on the perimeter of the base of a cone to the apex of the cone; the distance from the midpoint of the base of one triangular face of a regular pyramid to the apex of the pyramid



slope: a measure of how one quantity changes with respect to the other; it can be determined by calculating $\frac{\text{rise}}{\text{run}}$



slope-intercept form: the equation of a line in the form $y = mx + b$, where m is the slope of the line, and b is its y-intercept

slope-point form: the equation of a line in the form $y - y_1 = m(x - x_1)$, where m is the slope of the line, and the line passes through point $P(x_1, y_1)$

solving a triangle: determining the measure of each angle in a triangle and the length of each side of the triangle

sphere: an object where every point on the surface of the object is the same distance from the centre of the object

square: a rectangle with 4 equal sides

square number: a number that can be written as a power with an integer base and exponent 2; for example, $49 = 7^2$

square root: a number which, when multiplied by itself, results in a given number; for example, 5 is a square root of 25

square units: units that measure area

standard form: the equation of a line in the form $Ax + By = C$, where A, B, and C are integers

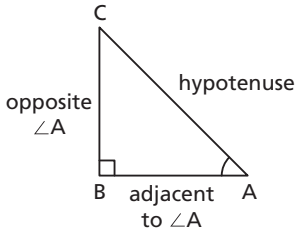
substituting into an equation: in an equation of a linear function, replacing one variable with a number or an expression

surface area: the total area of the surface of an object

system of linear equations: two equations of linear functions in the same two variables

tangent ratio: for an acute $\angle A$ in a right triangle, the ratio of the length of the side opposite $\angle A$ to the length of the side adjacent to $\angle A$; written tan A

$$\tan A = \frac{\text{length of side opposite } \angle A}{\text{length of side adjacent to } \angle A}$$



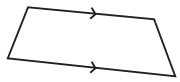
term: a number, a variable, or the product of numbers and variables; for example, -5, y, $7a^2$

terminating decimal: a decimal with a certain number of digits after the decimal point; for example, 0.125

tetrahedron: a pyramid that has a triangular base

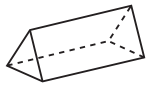
three-dimensional: having length, width, and depth or height

trapezoid: a quadrilateral with exactly 1 pair of parallel sides



triangle: a polygon with 3 sides

triangular prism: a prism with triangular bases



trigonometry: the study of the properties and applications of triangles

trinomial: a polynomial with three terms; for example, $3x^2 + 5x - 8$

unit analysis: a method of converting a measure in a given unit to a measure in a different unit by multiplying the measure by a conversion factor

variable: a letter or symbol representing a quantity that can vary

vertex (*plural*, **vertices**)**:** the point where 2 sides of a shape meet, or the point where 3 or more edges of an object meet

vertical axis: see *y-axis*

vertical intercept: see *y-intercept*

vertical line: a line perpendicular to the horizontal

volume: the amount of space occupied by an object

whole numbers: the set of numbers 0, 1, 2, 3, …

***x*-axis:** the horizontal number line on a coordinate grid

***x*-coordinate:** on a coordinate grid, the first number in an ordered pair

***x*-intercept:** the *x*-coordinate of a point where a graph intersects the *x*-axis

***y*-axis:** the vertical number line on a coordinate grid

***y*-coordinate:** on a coordinate grid, the second number in an ordered pair

***y*-intercept:** the *y*-coordinate of a point where a graph intersects the *y*-axis

Zero Principle: the property of addition that states that adding 0 to a number does not change the number; for example, $3 = 0 + 3$

Index

Acknowledgments

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