Answers

Chapter 1

1.1 SI Measurement, pages 15 to 21

1. a) Example: Use a fingernail width as a referent for 1 cm.
- **i)** 18 fingernail widths (18 cm)
- **ii)** 23 fingernail widths (23 cm)

b) Example:
- **i)** 18.6 cm
- **ii)** 25 cm. It is not necessary to measure all sides. Opposite sides are equal, and subtraction can be used to calculate some of the smaller sides.

2. a) i) Example: Using a fingernail width as a referent for 10 mm, the curve of the S could be about $2\frac{1}{2}$ fingernail widths.

ii) Example: Using a hand width as a referent for 10 cm, the curve of the S could be about 2 hand widths.

b) Use a piece of string and lay it down along the shape of the letter, and then measure the string.

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

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

5. a) No. Mountain heights are usually reported in metres. 5959 m

b) No. Centimetres are commonly used for distances about as wide as a hand. 6.4 cm

c) No. Metres would be more appropriate for something about twice the height of a person. 4.2 m

d) No. Metres or centimetres are commonly used for distances about the height of a person. 1.95 m or 195 cm

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

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

8. Example: 159 mm

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

10. 1.4 m

11. a) dime: 17.79 mm
quarter: 23.59 mm

b) $17.79 : 23.59 \approx 1 : 1.3$

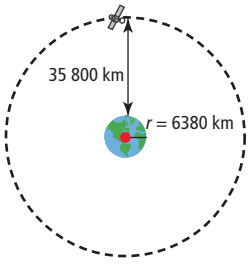
c) Example: 31.28 mm. The actual diameter of a loonie is 26.5 mm. The ratio does not apply. Also, the penny and nickel are bigger in size than the dime yet worth less. The size of the coin does not indicate its value.

12. a) 1 : 6 250 000

b) 475 km

c) Example: from Virginia Falls: 250 km; from Rabbitkettle Lake: 338 km. The distance is 88 km greater from Rabbitkettle Lake.

13. a)



b) 40 086.7 km

c) 265 024.8 km **d)** 9372.4 km/h faster

14. a) Example: Use a fingernail width as a referent for 1 cm: 10 cm by 1.5 cm by 5 cm

b) front face: 22.4 cm; side face: 12.2 cm; top face: 28.6 cm. Three perimeters were calculated because opposite faces are the same. There are six faces in total.

c) 293 mm

15. 230 m

16. a) 442.5 m

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

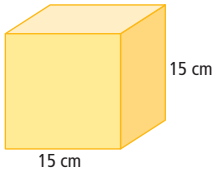
17. 15.9 cm

18. a) about 1 m or 100 cm

c) Example: The bandage will stretch more if pulled tight, and as well, there will be some overlapping of the bandage.

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

b)



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

20. a) Example: Measuring down the inside of a pan, across the bottom, and up the other side gives 36.8 cm. Inside surface area is 338.56π cm^2; measuring according to the formula gives $d = 30$ cm and $h = 6.0$ cm. $S = 405\pi$ cm^2; the factory formula yields a surface area that is too large, since the formula does not take into account the curved nature of most frying pans.

b) No. Since d is the diameter of the entire pan, including the distance the sloping side adds to the flat bottom dimension, the formula will produce an area that is too large unless the side of the pan is perfectly vertical.

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

1.2 Imperial Measurement, pages 29 to 35

1. a) $\frac{1}{16}$ in. **b)** $\frac{1}{40}$ in.; 0.025 in.

c) $\frac{1}{1000}$ in.; 0.001 in.

2. a) $13\frac{1}{2}$ in. **b)** $\frac{3}{4}$ yd

c) 76 mi **d)** 15 840 ft

3. Example:

a) $1\frac{7}{8}$ in.; length of an eraser

b) 3.154 in.; width of a calculator

c) 0.593 in.; diameter of a penny

4. Example:

a) a caliper; $\frac{5}{16}$ in. **b)** a string; 1 in.

c) a ruler; $5\frac{7}{8}$ in.

5. Example:

a) $4\frac{3}{4}$ small paper clips; $5\frac{1}{4}$ in.

b) $6\frac{3}{4}$ paper clips; 7 in.

6. a) Example: Use one large step as a referent for 3 ft.

b) Example: Use the length of your calculator as a referent for 6 in.

7. a) 6.25 mph **b)** 9.6 min

8. 183.4 in.

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

b) about 119 **c)** about 1261

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

11. a) Example: No. Gail calculated (7.5)(5) = 37.5 ft^2, but 0.5 ft^2 ≠ 5 in^2. 1 ft^2 = (12 in.)(12 in.) = 144 in.^{2}, so 0.5 ft^2 = 72 in.^{2}.

b) 75 tiles

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

c) Example: 10 in.

13. a) Example: about 1000 yd. The direct distance on the map from the captain to the cache is about $2\frac{1}{2}$ in. The distance on the map along the route taken is about 5 in.

b) 950 yd or 2850 ft. The actual distance is farther since the paths between the red dots are not straight.

14. a) 19 ft 1 in.

b) 62 ft: 19 ft 9 in.; 65 ft: 20 ft 8 in.; 70 ft: 22 ft 3 in.

c) The 62 ft length would add approximately 4 in. all around the circumference of the pool.

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

b) 112 774 083 mi

16. a) Any pairs of corresponding sides.

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

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

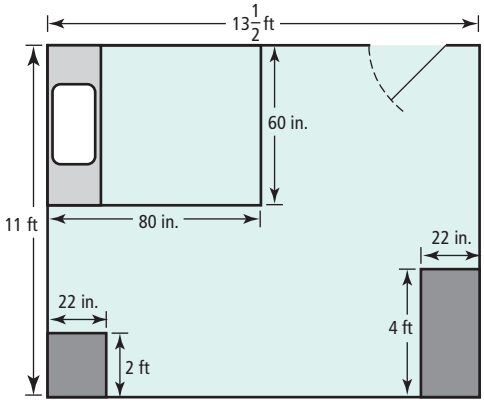
$AB:DE = \frac{9}{16}:1 = 1:1.8$

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

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

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

b) Example:



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

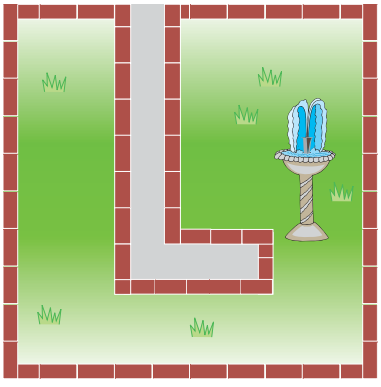
18. a) 14 ft

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

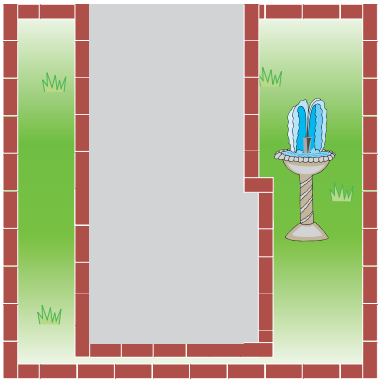
19. a) Example: 15 in. Each side looks to be about 2.5 in. and the border around the pathway looks to be about the same as the length of two sides.

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

c) Perimeter is 11.75 in.



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



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

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

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

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

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

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

b) Example: 5 hand spans

c) Example: 24 in. or 60 cm

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

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

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

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

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

6. a) 63 mm; $2\frac{1}{2}$ in. **b)** $2\frac{5}{16}$ in.; 5.87 cm

c) 1.536 in.; 3.901 cm **d)** 4.78 cm; 1.9 in.

7. a) $45\frac{1}{2}$ ft or 45 ft 6 in.

b) 13.87 m. Usually, measurements greater than 200 or 300 cm are reported using metres.

8. 175 km

9. a) metres to kilometres: divide by 1000; metres to centimetres: multiply by 100; yards to miles: divide by 1760

b) In a length conversion, if the unit gets larger, the number must get smaller. Therefore, divide by the conversion factor to get a smaller number of the larger units. This works in either system, because a smaller number of larger units are required for the equivalent length.

c) If the units get smaller, the number must get larger. Therefore, multiply by the conversion factor to get more of the smaller units.

10. Multiply the number of kilometres by $\frac{5}{8}$.

Since 164 km ≈ 103 mi, Penny travelled a greater distance.

11. Lake Baikal: 1636 m; Great Slave Lake: 614 m; Great Slave Lake is 108 m deeper than Quesnel Lake

12. about 3951 mi

13. a) $41\frac{3}{4}$ in.

b) Example: Using the SI measurements given, calculate the perimeter taking advantage of equal distances, then convert to inches. This way, you only have to do one conversion instead of many, which would make your answer less accurate.

14. a) 1667 LPs. Example: $\frac{20\,000}{10} = 2000$ LPs

b) 185.2 in. or 15 ft $5\frac{3}{16}$ in.; 9400 : 183 or 51.4 : 1

15. a) 24 blocks

b) 63 in. by $47\frac{1}{4}$ in. by $15\frac{3}{4}$ in.

c) 32 extra blocks. Example: Each length and each width will be increased by 2 units. So, 1 extra block is needed on each side. (2)(4) = 8 more blocks than for the inside wall. 24 + 8 = 32

16. a) Example: 234 m^2

b) This formula will work for imperial units, as long as the imperial units are converted to decimals. For example, 6 ft 6 in. = 6.5 ft.

17. a) Example: SI: distances between towns, distances in Olympic events, thickness of plastic sheeting. Imperial: dimensions of building materials, distances between towns in the United States, dimensions of paper

b) Approximate: distances between towns, distances between towns in the United States. Exact: distances in Olympic events, thickness of plastic sheeting, dimensions of building materials, dimensions of paper stock

18. Example: 144 in.: $144 \text{ in.}\left(\frac{1 \text{ yd}}{36 \text{ in.}}\right) = 4$ yd;

$4 \text{ yd}\left(\frac{0.9144 \text{ m}}{1 \text{ yd}}\right) = 3.6576$ m

Chapter 1 Review, pages 48 to 50

1. Example: Use a string to follow the curve of the object or, if possible, roll the object across a surface one rotation and measure the distance travelled.

2. 5.7 cm

3. 2.46 cm

4. 62.8 cm; 285.8 cm^2

5. Example: 46.7 cm

6. b) Use a string to trace out the S shape, then measure the length of the string.

7. D = $6\frac{3}{4}$ in.; distance from C to D is $2\frac{9}{16}$ in.

You could count by $\frac{1}{16}$ or subtract the reading at C from the reading at D.

8. a) 5.356 in.

b) 5.121 in. The perimeter of the triangle is smaller because the triangle can be drawn inside the quarter circle. The shortest distance between two points is a straight line, not a curve.

9. a) $2\frac{1}{4}$ in. by $4\frac{1}{2}$ in.

b) Scale factor is 1.78 to fit the height. The width will need to be cropped, as the scale factor for the width is smaller than that of the height.

10. a) 256 mi **b)** 83 ft

11. Approximation, because 8 ft $11\frac{1}{10}$ in.

= 2.72034 m. The stated height of 2.7 m is shorter by a little more than 2 cm.

12. Example: About 2.6 times as tall with head down. About 63.75 in. tall with head up. This could be stated as 5 ft $3\frac{3}{4}$ in. Most heights are given this way.

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

Chapter 1 Practice Test, pages 51 to 53

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

The conversion factor for SI units of volume is found by raising the conversion factor from the smaller unit to the larger unit, to the power of 3. This result is the power of 10 to be used when dividing. The same method is used when converting from larger to smaller units, except for multiplying by the power of 10.

a) 1 000 000 cm^3
b) 0.000 355 m^3
c) 2 500 000 000 mm^3

12. **a)** 80 586 ft^2
b) 7487 m^2
c) 0.7487 ha
14. Example: architect, draftsperson, mechanic, carpenter, electrician, grocer, tile layer, plumber, engineer
16. Example: There may be a need for conversions in the meat, deli, and produce department. Some customers may still think in imperial measurements when purchasing a mass of meat, cheese, vegetables, or fruit.