Answers

Chapter 1

Get Ready, pages 4–5

1. **a)** $1\frac{1}{5}$ **b)** $\frac{5}{8}$ **c)** $\frac{13}{30}$ **d)** $1\frac{17}{45}$

2. **a)** $\frac{1}{8}$ **b)** $1\frac{1}{8}$ **c)** $18\frac{11}{16}$ **d)** $\frac{7}{72}$

3. $\frac{13}{24}$

4. **a)** 8 **b)** −5 **c)** −23 **d)** −4
e) −14 **f)** 15 **g)** 4 **h)** −400
i) −49 **j)** 42 **k)** −7 **l)** −4

5. **a)** 48 **b)** −8 **c)** −23

6. loss of \$3570

7. **a)** −60 **b)** 110 **c)** −1 **d)** −65
e) 6241 **f)** 39

9. net loss \$8

10. Answers will vary.

1.1 Focus on Problem Solving, pages 6–9

1. **a)** 11, 13, 15; add 2 to the previous term
b) 56, 69, 82; add 13 to the previous term
c) 32, 64, 128; multiply the previous term by 2
d) 13, 21, 34; add the two previous terms

2. 11

3. **a)** $1 \times 1 = 1$
$11 \times 11 = 121$
$111 \times 111 = 12\ 321$
$1111 \times 1111 = 1\ 234\ 321$
b) The digits increase from 1 up to the number of 1s in one of the factors and then decrease to 1 so that the answer is symmetric.
c) There are nine 1s in the first factor, so the product is 12 345 678 987 654 321.

4. **a)** 407, 814, 1221
b) 1628, 2035, 2442; add 407 to the previous term
c) 99×37 is the eighth term after 11×37, so add 407 eight times to 407 to get 3663.

5. **a)** $0.\overline{1}$, $0.\overline{2}$, $0.\overline{3}$, …; If the numerator is less than 9, then the decimal will be that digit repeated infinitely after the decimal place.
b) If the numerator is less than 99, then the decimal will be that number written as a two-digit number, repeated infinitely after the decimal place.
c) If the numerator is less than 99 999 then the decmal will be that number written as a five-digit number, repeating infinitely after the decimal point.

6. The middle 3 by 3 square is shown.

2	4	3
9	5	8
1	6	7

7. **a)** Gina: 22 years, 3 months, and 17 days; Sam: 25 years, 11 months, and 9 days
b) To find the number of years, subtract the birth year from 2019. To find the number of months, subtract the month number from 12. To find the number of days, subtract the birthday number from 31 and add 1.

8. **a)** 1 **b)** 3 **c)** 6 **d)** 45

9. 7

10.

630	or	860
1766		1788
2396		2648

11.

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

1.2 Focus on Communicating, pages 10–13

1. **a)** Subtract 5 from the previous term; 0, −5
b) Subtract 4 from the previous term: −18, −22
c) Add $\frac{1}{4}$ to the previous term; 1, $1\frac{1}{4}$
d) Subtract $\frac{2}{5}$ from the previous term; $\frac{6}{5}$, $\frac{4}{5}$
e) Multiply the previous term by −2; 48, −96
f) Divide the previous term by 2; −12, −6
g) Subtract descending multiples of 5, starting with 20, from the previous term; 50, 50
h) Multiply the previous term by 1, 2, 3, 4, …; 360, 2160
i) Multiply the previous term by $\frac{1}{5}$;

i) Multiply the previous term by 2;

2. Answers will vary.

3. Yes; the area of the semicircle on the hypotenuse equals the sum of the areas of the semicircles on the other two sides.

4. B; As the wheel moves forward, the height of the light will increase and decrease smoothly.

5. **a)** The map is divided into sections where time changes by 1-h intervals. Starting at the original time zone, count how many time zones away the other one is using positive integers to the right and negative integers to the left. Add this integer value to the original time.
b) 4:00 P.M. **c)** 4:30 A.M.

6. **a)** Use the last two rows. In the fraction strip made of $\frac{1}{7}$ pieces, shade three parts. In the fraction strip made of $\frac{1}{8}$ pieces, shade four parts. Compare the shaded parts. $\frac{4}{8} > \frac{3}{7}$ because four pieces of $\frac{1}{8}$ are wider than three pieces of $\frac{1}{7}$.

b) Place the $\frac{1}{2}$ piece and the $\frac{1}{3}$ piece side by side; they will have the same width as a $\frac{5}{6}$ piece.

c) Twelve rows are needed because the lowest common denominator is 12.

d) The dark blue bars are getting smaller. When 1 is divided by larger and larger numbers, the pieces become smaller and smaller. The number of pieces is the denominator of the fraction.

7. a) The rectangle is divided into thirds horizontally and two of these rows are shaded to show $\frac{2}{3}$. Then the rectangle is divided into quarters vertically and three of these columns are shaded to show $\frac{3}{4}$. The overlap of the shading shows the product. Since six parts are double shaded, $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$

b) $3 \times \frac{3}{4} = 2\frac{1}{4}$

8. a) The sum of the first n odd numbers is n^2.

b) fifth diagram: $1 + 3 + 5 + 7 + 9 = 25 = 5^2$; sixth diagram: $1 + 3 + 5 + 7 + 9 + 11 = 36 = 6^2$

c) There are 50 odd numbers from 1 to 99 inclusive. The sum is $50^2 = 2500$.

d) There are 75 odd numbers from 1 to 150. There are 300 odd numbers from 1 to 600. The sum of the odd numbers from 150 to 600 is $300^2 - 75^2 = 84\ 375$.

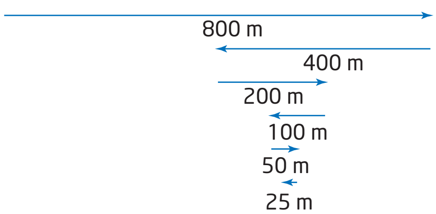
9.

6	1	9	3	7	8	4	5	2
4	7	5	2	6	9	3	8	1
8	2	3	4	5	1	6	7	9
1	6	7	5	2	3	8	9	4
5	3	8	1	9	4	2	6	7
9	4	2	6	8	7	1	3	5
7	9	1	8	3	2	5	4	6
3	5	4	7	1	6	9	2	8
2	8	6	9	4	5	7	1	3

10. The best location would be 4.5 m from the end of the assembly line toward the middle of the line and a perpendicular distance of 5 m from the line.

1.3 Focus on Connecting, pages 14–18

1. a)



b) 1575 m

c) 525 m

2.

Quarters	Dimes	Nickels	Value ($)
4	0	0	1.00
3	1	0	0.85
3	0	1	0.80
2	2	0	0.70
2	1	1	0.65
2	0	2	0.60
1	3	0	0.55
1	2	1	0.50
1	1	2	0.45
1	0	3	0.40
0	4	0	0.40
0	3	1	0.35
0	2	2	0.30
0	1	3	0.25
0	0	4	0.20

3. Answers will vary depending on the dimensions of the classroom. A possible estimate can be made using this formula: Number of pucks = Volume of classroom ÷ Volume of one puck (108 cm^3).

4. Each day, Honi rides about 16 km to and from school. So, her tires will last about 125 school days which is about 6 months of riding to and from school.

5. Guess and test. Start by guessing that Joe ate 1 slice, then Emily ate 2 slices, Samir ate 3 slices, then Kendra ate 1 slice and Fong ate 5 slices. This works, since $1 + 2 + 3 + 1 + 5 = 12$. Then, rewrite each person's share as a fraction of the pizza.

Emily: $\frac{1}{6}$, Samir: $\frac{1}{4}$, Joe: $\frac{1}{12}$, Kendra: $\frac{1}{12}$, Fong: $\frac{5}{12}$

6. Add up the number of triangles with side lengths 1, 2, 3, and 4; 27

7. Each square has area 0.25 cm^2. The area of the arrow is about 12 squares, or 3 cm^2.

8. The snail will have a net climb of 1 m up per day. But, on the last day, the snail will not slide down. It will reach 3 m above ground by the end of the 23rd day. So, on the 24th day, the snail will reach the top.

9. Answers will vary. Research the average heart rate and lifespan of a cat. Multiply the rate per minute by 525 600 and by the lifespan in years.

10.

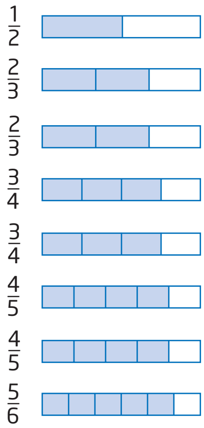
9	6	1	7	5	3	2	8	4
2	8	7	6	1	4	5	9	3
4	3	5	8	2	9	6	1	7
1	7	6	4	8	5	9	3	2
3	2	8	9	6	1	4	7	5
5	4	9	2	3	7	1	6	8
7	9	3	1	4	2	8	5	6
8	1	2	5	7	6	3	4	9
6	5	4	3	9	8	7	2	1

11. Answers will vary.

12. 170

1.4 Focus on Representing, pages 19–22

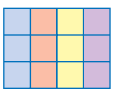
1. 2 km east of the starting point.
2. 4 floors with 27, 18, 12 and 8 apartments on the floors. The maximum is 27 apartments because the next lower floor would have 40.5 apartments, which is not possible.
3. 11
4. 15
5. **a)** The x-coordinate increases by 3 and the y-coordinate increases by 1. D(11, 6), E(14, 7), F(17, 8)
   b) The x-coordinate decreases by 5 and the y-coordinate decreases by 2. S(-14, 0), T(-19, -2), U(-24, -4)
   c) Both the x- and y-coordinates decrease by 3. J(-6, -6), K(-9, -9), L(-12, -12)
6. **a)** $\frac{1}{2} < \frac{2}{3}$
   b) $\frac{2}{3} < \frac{3}{4}$
   c) $\frac{3}{4} < \frac{4}{5}$
   d) $\frac{4}{5} < \frac{5}{6}$



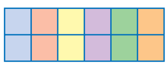
7. **a)** $4\frac{1}{2}$ **b)** $\frac{3}{4}$ **c)** $3\frac{1}{3}$ **d)** $\frac{3}{10}$
8. (1, -2) and (-3, 2); (5, -2) and (1, -6); (-7, 2) and (-3, 6)
9. (-1, 2), (-1, -8), (-7, 2), (-7, -8)
10. The same answers would result. The middle cog does not change the ratio of the driver cog to the driving cog.

1.5 Focus on Selecting Tools and Computational Strategies, pages 23–28

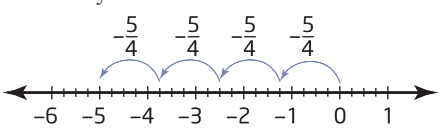
1. **a)** 12 squares divided into 4 columns gives 3 squares in each column.
   b)



   c)



   d) You can never arrange the squares with a width of zero, so the quotient is undefined.
2. **a)** $3 \times \left(-\frac{2}{3}\right)$ means subtracting $\frac{2}{3}$ three times, which will land you at -2.
   b)



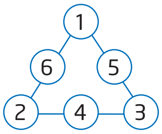
3. **a)** $\perp$ **b)** Make a physical model.
   c) Answers will vary.
4. calculator, survey
5. Answers will vary.
   a) for complicated math expressions involving square roots and fractions
   b) to draw a diagram to scale
   c) to solve real life problems
   d) to organize data and generate complicated graphs
6. 39; Answer will vary. Use a calculator.
7. **a)** -57, -63 **b)** 1215, 3645
   c) -4, 2 **d)** -158, -161
   e) -6144, 12 288 **f)** 32, 56
8. **a)** $\frac{1}{3}, \frac{1}{21}, \frac{1}{168}$ **b)** $-\frac{4}{3}, -\frac{5}{3}, -2$
   c) $0, -\frac{1}{4}, -\frac{1}{2}$ **d)** $\frac{1}{3}, \frac{1}{4}, \frac{1}{6}$
9. **a)** -1 **b)** $-1\frac{5}{12}$ **c)** $-\frac{9}{35}$ **d)** $-\frac{7}{24}$
10. **a)** $-\frac{11}{24}$ **b)** $-\frac{1}{6}$ **c)** $-\frac{5}{12}$ **d)** $-\frac{1}{2}$
11. Answers will vary. To multiply rational numbers in fraction form, multiply the numerators and multiply the denominators. To divide rational numbers in fraction form, multiply the dividend by the reciprocal of the divisor.
12. **a)** $-\frac{1}{4}$ **b)** $\frac{3}{35}$ **c)** $-\frac{3}{44}$
    d) $-1\frac{1}{20}$ **e)** $1\frac{1}{9}$ **f)** $-2\frac{4}{5}$
13. **a)** Answers will vary. **b)** 0.16 mm
    c) 83 886.08 mm or 83.886 08 m
    d) 7. As the number of folds increases, the thickness also increases, making it more difficult to fold the paper.
14. Answers will vary.
15.

Length (cm)	Width (cm)	Perimeter (cm)	Area (cm^2)
1	9	20	9
2	8	20	16
3	7	20	21
4	6	20	24
5	5	20	25
6	4	20	24
7	3	20	21
8	2	20	16
9	1	20	9

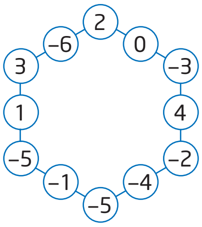
16. **a)** A, B = $\frac{1}{4}$; C, E = $\frac{1}{16}$; D, F, G = $\frac{1}{8}$
    b) i) $\frac{1}{2}$ **ii)** $\frac{3}{16}$ **iii)** $\frac{3}{16}$ **iv)** $\frac{1}{16}$ **v)** $\frac{1}{16}$ **vi)** $-\frac{1}{16}$
17. **a)** F = C + E **b)** B = C + E + F
18. -3951
19. 101st term
20. Answers will vary. Consider the dimensions of a bathtub to find the volume. Then consider the dimensions and volume of a cup. The number of cups required will be the quotient of the two volumes.
21. $2^n + 1$
22. at least 40 m

1.6 Focus on Reasoning and Proving, pages 29–33

1.



2.



3. Let the consecutive whole numbers be $n - 1$, n, and $n + 1$. Then, the sum is $n - 1 + n + n + 1 = 3n$, which is divisible by 3.

4. Answers may vary. Example: Since a newspaper is made by folding a sheet in half, there will always be an even number of pages because the number of pages equals two times the number of sheets.

5.

Cents	Number of Coins
1	1
2	2
3	3
4	4
5	1
6	2
7	3
8	4
9	5
10	1

Continue this pattern. For example, 14¢, 18¢, 23¢, and 29¢ require five coins each. 24¢, 34¢ and 39¢ each require six coins. As a maximum, 44¢ and 49¢ each require seven coins. Therefore, you only need seven coins to be able to make any amount of money up to 50¢.

6. **a)** $5 \times 2 + 8 - 3 = 15$ **b)** $25 \div 5 + 11 = 25 - 9$
c) $\frac{1}{2} + \frac{1}{3} = \frac{11}{12} - \frac{1}{12}$ **d)** $\frac{2}{3} \times \left(-\frac{1}{8}\right) = -\frac{1}{12}$

7. **a)** −36°C **b)** 10.5°C

8. **a)** 2 is a prime number that is not odd.
b) $4 + (-1) = 3$ is a positive sum, not negative.
c) $\frac{3}{2}$ is a fraction, but is not less than 1.
d) A trapezoid is a quadrilateral, but not a rectangle.

9. Yes.

10. 3 lbs

11. seven (−1, −3, −4, −5, −7, −8, −9)

12. Roller Magic: 1, Death Drop: 1, Amazing Loop: 2, Fire Pit: 4

13. Answers will vary. Divide the surface area of each hallway by the surface area of one tile.

14.

5	4	1	6	9	7	8	3	2
2	6	7	5	3	8	1	4	9
8	9	3	2	4	1	5	7	6
9	2	5	3	7	4	6	8	1
4	1	6	8	5	9	7	2	3
7	3	8	1	6	2	9	5	4
6	7	2	4	1	5	3	9	8
1	5	4	9	8	3	2	6	7
3	8	9	7	2	6	4	1	5

15. Answers will vary. Estimate the average mass of a bus and the average mass of a student.

16. **a)** −10 **b)** −14 **c)** −5 **d)** −35

1.7 Focus on Reflecting, pages 34–36

1. You obtain two double Mobius strips that are looped together.

2. 56

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

4. Answers will vary. Working backward is very effective.

5. 2520. Find the lowest common multiple of the integers.

6. **a)**

X	*Y*	*Z*
–3	–3	1
–3	–2	0
–3	–1	–1
–3	0	–2
–3	1	–3
–2	–3	0
–2	–2	–1
–2	–1	–2
–2	0	–3
–1	–3	–1
–1	–2	–2
–1	–1	–3
0	–3	–2
0	–2	–3
1	–3	–3

b) organized table and patterning

7. **a)** 24 **b)** 24 **c)** 120
d) 120 **e)** 840 **f)** 840
g) When you multiply four consecutive natural numbers, the product equals one less than the square of one more than the product of the first and last number.
h) $5 \times 6 \times 7 \times 8 = 41^2 - 1$;
$10 \times 11 \times 12 \times 13 = 131^2 - 1$

8. **a)** 5 moves
b) $-60 + 90 = 30$; $30 + (-75) = -45$; $-45 + 60 = 15$; $15 + (-45) = -30$; $-30 + 30 = 0$

9. 66; 49 numbers are divisible by 2 and 33 numbers are divisible by 3. However, 16 of these are numbers that are divisible by both 2 and 3. Subtract 16 from 49 + 33 to give 66. You could check by using a hundred chart and circling numbers that are divisible by 2 or 3.

10. a) Karen used too much milk and sugar. She used the wrong unit, litres instead of millilitres, for the milk.

b) 3×500 mL = 1500 mL or 1.5 L;
3×125 g = 375 g or 0.375 kg

11. Answers will vary. Consider the average size and surface area of a pizza, how many pizzas are ordered in a week, and how many pizza restaurants are in Ontario.

12. a) i)

2	7	6
9	5	1
4	3	8

ii)

−3	2	1
4	0	−4
−1	−2	3

b) Pair off the least and greatest numbers, moving toward the median. Then, put that single number in the centre square and arrange the pairs around it.

Chapter 1 Review, page 37

1. a) 0, −3, −6; subtract 3 from the previous term.

b) 56, 112, 224; multiply the previous term by 2.

c) 15, 20, 26; add consecutive numbers, 1, 2, 3, …, to the previous term.

d) −19, −27, −36; subtract consecutive numbers, 4, 5, 6, …, from the previous term.

2. 68; $2(100 \div 5) + 2(70 \div 5)$

3. a) Make a table and use patterning.

b)

20s	15s	10s	−5s	Score
3	0	0	0	60
2	1	0	0	55
2	0	1	0	50
2	0	0	1	35
1	2	0	0	50
1	1	1	0	45
1	1	0	1	30
1	0	2	0	40
1	0	1	1	25
1	0	0	2	10
0	3	0	0	45
0	2	1	0	40
0	2	0	1	25
0	1	2	0	35
0	1	1	1	20
0	1	0	2	5
0	0	3	0	30
0	0	2	1	15
0	0	1	2	0
0	0	0	3	−15

4. It cannot be done because one house will always be blocked from one of the services.

5. (−2, 1), (10, 9), (4, −9)

6. 30. Use a table to keep track of the number of squares of each dimension.

7. Dave needs to catch the bus by 6:47 P.M. Calculate the time to travel 20 km, and then subtract this time from 7:30 P.M.

8. a) The new area is four times greater.

b) One method is to use the formula for the area of a rectangle, $A = lw$.

$$\begin{aligned}\text{New Area} &= 2l \times 2w \\ &= 4 \times l \times w \\ &= 4 \times (\text{Old Area})\end{aligned}$$

9. 9; systematic trial

10. −135, −134, −133. Divide 402 by 3 to find the approximate value of each integer. Then, use systematic trial to find the correct three integers.

11. a) $-\frac{1}{35}$ **b)** $-\frac{1}{18}$ **c)** $-\frac{1}{6}$ **d)** $-\frac{1}{3}$

12. Answers will vary. Example:

$$-\frac{11}{12} + \frac{5}{12} + \left(-\frac{1}{12}\right) = -\frac{7}{12},$$
$$\frac{1}{2} + \left(-\frac{3}{4}\right) + \left(-\frac{1}{3}\right) = -\frac{7}{12},$$
$$\frac{7}{12} + \left(-\frac{2}{3}\right) + \left(-\frac{1}{2}\right) = -\frac{7}{12}$$

13. 3; Make a model or draw a diagram.

Chapter 2

Get Ready, pages 40–41

1. a) unemployment rates in 2003

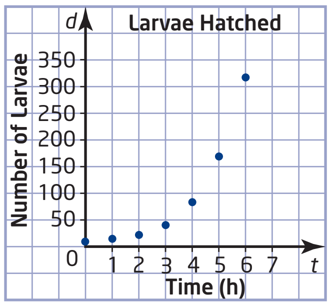
b) Newfoundland and Labrador

c) the prairie provinces since they have the lowest unemployment rates

2. a) \$1.16 CDN **b)** May

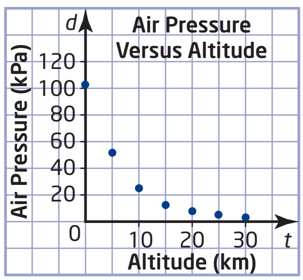
c) a downward trend overall

3. a)



b) about 110

4. a)



b) about 7.5 kPa

5. a) 7 pages/min **b)** \$3/kg **c)** 80 km/h

6. a) 0.56¢/g **b)** 20.8 mL/muffin **c)** 130 m/min

2.1 Hypotheses and Sources of Data, pages 42–47

1. **a)** Most people's favourite number is not 7.
   b) Adults do not spend more time listening to classical music than rap. (Alternative: Adults spend either less time or as much time listening to classical music as they spend listening to rap.)
   c) In Ontario, the number of teenagers who join hockey teams is greater than or equal to the number who join soccer teams.
   d) Chocolate is the most popular flavour of ice cream.
2. Answers will vary. Examples:
   a) Hypothesis: Time spent doing homework increases as a student's age increases. Opposite: Time spent doing homework does not increase as a student's age increases.
   b) Hypothesis: Children tend to grow to the same height as their mothers. Opposite: Children do not tend to grow to the same height as their mothers.
   c) Hypothesis: As temperature increases, the crime rate also increases. Opposite: As temperature increases, the crime rate decreases or remains constant.
   d) Hypothesis: As the cost of gasoline increases, the number of people using public transit increases. Opposite: As the cost of gasoline increases, the number of people using public transit decreases or stays the same.
3. **a)** Primary; the office manager gathers the data.
   b) Secondary; the student uses data gathered by Statistics Canada.
   c) Primary; the researcher gathers the data.
   d) Secondary; the researcher uses data gathered by the transit authority.
4. Answers about advantages will vary.
   a) Primary; data are up-to-date
   b) Secondary; Internet search is fast and easy
   c) Primary; getting opinions from customers
   d) Primary; data are up-to-date
5. Answers will vary. Examples:
   a) Most students in the class prefer dogs as pets.
   b) Survey the class. Primary data are best since the population is small and secondary data may not be available.
6. **a)** Primary; Steve gathered the data himself.
   b) Answers will vary. Examples: Brown-eyed students are shorter. Blue is the least common eye colour.
   c) Survey a larger sample.
7. Answers will vary. Examples:
   a) Females make more phone calls than males.
   b) Survey 50 females and 50 males.
   c) Look for data on the Internet or in publications.
   d) Secondary sources using larger samples are more likely to be accurate.
8. Answers will vary. Examples:
   a) Taller people perform better at the high jump.
   b) Heights of the athletes and how high the athletes can jump; primary data for the school team would be easy to collect, but secondary sources could give a larger sample and more accurate results.
9. Answers will vary. Examples:
   a) The faster the computer, the more it will cost.
   c) primary if you collect prices from Web sites for individual suppliers; secondary if you find price surveys with data gathered by someone else
   d) Visit a computer store to research speeds and prices.
10. **a), b)** Answers will vary.
    c) secondary since the data was collected by others
12. Answers will vary. Example:
    a) The greater the latitude of a city, the lower the mean of its daily maximum temperatures in January.
13. Answers will vary.
14. 10

2.2 Sampling Principles, pages 48–55

1. **a)** all children **b)** everyone who wrote the test
   c) all cars **d)** all food stores
2. **a)** age when girls and boys learn to walk; sample
   b) test marks; census
   c) salaries of Canadian employees; sample
   d) people's heights and ages; sample
   e) make of car in school parking lot; census
   f) colour of cars driving by the school; sample
3. Answers will vary. Examples:
   a) Survey every fourth customer who comes into the cafe.
   b) Randomly select 1% of the teenagers in every high school across Ontario.
   c) Use a random number generator to select telephone numbers within Canada, and then survey the people who identify themselves as bilingual.
   d) Select households to survey by any random method, and then ask the people surveyed where they were born.
4. **a)** non-random sample; could be biased since University of Waterloo students may not be representative of all university graduates
   b) simple random sample; could be biased since the sample excludes anyone who does not have a telephone listing
   c) non-random sample; biased because it includes only people who have chosen to spend some of their free time going to a movie
   d) systematic random sampling
5. by age, by grade, by gender
6. **a)** all Ontario farmers
   b) Answers will vary. Example: Randomly select 10% of the farmers in each county.
7. **a)** the company's employees
   b) Randomly select a starting point on an alphabetical list of the employees, and then select every sixth person until you have a total of 50.
8. **a)** members of the school teams
   b) Answers will vary. Example: Write each team member's name on a slip of paper, and then randomly draw 15% of the slips out of a box.
9. grade 9, 41; grade 10, 38; grade 11, 36; grade 12, 35
10. **a)** randInt(12,36,25)
    b) Enter randInt(1,500,40). If any numbers are repeated, change the command to generate more random numbers and use the first 40 that are not duplicates.
    c) Enter randInt(100,1000,75). Increase 75 to 100 or more if some numbers are repeated.

11. a) Students at small schools have a greater chance of being selected than students at large schools.

b) The sample is likely to have a greater proportion of students from small schools than the population does.

12. Answers for sampling methods will vary.

a) students in the school

b) all people in the community

c) all people aged 18 to 30

d) all senior citizens in Ontario

e) all computer printers for sale in Canada

f) gasoline prices at all vendors in the community

13. The sample is representative only of people who browse the site and are willing to fill out the form. The sample excludes anyone who does not have Internet access or the time to complete the survey.

14. a) In the 1920s, many people did not have telephones. Since these people were not included in the surveys, the samples were not representative of the whole population.

b) Answers will vary. Examples: People with more than one telephone number have a greater chance of being selected. People refusing to answer telephone surveys may make the sample unrepresentative of certain groups. Deaf people will be left out of the sample.

15. Answers will vary.

16. Answers will vary.

17. Answers will vary. Examples: Poorly designed questions could influence people's answers. People may give false answers to personal questions.

18. Answers will vary. Examples:

a) Assign each tree a number and use a random number generator to choose 10% of the trees.

b) Divide the park into sections and randomly select 10% from each section.

c) Assign each tree a number. Randomly select a starting point, and then select every tenth number before and after the starting number.

d) Sample the 10% of the trees closest to roads.

Any of the random samples will test trees throughout the park. However, the forester could choose a non-random sample with a larger proportion of the hardwood trees that the beetle attacks most often.

19. a) Answers will vary. Examples: interviewing sports fans at a sports venue, interviewing classmates

b) Convenience samples are not truly random because every member of the population does not have an equal chance of being selected.

20. 120

2.3 Use Scatter Plots to Analyze Data, pages 56–67

1. a) independent: physical fitness; dependent: blood pressure

b) independent: level of education; dependent: income

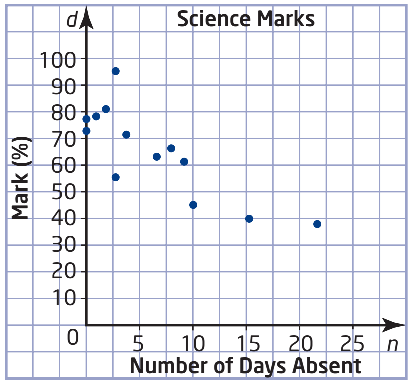
c) independent: load in an airplane; dependent: length of runway needed for take off

2. a) Put wingspan on the horizontal axis.

b) As the length increases, so does the wingspan.

3. a) independent: number of days absent; dependent: science mark. Marks depend on attendance, rather than attendance depending on marks.

b)

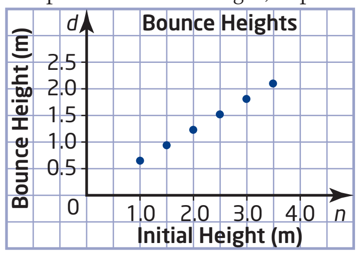


c) As the number of days absent increases, the marks generally decrease.

d) The point (3, 95) lies somewhat apart from the rest of the data.

4. a) independent: initial height; dependent: bounce height

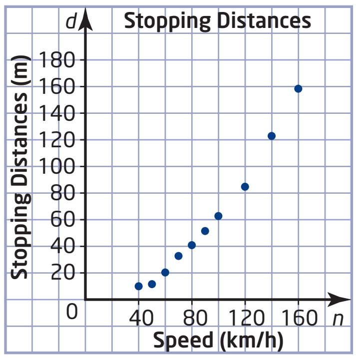
b)



c) As the initial height increases, so does the bounce height.

d) (4.00, 1.62) is an outlier. Discard only for a valid reason, such as a measurement error.

5. a)



b) As the speed of a car increases, the stopping distance increases; the pattern is non-linear.

c) A car travelling at 85 km/h needs 46 m to stop. The point is not an outlier since it follows the pattern of the other data.

6. Answers will vary. Examples:

a) As person's height increases, so does the shoulder width.

d) Improve accuracy of measurements; use a larger sample.

7. Answers will vary. Examples:

a) Measure each athlete's height and the maximum height they can jump.

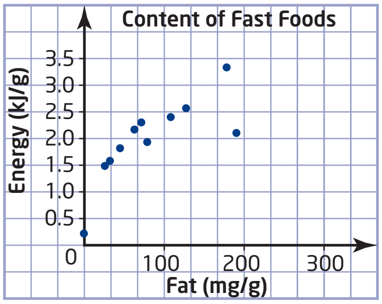
b) independent: height; dependent: jump height

c) If the hypothesis is true, then the points should follow a line or curve that rises to the right.

8. a)

Item	Fat (mg/g)	Energy (kJ/g)
Harvey's Original Hamburger	127	2.6
Harvey's Veggie Burger	63	2.2
Mr. Submarine Small Assorted Sub	34	1.6
Mr. Submarine Small Vegetarian Sub	26	1.5
Pizza Pizza Pepperoni Slice (walk-in)	69	2.3
Pizza Pizza Vegetarian Slice (walk-in)	43	1.8
KFC Chicken Breast	118	2.4
KFC Popcorn Chicken	184	3.3
Swiss Chalet Quarter Chicken Breast	75	1.9
Swiss Chalet Garden Salad, undressed	0	0.2
Swiss Chalet Caesar Salad	188	2.1

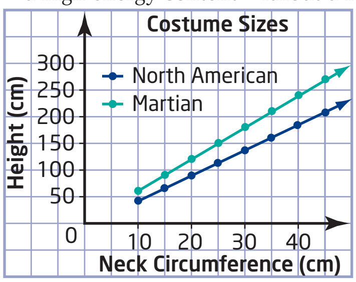
b)



c) The point for Caesar Salad is an outlier due to its high fat content. Nonetheless, this point represents valid data that should not be discarded.

d) Answers will vary. Example: Fast foods can have a high energy content without a high fat content.

9.



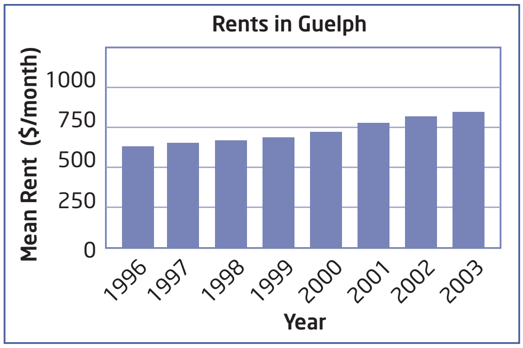
10. a)-c) Graphs will vary.

d) Home runs per at bat seem to increase somewhat as the number of strikeouts per at bat increases. The other two scatter plots do not show any relationship between the variables.

11. $\frac{1}{4} + \frac{2}{5} + \frac{3}{6} = 1\frac{3}{20}$

2.4 Trends, Interpolation, and Extrapolation, pages 68–76

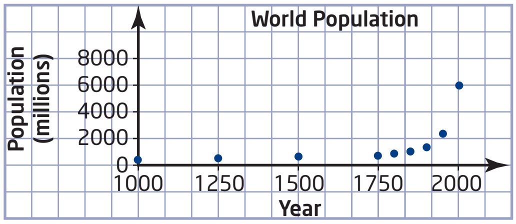
1. a)



b) Rents increased every year.

c) about $986

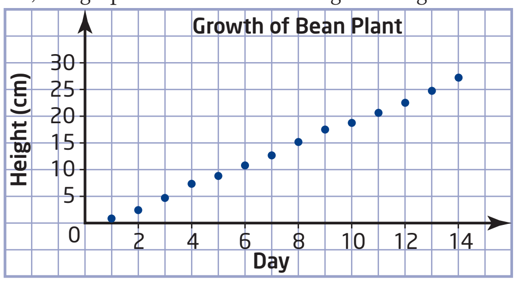
2. a)



b) The world population is growing much more quickly now than in the past.

c) No; the graph shows an increasing rate of growth.

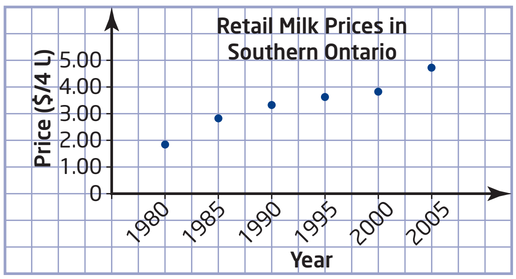
3. a)



b) The height is increasing at a nearly constant rate.

c) The height will increase at a slower rate as the plant matures.

4. a)



b) Milk prices increased over each 5-year period, but not at a constant rate.

c) about $3.69

d) 2020, assuming prices increase at the same overall rate

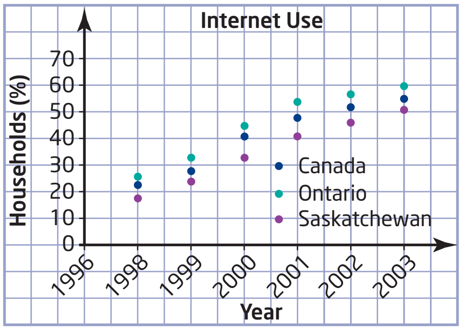
5. Bar graphs will vary depending on scale chosen for vertical axis.

a) The donation rate increases up to the 35–44 age group, then decreases somewhat.

b) Donation amounts increase with age up to the 45–54 interval, then decrease somewhat, but increase again for people over 74. Donation amounts are greater for people over 44 than for younger people.

c) Both graphs rise to a maximum for middle-aged people, then decease somewhat. However, the donation amount rises again in the 75+ interval while the donor rate continues to decrease.

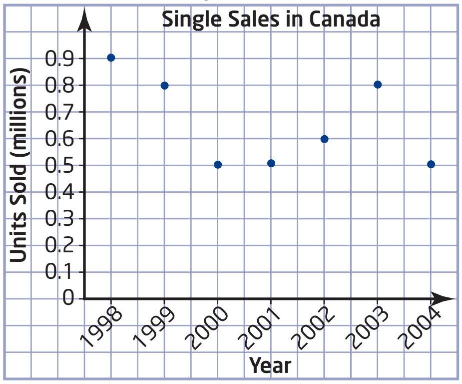
6. a)

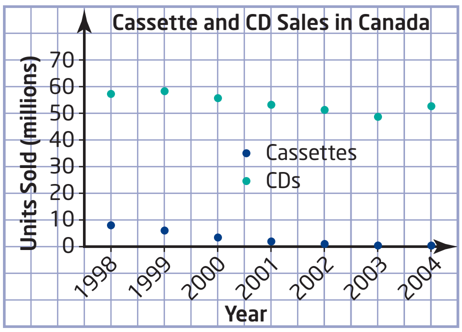


Internet use increased each year, with the national rate being about halfway between the rate in Ontario and the rate in Saskatchewan.

b) about 70%, assuming the rate of increase is constant

7. a)





Overall, sales of singles have a downward trend. Sales of cassettes have a clear downward trend, while sales of CDs show a moderate downward trend.

b) Answers will vary. Example: singles, 0.5 million; cassettes, 0.05 million; CDs, 55 million

9. a) The volunteer rate in Ontario is about the same as for all Canadians except in the age group 25–34, when 5% fewer Ontarians volunteer.

b) Ages 45–54; people in this age range may have more free time.

c) As age increases, the hours per volunteer across Canada also increase, especially beyond the age of 65. Most people over 65 are retired and could have more time to volunteer.

10. Answers will vary.

11. B

12. 15 when the first or 100th day is a Saturday.

2.5 Linear and Non-Linear Relations, pages 77–87

1. a) Yes; the points lie close to a straight line.

b) No; the points lie close to a curve.

2. a) Linear; the points lie on a straight line.

b) Non-linear; the points lie on a curve.

3. a) Yes; points are reasonably close to a straight line.

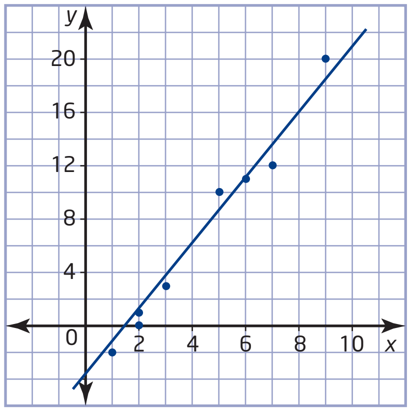
b) No; the points follow a curve.

c) Yes; the points lie close to a straight line.

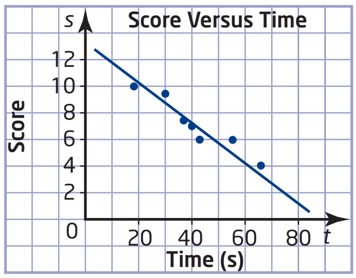
d) No; there is no apparent pattern.

e) No; there are not enough points to find a good line of best fit.

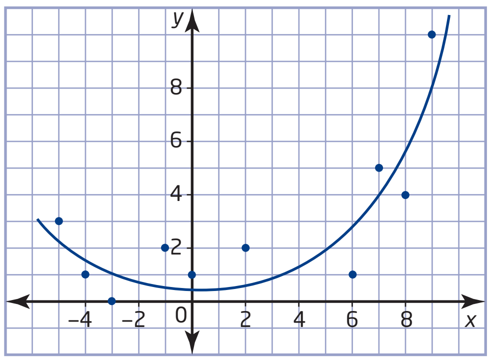
4. a)



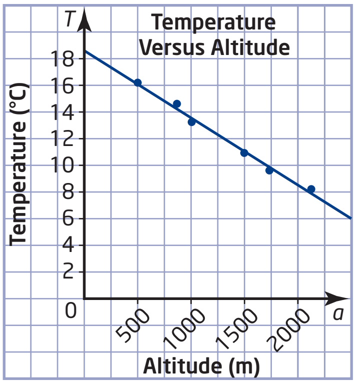
b)



c)



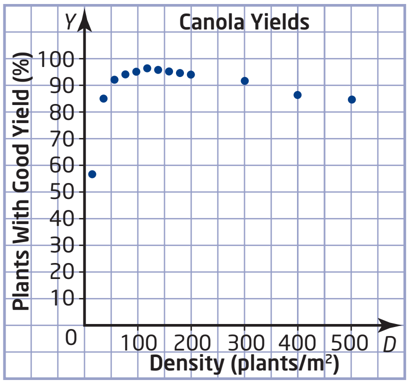
5. **a), b)**



The temperature decreases linearly as the altitude increases.

c) 15.5°C **d)** 6.0°C

6. **a)**

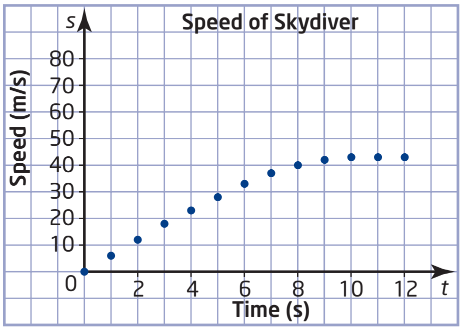


b) The yield rises steeply at first, levels off to a maximum around 120 plants/m^2, and then decreases slowly.

c) No; the points follow a curve.

d) Answers will vary. Examples: crowding out weeds, water and nutrients in the soil, pollination

7. **a), c)**



b) about 70 m/s

d) Air resistance increases with speed, so the speed increases only until the air resistance offsets the acceleration due to gravity.

e) The relationship between the variables may change beyond the range of the data.

8. Answers will vary. Examples:

a) to investigate how a person's heart rate changes immediately after exercise

b) A person's heart rate will decrease steadily in the time immediately after vigorous exercise.

9. Answers will vary.

11. **a)** Linear; each time t increases by 1, d increases by 5.

b) Non-linear; h does not change by a constant amount each time t increases by 1.

12. There is a non-linear relation between the gauge reading and the volume of fuel in the tank. The eighths at the low end of the gauge correspond to less fuel than than the eighths at the "full" end of the gauge.

13. D

14. 60

2.6 Distance-Time Graphs, pages 88–94

1. **a)** moving away at constant speed

b) moving away with increasing speed

c) no movement

d) moving closer at constant speed

e) moving away at increasing speed, then slowing down and stopping

f) moving away at decreasing speed, stopping for a moment, then coming back with increasing speed

2. Graphs a, c, d; the points lie on a line.

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

c) stopping at the end of the lake

d) on the way back

4. After starting out, the cyclist increases her speed, then slows down. Then she travels a bit faster than before, then slows down and stops.

5. **a)** Move away from the wall at a constant speed, then walk back toward the wall at the same speed, but stop before you reach your starting position.

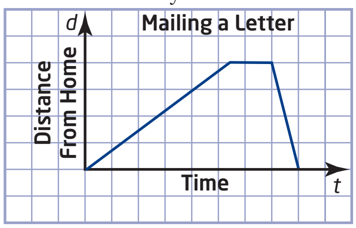
b) The sloped line segments would be steeper.

c) The sloped line segments would be less steep.

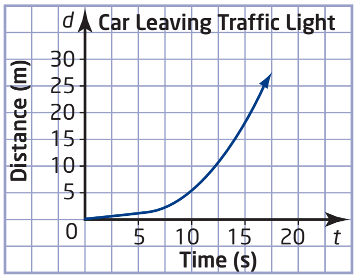
d) The middle segment would be shorter and the horizontal segment would be higher.

6. Answers will vary.

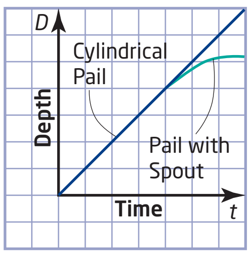
7.



8.



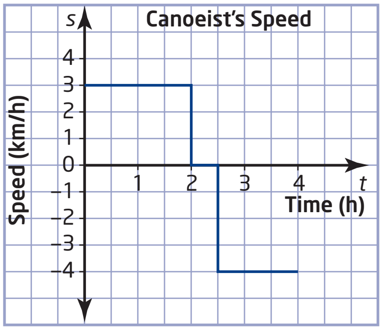
9.



10. Answers will vary.

11. a) 3 km/h, 0 km/h, 4 km/h

b)



c) The faster the speed, the steeper the slope.

d) rate at which the canoeist moves toward the dock

12. d) horizontal: time; vertical: distance from the CBR™

e) No; the points do not lie close to a line

i) Yes; the points lie close to a line.

13. Answers will vary.

14. 1979

Chapter 2 Review, pages 95–96

1. Answers will vary. Examples:

a) Hypothesis: As the temperature in a town during the summer increases, so does the volume of water used by the town's residents. Opposite: As the temperature in a town during the summer increases, the volume of water used by the town's residents does not increase.

b) Hypothesis: Taller people have higher marks in mathematics. Opposite: Taller people do not have higher marks in mathematics.

2. a) Primary; a survey of students at the school could give more accurate results than secondary data would.

b) Secondary; primary data could take a lot of time to collect.

c) Secondary; the encyclopedia might not give information on bears in a specific province.

d) Secondary; the source of data is convenient, but may not reflect the tastes of students at the school.

3. a) students at the school

b) Answers will vary. Example: Use a graphing calculator to randomly select 25% of the students from the class lists for each grade.

4. a) passengers of the airline

b) Answers will vary. Example: Randomly select one name on a list of the airline's passengers, and then select every hundredth person before and after that name.

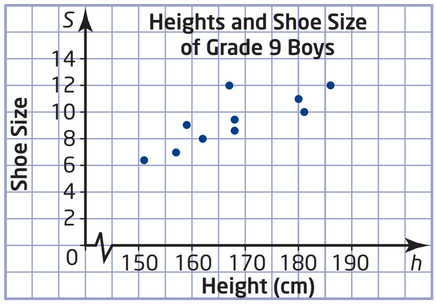
5. a) customers of the department store

b) campers at provincial parks

c) students at the school

Answers for survey methods will vary, but the methods should use random samples.

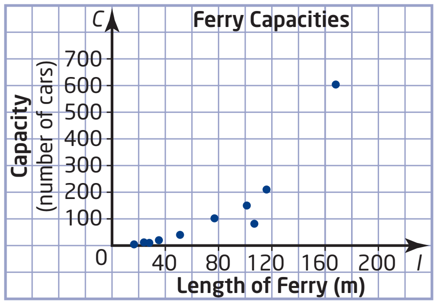
6. a)



b) As the students' heights increase, so do their shoe sizes.

c) (167, 12) is an outlier, but should not be discarded since it is a valid measurement.

7. a)



b) As the length of the ferry increases, the capacity also increases. The points follow a curve, so the relationship is non-linear.

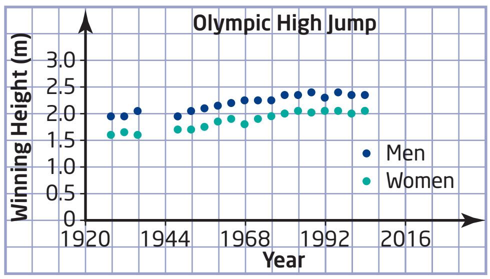
c) The point (110.8, 80) is an outlier. Answers about causes may vary. Examples: The ferry might carry cargo as well as cars, or it might carry fewer cars so that it can travel faster.

8. a) Graphs may vary.

b) The population of Canada has grown at an increasing rate since 1861.

c) 20 million **d)** 40 million

9. a)

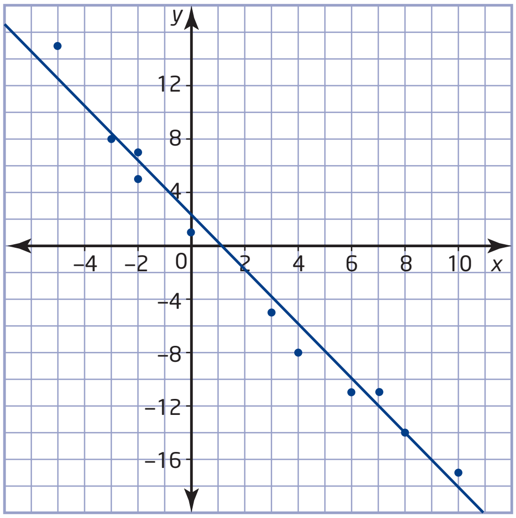


b) Both the men's and women's winning heights are increasing, but the rate of increase has been slower since about 1980.

c) no outliers

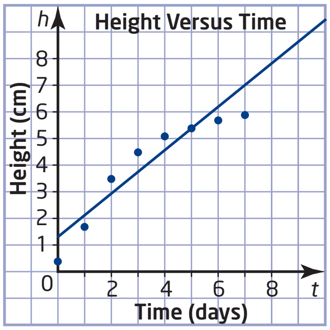
d) Answers will vary. Examples: Men's winning height about 2.48 m, women's winning height about 2.15 m

10. a)



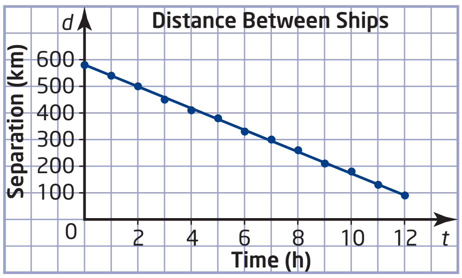
Yes; the points lie close to the line.

b)



No; the points follow a curve.

11. a)



b) As time increases, the distance between the two ships decreases. The relationship is linear.

c) no outliers

d) after 14.3 h

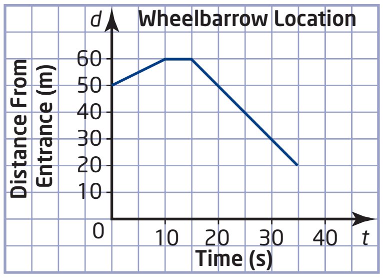
12. Answers will vary. Examples:

a) Marni walks away from her home for 3 min at a constant speed, and then runs in the same direction at a constant speed.

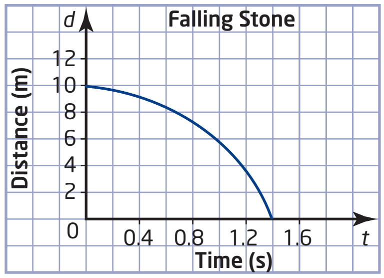
b) John bikes from school to a store, buys something, and then bikes back past the school to home.

c) A car speeds up as it leaves a traffic light, and then slows down and stops at another light.

13. a)



b)



Chapter 2 Test, pages 98–99

1. B

2. C

3. A

4. C

5. a) Caffeine cannot affect your sleep.

b) If you study more, your results on tests either improve or stay the same.

c) At least half of the students in your school do not have a part-time job.

d) Cell phone use has not more than doubled in the past 2 years.

6. a) teachers working for the school board

Answers will vary. Examples:

b) Randomly select 20% of the teachers in each school.

c) Select a name at random from a list of all of the teachers, and then select every fifth name before and after the first name selected.

d) Survey all the teachers in the nearest school.

e) Teachers at the school have the same students and work conditions. These teachers may not have the same concerns and opinions as teachers at other schools.

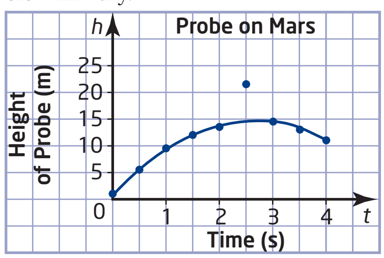
7. a) Non-linear; the points follow a curve.

b) Linear; the points lie close to a straight line.

8. AB: distance decreasing at a steady rate; BC: distance increasing at a steady rate; CD: no motion; DE: distance increasing at an increasing rate; EF: distance increasing at a decreasing rate.

9. Answers will vary.

10. a), d)



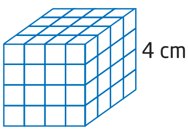
b) Non-linear: As time increases, the height increases and then decreases.
c) (2.5, 21.4) is an outlier. Possible causes include an inaccurate reading or a transmission error.
e) 4.7 m

Chapter 3

Get Ready, pages 102–103

1. a) 12 **b)** 7 **c)** -4 **d)** 9
e) 2 **f)** -2 **g)** -14 **h)** 4
2. a) -3 **b)** 13 **c)** 5 **d)** -1
e) -15 **f)** 2 **g)** -13 **h)** -1
3. a) -24 **b)** 24 **c)** -32 **d)** 30
e) -60 **f)** -40
4. a) -2 **b)** -3 **c)** -2 **d)** 1
e) -5 **f)** 9
5. a) $\frac{4}{15}$ **b)** $-\frac{1}{12}$ **c)** $-\frac{2}{15}$
d) $\frac{3}{20}$ **e)** $-\frac{3}{10}$ **f)** $-\frac{3}{4}$
6. a) $-\frac{1}{10}$ **b)** $\frac{1}{4}$ **c)** -0.57
d) 0.12 **e)** 8.0 **f)** -30.4

3.1 Build Algebraic Models Using Concrete Materials, pages 104–109

1. C
2. a)–d) Tile models may vary.
3. a) $x + 3$ **b)** $x^2 + 2$
c) $2x^2 + x + 6$ **d)** $x^2 + 4x + 4$
4. a) 4 km **b)** 7 km
c) x kilometres **d)** $4x$ kilometres
5. Answers will vary.
6. a)


b) 4^3 cm^3
c) $A = 4^2 = 16$; Area $= 16$ cm^2
7. a) 6 cm **b)** 36 cm^2
8. a) 7 m **b)** 343 m^3
9. a)

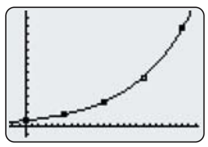
b)

10. 24 cm^2
11. Answers will vary.
12. $1^6 + 5^2 + 4^3 = 90$
13. C
14. Answers will vary.

3.2 Work With Exponents, pages 110–118

1. B
2. C
3. a) $(-5)^3$ **b)** 1.05^6 **c)** $\left(-\frac{3}{5}\right)^3$
4. a) $(-4) \times (-4) \times (-4) = -64$ **b)** $0.8 \times 0.8 = 0.64$
c) $\frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = \frac{81}{256}$
5. a) 729 **b)** 49 **c)** -16 **d)** $\frac{125}{216}$
e) $\frac{16}{81}$ **f)** 1.44 **g)** 1 **h)** -1
i) 0.125
6. a) 2 **b)** 100 **c)** 1 **d)** 10
e) $\frac{1}{6}$ **f)** 734.66
7. a) 150 **b)** 19.6 **c)** 25 **d)** 86.4
e) 14.1 **f)** 24
8. a) 4, -8, 16, -32
b) When the exponent is odd, the power is negative, and when the exponent is even, the power is positive.
c) Negative bases will give a positive answer if the exponent is even ($(-1)^2 = -1 \times -1 = 1$) and a negative answer if the exponent is odd ($(-1)^3 = -1 \times -1 \times -1 = -1$).
9. a)

Time (min)	Population of Listeria
0	800
60	1 600
120	3 200
180	6 400
240	12 800

b)

The graph is non-linear. It is increasing, as an upward curve.
c) 800×2^{24}, 800×2^{48}
d) Food poisoning will occur much faster if a large quantity of the bacteria is ingested rather than a smaller quantity because it will take the bacteria longer to multiply to a harmful amount. A faster growth rate of bacteria will cause the food poisoning to begin rapidly while a slower growth rate of bacteria will cause the food poisoning to start at a relatively slower rate.
10. a)

Time (min)	Population of Listeria	Population of E. Coli
0	800	10
20		20
40		40
60	1600	80
80		160
100		320
120	3200	640

b) after 3 h **c)** about 7000

11.

Note	Duration (in beats)	Power Form
whole	1	
half	$\frac{1}{2}$	$\left(\frac{1}{2}\right)^1$
quarter	$\frac{1}{4}$	$\left(\frac{1}{2}\right)^2$
eighth	$\frac{1}{8}$	$\left(\frac{1}{2}\right)^3$
sixteenth	$\frac{1}{16}$	$\left(\frac{1}{2}\right)^4$
thirty-second	$\frac{1}{32}$	$\left(\frac{1}{2}\right)^5$

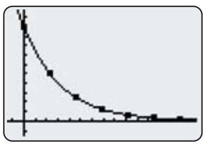
12. $\left(\frac{1}{2}\right)^0 = 1$. Any base (except 0) to the exponent 0 is equal to 1.

13. a) Let the area of the rectangle be A.
Let the width of the rectangle be w.
Let the height of the rectangle be h.
Then, $A = w \times h$. Since $h = 2w$, $A = 2w^2$.
b) 128 cm^2 **c)** 12 cm

14. a)

Number of Half-Life Periods	Time (min)	Amount of U-238 Remaining (mg)	Expression
0	0	100	
1	23	50	$100\left(\frac{1}{2}\right)^1$
2	46	25	$100\left(\frac{1}{2}\right)^2$
3	69	12.5	$100\left(\frac{1}{2}\right)^3$
4	92	6.25	$100\left(\frac{1}{2}\right)^4$

b)



The graph has a decreasing non-linear (curved) trend.
c) 2.69 mg **d)** 152.8 min
e) $100\left(\frac{1}{2}\right)^0$. Yes, this does make sense.

15. a) 4.5×10^9 **b)** 1.4×10^{17}
c) 602 200 000 000 000 000 000 000
d) Answers will vary. Very large and very small numbers can be represented using a lot less space. It is also easier to understand scientific notation than trying to count the number of zeros in very large or very small numbers. It also reduces the probability of errors when rewriting these numbers.

16. a) 7, 63 **b)** 9th day **c)** $C = 2^n$
d) Answers will vary. Assume that the trend continues without any change.

17. 9

18. C

19. 1, 4, 8, 16, 32, 64, 128, 256, 512, 9, 27, 81, 243, 729, 25, 125, 625, 36, 49, 216, 343, 121, 144, 169, 196, 225, 289, 324, 361, 400, 441, 484, 529, 576, 676, 784, 841, 900, 961

20. Use a table or a spreadsheet to find a pattern.

$x = 1$	$y = 0$
$x = 2$	$y \le 1$ or $y \ge 5$
$x = 3$	$y \le 2$ or $y \ge 4$
$x \ge 4$	$y \le 1$ or $y > x$

3.3 Discover the Exponent Laws, pages 119–129

1. B

2. a) $3^{11} = 177\ 147$ **b)** $2^8 = 256$
c) $(-1)^{11} = -1$ **d)** $\left(\frac{2}{5}\right)^6 = \frac{64}{15\,625}$

3. D

4. a) $12^6 = 2\ 985\ 984$ **b)** $(-6)^1 = -6$
c) $\left(-\frac{3}{4}\right)^3 = -\frac{27}{64}$ **d)** $(0.1)^0 = 1$

5. A

6. a) $4^4 = 256$ **b)** $(-3)^6 = 729$
c) $(-0.1)^8 = 0.000\ 000\ 001$ **d)** $\left(\frac{3}{2}\right)^6 = \frac{729}{64}$

7. a) $5^1 = 5$ **b)** $3^3 = 27$
c) $(0.5)^2 = 0.25$ **d)** $(-2)^0 = 1$

8. a) y^6 **b)** m^3 **c)** k^{10}
d) c^{12} **e)** a^5b^3 **f)** $8u^3v^6$
g) m^3n^3 **h)** hk^2 **i)** a^6b^2

9. a) $3km^3$ **b)** $-32a^{11}$ **c)** $-9x^{10}$
d) dw^4 **e)** $\frac{2}{3}fg$ **f)** $9a^2$
g) $5cd$ **h)** $-27xy^3$ **i)** $4g^2$

10. a) $-\frac{15}{2}$ **b)** $-\frac{15}{2}$
c) Answers will vary. Substituting values into a simplified expression is much easier than substituting into the original expression. The disadvantage is that it is easy to make a mistake when simplifying the expression.

11. 10 000 m^3

12. a) 6 heads: $\frac{1}{64}$; 12 heads: $\frac{1}{4096}$
b) $\left(\left(\frac{1}{2}\right)^2\right)^3$, $\left(\left(\frac{1}{2}\right)^2\right)^6$

13. a) $\frac{1}{6}$ **b)** $\frac{1}{1296}$ **c)** $\frac{1}{3}$ **d)** $\frac{1}{6561}$
e) $\left(\left(\frac{1}{6}\right)^2\right)^2$, $\left(\left(\frac{1}{3}\right)^4\right)^2$

15. a) $8 \times 10^5 = 800\ 000$ **b)** $9 \times 10^{10} = 90\ 000\ 000\ 000$
c) $4 \times 10^2 = 400$ **d)** $1.3 \times 10^4 = 13\ 000$

16. a) Answers will vary. **b)** 0.15

17. a) Answers will vary. **b)** 5.0×10^{15}

18. a) $8 \times 10^{15} = 8\ 000\ 000\ 000\ 000\ 000$
b) Answers will vary. $(a^x \times 10^y)^z = a^{xz} \times 10^{yz}$

19. The missing entries, from top to bottom, are a^5b^2, $a^{17}b^{14}$, and $a^{11}b^8$.

20. x^3, x^2, x, $\sqrt{x}$, $\frac{1}{x}$

3.4 Communicate With Algebra, pages 130–139

1. a) coefficient: 2, variable: y
b) coefficient: -3, variable: x
c) coefficient: 1, variable: mn
d) coefficient: $\frac{1}{2}$, variable: x^2
e) coefficient: -1, variable: w^2
f) coefficient: -0.4, variable: gh^3
2. C
3. a) monomial **b)** trinomial **c)** binomial
d) trinomial **e)** binomial **f)** four-term polynomial
4. B
5. a) 2 **b)** 1 **c)** 0
d) 6 **e)** 5 **f)** 3
6. a) 1 **b)** 2 **c)** 3
d) 7 **e)** 6
7. B
8. a) C, D
b) Yes. C shows a coefficient of 1 and D does not, but $1t = t$.
9. a) 11 **b)** -4 **c)** 11 **d)** -1
10. a) s **b)** $0.37s$
c) \$9.62 **d)** \$1575.27
11. a) $5s + 7a$
b)

Term	Variable	Coefficient	Meaning
$5s$	s	5	s: number of student memberships she sells
$7a$	a	7	a: number of adult memberships she sells

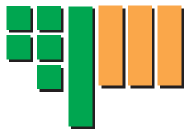
c) \$130
12. a) $25g + 18r + 15b$
b)

Term	Variable	Coefficient	Meaning
$25g$	g	25	g: number of gold seats sold
$18r$	r	18	r: number of red seats sold
$15b$	b	15	b: number of blue seats sold

c) \$10 000
13. a) $2c - w$ **b)** 27
14. Answers will vary.
15. Answers will vary. Example:
Hello Manuel,
A term is made up of a coefficient (a number) and a variable (e.g., a, x, j), but there are no mathematical operations (addition, subtraction) involved. A polynomial is a set of terms being added or subtracted (e.g., $7x + 5y$).
Jill
16. a) height $= 2w$ **b)** 10 cm **c)** 12.5 cm
18. a) Answers will vary. s: swim, c: cycle, r: run.
b)

Part of the Race	Speed (km/h)	Distance (km)	Time (h)
Swim	1.2	s	$\frac{s}{1.2}$
Cycle	25	c	$\frac{c}{25}$
Run	10	r	$\frac{r}{10}$

c) $\frac{s}{1.2} + \frac{c}{25} + \frac{r}{10}$
d) 3.85 h or 3 h 51 min
e) Answers will vary. It is a reasonable time considering all the things he has to complete in only 3.85 h.
19. a) Answers will vary. Walking is faster.
b) 17.5 s **c)** $\frac{s}{1}$; 26.9 s
d) Walking is faster by 9.4 s.
20. a) Answers will vary.
b) 22.25 s; Walking all the way is faster.
c) Walking all the way takes 17.5 s and it is the fastest way. Find the time for all three ways and compare the times.
21. a) Let an x-tile represent $0.1v$, and show one of them.
b) Let a y-tile represent $100s$, and show three of them.
c) Let an x-tile represent \$100.



d) \$65 500
22. C
23. B
24. $m = 2$. Yes, this expression is true for all values of m.

3.5 Collect Like Terms, pages 144–153

1. B
2. a) like terms **b)** unlike terms
c) like terms **d)** unlike terms
e) unlike terms **f)** unlike terms
g) like terms **h)** like terms
3. $3x^2$, $4x^2$; $-x$, $7x$; xy, $-4xy$; $2y^2$, y^2; $5x^2y$, $3x^2y$; $-7y$, $\frac{1}{2}y$
4. Answers will vary.
a) $3m$, $9m$ **b)** $4x$, $-6x$ **c)** $9y^2$, $7y^2$ **d)** $-ab$, $2ab$
5. a) $9x$
b) The terms cannot be added together because they are not like terms.
c) $15h$ **d)** $12u$
6. a) $2k$ **b)** $7n$ **c)** $-4z$
d) These are not like terms, so it is not possible to simplify.
7. a) $5x + 6$ **b)** $8y + 11$ **c)** $8k + 7m$
d) $8u + 2v$ **e)** $5n + 3$ **f)** $3p + 4q$
8. a) $-x - 5$ **b)** $-5y - 16$ **c)** $6x^2 + 8x$
d) $7m^2 + 5m$ **e)** $-2k + 4$ **f)** $u^2 - 6$
9. a) $4b^2 + 2ab - 3b + 1$ **b)** $5m^2 + n^2 - 1$
10. a) Claudette: $7t + 100$, Johanna: $7t + 125$, Ming: $7t + 110$
b) Claudette: \$240, Johanna: \$300, Ming: \$299
c) $7t + 335$ **d)** \$839
11. a) Yannick added the constants to the coefficients of the x-terms. He did not realize that 4 is an unlike term.
b) Answers will vary. Example: Substitute any value for x into the original expression and into the simplified expression.
c) $9x + 4$. Verify by substituting a value for x into the expressions.
12. a) $2(w + 3w)$ **b)** 2400 m
c) 200 m wide and 600 m long
13. a) $8x + 5$ **b)** $3y + 1$ **c)** $3y + 10$
14. a) $6w$, $7w$ **b)** 70 cm

15. **a)** $3x$

b) The perimeter of the isosceles triangle is $2x + x\sqrt{2}$, which is greater than the perimeter of the equilateral triangle.

16. The area of the isosceles triangle is $\frac{x^2}{2}$, which is greater than the area of the equilateral triangle, which is $\frac{x^2\sqrt{3}}{4}$.

17. D

18. C

3.6 Add and Subtract Polynomials, pages 154–159

1. C

2. **a)** $10x + 9$ **b)** $7y + 5$ **c)** $7m - 9$ **d)** $-2d - 1$ **e)** $10k + 5$ **f)** $3r$

3. A

4. **a)** $x - 3$ **b)** $7s$ **c)** $4m + 3$ **d)** $7v - 17$ **e)** 17 **f)** $10h + 3$

5. **a)** $8x - 13$ **b)** $2y + 3$ **c)** $7c - 13$ **d)** $-2k + 4$ **e)** $12p^2 - 4p$ **f)** $2xy^2 + 12x - 14y$ **g)** $3x + 10$ **h)** $6uv^2 - 4v - 12u$

6. **a)** $8500 + 0.6n$

b) 100 copies: \$8560, gold status: \$38 500, diamond status: \$608 500

c)

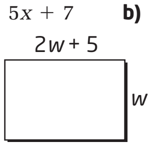
Status	Musician
gold	Fredrick
platinum	Fredrick
diamond	Fredrick

d) Answers will vary. Example: **Fixed rate**: If there are few sales, the musician still makes some money. However, if there are lots of sales, the musician does not profit as much as they would with other methods of payment. **Royalty**: The more sales that are made, the more money the musician makes. The musician, however, will make no money if there are no sales. **Combination**: The musician still gets the fixed rate if there are no sales but receives some royalties if there are sales. The downside is that the fixed rate is smaller than if they were just being paid by a fixed rate and the royalties rate is also smaller than if they were just receiving royalties.

7. **a)** $190\,000 + 100b$ **b)** \$198 900

8. **a)** $5x + 7$ **b)** $2y^2 + 5y + 3$ **c)** $4x^2 + 4x + 6y^2$

9. **a)**



b) $6w + 10$ **c)** 46 m

10. **a)** Answers will vary. **b)** 82 m

11. No. Width $= w$, Length $= 2w + 5$, Perimeter $= 2(3w + 5)$. When the width changes, the length and the perimeter also change but not by the same factor. So, the proportions between the three do not change; only their actual values change.

12. **a)** missing expressions: step 1: $-11k$ and $-2p - 2k$; step 2: $-14k + 11p$ and $-2p - 13k$; step 3: $-27k + 9p$.

b) Answers will vary.

3.7 The Distributive Property, pages 160–169

1. D

2. **a)** $2x + 6$ **b)** $x^2 + 4x$ **c)** $5x + 13$

3. **a)** $4x + 8$ **b)** $5k - 15$ **c)** $-2y - 2$ **d)** $8d - 16$ **e)** $10t - 15$ **f)** $-4y + 5$

4. **a)** $y^2 - 4y$ **b)** $r^2 + 5r$ **c)** $2x^2 - 5x$ **d)** $-4q^2 + 8q$ **e)** $-3z^2 + 2z$ **f)** $-m^2 - 5m$

5. **a)** $6b^2 - 10b$ **b)** $24v^2 + 21v$ **c)** $-12w^2 + 4w$ **d)** $6m^2 + 30m$ **e)** $-8q^2 + 6q$ **f)** $3d^2 - 6d$

6. **a)** $4n - 20$ **b)** $18p + 36$ **c)** $-28m - 24$ **d)** $3c^2 + 21c$ **e)** $12w - 6$ **f)** $-12k^2 - 21k$

7. **a)** $2a^2 + 10a + 6$ **b)** $-6n^2 + 24n - 15$ **c)** $4k^3 + 4k^2 - 12k$ **d)** $-15h^3 + 35h^2 + 10h$ **e)** $-3x^2 + 15x - 6$ **f)** $8y^3 + 12y^2 - 4y$

8. **a)** $7x - 14$ **b)** -10 **c)** $-u + 5v$ **d)** -22 **e)** $-5a - b$ **f)** 0

9. **a)** $9x - 24$ **b)** $10y - 25$ **c)** $3k - 6$ **d)** $-4r + 60$ **e)** $-6h + 4$ **f)** $3p - 12$

10. **a)** $50 + 30h$ **b)** \$125 **c)** $100 + 60h$ **d)** \$250. Yes, the answer makes sense.

11. Niko is right. The order of operations always apply and if there is no other way to simplify the expression according to the order of operations, then the expression is in simplified form.

12. $A = \frac{ah}{2} + \frac{bh}{2}$

13. **a)** $10x + 2$ **b)** $6x^2 + 2x$

c) $P = 30x + 6$, $A = 54x^2 + 18x$

d) Yes. Triple the old perimeter is $3(10x + 2)$ or $30x + 6$, which is equal to the new perimeter

e) No. Triple the old area is $3(6x^2 + 2x)$ or $18x^2 + 6x$, which is not equal to the new area

14. Yes. Example:

$$\begin{aligned} &2(5 - 3) \\ &= 2(2) \\ &= 4 \end{aligned} \qquad \begin{aligned} &2(5 - 3) \\ &= 2 \times 5 - 2 \times 3 \\ &= 10 - 6 \\ &= 4 \end{aligned}$$

15. **a)** $5x + 9$ **b)** $k - 14$ **c)** $1.4p^2 - 1.8p$ **d)** $-2h^2 - 11h$ **e)** $3j^2 - 12j$ **f)** $-2w^2 + 0.3w$ **g)** -8 **h)** $k^2 - 6k - 3$

16. **a)** $2a + \frac{1}{6}$ **b)** $-\frac{x}{6}$ **c)** $-4m + \frac{1}{6}$ **d)** $-\frac{23}{5}u + \frac{27}{4}v$

18. **a)** $-4m^2 - 12m$ **b)** $-9p^3 - 24p^2$ **c)** $-2x + 36$ **d)** $-y - 81$

19. **a)** $2x^2 + 4x - 6$. Yes, they are equivalent.

b) Answers will vary.

c) Answers will vary. For example, multiply the first term in the first binomial by each term in the second binomial, and then multiply the second term in the first binomial by each term in the second binomial. Simplify the resulting polynomial by collecting like terms.

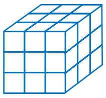
20. $k^3 - k^2 - 3k - 1$

21. $x = 6$

Chapter 3 Review, pages 174–175

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

2. a)



3 cm

b) 27 cm^3; 3^3 cm^3
c) 9 cm^2; 3^2 cm^2

3. a) 1024 **b)** 81 **c)** $\frac{8}{125}$ **d)** 1.4775

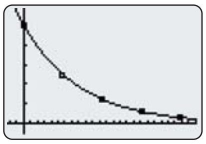
4. a) \$133.82 **b)** \$179.08

5. 6%

6. a)

Number of Half-Life Periods	Years	Amount of C-14 Remaining (g)	Expression
0	0	50	
1	5 700	25	$50\left(\frac{1}{2}\right)^1$
2	11 400	12.5	$50\left(\frac{1}{2}\right)^2$
3	17 100	6.25	$50\left(\frac{1}{2}\right)^3$
4	22 800	3.125	$50\left(\frac{1}{2}\right)^4$

b)



c) Students should use their graphs to interpolate an answer close to about 4.4 g.
d) Students should use their graphs to extrapolate an answer close to about 32 000 years.

7. a) $2^9 = 512$ **b)** $6^2 = 36$
c) $(-4)^6 = 4096$ **d)** $7^1 = 7$

8. a) n^4 **b)** c^5d^5 **c)** $\frac{3}{8}a^2b$

9. a) coefficient: 5, variable: y
b) coefficient: 1, variable: uv
c) coefficient: $\frac{1}{2}$, variable: ab^2
d) coefficient: -1, variable: de^2f
e) coefficient: 8, variable: none

10. a) trinomial **b)** monomial **c)** four-term polynomial
d) monomial **e)** binomial

11. a) $3w + 2o + l$, where w represents a win, o represents an overtime win, and l represents an overtime loss.
b) 16

12. a) 2 **b)** 4 **c)** 0 **d)** 4

13. a) 1 **b)** 2 **c)** 2 **d)** 3

14. a) $2p$, p **b)** $5x^2$, $-5x^2$, $3x^2$

15. a) $10x + 2$ **b)** $6k - m$
c) $3a^2 - 1$ **d)** $6x^2 + 5y^2 - 8$

16. a) $7x + 1$ **b)** $8k - 7$ **c)** $4u - 4$
d) $-y^2 + 2y$ **e)** $a^2 - 4$ **f)** $4v - 6$

17. $10x - 10$

18. a) $3y - 21$ **b)** $-2x - 6$ **c)** $5m^2 - 3m$
d) $-8k^2 - 24k$ **e)** $-5p^2 - 15p + 5$ **f)** $4b^3 - 8b^2 + 20$b

19. a) $14q - 2$ **b)** $4x^2 - 20x - 24$
c) 10 **d)** d^2 − 3d − 20

20. a) $6x - 22$ **b)** $-9k - 9$

Chapter 3 Practice Test, pages 176–177

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

10. a) $(-2)^6 = 64$ **b)** $3^2 = 9$

11. a) k^3n^7 **b)** $-2p^3$ **c)** $-27g^6h^3$

12. a) $7x + 4$ **b)** $-2u - 3$

13. a) $9y$ **b)** $-27b + 7$

14. a) They are both correct. It is possible for the expressions to be equal. Use the distributive property to expand the right side of James's formula.
b) $P = l + l + w + w$, $P = l + w + l + w$; These can both be simplified to Sylvia's formula, which is equivalent to James's formula.
c) Answers will vary.

15. a) 128
b) ninth; I used patterns of powers to determine that 2^n students receive the e-mail on the nth mailing.
c) 1022 **d)** 8

16. a) $5n + 5500$
b) 200 copies: \$6500, 5000 copies: \$30 500

17. a) 2^{63} **b)** $2^{64} - 1$

Chapters 1 to 3 Review, pages 178–179

1. a) 11, 16, 22: add consecutive integers (1, 2, 3, …) to the previous term
b) 25, 36, 49: the sequence shows the number of the term squared (term 2 is 2^2 or 4)
c) -3, -8, -13: subtract 5 from the previous term
d) 30, 42, 56: add consecutive even integers, starting from 4 (4, 6, 8, 10, …), to the previous term

2. A = 2, B = 40, D = $\frac{9}{10}$, E = 20. Strategy: Substitute the given value of 100 for C in equation 2 and solve for A, and then substitute that value for A in equation 1. Solve for B and substitute that value for B in equation 3. Solve for D and substitute the value into equation 4 and solve for E.

3. 14

4. 110 cm

5. a) $\frac{7}{24}$ **b)** $-\frac{1}{24}$ **c)** $\frac{5}{12}$ **d)** $\frac{1}{24}$

6. -3°C

7. 28 **Strategy**: A prime number cannot be a perfect number. Skip all prime numbers. Factor each number and calculate the sum of the factors.

8. Answers will vary. Example: Count how many breaths you take in a minute, multiply by the number of minutes in an hour, hours in a day, and days in a year (number of breaths $\times$ 60 $\times$ 24 $\times$ 365).

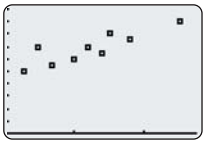
9. No. Every odd number can be represented as the sum of an even number and 1. So, let the odd numbers be represented by $a + 1$, $b + 1$, $c + 1$, $d + 1$, and $e + 1$.

Their sum is
$(a + 1) + (b + 1) + (c + 1) + (d + 1) + (e + 1)$
$= a + b + c + d + e + 5$
The sum of even numbers is an even number, so $a + b + c + d + e$ is an even number. The sum of an even number plus an odd number is an odd number, so $a + b + c + d + e + 5$ is an odd number. Thus, five odd numbers cannot have a sum of 50.
Since the sum of five odd numbers must be an odd number, the sum of six odd numbers is an odd number plus an odd number, which gives an even number. So, six odd numbers can have a sum of 50. An example is $3 + 5 + 7 + 9 + 11 + 15 = 50$.

10. a) Answers will vary. Example: $4 + 9 = 13$
b) Answers will vary. Example: $10° + 20° = 30°$
c) Answers will vary. Example: $2 + 7 = 9$

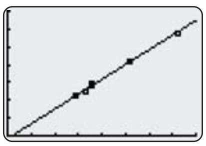
11. a) Answers will vary.
b) Answers will vary. Example: Conduct a stratified random sample survey by grade of your school. This is primary data.

12. a) Answers will vary. Example: A simple random sample of 20% of the grade 9 girls.
b) Answers will vary. Example: Stratified random sample by grade.

13. a)


b) The taller the student, the greater the shoe size.
c) There are no outliers. Outliers should not be disregarded unless the data were inaccurate or unrepresentative.

14. a) the 50 employees
b) Answers will vary. He can randomly select 20% of the female employees and 20% of the male employees.

15. a), b)


c) The greater the number of storeys, the taller the building.
d) Answers will vary. 160 m

16. Starting at 9:00, Claire ran at 6 km/h until 9:30, then stopped for 15 min, and then ran at a speed of 8 km/h until 10:15 when she stopped again for 15 min. Claire then ran back home at 7 km/h. She got there at 11:30.

17. a) 8 cm **b)** 512 cm^3

18. a) 17 **b)** 16 **c)** 39 **d)** $\frac{2}{5}$

19. a) n^5 **b)** d^6 **c)** a^{12} **d)** $12m^3n^4$ **e)** $6kq$

20. a) $10c - 5i$ **b)** 95

21. a) $2m - 2$ **b)** $2x^2 + x - 4$ **c)** $-2h + 13$ **d)** $2t - w$

22. a) $5x + 15$ **b)** $2k^2 - k$ **c)** $18y - 13$ **d)** $4a + \frac{1}{6}$

23. a) $13n - 21$ **b)** 44

Chapter 4

Get Ready, pages 184–185

1. a) $8x$ **b)** $4y$ **c)** $4m$ **d)** $5n$

2. a) $4v - 2$ **b)** $7x + 3$ **c)** $-3y + 4$ **d)** $-2k - 3$

3. a) $8k - 36$ **b)** $-10m - 12$ **c)** $18x + 3$ **d)** $-7y + 14$

4. a) $7x + 17$ **b)** $26y - 16$ **c)** $19n$ **d)** $-11k - 1$

5. a) 60° **b)** 65°

6. a) $x = 70°$, $z = 110°$ **b)** $m = 30°$

7. a) 40 **b)** 18

8. a) 12 **b)** 36

9. a) $\frac{4}{3}$ **b)** $\frac{3}{8}$

10. a) $\frac{31}{24}$ **b)** $\frac{49}{60}$

4.1 Solve Simple Equations, pages 186–195

1. a) $x = 9$ **b)** $m = 3$ **c)** $y = 3$ **d)** $h = 4$

2. a) $x = 7$ **b)** $x = 13$ **c)** $y = 7$ **d)** $y = 6$

3. a) $x = 5$ **b)** $n = 19$ **c)** $y = 3$ **d)** $h = 3$

4. a) $x = 4$ **b)** $y = 4$ **c)** $n = 24$ **d)** $k = -8$

5. a) $z = -6$ **b)** $h = 30$ **c)** $c = 7$ **d)** $u = -5$

6. a) $x = 2$ **b)** $k = 2$ **c)** $p = 7$ **d)** $g = -\frac{11}{4}$

7. a) $k = -5$ **b)** $x = -5$ **c)** $q = 14$ **d)** $y = 8$ **e)** $w = -5$ **f)** $q = -2$

8. a) $p = -11$ **b)** $x = -7$ **c)** $u = -32$ **d)** $r = 5$ **e)** $c = -1$ **f)** $v = 5$

9. The variable used may vary.
a) $7p = 84$ **b)** 12 pies

10. The variable used may vary.
a) $50j = 700$ **b)** 14 jerseys

11.

Step	Explanation
$3x - 8 = 7$	Given equation
$3x - 8 + 8 = 7 + 8$	Add 8 to both sides.
$3x = 15$	Simplify by adding integers.
$\frac{3x}{3} = \frac{15}{3}$	Divide both sides by 3.
$x = 5$	Divide integers to give the solution for *x*.

12. a) $k = -\frac{1}{2}$ **b)** $x = -2$ **c)** $m = \frac{9}{2}$ **d)** $u = -\frac{5}{3}$

13. a) $r = -\frac{27}{16}$ **b)** $h = -\frac{14}{25}$

14. a) $50n = 2000$; $n = 40$
b) In addition to the fee of $30 per person, there is a $1000 charge for renting Broadway Nights.
c) $n = 33$
d) Royal James Hall, because, for the same price, seven more contestants can be invited.

15. The variables used may vary.
a) $C = 40n + 75$
b) $n = 15.625$; The team can afford 15 jerseys.

c) Rink Rat, because, for the same price, the team can buy one more jersey.

d) The answers may vary. Example: the quality of the jerseys

16. Without membership pass:

Number of rides = $\frac{40}{1.5} \doteq 26.67$ or 26 rides.

With a membership pass:

Number of rides = $\frac{40 - 5}{1.25} = 28$ rides.

For the same amount of money, with a membership pass, Marcel can go on 28 rides. Therefore, he should buy the membership pass.

18. a) $5000 + 840n = 21\ 800$, where n is the number of litres

b) 20 L

19. a) Yes. When the amount is doubled, the number of people in Royal James Hall will be $\frac{4000}{50}$ or 80. On the other hand, for the same amount, the number of people in Broadway Nights will be $\frac{4000 - 1000}{30}$ or 100.

b) Yes. For a budget of $2500, it does not matter which hall is rented.

20. E

4.2 Solve Multi-Step Equations, pages 196–203

1. a) $m = 2$ b) $y = 5$ c) $w = -4$ d) $d = \frac{8}{3}$

2. a) $x = -1$ b) $u = -1$ c) $y = 2$ d) $m = 3$

3. a) $x = -1$ b) $n = 2$ c) $t = 5$ d) $k = 0$

4. a) $x = -1$ b) $c = -15$ c) $p = -5$ d) $k = 12$

5. a) $x = 6$ b) $y = 3$ c) $c = 2$ d) $t = 4$

6. a) $x + 2x = 180$, $x = 60$; the two angles are 60° and 120°.

b) 30°, 150°

7. 15°, 30°, 45°

8.

Step	Explanation
L.S. = 2[(–3) + 4] + 5	Substitute the root into the left side.
= 2(1) + 5	Simplify the expression inside the brackets.
= 2 + 5	Multiply.
= 7	Add.
L.S. = 6 – [(–3) + 2]	Substitute the root into the right side.
= 6 – (–1)	Simplify the expression inside the brackets.
= 6 + 1	Subtract by adding the opposite.
= 7	Add.

9. a) $x = -\frac{9}{2}$ b) $i = -\frac{7}{2}$ c) $u = -\frac{8}{5}$

d) $k = \frac{10}{3}$ e) $p = -\frac{2}{3}$ f) $x = \frac{4}{3}$

10. a) $x = 8.1$ b) $d = 1.0$

11. b) $5(y - 3) - (y - 2) = 19$

$4y - 13 = 19$

c) The CAS has expanded the brackets on the left side of the equation and collected like terms.

d) $y = 8$

12. a) $q = 3$ b) $u = 0$

13. isosceles triangle: 5, 5, 8; equilateral triangle: 6, 6, 6

14. 90° , 45° , 45°

15. a) 14.7 cm, 14.7 cm, 20.6 cm

b) The perimeter is the sum of the sides and this is to be 50. So, write and solve the equation $1x + 1x + 1.4x = 50$.

16. 386 cm^2

17. a) $x = \frac{22}{7}$ b) $k = -6$

18. a) $x = -2$ b) $x = \frac{6}{11}$

19. E

20. D

21. No. For a triangle to be equilateral, all the sides must be equal. However, no value of x satisfies all three equations.

(1) $2x + 7 = 3x - 4$
$x = 11$

(2) $3x - 4 = 5x - 8$
$x = 2$

(3) $2x + 7 = 5x - 8$
$x = 5$

4.3 Solve Equations Involving Fractions, pages 204–210

1. a) $x = 17$ b) $p = -4$ c) $m = 17$ d) $h = -32$

2. a) $y = -26$ b) $u = -3$ c) $n = \frac{1}{2}$ d) $v = \frac{11}{3}$

3. a) $m = -13$ b) $w = -11$ c) $x = -1$ d) $y = 38$

4. a) $n = -\frac{8}{59}$ b) $d = -\frac{13}{63}$ c) $c = -1$ d) $a = \frac{1}{6}$

5. 10 m

6. a) The error is in the second line, $5(x - 3) = 4(x + 1)$. The numerators on each side of the first line were multiplied by their own denominators. The correct step should be to multiply both sides by 20 (the LCD).

b) The third line is incorrect. In the previous line, the denominators and the 12 were eliminated instead of being simplified. The third line should be $4(3y - 2) = 3(y + 3)$.

7. a) $-\frac{35}{9}$ °C or approximately −4°C b) 68°F

8. 10 cm

9. 30 m

11. a) $p = 2$ b) $u = -\frac{59}{33}$

12. a) 3, 7 b) 0, 4, −2

13. 84 years old

4.4 Modelling With Formulas, pages 211–219

1. a) $s = \frac{P}{4}$ b) $P = A - I$

c) $r = \frac{C}{2\pi}$ d) $b = y - mx$

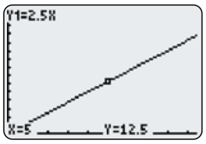
2. a) $m = \frac{d - b}{t}$ b) $w = \frac{P - 2l}{2}$ c) $v = at$

d) $t = \frac{d}{v}$ e) $r = \sqrt{\frac{A}{\pi}}$ f) $I = \sqrt{\frac{P}{R}}$

3. a) 15 cm; 90 cm **b)** $I = \frac{C}{2.5}$

c) 30 inches; 40 inches

4. a)



b) Linear. When the equation is graphed, a straight line results.

c) 20 cm; 14 inches

5. Answers may vary.

a) The equation model shows the relation between the two variables in a concise way.

b) The graphical model gives a visual picture of the relationship and you can easily find approximate values from the graph. The disadvantage is that the values obtained by reading the graph may only be approximate.

6. a) $C = 15n + 250$ **b)** \$1000, \$1750

c) $n = \frac{C - 250}{15}$ **d)** 250 people, 116 people

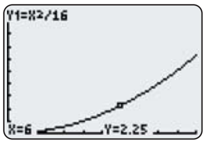
e) the rearranged equation, because the unknown variable is already isolated and so its value can be calculated more easily

f) Linear. For a relation to be non-linear, at least one of the variables must have degree greater than or equal to 2. In this formula, all the variables have degree 1. Hence, it is linear.

7. a) 119 **b)** yes, 9

8. a) $P = \sqrt{16A}$ or $P = 4\sqrt{A}$ **b)** 20 m; 28.3 m

9. a)



b) Non-linear. Since the graph is curved, the relation is non-linear.

c) Answers will vary. Example: The equation is easily simplified to get an answer. The algebraic model is probably faster than graphing.

d) Answers will vary. Example: A graphical model provides a clear visual representation. Any ordered pair can easily be found using tools of the graphing calculator .

10.

Step	Explanation
$E = \frac{1}{2}mv^2$	Start with the original formula.
$2E = mv^2$	Multiply both sides of the equation by 2.
$\frac{2E}{m} = \frac{mv^2}{m}$	Divide both sides of the equation by *m*.
$\frac{2E}{m} = v^2$	Simplify .
$\sqrt{\frac{2E}{m}} = \sqrt{v^2}$	Take the square root of both sides.
$\sqrt{\frac{2E}{m}} = v$	Simplify to isolate *v*.

11. a) Biff; Use the formula from the previous question, $v = \sqrt{\frac{2E}{m}}$, to find each bear's speed. Rocco's speed is 1.3 m/s and Biff's is 1.375 m/s. Since Biff is running faster, he will reach the eucalyptus first.

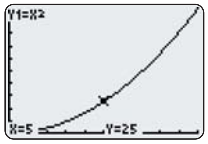
b) 0.53 J more

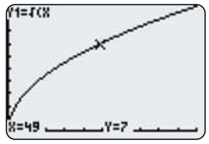
12. a) $P = \frac{nRT}{V}$; $V = \frac{nRT}{P}$; $n = \frac{PV}{RT}$; $R = \frac{PV}{nT}$; $T = \frac{PV}{nR}$

b) If you want to calculate one specific unknown value, given the values of the other four variables, you can enter the given values in the appropriate form of the formula and evaluate the answer.

13. a) $l = \sqrt{A}$

b)





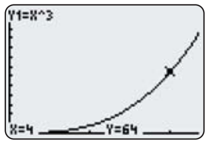
c) Answers will vary. Both the graphs show a non-linear relationship.

d) Answers will vary. In the first graph, $A = l^2$, the curve opens upward. In the second graph, the curve opens to the right.

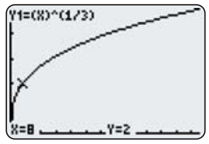
14. a) $l = \sqrt[3]{V}$

b) Answers will vary.

Graph 1



Graph 2



15. a) $v = \frac{d}{t} - \frac{at}{2}$ **b)** 1 m/s

16. a) $a = \frac{2(d - vt)}{t^2}$ **b)** 12.7 m/s^2

17. $e = \frac{w - st}{10}$; 5 errors

18. $L = \frac{gp^2}{4\pi^2}$, 0.248 m

19. a) 11.18 km/s **b)** $M = \frac{rv^2}{2G}$ **c)** 6.36×10^{23} kg

4.5 Modelling With Algebra, pages 220–229

1. The variable used may vary.

a) $3n$ **b)** $n + 4$ **c)** $\frac{1}{2}n$ **d)** $2n - 5$

2. a) $4n = 112$; the variable *n* represents any number.

b) $p + 12 = 56$; the variable *p* represents the perimeter.

c) $3x + 5 = 29$; the variable *x* represents any number.

d) $x + (x + 1) = 63$; the variable *x* represents any number.

3. a) 28; this represents the number that equals 112 when multiplied by 4.

b) 44; this represents the perimeter that when increased by 12 equals 56.

c) 8; this represents the number that, when multiplied by 3, is five less than 29.

d) 31; The sum of this number and the next consecutive number, 32, is 63.

4. Estaban: 16, Raoul: 22

5. Jamal: 1025, Fayth: 1225

6. Natalie: 11, Samara: 22, Chantal: 19

7. \$8350

8. a) $T = 5000m + 2n$ **b)** \$6000 **c)** 29 500 CDs **d)** \$130 000

9. 17, 18, 19

10. −68, −66

11. 8.8 m

12. Answers may vary.

13. a) 50.6 m

b) The cat gets back first. Laurie has to swim 50.6 m, and the cat has to walk 64 m. The speed ratio between Laurie and the cat is 0.75:1. In the time Laurie swims, the cat will be able to walk $\frac{50.6}{0.75}$, or 67.5 m, which is more than the cat needs to get back to the starting point.

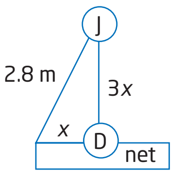
14. Answers will vary.

16. 12.5 cm²

17. a) 1.77 m **b)** Use the Pythagorean theorem.

$2.8^2 = (3x)^2 + (x)^2$

$x \doteq 0.885$



c) Answers will vary. Example: I assumed that the goalie, Dougie, is standing exactly midway between the goalposts and on the goal line.

18.

Planet	Radius of Orbit (AU)	Period of Orbit (Earth Days)	$\frac{(\text{Period})^2}{(\text{Radius})^3}$
Mercury	0.389	87.77	130 870.9915
Venus	0.724	224.70	133 042.5151
Earth	1.0	365.25	133 407.5625
Mars	1.524	686.98	133 331.6600
Jupiter	5.200	4332.62	133 503.0444
Saturn	9.150	10 759.20	151 111.2085

Mean = 135 877.8303

b) $\frac{T^2}{R^3}$ = Kepler's constant **c)** 19.025 AU

d) 60 569.84 Earth days

e) Yes, $\frac{90588^2}{39.5^3} = 133\ 152.7241$, which is very close to the actual value.

f) Answers will vary.

19. 72 g

20. D

Chapter 4 Review, pages 230–231

1. a) $m = -10$ **b)** $k = -4$ **c)** $x = 6$ **d)** $h = -20$

2. a) $y = 10$ **b)** $v = -5$ **c)** $x = 5$ **d)** $s = -5$

3. a) $n = 4$ **b)** $r = 9$ **c)** $x = 4$ **d)** $y = 2$

4. a) $0.12c + 0.70 = 2.50$ **b)** $c = 15$

5. a) $m = 2$ **b)** $w = -1$ **c)** $x = -10$ **d)** $w = 1$

6. a) $y = 2$ **b)** $k = 5$ **c)** $w = 1$ **d)** $n = -8$

7. a) $p = 4$ **b)** $h = -2$ **c)** $n = 2$ **d)** $k = \frac{3}{2}$

8. 15°, 45°, 120°

9. a) $x = 13$ **b)** $b = -11$ **c)** $p = 5$ **d)** $x = -5$

10. a) $q = \frac{10}{3}$ **b)** $u = -5$

11. a) $y = -28$ **b)** $w = -58$ **c)** $c = -19$ **d)** $x = 37$

12. a) $a = P - b - c$ **b)** $d = \frac{C}{\pi}$ **c)** $F = am$ **d)** $t = \frac{d - b}{m}$

13. a) 150 W **b)** 125 Ω **c)** 5 A

14. Dina: 9 years, Michelle: 18 years, Juliette: 12 years

15. a) \$32.10 **b)** 129 hamburgers

16. increase by 8 m

17. Answers may vary.

Chapter 4 Practice Test, pages 232–233

1. B

2. D

3. C

4. C

5. a) $y = 9$ **b)** $h = -21$ **c)** $k = 3$ **d)** $x = 5$ **e)** $r = \frac{3}{5}$ **f)** $y = 17$

6. a) $w = -9$ **b)** $a = -\frac{41}{7}$ **c)** $k = 6$

7. a) $b = P - 2a$ **b)** $a = \frac{P - b}{2}$ **c)** 12.5 cm

8. Kristi earns \$550 per week, Charlene earns \$700 per week, and Sacha earns \$800 per week.

9. $p = \frac{11}{3}$

10. a) \$173

b) Murray needs to sell 30 service contracts.

Chapter 5

Get Ready, pages 236–237

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

2. a) 0.4 **b)** −0.7 **c)** −0.875 **d)** −2.4

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

4. a) 1:4 **b)** 1:8 **c)** 6:7 **d)** 4:85

5. 84 people

6. 64 inches

7. Toronto 32.3%, Vancouver 22.6%, Charlottetown 38.7%, St. John's 45.2%

8. a) nitrogen 2.0 kg, phosphorus 0.4 kg, potassium 0.8 kg

b) nitrogen 5.25 kg, phosphorus 1.75 kg, potassium 1.75 kg
c) nitrogen 7.5 kg, phosphorus 2.5 kg, potassium 1.5 kg
d) nitrogen 2.0 kg, phosphorus 1.2 kg, potassium 0.8 kg

5.1 Direct Variation, pages 238–245

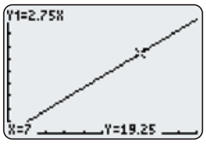
1. a) 80 **b)** 7 **c)** 100
2. a) $C = 22.5s$ **b)** the cost of 1 m of sidewalk **c)** $15 750
3. a)

Time, t (h)	Pay, p ($)
0	0
1	8
2	16
3	24

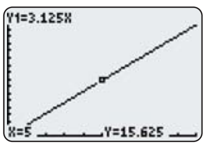
b) Graphs may vary depending on scales used.
c) $p = 8t$
4. a)

Mass of Apples, a (kg)	Cost, c ($)
0	0.00
1	1.50
2	3.00
3	4.50

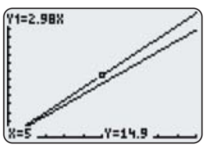
b) Graphs may vary depending on scales used.
c) $c = 1.5a$
5. a) To get the cost of parking, multiply the time parked, in hours, by $2.75. The cost c, in dollars, of parking, varies directly with the time, t, in hours, for which the car is parked.
b) $c = 2.75t$



c) Answers will vary. Example: about $20
d) $19.25
6. a) To get the cost C, of oranges, multiply the mass r, in kilograms, of oranges, by $2.25.
b) $C = 2.25r$; the constant of variation represents the constant average cost, $2.25/kg.
c) $67.50
7. a)



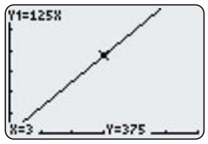
b) $A = 3.125t$ **c)** $75.00
8. a) $P = 9.5h$ **b)** $T = 14.25h$
c) $P = 10h$, $T = 15h$
9. a) This relationship is a direct variation because the price of the sugar varies directly with the amount of sugar that is bought.
b), c) The graph shows that if the price increases to $1.49 for 0.5 kg (or $2.98/kg), the graph becomes steeper.



10. a) Answers will vary. Example: Consider the distance, in metres, a cyclists travels in seconds (10 m in 1 s, 20 m in 2 s).
b) Answers will vary. Example: Consider the cost, in dollars, of parking a car for a certain time, in hours, ($2 for 4 h, $4 for 8 h).
11. $d = 171t$

Object	Time (s)	Distance (m)
Tree	0.1	17.1
House	0.25	42.75
Cliff wall	0.04	6.84

12. a) $V = 125t$, where V is the volume of the water, in litres, and t is the time, in minutes. The constant of variation represents the constant average increase in volume, 125 L/min.
b)



c) 2500 L **d)** 920 min or 15 h 20 min
e) New equation: $V = 100t$. The graph would still increase to the right, but less steeply. It would take longer to fill the pool.
13. a) The freezing point depends on the salt content so the salt content is the independent variable.
b) $F = -0.57s$, where F is the freezing point, in degrees Celsius, and s is the salt content, as a percent.
c) -0.57°C **d)** 5.25%
14. $k = 1.61m$, where k is the number of kilometres and m is the number of miles.
15. Yes, $k = \pi$.
16. From 1 to 100, there are 19 disks that contain a 3: 3, 13, 23, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 43, 53, 63, 73, 83, and 93. So, the probability that a disk contains a 3 is $19 \div 100 = 0.19$ or 19%.
17. 41 958

5.2 Partial Variation, pages 246–253

1. a) Direct variation: the equation is of the form $y = kx$.
b) Partial variation: the equation is of the form $y = mx + b$.
c) Partial variation: the equation is of the form $y = mx + b$.
d) Direct variation: the equation is of the form $y = kx$.
2. a)

x	y
0	5
1	10
2	15
3	20
4	25
7	40

b) 5, 5 **c)** $y = 5x + 5$
d) Graphs may vary.
e) The graph is a straight line that intersects the y-axis at (0, 5). The y-values increase by 5 as the x-values increase by 1.

3. a)

x	*y*
0	−2
1	3
2	8
3	13
4	18
7	33

b) −2, 5 **c)** $y = 5x - 2$

d) Graphs may vary.

e) The graph is a straight line that intersects the y-axis at (0, −2). The y-values increase by 5 as the x-values increase by 1.

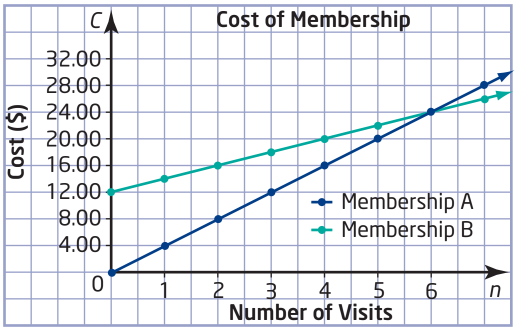
4. a) \$7.00, \$1.50 × number of toppings

b) $C = 1.50n + 7.00$ **c)** \$14.50

5. a) \$250, \$4 × number of students

b) $C = 4n + 250$ **c)** \$350

6. a)



b) A: direct variation; B: partial variation

c) In both cases, C represents the cost of membership and n represents the number of visits.
A: $C = 4n$; B: $C = 2n + 12$

d) Membership A is cheaper when fewer than six visits are made. Membership B is cheaper when more than six visits are made. They cost the same when six visits are made.

7. a) The fixed cost is \$100 and could represent, for example, the cost of paper, ink, and overhead.

b) From the table, it costs \$20 to print 100 flyers, so the variable cost to print one flyer is \$20 ÷ 100 or \$0.20.

c) $C = 0.2n + 100$

d) \$300 **e)** 900 flyers

8. a) $T = 2n + 1$, where T is the number of toothpicks and n is the diagram number. This is a partial variation because it is of the form $y = mx + b$.

b) 41 toothpicks

9. a) $P = 10.13d + 102.4$, where P is the pressure, in kilopascals, and d is the depth below the lake's surface, in metres.

b) 29 m, to the nearest metre

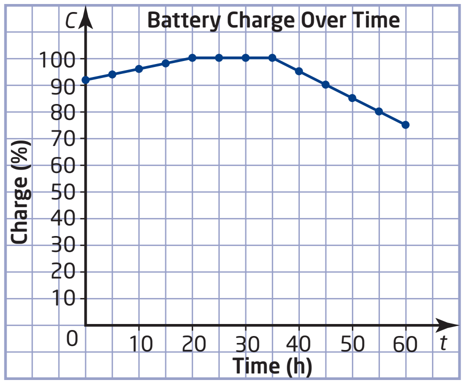
10. Answers will vary. Example: Consider the cost of a plumber repairing a leak. It costs \$30 for a service call and \$10 for each hour after that.

11. a) Graphs may vary. **b)** −250 m/min

c) $H = -250t + 8000$, where H is the height above ground, in metres, and t is the time, in minutes

13. a) i) 349 m/s **ii)** 313 m/s **b)** 227.5 m

14. a)



b) In each case, C is the charge as a percent and t is the time, in hours. From 0 to 20 h, $C = 0.4t + 92$; from 20 to 35 h, $C = 100$; for 35 h and more, $C = -t + 135$.

c) i) 96.8% **ii)** 100% **iii)** 64%

5.3 Slope, pages 254–263

1. a) 0.6 **b)** 1.375

2. 0.02

3. no

4. a) rise 3, run 5, slope 0.6 **b)** rise −3, run 5, slope −0.6

5. a) $\frac{1}{3}$ **b)** 0.5 **c)** −2.5

d) 0 **e)** not possible **f)** −0.4

6. a) b) Answers will vary. For example, B(5, 4).

7. Answers will vary. For example, B(10, −5).

8. a) no **b)** no

9. Answers will vary. Examples:

a) (1, 7) **b)** (1, 3) **c)** (−1, 9)

d) (−1, 2) **e)** (−1, 5) **f)** (−2, 6)

10. 0.6 m, 1.2 m, 1.8 m, 2.4 m

11. a) 4.2% **b)** 18 m

12. a) i) medium **ii)** steep **b)** 2.1 m, to the nearest tenth

13. Yes it does; otherwise the slopes would be different.

14. 1.6, to the nearest tenth

15. minimum 0.84 m, maximum 1.27 m, both to two decimal places

16. The slope is 1.3, to the nearest tenth, so the pyramid is almost twice as steep as a standard staircase.

17. The slope is 0.65, to the nearest hundredth, so the sides of the pavilion are about half as steep as those of the pyramid.

18. more than 111.1 m, easy; from 55.6 m to 111.1 m, intermediate; less than 55.6 m, difficult

19. 0.40, to the nearest hundredth

20. −1.73, to the nearest hundredth

21. a) Answers will vary. Example: one set of stairs has a slope of 0.62 and another has a slope of 0.70. Both sets of stairs are safe, but the set of stairs with the more gradual slope is safer.

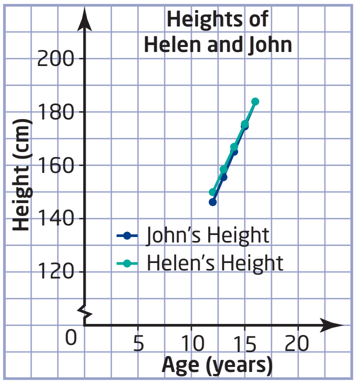
b) Answers will vary.

22. Answers will vary. example: 5 switchbacks. There needs to be an odd number of switchbacks for the train to end up going in the correct direction. If the run is 1 km, then the slope of each switchback would be 0.05 or 5% (50 m ÷ 1000 m), which is less than 7%, as required.

23. D

5.4 Slope as a Rate of Change, pages 264–271

1. 7.4 L/min
2. 300 L/h
3. 60 flaps/s
4. **a)** −3.25 **b)** The height decreases by 3.25 m/s.
5. **a)** −0.006 **b)** The temperature decreases by 0.006°C/m.
6. 11¢/year
7. 0.23 cm/day, to the nearest hundredth
8. **a)** Graphs may vary.
b) The slope is about 2571, which means the rate of change is about 2571 downloads/day.
c) Answers will vary. Example: Yes, it is popular, because the number of downloads continues to increase.
9. **a)** Graphs may vary. **b)** 4 **c)** 4 toothpicks/diagram
10. age 16



11. **a)** The graph is a line starting at (0, 0) and passing through (30, 15 000)
b) The slope will become twice as steep.
12. **a)** Graphs may vary. **b)** 1.56 L/m^2
c) 1.1 min, to the nearest tenth
13. **a)** The graph is a line starting at (0, 0) and passing through (8, 2.5). **b)** 32 s
14. **a)** Car B, by 36 km/h
b) It is the time at which they have travelled the same distance. If they are travelling in the same direction, it is the time at which Car B passes Car A.
15. **a)** Graphs may vary dependng on scales used.
b) from 1990 to 2000
c) from 2000 to 2005; the rate of change increased
16. **a)** 0.030 m^2 **b)** about 87 min
c) about 43 min **d)** about 17 min
17. **a)** No
b) Answers will vary. Example: The rates of change are large because the number of jobs increased by about 4300, or 11%, which is a significant amount.
19. **a)**

Time (h)	Price of Coat ($)
0	190.00
2	180.50
4	171.48
6	162.90
8	154.76
10	147.02
12	139.67
14	132.68
16	126.05

b) Graphs may vary depending on scales chosen.
c) The graph is decreasing and it is curved because the rate of change changes at each interval.

20. From 0 to 100 min, the charge is 35¢/min; from 100 to 200 min, it is 25¢/min; for more than 200 min, it is 20¢/min.

5.5 First Differences, pages 272–278

1. **a)** linear **b)** linear **c)** non-linear
d) non-linear **e)** linear **f)** non-linear
2. **a)** 1, 2, 4; non-linear **b)** 3, 3, 3; linear
c) −1, 1, 3; non-linear **d)** −4, −4, −4; linear
3. **a)** linear **b)** non-linear
4. **a)** linear, $S = 5h + 1$, 36 segments
b) non-linear, 49 tiles
5. **a)** linear, $I = 2c - 2$, 12 intersection points
b) non-linear, 35 diagonals
6. **a)**

Diagram Number	Number of Toothpicks
1	4
2	7
3	10

b) The first differences are the same, 3. The pattern is linear.
c) $T = 3d + 1$ **d)** 31 toothpicks
7. **a)**

Height (cm)	Wet Area (cm^2)
0	0
1	16
2	32
3	48
4	64
5	80
6	96
7	112
8	128
9	144
10	160

b) linear
c) 800 cm^2
8. **a)** Example:

Height (cm)	Painted Area (cm^2)
0	0
1	1
2	4
3	9
4	16

b) non-linear
9. non-linear, by first differences and by graph
10. **a)**

Figure Number	Number of Circles in Pattern
1	1
2	3
3	6
4	10
5	15
6	21
7	28
8	36

b) **L3** contains the first differences; $C = 0.5n^2 + 0.5n$

5.6 Connecting Variation, Slope, and First Differences, pages 279-287

1. a) 2.5 **b)** 6 **c)** $y = 2.5x + 6$

2. a) $\frac{4}{3}$ **b)** -1 **c)** $y = \frac{4}{3}x - 1$

3. a) Tables and graphs may vary. Sample tables are shown.

x	y
0	1
1	3
2	5
3	7
4	9

slope 2

b)

x	y
0	4
1	1
2	–2
3	–5
4	–8

slope -3

c)

x	y
0	0.0
1	–1.5
2	–3.0
3	–4.5
4	–6.0

slope $-\frac{3}{2}$

d)

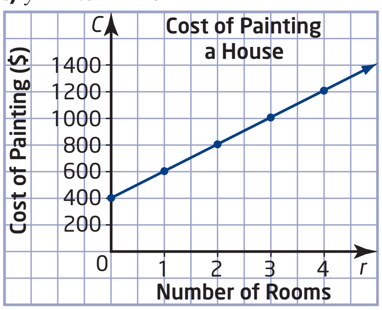
x	y
0	0.2
1	0.7
2	1.2
3	1.7
4	2.2

slope 0.5

4. a) Graphs may vary.
b) Each time the value of x increases by 1, the value of y increases by 3. The graph is a straight line that does not pass through (0, 0). This is a partial variation.
c) $y = 3x + 2$

5. a) Graphs may vary.
b) Each time the value of x increases by 2, the value of y increases by 5. The graph is a straight line that does not pass through (0, 0). This is a partial variation.
c) $y = 2.5x + 16$

6.

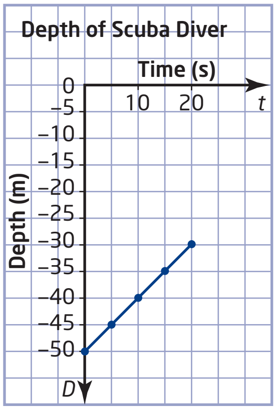


Number of Rooms, r	Cost of Painting, C ($)
0	400
1	600
2	800
3	1000
4	1200

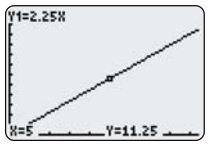
$C = 200r + 400$

7. a) The graph is a line starting at (0, 5) and passing through (1, 6.5) and (2, 8).
b) slope 1.50, cost of travelling 1 km; vertical intercept 5.00, cost of getting cab at start of journey
c) partial variation: graph is a straight line that does not pass through (0, 0).
d) $C = 1.5d + 5.00$

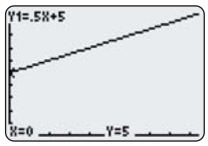
8. Each second, the scuba diver swims 1 m toward the surface of the water. $D = t - 50$



9. a) 2.25, 0 **b)** $y = 2.25x$ **c)**



10. a) 0.5, 5 **b)** $y = 0.5x + 5$ **c)**



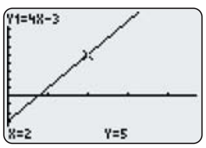
11.

x	y
–6	9
–3	2
0	–5
3	–12

y varies partially with x. As the value of x increases by 3, the value of y decreases by 7.

$y = -\frac{7}{3}x - 5$

12.



x	y
0	–3
1	1
2	5
3	9

y varies partially with x. As the value of x increases by 1, the value of y increases by 4.

13. a) linear

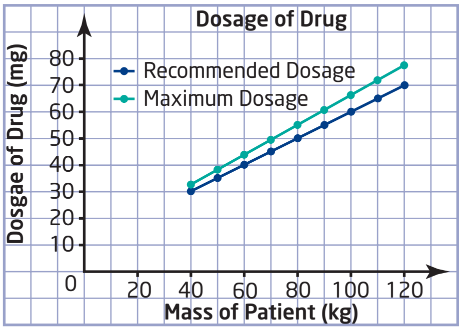
b) Graphs may vary.

c) $-\frac{1}{4}$, -0.25; constant; it represents the fact that 0.25 kL of water drains from the pool every minute.

d) $V = -0.25t + 50$ **e)** 35 kL

15. a) $D = \frac{1}{2}m + 10$ **b)** $D = \frac{11}{20}m + 11$

c)



The graph of the maximum dosage has a vertical intercept of 11, which is 1 higher than the vertical intercept of the recommended dosage, 10. The maximum dosage graph rises more steeply.

16. base salary \$1000/month, commission 2%; the percent commission is constant

Chapter 5 Review, pages 288-289

1. Graphs may vary.

Time Worked, t (h)	Pay, P (\$)
0	0
1	9
2	18
3	27

c) $P = 9t$

2. a) $d = 96t$, speed of 96 km/h

b) 3 h 7 min 30 s

3. a) Direct variation: the volume of soup varies directly with the volume of water used to prepare it.

b) The graph is a line starting at (0, 0) and passing through (2.5, 3).

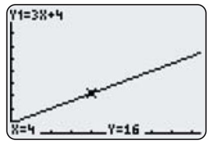
c) The graph will become less steep.

4. a)

x	y
0	4
1	7
2	10
3	13
4	16
7	25

b) 4, 3 **c)** $y = 3x + 4$

d)



The graph is a straight line that starts at (0, 4) and rises upward to the right with a slope of 3.

5. a) Neither: it is not a straight line.

b) Partial variation: it is a straight line that does not pass through (0, 0).

c) Direct variation: it is straight line that passes through (0, 0).

d) Partial variation: it is a straight line that does not pass through (0, 0).

6. a) 500, $0.15f$ **b)** $C = 0.15f + 500$ **c)** \$575

7. a) 0.13 **b)** 1.406 25

8. a) $\frac{1}{4}$ **b)** $\frac{5}{4}$ **c)** $-\frac{3}{4}$

9. a) Answers will vary. Example: Any horizontal line segment from (3, 5) to another point (x, 5)

b) Answers will vary. Example: Any vertical line segment from (−4, 1) to another point (−4, y)

10. No.

11. walking burns 0.8 kJ/min; swimming burns 1.6 kJ/min; cycling burns 1.2 kJ/min; playing basketball burns 2.8 kJ/min

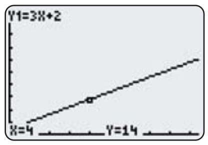
12. 12.2; hair grows 12.2 cm/year

13. a) linear **b)** non-linear

14. linear

15. a) linear **b)** 3 **c)** $y = 3x + 2$

d)



16. a) linear **b)** Graphs may vary.

c) The slope is −0.4 and means that propane is used up at 0.4 kg/h. The vertical intercept is 9.0 and is the initial amount of propane, in kilograms.

d) $M = -0.4t + 9$

Chapter 5 Practice Test, pages 290-291

1. C

2. A

3. C

4. C

5. D

6. a) −1.5 **b)** $y = 1$ **c)** $y = -\frac{3}{2}x + 1$

7. a) $d = 342.5t$

b) The graph is a line starting at (0, 0) and passing through (2, 685).

8. linear: first differences are equal

9. a) $P = 50t + 60$ **b)** \$235 **c)** $P = 45t + 60$

10. a) \$60/page; it is the slope of the graph

b) $C = 60p + 8000$

c) $C = 60p + 9000$; the vertical intercept would be 9000

d) $C = 64.8p + 8000$

Chapter 6

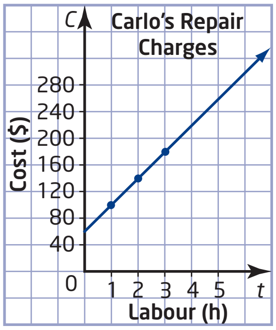
Get Ready, pages 294–295

1. a)

Time Worked (h)	Earnings ($)
3	30
5	50
6	60
9	90

b) The graph crosses the vertical axis at the point (0, 0). This point shows the earnings, $0, after zero hours.

2. a)



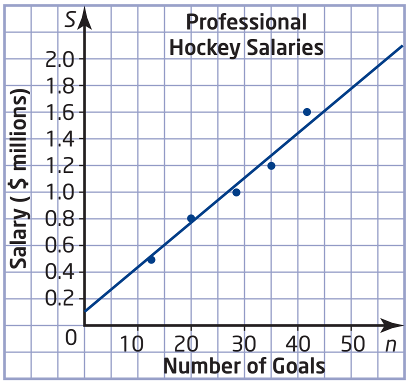
b) A 5-h job would cost $260.

c) The graph crosses the vertical axis at the point (0, 60). This point shows the repair cost, $60, for 0 h. It is Carlo's basic charge to make a house call.

3. Answers may vary.
Examples: **a)** 220 m **b)** 540 m

4. Answers may vary.
Examples: **a)** 2 min 15 sec **b)** 7 min

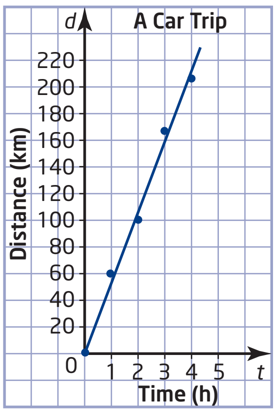
5. a)



b) $1.1 million; $1.8 million **c)** 38 goals; 56 goals

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

7. a)



b) Answers may vary. (2, 106), (4, 209)

c) The slope is 51.5. This means that the average speed of the car is 51.5 km/h.

6.1 The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$, pages 296–307

1.

	Equation	Slope	*y*-intercept
a)	$y = 4x + 1$	4	1
b)	$y = \frac{2}{3}x + 3$	$\frac{2}{3}$	3
c)	$y = x - 2$	1	−2
d)	$y = -\frac{2}{3}x$	$-\frac{2}{3}$	0
e)	$y = 3$	0	3
f)	$y = -x - \frac{1}{2}$	−1	$-\frac{1}{2}$

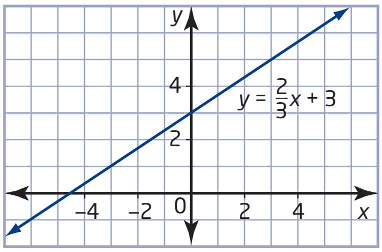
2. a) slope 3; *y*-intercept −2
b) slope −2; *y*-intercept 3
c) slope $\frac{1}{4}$; *y*-intercept −2
d) slope $-\frac{3}{4}$; *y*-intercept −2

3. a) $y = 3x - 2$ **b)** $y = -2x + 3$
c) $y = \frac{1}{4}x - 2$ **d)** $y = -\frac{3}{4}x - 2$

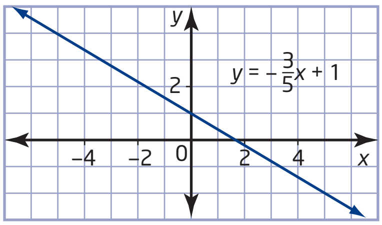
4. a) $y = 2$; slope 0; *y*-intercept 2
b) $x = -3$; slope undefined; no *y*-intercept
c) $x = 4$; slope undefined; no *y*-intercept
d) $y = 0$; slope 0; *y*-intercept 0

5. *x*-axis

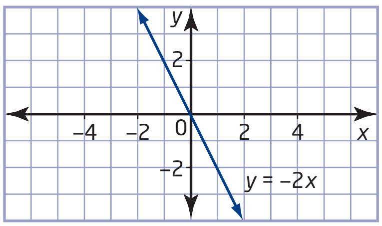
6. a) $y = \frac{2}{3}x + 3$



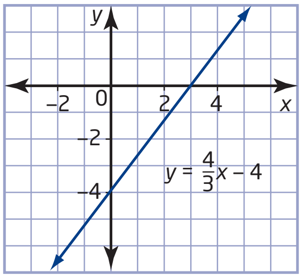
b) $y = -\frac{3}{5}x + 1$



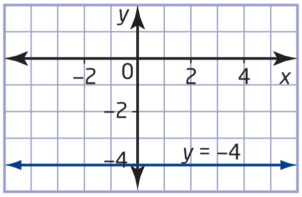
c) $y = -2x$



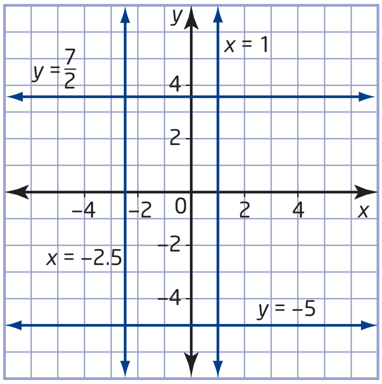
d) $y = \frac{4}{3}x - 4$



e) $y = -4$

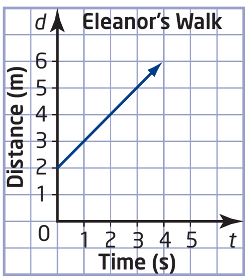


7. a) slope 0; y-intercept -5
b) slope undefined; no y-intercept
c) slope 0; y-intercept $\frac{7}{2}$
d) slope undefined; no y-intercept

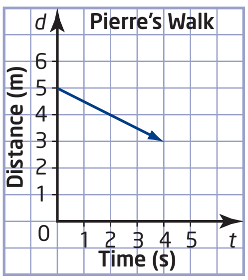


8. a) The person was at an initial distance of 1 m from the sensor.
b) The person was walking at a speed of 0.5 m/s.
c) The person was walking away from the sensor. This is because on the graph, the person's distance from the sensor increases as time goes by.

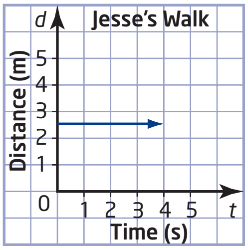
9. a)



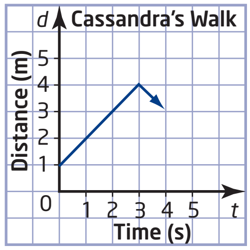
b)



c)



d)



10. a) slope 1; t-intercept 1.5; The slope represents Shannon's walking speed of 1 m/s away from the sensor. The t-intercept represents Shannon's initial distance of 1.5 m away from the sensor; $d = t + 1.5$.
b) slope 3; a-intercept 0; The slope shows that the circumference of the trunk is three times its age. The a-intercept shows that when the tree began to grow from a seed, it had circumference zero. $C = 3a$.

11. 13; 1

12.–14. Answers will vary.

15. a) The value of the y-coordinate for any x-intercept is 0.
b) 2; $-\frac{15}{2}$

16. a) 11 **b)** 23, 35, 47, 59, 71
c) Multiply any whole number by 12 and add 11.

6.2 The Equation of a Line in Standard Form: *Ax* + *By* + *C* = 0, pages 308–314

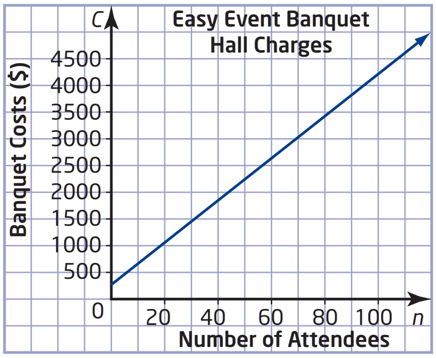
1. a) $y = -x + 3$ **b)** $y = -\frac{2}{3}x - 2$
c) $y = \frac{1}{4}x + 3$ **d)** $y = -\frac{3}{2}x + \frac{5}{2}$

2. a) slope -1; y-intercept 3; the graph is a line crossing the y-axis at 3 and the x-axis at 3.
b) slope $-\frac{2}{3}$; y-intercept -2; the graph is a line crossing the y-axis at -2 and the x-axis at -3.
c) slope $\frac{1}{4}$; y-intercept 3; the graph is a line crssing the y-axis at 3 and passing through (4, 4).
d) slope $-\frac{3}{2}$; y-intercept $\frac{5}{2}$; the graph is a line crossing the y-axis at $2\frac{1}{2}$ and passing through (3, -2).

3. a) slope $-\frac{1}{3}$; y-intercept 1
b) slope $\frac{2}{5}$; y-intercept $\frac{8}{5}$

4. a) $C = 40n + 250$
b) fixed cost \$250; variable cost \$40 per person

c)



d) $4250

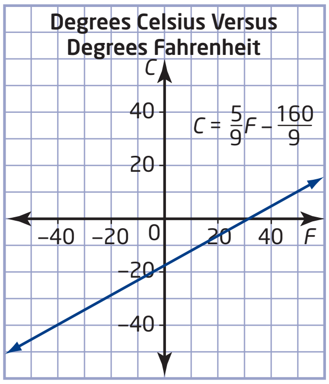
e) This is not a better deal than Celebrations. Celebrations charges $3750 for 100 people, whereas Easy Event charges $4250.

5. If only 50 people attend, then the cost at Celebrations is $2500 and the cost at Easy Event is $2250. In this case, Easy Event is a better deal. This is because the lower fixed cost at Easy Event offsets the higher variable cost when there are fewer people at a banquet.

6. $15; $20

7. a) $C = \frac{5}{9}F - \frac{160}{9}$

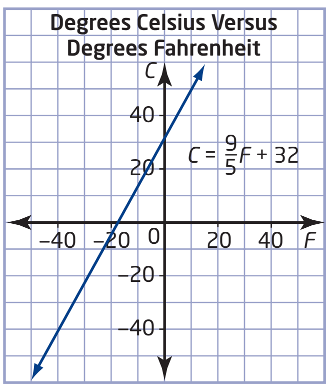
b)



c) The slope is $\frac{5}{9}$ and the C-intercept is $-\frac{160}{9}$. The slope is a multiplication coefficient and the C-intercept is a constant. To change a Fahrenheit temperature to a Celsius temperature, multiply the Fahrenheit temperature by the slope and add the C-intercept.

8. a) $F = \frac{9}{5}C + 32$

b)



c) The slope is $\frac{9}{5}$ and the F-intercept is 32. The slope is a coefficient and the F-intercept is a constant. To change a Celsius temperature to a Fahrenheit temperature, multiply the Celsius temperature by the slope and add the F-intercept.

9. a) The two graphs are similar in that they both have positive slope. They are different in that one has a positive vertical intercept while the other has a negative vertical intercept.

b) The slopes of the two graphs are reciprocals because $\frac{9}{5} \times \frac{5}{9} = 1$.

11. a) $2x + y - 7 = 0$; $A = 2$, $B = 1$, $C = -7$

b) $x - y - 3 = 0$; $A = 1$, $B = -1$, $C = -3$

c) $3x - 4y - 8 = 0$; $A = 3$, $B = -4$, $C = -8$

12. f) $y = -3x + 8$, $y = \frac{4}{5}x + 4$

6.3 Graph a Line Using Intercepts, pages 315–322

1. a) x-intercept -2; y-intercept 4

b) x-intercept -5; y-intercept 1

c) x-intercept 3; y-intercept $\frac{1}{2}$

d) no x-intercept; y-intercept 3

e) x-intercept -2; no y-intercept

2. a) The graph is a line crossing the x-axis at 2 and the y-axis at 5.

b) The graph is a line crossing the x-axis at -3 and the y-axis at 3.

c) The graph is a line crossing the x-axis at 1.5 and the y-axis at -4.

d) The graph is a horizontal line crossing the y-axis at 6.

e) The graph is a vertical line crossing the x-axis at 4.

3. a) x-intercept 6; y-intercept 4

b) x-intercept 2; y-intercept 6

c) x-intercept 4; y-intercept -1

d) x-intercept -2; y-intercept 5

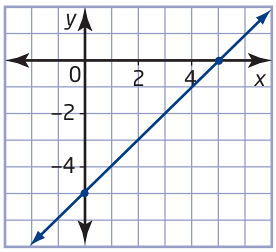
e) x-intercept 3; no y-intercept

f) no x-intercept, y-intercept -3

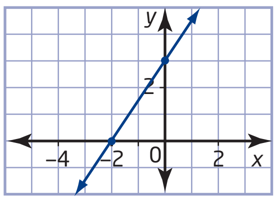
g) x-intercept $\frac{3}{2}$; y-intercept 3

h) x-intercept 5; y-intercept $-\frac{5}{3}$

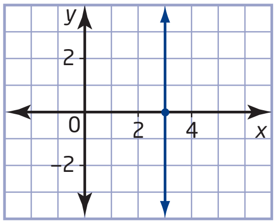
4. a) slope 1



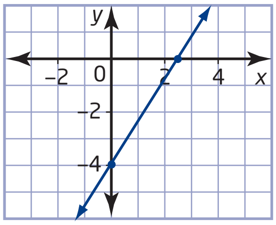
b) slope $\frac{3}{2}$



c) slope undefined



d) slope $\frac{8}{5}$



5. a) slope $-\frac{5}{6}$ **b)** slope $\frac{4}{3}$ **c)** slope $\frac{1}{2}$ **d)** slope 0

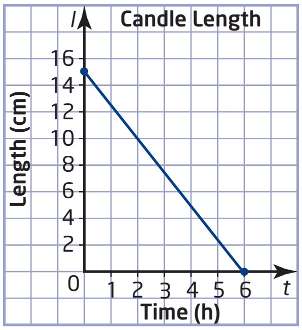
6. a) The d-intercept, 3.5, represents Carlo's initial distance from the motion sensor because the t-value at the d-intercept is 0.

b) The t-intercept, 7, represents the time at which Carlo's distance from the motion sensor is 0 because the d-value at the t-intercept is 0.

c) Answers will vary. Example: Stand 3.5 m away from the motion sensor and walk at a speed of 0.5 m/s.

7. Answers will vary.

8. a), c)



b) The slope should be negative because the candle's length decreases with time.

d) 7.5 cm; 3.75 cm.

e) The t-intercept, 6, represents the time it takes for the candle to burn out completely.

f) The graph has no meaning below the t-axis because a candle cannot have negative length.

9. a) Yes. A horizontal line having y-intercept not equal to 0 has no x-intercept.

b) No. Two distinct lines intersect at one point at most. Considering the x-axis as a line, no other line will cross the axis twice.

c) No. A line can have no x-intercept or no y-intercept, but not both. A line that has no x-intercept is parallel to the x-axis and a line that has no y-intercept is parallel to the y-axis. No line can be parallel to both the x-axis and the y-axis at the same time.

10. b) Answers will vary. Examples:
The x-intercept is increased: The slope decreases.
The x-intercept is decreased: The slope increases.
The y-intercept is increased: The slope increases.
The y-intercept is decreased: The slope decreases.

c) Answers will vary. The increase in the price of comic books means that Joanne will be able to buy fewer comic books. This means that the linear model will have a lower horizontal intercept. Joanne's buying power will be less.

d) Answers will vary. The decrease in the price of novels means that Joanne will be able to buy more novels. This means that the linear model will have a higher vertical intercept. Joanne's buying power will be greater.

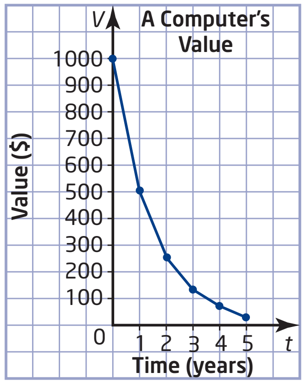
11. a) \$1000 **b)** 5 years

c) The slope, −200, shows that the value of the computer decreases by \$200 each year.

12. a)

Time (years)	Computer's Value
0	\$1000.00
1	\$500.00
2	\$250.00
3	\$125.00
4	\$62.50
5	\$31.25

b) non-linear, the points form a curve



c) Answers will vary. Example: The computer will be worth less than 10% of its value after 3.5 years. It will never be worth \$0 because half of a positive number is always another positive number.

d) No. Answers will vary. Example: It does not exist because the computer's value will never reach 0.

e) Answers will vary. Example: The computer's value depreciates faster in the system where its value is halved each year. This is because half of \$1000 is more than \$200, which is the amount subtracted each year in the other model.

13. a) two x-intercepts; 3 and −3

b) one y-intercept; 9

c)–e) Answers will vary.

14. Answers will vary. Example: Locate B by moving 5 units right, 3 units down, and 1 unit out of the page. Locate C by moving 2 units left, 0 units down, and 4 units out of the page. The resulting figure is a triangle.

15. $y = 3(x - 3)$; The value of a, in this case 6, is the x-intercept. For an equation in the form $y = m(x - a)$, the value of a is the x-intercept of the graph of the line.

Use Technology: Use *The Geometer's Sketchpad*® to Explore Parallel and Perpendicular Lines, pages 323–325

3. b) Answers will vary. In Step 2, the default parameter value for m was left at 1.

4.–6. Answers will vary.

7. 2

9. Answers will vary. Example:

Given Line	Slope of Given Line	Slope of Parallel Line	Slope of Perpendicular Line
$y = -x + 2$	-1	-1	1
$y = \frac{2}{3}x - 4$	$\frac{2}{3}$	$\frac{2}{3}$	$-\frac{3}{2}$
$y = 3x - 3$	3	3	$-\frac{1}{3}$

10. a) They are the same as the original slopes.
b) They are the negative reciprocals of the original slopes.

6.4 Parallel and Perpendicular Lines, pages 326-329

1. a) $\frac{1}{4}$; $\frac{1}{4}$; parallel **b)** 2; 2; parallel
c) -1; 1; perpendicular **d)** $\frac{1}{2}$; $\frac{1}{2}$; parallel

2. a) 0; undefined; perpendicular
b) 0; 1; neither parallel nor perpendicular
c) undefined; undefined; parallel
d) 1; -1; perpendicular

3. a) parallel; $\frac{2}{3}$ and $\frac{4}{6}$ are equivalent
b) perpendicular; $\frac{3}{4}$ and $-\frac{4}{3}$ are negative reciprocals
c) neither; 2 and -2 are unequal and are not negative reciprocals
d) perpendicular; 1 and -1 are negative reciprocals
e) parallel; $\frac{1}{5}$ and 0.2 are equivalent
f) perpendicular; $2\frac{1}{4}$ and $-\frac{4}{9}$ are negative reciprocals

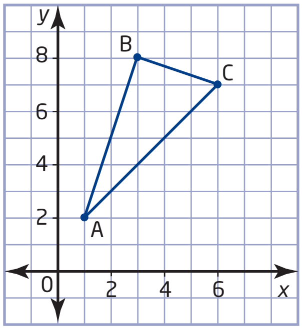
4. a) $\frac{3}{5}$ **b)** -1 **c)** 2
d) $-\frac{4}{3}$ **e)** 0 **f)** undefined

5. a) $-\frac{5}{3}$ **b)** 1 **c)** $-\frac{1}{2}$
d) $\frac{3}{4}$ **e)** undefined **f)** 0

6. Answers will vary. Example: Any two lines with slope $\frac{1}{2}$.

7. Answers will vary. Example: Any two lines with slope $\frac{1}{4}$.

8. a)



b) The triangle appears to be a right triangle with the right angle at B.
c) slope of AB is 3; slope of AC is 1; slope of BC is $-\frac{1}{3}$
d) The slopes of AB and BC are negative reciprocals. This means that AB and BC are perpendicular. Perpendicular lines meet at right angles so this is a right triangle.

9. a) The slope of AB is $-\frac{4}{3}$. The slope of AC is $-\frac{3}{2}$. The slope of BC is $-\frac{7}{5}$. No two pairs of slopes are negative reciprocals so no two of lines AB, AC, and BC are perpendicular. △ABC is not a right triangle.
b) The slope of PQ is $\frac{1}{2}$. The slope of PR is -2. The slope of QR is $-\frac{4}{7}$. The slopes of lines PQ and PR are negative reciprocals so PQR is a right triangle.

10. a) Possible answers: $(-2, -2)$; $(-6, 3)$; $(3, -1)$; $(8, -5)$; $(-1, -6)$; $(4, -10)$
b) There is more than one solution. Example: the points $(-2, -2)$ and $(-6, 3)$ both produce right triangles.

12. a) $2x + 5y = 10$: x-intercept 5, y-intercept 2; $2x + 5y = -10$: x-intercept -5, y-intercept -2
b) $3x + 4y = 12$: x-intercept 4, y-intercept 3; $3x + 4y = -12$: x-intercept -4, y-intercept -3
c) Answers will vary.

13. a) $3x + 5y = 15$: x-intercept 5, y-intercept 3; $5x - 3y = -15$: x-intercept -3, y-intercept 5
b) $2x + 7y = 14$: x-intercept 7, y-intercept 2; line $7x - 2y = -14$: x-intercept -2, y-intercept 7
c) Answers will vary.

14. a) 7 **b)** 4 **c)** none

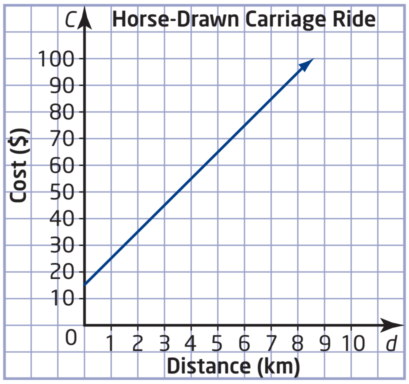
6.5 Find an Equation for a Line Given the Slope and a Point, pages 330–337

1. a) $y = x + 2$ **b)** $y = -3x - 4$ **c)** $y = \frac{2}{3}x + \frac{22}{3}$
d) $y = -\frac{1}{2}x + \frac{1}{2}$ **e)** $y = -\frac{4}{5}x$ **f)** $y = 2x - \frac{1}{4}$

2. a) $y = -3x$ **b)** $y = \frac{2}{3}x - \frac{23}{3}$ **c)** $y = -6$
d) $y = \frac{5}{2}x$ **e)** $y = -3$ **f)** $y = -\frac{1}{4}x + \frac{13}{2}$

3. a) $C = 10d + 15$ **b)** \$80

c)



d) \$80

4. a)

Distance (km)	Cost (\$)	First Differences
2.5	40	
3.5	50	10
4.5	60	10
5.5	70	10
6.5	80	10

b) 8.5 km **c)** \$73 **d)** Answers will vary.

5. $y = \frac{2}{3}x - 1$

6. $y = -\frac{5}{4}x - 4$

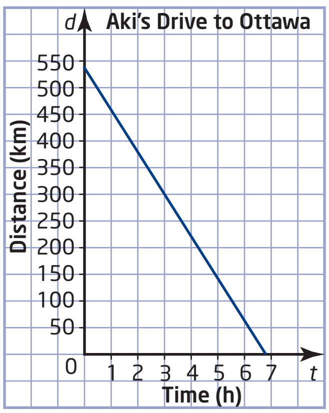
7. x-intercept 9; y-intercept 8

8. a) Answers will vary. Example: It means that after 3 h of driving toward Ottawa, Aki has 300 km left to drive.

b) This value shows that for each hour that Aki drives, his distance from Ottawa decreases by 80 km. It is negative because it represents a decreasing distance per hour.

c) 540 **d)** $d = -80t + 540$

e) The d-intercept represents Aki's distance from Ottawa just as he started his trip.

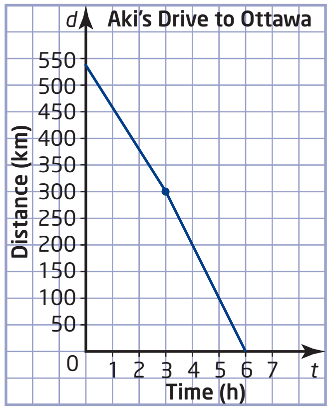


f) $6\frac{3}{4}$ h

g) No. Aki has driven for 3 h at 80 km/h. So, he has driven 240 km. He still has 300 km to drive. At 80 km/h, this will take him another $3\frac{3}{4}$ h.

10. a) 7 **b)** $C = 2.5d + 7$

11. a)



b) Answers will vary. The answer to part f) would change from $6\frac{3}{4}$ h to 6 h, and the answer to part g) would change to yes, because Aki has driven for 3 h up to this point and will drive for exactly another 3 h.

c) Explanations and methods used will vary.

6.6 Find an Equation for a Line Given Two Points, pages 338–343

1. a) $y = x + 1$ **b)** $y = -\frac{3}{2}x + 5$

c) $y = -10x - 26$ **d)** $y = -\frac{5}{3}x + \frac{5}{6}$

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

3. a) $y = \frac{1}{2}x - 2$ **b)** $y = -x - 5$

4. a) $y = 3$ **b)** $x = -2$

5. a) \$2 per game **b)** $C = 2.00g + 10.50$

c) Graphs will vary depending on scale chosen.

d) \$10.50; It represents the fixed base cost of using the bowling alley.

e) \$50.50 **f)** \$50.50

g) Answers will vary. The graph is inexact. The equation does not give a visual image.

6. a) Fiona is moving away from the sensor because she is farther away from it after 4 s than she was after 2 s.

b) 1.5 m/s **c)** $d = 1.5t - 1.5$

d) The d-intercept, -1.5, means that Fiona's initial position was 1.5 m behind the motion sensor.

7. a) The point (5, 17.25) represents Colette's wage of \$17.25/h with 5 years of experience and the point (1, 14.25) represents Lee's wage of \$14.25/h with 1 year of experience.

b) slope 0.75; w-intercept 13.50; The slope represents the yearly wage increase, and the w-intercept represents the starting wage.

c) $w = 0.75n + 13.50$ **d)** \$18.75

e) \$32.25; Answers will vary.

8. a) 80 km/h **b)** $d = -80t + 240$

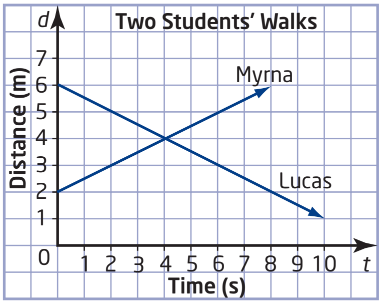
c) Yes, with 15 min to spare. It is necessary to assume that the family's driving speed stays at 80 km/h.

9. a) Lucas: $d = -\frac{1}{2}t + 6$; Myrna: $d = \frac{1}{2}t + 2$

b) 4 s **c)** 4 m

d) Answers will vary. Example: Lucas's distance has to equal Myrna's distance, so set the right sides of the equations equal. Then solve for t.

10. a)



b) (4, 4)

c) Answers will vary. Example: The point of intersection shows that Lucas and Myrna were both 4 m away from the sensor after 4 s. This means that they must have crossed paths at this time and distance from the sensor.

6.7 Linear Systems, pages 344–351

1. a) (3, 1) **b)** $(-2, 2)$

2. a) $(3, -3)$ **b)** $(6, -2)$

c) (3, 2) **d)** (3, 3)

3. a) Standard Rate option: \$300; Frequent Extremist option: \$340

b) The Standard Rate option, because it costs \$40 less.

4. a) Standard Rate option: \$1000; Frequent Extremist option: \$900

b) The Frequent Extremist option, because it costs \$100 less.

5. Yes. If Mike went skiing 10 times, then the Standard Rate option would cost $10 \times \$50$, or \$500, while the Frequent Extremist option would cost $\$100 + 10 \times \$40$, or \$500. This situation is represented in the graph by the point of intersection (10, 500).

6. Answers will vary. Example: This special may affect the couple's decision because the point of intersection is now (30, 1400). This means that the cost for 30 guests at each hotel is the same. For fewer than 30 guests, the Waverly Inn is cheaper. For more than 30 guests, the Hotel Niagara is cheaper.

7. 2:50 P.M.; 16.6 km

8. (12, 14)

9. a) 100 m **b)** 8 m/s **c)** 6 m/s

d) Cersei will win if the race is longer than 400 m while Tyrion will win if the race is shorter than 400 m. If the race is 400 m, then they will tie.

e) Answers will vary. Example: The solution of this linear system is the point (50, 400). This means that if Cersei gives Tyrion a head start of 100 m, she will catch up with him after she has run 400 m and he has run 300 m. This will occur 50 s after they both start running.

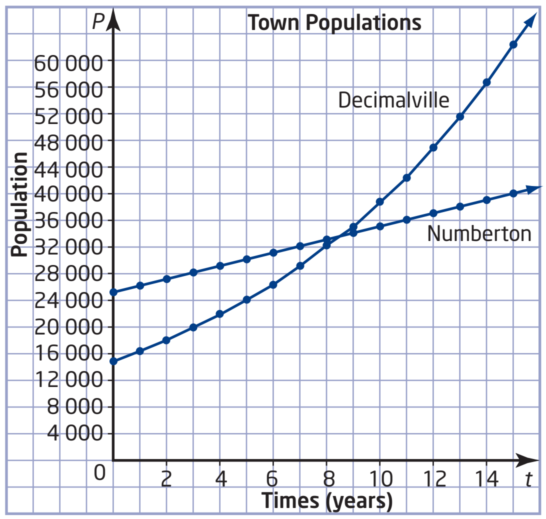
10. a) Answers will vary. Example: If Tyrion's head start is doubled, then his distance-time equation will be $d = 6t + 200$ and the new intersection point will be (100, 800). This means that if the race is less than 800 m, Tyrion will win, and if the race is more than 800 m, Cersei will win. If the race is 800 m exactly, they will tie.

b) Answers will vary. Example: If Tyrion's head start is halved, then his distance-time equation will be $d = 6t + 50$ and the new intersection point will be (25, 200). This means that if the race is less than 200 m, Tyrion will win, and if the race is more than 200 m, Cersei will win. If the race is 200 m exactly, they will tie.

12. a)

Year	Numberton's Population	Decimalville's Population
0	25 000	15 000
1	26 000	16 500
2	27 000	18 150
3	28 000	19 965
4	29 000	21 962
5	30 000	24 158
6	31 000	26 573
7	32 000	29 231
8	33 000	32 154
9	34 000	35 369
10	35 000	38 906
11	36 000	42 797
12	37 000	47 076
13	38 000	51 784
14	39 000	56 962
15	40 000	62 659

b)



c) Numberton's population growth pattern is linear while Decimalville's population growth pattern is non-linear.

d) The solution to this system occurs some time in the eighth year when both populations number between 33 000 and 34 000. Up to this time, Numberton's population was greater, but after this time, Decimalville's population will be greater.

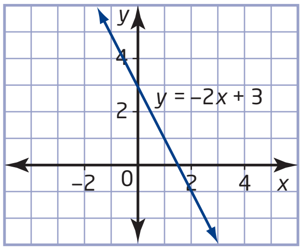
13. B

14. $y = -\frac{3}{2}x + \frac{3}{2}$

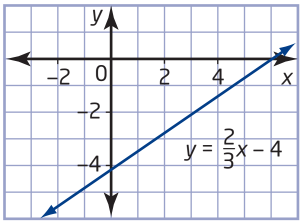
15. **a)** $(-1, 2)$ **b)** $(-1, 2)$
c) Answers will vary. Example: The point of intersection of several lines whose constants, in standard form, are arithmetic sequences is always $(-1, 2)$.

Chapter 6 Review, pages 352–353

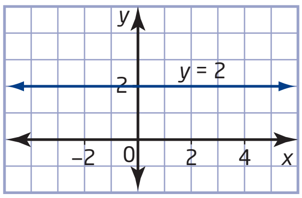
1. **a)** slope 1; y-intercept 2 **b)** slope -2; y-intercept 0
2. **a)** slope -3; y-intercept 2 **b)** slope $\frac{3}{5}$; y-intercept -1
3. **a)** $y = -2x + 3$



b) $y = \frac{2}{3}x - 4$



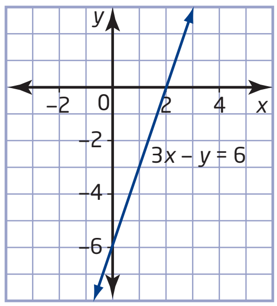
c) $y = 2$



4. **a)** The slope is 1 and the d-intercept is 2. The slope shows that the person is moving away from the motion sensor at a speed of 1 m/s. The d-intercept shows that the person started 2 m away from the sensor.
b) $d = t + 2$
5. **a)** $y = -2x + 6$ **b)** $y = -\frac{3}{5}x - 3$
6. **a)** $C = 60n + 90$
b) The slope is 60 and the C-intercept is 90. The slope represents the dollar amount per hour that the plumber charges. The C-intercept shows that the plumber also charges a base cost of \$90.
c) Graphs will vary depending on scale chosen.
d) \$270
7. **a)** x-intercept 4; y-intercept -3
b) x-intercept $\frac{3}{2}$; y-intercept -9
8. **a)** 6 **b)** 9
c) 2 hamburgers and 6 pops; 4 hamburgers and 3 pops; also, any combination of hamburgers and pops that totals less than \$18.
9. The slopes of parallel lines are identical. For example, $y = 3x + 1$ and $y = 3x - 5$ are parallel lines with slope 3.
10. The slopes of perpendicular lines are negative reciprocals. For example, $y = 3x + 1$ and $y = -\frac{1}{3}x$ are perpendicular lines.
11. $y = \frac{2}{3}x - \frac{14}{3}$
12. $y = \frac{3}{4}x - \frac{9}{2}$
13. $y = -\frac{1}{2}x$
14. **a)** 24 L **b)** $f = 32t + 24$
c) 4 h 15 min **d)** $f = 24t + 24$; 5 h 40 min
15. $y = -2x + 1$
16. **a)** $d = 0.75t + 1.75$
b) The slope, 0.75, shows that Claudia is walking at a speed of 0.75 m/s away from the motion sensor. The d-intercept, 1.75, shows that she started 1.75 m away from the sensor. **c)** 5.5 m
17. **a)** $(-3, -3)$
18. **a)** (4, 160). This means that both tutors charge \$160 for 4 h of tutoring.
b) If a student wants to spend as little money as possible, then for less than 4 h the student should hire Mr. Wellington. The student should hire Ms. Tenshu for more than 4 h of tutoring. The assumption is that both tutors are equally helpful.

Chapter 6 Practice Test, pages 354–355

1. C
2. D
3. B
4. B
5. A
6. **a)** 5 m
b) She was walking toward the sensor, because the distance-time graph has a negative slope.
c) She was walking at a speed of 1 m/s.
d) $d = -t + 5$
7. **a)** The x-intercept is 2 and the y-intercept is -6.
b)



8. **a)** $C = 75n + 60$
b) The slope, 75, represents the dollar amount per hour that the electrician charges. The y-intercept, 60, represents the fixed dollar amount that the electrician charges on top of the hourly charge.
c) Graphs will vary depending on scale chosen.
d) \$210

9. $y = \frac{2}{3}x - \frac{11}{3}$

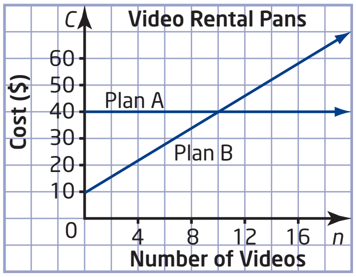
10. $y = \frac{4}{3}x$

11. **a)** 1.9 L; 0.45 L **b)** $G = \frac{L}{3.8}$

c) approximately 1.053 gallons; approximately 0.066 gallons

12. $y = -\frac{3}{2}x - \frac{9}{2}$

13. **a)**



b) If you rent fewer than 10 videos in a month, Plan B is cheaper. If you rent more than 10 videos, Plan A is cheaper. For 10 videos both plans cost the same, \$40.

14. **a)** 160 km/h **b)** $d = 160t$ **c)** 2:30 P.M.

Chapters 4 to 6 Review, pages 356–357

1. **a)** $x = -3$ **b)** $y = -42$ **c)** $w = 4$ **d)** $s = 4$ **e)** $n = 4$ **f)** $r = 6$

2. **a)** $x = 5$ **b)** $y = -3$ **c)** $w = -2$ **d)** $s = -1$ **e)** $n = \frac{10}{7}$ **f)** $k = 3$

3. 5, 5, 6

4. **a)** $x = -16$ **b)** $n = 16$ **c)** $y = -17$ **d)** $k = 19$

5. **a)** $P = A - I$ **b)** $r = \frac{d}{2}$ **c)** $a = \frac{v - u}{t}$ **d)** $l = \frac{P}{2} - w$

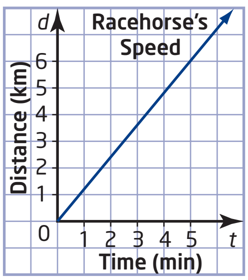
6. **a)** width 15 m, length 28 m **b)–c)** Answers will vary.

7. **a)** Natalie is paid \$9 for each hour that she works.
b) $P = 9t$, where t represents the time, in hours, that Natalie works and P represents the total amount she is paid for this time. The constant of variation represents the dollar amount that Natalie is paid per hour.
c) \$81

8. **a)** \$50 **b)** \$15 per 100 km **c)** $C = 0.15d + 50$ **d)** \$162.50

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

10. **a)** 1.2 km/min
b)



c) The rate of change of the horse's distance is the slope of the line. It shows how quickly the horse's distance changes. It represents average speed: in this case 1.2 km/min or 72 km/h.

11. **a)** linear

x	y	First Differences
0	5	
1	7	2
2	9	2
3	11	2
4	13	2

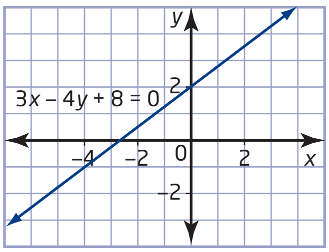
b) non-linear

x	y	First Differences
0	–4	
2	–2	2
4	2	4
6	8	6
8	16	8

12. **a)** Graphs will vary depending on scale chosen.
b) Answers will vary. Multiply any value of x by $\frac{4}{5}$ and add 4 to obtain the corresponding y-value.
c) $y = \frac{4}{5}x + 4$

13. **a)** slope $\frac{1}{2}$; y-intercept -1; $y = \frac{1}{2}x - 1$
b) slope $-\frac{2}{3}$; y-intercept 4; $y = -\frac{2}{3}x + 4$

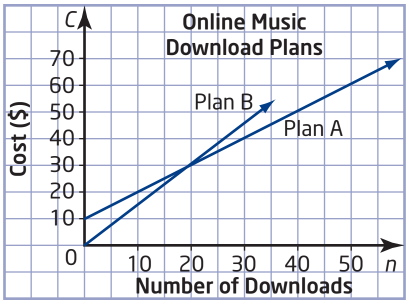
14. **a)** $y = \frac{3}{4}x + 2$
b) The slope is $\frac{3}{4}$ and the y-intercept is 2.
c)



15. **a)** x-intercept 2; y-intercept -6
b) x-intercept $-\frac{15}{2}$; y-intercept: 3

16. **a)** The lines are perpendicular because their slopes, 2 and $-\frac{1}{2}$, are negative reciprocals.
b) The lines are parallel because their slopes are both -3.
c) The lines are neither parallel nor perpendicular. Their slopes are $\frac{3}{4}$ and $\frac{4}{3}$, which are neither equal nor negative-reciprocals.
d) The lines are perpendicular because $y = 3$ is a horizontal line and $x = -2$ is a vertical line.

17. **a)** $y = \frac{1}{3}x + 1$ **b)** $y = -2x - 1$

18. **a)** 

b) If you make fewer than 20 downloads per month, then Plan B is cheaper. If you make more than 20 downloads a month, then Plan A is cheaper.

Chapter 7

Get Ready, pages 362–363

1. **a)** isosceles **b)** scalene
2. **a)** equilateral, acute **b)** isosceles, obtuse
3. **a)** irregular pentagon **b)** regular hexagon
4. **a)** parallelogram; opposite sides are parallel.
   b) rhombus; the four sides are equal
5. **a)** 50° **b)** 55°
6. **a)** $a = 75°$, opposite angles; $b = 75°$, corresponding angles; $c = 75°$, alternate angles.
   b) $a = 40°$, corresponding angles; $b = 40°$, opposite angles; $c = 140°$, supplementary angles (also co-interior with a)

7.1 Angle Relationships in Triangles, pages 364–373

1. **a)** 115° **b)** 126° **c)** 134° **d)** 112°
2. **a)** 40° **b)** 155° **c)** 145°
3. C
4. **a)** 105° **b)** 155° **c)** 80°
5. **a)** 70° **b)** $x = 115°$, $y = 146°$, $z = 81°$
   c) $w = 43°$, $x = 137°$, $y = 43°$, $z = 137°$
   d) $w = 92°$, $x = 136°$, $y = 44°$, $z = 136°$
   e) $a = 22°$, $b = 92°$, $c = 22°$, $d = 136°$, $e = 44°$
6. 140° and 80°, or 110° and 110°
7. 120°
8. isosceles and equilateral
9. **a)** The sum of two obtuse angles is more than 180°.
   b) Yes, any acute triangle has three obtuse exterior angles.
10. **a)** 175°
    b) interior angle, 85°; exterior angle, 95°
11. $w = 40°$, $x = 43°$, $y = 90°$, $z = 47°$
12. **a)** 120°, 120°, 120° **b)** 72°, 144°, 144°
    c) 60°, 120°, 180°, impossible
    d) 90°, 90°, 180°, impossible
    e) 90°, 120°, 150°
    f) 96°, 120°, 144°
    g) 72°, 96°, 192°, impossible; exterior angles must be less than 180°
14. B
15. C

7.2 Angle Relationships in Quadrilaterals, pages 374–383

1. **a)** 64° **b)** 101°
   c) 45° **d)** 115°
2. A
3. B
4. **a)** 135° **b)** 155°
   c) 150° **d)** 90°
5. **a)** $w = 110°$, $x = 70°$
   b) $y = 138°$, $z = 42°$
   c) $a = 55°$, $b = 125°$, $c = 125°$
6. The sum of the exterior angles is 360°.
7. **a)** $x = 95°$, $y = 85°$
   b) $a = 61°$, $b = 72°$, $c = 108°$, $d = 93°$, $e = 76°$
8. Three angles, each at a different vertex; you can use angle relationships to calculate the others.
9. **a)** impossible since $\angle A + \angle B + \angle C = 395°$
   b) fourth angle measures 105°
   c) fourth angle measures 205°
10. **a)** impossible; sum of four obtuse angles is greater than 360°
    b) Example: two 120° angles and two 60° angles
    c) Example: 150° angle and three 70° angles
    d) Example: 120° angle, 60° angle, and two 90° angles
    e) impossible; fourth angle must also be a right angle
11. 90°
12. **a)** 125° **b)** 80°
    c) Answers will vary. Example: Triangles and quadrilaterals are easy to construct; triangles are rigid.
13. $u = 106°$, $w = 74°$, $x = 50.5°$, $y = 89°$, $z = 114.5°$
14. **a)** Yes.
    b), c) yes for square but not for rectangle
15. **b)** 360° **c)** 720°
    d) The sum of the interior angles of quadrilateral is equal to the sum of the interior angles of the four triangles less the sum of the angles at E.
16. **a)** 90°, 90°, 90°, 90° **b)** 60°, 60°, 120°, 120°
    c) 36°, 72°, 108°, 144° **d)** 60°, 80°, 100°, 120°
17. Answers will vary.
18. B
19. 3 or 0

7.3 Angle Relationships in Polygons, pages 384–393

1. **a)** 1440° **b)** 2340° **c)** 3240°
2. **a)** 128.6° **b)** 150°
3. **a)** 5 sides **b)** 12 sides **c)** 19 sides
4. pentagon: 5, 2, 3, 540°
   decagon: 10, 7, 8, 1440°
   icosagon: 20, 17, 18, 3240°
5. equal interior angles, equal exterior angles, and equal sides
6. Sum of the interior angles is $180°(4 - 2) = 360°$. Since the angles are equal, each one measures $\frac{360°}{4}$ or 90°.
7. **a)** 120° **b)** Answers will vary.
   c) The angles do not change.
8. **b)** 6 **c)** 1260°
9. **a)** 144° **b)** 157.5° **c)** 162°
   d) $\frac{180(n - 2)}{n}$

10. a) 11 sides **b)** 147.3°
c) Answers will vary. Examples: easier for blind people and vending machines to recognize, harder to forge
11. No; the sum is 360° for all convex polygons.
12. triangles, squares, hexagons
13. a) 12 **b)** 150°
c) 30° **e)** 60°
14. a) pentagon
b) Rotate a line segment 45° about one endpoint seven times.
c) 18°
d) The angle of rotation is 360° divided by the number of sides.
16. Yes; regular polygons have angles less than 180°.
17. Answers will vary. Example: Yes; an n-sided concave polygon can be divided into $n - 2$ triangles by diagonals from two or more vertices (or use *The Geometer's Sketchpad*® to measure angle sums in various concave polygons).
18. Answers will vary.
19. Answers will vary.
20. B
21. A

7.4 Midpoints and Medians in Triangles, pages 394–400

1. a) 2 cm **b)** 12 cm
2. a) 8 cm^2 **b)** 8 cm^2
3. a) 19 cm^2 **b)** 38 cm^2
4. 2.5 cm
5. a) Answers will vary. Examples:
b) Fold along the median and see if the equal sides line up.
c) Construct the isosceles triangle and median, and then measure the angle on either side of the median.
d) The median bisects the angle.
6. ∠ADC is obtuse when D is close to A.
7. a), b) Any scalene triangle with a 60° angle is a counter-example.
c) Since the angles sum to 180°, one of the angles must be larger than 60° and the third angle must be smaller. The largest angle is opposite the largest side, and the smallest angle is opposite the smallest side. Therefore, the 60° angle is opposite the second-longest side.
8. Yes; since △ABD and △ACD are congruent (ASA or SAS), the perpendicular at D must pass through A.
9. No; the angles in each triangle are not equal.
10. Medians intersect at one point in all triangles.
11. a) △BEG and △CEG have the same area because GE is a median of △BGC.
b) The same logic applies, since DG and GF are also medians.
c) AE is a median, so △ABE has the same area as △ACE. Since the areas of △BEG and △CEG are equal, the areas of △ABG and △ACG are also equal. The areas of the two triangles in △ABG are equal, as are the areas of the two triangles in △ACG. Therefore, △ADG, △BDG, △AFG, and △CFG each have an area equal to half that of △ABG. Comparing △BCF and △BAF shows that △BEG and △CEG also each have an area half that of △ABG.

12. b) First step, $\frac{1}{4}$; second step: $\frac{1}{4} + \frac{1}{4}\left(\frac{3}{4}\right)$;
third step: $\frac{1}{4} + \frac{1}{4}\left(\frac{3}{4}\right) + \frac{1}{4}\left(\frac{3}{4}\right)^2$;
nth step $\frac{1}{4} + \frac{1}{4}\left(\frac{3}{4}\right) + \frac{1}{4}\left(\frac{3}{4}\right)^2 + \ldots + \frac{1}{4}\left(\frac{3}{4}\right)^{n-1}$
c) about 0.6836 or 68.36%
13. a) The right bisectors of a triangle intersect at a single point.
b) Yes; the circle passes through all three vertices of the triangle.
14. a) The angle bisectors of a triangle always intersect at a point.
b) Yes; the circle's radius is the minimum distance from the intersection of the angle bisectors to any side of the triangle.
15. No; for an obtuse triangle the intersection is outside the triangle.
16. c), d), g)

7.5 Midpoints and Diagonals in Quadrilaterals, pages 401–407

1. EF is parallel to HG, EH is parallel to FG
2. BE = 6 cm, CE = 8 cm, AC = 16 cm, BD = 12 cm
3. PT = 7 m, ST = 5 m
4. 40 cm
5. a) all four **b)** rectangle, square
c) rhombus, square **d)** rhombus, square
6. when ABCD is a rectangle
7. a) False; any quadrilateral with four unequal sides is a counter-example.
b) True; a line segment joining opposite midpoints creates two parallelograms with equal heights and bases.
8. a) square
b) The area of WXYZ is half the area of PQRS. The diagonals of WXYZ form four triangles that are congruent to the triangles outside WXYZ.
c) rhombus
d) No; all the triangles are still congruent.
9. b) 90° **c)** rectangle
d), e) Answers will vary. Example: The area of EFGH is half the area of ABCD.
10. Answers will vary. Examples:
a) The area of EFGH is half the area of ABCD.
b) Use geometry software to compare the areas.
11. Answers will vary. Example:
b) By the Pythagorean theorem, $AD^2 + AB^2 = BD^2 = CD^2 + AB^2$. So, AD = CD.
c) △ABD is congruent to △CBD (SSS), so ∠ABD equals ∠CBD.
13. In any parallelogram ABCD, △ABC and △CDA are congruent (SSS), as are △ABD and △CDB. Thus, ∠CAB = ∠ACD, ∠CDB = ∠ABD, ∠ACB = ∠DAC, and ∠ADB = ∠CBD. △ABE and △CDE are congruent (ASA), so DE = BE and AE = CE.
14. b) △ABC and △CDA are congruent (SSS). So, ∠BCA = ∠CAD. Since ∠BCA, ∠CAB, and ∠ABC sum to 180°, ∠CAD + ∠CAB+ ∠ABC = 180°. Therefore, AD is parallel to BC. Similarly, AB is parallel to CD.

15. Answers will vary. Examples:
 a) The five triangles formed by two adjacent sides of PQRST ($\triangle$ABC, $\triangle$BCD, and so on) are isosceles and congruent (SAS). So, all the acute angles in these triangles are equal. Then, $\triangle$ABR, $\triangle$BCS, $\triangle$CDT, $\triangle$DEP, and $\triangle$EAQ are all congruent (ASA). The obtuse angles of these triangles are opposite to the interior angles of PQRST. Thus, these angles are all equal. $\triangle$DPT, $\triangle$EPQ, $\triangle$AQR, $\triangle$BRS, and $\triangle$CST are all congruent (SAS), so the sides of PQRST are all equal.
 b) Yes; both are regular pentagons.
 c) By measuring the diagram $\frac{AB}{PQ} \doteq 2.7$
 d) Ratio of areas is $\left(\frac{AB}{PQ}\right)^2 \doteq 7.1$.
16. a) 45 b) 66
17. a) $\frac{n(n-1)}{2}$ b) $\frac{n(n-3)}{2}$

Chapter 7 Review, pages 408–409

1. a) 110° b) 125°
 c) $w = 75°$, $x = 105°$, $y = 135°$, $z = 30°$
2. The exterior angle would be greater than 180°.
3. a) any obtuse triangle
 b) impossible; third exterior angle would be greater than 180°
 c) any acute triangle
 d) impossible; sum of exterior angle would be less than 360°
4. a) 100°
 b) $b = 105°$, $c = 70°$, $d = 85°$, $e = 100°$, $f = 80°$
 c) $x = 52°$, $y = 52°$, $z = 128°$
5. a) Example: three 110° angles
 b) impossible; sum of the interior angles would be greater than 360°
 c) Example: three 100° angles
 d) impossible; sum of the exterior angles would be greater than 360°
6. a) 720° b) 1080° c) 1800°
7. a) 108° b) 140° c) 157.5°
8. 30
9. Answers will vary.
10. DE connects the midpoints of AB and AC. Therefore, the base and altitude of $\triangle$ADE are half those of $\triangle$ABC.
11. a) Each median divides the triangle into two triangles. All of these triangles are congruent (SAS). The medians are equal in length since they are sides of the congruent triangles.
 b) False; any scalene triangle is a counter-example.
12.–13. Answers will vary.

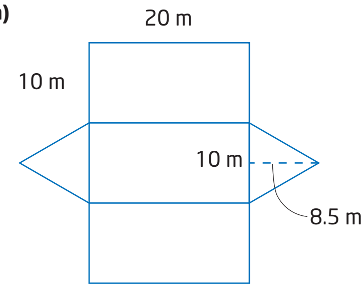
Chapter 7 Test, pages 410–411

1. C
2. B
3. B
4. D
5. B
6. a) 95° b) 90°
 c) $c = 145°$, $d = 60°$, $e = 85°$, $f = 95°$
 d) $v = 55°$, $w = 50°$, $x = 75°$, $y = 70°$, $z = 110°$
7. Answers will vary. Examples:
 a) The sum of the interior angles is 360°. Opposite interior angles are equal. Adjacent interior angles are supplementary.
 b) The diagonals bisect each other and bisect the area of the parallelogram.
8. Example: $\angle A = \angle C = 90°$, $\angle B = 60°$, $\angle D = 120°$
9. 2160°
10. 15
11. Answers will vary. Example: Run the fence along the median from the right vertex of the lot.
12. a) hexagon
 b) Yes, the sides are equal, and measuring with a protractor shows that the interior angles are equal.
 c) 120°
 d) For regular polygons, the measure of the interior angles increases as the number of sides increases.

Chapter 8

Get Ready, pages 414–417

1. a) 9.6 m b) 26 cm c) 6.3 mm
 d) 13.2 cm e) 90 m f) 35 mm
2. a) 17.6 cm b) 32.0 m c) 219.9 mm
 d) 39.3 cm
3. 42 m
4. a) 38.6 cm^2 b) 105.7 cm^2
5. a) 11.34 m^2 b) 60.45 cm^2
6. a) 52 m^2 b) 2513 cm^2
7. 24 m^3; 9425 cm^3
8. a)



 b) 685 m^2 c) 850 m^3
9.–11. Answers will vary.

8.1 Apply the Pythagorean Theorem, pages 418–425

1. a) 10 cm b) 13 m c) 6.6 m d) 8.6 cm
2. a) 15 cm b) 9.2 m c) 7.7 m d) 7.4 cm
3. a) 24 cm^2 b) 34.1 m^2
4. a) 4.5 units b) 2.8 units c) 5 units
5. 35 cm
6. 38 m
7. 119 m
8. 104.56 m

9. 11 stones
10. 64 cm
11. 40 ft
12. **a)** $\sqrt{2}$; $\sqrt{3}$; $\sqrt{4}$; $\sqrt{5}$
b) $\frac{\sqrt{1}}{2} + \frac{\sqrt{2}}{2} + \frac{\sqrt{3}}{2} + \frac{\sqrt{4}}{2}$
c) As you add right triangles to the spiral pattern, the area will increase by $\frac{\sqrt{\text{Number of Triangles}}}{2}$.
13. **a)** This name is appropriate because this set of three whole numbers satisfies the Pythagorean theorem.
b) Yes.
c) Yes, they are Pythagorean triples, with some restrictions on the values of m and n.
d) $m > n > 0$

8.2 Perimeter and Area of Composite Figures, pages 420–435

1. **a)** 52 m **b)** 29 cm **c)** 54 m **d)** 52 cm **e)** 24 cm
2. **a)** 370 mm^2 **b)** 104 m^2 **c)** 30 cm^2 **d)** 45 cm^2 **e)** 321 cm^2 **f)** 174 m^2
3. **a)** 62 m **b)** 232 m^2
c) To find the perimeter:
Step 1: Use the Pythagorean theorem to determine the length of the unknown side.
Step 2: Add the dimensions of the outer boundary to determine the perimeter.
To find the area: Use the formula for the area of a trapezoid.
4. **a)** 1500 cm^2 **b)** 1 paint can **c)** \$4.54
5. 300 mm^2
6.–7. Answers will vary.
8. **a)** 180 plants **b)** 48 m^2
9. Answers will vary.
10. **a)** 1810 cm^2 **b)** 36%
11. **a)** 2.2 m **b)** 9 m
12. 5400 cm^2
14. **a)** 50 m^2
b) The area of the lawn is four times the area of one flower bed.
c) It is only true if the vertices of the inscribed square are at the midpoints.
15. Doubling the radius quadruples the area. $\text{Area}_1 = \pi r^2$; $\text{Area}_2 = \pi(2r)^2$ or $4\pi r^2$. So, $\text{Area}_2 = 4 \times \text{Area}_1$.
16. **a)** 34, 55, 89, 144
b) areas: 1, 2, 6, 15, 40, 104, ...
c)–d) Answers will vary.
17. 1:5
18. 40 cm^2

8.3 Surface Area and Volume of Prisms and Pyramids, pages 436–443

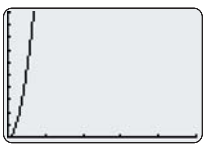
1. **a)** 279.65 cm^2 **b)** 147 cm^2
2. **a)** 2000 mm^3 **b)** 2 m^3
3. **a)** 700 mm^2 **b)** 492 cm^2
4. **a)** 480 cm^2 **b)** 10.35 m^2
5. **a)** 52 m^2 **b)** 24 m^3
6. 30 cm
7. **a)** 1 694 000 m^3 **b)** 115 324 m^2
8. 143.5 m
9. Yes
10. **a)** 30 cm
b) There are no irregularities (bumps/dimples) on the surface. Also, the top of the juice container is flat and the container is completely full.
11. **a)** 47 m^3 **b)** 15 cans **c)** \$292.39
12. **a)** Answers will vary. Example: 80 m^3
b) 92 000 L
c) 920 min or 15 h and 20 min
13. **a)** Answers will vary. Example: Double the volume.
b) original prism 240 cm^3; new prism 480 cm^3
c) Answers will vary. Yes.
d) Yes; doubling the height of a triangular prism doubles the volume of the prism.
15. The height of the pyramid is three times the height of the prism.
Volume of pyramid $= \frac{1}{3}lwh$
Volume of prism $= lwh$
If the two volumes are equal, then the height of the pyramid must be three times the height of the prism because w and l are the same for both.
16. **a)** 56 m^2 **b)** \$1980
17. **a)**
$$\begin{aligned} \text{SA} &= 2(lw + wh + lh) \\ \text{SA}_{\text{new}} &= 2[(2l \times 2w) + (2w \times 2h) + (2l \times 2h)] \\ &= 2[4lw + 4wh + 4lh] \\ &= 4[2(lw + wh + lh)] \end{aligned}$$
b) The new volume is eight times the old volume.
$$\begin{aligned} \text{Volume}_{\text{old}} &= lwh \\ \text{Volume}_{\text{new}} &= 2l \times 2w \times 2h \\ &= 8lwh \end{aligned}$$
18. 48

8.4 Surface Area of a Cone, pages 444–450

1. **a)** 9 m^2 **b)** 1257 cm^2 **c)** 141 cm^2
2. **a)** 13 m **b)** 283 m^2
3. **a)** 158 cm^2
b) Answers will vary. There is no paper being overlapped.
4. **a)** Yes.
b) No. The second cone. The slant height is the same for both, but in the expression πrs, the second cone has the greater radius.
c) 141 cm^2; 249 cm^2; yes
5. **a)** 5 cm **b)** 3 cm
6. No. Answers will vary. Example: The formula for the surface area of the cone is $\text{SA} = \pi r^2 + \pi rs$. When the height is doubled only the term πrs is changed. The term πr^2 remains unaltered. Hence, doubling the height of a cone does not double the surface area.
7. No. Answers will vary. Example: The formula for the surface area of a cone is $\text{SA} = \pi r^2 + \pi rs$. When the radius is doubled, the term πr^2 will quadruple and the term πrs will more than double. Hence, the surface area of the new cone will be more than double the original cone.
8. **a)** radius 5 cm, height 10 cm
b) 254 cm^2
9. 1307 cm^2
10. 158 m^2

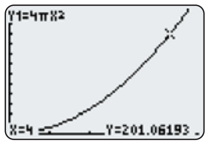
11. a) base of the frustum, lateral area of the frustum, top of the frustum, outer walls of the cylinder, inner walls of the cylinder, the thin strip of the cylinder, the outer part of the base of the cylinder, the inner part of the base of the cylinder
b) 34 382 cm^2 c) 4 cans
12. Answers will vary.
13. a) radius $= \frac{x}{2}$, height $= x$, slant height $= \frac{\sqrt{5}}{2}x$
b) $SA = \frac{\pi x^2}{4} + \frac{\sqrt{5}}{4}\pi x^2$
14. a) $s = \frac{\text{Lateral Area}}{\pi r}$ b) $s = 7.96$ cm
15. Answers will vary. about 72 000 000 m^2
16. a) $SA = 4\pi + 2\pi s$
b) Graphs will vary. Should be a set points along a straight line.
c) Answers will vary. Example: It is a linear relation.

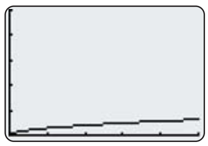
8.5 Volume of a Cone, pages 451–456

1. a) 25 cm^3 b) 188 m^3
c) 2827 cm^3 d) 25 133 cm^3
2. a) 2 m^3 b) 2964 cm^3
3. 264.1 cm^3
4. 7.1 cm
5. 100 cm^3
6. Answers will vary.
7. 450 cm^3
8. a) Answers will vary. Example: 18 m
b) 16.98 m
c) Answer will vary.
9. a) Answers will vary. Example: The cone with base radius of 4 cm has the greater volume. The formula for the volume of a cone contains two factors of r and only one factor of h. Hence, the volume is more dependent on r than on h.
b) Cone (height 4 cm, base radius 3 cm):
Volume = 38 cm^3
Cone (height 3 cm, base radius 4 cm):
Volume = 50 cm^3
10. 141 045 cm^3
11. a) $h = \frac{3V}{\pi r^2}$ b) 59.7 cm
12. 2.8 cm
13. a) radius 5 cm, height 10 cm b) Estimates will vary. 1:4
c) 262 cm^3 d) 1:3.82 e) Answers will vary.
14. 9.1 m
15. Answers will vary. Example: When the radius is constant, a change in height produces a proportional change in volume.
16. a) $V = \frac{20}{3}\pi r^2$
b) 

c) Answers will vary. Example: The relation is increasing for all values of r greater than 0 (since the radius cannot be negative). The growth rate is non-linear.
17. D

8.6 Surface Area of a Sphere, pages 457–461

1. a) 452 cm^2 b) 11 461 mm^2
c) 28 m^2 d) 99 m^2
2. a) Answers will vary. about 4800 mm^2
b) 5027 mm^2; Answers will vary.
3. 1.8 m
4. a) 1932.2 cm^2 b) $5.41
5. a) 514 718 540 km^2
b) Assumption: Earth is a sphere
6. a) 145 267 244 km^2
b) approximately 3.5 times greater
7. a) Answers will vary. Example: 10 800 cm^2. No; two jars will be required.
b) 11 310 cm^2
c) Answers will vary. Example: Yes; whether you use the approximate value or the exact value, two jars of reflective crystals are required to cover the gazing ball.
8. a) Answers will vary. Example: 750 cm^2
b) 804 cm^2 c) Answers will vary.
9. a) 

b) The radius must be greater than 0. As the radius increases, the surface area also increases in a non-linear pattern.
c) 360 cm^2; 2.5 cm
10. a) $r = \sqrt{\frac{SA}{4\pi}}$ b) 
c) The radius and the surface area must be greater than 0. The trend between the two variables is non-linear with the radius increasing as the surface area increases but at a slower rate.
d) 4 cm
11. The surface area has increased by a factor of nine.
$SA_{old} = 4\pi r^2$
$SA_{new} = 4\pi(3r)^2$
$= 4\pi(9r^2)$
$= 9(4\pi r^2)$
12. The cube with edge length $2r$.
13. a) Answers will vary. Example: $\frac{1}{2}$
b) surface area of sphere = 100π;
surface area of cube = 600; π:6
c) Answers will vary.
d) 1:1.91

8.7 Volume of a Sphere, pages 462–469

1. **a)** 11 994 cm^3 **b)** 137 258 mm^3 **c)** 5 m^3
2. 42 cm^3
3. 268 cm^3
4. **a)** 33 510 mm^3 **b)** 64 000 mm^3 **c)** 30 490 mm^3
5. **a)** 70.16 cm
b) Answers may vary. Example: The largest lollipop had the same mass per cubic centimetre as the small lollipop.
6. **a)** 113 097 cm^3 **b)** 169 646 cm^3 **c)** 2:3
d) Yes. When the sphere just fits inside the cylinder, $h = 2r$. So,

$$\frac{\text{Volume}_{\text{sphere}}}{\text{Volume}_{\text{cylinder}}} = \frac{\frac{4}{3}\pi r^3}{\pi r^2(2r)} = \frac{\frac{4}{3}\cancel{\pi r^3}}{2\cancel{\pi r^3}} = \frac{4}{3} \times \frac{1}{2} = \frac{2}{3}$$

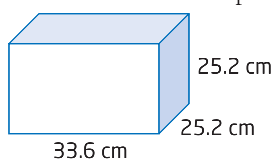
7. 258.86 cm^2
8. **a)** Answers will vary. **b)** 736 m^3
c) 588 m^3 **d)** 12 truckloads
9. 111 m^3
10. Answers will vary.
12. Estimates will vary. Actual radius is 5.23 cm.
13. **a)** 998.3 cm^3
b) 5.2 cm
14. by a factor of about 2.83
15. **a)** Estimates will vary. Example: 1:2
b) Volume of the sphere = 268 cm^3; Volume of the cube = 512 cm^3; π:6
c) Answers will vary.
16. the cube
17. Answers will vary.
18. B
19. 365.88 cm^3

Review, pages 470–471

1. **a)** perimeter 32.0 cm; area 43.1 cm^2
b) perimeter 28.4 cm; area 31.2 cm^2
2. 5.7 m
3. **a)** perimeter 28 m; area 48 m^2
b) perimeter 32.6 cm; area 61.8 cm^2
4. **a)** 401.1 m **b)** 463.9 m **c)** 62.8 m
5. **a)** 220 cm^2 **b)** 138 736 m^2
6. **a)** 6 510 000 cm^3
b) 256 024 cm^2
c) Answers will vary. Example: The side walls of the tent are flat.
d) Answers will vary. Example: The answer is fairly reasonable as when erecting a tent, you want the side walls to be as flat and stretched as possible.
7. 9.9 cm
8. 283 cm^2
9. 1458 cm^2
10. 3.1 cm
11. 670 cm^3; $\text{Volume}_{\text{Cone}} = \frac{1}{3} \times \text{Volume}_{\text{Cylinder}}$
12. 1493.0 cm^2
13. **a)** 257 359 270 km^2
b) Earth is a sphere.
c) Answers will vary. Example: about $\frac{1}{25}$.
14. 5806.5 cm^3
15. **a)** Answers will vary. Example: about 5200 cm^3
b) 5283.07 cm^3
c) Answers will vary.

Practise Test, pages 472–473

1. C
2. A
3. A
4. D
5. B
6. **a)** 213 cm^3 of wax
b) 236.3 cm^2; Assumption: No plastic cover is being overlapped.
7. Answers will vary. Example: 5080 cm^2 if the paper towels are stacked in three columns with two rolls in each column.
8. Doubling the radius of a sphere will increase the volume eight times. Doubling the radius of a cylinder will quadruple the volume.
9. 523 cm^2
10. 1047 m^3
11. **a)** 1396.5 cm^3 **b)** 776 cm^2 **c)** 55 cm^2
d) Answers will vary. Example: The circular lid covers the top of the cylindrical can with no side parts.
12. **a)** 465.5 cm **b)**



c) 10 165.3 cm^3 **d)** 4657 cm^2

Chapter 9

Get Ready, pages 476–477

1. **a)** 60 cm; 200 cm^2 **b)** 38 m; 76.56 m^2
2. **a)** 25.1 cm; 50.3 cm^2 **b)** 3.8 cm, 1.1 cm^2
3. **a)** 320 cm^3; 304 cm^2 **b)** 114.39 m^3; 143.54 m^2
4. **a)** 1847 cm^3; 836 cm^2 **b)** 314 m^3; 291 m^2
5. **a)** **i)** 3072 cm^3; 1280 cm^2 **ii)** 3072 cm^3; 1088 cm^2
b) Their volumes are equal.
c) The second container requires less material.
6. **a)** **i)** 2513 cm^3; 817 cm^2 **ii)** 2513 cm^3; 1084 cm^2
b) Their volumes are equal.
c) The first container requires less material.

9.1 Investigate Measurement Concepts, pages 478–483

1. a) the dimensions of various rectangles with a perimeter of 24 units

b) Answers will vary. Example:

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	11	24	11
2	2	10	24	20
3	3	9	24	27
4	4	8	24	32
5	5	7	24	35

2. a) the dimensions of various rectangles with a perimeter of 20 units using toothpicks

b) Answers will vary. Example: Begin with one toothpick as the width and nine toothpicks as the length. Then increase the width by one toothpick and decrease the length by the same amount to construct a series of rectangles with a perimeter of 20 units.

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	9	20	9
2	2	8	20	16
3	3	7	20	21
4	4	6	20	24
5	5	5	20	25

3. a) the dimensions of various rectangles with an area of 12 square units using a geoboard

b) Answers will vary. Example: Let the space between two pins be 1 unit and use an elastic band to make different rectangles with an area of 12 square units. Start with a width of 1 unit and increase by intervals of one, and find the necessary length.

Rectangle	Width (units)	Length (units)	Area (square units)	Perimeter (units)
1	1	12	12	26
2	2	6	12	16
3	3	4	12	14

4. a)

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	16	34	16
2	2	8	20	16
3	4	4	16	16

b) The greater the perimeter, the more expensive the shed; the smaller the perimeter, the lower the cost.

c) Rectangle 3 (a square) with dimensions 4 m by 4 m will be the most economical.

d) Answers will vary. Example: The quality of the material used to construct the shed and what will be stored in it.

5. A rectangle with dimensions 4 m by 4 m encloses the greatest area for the same amount of fencing.

6. 64 m^2

7. b) triangle: equilateral with each side 12 m, area 62.35 m^2
rectangle: each side 9 m, area 81 m^2
hexagon: each side 6 m, area 93.6 m^2
circle: radius of 5.73 m, area 103.15 m^2

c) Yes. Difference shapes allow for different areas. The greatest area can be achieved by using a circle.

9.2 Perimeter and Area Relationships of a Rectangle, pages 484–490

1. a) 5 m by 5 m **b)** 9 m by 9 m
c) 12.5 m by 12.5 m **d)** 20.75 m by 20.75 m

2. a Answers may vary. Example: 1 m by 2 m, 1.5 m by 1.5 m, 1.4 m by 1.6 m

b) 1.5 m by 1.5 m

3. a) 20.5 m by 20.5 m

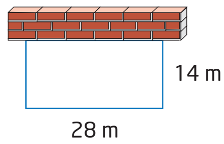
b) No. 20.5 m cannot be created using 2-m barriers.

c) 20.25 m^2

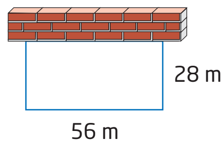
4. 8 m by 4 m

5. a) 196 m^2 **b)** 784 m^2

6. a) extra 196 m^2

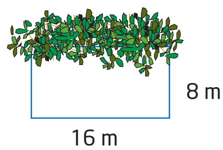


b) extra 789 m^2

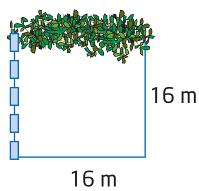


7. The greatest area, 400 m^2, is enclosed when the length and width are each 20 m.

8. 4 sides: a square with sides each 8 m; area 64 m^2
3 sides: a rectangle 8 m by 16 m; area: 128 m^2



2 sides: a square with sides 16 m; area: 256 m^2



9. a)

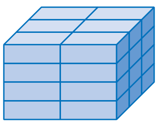
Rectangle	Width (m)	Length (m)	Area (m^2)	Fence Used (m)
1	1	72	72	74
2	2	36	72	40
3	3	24	72	30
4	4	18	72	26
5	5	14.4	72	24.4
6	6	12	72	24

b) 6 m by 12 m **c)** 24 m

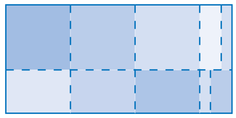
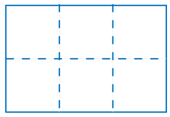
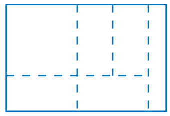
10.–11. Answers will vary.

13. 5.92 m by 5.92 m
14. 5 m by 10 m
15. an equilateral triangle with side length 17.3 cm
16. a square with side length 14.1 cm
17. Yes. A circle has greater area, 45.8 cm^2.
18. Each field is 41.7 m by 62.45 m.

9.3 Minimize the Surface Area of a Square-Based Prism, pages 491–497

1. B, C, A
2. **a)** 8 cm by 8 cm by 8 cm
   b) 10 cm by 10 cm by 10 cm
   c) 9.1 cm by 9.1 cm by 9.1 cm
   d) 10.6 cm × 10.6 cm × 10.6 cm
3. **a)** 384 cm^2 **b)** 600 cm^2 **c)** 497 cm^2 **d)** 674 cm^2
4. cube with side length 14.7 cm
5. **a)** 15.9 cm by 15.9 cm by 15.9 cm
   b) Answers will vary.
6. **a)** 9.09 cm by 9.09 cm by 9.09 cm
   b) 495.8 cm^2
7. 1110 cm^2
8. **a)** 17.1 cm by 17.1 cm by 8.5 cm
   b) different
   c) The lidless box requires less material.
9. **a)** cube with side length 5.8 cm
   b) Answers will vary. Example: Cubical boxes are harder to hold and the cube would be very small.
   c) Answers will vary.
10. Answers will vary.
11. Try to get the square-based prism to be as close to a cube in shape as possible. The dimensions are 5 by 5 by 4.
12. **a)**

   b) This is the closest that 24 boxes can be stacked to form a cube.
   c) Answers will vary. Example: No. A cube can be created to package 6 tissue boxes: length 1 box (1 × 24 cm), width 2 boxes (2 × 12 cm), and height 3 boxes (3 × 8 cm).
13. 12.6 m by 12.6 m by 6.3 m; surface area 476.22 m^2
14. 23 760 cm^2
15. 1206.7 cm^2

9.4 Maximize the Volume of a Square-Based Prism, pages 498–503

1. B, C, A
2. **a)** 5 cm by 5 cm by 5 cm
   b) 20 m by 20 m by 20 m
   c) 11.2 cm by 11.2 cm by 11.2 cm
   d) 14.1 m by 14.1 m by 14.1 m
3. **a)** 125 cm^3 **b)** 8000 m^3
   c) 1405 cm^3 **d)** 2803 m^3
4. 10.8 cm by 10.8 cm by 10.8 cm
5. **a)** 2016 cm^2; 5184 cm^3
   b) 18.3 cm by 18.3 cm by 18.3 cm
   c) 6128 cm^3
6. **a)** 6.72 m^2; 1.152 m^3
   b) 1.1 m by 1.1 m by 1.1 m
   c) 1.331 m^3
7. **a)** 1.4 m by 1.4 m by 1.4 m **b)** 3 m^3
8. **a)** 20.4 cm by 20.4 cm by 20.4 cm
   b) 8490 cm^3 **c)** 7790 cm^3
   d) Answers will vary. There is no empty space in the box. The DVD would fit into the cube with enough room around the edges for the shredded paper. The shredded paper is tightly packed.
10. **a)** 69.3 cm by 69.3 cm by 69.3 cm
   b)

   Diagrams will vary.
   c) Answers will vary. Assume that Dylan cuts the wood carefully to not waste any pieces.
11. **a)**

   b) 1000 cm^3
   c) Answers will vary.

   d) 1185.2 cm^3
   e) Answers will vary. Example: No loss due to cuts.

9.5 Maximize the Volume of a Cylinder, pages 504–509

1. **a)** h = 15.96 cm, r = 7.98 cm
   b) h = 1.46 m, r = 0.73 m
   c) h = 5.16 cm, r = 2.58 cm
   d) h = 36.86 mm, r = 18.43 mm
2. **a)** 3193 cm^3 **b)** 2 m^3
   c) 108 cm^3 **d)** 39 333 mm^3
3. 2 m^3
4. **a)** r = 2.0 m, h = 4.0 m **b)** 50 265 L
   c) Answers will vary. Example: no metal will be wasted in the building process, no metal is being overlapped
5. **a)** 12 cm
   b) 60 CDs
   c) Answers will vary. Example: only the dimensions of the CDs need to be considere; no extra space is left for the container's closing mechanism, the plastic container has no thickness.
6. **a)** Answers will vary. Example: Adjust the surface area formula for the new cylinder, isolate the height and run a few trials using a spreadsheet to find the maximum volume.
   b) h = 7.3 cm, r = 7.3 cm
7. **a)** Answers will vary.
   b) cylinder: r = 11.28 cm, volume 9018 cm^3; square-based prism: s = 20 cm, volume 8000 cm^3

8. **a)** Answers will vary.
   b) sphere: $r = 12.62$ cm; cylinder: $r = 10.30$ cm, $h = 20.60$ cm, ; square-based prism: $s = 18.26$ cm
   c) sphere 8419.1 cm^3; cylinder 6865.8 cm^3; square-based prism 6088.4 cm^3
   d) The sphere has the greatest volume. Yes, this will always be the case.
   e) For a given surface area:
   volume of a sphere > volume a cylinder > volume of a square-based prism
9. **a)** $r = 0.33$ m, $h = 0.63$ m
   b) $r = 0.46$ m, $h = 0.46$ m
10. $r = 6.53$ cm, $h = 9.24$ cm

9.6 Minimize the Surface Area of a Cylinder, pages 510–515

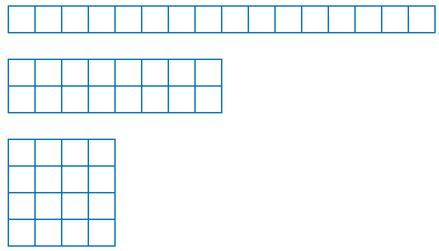
1. **a)** $r = 5.8$ cm, $h = 11.6$ cm
   b) $r = 0.5$ m, $h = 1.0$ m
   c) $r = 3.3$ cm, $h = 6.6$ cm
   d) $r = 0.9$ cm, $h = 1.8$ cm
2. **a)** 634 cm^2 **b)** 5 m^2
   c) 205 cm^2 **d)** 15 m^2
3. $r = 4.4$ cm, $h = 8.8$ cm
4. **a)** $r = 9.3$ cm, $h = 18.6$ cm
   b) Answers will vary. Example: No extra material will be needed to enclose the volume.
5. $r = 12.4$ cm, $h = 24.8$ cm
6. **a)** $r = 3.9$ cm, $h = 7.8$ cm
   b) $3.44
7. Answers will vary. Example: It is not always practical to use cylinders with the optimum volume. They may be harder to use, to handle, to carry, or to store.
8. A cylinder will have a surface area of 349 cm^2, and a cube will have a surface area of 378 cm^2. A cylinder is more cost efficient.
9. No, because the cylindrical shape is taller than its diameter. However, there is a large glass area which would encourage solar heating.
11. **a)** $r = 7.8$ cm, $h = 7.8$ cm
   b) 576 cm^2
   c) Answers will vary. Example: The only cardboard needed is used to enclose the required volume so there is no wastage.
12. **a)** Answers will vary.
   b) prism 600 cm^2, cylinder 553.7 cm^2, sphere 483.1 cm^2; The sphere has the least surface area.
13. a sphere with volume 20 183 cm^3
14. $s = 26.67$ cm, $h = 10$ cm
15. $r = 4.24$ cm, $h = 11.95$ cm
16. $r = 6.91$ cm, $h = 19.54$ cm

Review, pages 516–517

1. **a)**

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	19	40	19
2	2	18	40	36
3	3	17	40	51
4	4	16	40	64
5	5	15	40	75
6	6	14	40	84
7	7	13	40	91
8	8	12	40	96
9	9	11	40	99
10	10	10	40	100

   b) 10 possible rectangles when the side measurements are integers
   c) 10 by 10 because it has the greatest area
2. **a)**



   b)

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	16	34	16
2	2	8	20	16
3	4	4	16	16

   c) 4 m by 4 m because for the same enclosed area, it has the least perimeter. Thus, fewer edging bricks will be required.
3. 1 m by 1 m
4. **a)** 900 m^2 **b)** 1800 m^2
5. **a)** 42.4 m by 42.4 m
   b) Answers will vary. Example: A square ice rink may not be best as people want longer straight paths to gain speed.
6. 9.6 cm by 9.6 cm by 9.6 cm
7. **a)** 10 cm by 10 cm by 10 cm
   b) Answers will vary. Example: The surface area of a cylinder that contains the same volume will be less than the surface area of the box. The manufacturer could save on packaging costs.
8. 1244 cm^2
9. 0.58 m by 0.58 m by 0.58 m
10. 14.1 cm by 14.1 cm by 14.1 cm
11. It is not possible to cut six 14.1 cm by 14.1 cm pieces from a 60 cm by 20 cm piece of cardboard because only four such pieces fit.
12. $r = 6.18$ cm, $h = 12.36$ cm, volume 1483 cm^3

13. Change the formula in the height column from =(D2-2*PI()*A2^2)/(2*PI()*A2) to =(D2-PI()*A2^2)/(2*PI()*A2). The mathematical formula for finding the height changes from

$$h = \frac{SA - 2\pi r^2}{2\pi r} \text{ to } h = \frac{SA - \pi r^2}{2\pi r}.$$

14. Answers will vary. Example: A cylinder will have a greater volume using the same amount of cardboard but the square-based prism may be easier for customers to store.

15. **a)** 300.53 cm^2, when $r = 3.99$ cm, $h = 8.00$ cm
b) Answers will vary. Example: There is no waste while making the pop can.

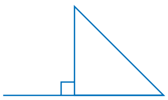
16. **a)** 61 CDs **b)** No extra space is allowed.
c) 701.4 cm^2

Practice Test, pages 518–519

1. B
2. D
3. B
4. A
5. 50 cm by 50 cm
6. Their volumes are equal but the cylinder requires less material to make.
7. **a)** 17.1 cm by 17.1 cm by 17.1 cm
b) Answers will vary. Example: No material is overlapped, no extra material is required for sealing purposes.
8. **a)** 1.2 m by 1.2 m by 1.2 m
b) 1.728 m^3
c) 0.69 m by 0.69 m by 0.69 m
d) The three small bins have a total volume of 0.99 m^3, which is less than the one large box.
9. $r = 18.53$ m, $h = 18.54$ m
10. 1.2 m by 1.2 m by 0.5 m

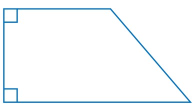
Chapters 7 to 9 Review, pages 520–521

1. **a)** $a = 68°$, $b = 60°$
b) $x = 45°$, $y = 135°$, $z = 135°$
2. **a)** $p = 90°$, $q = 65°$, $r = 115°$
b) $b = 75°$, $c = 30°$, $d = 100°$
3. **a)**

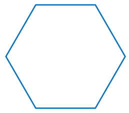


b) Each exterior angle and its adjacent interior angle have a sum of 180°. Thus an exterior right angle has an adjacent interior right angle. This cannot occur in a triangle because two right interior angles have a sum of 180°, leaving no room for the triangle's third angle.
c)

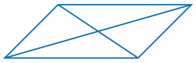
d)



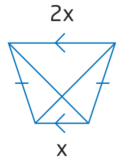
4. **a)** 10 **b)** 360°
5. **a)**



b) Answers will vary.
6. Yes.
7. **a)** False.



b) True. The line joining the midpoints of two sides of a triangle is always parallel to the third side.
c) False.



8. **a)** 13.9 m, 8.1 m^2
b) 60.3 cm, 155.7 cm^2
9. 20 m, 18.56 m^2
10. **a)** 48.3 m^2, 15.6 m^3
b) 2425 cm^2, 4583.3 cm^3
11. 8.0 cm
12. **a)** 108 cm^2
b) 75 cm^3
13. **a)** 33 510 mm^3
b) 5027 mm^2
c) The entire surface of a golf ball is covered with small indentations (commonly known as dimples). Due to the presence of dimples, the actual surface area of the golf ball is greater and the volume of the golf ball is less than that calculated in parts a) and b).
14. **a)** 6.5 m by 6.5 m
b) 42.25 m^2
c) 26 m
15. 2774 cm^2
16. **a)** 5 cm by 5 cm by 5 cm
b) radius 2.8 cm, height 5.6 cm
17. 293 cm^2