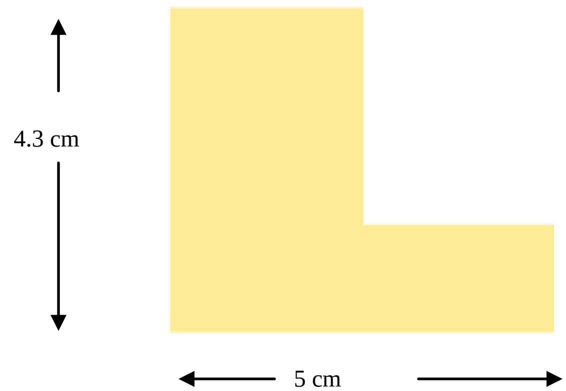
Chapter 1 Measurement Systems

Section 1.1 SI Measurement

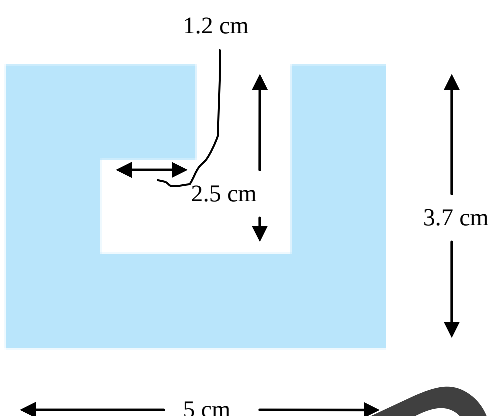
Section 1.1 Page 15 Question 1

a) Estimates may vary. Examples:
i) 20 cm **ii)** 26 cm

b) i) 18.6 cm **ii)** 24.8 cm
It is not necessary to measure all sides, because opposite pairs of sides occupy the same distance.
In part i) the perimeter is 2 × width + 2 × height. This is 2(5) + 2(4.3), or 18.6 cm.



Part ii) has some extra edges because of the "L-shaped" cut out. Its perimeter can be found as 2(5) + 2(3.7) + 2(2.5) + 2(1.2), which gives 24.8 cm.

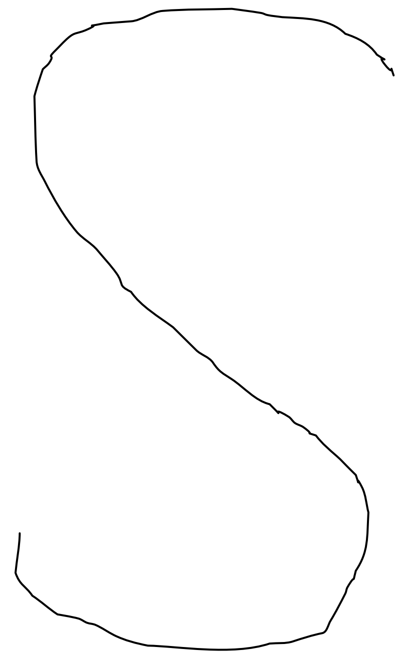


Section 1.1 Page 16 Question 2

a) Drawings may vary. Examples:

i)

ii)



b) You could use a length of thin string, placed on each letter S, to measure part i) to be 25 mm and part ii) to be 20 cm.

Section 1.1 Page 16 Question 3

a) 72 mm, 7.2 cm **b)** 18.4 mm, 1.84 cm **c)** 34.4 mm, 3.44 cm

Section 1.1 Page 16 Question 4

a) The length of Ares V in the photo is 10.5 cm. Since the scale is 1:1000, the actual length is 1000 times the measure in the photo.
Actual length is (1000)(10.5) cm, or 105 m. (using 100 cm = 1 m)

b) Assume that the two smaller cylinders are the solid-rocket boosters.
The diameter on the photo is approximately 0.3 cm.
The actual diameter will be (1000)(0.3) cm, or approximately 3 m.

Section 1.1 Page 17 Question 5

a) No. Mountain heights are usually expressed in metres. Since 100 cm = 1 m, the height of Mount Logan is $\frac{595\ 900}{100}$, or 5959 m.

b) No. It is hard to visualize 0.064 m. A water bottle is fairly small so the diameter would usually be expressed in centimetres.
The diameter of the water bottle is (0.064)(100), or 6.4 cm.

c) No. Millimetres are used to measure very small things. It is much more likely that the height of a bear, like the height of a person, would be expressed in centimetres or in metres.

Since 10 mm = 1 cm, the height of the tallest bear is $\frac{4200}{10}$, or 420 cm. In metres, this height is 4.2 m.

d) No. Kilometres are used to measure large distances. The wingspan of a whooping crane is more likely to be measured in metres or perhaps in centimetres.
Since 1000 m = 1 km, the wingspan is 0.001 95(1000), or 1.95 m. This wingspan might also be expressed in centimetres, as 195 cm.

Section 1.1 Page 16 Question 6

a) The circular track is made by joining 12 pieces, each measuring 32 cm on the inside. The circumference of the inside of the track is 12(32), or 384 cm. The toy train will travel 384 cm, or 3.84 m, along the inside of the track.

b) Use the formula for circumference to find the radius.

$$\begin{aligned} C &= 2\pi r \\ 384 &= 2\pi r \\ \frac{384}{2\pi} &= r \\ 61.1154... &= r \end{aligned}$$

The radius of the inside edge of the track is 61.1 cm or 611 mm, to the nearest millimetre.
c) Example: In the diagram 4 cm represents approximately 32 cm. So, the scale is about $1:8$. The width of the track on the diagram is about 0.5 cm. So, the actual width of the track is approximately 4 cm.
Then, the radius of the outside edge of the track is about 65 cm.

Section 1.1 Page 17 Question 7

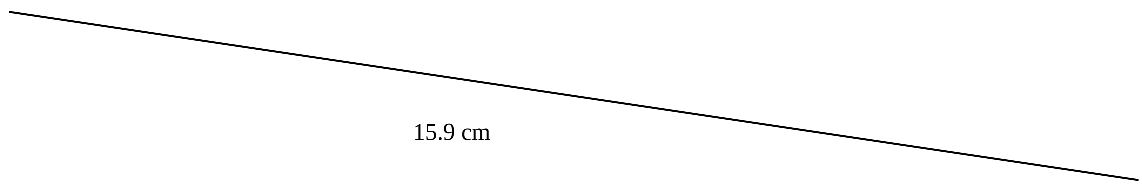
Examples: Cloth or paper tape measures are used in sewing, steel tape measure is used to measure rooms for decorating and in construction projects, ruler is used for smaller crafts such as knitting and cooking, special gauges are used in special applications such as to measure diameter of nails and wire.

Section 1.1 Page 17 Question 8

Use the formula to find the radius that gives a circumference of 1 m. Work in centimetres.

$$C = 2\pi r$$
$$100 = 2\pi r$$
$$\frac{100}{2\pi} = r$$
$$15.915... = r$$

A trundle wheel that travels 1 m in one turn has a radius of 15.9 cm or 159 mm, to the nearest millimetre.



Section 1.1 Page 17 Question 9

The photograph of the dogs measures 8 cm by 5 cm. Its width to height ratio is $\frac{8}{5}$ or 1.6.

The yellow rectangle measures 5 cm by 2.5 cm. Its length is double its width. So the photograph cannot be reduced proportionally to fill this rectangle.

Section 1.1 Page 18 Question 10

The height of the person standing in the photo is 2.3 cm.
The height of the inukshuk, in the photo, is 6.6 cm.
Let x represent the actual height of the person.
Use proportional reasoning. Work with measures in centimetres.

$$\frac{\text{actual height of person}}{\text{actual height of inukshuk}} = \frac{\text{height of person in photo}}{\text{height of inukshuk in photo}}$$
$$\frac{x}{410} = \frac{2.3}{6.6}$$
$$x = \frac{(410)(2.3)}{6.6}$$
$$x = 142.878...$$

The height of the person standing is approximately 142.9 cm, or 1.4 m to the nearest tenth of a metre.

Section 1.1 Page 18 Question 11

These measures were obtained using a ruler. If you have SI calipers available you will get better accuracy, as in the text answers.

a) The diameter of a Canadian dime is approximately 1.8 cm.
The diameter of a Canadian quarter is approximately 2.4 cm.

b) $\dfrac{\text{diameter of dime}}{\text{diameter of quarter}} = \dfrac{1.8}{2.4}$

$\dfrac{\text{diameter of dime}}{\text{diameter of quarter}} \approx \dfrac{1}{1.333...}$

The ratio of the diameters is approximately 1 : 1.3.

c) Let x represent the diameter of the loonie.
Use proportional reasoning.

$$\begin{aligned}\frac{\text{diameter of quarter}}{\text{diameter of loonie}} &= \frac{1}{1.3}\\ \frac{2.3}{x} &= \frac{1}{1.3}\\ \frac{(2.3)(1.3)}{1} &= x\\ 2.99 &= x\end{aligned}$$

If the ratios were the same, the diameter of a loonie would be approximately 3 cm. This is not correct. The measured diameter of an actual loonie is approximately 2.6 cm.

Section 1.1 Page 18 Question 12

a) The scale bar measures approximately 0.8 cm.
So, 0.8 cm represents 50 km. Express both measures in the same units to write a ratio.

$$\begin{aligned}\text{Scale ratio} &= 0.8 : 50(1000)(100)\\ &= 0.8 : 5\,000\,000\\ &= 1 : \frac{5\,000\,000}{0.8}\\ &= 1 : 6\,250\,000\end{aligned}$$

The scale ratio of the map, in lowest terms, is 1: 6 250 000.

b) Estimate of direct distance from Fort Simpson to Moose Ponds is 500 km.
The measured distance on the map is 7.6 cm. Use the scale from part a) to find the actual distance.
7.6(6 250 000) = 47 500 000
Change this distance, which is in centimetres, to kilometres.

$$\begin{aligned}\text{Actual distance} &= \frac{47\ 500\ 000}{(100)(1000)}\\ &= 475\end{aligned}$$

The actual direct distance from Fort Simpson to Moose Ponds is approximately 475 km.

c) From Virginia Falls to Fort Simpson, map distance is 4 cm.

$$\begin{aligned}\text{Actual distance} &= \frac{4(6\ 250\ 000)}{(100)(1000)}\\ &= 250\end{aligned}$$

The direct distance from Virginia Falls to Fort Simpson is 250 km.

From Rabbitkettle Lake to Fort Simpson, map distance is 5.4 cm.

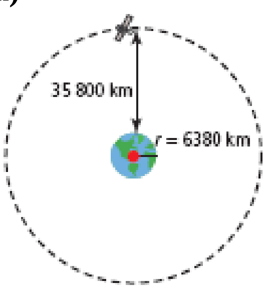
$$\begin{aligned}\text{Actual distance} &= \frac{5.4(6\ 250\ 000)}{(100)(1000)}\\ &= 337.5\end{aligned}$$

The direct distance from Rabbitkettle Lake to Fort Simpson is 338 km.

So, the distance from Rabbitkettle Lake to Fort Simpson is 338 – 250, or 88 km greater than the distance from Virginia Falls to Fort Simpson.

Section 1.1 Page 19 Question 13

a)



b) Use the formula to find the circumference of Earth at the equator.
$C = 2\pi r$
$C = 2\pi(6380)$
$C \approx 40\ 086.7$
An observer on the equator travels 40 086.7 km in one day due to Earth's rotation.

c) Use the formula to find the circumference of one circular path of the satellite. The radius of its path will be 35 800 + 6380, or 42 180 km.

$C = 2\pi r$
$C = 2\pi(42\ 180)$
$C \approx 265\ 024.8$

The satellite would travel 265 024.8 km in one day to appear stationary above an observer on the equator.

d) Velocity of observer $= \dfrac{40\ 086.7}{24}$

≈ 1670.3

Velocity of satellite $= \dfrac{265\ 024.8}{24}$

$\approx 11\ 042.7$

The satellite is travelling 11 042.7 – 1670.3, or 9372.4 km/h faster.

Section 1.1 Page 19 Question 14

Examples:

a) The width of my little fingernail is about 1 cm and the width of my palm is about 8 cm. Using these as a referents, estimates for the dimensions of the cassette case are: length 10 cm, width 5 cm, depth 1.5 cm

b) Three pairs of opposite faces of the cassette case are the same.
For the top and bottom faces: length 9.7 cm, width 4.6 cm

$$\begin{aligned}\text{Perimeter} &= 2(9.7) + 2(4.6)\\ &= 28.6\end{aligned}$$

The perimeter of the top face (and of the bottom face) is 28.6 cm.

For the front and back faces: length 9.7 cm, depth 1.5 cm

$$\begin{aligned}\text{Perimeter} &= 2(9.7) + 2(1.5)\\ &= 22.4\end{aligned}$$

The perimeter of the front face (and of the back face) is 22.4 cm.

For the side faces: width 4.6 cm, depth 1.5 cm

$$\begin{aligned}\text{Perimeter} &= 2(4.6) + 2(1.5)\\ &= 12.2\end{aligned}$$

The perimeter of the left side face (and of the right side face) is 12.2 cm.

c) The diameter of the LP appears to be slightly less than double the diameter of the 45 record. An estimate for the diameter of the LP is 32 cm.

On the photograph, the diameter of the 45 record measures 2.75 cm. The diameter of the LP measures 4.5 cm.
Use proportional reasoning to find the actual diameter of the LP.
Let *d* represent the diameter of the LP in centimetres.

$$\frac{d}{4.6} = \frac{17.5}{2.75}$$
$$d = \frac{(4.6)(17.5)}{2.75}$$
$$d = 29.272...$$

The actual diameter of an LP is 29.3 cm, or 293 mm.

Section 1.1 Page 20 Question 15

Example: In a ratio, both terms are in the same units. Choose centimetres.
Scale of aerial photo = camera's focal length: airplane's altitude
= 4.5 : 305(100)
= 9 : 61 000
In the photo, the greatest distance across the crater is 3.5 cm.
Use proportional reasoning to find the diameter of the actual crater.
Let *d* represent the actual diameter in metres.

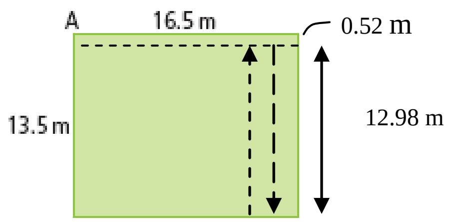
$$\frac{3.5}{d} = \frac{9}{61\ 000}$$
$$\frac{3.5(61\ 000)}{9} = d$$
$$d = 23\ 722.222...$$

The greatest distance across the actual crater is 23 722 cm or approximately 237 m.

Section 1.1 Page 20 Question 16

Consider walking across 16.5 m from A, turning and walking back across towards A.
Each width cut is 52 cm, so the number of walks across is $\frac{13.5}{0.52}$, which is 26 strips to the nearest whole number. This is an even number, so to return to A you would need to add one extra distance of 13.5 m from the bottom corner back up to A.
Distance = 16.5(26) + 13.5
= 442.5
The distance walked cutting the grass this way is 442.5 m.

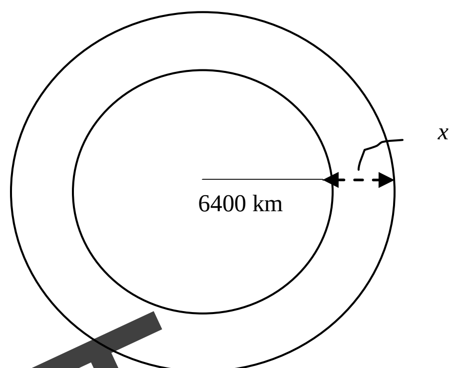
b) Your route does affect the distance walked. In the method in part a), there is extra walking to get back to A. It is better to end up as close to A as possible.
If you cut once across 16.5 m from A, then the remaining rectangle measures 16.5 m by 12.98 m. Turn 90º and cut the remaining grass up and down. The number of up and downs is $\frac{16.5}{0.52}$, which is 32 walks to the nearest whole number. However, since this is an even number, you will end up close to A and only need to walk 0.52 m farther to get back to A.



Distance = 16.5 + 12.98(32) + 0.52
= 432.38
Using this route, the distance walked is 432. 4 m.

Section 1.1 Page 20 Question 17

Let x represent the unknown distance in metres.
Find the circumference of Earth, in metres.
$C = 2\pi r$
$C = 2\pi(6400)(1000)$
$C = 40\ 212\ 385.97\ldots$
The circumference of Earth is about 40 212 385.97 m.



If the band around Earth is 1 m longer, it will have circumference 40 212 386.97 m.
Determine what radius gives this circumference.

$$C = 2\pi r$$
$$\frac{40\ 212\ 386.97}{2\pi} = r$$
$$6\ 400\ 000.159 = r$$

The radius of the band is 0.159 m greater than the radius of Earth.
The band is 0.159 m, or 15.9 cm above the surface of Earth.

Section 1.1 Page 20 Question 18

Examples:

a) An estimate is 4 times 40 cm, or 160 cm.

b) The actual measure is 48 cm, which gives a length of bandage of 192 cm. My estimate was a bit low.

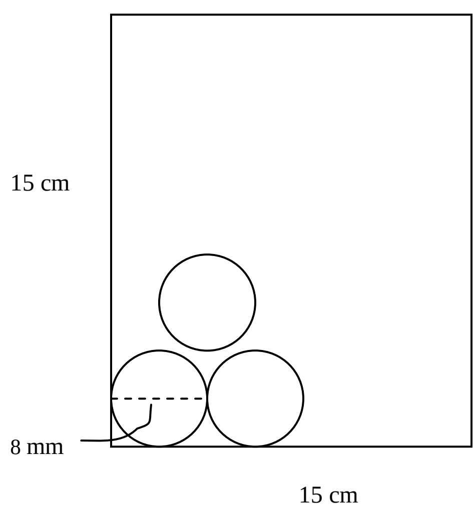
c) There is twice the distance from the ankle to the instep not accounted for in Darwin's method.

Section 1.1 Page 21 Question 19

Examples:

a) I estimate that 20 rows of 20, or 400 tubes, will fit.

b)



c) The number of tubes across the bottom row is 15 cm ÷ 8 mm.

$$\frac{15}{0.8} = 18.75$$

Since there cannot be part of a tube, 18 tubes will fit across the bottom.
However, since the tubes in the next row will sit slightly in between two tubes below, more than 18 rows will fit. It is fairly certain that 20 rows will fit.
The number of tubes that will fit in the nesting box is 18(20) or 360.

You could check this by drawing a square 15 cm by 15 cm. Then, use a circle template with radius 8 mm and fill the square as much a possible.

Section 1.1 Page 21 Question 20

Examples:

a) Diameter is 30 cm across the top. Diameter of base circle is 26 cm. Depth is 6 cm. To find its inner surface area, calculate the area of the base circle plus the area of the curved side which is a rectangle whose length is the circumference of the base.

$$\begin{aligned}\text{Area of base} &= \pi r^2 \\ &= \pi(13)^2 \\ &= 169\pi\end{aligned}$$

$$\begin{aligned}\text{Area of sides} &= 2\pi rh \\ &= 2\pi(13)(6) \\ &= 156\pi\end{aligned}$$

The inside surface area of this frying pan is $169\pi + 156\pi$, or 325π cm^2.

Using the company's formula:

$$S = \pi D\left(\frac{D}{4} + h\right)$$

$$S = \pi(30)\left(\frac{30}{4} + 6\right)$$

$$S = 405\pi$$

Using the company's formula, the inside surface area of this frying pan is 405π cm^2. The factory's formula is incorrect. It gives an area that is too large.

Note: The factories formula would work, if D were the diameter of the base (which is not normal practice):

$$\begin{aligned}\text{Surface area} &= \text{area of base} + \text{area of curved side} \\ &= \pi\left(\frac{D}{2}\right)^2 + \pi Dh \\ &= \pi\left(\frac{D^2}{4}\right) + \pi Dh \\ &= \pi D\left(\frac{D}{4} + h\right)\end{aligned}$$

b) Li is not correct because most frying pans have sides that slope outward a bit, making the top edge longer than the circumference of the base. So, the sides will actually be a trapezoid. Some frying pans have sides that curve slightly concavely (as a safety feature); this would also increase the surface area.
Using a string, I measured the bottom circumference of my frying pan. It measures 82 cm.
Use the formula for the area of a trapezoid:

$$A = \frac{(a+b)h}{2}$$

$$A = \frac{(\pi d + 82)6}{2}$$

$$A = \frac{(\pi(30) + 82)6}{2}$$

$$A = 528.743...$$

So, a better approximation for the inner surface area of this frying pan is $169\pi + 528.743$, or 1059 cm^2, to the nearest square centimetre.

Section 1.1 Page 21 Question 21

Examples:

Step 1: 20 min
Step 2: People walk at different rates which may depend on their leg length, physical condition, and other factors.
Step 3: Distances vary from about 150 m to 300 m.
Step 4: library, department store

Section 1.2 Imperial Measurement

Section 1.2 Page 29 Question 1

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

Section 1.2 Page 30 Question 2

a) $1 \text{ ft } 1\frac{1}{2} \text{ in.} = 12 \text{ in.} + 1\frac{1}{2} \text{ in.}$
$= 13\frac{1}{2} \text{ in.}$

b) $2' \, 3'' = 2.25'\left(\frac{1 \text{ yd}}{3 \text{ ft}}\right)$
$= 0.75 \text{ yd or } \frac{3}{4} \text{ yd}$

c) $400\,000 \text{ ft}\left(\frac{1 \text{ mi}}{5280 \text{ ft}}\right)$
$= 75.7575\ldots \text{ mi}$
$= 76$ mi, to the nearest mile

d) 3 mi
$= 3 \text{ mi}\left(\frac{5280 \text{ ft}}{1 \text{ mi}}\right)$
$= 15\,840 \text{ ft}$

Section 1.2 Page 30 Question 3

Examples.

a) $1\frac{7}{8}$ in., the length of a large paperclip

b) 3.154 in., the diameter of a bagel

c) 0.594 in., the thickness of a slice of bread

Section 1.2 Page 30 Question 4

Examples:

a) imperial caliper, 0.3125 in. or $\frac{5}{16}$ in.

b) imperial measuring tape, 1 in.

c) imperial ruler, $5\frac{7}{8}$ in.

Section 1.2 Page 31 Question 5

a) Estimate: 5 in., using lowest part of my little finger as referent for 1 in.
Measure: $5\frac{1}{4}$ in.

b) Estimate: $8\frac{1}{2}$ in. Measure: 7 in.

Section 1.2 Page 31 Question 6

Examples:

a) As a referent, I use the length of my foot. This is 10 in., without shoes. I count the number of heel-to-toe steps across the room and multiple by 10, to obtain the width in inches. Then, I divide by 12 to find the number of feet.

b) As a referent I use my hand span, which is 8 in. I find the number of whole hand spans along each edge of the desk and multiply by 8 to find the length in inches. For part hand spans, I use the first joint of my little finger to estimate single inches. I find the width the same way. Double the sum of the length and width gives the perimeter.

Section 1.2 Page 31 Question 7

a) $$\begin{aligned}\text{Average speed} &= \frac{\text{distance run}}{\text{number of hours}}\\ &= \frac{100}{16}\\ &= 6.25\end{aligned}$$

Billy Loutit ran 6.25 mph.

b) He ran 6.25 mi in 1 h.

Then, he can run 1 mi in $\frac{60}{6.25}$ min. This is 1 mi in approximately 9.6 min.

Section 1.2 Page 31 Question 8

Measures on diagram are:

Width and diameter of semicircle = $1\frac{1}{16}$ in.

Height of rectangular part = $1\frac{1}{2}$ in.

Use the scale 1:32 to find the actual dimensions.

$$\begin{aligned} \text{width} &= 32\left(1\frac{1}{16}\right) \\ &= 34 \end{aligned} \qquad \begin{aligned} \text{height} &= 32\left(1\frac{1}{2}\right) \\ &= 48 \end{aligned}$$

Use a formula to find the length of the semicircular part:

$$\begin{aligned} \frac{1}{2}C &= \frac{\pi d}{2} \\ &= \frac{\pi(34)}{2} \\ &= 53.407... \end{aligned}$$

The distance around the window is 53.4 + 2(48) + 34, or 183.4 in.

Section 1.2 Page 32 Question 9

a) Find the circumference of a drive wheel and of a caster wheel. Divide to determine how many turns of the smaller caster wheel are needed for each rotation of the drive wheel.

For the drive wheel:

$C = \pi d$

$C = \pi(24)$

For the castor wheel:

$C = \pi d$

$C = \pi(3)$

Number of turns $= \frac{\pi(24)}{\pi(3)}$

Number of turns = 8

Ratio of drive wheel rotations to caster wheel rotations is 1 : 8.

b) Convert 250 yd to inches.
250 yd = 250(3)(12) in.
250 yd = 9000 in.

$$\text{Number of rotations of the drive wheel in 250 yd} = \frac{9000}{\pi(24)}$$
$$= 119.366...$$

The number of rotations of the drive wheel in 250 yd is approximately 119.

c) 1.5 mi = 1.5(1760)(3)(12) in.
1.5 mi = 95 040 in.

$$\text{Number of rotations} = \frac{95\ 040}{\pi(24)}$$
$$= 1260.507...$$

The drive wheels will make approximately 1261 rotations in $1\frac{1}{2}$ mi.

Section 1.2 Page 32 Question 10

a) Measure the Virginia Falls photo: width is $1\frac{9}{16}$ in., or 1.5625 in.

Let *s* represent the scale factor.

$$\text{Scale factor} = = \frac{\text{englargement measurement}}{\text{original measurement}}$$
$$= \frac{3.25}{1.5625}$$
$$= 2.08$$

b) Height of original photo is approximately $1\frac{7}{8}$ in., or 1.875 in.

Use the scale factor.
Unknown side of frame is (2.08)(1.875), or approximately 3.9 in.

Section 1.2 Page 32 Question 11

a) Gail is not correct. The lengths are in feet, so the area will be in square feet.
Area = (length)(width)

$A = 7\frac{1}{2}(5)$

$A = 37\frac{1}{2}$

The area is $37\frac{1}{2}$ ft^2.
If Gail wanted to express the area in square feet and square inches, it would be 37 ft^2 72 in^2.
There are (12)(12) or 144 in^2 in 1 ft^2.

b) Each tile has an area of $\left(\frac{1}{2}\right)(1)$, or $\frac{1}{2}$ ft^2.

So for $37\frac{1}{2}$ ft^2, they need 37(2) + 1 or 75 tiles.

Section 1.2 Page 33 Question 12

Since all three of the devices are small, I chose to measure in inches.

a) The diameter of a CD is $4\frac{11}{16}$ in.

b) The dimensions of a music cassette case are $4\frac{1}{4}$ in. by $2\frac{3}{4}$ in. by $\frac{5}{8}$ in.

c) The perimeter of the front face of an MP3 player is $12\frac{3}{4}$ in.

Section 1.2 Page 33 Question 13

a) On the diagram, the distance from the captain to the cache is approximately $2\frac{1}{2}$ in., or 2.5 in.

This distance represents 500 yd, so the scale is 1 in. represents $\frac{500}{2.5}$ or 200 yd.

Using the lowest part of my little finger as the 1 in. referent, an estimate for the distance walked from the map is 5 in. So, the actual distance is about 5(200) or 1000 yd.

b) My estimate for the GPS distances is the same, 1000 yd. The actual distance walked is probably a little more than this because the paths are not straight.

Section 1.2 Page 34 Question 14

a) Use the formula $C = \pi d$ and solve for d. Work in inches.

$$60(12) = \pi d$$
$$\frac{60(12)}{\pi} = d$$
$$d = 229.183...$$

The diameter of the pool is 229 in., or 19 ft 1 in. to the nearest inch.

b) Calculate the diameter that each length of insulating material would create.
For a circumference of 62 ft:

$$62(12) = \pi d$$
$$\frac{62(12)}{\pi} = d$$
$$d = 236.822...$$

This wall would have a diameter of 237 in., or 19 ft 9 in. to the nearest inch.
This is 237 – 229 or 8 in. greater than the diameter of the pool. So, the insulation would be half of this, or 4 in. thick.

For a circumference of 65 ft:

$$65(12) = \pi d$$
$$\frac{65(12)}{\pi} = d$$
$$d = 248.281...$$

This wall would have a diameter of 248 in., or 20 ft 8 in. to the nearest inch.
This is 248 – 229 or 19 in. greater than the diameter of the pool. So, the insulation would be half of this, or 9.5 in. thick.

For a circumference of 70 ft:

$$70(12) = \pi d$$
$$\frac{70(12)}{\pi} = d$$
$$d = 267.380...$$

This wall would have a diameter of 267 in., to the nearest inch.
This is 267 – 229 or 38 in. greater than the diameter of the pool. So, the insulation would be half of this or 19 in. thick.

c) The 62 ft length will probably be best. The other lengths will make the wall too thick, and might make entry into the pool difficult.

Section 1.2 Page 34 Question 15

a) For comet Hyakutake:
Distance = 0.1018(92 955 887.6)
= 9 462 909. 358
Comet Hyakutake came within 9 462 909 mi of Earth, to the nearest mile.

For comet Hale-Bopp:
Distance = 1.315(92 955 887.6)
= 122 236 992.2
Comet Hyakutake came within 122 236 992 mi of Earth, to the nearest mile.

b) The difference in the distances from Earth of the two comets is
122 236 992.2 – 9 462 909.358, or 112 774 082.8 mi.
The difference in the distances is 112 774 083 mi, to the nearest mile.

Section 1.2 Page 34 Question 16

a) If ΔDEF is an enlargement of ΔABC, then the ratios of corresponding pairs of sides should be the same.
By measuring in inches:

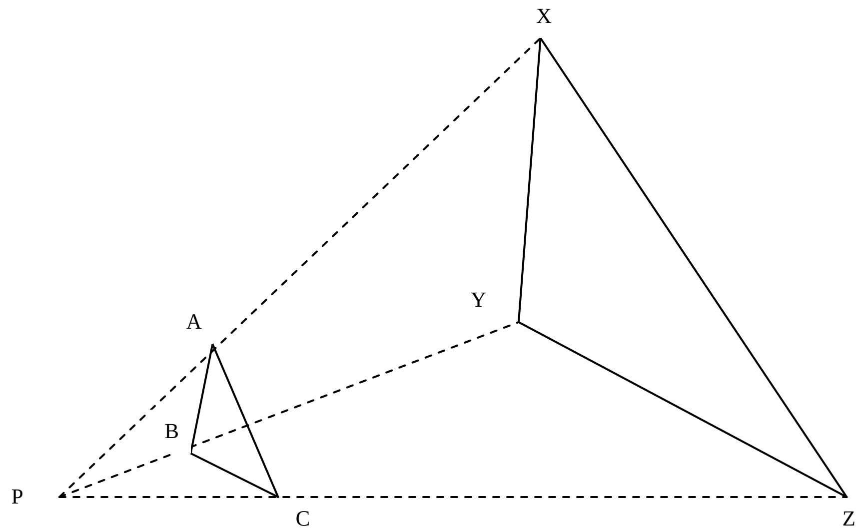
$AB : DE = \frac{9}{16} : 1$ or $1: 1.8$

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

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

b) ΔDEF is a dilatation of ΔABC, from centre P. ΔDEF and ΔABC are similar triangles, so their corresponding pairs of sides are proportional.

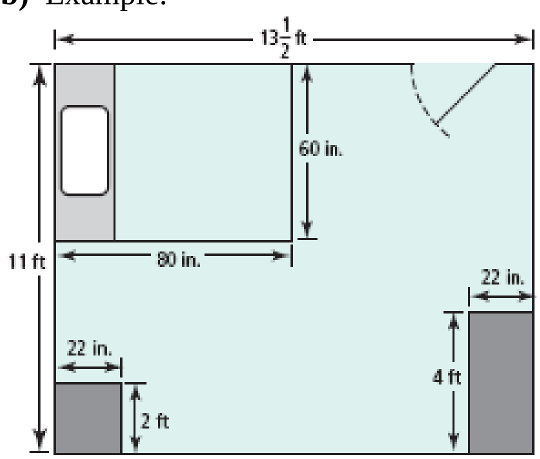
c) Example:



Section 1.2 Page 35 Question 17

a) Double bed measures 54 in. by 75 in. (or sometimes 72 in.)
Queen-size bed measures 60 in. by 80 in.

b) Example:



c) Either bed will fit in Sam's room. A queen-size bed will give him more room to spread out and so may be the better buy.

Section 1.2 Page 35 Question 18

a) For the smaller turbine:
Length of blade = 215 – 98
= 117

For the larger turbine:
Length of blade = 262 – 131
= 131
The length of the smaller blade is 117 ft and the length of the longer blade is 131 ft.
The difference in the blade lengths is 14 ft.

b) Find the distance travelled by the tip of the blade. In one revolution, this is its circumference. Multiply by 30 to find the tip speed per minute.
For the smaller turbine:
$C = \pi d$
$C = \pi(2)(117)$
Speed = $(30)\pi(2)(117)$
Speed = 7020π ft/min

$$\text{Tip speed in miles per hour} = \frac{7020\pi(60)}{3(1760)} = \frac{1755\pi}{22}$$

$$\text{Then, maximum speed of the wind} = \frac{\text{tip speed}}{6} = \frac{1755\pi}{22(6)} = 41.7689...$$

The maximum wind speed for the smaller turbine is 41.77 mph.

For the larger turbine:
$C = \pi d$
$C = \pi(2)(131)$
Speed = $(30)\pi(2)(131)$
Speed = 7860π ft/min

$$\text{Tip speed in miles per hour} = \frac{7860\pi(60)}{3(1760)}$$
$$= \frac{1965\pi}{22}$$

$$\text{Then, maximum speed of the wind} = \frac{\text{tip speed}}{6}$$
$$= \frac{1965\pi}{22(6)}$$
$$= 46.7668...$$

The maximum wind speed for the larger turbine is 46.77 mph.

Section 1.2 Page 35 Question 19

Examples:

a) Using the lowest part of my little finger referent for 1 in., I estimate the perimeter of the border to be 4(2) + 4, or 12 in.

b) $P = 4\left(1\frac{15}{16}\right) + 2\left(1\frac{1}{2}\right) + 2\left(\frac{1}{2}\right)$

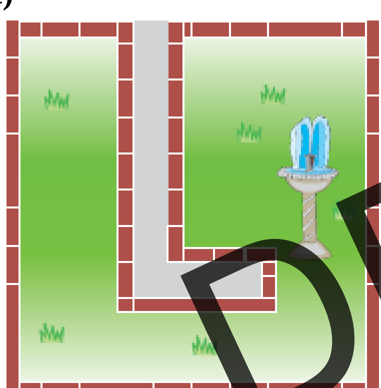
$P = 7\frac{3}{4} + 3 + 1$

$P = 11\frac{3}{4}$

The perimeter of the border in the diagram is $11\frac{3}{4}$ in.

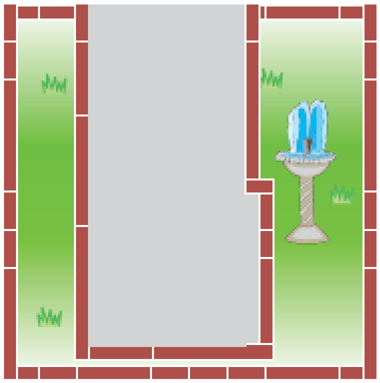
This shows that my estimate was pretty close.

c)



The perimeter of the border in this diagram is also $11\frac{3}{4}$ in.

d) The perimeter of the border in this diagram is also $11\frac{3}{4}$ in. The width of the path does not alter the overall sum of edges. In the widest case shown, the perimeter is close to (6)(length of one outside edge). Since one edge is $1\frac{15}{16}$ in., the perimeter is close to $11\frac{5}{8}$ in., which is almost $11\frac{3}{4}$ in.



Section 1.3 Converting Between SI and Imperial Systems

Section 1.3 Page 42 Question 1

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

c) In imperial units, AB = $1\frac{3}{4}$ in. and CD = $\frac{7}{8}$ in.

$$\begin{aligned} \text{AB} - \text{CD} &= 1\frac{3}{4} - \frac{7}{8} \\ &= \frac{7}{4} - \frac{7}{8} \\ &= \frac{14}{8} - \frac{7}{8} \\ &= \frac{7}{8} \end{aligned}$$

In SI units, AB = 44 mm and CD = 22 mm.
AB – CD = 22 mm

The difference in the lengths of AB and CD is $\frac{7}{8}$ in. or 22 mm.

Section 1.3 Page 42 Question 2

a) Use 1 in. = 2.54 cm.

$$\begin{aligned} 0.001 \text{ in.} &= (0.001)(2.54) \text{ cm} \\ &= 0.002\ 54 \text{ cm} \\ &= 0.0254 \text{ mm} \end{aligned}$$

The diameter of a human hair is 0.03 mm, to the nearest hundredth of a millimetre.

b) Use 1 m ≈ 3.281 ft.

$$\begin{aligned} 4.9 \text{ m} &\approx 4.9(3.281) \text{ ft} \\ &= 16.0769 \text{ ft} \end{aligned}$$

The width of the key on an NBA basketball court is approximately 16 ft.

c) Use 1 mi ≈ 1.609 km and 1 yd = 0.9144 m.

$$\begin{aligned} 26 \text{ mi } 385 \text{ yd} &\approx 26(1.609 \text{ km}) + 385(0.9144 \text{ m}) \\ &= 41.834 \text{ km} + 352.044 \text{ m} \\ &= 41.834 \text{ km} + 0.352\ 044 \text{ km} \\ &= 42.186\ 044 \text{ km} \end{aligned}$$

The length of a snowmobile trail is 42.19 km, to the nearest hundredth of a kilometre.

d) Use 1 in. = 2.54 cm.

$$3\frac{7}{8}\text{ in.} = 3\frac{7}{8}(2.54\text{ cm})$$
$$= 9.8425\text{ cm}$$

The height of an envelope is 9.84 cm, to the nearest hundredth of a centimetre.

Section 1.3 Page 43 Question 3

Examples:

a) Estimate of my hand span is 20 cm or 7 in. The actual measure is 20.5 cm or 8 in.

b) My desk's length is 4 hand spans.

c) Estimate of one pace is 35 cm or 15 in. The actual measure is 43 cm or 17 in.

d) To find the number of paces for 1 mi, convert 1 mi to inches and divide by 17.

$$\text{Number of paces in 1 mi} = \frac{1(1760)(3)(12)}{17}$$
$$\approx 3727$$

I would take about 3727 paces to walk 1 mi.

$$\text{Number of paces in 1 km} = \frac{1(1000)(100)}{43}$$
$$\approx 2326$$

I would take about 2326 paces to walk 1 km.

e) I prefer the SI system because I have a better mental picture of 10 cm, 1 m, and 1 km.

Section 1.3 Page 43 Question 4

Examples:

a) Estimate of side length of closet is 1.4 m.

b) On the floor plan, 3.6 cm represents the width of the apartment.
3.6 cm represents 5.4 m.
The scale is 3.6 : 540 or 1: 150.

c) On the plan, one side of the closet measures 1 cm.
Using the scale, this represents 150 cm or 1.5 m.

d) Use 1 m ≈ 3.281 ft.

$$\begin{aligned} 2.8 \text{ m} &\approx (2.8)(3.281) \text{ ft} \\ &= 9.1868 \text{ ft} \end{aligned}$$

$$\begin{aligned} 3.9 \text{ m} &\approx (3.9)(3.281) \text{ ft} \\ &= 12.7959 \text{ ft} \end{aligned}$$

The dimensions of the bedroom in imperial units are approximately 9.2 ft by 12.8 ft.

Section 1.3 Page 43 Question 5

Use 1 m ≈ 3.281 ft.

$$\begin{aligned} 365 \text{ m} &\approx 365(3.281) \text{ ft} \\ &= 1197.565 \text{ ft} \end{aligned}$$

$$\begin{aligned} 3745 \text{ m} &\approx 3745(3.281) \text{ ft} \\ &= 12\,287.345 \text{ ft} \end{aligned}$$

$$\begin{aligned} 3491 \text{ m} &\approx 3491(3.281) \text{ ft} \\ &= 11\,453.971 \text{ ft} \end{aligned}$$

$$\begin{aligned} 100 \text{ cm} &= 1 \text{ m} \\ &\approx 3.281 \text{ ft} \\ &= 3281(12) \text{ in.} \\ &= 39.372 \text{ in.} \end{aligned}$$

…depth of 1198 ft … Mount Columbia at 12 287 ft … Mount Athabasca at 11 454 ft … snowfall … 39 in.

Section 1.3 Page 44 Question 6

a) 63 mm; $\begin{aligned} 63 \text{ mm} &\approx (63)(0.1)(0.3937) \text{ in.} \\ &= 2.480\,31 \text{ in. or about } 2\frac{1}{2} \text{ in.} \end{aligned}$

b) $2\frac{5}{16}$ in.; $\begin{aligned} 2\frac{5}{16} \text{ in.} &= \left(2\frac{5}{16}\right)(2.54) \text{ cm} \\ &= 5.873\,75 \text{ cm} \end{aligned}$

c) 1.536 in.; $\begin{aligned} 1.536 \text{ in.} &= (1.536)(2.54) \text{ cm} \\ &= 3.901\,44 \text{ cm} \end{aligned}$

d) 4.78 cm; $\begin{aligned} 4.78 \text{ cm} &\approx (4.78)(0.3937) \text{ in.} \\ &= 1.881\,886 \text{ in.} \\ &\approx 1.9 \text{ in.} \end{aligned}$

Section 1.3 Page 44 Question 7

a) Total length of rope $= (13)\left(3\frac{1}{2}\right)$

$= 45\frac{1}{2}$

The total length of rope needed for a team of 13 dogs is $45\frac{1}{2}$ ft or 45 ft 6 in.

b) Rope is usually sold in metres. Use 1 ft = 0.3048 m.

$45\frac{1}{2}$ ft = (45.5)(0.3048) m

= 13.8684 m

The length of rope, in SI units, is approximately 13.87 m.

Section 1.3 Page 45 Question 8

Convert 28 mi to kilometres.
Use 1 mi ≈ 1.609 km.
28 mi ≈ (28)(1.609) km
= 45.052 km

The driving distance between Mohall and Moosomin is approximately 45 + 130, or 175 km.

Section 1.3 Page 45 Question 9

a) To convert from metres to kilometres, divide by 1000 since 1000 m = 1 km. To divide by 1000, move the decimal point 3 places to the left.
For example, 3556.8 m = 3.5568 km.

To convert from metres to centimetres, multiply by 100 since 1 m = 100 cm.
For example, 5.9 m = 590 cm.

To convert from yards to miles, divide by 1760 since 1760 yd = 1 mi.
For example, 3000 yd ≈ 1.7 mi.

b) To convert from a smaller unit of length to a larger unit, divide by the number of the smaller units in one larger unit. This makes sense because there will be fewer of the larger unit. This strategy works in both systems of measurement.

c) To convert from a larger unit of length to a smaller unit, multiply by the number of the smaller units in one larger unit. This makes sense because there will be more of the smaller unit.

Section 1.3 Page 45 Question 10

Example: To convert Margaux's distance to miles, use 1 km ≈ 0.6 mi. An estimate of the imperial equivalent of 164 km is 100(0.6) + 60(0.6) or 60 + 36, which is 96 mi.
This estimate suggests that Penny travelled farther.

Section 1.3 Page 45 Question 11

Step 1: Express each depth in metres. Use 1 ft = 0.3048 m.
Step 2: Compare the depths.

For Lake Baikal,

$$\begin{aligned}5369 \text{ ft} &= 5369(0.3048) \text{ m}\\ &= 1636.4712 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Lake Baikal} - \text{Quesnel Lake} &= 1636.4712 - 506\\ &= 1130.4712\end{aligned}$$

Lake Baikal is 1130 m deeper than Quesnel Lake, to the nearest metre.
For Great Slave Lake,

$$\begin{aligned}2015 \text{ ft} &= 2015(0.3048) \text{ m}\\ &= 614.172 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Great Slave Lake} - \text{Quesnel Lake} &= 614.172 - 506\\ &= 108.172\end{aligned}$$

Great Slave Lake is 108 m deeper than Quesnel Lake, to the nearest metre.

Section 1.3 Page 46 Question 12

$$\begin{aligned}\text{Radius at North Pole} &= 6380 \text{ km} - 13 \text{ mi}\\ &\approx 6380(0.6214) \text{ mi} - 13 \text{ mi}\\ &= 3951.532\end{aligned}$$

A person standing on the North Pole would be about 3951 mi from the centre of Earth.

Section 1.3 Page 46 Question 13

a) The diameter of each semicircle = 21 – 2(3.5)
= 14

$P = 2(24) + 4(3.5) + \pi(14)$
$P = 48 + 14 + 14\pi$
$P \approx 105.982\ldots$
The perimeter of the figure is approximately 105.982 cm.

Use 1 cm ≈ 0.3937 in. to convert the perimeter to inches.
$P \approx 105.982(0.3937)$
$P = 41.725\ldots$ in.

The perimeter of the figure is $41\frac{3}{4}$ in., to the nearest quarter of an inch.

b) I found the perimeter in centimetres first, then converted the answer to inches. I think this method is better as it is easier to calculate with SI units than inches, which often involve fractions. Also, there is only one conversion so less rounding errors will occur.

Section 1.3 Page 46 Question 14

a) Each LP holds 12 songs.

$$\begin{aligned}\text{Number of LPs to hold 20 000 songs} &= \frac{20\ 000}{12}\\ &\approx 1666.7\end{aligned}$$

To hold as many songs as the MP3 player, you would need 1667 LPs.

b)
$$\begin{aligned}\text{Height of 1667 LPs} &= 1667\left(\frac{1}{9}\text{ in.}\right)\\ &= 185.222...\text{ in.}\end{aligned}$$

The height of the stack of LPs would be about 185 in.

$$\begin{aligned}\text{Height of stack of LPs compared to height of MP3 player} &= 185.222(2.54) : 9.15\\ &\approx 470 : 9.15\\ &= 94 : 1.83\\ &= 9400 : 183 \text{ or } 51.4 : 1\end{aligned}$$

Section 1.3 Page 46 Question 15

a) The top layer needs 3 blocks across the width and 3 to fill in the length. So, for the wall 2(4)(3) blocks are needed.
The farmer needs 24 blocks.
b) The outside dimensions in SI units are: width 3(40) cm, length 4(40) cm, height 2(20) cm, or 120 cm by 160 cm by 40 cm.
Convert to imperial. Use 1 cm ≈ 0.3937 in.

$$\begin{aligned}\text{width} &\approx 120(0.3937)\\ &= 47.244\text{ in.}\end{aligned}$$
$$\begin{aligned}\text{length} &\approx 160(0.3937)\\ &= 62.992\text{ in.}\end{aligned}$$
$$\begin{aligned}\text{height} &\approx 40(0.3937)\\ &= 15.748\text{ in.}\end{aligned}$$

The outside dimensions, in inches, are about $47\frac{1}{4}$ in. by 63 in. by $15\frac{3}{4}$ in.

c) The perimeter of the outer layer will be 28 units. Each width will need one more block and each length will need one more block. So, in the two layers 2(4) or 8 more blocks will be needed. So, the farmer would need 32 blocks to build another wall outside the existing one.

Section 1.3 Page 47 Question 16

Example:

a) Use the given width, 23 m, to estimate the other dimensions needed in the formula. The width of the arch on the photograph is 9.5 cm. Use proportional reasoning to find H and h.

$$\frac{H}{23} = \frac{6.4}{9.5} \qquad\qquad \frac{h}{23} = \frac{4.7}{9.5}$$
$$H \approx 15.49 \qquad\qquad h \approx 11.38$$

Substitute into the given formula.

$$A = \frac{w(H + 4h)}{6}$$
$$A = \frac{23(15.49 + 4(11.38))}{6}$$
$$A = 233.87...$$

The area under River Arch is approximately 234 m^2.

b) There is no reason why the formula will not work for any units, so long as the variables are expressed in the same unit.

Section 1.3 Page 47 Question 17

Examples:

a) SI units: distances between places on the highway in Canada, distances between planets, dimensions of rooms on house plans in Canada

Imperial units: lumber measures, distances on a football field, pizza diameters

b) approximate: distances between places on the highway are rounded to the nearest kilometre, distances between planets are huge and are often rounded to the nearest 1000 km, pizza diameters are approximate as the dough may be slightly more or less than the pan diameter, lumber is very rough—a "2 by 4" is not actually 2 in. by 4 in.
exact: dimensions on plans are exact usually to the nearest millimetre, the markings on a football field are exactly placed

18. 1 yd = 3 ft and 1 ft = 12 in. So, 1 yd = 3(12) or 36 in. Therefore, 36 in. = 0.9144 m.

To convert from inches to metres, multiply the measurement by $\frac{0.9144}{36}$.

For example, 6 in. $= 6\left(\frac{0.9144}{36}\right)$ m

6 in. = 0.1524 m

Chapter 1 Review

Chapter 1 Review Page 48 Question 1

Example:
Can of shaving cream: estimate 10 cm, actual 16.5 cm
Use a length of string to measure the circumference. My estimate was too low.

Chapter 1 Review Page 48 Question 2

AB = 18.1 cm – 12.4 cm
AB = 5.7 cm

Chapter 1 Review Page 48 Question 3

2.46 cm. Example: the width of a tape dispenser

Chapter 1 Review Page 48 Question 4

Greatest diameter possible is 20 cm.

$$C = \pi d$$
$$C = \pi(20)$$
$$C = 62.831\ldots$$

The circumference of the largest circle that can be cut from a sheet of paper measuring 30 cm by 20 cm is approximately 62.8 cm.

$$\begin{aligned}\text{Area cut away} &= \text{area of rectangle} - \text{area of circle}\\ &= lw - \pi r^2\\ &= (20)(30) - \pi(10)^2\\ &= 285.840\ldots\end{aligned}$$

The area of paper cut away is approximately 285.8 cm^2.

Chapter 1 Review Page 48 Question 5

4.5 cm represents 210 cm. The width of the antlers on the photo is 1 cm.
Let x represent the actual width.

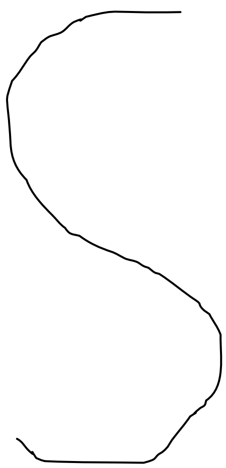
$$\frac{x}{210} = \frac{1}{4.5}$$
$$x = \frac{210}{4.5}$$
$$x = 46.666...$$

The actual distance between the tips of the antlers is 46.7 cm, to the nearest tenth of a centimetre.

Chapter 1 Review Page 48 Question 6

Example:

a)



b) Use a piece of string to trace the S-curve and measure it.

Chapter 1 Review Page 49 Question 7

D is at $6\frac{3}{4}$ in.; C is at $4\frac{3}{16}$ in.

$$\begin{aligned}\text{Distance CD} &= 6\frac{3}{4} - 4\frac{3}{16}\\ &= 6\frac{12}{16} - 4\frac{3}{16}\\ &= 2\frac{9}{16}\end{aligned}$$

The distance from C to D is $2\frac{9}{16}$ in. This can be confirmed by counting sixteenths on the ruler shown.

Chapter 1 Review Page 49 Question 8

a) The perimeter consists of two straight edges, each $1\frac{1}{2}$ in. long, plus one-quarter of the circumference of a circle with radius $1\frac{1}{2}$ in.

$$P = 2\left(1\frac{1}{2}\right) + \frac{1}{4}(\pi)(3)$$
$$P = 5.356...$$

The perimeter is approximately 5.36 in. This answer seems reasonable because it is greater than 3(1.5), but less than 4(1.5) which would be a square cross-section.

b) Use the Pythagorean relationship to find the length of the hypotenuse, then add the three sides.

$$h^2 = \left(1\frac{1}{2}\right)^2 + \left(1\frac{1}{2}\right)^2$$
$$h^2 = 4.5$$
$$h = 2.121...$$

$$P = 2\left(1\frac{1}{2}\right) + 2.121...$$
$$P = 5.121...$$

The perimeter is approximately 5.12 cm. This answer seems reasonable because it is slightly less than the answer in part a). The curved edge will be longer than the straight edge.

Chapter 1 Review Page 49 Question 9

a) Example: Estimates: width 4 in., height 2.25 in.
Actual measurements: width 4.5 in., height 2.25 in.

b) Enlargement factor for the width $= \dfrac{6}{4.5}$

$= 1.333...$

Enlargement factor for the height $= \dfrac{4}{2.25}$

$= 1.777...$

The photo will need to be cropped, because its width to height proportion is not the same as for the frame.
For the frame: 6 : 4 = 1.5 : 1; for the photo 4.5 : 2.25 or 2 : 1.
I would probably use 1.78 as the scale factor and crop the width to fit.

$x(1.777) = 6$

$x = 3.375\ldots$

The width would need to be cropped to be approximately 3.375 in.

Chapter 1 Review Page 50 Question 10

a) Use 1 km ≈ 0.6214 mi.
412 km ≈ 412(0.6214) mi
412 km = 256.0168 mi
The distance from Calgary to Jasper is 256 mi, to the nearest mile.

b) Use 1 m ≈ 3.281 ft.
25.3 m ≈ 25.3(3.281) ft
25.3 m = 83.0093 ft
The height of Twister is 83 ft, to the nearest foot.

Chapter 1 Review Page 50 Question 11

Robert P. Wadlow's height of 2.7 m is probably an approximation.

Use 1 ft = 30.48 cm and 1 in. = 2.54 cm.

$8 \text{ ft } 11\frac{1}{10} \text{ in.} = 8(30.48) \text{ cm} + 11.1(2.54) \text{ cm}$

$8 \text{ ft } 11\frac{1}{10} \text{ in.} = (243.84 + 28.194) \text{ cm}$

$8 \text{ ft } 11\frac{1}{10} \text{ in.} = 272.034 \text{ cm}$

The tallest man's height was actually 2.720 34 m.

Chapter 1 Review Page 50 Question 12

Example:
The horse is about three times as tall as the small pony.
In the photograph, Thumbelina's height is approximately $\frac{5}{8}$ in.

The shoulders of the horse are $1\frac{3}{4}$ in. above the ground. The distance from the shoulders to the top of the horse's head is about $\frac{1}{2}$ in. Let *x* represent the approximate height of the horse with its head up.

$$\frac{x}{17} = \frac{1\frac{3}{4} + \frac{1}{2}}{\frac{5}{8}}$$

$$x = \frac{(17)(2.25)}{0.625}$$

$$x = 61.2$$

The height of the horse is approximately 61.2 in.
The height may be more commonly expressed in feet and inches, as 5 ft $1\frac{1}{5}$ in.

Chapter 1 Review Page 50 Question 13

a) Use the scale. 1 cm represents 880 000 cm.
880 000 cm = 8800 m
880 000 cm = 8.8 km
On this map, 1 cm represents 8.8 km.

b) Use 1 in. = 2.54 cm.
So, on this map, 1 in. represents 2.54(8.8) km or 22.352 km.
Use 1 km ≈ 0.6214 mi.
22.352 km ≈ 22.352(0.6214) mi
22.352 km = 13.889 532 8 mi
On this map, 1 in. represents approximately 13.9 mi.

c) Example: Estimate on the map 2.25 in. So, about 2.25(14) mi, or 28 + 4, which is 32 mi.

d) An actual distance of 57 km is about $\frac{57}{8.8}$ cm, or about 6.5 cm, on the map. On the map, Faust is about 6.5 cm west of Slave Lake. The person is probably going to Faust.

Chapter 1 Practice Test

Chapter 1 Practice Test Page 51 Question 1

Use 1 mi = 1760 yd and $2\frac{3}{4}$ ft is a bit less than 1 yd.
So, the student would take more than 1760 paces to walk 1 mi.
Answer D is best.

Chapter 1 Practice Test Page 51 Question 2

Since 1 yd = 36 in, 36 in. = 0.9144 m. One metre is just greater than 0.9144 m.
Answer B is best, because 39.37 in. is a little greater than 36 in.

Chapter 1 Practice Test Page 51 Question 3

A school door is about 2.2 m tall. So, it would take more than four doors to exceed the whale's length.
Answer C is best.

Chapter 1 Practice Test Page 51 Question 4

Use 1 in. = 2.54 cm.

$2\frac{3}{4}$ in. = 2.75(2.54) cm

$2\frac{3}{4}$ in. = 6.985 cm

Diameter 7 cm would not be allowed.
Answer C is best.

Chapter 1 Practice Test Page 52 Question 5

The middle rod in the top row has diameter $\frac{13}{16}$ in. and the lower left rod has diameter $\frac{3}{4}$ in.; both of which are greater than $\frac{5}{8}$ in.
Answer C is best.

Chapter 1 Practice Test Page 52 Question 6

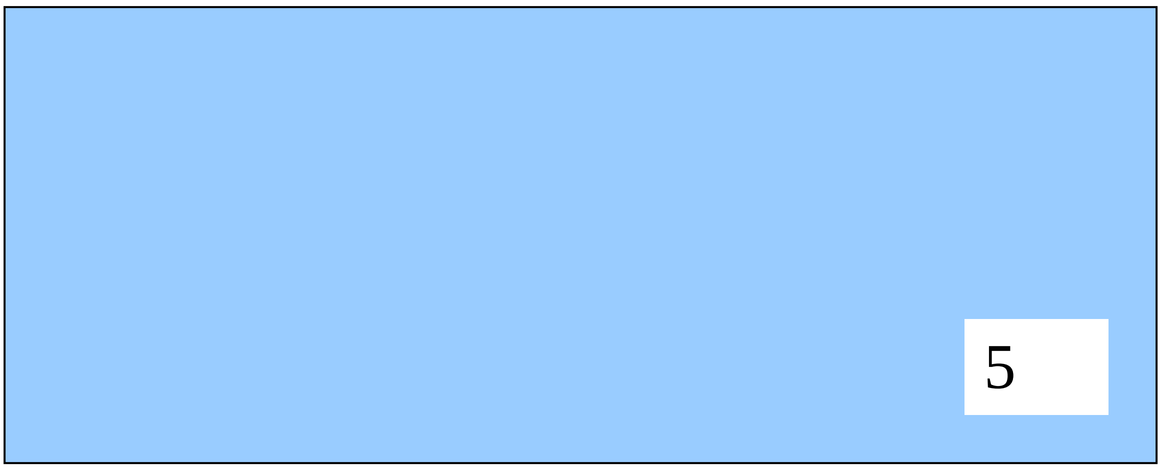
Examples:

a) Referents might be hand spans, arm spans. Units could be centimetres, metres, or feet.

b) SI unit: centimetres; imperial unit: inches
Conversion: 1 cm ≈ 0.3937 in. or 1 in. = 2.54 cm

Chapter 1 Practice Test Page 52 Question 7

Example:



A $5-bill measures about 16 cm by 6 cm, in SI units.

Chapter 1 Practice Test Page 52 Question 8

Use 1 in. = 2.54 cm.

$$\left(\frac{1}{4}\right)\text{ in.} = \left(\frac{1}{4}\right)(2.54)\text{ cm}$$
$$\frac{1}{4}\text{ in.} = 0.635\text{ cm}$$
$$\frac{1}{4}\text{ in.} = 6.35\text{ mm}$$

$$\left(\frac{3}{8}\right)\text{ in.} = \left(\frac{3}{8}\right)(2.54)\text{ cm}$$
$$\frac{3}{8}\text{ in.} = 0.9525\text{ cm}$$
$$\frac{3}{8}\text{ in.} = 9.525\text{ mm}$$

So, SI wrenches between the two are 7 mm, 8 mm, and 9 mm.

Chapter 1 Practice Test Page 53 Question 9

Use the fact that the distance between the arches is 6 ft to estimate the scale of the photograph. Then, measure the sides of an arch on the photograph and use proportional reasoning to determine the actual side lengths. Use the formula for circumference to calculate the distance around the semicircle at the top.

The distance between the arches on the photograph is $\frac{5}{8}$ in.

The scale of the photograph is $\frac{5}{8} : 72$, or 1 in. represents 115.2 in.

The width of the arch on the left side of the photograph is $\frac{5}{8}$ in. So, the actual width is 6 ft, or 72 in.

The height of the same arch on the photograph is $\frac{7}{8}$ in. So, the actual height is $\frac{7}{8}(115.2)$ or 100.8 in.

P = 2 sides + base + semicircle

$P = 2(100.8) + 72 + \frac{1}{2}(72)\pi$

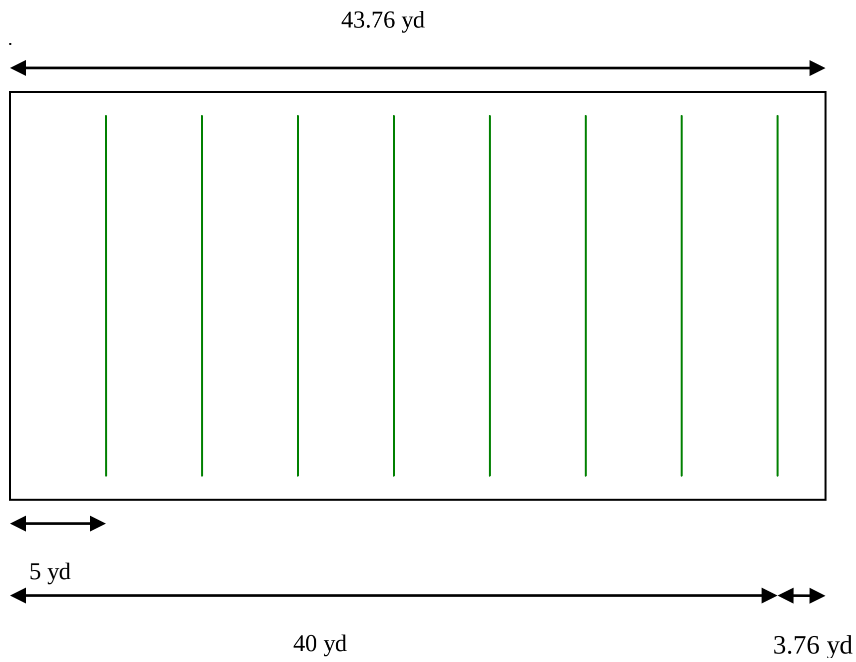
$P = 386.6\ldots$

The perimeter of one archway, including the bottom, is 387 in. or 32 ft 3 in., to the nearest inch.

Chapter 1 Practice Test Page 53 Question 10

a) Use 1 m ≈ 1.094 yd.
Length of gym ≈ 40(1.094) yd
Length of gym ≈ 43.76 yd
If lines are made 5 yd apart, and the first line is 5 yd from one end wall, the students made 8 lines.

b) Distance of last line from the end wall = 43.76 – 8(5)
Distance of last line from the end wall = 3.76
The last line is 3.76 yd from the end wall of the gym.



c) Distance run = 2(5) + 2(10) + 2(15) + 2(20) + 2(25) + 2(30) + 2(35) + 2(40) + 43.76
Distance run = 403.76
The minimum distance run is 404 yd, to the nearest yard.
The students run back and forth to each yard line and then to the end wall.

d) If the lines were 5 m apart:
Distance run = 2(5) + 2(10) + 2(15) + 2(20) + 2(25) + 2(30) + 2(35) + 40
Distance run = 320
With the lines 5 m apart the training run would cover 320 m.
320 m = 320(1.094) yd
320 m = 350.08 yd
This distance is about 404 – 350, or 54 yd less. The answer is reasonable because with lines 5 m apart there would only be 7 lines, so one extra run of almost the whole length of the gym is not made.