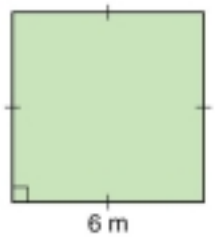
Answers

Chapter 1 Measuring Figures and Objects

1.1 Measuring Perimeter and Area, page 5

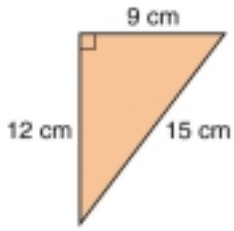
1. a) $P = 28$ m; $A = 45$ m^2
   b) $P \doteq 50.27$ cm; $A \doteq 201.06$ cm^2
   c) $P = 60$ cm; $A = 120$ cm^2
2. a) $P = 26$ cm; $A = 24$ cm^2
   b) $P = 62$ cm; $A = 204$ cm^2
   c) $P \doteq 25.7$ cm; $A \doteq 39.27$ cm^2
3. a) $P = 13$ cm; $A = 10.36$ cm^2
   b) $P = 11.2$ cm; $A = 3.9$ cm^2
   c) $P = 33.3$ cm; $A \doteq 51.8$ cm^2
4. The area of the sail is about 2.6 m^2.
5. About 2356 cm; 23.56 m
   Reanne needs about 24 m of plastic tubing.
6. 369.6 cm^2
7. a) 8 cm b) 4 cm
8. 6 m



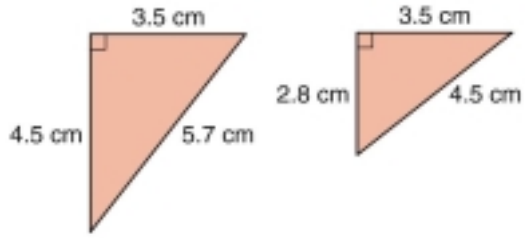
9. a) 120 cm
   b) 105 cm
   The sum of the lengths of the 3 sides is 300 cm.
10. a) About 38 cm
    b) No. Since the diameter of the circle of wire is about 38 cm, it will not fit around a circular tube with diameter 40 cm.

1.2 Measuring Right Triangles, page 9

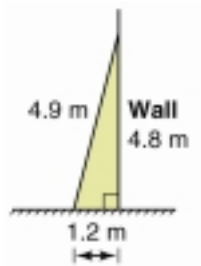
1. a) 10 cm
   b) 13 cm
   c) About 11.3 m
2. a) About 6.8 cm b) About 6.5 m
   c) About 16.6 m
3. About 3.4 km
4. $P = 36$ cm



5. a) The offset is about 34 cm long.
   b) The result is reasonable. The offset should be greater than 24 cm.
6. 4.5 m
7. a) Yes; $3^2 + 4^2 = 5^2$
   b) No; $2.5^2 + 5.6^2 \neq 6.4^2$
   c) Yes; $9.6^2 + 12.8^2 = 16^2$
8. a) 12 cm
   b) About 2.5 m
   c) 2 m
9. About 5.7 cm or about 2.8 cm



10. a)



The ladder reaches up the wall about 4.8 m. Yes. One quarter of 4.8 m is 1.2 m. The ladder is positioned safely.

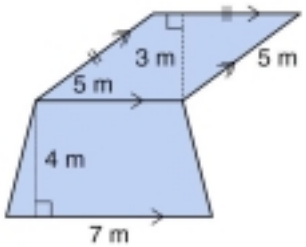
1.3 Area of a Composite Figure, page 12

1. a) 16 cm^2 b) 12 cm^2
   c) 14 cm^2
2. a) 25 cm^2 b) 48 cm^2
   c) 29 cm^2
3. a) 600 cm^2 b) 24 m^2
   c) 1575 cm^2
4. a) 151 m^2 b) About 317.5 cm^2
5. a) 33 m^2 b) 94.5 m^2
   c) About 31.4 m^2
   The answers are reasonable. Justifications may vary. For example: In part a, the area of the composite figure should be less than the area of a square with side length 6 m. In part b, the area of the composite figure should be a little less than the area of a parallelogram with base 15 m and height 7 m. In part c, the area of the composite figure should be less than the area of the semicircle with radius 6 m, but greater than the area of the semicircle with radius 4 m.
6. a) 13.5 m^2
   b) 135 000 cm^2

c) 900 cm^2

d) 150 tiles; 135 000 $cm^2 \div 900\ cm^2 = 150$

7. a)



b) 39 m^2

c) 156 bags

d) $357.24

1.4 Perimeter of a Composite Figure, page 16

1. a) i) 24 cm

ii) 24 cm

iii) 22 cm

iv) 22 cm

b) The perimeters in part a are equal in pairs: i and ii, iii and iv.
All 4 composite figures start from a 6-cm by 4-cm rectangle, but:
Part i: has an extra equilateral triangle on one of the 4-cm sides
Part ii: has an equilateral triangle on one of the 4-cm sides removed
Part iii: has an isosceles triangle on one of the 6-cm sides removed
Part iv: has an extra isosceles triangle on one of the 6-cm sides
So, the areas are different.

2. About 26.2 m

3. a) $P \doteq 117.2$ cm

b) Yes, the result is reasonable. The perimeter of the composite figure should be at least double the perimeter of the interior square.

4. a) About 60.1 cm

b) About 86.8 cm

5. a) i) About 52.6 m
40 m of edging are needed for the rectangular patio, about 12.6 m of edging are needed around the circular fish pond.

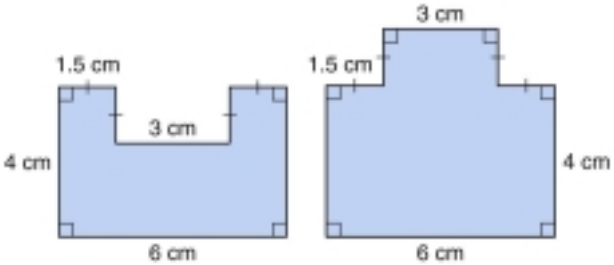
ii) About $252

b) i) About 83.4 m^2

ii) About $3753

c) I made the assumption that I could buy fractions of a metre of edging and fractions of a square metre of sandstone.

6. Answers may vary. For example:



$P = 23$ cm
$A = 19.5\ cm^2$

$P = 23$ cm
$A = 28.5\ cm^2$

7. a) 17 m

b) About 4 rolls

c) About $60

Chapter 1 Mid-Chapter Review, page 20

1. a) $A = 6.25\ m^2$; $P = 10$ m

b) $A \doteq 6.16\ m^2$; $P \doteq 8.8$ m

c) $A = 5.04\ m^2$; $P = 9.4$ m

2. Answers may vary. For example: Yes, I used the formulas for the area and perimeter of a square, a circle, and a trapezoid.

3. a) $A \doteq 565\ cm^2$; $P \doteq 30.85$ cm

b) $A \doteq 15.6\ cm^2$; $P = 18$ cm

4. a) About 8.1 m **b)** About 13.2 cm

5. a) $P \doteq 43$ cm

b) $P \doteq 43.4$ cm

6. a) $c \doteq 17$ m **b)** $h \doteq 6.6$ m

7. a) $P = 52$ cm; $A = 104\ cm^2$
Explanations may vary. For example: I know my results are reasonable because the area should be less than the area of a 12-cm by 10-cm rectangle.

b) $P \doteq 25.4$ m; $A \doteq 40.3\ m^2$
Explanations may vary. For example: I know my results are reasonable because the area should be less than the area of a 6-m by 8-m rectangle.

8. Andrew needs just a little more than 6 cans of paint.

1.5 Volumes of a Prism and a Cylinder, page 23

1. a) 216 cm^3

b) 3456 cm^3

c) 512 cm^3

2. a) 36 cm^3

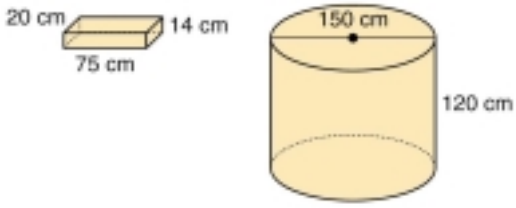
b) 192 cm^3

c) 1728 m^3

3. a) About 4423.4 m^3

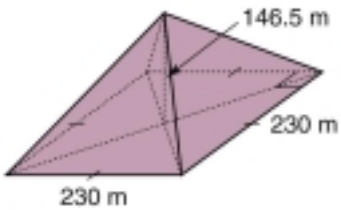
b) About 942.5 cm^3

c) About 1131 cm^3

4. a) 486 cm^3
   b) Yes. The party-pack box of pasta serves 32 people. If each dimension is doubled, the volume is 2 × 2 × 2, or 8 times as great; so, the party-pack will serve 8 times as many people as the regular size: $4 \times 8 = 32$
5. a) 

   The cylindrical bale has a greater volume.
   $V_{rectangular\ bale}$ = 21 000 cm^3, or 0.021 m^3
   $V_{cylindrical\ bale}$ = 2 120 575 cm^3, or about 2.1 m^3
   b) About 100
6. a) 684 m^3
   b) Yes; 0.021 $m^3 \times 1000 = 21\ m^3$
   21 m^3 < 684 m^3
   c) No; 2.1 $m^3 \times 1000 = 2100\ m^3$
   2100 m^3 > 684 m^3
7. a) $V \doteq 70\ cm^3$
   b) $V \doteq 78\ cm^3$
8. a) About 5132 cm^3
   b) About 6.2 kg

1.6 Volume of a Pyramid, page 26

1. Prism: $V = 216\ cm^3$; pyramid: $V = 72\ cm^3$
2. a) 1500 cm^3
   b) About 46.7 m^3
   c) 2250 cm^3
3. a) 80 m^3
   b) 306 cm^3
   c) 522.5 m^3
4. a) 

   b) About 167 517 m^3 of rock have been lost, perhaps due to wind and water erosion.
5. a) About 11 m^3
   b) Answers may vary.
6. a) 208 cm^3
   b) Explanations may vary. For example: There is probably some air inside the package as well. Water expands as it freezes.
7. a) About 15.3 cm
   b) About 999.6 cm^3
8. About 452 m

1.7 Volume of a Cone, page 31

1. a) 14 cm^3
   b) 6.4 cm^3
2. a) About 9.42 cm^3 (cylinder); about 3.14 cm^3 (cone)
   b) About 92.4 cm^3 (cylinder); about 30.8 cm^3 (cone)
3. a) About 301.6 cm^3
   b) About 28.3 cm^3
   c) About 194.4 m^3
4. About 113.1 cm^3
5. a) $h = 4$ cm; $V \doteq 37.7\ cm^3$
   b) $h \doteq 7.1$ m; $V \doteq 285.8\ m^3$
   c) $h \doteq 7.5$ cm; $V \doteq 502.7\ cm^3$
6. a) About 13.2 m^3
   b) Answers may vary. For example: It should be one-third the volume of a related cylinder.
7. About 153 million cubic metres, or 0.15 km^3

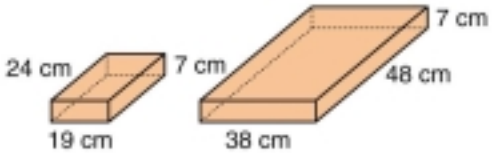
1.8 Volume of a Sphere, page 35

1. Cylinder: about 785.4 cm^3; sphere: about 523.6 cm^3
2. About 1436.8 cm^3
3. a) About 4188.8 cm^3
   b) About 268.1 m^3
   c) About 179.6 cm^3
4. a) About 3053.6 m^3
   b) About 1436.8 cm^3
   c) About 310.3 cm^3
5. a) About 4 breaths; I assumed the student emptied only part of his lungs with one breath.
   b) Answers will vary. For example: It usually takes me 5 or 6 breaths to blow up a balloon.
6. a) 2744 cm^3
   b) 14 cm
   c) About 1436.8 cm^3
   d) 1307.2 cm^3
   Answers may vary. For example: I assumed Lyn will make the largest possible wooden ball and that her ball will be spherical.
7. a) About 19 scoops
   b) About 23¢ per scoop
   c) 17¢ per cone; single-scoop ice-cream cone: 40¢ (or about 50¢); double-scoop ice-cream cone: 63¢ (or about 75¢). I rounded up to the nearest quarter so Meighan could make a profit.

Chapter 1 Review, page 38

1. a) $P = 30$ cm; $A = 40\ cm^2$
   b) $C \doteq 37.7$ cm; $A \doteq 113.1\ cm^2$
2. a) 4356 cm^2
   b) 3744 cm^2
3. a) 15 cm
   b) 18 cm
4. About 4.9 m

5. About 61.6 cm^2
6. About 5731.83 cm^2
7. About 81.2 cm
8. a) About 51.4 cm
   b) The answer is reasonable. The perimeter should be a little longer than the perimeter of a 10-cm by 10-cm square; that is, a little larger than 40 cm
9. a) 1820 cm^3
   b) About 2152.8 cm^3
10. a) 16 people; the new volume is 2 × 2, or 4 times as great. 4 people × 4 = 16 people
    b) 32 people; the new volume is 2 × 2 × 2, or 8 times as great. 4 people × 8 = 32 people



11. 560 cm^3
12. a) 1880 m^3
    b) The volume of the pyramid is one-third the volume of a square prism with a 20-m by 20-m square base and height 14.1 m.

    $V_{pyramid} = \frac{1}{3} \times V_{prism}$

    $1880 = \frac{1}{3} \times 5640$

    The answer is reasonable.
13. a) 28 cm^3
    b) 6 cm
    c) 2 cm; 14 $cm^2 \times$ 2 cm = 28 cm^3
14. $h \doteq 51.5$ cm; $V \doteq 26\,102.4$ cm^3
15. a) About 2482.7 cm^3
    b) About 7238.2 m^3
16. a) About 43 396.8 cm^3
    b) Answers may vary. For example: the volume of the sphere is two-thirds the volume of a cylinder into which the sphere just fits.

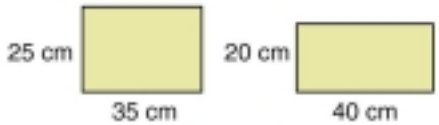
Chapter 1 Practice Test, page 40

1. C
2. C
3. a) About 16.6 cm
   b) About 8.9 m
4. a) The hypotenuse of the right triangle: about 640 m; park's area: 292 000 m^2
   b) About 2151 m
5. No. $24^2 + 17^2 \neq 29^2$
6. About 12 bags. I assumed that there was no room left between the bags in the cylindrical cooler.

Chapter 2 Investigating Perimeter and Area of Rectangles

2.1 Varying and Fixed Measures, page 45

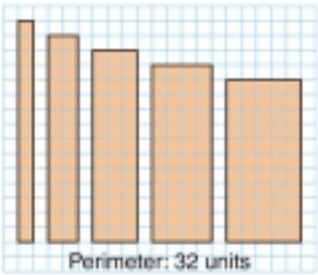
1. a) The lengths of line segments AP and PB vary.
   b) The length of line segment AB stays the same.
2. a) The measures of arc AB and of ∠BOA vary.
   b) The lengths of radii OA and OB stay the same. The circumference stays the same.
3. a) The lengths of line segments AC, AD, and AB, and the measures of ∠BAC, ∠DAB, and ∠CBA vary.
   b) The lengths of line segments BC and CD and the measure of ∠ACB remain the same.
4. a) P = 120 cm, A = 875 cm^2
   b) Answers may vary. For example: The perimeter will stay the same (the sum of width and length stays the same). The area will change.



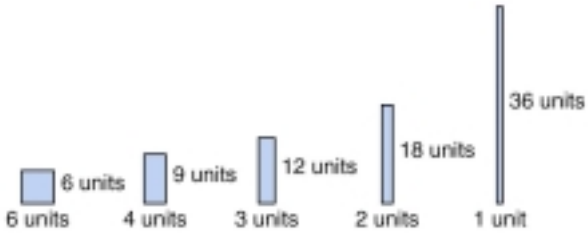
   c) P = 120 cm, A = 800 cm^2
   Yes. The perimeter stays the same.
   The area decreases.
5. a) The perimeter will increase. The area will stay the same, since length × width stays the same.
   b) Yes. P = 165 cm, A = 875 cm^2

6. a) Answers may vary. For example: 1 unit by 9 units, 2 units by 8 units, 3 units by 7 units, 4 units by 6 units, 5 units by 5 units

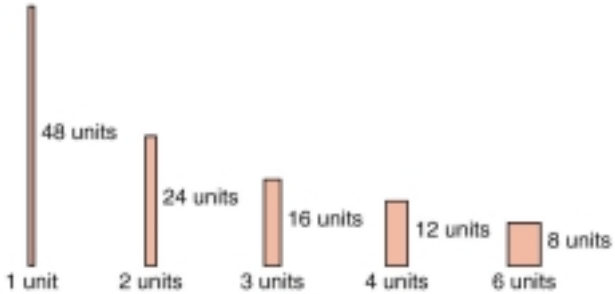
   b) Answers may vary. For example: 1 unit by 15 units, 2 units by 14 units, 3 units by 13 units, 4 units by 12 units, 5 units 11 units



7. **a)** Answers may vary.



b) Answers may vary.



8. **a)**

Length (cm)	Width (cm)	Perimeter (cm)	Area (cm^2)
4	4	16	16
5	3	16	15
6	2	16	12
7	1	16	7

b) No. Rectangles with the same perimeter have different areas.

c)

Width (cm)	Length (cm)	Perimeter (cm)	Area (cm^2)
4	4	16	16
2	8	20	16
1	16	34	16

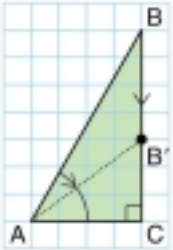
d) No. Rectangles with the same area have different perimeters.

9. **a)** The area stays the same if one dimension is multiplied by a number and the other dimension is divided by the same number. For example: the length is doubled and the width is halved.

b) I list factors whose product equals the given area.

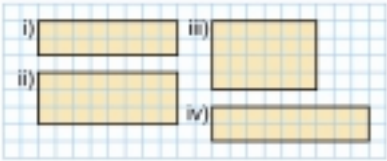
10. **a)** The lengths of line segments AB and BC, and the measures of ∠A and ∠B change.

b) Line segment AC and ∠C stay the same.



2.2 Rectangles with Given Perimeter or Area, page 51

1. **a)**



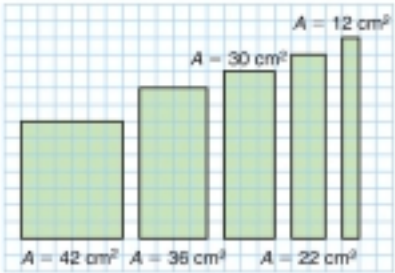
b) i and iii have the same perimeter, 20 cm. The sum of the length and width is equal, 10 cm. ii and iv have the same perimeter, 22 cm. The sum of the length and width is equal, 11 cm.

c) ii and iii have the same area. The product of the length and width is 24 cm^2.

d) Yes. For example: i and iii have the same perimeter, 20 cm, but different areas: **i)** 16 cm^2 and **iii)** 24 cm^2

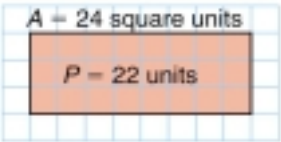
e) Yes. For example: ii and iii have the same area, 24 cm^2, but different perimeters: **ii)** 22 cm and **iii)** 20 cm

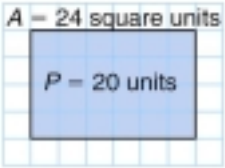
2. **a), b)**

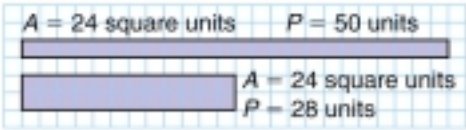


d) As area increases, the dimensions get closer in value, and the rectangles become more like a square.

3. **a), b)**

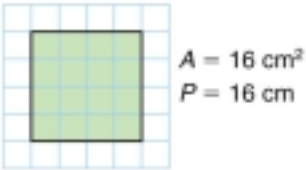




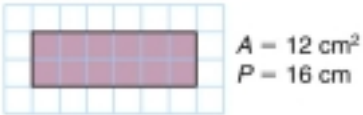


d) As the perimeter increases, the difference between length and width increases, and the rectangles become long and narrow.

4. **a)**



b)



c) The square has the greatest area.

5. **a)** Each rectangle has area 36 cm^2.

b) Rectangle C has the least perimeter. Its length and width are closest in value. Rectangles A and E have the greatest perimeter. The difference between their length and width is the greatest.

c) A: 30 cm; B: 26 cm; C: 24 cm; D: 26 cm; E: 30 cm
Yes. Rectangle C has the least perimeter, 24 cm. Rectangles A and E have the greatest perimeter, 30 cm.

6. **a)** Each rectangle has perimeter 18 cm.

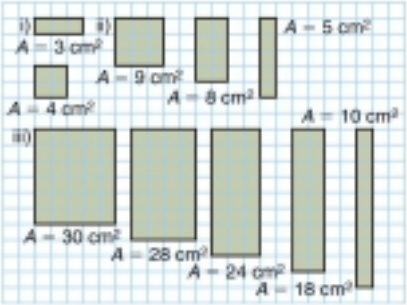
b) Rectangles D and E have the greatest area. Their length and width are closest in value. Rectangles A and H have the least area. The difference between their length and width is the greatest.

c) A: 8 cm^2; B: 14 cm^2; C: 18 cm^2; D: 20 cm^2; E: 20 cm^2; F: 18 cm^2; G: 14 cm^2; H: 8 cm^2
Yes. Rectangles D and E have the greatest area, 20 cm^2. Rectangles A and H have the least area, 8 cm^2.

7. No. Two rectangles with the same perimeter and the same area are congruent.

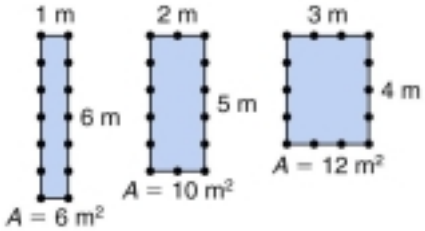
2.3 Maximum Area for a Given Perimeter, page 55

1. **a), b)**



c) **i)** 2 cm by 2 cm
ii) 3 cm by 3 cm
iii) 6 cm by 5 cm

2. **a), b)**



c) The 3-m by 4-m garden has the maximum area. Its length and width are closest in value. The garden cannot be a square. The sides are whole numbers only.

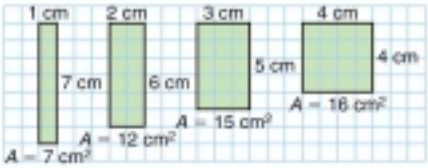
3. **a)** 81 cm^2 (9 cm by 9 cm)

b) 225 cm^2 (15 cm by 15 cm)

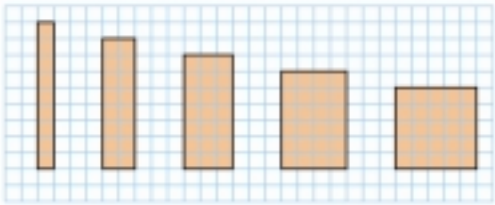
c) 351.5625 cm^2 (18.75 cm by 18.75 cm)

4. The maximum area occurs when the rectangle is a square, with dimensions 10.5 m by 10.5 m. The greatest area for a rectangle with perimeter 42 m is 110.25 m^2.

5. Explanations may vary.
For example: Yes. For a given perimeter, the maximum area occurs when length and width are closest in value (the rectangle is as close to a square as possible). Among all possible rectangles with perimeter 16 cm, the 4-cm by 4-cm square has the maximum area.



6. a) A table that seats 20 people can be represented as a rectangle with perimeter 20 units. That is, the sum of its length and width is 10. There are 5 possible rectangular arrangements: 1 by 9, 2 by 8, 3 by 7, 4 by 6, 5 by 5.



b) The arrangement with greatest area (5 by 5) requires the most tables: 25. The arrangement with least area (1 by 9) requires the fewest tables: 9

c) If you use the 1 by 9 table, the person at one end of the table won't be able to speak to the person at the other end. The square is closest to a circle, which is the best shape for communicating around a table.

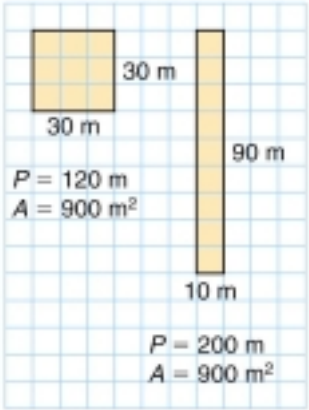
7. a) Area of square flowerbed: 4 m^2; area of circular flowerbed: about 5.1 m^2

b) Bonnie's; the area of a circle with perimeter P is always greater than the area of a rectangle with the same perimeter. Students' answers should include drawings.

Chapter 2 Mid-Chapter Review, page 60

1. a) Both the area and the perimeter increase.
   b) Both the area and the perimeter decrease.
   c) Both the area and the perimeter increase.
   d) Both the area and the perimeter decrease.
   e) The perimeter stays the same and the area increases.
2. a) All rectangles have the same perimeter: 16 cm
   b) The area varies. From least to greatest: 7 cm^2, 12 cm^2, 15 cm^2, 16 cm^2. The 4-cm by 4-cm square has the greatest area.
3. a) i) 1 m by 30 m, 2 m by 15 m, 3 m by 10 m, 5 m by 6 m
   ii) 1 m by 64 m, 2 m by 32 m, 4 m by 16 m, 8 m by 8 m
   b) i) 62 m, 34 m, 26 m, 22 m
   ii) 130 m, 68 m, 40 m, 32 m
4. Students' answers should include diagrams and calculations.
   a) The perimeter stays the same. The area decreases by 27 cm^2.
   b) The area stays the same. The perimeter doubles.

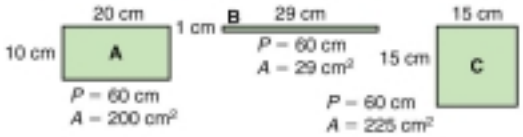
5.



a) $A_{first\ paddock} = 30\ m \times 30\ m = 900\ m^2$
$A_{second\ paddock} = 10\ m \times 90\ m = 900\ m^2$

b) No; 120-m of fencing are needed for the 30-m by 30-m paddock. 200-m of fencing are needed for the 10-m by 90-m paddock.

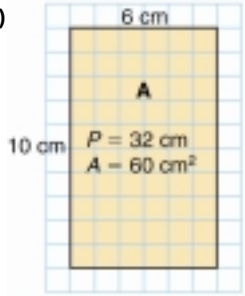
6.



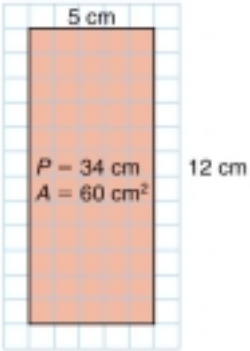
7. The maximum area is 2025 m^2 (for a 45-m by 45-m square lot).

2.4 Minimum Perimeter for a Given Area, page 63

1. a)

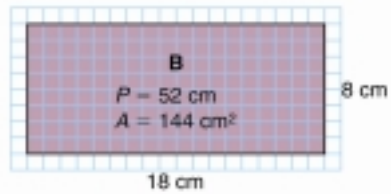


b)

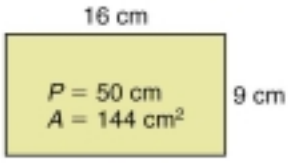


c) No. The perimeter of the 5-cm by 12-cm rectangle is greater than the perimeter of rectangle A.

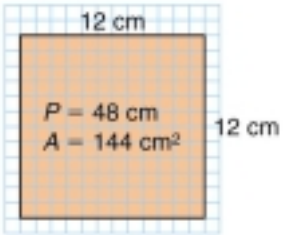
2. a)



b)



c) The 12-cm by 12-cm square has the minimum perimeter for the given area.



3. **a)** The minimum perimeter occurs when length and width are closest in value.
i) 5 by 5, P = 20 units
ii) 10 by 5, P = 30 units
iii) 15 by 5, P = 40 units
iv) 10 by 10, P = 40 units
b) **i)** P = 600 cm
ii) P = 900 cm
iii) P = 1200 cm
iv) P = 1200 cm

4. **a)** Start at 25. The area increases by 25 stones each time.
b) No. There is no pattern in the perimeters.

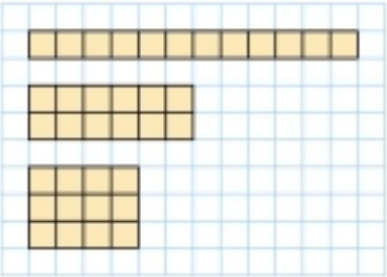
5. **a)** About 21.9 m
b) About 31.0 m
c) About 38.0 m
d) About 43.8 m

6. Both the length and width of a rectangle with the least possible perimeter are about 31.6 m. The least possible perimeter for a rectangle with area 1000 m^2 is approximately 126.5 m.

7. **a)** The minimum perimeter occurs when the length and width are closest in value: 8 tiles by 7 tiles. The minimum perimeter is 30 units.
b) No; 56 tiles do not form a square. We cannot use fractions of a square tile.

8. No. Explanations may vary. For example: For a given area, rectangles whose lengths and widths are closest in value have the least perimeter.

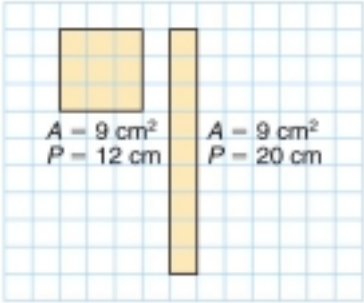
9. **a)**



b) The arrangement that seats the most people is the rectangle with the maximum perimeter: 12 by 1 arrangement
The arrangement that seats the fewest people is the rectangle with the minimum perimeter: 4 by 3 arrangement

c) The rectangular arrangement with the minimum perimeter seats the fewest people.

10. **a), b)** Answers may vary.



c) No. For a given area, a square has the minimum perimeter.

2.5 Problems Involving Maximum or Minimum Measures, page 67

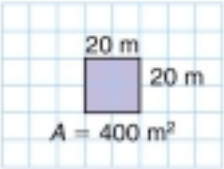
1. **a)** 8 m; 6 m; 4 m; 2 m; students' answers should include diagrams.
b) 4 m by 8 m; A = 32 m^2; the length is twice the width.

2. **a)** Students' answers should include diagrams of 9 possible rectangles: 1 m by 18 m; 2 m by 16 m; 3 m by 14 m; 4 m by 12 m; 5 m by 10 m; 6 m by 8 m; 7 m by 6 m; 8 m by 4 m; 9 m by 2 m.
b)

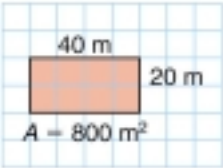
Width (m)	Length (m)	Area (m^2)
1	18	18
2	16	32
3	14	42
4	12	48
5	10	50
6	8	48
7	6	42
8	4	32
9	2	18

c) 5 m by 10 m; the length is twice the width.

3. **a)** **i)** 20 m by 20 m



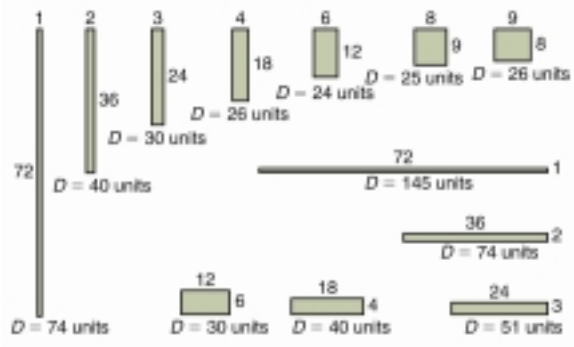
ii) 20 m by 40 m



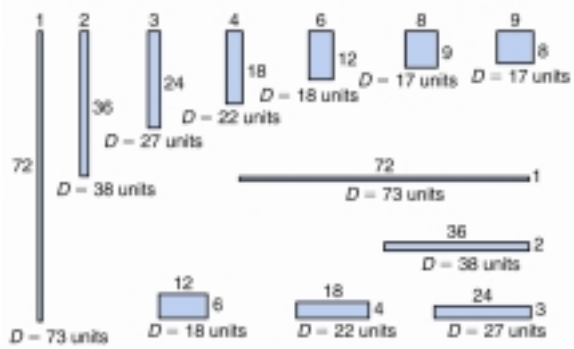
b) **i)** Length equals width.

ii) Length is twice the width.

4. The 6-units by 12-units arrangement has the minimum distance: 24 units.



5. The minimum edging is required when the dimensions are closest in value: 8 units by 9 units.



6. **a)**

Sections along each of 3 sides	Sections along each of 2 sides	Overall area (m^2)
2	10	20
4	7	28
6	4	24

b) 4 sections along 3 sides, and 7 sections along the other 2 sides for a maximum area of 28 m^2.

Chapter 2 Review, page 70

1. **a)** The length of the ladder stays the same. The right angle between the floor and the wall remains the same.

b) The distance from the top of the ladder to the floor decreases; the horizontal distance from the ladder to the wall increases. The angle that the ladder makes with the floor decreases, the angle that the ladder makes with the wall increases.

2. **a)**

Width (cm)	Length (cm)	Area (cm^2)
5	45	225
10	40	400
15	35	525
20	30	600
25	25	625

b) For a rectangle with perimeter 100 cm, with each 5-cm increase of the width, the length decreases by 5 cm. The sum of the width and length is always equal to 50 cm. The area increases as the length and width become closer in value.

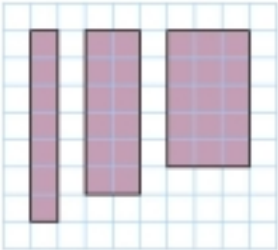
3. **a)**

Width (cm)	Length (cm)	Perimeter (cm)
2	36	76
4	18	44
6	12	36
8	9	34

b) If the width is multiplied by a number, the length is divided by the same number. The perimeter decreases as the length and width become closer in value.

4. **a)** P = 16 cm; A = 16 cm^2

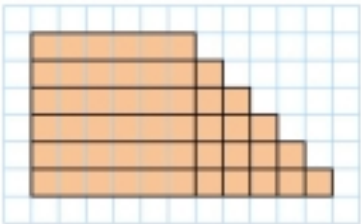
b) There are 3 possible rectangles with the same perimeter as square B: 1 cm by 7 cm, 2 cm by 6 cm, 3 cm by 5 cm



c) No. For a given perimeter, the maximum area occurs when the rectangle has equal length and width (it is a square).

5. **a)** OABC and ODEF have equal perimeters: 24 units, but different areas.
A_{OABC} = 32 square units,
A_{ODEF} = 27 square units

b)



c) For a given perimeter, when the length decreases by 1 unit, the width increases by 1 unit.

d) **i)** A_{max} = 36 square units (6 units by 6 units)
ii) A_{min} = 11 square units (1 unit by 11 units)

e) No for part d) i): For a given perimeter of 24 units, the rectangle with the maximum area is always the one that has equal length and width (the 6-units by 6-units square).
Yes for part d) ii): More rectangles are possible if the width can be less than 1 unit.
For example: 0.5 units by 11.5 units

6. **a)** **i)** 2 cm by 2 cm
ii) 8.5 cm by 8.5 cm
iii) 13.5 cm by 13.5 cm

b) For a rectangle with a given perimeter, the maximum area occurs when the dimensions are equal.
i) 4 cm^2
ii) 72.25 cm^2
iii) 182.25 cm^2

7. **a)** 14.5 m by 14.5 m
b) 210.25 m^2

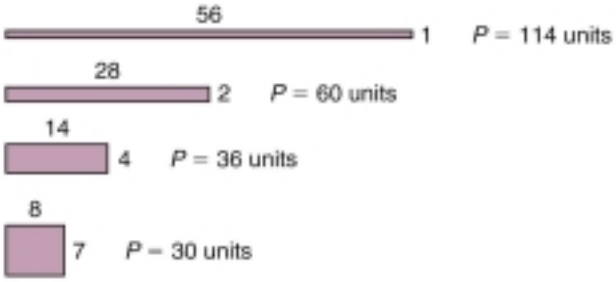
8. **a)** 14 m by 15 m
b) 210 m^2

9. **a)** **i)** 4 m by 4 m
ii) About 4.9 m by 4.9 m
iii) About 7.1 m by 7.1 m

b) For a rectangle with a given area, the minimum perimeter occurs when the dimensions are closest in value.
i) 16 m
ii) 19.6 m
iii) 28.4 m

10. 14 cm by 14 cm; P = 56 cm

11. **a)**



b) The 8-m by 7-m arrangement requires minimum fencing. The dimensions are closest in value.

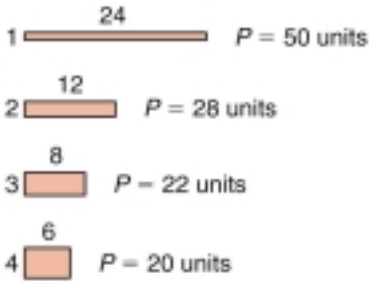
12. **a)** 50 m
b) 230 m
c) 100 m by 200 m; the maximum area is 20 000 m^2. Given a fixed length for 3 sides of a rectangle, the rectangle with greatest area has length double its width.

Chapter 2 Practice Test, page 72

1. D

2. A

3. **a)**



b) The patio with dimensions that are closest in value requires the minimum amount of edging: 4 m by 6 m (P = 20 units).

4. **a)** 49 cm^2
b) 462.25 cm^2

5. Students' answers should include diagrams.
a) For a rectangle with a given area, the minimum perimeter occurs when the dimensions are closest in value.
b) For a rectangle with a given perimeter, the maximum area occurs when the dimensions are closest in value.

6. **a)** 4 sections by 5 sections. The maximum area is 20 m^2.
b) Workers should use the 2 sections to make a 5-m by 5-m rectangular storage, with an area of 25 m^2. The maximum area occurs when the rectangle has equal length and width (it is a square).

7. 4 m by 10 m, or 5 m by 8 m

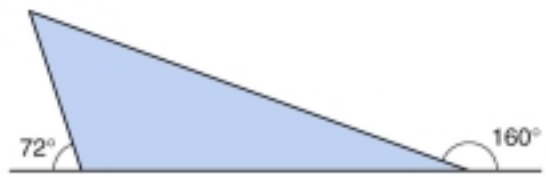
Chapter 3 Relationships in Geometry

3.1 Angles in Triangles, page 77

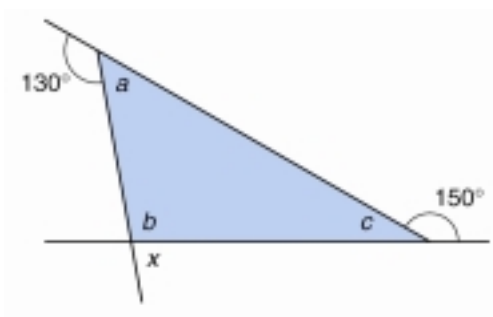
1. This shows the property that the sum of the angles in a triangle is 180°.
2. **a)** $\angle C = 50°$
   b) $\angle E = 46°$
   c) $\angle K = 23°$
3. **a)** Yes, since 41° + 67° + 72° = 180°
   b) No, since 40° + 60° + 100° ≠ 180°
   c) No, since 100° + 45° + 30° ≠ 180°
4. No, a triangle cannot have two 90° angles. Since 90° + 90° = 180°, the third angle would be 0°. Also, if there are two 90° angles then two sides would be parallel, and they can never intersect, so the triangle cannot be formed.
5. **a)** The acute angles in a right triangle have a sum of 90°.
   b) The sum of the angles in any triangle is 180°. If one of the angles is a right angle, the other two angles must have a sum of 180° – 90° = 90°.
   c) **i)** $\angle D = 30^\circ$
   ii) $\angle P = 36^\circ$
   iii) $\angle C = 45^\circ$
6. The angles opposite the equal sides in an isosceles triangle are equal.
7. **a)** **i)** $\angle A + 50° + \angle B = 180°$
   ii) $\angle A = \angle B = 65°$
   b) **i)** $\angle A + \angle B + 90^\circ = 180^\circ$
   ii) $\angle A = \angle B = 45°$
   c) **i)** $\angle A + \angle B + 31^\circ = 180^\circ$
   ii) $\angle A = 118°$, $\angle B = 31°$
   d) **i)** $\angle A + \angle B + 66^\circ = 180^\circ$
   ii) $\angle A = 48°$, $\angle B = 66°$
8. **a)** 100°
   b) Since each of the lower angles increases by 2° from 40° to 42°, the upper angle decreases by 4° from 100° to 96°.
   The upper angle is 96°.
9. 180° ÷ 3 = 60°; each angle measures 60°.
10. **a)** $\angle A = 97^\circ$ $\angle B = 83^\circ$ $\angle C = 69^\circ$
    b) $\angle D = 62^\circ$ $\angle E = 36^\circ$
    c) $\angle F = 80^\circ$ $\angle G = 100^\circ$ $\angle H = 40^\circ$

3.2 Exterior Angles of a Triangle, page 83

1. **i)** **a)** $\angle A$ and $\angle B$
   b) $\angle BCD = \angle A + \angle B$
   ii) **a)** $\angle D$ and $\angle E$
   b) $\angle DFG = \angle D + \angle E$
   iii) **a)** $\angle H$ and $\angle K$
   b) $\angle KJM = \angle K + \angle H$
2. **a)** $\angle CAD = \angle B + \angle C$
   = 118°
   b) $\angle EGH = \angle E + \angle F$
   = 111°
   c) $\angle JKM = \angle J + \angle H$
   = 72°
   d) $\angle MRP = \angle M + \angle N$
   = 92°
   e) $\angle QST = \angle Q + \angle R$
   = 143°
   f) $\angle XVU = \angle X + \angle W$
   = 120°
3. **a)** $\angle BAC = 55°$, $\angle C = 55^\circ$
   b) $\angle F = 79^\circ$, $\angle FGE = 60°$
   c) $\angle H = 49°$, $\angle JKH = 109°$
4. The plate angle is 40°; each exterior angle of a triangle is equal to the sum of the two opposite interior angles.
5. $\angle HJK = 28°$, $\angle GHK = 56°$, $\angle DEK = 90°$, $\angle DFE = 72°$, $\angle ABF = \angle JHK = 124°$, $\angle BFA = \angle HKJ = 28°$, $\angle BCF = \angle HGK = \angle BFC = \angle HKG = 62°$, $\angle FCD = \angle KGD = 118°$, $\angle CDF = \angle GDK = 44°$, $\angle CFD = \angle GKD = 18°$, $\angle FDE = \angle KDE = 18°$
6. **a)** 128°



   b) The sum of the 3 exterior angles is 360°.
   c) The triangles have the same angles but the triangles have different sizes.
7. **a)** $x = 125°$
   b) $x = y = 145°$
   c) $x = 47°$, $y = 133°$, $z = 142°$
8.



For example, 130° + 150° + x = 360°; x = 80°
a + 130° = 180°; a = 50°
c + 150° = 180°; c = 30°
b = 180° – a – c = 100°
Also, $a + b$ = 150°; $b + c$ = 130°, $c + a = x$
Or, $a + b + c$ = 180°

3.3 Angles Involving Parallel Lines, page 89

1. I used these relationships:
   - opposite angles are equal

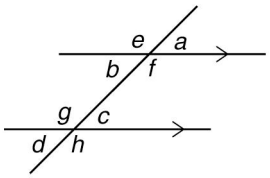
- angles that form a straight angle have a sum of 180°
- when parallel lines are intersected by a transversal, corresponding angles are equal

a) ∠BCH = ∠GCD = ∠EBC = 62°,
∠ABE = ∠FBC = ∠BCG = ∠DCH = 118°

b) ∠EBC = 62°
∠ABE = ∠FBC = 118°

2. **a)** $b = 60°$, $a = 15°$
b) $d = e = 86°$, $f = 94°$, $g = 141°$, $h = 39°$
c) $a = 55°$, $b = c = 65°$, $d = 120°$

3. Yes, Petra is correct.



- $a = b = c = d$
  So, all the acute angles are equal.
- $e = f = g = h$
  So, all the obtuse angles are equal.
- $c + f = b + g = 180°$
  $e + b = a + f = 180°$
  So, the sum of an acute angle and an obtuse angle is 180°.

4. ∠BCD = 133°

5. 34° + 145° = 179°, not 180°, so the boards are not parallel.

6. ∠CED = 88°, ∠ECD = ∠EDC = 46°

7. **a)** The sum of the interior angles is 180°.
The sum of the exterior angle and the adjacent interior angle is 180°.
The exterior angle is equal to the sum of the opposite interior angles.
The sum of the exterior angles of a triangle is 360°.

b) Corresponding angles are equal.
Alternate angles are equal.
Interior angles have a sum of 180°.

c) Students' answers should include a design.

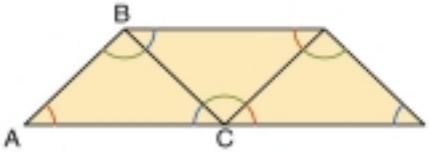
8. **a)** $a + c = b$

b) Yes. As long as the top and bottom lines are parallel, a, b, and c are always related so that $a + c = b$.

c) If you draw a third parallel line through B, and use the property that alternate angles are equal, the sum of a and c is always equal to b.

Chapter 3 Mid-Chapter Review, page 92

1. When you arrange the three angles of a triangle next to each other, they form a straight line. That is, the angles in a triangle have a sum of 180°.



2. $a = 50°$, $b = 40°$

3. Students' answers may show diagrams with congruent angles labelled.

4. **a)** $a = c = 58°$, $b = 122°$
b) $e = 115°$, $f = 65°$, $g = 72°$, $h = 43°$

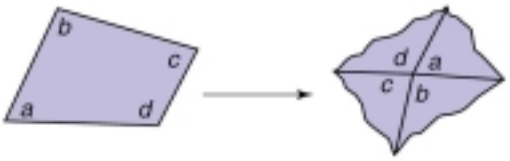
5. Angle measures will vary according to students' drawings.

6. $x = 55°$, $y = 125°$, $z = 55°$
Assumptions: The flag is a rectangle; the horizontal line segments are parallel.

7. **a)** $a = b = c$, $c = e$, $f + b + e = 180°$, $g + h = 90°$, $e + d = 90°$, $a = f$, $c + d = 90°$, $g + 90° = 143°$
b) $a = b = c = 60°$, $d = 30°$, $e = 60°$, $f = 60°$, $g = 53°$, $h = 37°$

3.4 Interior and Exterior Angles of Quadrilaterals, page 97

1.



2. **a)** $a = 75°$ **b)** $b = 27°$ **c)** $c = 61°$

3. **a)** They have a sum of 180°.
b) The angles that are between the parallel lines on the same side of a transversal are interior angles and have a sum of 180°.

4. **a)** $a = 91°$ $b = 89°$ $c = 91°$
b) $d = 53°$ $e = 127°$ $f = 53°$
c) $h = 132°$ $j = 48°$ $k = 132°$

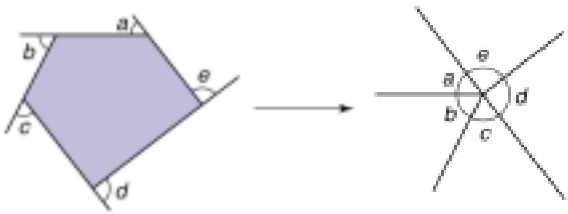
5. The opposite angles in a parallelogram are equal.

6. **a), b)** The sum of all the angles is 360°, because it is a quadrilateral. If we draw the diagonal that forms 2 congruent triangles, we see that one pair of opposite angles are equal.

7. **a)** $a = 86°$
b) $b = 54°$
c) $d = 124°$

8. **a)** ∠R + ∠O + ∠S + ∠E = 360°
∠R = ∠E, ∠O = ∠S
∠O + ∠R = 180°, ∠S + ∠E = 180°
b) Students can measure angles with a protractor to demonstrate the relationships in part a.

3.5 Interior and Exterior Angles of Polygons, page 101

1. 

2. **a)** 900° **b)** 1440° **c)** 3960°
3. **a)** $x = 148°$ **b)** $x = 55°$
4. **a)** 108° **b)** 135°
   c) 144° **d)** 162°
5. **a)** 72° **b)** 45° **c)** 36° **d)** 18°
6. **a)** The Canadian loonie has 11 sides.
   b) About 147°
7. **a)** The sum S of the interior angles in an n-sided polygon is $S = (n - 2) \times 180°$.
   If the polygon is a regular polygon, then the measure of each interior angle is:
   $\frac{(n-2)\times 180°}{n}$
   The exterior angles in any polygon have a sum of 360°.
   If the polygon is a regular polygon with n sides, then the measure of each exterior angle is:
   $\frac{360°}{n}$
   At each vertex, the interior angle and the exterior angle have a sum of 180°.
   b) Students' answers should include designs.
8. **a)**, **b)** Students' answers should include drawings.
   c) Quadrilateral: 360°, pentagon: 540°
   d) Yes, the number of triangles the polygon can be divided into is still 2 less than the number of sides.
9. **a)** Regular pentagons and regular hexagons
   b) 120°
   c) 108°
   d) 348°; the sum is close to, but not equal to, 360°. This is because the surface is curved.
10. **a)** $6 \times 180° = 1080°$
    b) 360°; this is the sum of the angles at the point inside the hexagon. These angles are *not* interior angles of the hexagon.
    c) $n \times 180° - 360° = (n - 2) \times 180°$

Chapter 3 Review, page 106

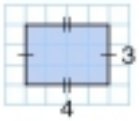
1. If you cut off the corners (angles) of a triangle and arrange them side by side, they form a straight angle, which has a measure of 180°.
2. No. If a triangle had 2 obtuse angles, the sum of those two angles would be greater than 180°.
3. **a)** $x = 59°$
   b) $x = y = 69°$
   c) $x = 48°$
4. $a = 44°$, $b = 44°$, $c = 63°$, $d = 63°$, $e = 63°$
5. **a)** No. Alternate angles are not equal.
   b) Yes. The interior angles 116° and 64° have a sum of 180°.
6. $x = 49°$ $y = 49°$
7. **a)** $x = 89°$
   b) $x = 21°$, $y = 40°$, $z = 119°$
   c) $y = 85°$
   d) $x = 105°$
8. **a)** 1080°
   b) **i)** 135°
   ii) 45°
9. **a)** 720°
   b) 1800°
   c) 2880°
10. **a)** 540°
    b) The sum of the exterior angles of a pentagon is 360°.
    c) Yes
11. Interior angle: 176.4°; exterior angle: 3.6°

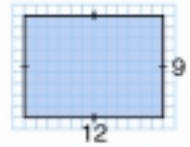
Chapter 3 Practice Test, page 108

1. B
2. B
3. Cut out and arrange the corners next to each other; draw a diagonal and add the interior angles of the 2 triangles formed by the diagonal.
4. **a)** $a = 81°$
   b) $a = 34°$, $b = 49°$, $c = 34°$, $d = 131°$
   c) $x = 135°$, $y = 45°$
5. **a)** 540°
   b) 135°
6. $\angle PRS = \angle PSR$ (because it is an isosceles triangle)
   $\angle PRQ + \angle PRS = 180°$
   $\angle RST + \angle PSR = 180°$
   So, $\angle PRQ = \angle RST$

Chapter 4 Proportional Reasoning

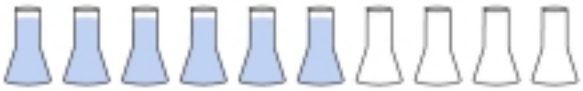
4.1 Equivalent Ratios, page 112

1. **a)** 4:6 **b)** 8:6 **c)** 12:15 **d)** 30:25
2. **a)** 3:5 **b)** 3:1 **c)** 5:4 **d)** 1:2
3. **a)** 4:10, 20:50 **b)** 1:4, 25:100
   c) 20:2, 100:10 **d)** 150:100, 15:10
4. **a)** 

   b) 

   c) No, 18:26 is not equivalent to 6:8.
5. The ramp should have dimensions in the ratio 2:24. It could be 20 cm high and 240 cm long.

6. a) 24:16, 24:15
   b) Megan's punch uses less ginger ale for the same amount of concentrate.
7. a) Punch B; it uses concentrate and water in the ratio 5:8, punch A uses a ratio of 4:8.
   b) Punch B; it uses concentrate and water in the ratio 5:6, punch A uses a ratio of 4:6.
8. a) Set B; explanations may vary.
   b) Set B;
   Set A uses blue and clear liquid in the ratio 3:2.
   Set B uses blue and clear liquid in the ratio 4:2.
   c) Sketches may vary. The ratio of blue to clear liquid must be equivalent to 3:2. For example:



9. 15 cm by 24 cm
10. a) 0.5 cm b) 0.4 cm

4.2 Ratio and Proportion, page 117

1. a) First terms: 125 = 25 × 5; first ratio: 20 = 4 × 5
   b) First terms: 120 = 12 × 10;
   first ratio: 10 = 10 × 1
   c) Second terms: 100 = 4 × 25; first ratio: 75 = 3 × 25
   d) Second terms: 48 = 16 × 3; first ratio: 3 = 3 × 1
2. a) $n = 20$ b) $n = 3$ c) $n = 3$ d) $n = 30$
3. a) $z = 6$ b) $z = 15$ c) $z = 7$ d) $z = 8$
4. Yes, the ratios are equivalent, so the number of the songs is proportional to the amount of memory.
5. 18 L
6. 25 h
7. 15 potatoes
8. a) $c = 45$ b) $n = 30$
   c) $y = 8$ d) $z = 15$
9. a) 84 cm
   b) Calculate 28 ÷ 17 ≐ 1.65 and then 51 × 1.65 ≐ 84.
10. 276 times
11. a) 84 teeth b) 189 teeth
12. a) 500 girls, 400 boys b) 15 girls, 12 boys

4.3 Unit Rates, page 123

1. a) 2 goals scored per game
   b) $10 per hour c) $0.50 per orange
   d) 110 km/h
2. a) $0.50 per CD b) $0.79 per apple
   c) 1.5 kg lost per week
   d) 4.4 km/h
3. 150 L/h
4. The hardwood is more expensive at \$44.12/m^2.
5. e-Tunes is the most economical music club at $1.05 per song.
6. No. The can from the machine costs 3 times as much as the cans in the 12-pack.
7. Can C
8. a) 144 tea bags for $5.39
   b) Use equivalent ratios.
   c) Sue might not use 144 bags of tea before they go stale.
9. a) Price (in dollars) per 100 g
   b) $0.62 per 100 g, $0.57 per 100 g
   c) Dee's Delight

Chapter 4 Mid-Chapter Review, page 126

1. a) equivalent b) not equivalent
   c) not equivalent d) equivalent
2. a) Pitcher B
   b) A pitcher containing 6 parts concentrate and 4 parts water
3. No, the ratios are not equivalent.
4. a) $n = 40$ b) $m = 20$
   c) $y = 3$ d) $r = 12$
5. 160 mL
6. a) 3:10
   b) 168 male doctors
   c) 51 female doctors
   d) The ratio of female doctors to male doctors remains the same.
7. a) 15 km/L b) 30 words/min
   c) $18.50/h d) 87.5 km/h
8. Beckie
9. a) $1.04, $1.08 b) Cereal A

4.4 Applying Proportional Reasoning, page 129

1. a) $15 b) $195
2. a) $56 b) $616
3. $480
4. a) 14 cases b) Use equivalent ratios.
5. a) 300 km b) 10 L
6. a) 7500 books b) 58 min
7. a) 750 cm, or 7.5 m b) 100 cm
8. a) 45 points b) 38 points
   c) Answers may vary. For example: Chloë and her father scored 19 baskets each.
9. a) $191.25 US
   b) $11.76 Can; The exchange rate remains the same.
10. Too dry

4.5 Using Algebra to Solve a Proportion, page 133

1. a) $n = 9$ b) $n = 3$ c) $n = 15$
   d) $n = 40$ e) $n = 10$
2. a) $c = 27$ b) $m = 7$
   c) $y = 105$ d) $a = 175$
3. a) 0.83 m b) 7.4 m
4. $445.00
5. a) 160 000 tickets b) 23.44 min
6. a) 2.03 m b) 95.4 cm
   c) Answers may vary.

4.6 Percent as a Ratio, page 137

1. a) 0.07 b) 0.15 c) 0.35
   d) 0.8 e) 1.2
2. a) \$36.50 b) 12.5 kg
   c) 14 m d) 150 g
3. \$111.99
4. 10 000 vehicles
5. a) \$8.40 b) \$68.39
6. \$219.45
7. a) 216 spectators b) 173 spectators
8. \$300
9. a) \$6.67 b) \$506.67
10. a) \$53.26 b) \$953.26
11. 8% per year

Chapter 4 Review, page 140

1. a) 6:10, 9:15 b) 6:7, 12:14
   c) 3:2, 6:4 d) 45:7, 90:14
2. a) No
   b) Any spinner with the same ratio of red sectors to total sectors would be equivalent.
   For example, a spinner with 16 sectors, 6 of which are red or 24 sectors, 9 of which are red
3. Mix A. It uses more concentrate for the same amount of water.
4. a) $n = 12$ b) $a = 7$
   c) $e = 42$ d) $m = 24$
5. 240 mL
6. a) $1\frac{1}{2}$ cups b) 45 cookies
7. a) 48 km/h b) 35 words/min
   c) \$0.40/min d) \$1.58/kg
   e) 30 pages/min
8. B: 130 mL for \$1.99 is the better buy.
9. a) 9 kg b) \$42.40
10. a) About 9 days b) 22.5 rows
11. a) 360 km b) 35 L
12. 15 copies
13. a) \$11.40 b) \$53.35
    c) \$27.00 d) \$9.47
14. a) \$51.99 b) \$59.27
15. 84 h
16. a) \$8.75 b) \$358.75
17. a) \$90 b) \$1590

Chapter 4 Practice Test, page 142

1. C
2. C
3. a) $a = 25$ b) $b = 5$
   c) $c = 20$ d) $n = 8.4$
4. 18 oranges
5. a) \$12.50 b) \$2512.50
6. You can measure your height and the length of your shadow. Then measure the length of the shadow of the flagpole and use equivalent ratios to find the height of the flagpole.

Cumulative Review Chapters 1–4, page 143

1. a) $P = 30$ cm, $A = 30$ cm^2
   b) $P = 24$ cm, $A = 28$ cm^2
2. $A \doteq 137.1$ cm^2
   $P \doteq 52.6$ cm
3. a) 108 cm^3 b) About 22 m^3
   c) About 205.3 cm^3 d) About 904.8 cm^3
4. a) 112 cm^3 b) 12 cm c) 4 cm
5. 1 cm, 20 cm; 2 cm, 10 cm;
   4 cm, 5 cm; 8 cm, 2.5 cm
6. a) 4.5 m by 4.5 m b) 20.25 m^2
   c) i) 4.5 m by 9 m ii) 40.5 m^2
7. a) i) 5 cm by 5 cm
   ii) About 5.7 cm by 5.7 cm
   iii) About 8.8 cm by 8.8 cm
   b) i) 20 cm ii) About 22.8 cm
   iii) About 35.2 cm
   For a given area, the rectangle with the minimum perimeter is always a square.
8. 73° and 73°, or 34° and 112°
9. a) $q = 77°$, $p = 135°$, $r = 58°$, $s = 122°$
   b) $a = c = y = 30°$,
   $b = d = x = z = 150°$
   c) $a = b = 105°$, $c = d = 75°$
10. a) 720°
    b) The hexagon can be divided into 4 triangles. Each triangle has interior angles measuring 180°. 180 × 4 = 720°; the answer is the same as for part a.
    c) i) 120° ii) 60°
11. Answers may vary.
    a) 4:14; 6:21 b) 3:11; 9:33
    c) 7:3; 14:6 d) 25:6; 50:12
12. a) $\frac{3}{4}$ b) 54
13. 775 g for \$5.49
14. 412.5 km
15. a) \$39.00 b) \$4.13 c) \$86.20
16. a) \$16.50 b) \$566.50

Chapter 5 Graphing Relations

5.1 Interpreting Scatter Plots, page 148

1. a) 26.1°, 29.8° b) 40 m
   c) The scatter plot shows a downward trend; as the depth increases, the temperature decreases.
2. a) The average daily temperature in March for several Ontario cities and towns
   b) 2°C c) About 175 m
   d) There are no trends in the data.
3. a) i) 154 cm ii) 2 students
   b) i) 177 cm ii) 5 students
   iii) 2 students

c) There is an upward trend; as the height increases, the arm spans increase.

4. **a)** **i)** 14 h
ii) 3
iii) Yes, the student who earned a little less than $150 worked for 12 h; the coordinates of the point are approximately (12, 145).
b) **i)** About $240
ii) 20 h
iii) Yes, the student who worked 21 h earned $200; the coordinates of the point are approximately (21, 200).
c) There is an upward trend in the data; the points tend to go up to the right; as the time increases, the earnings increase.

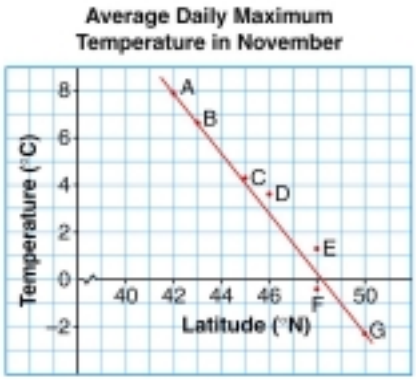
5. **a)** **i)** $72 **ii)** $9/h
b) The point (4, 48) represents a person who earns $12/h. The point (5, 40) represents a person who earns $8/h.

5.2 Line of Best Fit, page 153

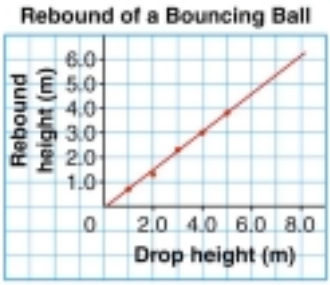
1. Graph b; in this graph, the number of points above the line is close to the number of points beneath the line.

2. Answers will depend on the data students collected in *Investigate*.

3. **a)** *Temperature* against *Latitude*; there is no trend in the *Temperature* against *Elevation* scatter plot, so we may not draw a line of best fit.
b) Answers may vary. For example: At a latitude of 44ºN, the temperature is about 5.5ºC.



4. **a)** An upward trend; the rebound height increases as the drop height increases.
b), c) Yes, the graph shows an upward trend.



d) 1.8 m; 6.2 m.
e) Answers may vary. For example: From which height should the ball be dropped so its rebound height is 2.5 m? *Answer*: About 3.4 m

5. **a)** Yes, the taller the person, the greater her/his knee height.
b), c), d) Answers will depend on students' data from *Investigate*.

6. Yes, the taller the person, the greater her/his shoe size.
a), b) Answers will depend on students' data.

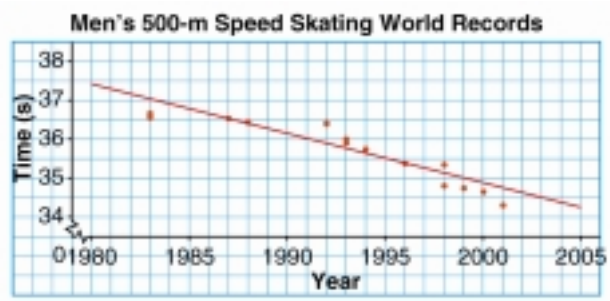
7. Answers will vary, depending on the measures chosen.

8. No, the number of points above and below the line will vary.

9. **a)** As the years increase, the record time decreases.

Year	Time (s)
1983	36.68
1983	36.57
1987	36.55
1988	36.45
1992	36.43
1993	36.41
1993	36.02
1994	35.92
1996	35.76
1998	35.39
1998	35.36
1999	34.76
2000	34.63
2001	34.32

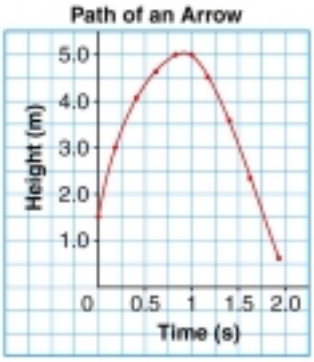
b)



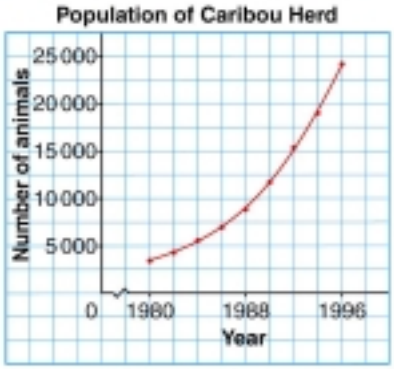
c) About 37.3 s. The actual world record in 1981 was 36.91 s.
d) Questions may vary. For example:
What might the world record time be in 2005?
Answer: About 34.2 s

5.3 Curve of Best Fit, page 160

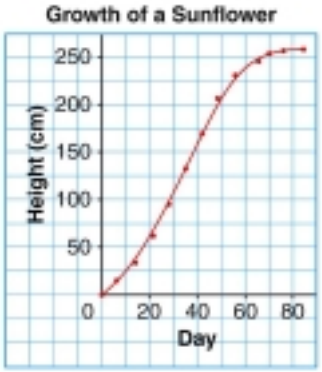
1. **a)** As the time increases, the height increases, then decreases.



b) As the time increases, the number of animals increases.

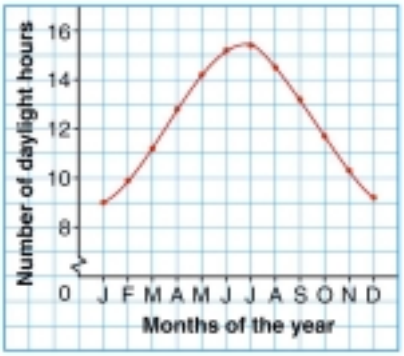


c) As the time increases, the height increases, then levels off.



2. **a)** The number of daylight hours increases from January to July, then decreases from July to December.

b)

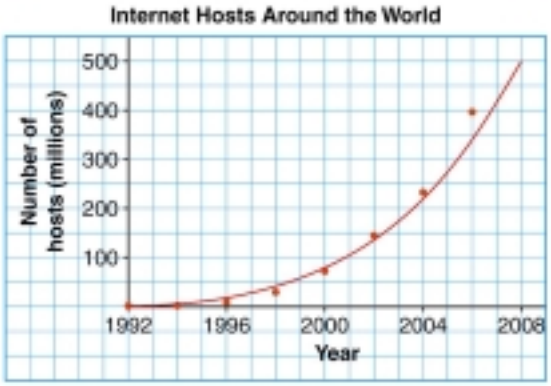


c) About 12.0 h **d)** About 15.6 h

d) Answers will vary. From your birth date on the horizontal axis move up to the graph, then across to the vertical axis to find the number of hours of daylight.

3. **a)** As the time increases, the number of hosts increases. Each year, the number is about 3 or 4 times the number the year before, until about 2000, when the number doubles, then it is multiplied by 1.5 each year.

b)

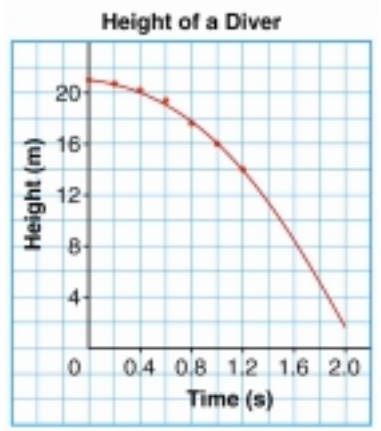


c) About 110 million

d) About 2008

4. **a)** As the time increases, the height decreases.

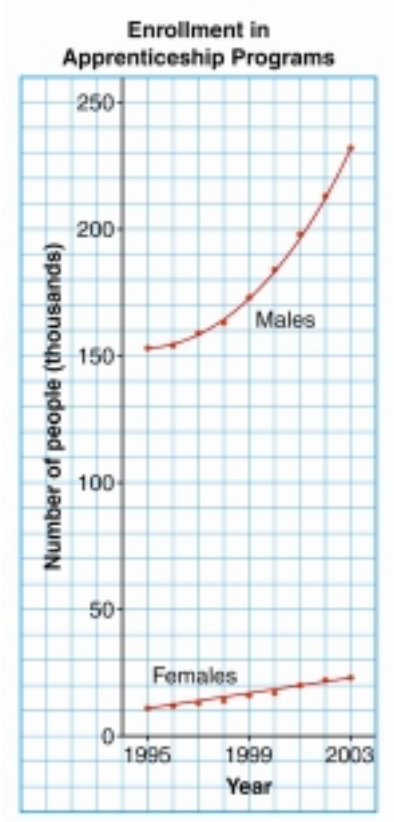
b)



c) After about 1.5 s

d) Extend the graph until it reaches the *Time* axis: a little more than 2.1 s

5. a)

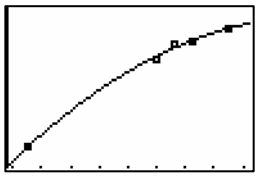


b) Line of best fit females: each year, the number of people increases by about 1000 or 2000. Curve of best fit males: for most years, the increase is greater than the year before.

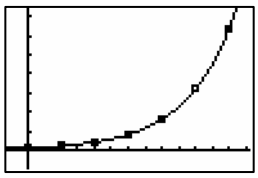
c) Extend the line and the curve to the year 2003: About 232 000 males, about 23 000 females

Technology: Using a Graphing Calculator to Draw a Curve of Best Fit, page 166

1. Quadratic curve



2. Exponential curve



Chapter 5 Mid-Chapter Review, page 168

1. a) Each point represents a boy. The horizontal coordinate represents the time played in minutes and the vertical coordinate represents the points he scored.

b) 7 points

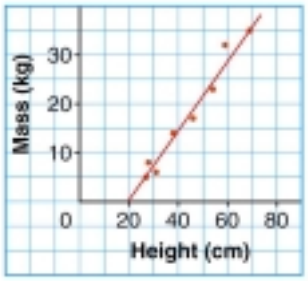
c) 7 boys, 2 boys

d) In the top left corner of the graph

e) As the time played increases, the number of points scored increases; the points go up to the right.

2. a) There is an upward trend indicating that the taller the dog, the greater its mass.

b)



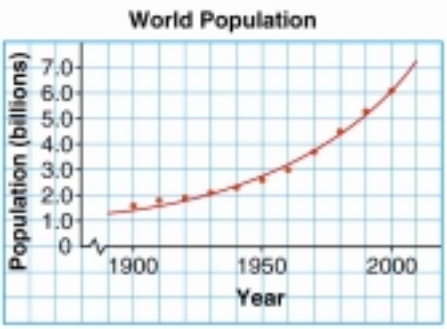
c) Yes, the line of best fit goes up to the right; as the height increases, the mass increases.

d) 42 cm e) 22 kg

f) Assume that the data for the dogs in parts d and e lie on the line of best fit.

3. a) The population increases as years go by; in later years, the population increases by a greater amount in each 10-year interval.

b)



c) About 2.0 billion, about 4.0 billion

d) About 1.3 billion

e) About 7.3 billion

f) The data for the years in parts c, d, and e lie on the line of best fit.

5.4 Graphing Linear Relations, page 171

1. a) Yes, the relationship is linear because the points lie on a straight line.

b) 77°F

c) –20°C

d) Use a thermometer that shows the temperatures in Fahrenheit and Celsius degrees

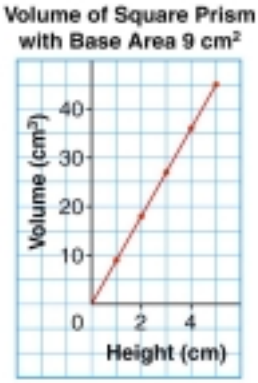
e) Questions may vary. For example: What is the Celsius temperature for 50°F? *Answer*: 10°C

2. a) Yes, since the relationship for a pyramid is linear.

b) Square Prisms with Base Area 9 cm^2

Height *h* (cm)	Volume *V* (cm^3)
1	9
2	18
3	27
4	36
5	45

c)



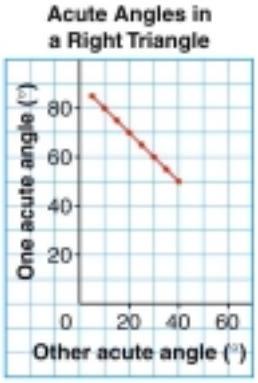
d) As the height increases, the volume increases; the relationship is linear.

e) The volume is 9 times the height.

f) 31.5 cm^3. Use the formula or the graph.

3. a) Acute Angles in a Right Triangle

One acute angle (°)	Other acute angle (°)
5	85
10	80
15	75
20	70
25	65



b) As one angle increases, the other angle decreases by the same amount; the points lie on a straight line.

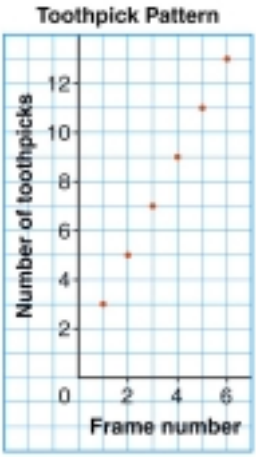
c) 60°, 50°

4. a)

Frame number	Number of toothpicks
1	3
2	5
3	7
4	9
5	11
6	13

b) Yes, as the frame number increases by 1, the number of toothpicks increases by 2.

c) The relationship is linear; the points lie on a straight line.



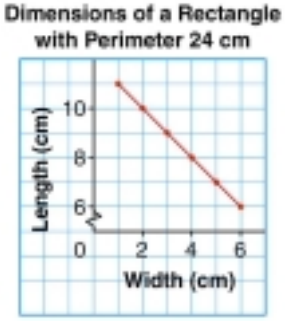
d) Add 2 more rows to the table; 17 toothpicks

e) The number of toothpicks is 1 more than two times the frame number.

f) Extend the pattern; or extend the table; or use the rule: 31 toothpicks

5. a) Yes, the length decreases by 1 cm, the width increases by 1 cm.

b) Yes, the points lie on a straight line.



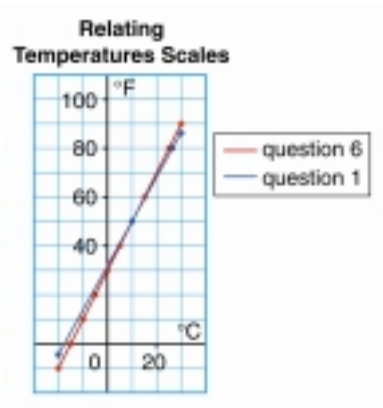
c) The length plus the width of the rectangle is 12 cm.

d) **i)** 7.5 cm **ii)** 1.5 cm

e) Use the rule or the graph.

6. **a), b), c)**

Celsius temperature (ºC)	Fahrenheit temperature (ºF)
–20	–10
–15	0
–10	10
–5	20
0	30
5	40
10	50
15	60
20	70
25	80
30	90

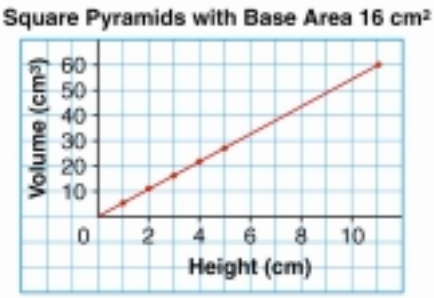


d) The rule "double and add 30" is useful from about 0ºC to 20ºC; beyond that, in either directions, the temperature the rule gives is more than 2ºC different from the true temperature.

7. **a)** **Square Pyramids with Base Area 16 cm²**

Height (cm)	Volume (cm^3)
1	$5.\overline{3}$
2	$10.\overline{6}$
3	16.0
4	$21.\overline{3}$
5	$26.\overline{6}$

b)



c) As the height increases, the volume increases. The relationship is linear because the points lie on a straight line.

d) Calculate or use the graph: 40 cm^3

e) Extend the graph: 11.25 cm

f) The volume is one-third the height multiplied by 16.

5.5 Graphing Non-Linear Relations, page 177

1. **a)** Linear, because the points lie on a straight line

b) Non-linear, because the points lie on a curve

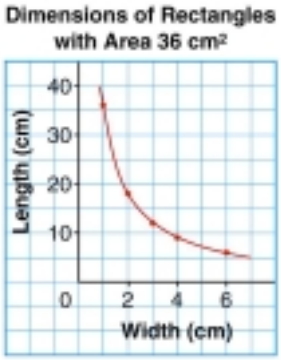
2. **a)** **i)** 135 calories, about 202 calories

ii) About 8 million, about 4 million

b) Questions may vary. For example: By how much did the population increase from 1960 to 1980? *Answer*: About 3 million

3. **a)** Yes, because as the width increases by 1, the length decreases by a different amount each time.

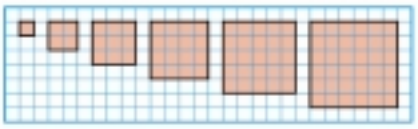
b) Yes, the points lie on a curve.



c) **i)** 7.2 cm **ii)** 4.5 cm

d) Length times width is 36; or length is 36 divided by width; or width is 36 divided by length.

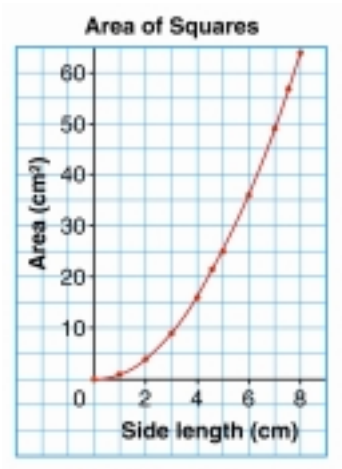
4. **a)**



b)

Side length (cm)	Area (cm^2)
1	1
2	4
3	9
4	16
5	25
6	36

c) As the side length increases by 1, the area increases by a greater amount each time; the increases are consecutive odd numbers: 3, 5, 7, 9, 11



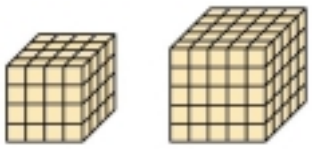
d) About 20 cm^2

e) About 56 cm^2

f) Multiply each side length by itself.

5. a) The edge length of each cube increases by 1 unit each time.

b))



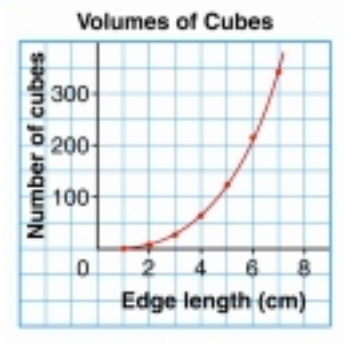
Edge length (cm)	Number of cubes
1	1
2	8
3	27
4	64
5	125
6	216
7	343

c) As the edge length increases, the number of cubes increases; each increase is much greater than the preceding increase.

d) i) Multiply:
edge length × edge length × edge length

ii) The number of cubes is equal to the volume in cubic units.

f)



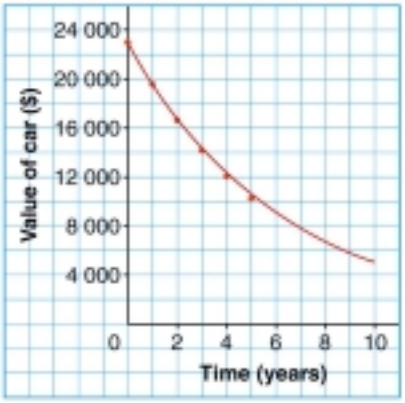
g) $V = e^3$ or $V = e \times e \times e$

h) 8 **i)** 1000

j) Extend the graph; or use the rule; or extend the pattern.

6. a) The graph will go down to the right. It will not be a straight line because the value of the car decreases by a different amount each time.

b)



c) The graph goes down to the right; the points lie on a curve.

d) Extend the graph: between 7 and 8 years

7. Answers will vary depending on students' data; the mass does *not* affect the time to complete 6 swings.

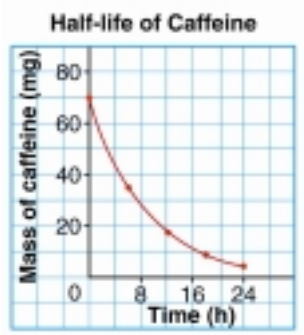
8. Answers will vary depending on the measurements chosen.

9. Answers will vary. For example:

a) I estimate my total daily caffeine intake is 70 mg.

b)

Time (h)	Mass of caffeine (mg)
0	70
6	35
12	17.5
18	8.75
24	4.375



c) Answers may vary. For adult family members, the initial data may be greater, but the graph has the same shape.

10. The relationship is non-linear.

5.6 Interpreting Graphs, page 182

1. **a)** Graph C **b)** Graph A **c)** Graph B

2. **a)** Walk at a constant speed toward the CBR for 3 s, stop for 4 s, then continue to walk toward the CBR at a slower speed.

b) Walk away from the CBR at a steady speed for 3 s, stop for 4 s, then continue to walk at the same speed toward the CBR.

c) Walk very slowly toward the CBR for 2.5 s, stop for 4 s, then walk away from the CBR at a faster speed.

3. From A to B: walks 200 m for 3 min
From B to C: stops for 1 min
From C to D: walks 300 m for 6 min
From D to E: stops at the store for 7 min
From E to F: walks 500 m home in 11 min

4. From 5:00 a.m. to 9:00 a.m., the volume decreases from 1 million litres to 500 000 L; people are having baths and showers, watering lawns, washing clothes and dishes.
From 9:00 a.m. to 11:00 a.m., the volume remains constant, the water entering the reservoir is equal to that being used.
From 11:00 a.m. to 2:00 p.m., more water enters the reservoir than leaves it, and the volume increases to 700 000 L.
From 2:00 p.m. to 3:00 p.m., the volume is constant.
From 3:00 p.m. to 10:00 p.m., the volume decreases to 300 000 L. People are home from work and school and use water at a faster rate than it enters the reservoir.

5. From 0 min to 7 min, the temperature remains the same. All the heat is used to melt the ice, so the temperature does not change.
From 7 min to 17 min, the water is heated to its boiling point of 100ºC.
From 17 min to 20 min, the water continues to boil, and the heat is used to create steam, so the temperature does not change.

Chapter 5 Review, page 186

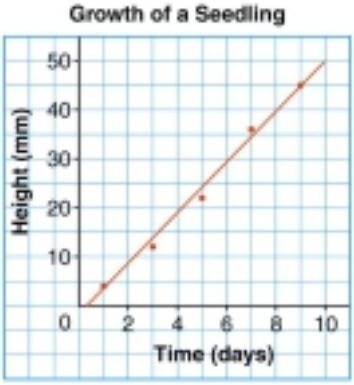
1. **a)** How the price of a used car changes with age

b) 3 years

c) $9000 and $12 000; The $12 000 car may be in better condition, and have less mileage

d) There is a downward trend; as the age of a car increases, its price decreases.

2. **a), b)** As the time increases, the height increases.



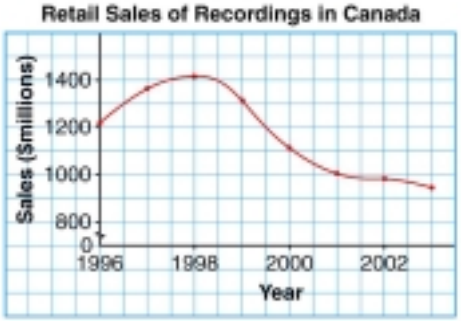
c) **i)** About 18 mm **ii)** 50 mm

d) About 12 days

e) No, the seedling will probably not continue to grow at the same rate.

3. **a)** From 1996 to 1998, sales increased. From 1998 to 2001, sales decreased. From 2001 to 2003, sales decreased very slowly.

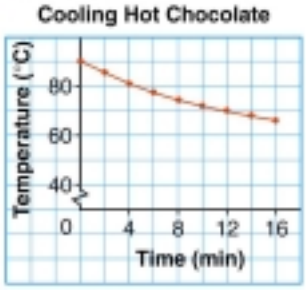
b)



c) About $1.4 billion, about $950 million

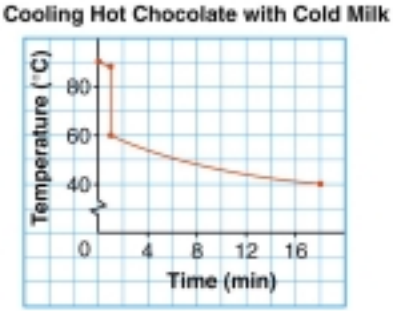
d) About $940 million; I assume the point lies on the graph that moves down gradually to the right.

4. **a)** As time increases, the temperature decreases.

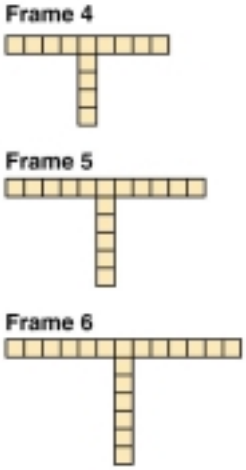


b) A curve of best fit

c) At 1 min, the temperature will suddenly fall, then continue to decrease. Graphs may vary.



5. **a)**

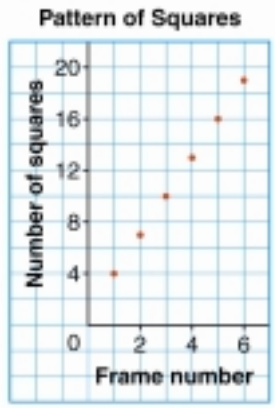


b)

Frame number	Number of squares
1	4
2	7
3	10
4	13
5	16
6	19

c) As the frame number increases by 1, the number of squares increases by 3. I think the graph will be linear.

d)



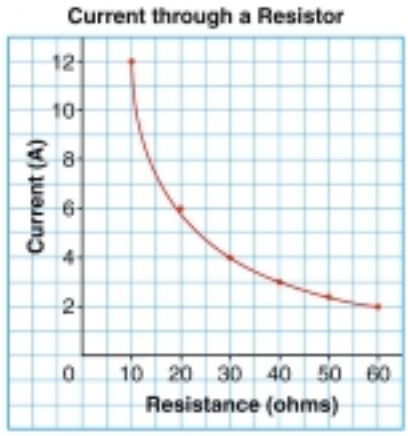
e) The number of squares is 1 more than 3 times the frame number.

f) Extend the table or graph; draw the next 2 frames; or use the rule: 25 squares

g) The 9th frame; I added 3 squares to the 8th frame to get the next frame.

6. **a)** As the resistance increases, the current decreases.

b)



c) About 8 A

d) About 12 ohms

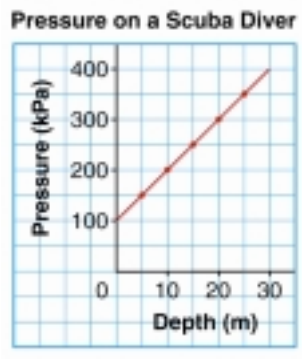
7. From A to B, Hasieba travels 200 m in 2 min. From B to C, she walks slower and travels 150 m in 4 min. From C to D, Hasieba stops for 4 min. From D to E, Hasieba walks 250 m in 3 min. From E to F, she stops for 3 min. From F to G, Hasieba walks 600 m home in 9 min.

Chapter 5 Practice Test, page 188

1. C

2. C

3. a) Line of best fit, because when the depth increases by 5 m, the increase in pressure is always 50 kPa.

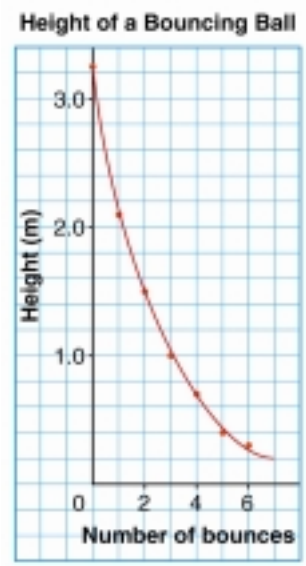


b) 12.5 m, 30 m c) 100 kPa

d) As the depth increases, the pressure increases.

4. a) As the number of bounces increases, the height decreases.

b) Curve of best fit, because when the number of bounces increases by 1, the decrease in height changes.



c) Extend the graph to the left to 0 bounces. The height is about 3.2 m.

d) Answers may vary. Extend the graph to the right to find the height of the 7th bounce, which is about 0.2 m.

5. If the points lie on a straight line, it is a linear relation. If the points lie on a curve, it is a non-linear relation. If the points are scattered on a grid and do not lie on a line or a curve, there is no relationship.

6. William has a head start of about 40 m. He runs for 10 s, slows down for 8 s, then runs for 12 s and slows down until he reaches the finish line at 40 s. Rhiannon runs for 12 s, slows down for 8 s, runs for 10 s, overtakes William, and wins the race in 34 s.

Chapter 6 Linear Relations

6.1 Recognizing Linear Relations, page 194

1. a) 6, 6, 6, 6; linear relation because all the first differences are equal

b) 1.0, 0.8, 0.7, 0.7; non-linear relation because the first differences are not equal

c) 5, 5, 5, 5; linear relation because all the first differences are equal

2. Answers may vary.

a) The cost to rent a canoe at $6/h

b) The mass of a baby from 0 to 4 months

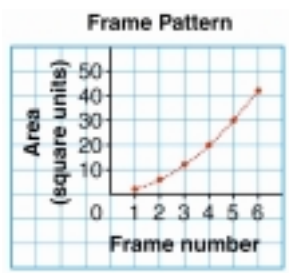
c) The distance driven at an average speed of 15 m/s

3. a)

Frame number	Area (square units)	First differences
1	2	
		4
2	6	
		6
3	12	
		8
4	20	
		10
5	30	
		12
6	42	

b) See the table in part a. The relation is not linear because the first differences are not equal.

c) Yes, the points lie on a curve.

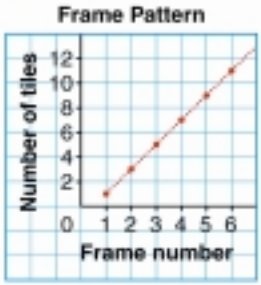


4. a)

Frame number	Number of tiles	First differences
1	1	
		2
2	3	
		2
3	5	
		2
4	7	
		2
5	9	
		2
6	11	

b) See the table in part a. The relation is linear because the first differences are equal.

c) Yes, the points lie on a straight line.

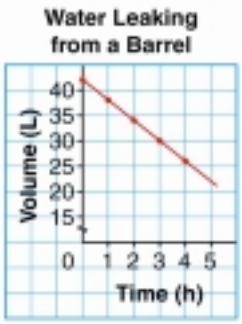


d) Extend the graph or the table: 17 tiles

5. a) –4, –4, –4, –4; the volume of water in litres that leaks out every hour

b) The relation is linear because the first differences are equal.

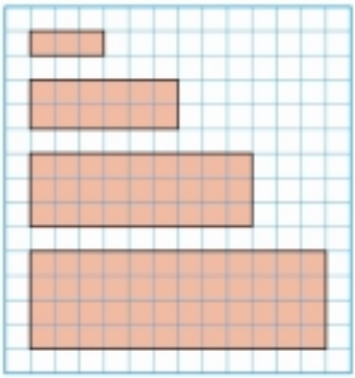
c) Yes, the points lie on a straight line.



d) 22 L; I assume water continues to leak at the rate of 4 L/h.

e) Answers may vary. For example: When is there 20 L of water in the barrel? *Answer*: After 5.5 h

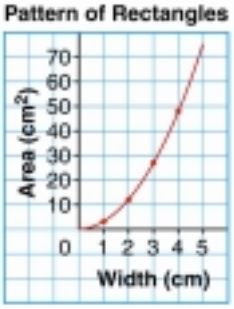
6. a)



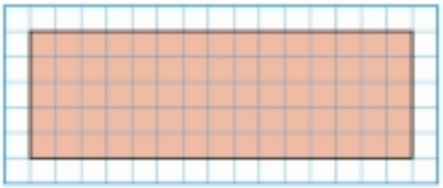
b) 9, 15, 21

c) The relation is non-linear because the first differences are different.

d) The graph is a curve that goes up to the right.



e) 75 cm^2

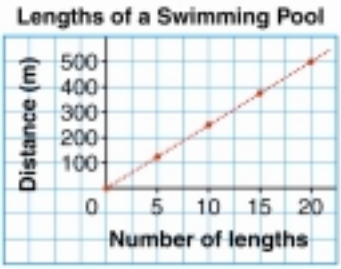


7. a) 5

b) 125, 125, 125, 125; the distance in metres for 5 lengths of the pool

c) The relation is linear because the first differences are equal.

d) Yes, the points lie on a straight line.



e) 25 m

8. Answers will depend on the pattern drawn.

6.2 Average Speed as Rate of Change, page 199

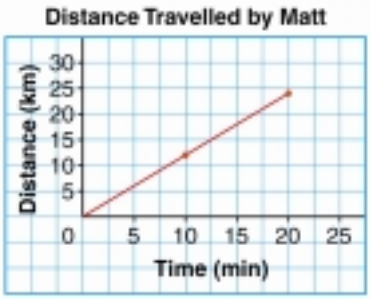
1. a) 80 km/h **b)** 15 km/h

2. a) The average speed of the car

b) The average speed of the cyclist

3. The rate of change is 75 km/h.

4. a)



b) 1.2 km/min

c) 1.2 km/min; the average speed is equal to the rate of change

d) 72 km/h

5. **a)**

Time (min)	Distance (km)
0	0
30	2
60	4
90	6
120	8
150	10
180	12
210	14
240	16

b) $0.0\overline{6}$ km/min or $\frac{1}{15}$, the distance the hikers walk in 1 min

c) Use the graph or table, 225 min

d) 4 km/h

e) Answers may vary. For example: How far have hikers travelled after 2.5 h? *Answer*: 10 km

6. Make a table of values; draw a graph; calculate each average speed: Keta because her average speed is 10.5 km/h.

6.3 Other Rates of Change, page 203

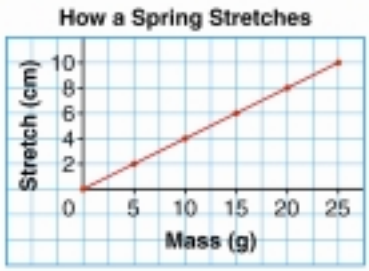
1. **a)** 15 km/L **b)** $25 per guest

2. **a)** The distance driven on 1 L of gas

b) The cost for 1 guest

3. Smart car: 792 km; SUV: 720 km

4. **a)**



b) Yes, the points lie on a straight line through the origin.

c) 0.4 cm/g; for every increase in mass of 1 g, the spring stretches 0.4 cm.

5. Answers will vary depending on the quantities chosen; for example, the rate of change could represent the average speed in kilometres per hour.

a), b) Cost of party on the vertical axis; number of guests on the horizontal axis

c) The rate of change is $5 per guest; this means that each guest costs $5 after $100 has been paid to rent the hall.

6. It will take 12 min in total, or 8 min from when the plane is at 1200 m

7. **a)** Approximately 2300 m and 1300 m

b) Approximately –143 m/min

c) The height is decreasing at a rate of 143 m per minute.

8. **a)** For the horizontal portion of the graph, the rate of change is 0. For the sloping portion of the graph, the rate of change is $1.25/person.

b) The cost is constant at $20 for any number of people from 0 to 10.
For 11 or more people, the cost increases by $1.25 per person.

c) $2.50

6.4 Direct Variation, page 207

1. **a)** No, the graph does not pass through origin.

b) Yes, the graph passes through the origin.

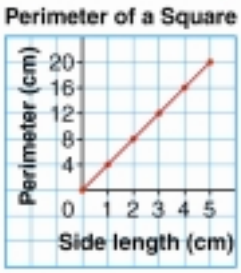
c) Yes, the graph passes through the origin.

d) No, the graph is not a straight line.

2. **a)**

Side length (cm)	Perimeter (cm)
0	0
1	4
2	8
3	12
4	16
5	20

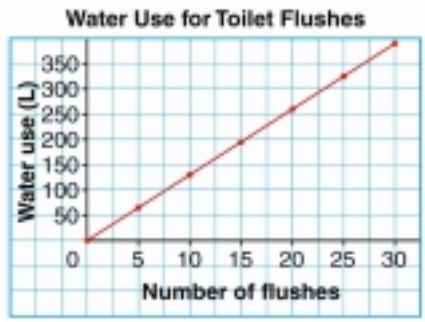
b) 4 cm/cm



c) The perimeter is 4 times the side length.

d) 44 cm

3. **a)** This is a direct variation situation because the graph is a straight line through the origin



b) 13 L/flush; one toilet flush uses 13 L of water.

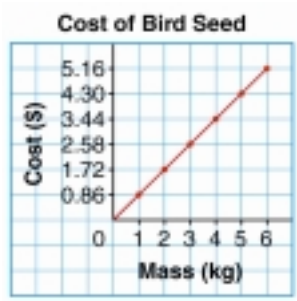
c) The water use in litres is 13 times the number of flushes.

d) 221 L

4. **a)**

Mass of bird seed (kg)	Cost ($)
1	0.86
2	1.72
3	2.58
4	3.44
5	4.30
6	5.16

b) Yes, the graph is a straight line passing through the origin.



c) The cost in dollars is 0.86 times the mass in kilograms.

d) $11.18

e) Yes, when 2 quantities are related by direct variation, when you double one quantity, the other quantity also doubles: the cost is $22.36.

5. **a)**

Number of trees, *n*	Earnings, *E* ($)
0	0
100	16
200	32
300	48
400	64
500	80
600	96
700	112
800	128
900	144
1000	160

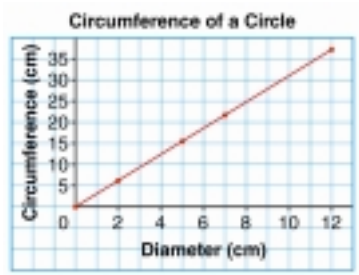
b) Yes. The graph is a straight line through the origin.

c) $0.16 per tree; the earnings for planting 1 tree

d) $E = 0.16n$ where E is the earnings in dollars and n is the number of trees planted

e) $272

6. **a)** Yes, the graph is a straight line through the origin.

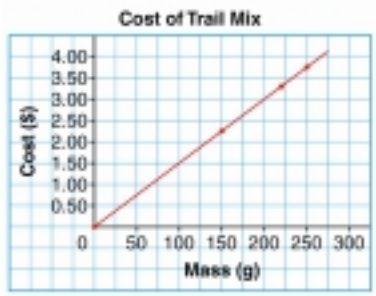


b) 3.1; the increase in circumference when the diameter increases by 1 cm; it is an approximate value of π.

c) $C = 3.1d$, where C is the circumference and d is the diameter.

d) About 40.3 cm

7. a) Yes, the graph is a straight line through the origin.



b) \$0.015/g; the cost of 1 g of trail mix
c) $C = 0.015m$
d) \$5.10
e) Questions may vary: How much trail mix could you buy with \$4.00? *Answer*: About 270 g

8. Answers may vary. For example:
a) The cost in dollars of v kilograms of apples that cost \$0.90 for 1 kg
b) The distance in kilometres driven at 90 km/h for t hours
c) The cost in dollars for n books that each cost \$5.50

9. Answers may vary.

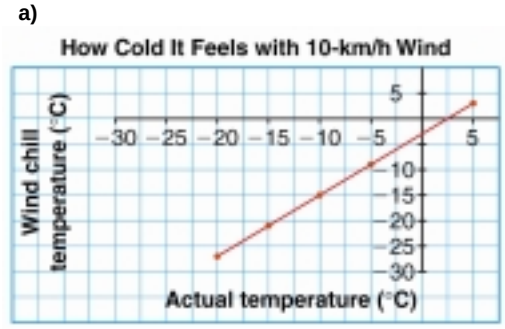
10. a) We cannot tell, because Anastasia might have stopped for a coffee on the way to work.
b) 44 km/h

6.5 Partial Variation, page 213

1. a) Yes, the graph is a straight line not passing through the origin.
b) No, the graph is not a straight line.
c) Yes, the graph is a straight line not passing through the origin.
d) No, the graph passes through the origin so it represents direct variation.

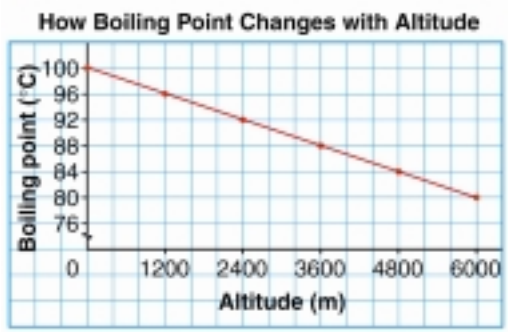
2. a) \$45; \$1/subscription
c) 3000 m; –400 m/lap

3. a)



b) Yes, the graph is a straight line not passing through the origin.
c) About –19°C, about 1°C

4. a) Join the points with a solid line because all altitudes and temperatures are possible.

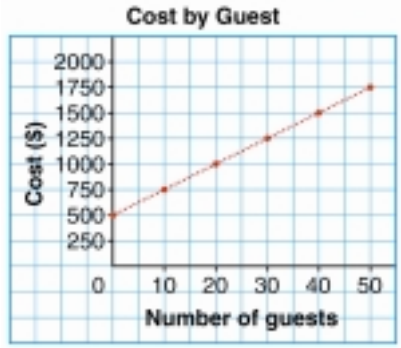


b) Yes, the graph is a straight line not passing through the origin.
c) i) About 90°C
ii) About 83°C

5. a)

Number of guests	Cost (\$)
0	500
10	750
20	1000
30	1250
40	1500
50	1750

b) Join the points with a broken line because a fraction or decimal number of guests is not possible.



c) Yes, the graph is a straight line not passing through the origin.
d) \$25/person; the extra cost for each extra person
e) \$1625, \$2750
f) No, the situation is not represented by direct variation, so the cost is not proportional to the number of guests.

6. a) $C = 20 + 0.10n$
b) \$38.00

7. a) $h = 25 + 1.3n$
b) 32.8 cm, 37.35 cm

c) Questions may vary. How much did Nuri's hair grow in 3 months? *Answer*: 3.9 cm

8. Answers may vary.

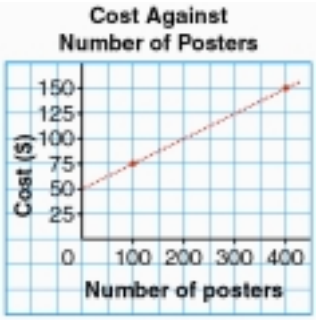
a) i) The cost in dollars of a party when the hall rental costs $150 and the cost per person is $20

ii) The length in centimetres of a rectangle when the length is 20 times the width

iii) The cost in dollars for *m* items, when 1 item costs $0.75

b) Equations ii and iii represent direct variation because their graphs are straight lines that pass through the origin.
Equation i represents partial variation because its graph is a straight line that does not pass through the origin.

9. a)



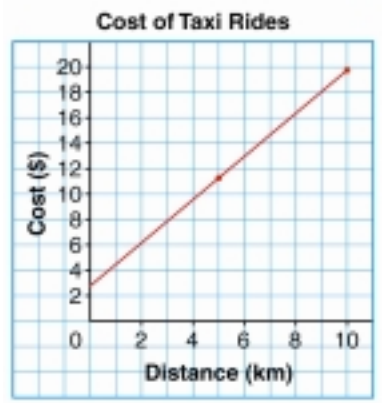
b) $50; it is the vertical intercept.

c) $0.25/poster; the cost per poster after the fixed cost has been paid

d) $C = 50 + 0.25p$, where C is the cost in dollars for p posters sold

e) $112.50

10. a)



b) $2.75; it is the vertical intercept.

c) $1.70/km; the cost per kilometre after the fixed cost has been paid

d) $C = 2.75 + 1.70d$, where C is the cost in dollars for a ride that is d kilometres

e) $28.25

f) The flat rate fare (the partial variation fare is $165.95)

11. a) i) Yes, the number of points is a fixed number plus a number that depends on the number of items handed in

ii) $P = 5i + 20$, where P is the total number of points when i items are handed in within 45 min

b) i) 41 or more items

ii) 45 or more items

Chapter 6 Mid-Chapter Review, page 220

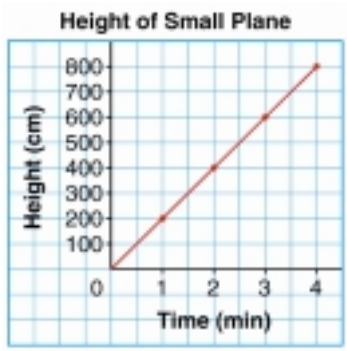
1. a) The height increase in 1 min

4. a)

Time (min)	Height (m)	First differences
0	0	
		200
1	200	
		200
2	400	
		200
3	600	
		200
4	800	

b) Yes, all first differences are equal.

c) The rate of change is 200 m/min; it has the same numerical value as the first differences.



d) 8 min from when the plane took off

2. a)

b) i) 255 m

ii) 340 m

c) 17 m/s

d) 17 m/s

3. **a)**

Rental time (days)	Cost ($)
0	0
2	66
4	132
6	198
8	264
10	330

b)

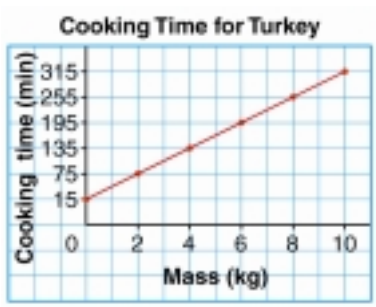
c) Direct variation because the graph is a straight line passing through the origin

d) $33/day; the daily cost to rent a kayak

4. **a)**

Mass of turkey (kg)	Cooking time (min)
0	15
2	75
4	135
6	195
8	255
10	315

b) 165 min



c) Cooking time is 30 min plus 30 min times the mass in kilograms

d) $t = 30m + 15$

e) 231 min

6.6 Changing Direct and Partial Variation Situations, page 222

1. **a)** Direct variation; there is no fixed or initial cost.

b) Partial variation; there is a fixed cost plus a cost that depends on the number of brochures printed.

c) Partial variation; there is a fixed amount plus an amount that depends on the number of subscriptions sold.

2. **a)** Partial variation

b) Direct variation

c) Direct variation

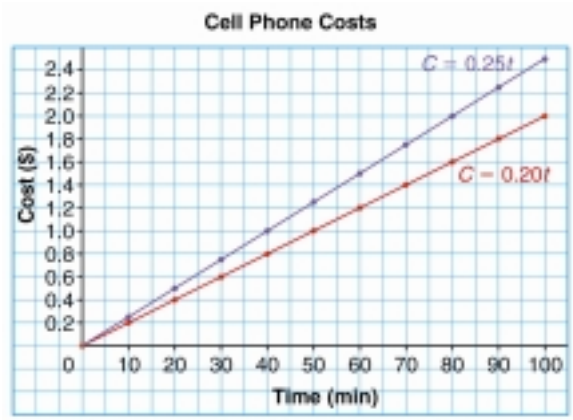
d) Partial variation

3. **a)** Direct variation

b)

Time (min)	Cost ($)
0	0
10	2.00
20	4.00
30	6.00
40	8.00
50	10.00
60	12.00
70	14.00
80	16.00
90	18.00
100	20.00

c), e)



d) $C = 0.20t$

e) **i)** The new graph is steeper than the original graph; the rate of change increases from $0.20/min to $0.25/min.

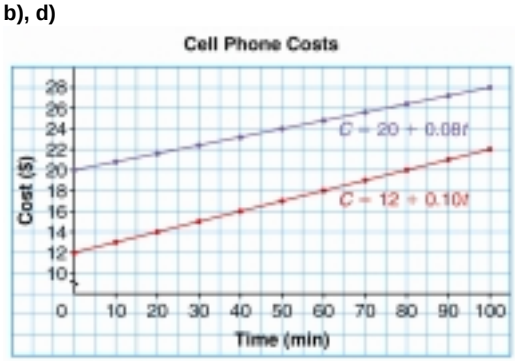
ii) The rate of change increases as in part i: $C = 0.25t$

4. The second pay scale is better because Jocelyn earns more money when she sells 2 or more ads.

5. a)

Time (min)	Cost ($)
0	12.00
10	13.00
20	14.00
30	15.00
40	16.00
50	17.00
60	18.00
70	19.00
80	20.00
90	21.00
100	22.00

b), d)



c) $C = 12 + 0.10t$

d) i) The new graph is less steep and its vertical intercept is greater.

ii) $C = 20 + 0.08t$

6. For the plan in question 3, the cost doubles when the time doubles because the plan is represented by direct variation and the cost is proportional to the time. For the plan in question 5, the cost does not double when the time doubles because the plan is represented by partial variation and the cost is *not* proportional to the time.

7. a)

Distance (km)	Cost ($)
0	29.00
50	29.00
100	29.00
150	34.00
200	39.00
250	44.00
300	49.00

b)

c) Neither; the graph is not a straight line.

d) The graph has 2 segments: one horizontal segment that represents a fixed cost of $29 up to 100 km, and a sloping segment that shows how the cost changes as the distance increases.

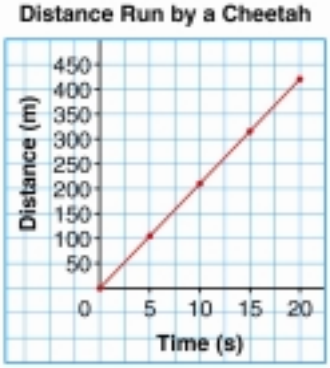
e) $29.00, $36.50, $47.00

6.7 Solving Equations, page 229

1. a) $x = 4$ b) $x = 9$ c) $x = 18$
   d) $x = 2$ e) $x = 1$ f) $x = 9$
2. a) $x + 4 = 9$; $x = 5$
   b) $2x + 5 = 13$; $x = 4$
   c) $3x = 18$; $x = 6$
   d) $6 = x + 3$; $x = 3$
   e) $11 = 2x + 3$; $x = 4$
   f) $2x = 8$; $x = 4$
3. a) $x = 5$ b) $x = 3$ c) $x = 7$
   d) $x = 3$ e) $x = 2$ f) $x = 8$
4. a) $x = -1$ b) $x = -1$ c) $x = -1$
   d) $x = -3$ e) $x = -2$ f) $x = -3$
   g) $x = -10$ h) $x = -4$
6. a) 24 cm b) 10 cm
   c) 15 cm
7. a) 86°F b) –10°C
8. 206 barrels
9. a) i) $2x + 40 + 70 = 180$
   ii) $5x + 20 = 50$
   iii) $58 + 58 + 3x + 7 = 180$
   b) i) $x = 35$
   ii) $x = 6$
   iii) $x = 19$

6.8 Determining Values in a Linear Relation, page 233

1. a) i) $48 ii) $96
   b) i) $80 ii) $240 iii) $400
2. a)



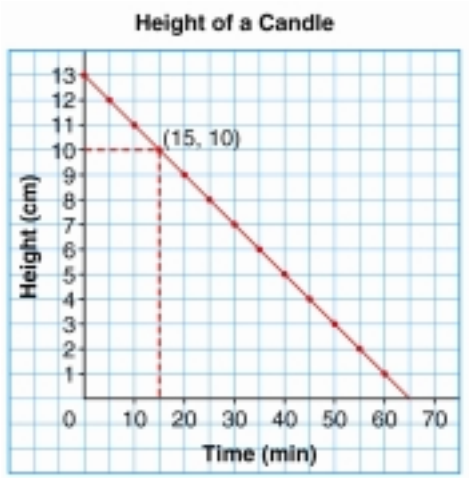
b) About 19 s

c) About 24 s; assume cheetah maintains an average speed of 21 m/s

d) $d = 21t$

e) About 19 s; about 23.8 s
Using the formula is easier and more precise than using the graph.

3. **a)** 15 min



b)

Time (min)	Height (cm)
0	13.0
5	12.0
10	11.0
15	10.0
20	9.0

c) Answers may vary. For example:
The table is the easiest way.

4. **a)** After 25 games

Number of games played, *n*	Value of card, *V* ($)
1	35.00
2	28.00
3	21.00
4	14.00
5	7.00
6	0

b) After 25 games

c) $V = 35 - 1.40n$

d) 25 games

e) Answers may vary.

5.

a) The vertical intercept changes from $35 to $45. The graph is less steep.

b) 50 games in total, so 25 more games

c) Answers may vary. For example: The $45 card is the better deal.

6.9 Solving Problems Involving Linear Relations, page 237

1. **a)**

Distance travelled (km)	Fare ($)
0	2.00
1	3.50
2	5.00
3	6.50
4	8.00
5	9.50

b)

Time (months)	Amount ($)
0	900
1	750
2	600
3	450
4	300
5	150
6	0

c)

Dollars	Pesos
0	0
20	180
40	360
60	540
80	720
100	900

2. **a)** Partial variation because the points lie on a line not passing through the origin.

b)

Frame	Toothpicks
1	6
2	11
3	16
4	21
5	26
6	31
7	36

c) $T = 5n + 1$ **d)** 86 toothpicks

3. **a)**

Time (h)	Car A distance (km)	Car B distance (km)
0	0	0
0.5	45	30
1	90	60
1.5	135	90
2	180	120

b) Car A: $d = 90t$; car B: $d = 60t$

c) Car A; the average speed is the rate of change.

d) Car A: 157.5 km; car B: 105 km

e) Car A: About 1.2 h; car B: about 1.8 h

4. $800

a)

Sales, s ($)	Earnings, E ($)
1000	550
2000	600
3000	650
4000	700
5000	750
6000	800

b) Use $E = 500 + 0.05s$; $800

c) Answers may vary. **d)** Drawing a graph

5. **a)** 20 min

b) Use: a graph; an equation; a table of values

6. 25 min

7. **a)** $d = 3 + 2t$

b) Answers may vary. For example: The distance a ball travels at an average speed of 2 m/s, and the ball has rolled 3 m before the time is measured.

6.10 Two Linear Relations, page 242

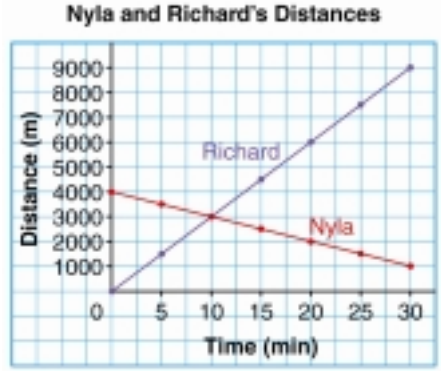
1. **a)** About 290 m

b) About (5.5, 250); the two balloons meet after 5.5 min at a height of about 250 m.

2. **a)** 4000 m or 4 km

b)

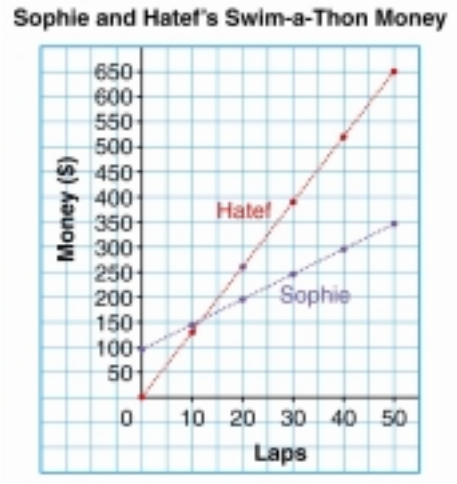
Time (min)	Nyla's distance (m)	Richard's distance (m)
0	4000	0
5	3500	1500
10	3000	3000
15	2500	4500
20	2000	6000
25	1500	7500
30	1000	9000



c) (10, 3000); Nyla and Richard meet after 10 min, when Richard has travelled 3000 m, and Nyla is 3000 m from where Richard started.

3. a)

Laps	Sophie's pledges ($)	Hatef's pledges ($)
0	96	0
10	146	130
20	196	260
30	246	390
40	296	520
50	346	650

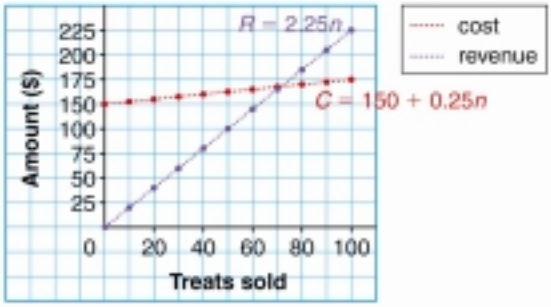


b) Hatef: $650; Sophie: $346

c) (12, 156); when both people have swum 12 laps, each has earned $156 in pledges.

4. a) $C = 150 + 0.25n$ **b)** $R = 2.25n$

c)



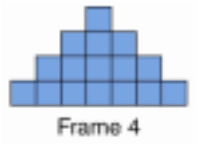
d) 75 treats

5. a) In 2.5 h; each person has read 100 pages.

b) Answers may vary; table of values; graph

Chapter 6 Review, page 248

1. a)

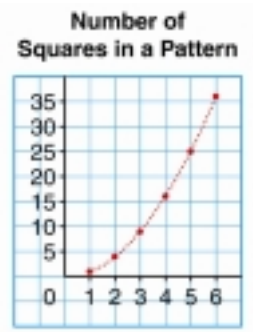


b)

Frame number	Number of squares	First differences
1	1	
		3
2	4	
		5
3	9	
		7
4	16	
		9
5	25	
		11
6	36	

c) Non-linear relationship because the first differences are not equal

e) The points lie on a curve so the relationship is non-linear.



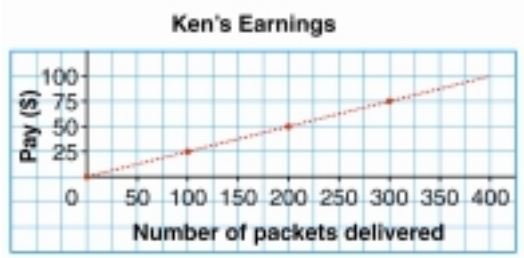
2. a) 70 km/h; average speed of a car

b) –2 L/h; the rate at which water evaporates

3. a) Direct variation because the graph is a straight line passing through the origin

b) Partial variation because the graph is a straight line *not* passing through the origin

4. a)

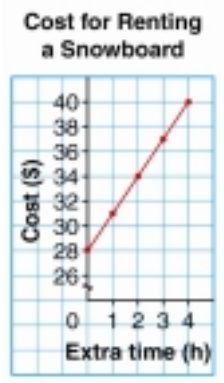


b) $62.50

c) 400 packets

d) 560 packets

5. **a)**



b) The rental cost when a snowboard is rented for 8 h

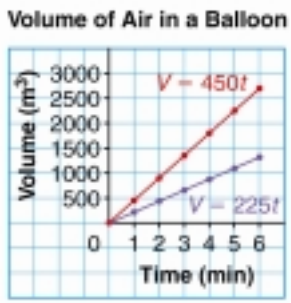
c) \$3/h; the extra cost (\$3 per hour) for renting a snowboard beyond 8 h

d) $C = 3t + 28$

6. **a)**

Time (min)	Volume of air (m^3)
0	0
1	450
2	900
3	1350
4	1800
5	2250
6	2700

b), d)



c) $V = 450t$

d) **i)** The new graph is less steep.

ii) $V = 225t$

7. **a)** $x = 1$ **b)** $x = -4$ **c)** $x = 4$

d) $x = -3$ **e)** $x = 3$ **f)** $x = -5$

8. **a)** Cost in dollars is 6 plus 0.75 times the number of toppings.

b) $C = 6.00 + 0.75n$

c) 5 toppings; use a table, a graph, or the equation

9. **a)** 27 cm **b)** 140 cm

c) $L = 0.15h$, where L is the length of the foot in centimetres and h is the height in centimetres

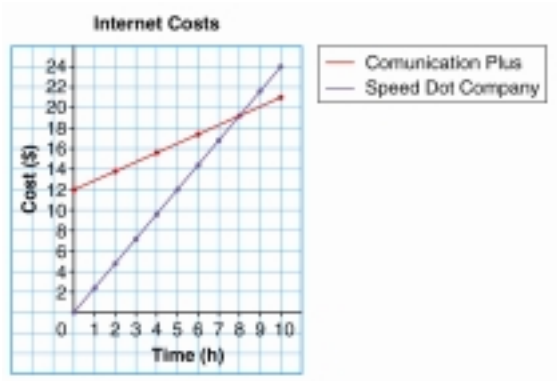
d) Make a table; draw a graph.

10. **a)** Speed Dot Company: $C = 2.40t$

Communications Plus: $C = 12 + 0.90t$

b)

Time (h)	Cost (\$) Speed Dot Company	Cost (\$) Communication Plus
0	0.00	12.00
2	4.80	13.80
4	9.60	15.60
6	14.40	17.40
8	19.20	19.20
10	24.60	21.00



c) (8, 19.20); for 8 h of use, both plans cost the same amount, \$19.20

d) Jo-Anne should choose Speed Dot Company because it is cheaper for 7 h.

Chapter 6 Practice Test, page 250

1. C

2. D

3. **a)**

b) \$8/h **c)** \$288 **d)** 27 h

4. Answers may vary. For example:

The cost of hall rental before any guests are included (\$250)

The cost for each guest, above the hall rental (\$15/person)

The cost for 10 guests (\$400); 20 guests (\$550); 30 guests (\$700); 40 guests (\$850); 50 guests (\$1000)

5. $80

a)

b) $C = 20 + 2a$; the ad will cost $80.

c) Answers may vary.

6. For 190 brochures, the costs are equal ($470).
For less than 190 brochures, printer B is cheaper.
For more than 190 brochures, printer A is cheaper.

Chapter 7 Polynomials

7.1 Like Terms and Unlike Terms, page 255

1. **a)** $2x^2$ **b)** $2x + 3$
c) $-2x + 4$ **d)** $-x^2 + 3x - 2$
e) $4x^2 + 6x - 1$ **f)** $-3x^2 - x - 2$

2. **a)**

b)

c)

d)

e)

f)

3. 1, x, x^2; the name of the tile describes its area.

4. $2x$ and $-4x$ are like terms.
They are modelled by like tiles.

5. $3x^2$ and $3x$ are unlike terms. They are modelled by different sized tiles.

6. **a)** $-5x$, $4x$, $-3x$, $7x$ **b)** $-3x^2$, x^2, $3x^2$
c) Like terms have the same variable raised to the same exponent.

7. **a)** $x + 4$ **b)** $2 + x$ **c)** $-2x^2 - x - 1$
d) $3x^2 + x + 1$ **e)** $2x + 4$ **f)** $x^2 + 2x + 1$

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

9. Answers may vary. For example: $x - 4x + 3 + 5x - 1$, which simplifies to $2x + 2$.

10. **a)** **i)** $2x + 1$ **ii)** $6x^2 - 9x$
iii) $4x^2 + 6x + 3$ **iv)** $-3x^2 + x + 1$
b) Answers may vary. For example: $-5x^2 - 1$
There are no like terms.

11. **a)** x^3
b) x^3 cube
c) **i)** $8x^3$ **ii)** $4x^3 + 8x$ **iii)** $3x^3 + 3x^2 + 5$

12. **a)** To ensure it has a different area. The y-tile represents a variable different from x.

b)

c) $-5x - y + 3$. There are no like terms.

7.2 Modelling the Sum of Two Polynomials, page 259

1. **a)** $-x + 5$ **b)** $3x^2 + 2x - 3$

2. **a)** $-2x^2 - 3$

b) $2x^2 + 3$

c) $-2x^2 + 3$

d) $-4x^2 + 7$

3. **a)** $6x + 2$ **b)** $3x + 2$ **c)** $4x + 1$
d) $-x - 2$ **e)** $2x - 8$ **f)** $2x + 4$

4. **a)** $8x^2 + 3x - 1$ **b)** $2x^2 - 12x - 5$
c) $4x^2 - x + 1$ **d)** $-x^2 + 2x - 8$
e) $-5x^2 + 2x + 4$ **f)** $x^2 + 5x - 3$

5. $x^3 - 4x^2 + 3x - 2$. I combined like terms.

6. **a)** $5x + 9$ **b)** $18x + 16$
c) $8x + 12$ **d)** $8x + 4$

7. **a)** Choose part a: 49 **b)** 49
c) Evaluate after simplification because there is less arithmetic to do.

8. **a)** $2x^2 + 2x + 2$ **b)** $x^2 + x + 1$
c) 0 **d)** $-x^2 - x - 1$
e) $-2x^2 - 2x - 2$ **f)** $-2x^2 - 3x - 3$

9. For example, $(x^2 + x + 1) + (2x^2 - 3x + 4)$. There is no limit to the number of polynomials that can be found. Algebra tiles help.

10. $-x^2 - 2x + 5$. I used algebra tiles.

7.3 Modelling the Difference of Two Polynomials, page 265

1. $x^2 - x + 1$
2. a) $2x + 1$ b) $2x + 5$
   c) $8x + 1$ d) $8x + 5$
3. a) $x^2 + x + 3$ b) $x^2 - x - 5$
   c) $5x^2 - 3x - 3$ d) $x^2 - x + 3$
4. a) $-3x + 2$ b) $2x^2 - 3x$

   c) $-4x^2 + 7x - 6$ d) $x^2 - 5x + 4$

5. a) 2 b) 12
   c) $2x + 2$ d) $2x + 12$
6. a) $x^2 - 4$ b) $x^2 + x$
   c) $-1 - 2x^2$ d) $3x - 9x^2$
7. a) $2x^2 + 3x - 6$ b) $-2x + 2$
   c) $x^2 + 4x - 7$ d) $-2 + 2x - 2x^3$
   e) $3 + 6x - 5x^3$ f) 0
8. a) John did not properly subtract each term of the second polynomial.
   b) $-x^2 - 6x + 10$
   c) Check by adding $(3x^2 + 2x - 4)$ to the answer to obtain $2x^2 - 4x + 6$.
9. a) i) $x^2 + 4x$ ii) $-x^2 - 4x$ iii) $-12 + 2x^3$
   iv) $12 - 2x^3$ v) 0 vi) 0
   b) The answers in each pair are opposite polynomials.
   c) Answers may vary. For example:
   $(x + 1) - (3x^2 + 3) = -3x^2 + x - 2$
   $(3x^2 + 3) - (x + 1) = 3x^2 - x + 2$
   The answers are also opposite polynomials.
10. a) i) For example, $3x + 4$ ii) $-3x - 4$
    b) $6x + 8$. It is the polynomial in part a) i) added to itself.
    c) There is a pattern. Subtracting the opposite polynomial is the same as adding the opposite of the opposite polynomial, which is the original polynomial. The result will always be the original polynomial added to itself.
11. Answers may vary. For example:
    $(x^2 + 6x - 6) - (3x^2 + 2x - 1)$
    There is no limit to the number of possible polynomials.

Chapter 7 Mid-Chapter Review, page 268

1. No. The order in which the terms are written does not matter.
2. a) $4x - 2$ b) $1 - x^2$
   c) $2x^2 + 3x - 2$ d) $-4x^2 + 5x - 3$
3. a) $8x + 6$ b) $2x + 2$
   c) $3x^2 - 3$ d) $-2 - x$
   e) $-4x + 2$ f) $5x^3 + 2x$
   g) $-x^2 + x - 2$
4. No. The terms are unlike.

5. Answers may vary.
   For example: $3x + 6x - 5x + 4x$, which simplifies to $8x$. I used only like terms.
6. $x^2 + 2x - 1$
7. a) $8x + 9$ b) $2x + 2$
   c) $10x^2 - 4x - 2$ d) $6x^2 - x - 4$
   e) $-x^2 + 3x - 1$ f) $-x^2 + x - 3$
8. $2x^2 + 2x + 3$
9. a) $5x + 7$ b) $12x + 8$
10. a) $-x - 3$ b) $-3x^2 + 5x$
    c) $-2x^2 - 3x - 7$ d) $5x^2 + 2x + 1$
11. a) 7 b) $6x^2 - 2x$
    c) $-2x^2 + x + 9$ d) $-5x^2 - 6x + 2$
    e) $3x + 7$

7.4 Modelling the Product of a Polynomial and a Constant Term, page 271

1. a) $2(2x + 2) = 4x + 4$
   b) $3(2x + 1) = 6x + 3$
   c) $2(3x + 2) = 6x + 4$
2. a) $8x + 2$

   b) $6x + 2$

   c) $10x + 15$

   d) $16x + 12$

3. a) $3(2x + 7) = 6x + 21$
   b) $3(1 + 4x) = 3 + 12x$
   c) $5(2x + 9) = 10x + 45$
   d) $5(x + 8) = 5x + 40$
4. a) The coefficient of x increases by 2 and the constant term increases by 1 each time.
   $12x + 6$; $14x + 7$
   b) The constant term increases by 1 and coefficient of x increases by 2 each time.
   $6 - 12x$; $7 - 14x$

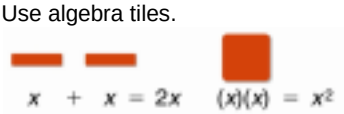
5. $-400x^2 - 100x + 400$; Algebra tiles are not useful because you would need too many tiles.
6. Use CAS. The screen shows $3x^2 + 12x - 6$. Jessica forgot to multiply every term by 3.
7. **a)** $21x - 7$ **b)** $12x - 15$ **c)** $12x - 8$ **d)** $25x^2 - 15x$ **e)** $-8x^2 + 12$ **f)** $9x^2 + 9x - 54$
8. **a)** $-8x - 4$ **b)** $-15x^2 + 9$ **c)** $-2x - 8$ **d)** $-7x^2 + 35$ **e)** $10x^2 - 2x$ **f)** $18 - 12x$
9. **a)** $-2x^2 + 4x - 8$ **b)** $3x^2 - 9x + 21$ **c)** $8x^3 - 4x^2 - 2x$ **d)** $24x^3 + 16x^2 - 24$ **e)** $-12x^2 + 6x - 30$ **f)** $4x^2 - 12x - 12$
   I used paper and pencil and the distributive law.
10. **a)** Square A: $P = 4(4x + 1) = 16x + 4$
    Square B: $P = 4 \times 3 \times (4x + 1) = 48x + 12$
    b) $32x + 8$
11. I would start by modelling the multiplication by the opposite (positive) constant.
    Then, I would replace each tile by its opposite and write the result.
    For example: $-2(x + 1)$. First model $2(x + 1)$

    Replace each tile by its opposite to model $-2(x + 1)$.

    $-2(x + 1) = -2x - 2$

7.5 Modelling the Product of Two Monomials, page 277

1. **a)** 12 **b)** $12x$ **c)** $12x^2$
2. All have coefficient 12. The first product has no factor of x, each of the other products has a different power of x.
3. **a)** $2x^2$ **b)** $4x^2$ **c)** $6x^2$
4. **a)** $3x^2$ **b)** $5x^2$ **c)** $15x^2$ **d)** $4x^2$ **e)** $4x^2$ **f)** $12x^2$ **g)** $14x^2$ **h)** $9x^2$
5. **a)** The coefficients increase by 2 each time: $12x^2$, $14x^2$, $16x^2$
   b) The coefficients increase by 3 each time: $18x^3$, $21x^3$, $24x^3$
6. **a)** $6x^3$ **b)** $4x^3$ **c)** $3x^3$ **d)** x^3 **e)** $24x^3$ **f)** $16x^3$ **g)** $24x^3$ **h)** $9x^3$
7. **a)** $-6x$ **b)** $-16x$ **c)** $-8x$ **d)** $-35x$ **e)** $-18x$ **f)** $-10x$ **g)** $-81x$ **h)** $18x$
8. **a)** $-6x^3$ **b)** $-12x^3$ **c)** $20x^3$ **d)** $-x^3$ **e)** $-32x^3$ **f)** $-4x^3$ **g)** $-12x^3$ **h)** $36x^3$
9. Use algebra tiles.

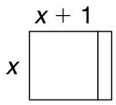


10. **a)** **i)** $15x^2$ **ii)** $-15x^2$ **iii)** $15x$ **iv)** $15x$ **v)** $15x^2$ **vi)** $-15x^2$ **vii)** $15x^2$ **viii)** $15x^3$
    b) All the products in part a except viii) $15x^3$. An x^3 term cannot be modelled with algebra tiles.
    c)

11. Eighteen different pairs of monomials are possible: $(1)(36x^3)$; $(x)(36x^2)$; $(x^2)(36x)$; $(x^3)(36)$; $(2)(18x^3)$; $(2x)(18x^2)$; $(2x^2)(18x)$; $(2x^3)(18)$; $(3)(12x^3)$; $(3x)(12x^2)$; $(3x^2)(12x)$; $(3x^3)(12)$; $(4)(9x^3)$; $(4x)(9x^2)$; $(4x^2)(9x)$; $(4x^3)(9)$; $(6)(6x^3)$; $(6x)(6x^2)$

7.6 Modelling the Product of a Polynomial and a Monomial, page 281

1. **a)** $x^2 + 3x$ **b)** $2x^2 + 6x$ **c)** $2x^2 + x$ **d)** $4x^2 + 2x$
2. **a)** $2x(3x + 4) = 6x^2 + 8x$
   b) $x(2x + 3) = 2x^2 + 3x$
   c) $3x(2x + 1) = 6x^2 + 3x$
   d) $3x(x + 4) = 3x^2 + 12x$
3. **a)** $3x^2 + 2x$ **b)** $4x^2 + 6x$ **c)** $6x^2 + 3x$ **d)** $12x^2 + 16x$
4. **a)** $4x^2 + 12x$ **b)** $2x^2 + 3x$ **c)** $2x^2 + 12x$ **d)** $15x^2 + 6x$
5. **a)** Each first term is x^2. The coefficients of x increase by 1 each time.
   b) $x^2 + 7x$; $x^2 + 8x$
6. Use an area model.
   The area of the rectangle is $x^2 + x$.



7. **a)** $12x^2 - 4x$ **b)** $8x^2 - 2x$ **c)** $5x^2 - 35x$ **d)** $-4x^2 + 3x$ **e)** $6x^3 - 8x$ **f)** $-8x^2 - 12x$ **g)** $6x^2 - 12x$ **h)** $-x^2 - x$
8. **a)** $-2x^2 - 6x$ **b)** $-2x^2 - x$ **c)** $2x^2 + 7x$ **d)** $-6x + 3x^2$ **e)** $-28x^2 + 63x$ **f)** $-2x^2 - 3x$ **g)** $-6x^2 + 10x$ **h)** $-12x^2 - 18x$
9. **a)** $2x^3 + 4x^2$ **b)** $-9x^3 + 15x^2$ **c)** $32x^3 + 24x$ **d)** $14x^3 + 21x^2 - 7x$ **e)** $-8x^3 + 10x^2 - 14x$ **f)** $12x^3 - 9x^2 - 27x$ **g)** $-2x^2 + 6x^3 - 2x$ **h)** $x^3 - 9x + x^2$
10. $5x(9x + 7) - x(6x + 4) = 39x^2 + 31x$

7.7 Solving Equations with More than One Variable Term, page 285

1. **a)** $x = 1$ **b)** $x = 3$ **c)** $x = 4$ **d)** $x = 2$
2. **a)** $x = 7$ **b)** $x = -4$ **c)** $x = -6$ **d)** $x = -2$ **e)** $x = 1$ **f)** $x = 8$
3. **a)** $x = -7$ **b)** $x = 4$ **c)** $x = -1$ **d)** $x = 6$ **e)** $x = -1$ **f)** $x = 2$ **g)** $x = -1$ **h)** $x = 49$

4. Substitute to check. **a)** L.S = –17; R.S. = –17
b) L.S. = 31; R.S. = 31

5. **a)** $x = 8$ **b)** $x = 2$ **c)** $x = 1$
d) $x = -3$ **e)** $x = 21$ **f)** $x = 7$

6. **a)** $x = 2$ **b)** $x = -13$ **c)** $x = -2$
d) $x = -3$ **e)** $x = 1$ **f)** $x = 15$

7. $x = 5000$. The number of parts that must be made and sold for the business to break even

8. **a)** $x = 12$ **b)** $x = -1$ **c)** $x = 2$

Chapter 7 Review, page 288

1. x has different exponents in each monomial.

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

3. **a)**

b)


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

5. For example, $2x^2 + x + 3 + x^2 - 3x$

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

7. Use algebra tiles.
a) $9x - 3$ **b)** $-x^2 + 4x$
c) $-2x^2 - 7x + 12$ **d)** $3x^2 - 3x + 11$

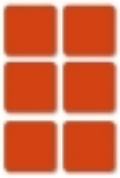
8. **a)** -12 **b)** $-2x^2 + 9$
c) $2x^2 - 5x$ **d)** $2x^2 + 2x + 2$
e) $-8x^2 + 6x + 5$ **f)** $x^2 - 4x + 6$

9. **a)** $15x^2 + 20$ **b)** $28 + 8x$
c) $3x^3 - 6x^2 + 6$ **d)** $16x^2 + 24x - 32$
e) $14x^3 - 7$

10. **a)** $-6x - 12$ **b)** $-7x^2 + 28$
c) $-4x^2 - 2$ **d)** $-15x^3 + 10x + 15$
e) $-3x^3 + 6x^2 - 12$

11. $16x - 4$; $20x - 4$; $24x - 4$

12. **a)**

b)


13. **a)** **i)** $24x^2$ **ii)** $12x^3$ **iii)** $-12x^2$ **iv)** $18x^3$
b) Parts i and iii. The other parts would require cubes.

14. **a)** $3x^2 + 4x$ **b)** $3x^3 - 24x$
c) $8x - 2x^2$ **d)** $-18x^3 + 24x^2 + 12x$
You can use algebra tiles for parts a, b, and c. You cannot use them for part d because no tile represents x^3.

15. **a)** $6x^2 - 9x$ **b)** $-2x^3 + 10x$
c) $-15x^2 - 35x$ **d)** $8x^3 + 10x^2 - 6x$

16. **a)** $12x^3$; $14x^3$; $16x^3$
b) $4x^2 - 12x$; $5x^2 - 15x$; $6x^2 - 18x$

17. **a)** $6x + 1 = 2x + 13$ **b)** $x = 3$ **c)** 3

18. **a)** $x = 2$ **b)** $x = 2$ **c)** $x = -3$

19. **a)** $x = 6$ **b)** $x = -4$
c) $x = -1$ **d)** $x = 3$

20. **a)** $x = 1000$
b) The number of tickets that must be sold to raise $60 000 after expenses.

Chapter 7 Practice Test, page 290

1. C

2. C

3. **a)** $5x^2 - 4x - 5$ **b)** $-x^2 + 2x$
c) $3x + 12$ **d)** $6x^3$ **e)** $4x^3 - 20x^2 + 12x$

4. **a)** $4900 **b)** 320 students

5. A polynomial can be simplified if it contains like terms. For example, $2x + 4 + 3x$ simplifies to $5x + 4$.

6. **a)** Joe forgot to subtract every term of the second polynomial.
b) $2x^2 + 2x - 4$
c) Add the difference to the second polynomial.

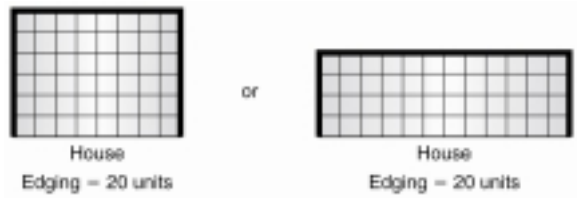
Cumulative Review Chapters 1–7, page 291

1. **a)** $P \doteq 29.7$ cm; $A = 51$ cm^2
b) $P \doteq 31.4$ cm; $A \doteq 33.9$ cm^2

2. **a)** About 62.8 cm^3 **b)** About 23.9 cm^3
c) 1440 cm^3 **d)** 400 cm^3
e) About 7238.2 cm^3

3. **a)** **i)** 10 cm by 10 cm
ii) 17 m by 17 m
iii) 22.5 cm by 22.5 cm
b) **i)** 100 cm^2 **ii)** 289 m^2
iii) 506.25 cm^2
For a given perimeter, the rectangle with the greatest area is a square.

4. 12 cm by 12 cm; 48 cm

5. 20 units


6. No; the sum of the angles in a triangle is 180°. The largest angle in a right triangle is 90°.

7. **a)** $a = 75°$, $b = 75°$, $c = 105°$, $d = 150°$
b) $y = b = d = 100°$; $a = c = x = z = 80°$
c) $m = 90°$, $n = p = 110°$

8. **a)** 72° **b)** 40° **c)** 36°

9. **a)** $n = 15$ **b)** $b = 18$
c) $a = 6$ **d)** $m = 20$

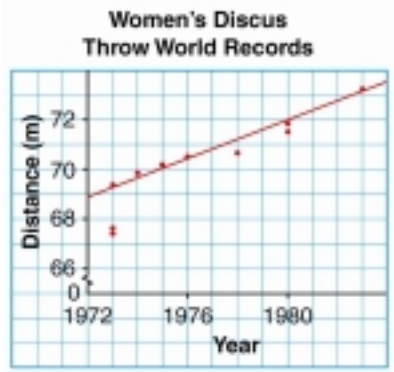
10. **a)** 72 km/h **b)** About $1.26/kg
c) $8.50/h **d)** 3.6 km/h
e) About $0.58/muffin

11. **a)** 12 lengths **b)** 22.5 min

12. **a)** $24.49 **b)** $28.16

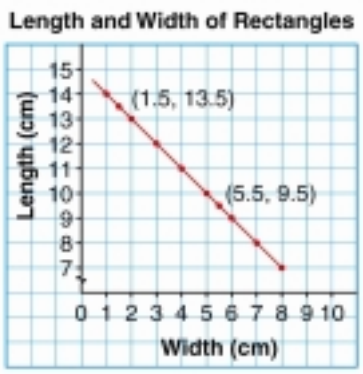
13. **a)** $37.50 **b)** $2537.50

14. **a)** World records for women's discus throw
b) About 70.2 m, about 71.5 m
c) 1974
d)



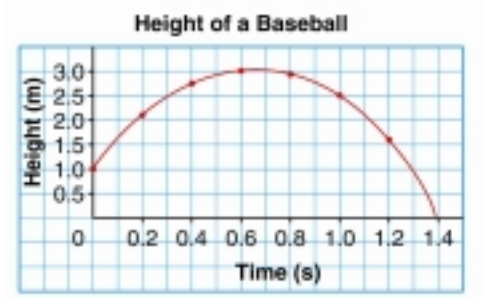
e) Extend the graph to the right: About 73.5 m

15. **a)** Yes, as the width increases by 1 cm, the length decreases by 1 cm.
b) Yes, the graph is a straight line.



c) **i)** 9.5 cm **ii)** 1.5 cm
d) Length plus width is 15 cm.

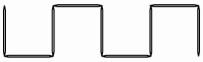
16. **a), b)**



c) About 3.0 m **d)** About 1.39 s
e) At about 0.18 s and at about 1.12 s

17. **a)** From A to B, Tyler drives at an average speed of 60 km/h for 30 min and travels 30 km.
From B to C, Tyler stops driving for about 15 min.
From C to D, Tyler drives at an average speed of 80 km/h for 45 minutes, and travels 60 km.
From D to E, Tyler stops driving for 5 min.
From E to F, Tyler drives at an average speed of 60 km/h for 40 min and travels 40 km.
b) From B to C, Tyler buys gas (it is a longer stop). From D to E, Tyler picks up his cousin (it is a shorter stop).

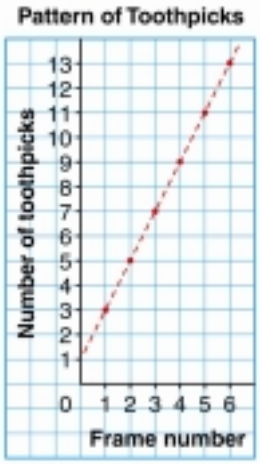
18. **a)** Frame 4:



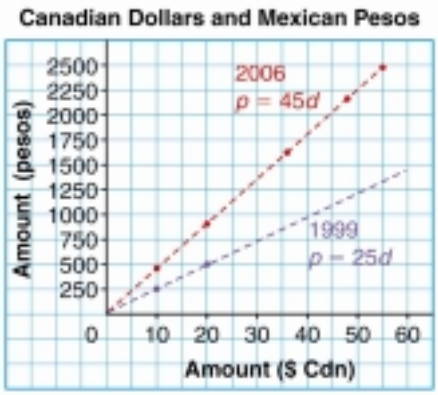
b) The relation is linear because the first differences are equal.

Frame number	Number of toothpicks	First differences
1	3	
2	5	2
3	7	2
4	9	2
5	11	2
6	13	2

c) Yes, the points lie on a straight line.



19. **a)** Yes, the graph is a straight line that passes through the origin.



b) 45 pesos/$; for $1, you can get 45 pesos.
c) $p = 45d$
d) 7875 pesos
e) About $166.67
f) Answers may vary.

20. a) The new graph would be less sharp. (Refer to graph in question 19 part a).
b) $p = 25d$

21. a)

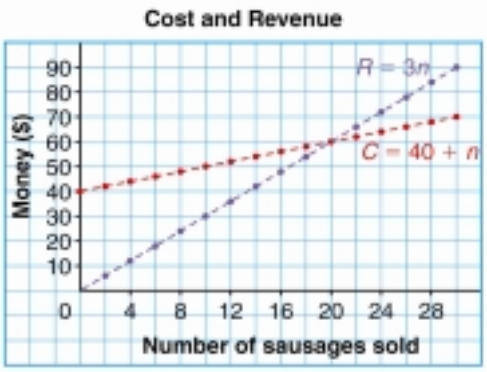
Time (h)	Cost ($)
0	50
10	85
20	120
30	155
40	190
50	225
60	260

b) No, the graph does not pass through the origin.

c) $C = 50 + 3.5n$ **d)** About 42 h

22. a) The vertical intercept is greater and the graph is steeper. (Refer to graph in question 21 part b).
b) $C = 75 + 4n$ **c)** About 31 h

23. a) $C = 40 + n$ **b)** $R = 3n$
c)



d) 20 sausages; then revenue is equal to cost.

24. a) $x^2 + 6x - 5$
b) $-2x^2 - 3x + 2$

25. a) $7x + 3$
b) $2x^2 - 3x$
c) 5
d) $5x^3 + 4x$

26. a) $11x - 4$
b) $-x^2 - 5x$
c) $2x^2 - 4x + 1$

27. a) $x + 3$
b) $x^2 - 5$
c) $7x^2 - 2x + 1$

28. a) $30 + 12x$
b) $2x^3 - 6x^2 + 6$
c) $-9x - 3$
d) $-8x^3 + 20x^2$
e) $2x^2 + 7x$
f) $21x - 9x^2$
g) $-4x^3 + 6x$
h) $6x^3 - 8x^2 + 10x$

29. a) $x = 1$
b) $x = -3$
c) $x = -3$
d) $x = 2$