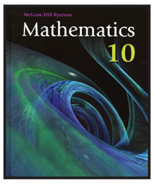
Enhance Your Understanding

Lesson 1.1: Referents



Refer to pages 15 and 31 in *Mathematics 10* for more practice.

- Page 15, #1, 2
- Page 31, #5, 6

Question 1, page 15

a. i. Example: Use the width of your pinky finger or the width of a fingernail as a referent for 1 cm. Answers may vary, but the perimeter should be approximately 18 cm.

ii. Example: Use the width of your pinky finger or the width of a fingernail as a referent for 1 cm. Answers may vary, but the perimeter should be approximately 23 cm.

b. i. 18.6 cm

ii. 23 cm

It is not necessary to measure all sides. Opposite sides are equal in length, and subtraction can be used to calculate the lengths of the shorter sides.

Question 2, page 16

a. i. Example: Use the width of your fingernail as a referent for 10 mm. The curve of the S should be about 2 fingernail widths.

ii. Example: Use the width of your hand as a referent for 10 cm. The curve of the S should 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 length of the string.

Question 5, page 31

a. Answers may vary. Example: $4\frac{3}{4}$ paper clips; $5\frac{1}{4}$ in.

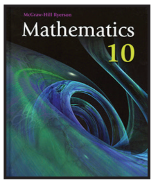
b. Answers may vary. Example: $6\frac{3}{4}$ paper clips; 7 in.

Question 6, page 31

a. Answers will vary. Example: Use the length of your large step as a referent for 3 ft.

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

Lesson 1.2: Measuring Instruments



Refer to pages 16 and 29 in *Mathematics 10* for more practice.

- Page 16, #3, 7, 8
- Page 29, #1a, 3a, 4

Question 3, page 16

a. 72 mm; 7.2 cm

b. 18.4 mm; 1.84 cm

c. 34.4 mm; 3.44 cm

Question 7, page 17

Answers will vary. Examples: Measuring tape, ruler, laser ruler, car odometer, metre stick, trundle wheel, calliper, 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, measure several convenient lengths (for example 25 m each) and then measure the last portion, as explained for shorter distances. Add up all of the smaller lengths to get the total distance.

Question 8, page 17

Use $C = 2\pi r$. Substitute $C = 1\text{ m}$ and solve for *r*.

$$1\text{ m} = 2\pi r$$
$$\frac{1\text{ m}}{2\pi} = r$$
$$0.159\text{ m} \doteq r$$

$$0.159\text{ m} \cdot \frac{1000\text{ mm}}{1\text{ m}} \doteq 159\text{ mm}$$

Question 1a, page 29

a. Divide 1 inch by the number of increments. $\frac{1}{16}$ in

Question 3a, page 30

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

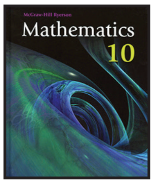
Question 4, page 30

a. a ruler or calliper; $\frac{5}{16}$ in

b. a string; 1 in

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

Lesson 1.3: The SI System



Refer to page 17 in *Mathematics 10* for more practice.

- Page 17, #5, 6, 10

Question 5, page 17

a. No. Mountain heights are usually reported in m. Since 1 m = 100 cm, $595900\text{ cm} \cdot \frac{1\text{ m}}{100\text{ cm}} = 5959\text{ m}$. Alternatively, move the decimal two places to the left.

b. No. Metres are too large for the diameter of a bottle. Centimetres would be more appropriate. Since 1 m = 100 cm, $0.064\text{ m} \cdot \frac{100\text{ cm}}{1\text{ m}} = 6.4\text{ cm}$. Alternatively, move the decimal two places to the right.

c. No. Millimetres would not be appropriate because the units are too small. Metres would be more suitable. Since 1 m = 1000 cm, $4200\text{ mm} \bullet \frac{1\text{ m}}{1000\text{ mm}} = 4.2\text{ m}$. Alternatively, move the decimal three places to the left.

d. No. Kilometres are used to measure very large distances. Metres or centimeters would be appropriate. Since 1 km = 1000 m, $0.001\,95\text{ km} \bullet \frac{1000\text{ m}}{1\text{ km}} = 1.95\text{ m}$. Alternatively, move the decimal three places to the right.

Question 6, page 17

a. $12(32\text{ cm}) = 384\text{ cm}$

b. Use $C = 2\pi r$. Substitute $C = 384\text{ cm}$ and solve for *r*.

$$384\text{ cm} = 2\pi r$$
$$\frac{384\text{ cm}}{2\pi} = r$$
$$61.1\text{ cm} \doteq r$$

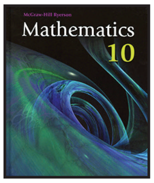
Since $1\text{ cm} = 10\text{ mm}$, $61.1\text{ cm} \bullet \frac{10\text{ mm}}{1\text{ cm}} \doteq 611\text{ mm}$.

c. The radius of the outside edge of the track can be found by adding the width of the track to the radius of the inside edge of the track. Example: If we estimate this to be about 3 cm or 30 mm, the outside radius will be $611\text{ mm} + 30\text{ mm} = 641\text{ mm}$. Answers will vary.

Question 10, page 18

Example: If we estimate the inukshuk to be about 3 times the height of the person, the height of the person is found by $\frac{4.1\text{ m}}{3} \doteq 1.4\text{ m}$. Answers will vary.

Lesson 1.4: The Imperial System



Refer to page 30 in *Mathematics 10* for more practice.

- Page 30, #2, 7, 8, 9, 11

Question 2, page 30

a. 1 ft = 12 inches, thus 12 inches + $1\frac{1}{2}$ inches = $13\frac{1}{2}$ inches.

b. 2 ft 3 inches, $2\text{ ft}\bullet\frac{12\text{ in}}{1\text{ ft}} = 24$ inches + 3 inches = 27 inches.

Now compare that to 36 inches in 1 yard: $27\text{ in}\bullet\frac{1\text{ yd}}{36\text{ in}} = 0.75\text{ yd}$, which is equivalent to $\frac{3}{4}$ yards.

c. 1 mile = 5280 feet, $400000\text{ ft}\bullet\frac{1\text{ mi}}{5280\text{ ft}} \doteq 75.8\text{ mi}$ or 76 miles.

d. 1 mile = 5280 ft, $3\text{ mi}\bullet\frac{5280\text{ ft}}{1\text{ mi}} = 15840\text{ ft}$.

Question 7, page 31

a.
$$\begin{aligned}\text{speed} &= \frac{\text{distance}}{\text{time}}\\ &= \frac{100\text{ mi}}{16\text{ h}}\\ &= 6.25\text{ mph}\end{aligned}$$

b. $\frac{16\text{ h}}{100\text{ mi}} = 0.16$ hours per mile

There are 60 min in an hour, so he could run a mile in $0.16\text{ h}\bullet\frac{60\text{ min}}{1\text{ h}} = 9.6$ min.

Question 8, page 31

The outside of the window consists of 3 sides of a rectangle plus a semi-circle. The scale is 1 inch: 32 inches.

Using a ruler, the length of the window (red corner to red corner) is $1\frac{1}{2}$ inches and the width is $1\frac{1}{16}$ inches. The total distance around the three sides of the rectangle is:

$$\begin{aligned} 1\frac{1}{2}\text{ in} + 1\frac{1}{2}\text{ in} + 1\frac{1}{16}\text{ in} &= 4\frac{1}{16}\text{ in} \\ &= 4.0625\text{ in} \end{aligned}$$

The circle has a diameter of $1\frac{1}{16}$ in. To find the circumference, can use $C = \pi d$.

$$\begin{aligned} C &= \pi d \\ &= \pi \bullet 1\frac{1}{16}\text{ in} \\ &\doteq 3.34 \end{aligned}$$

But, the window is made up of a semi-circle, so $\frac{3.34\text{ in}}{2} \doteq 1.67$ inches.

The total distance around the outside of the window = 4.0625 + 1.67 ≐ 5.73 inches.

Using the scale factor of 32, the actual size of window is: $5.73 \times 32 = 183.36$ inches. So, to the nearest half inch, the distance around the outside of the window is $183\frac{1}{2}$".

Question 9, page 32

a. Determine the circumference of each wheel and then divide the larger wheel's circumference by the smaller wheel's circumference.

Drive wheels: $d = 24$ inches

$$\begin{aligned} C &= \pi d \\ &= \pi \bullet 24\text{ in} \\ &= 24\pi\text{ in} \\ &\doteq 75.40\text{ in} \end{aligned}$$

Caster wheels: $d = 3$ inches

$$\begin{aligned} C &= \pi d \\ &= \pi \bullet 3\text{ in} \\ &= 3\pi\text{ in} \\ &\doteq 9.42\text{ in} \end{aligned}$$

$$\frac{\text{Drive}}{\text{Caster}} = \frac{24\pi\text{ in}}{3\pi\text{ in}} = \frac{8}{1}$$

b. The drive wheel travels 75.40 inches with each rotation. This is equivalent to:

$$75.40 \text{ in} \bullet \frac{1 \text{ yd}}{36 \text{ yd}} = 2.09 \text{ yd}$$

So, in 250 yards, the drive wheels will rotate $\frac{250 \text{ yd}}{2.09 \text{ yd}} = 119.6$ times.

c. $$1.5 \text{ mi} \bullet \frac{1760 \text{ yd}}{1 \text{ mi}} = 2640 \text{ yd}$$

Since the wheel travels 2.09 yards in one rotation, in 2640 yards, the drive wheel will rotate $\frac{2640 \text{ yd}}{2.09 \text{ yd}} = 1263.2$ times.

Question 11, page 32

a. $A = lw$

$$A = 7.5 \text{ ft} \bullet 5 \text{ ft}$$
$$= 37.5 \text{ ft}^2$$

$1 \text{ ft} = 12 \text{ in}$, so
$1 \text{ ft}^2 = 12 \text{ in} \times 12 \text{ in}$

and

$$0.5 \text{ ft}^2 = 0.5 \text{ ft}^2 \bullet \frac{144 \text{ in}^2}{1 \text{ ft}^2} = 72 \text{ in}^2$$

Thus the area is 37 ft^2 72 in^2 and Gail is incorrect.

b. Tile $= 6 \text{ in} \times 12 \text{ in} = 72 \text{ in}^2$

From part a. we know the area of the room is 37 ft^2 72 in^2. To work exclusively in inches, convert the area into in^2.

$$37 \text{ ft}^2 \bullet \frac{144 \text{ in}^2}{1 \text{ ft}^2} = 5328 \text{ in}^2$$

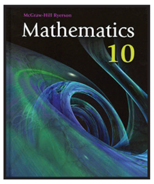
Now add 72 in^2 to get 5400 in^2.

Now divide the total area by the size of the tile $(A_{\text{tile}} = 6 \text{ in} \bullet 12 \text{ in} = 72 \text{ in}^2)$:

$$\frac{5400 \text{ in}^2}{72 \text{ in}^2} = 75$$

75 tiles are tiles needed.

Lesson 1.5: Conversions Between SI and Imperial



Refer to pages 42 in *Mathematics 10* for more practice.

- Page 42, #1, 2, 4, 5, 7, 8, 10, 12

Question 1, page 42

a. This ruler shows 16 sections between each large number, which means each section measures $\frac{1}{16}$ of an inch. Length AC = $2\frac{6}{16}$ inches, which can be reduced to $2\frac{3}{8}$ inches.

b. Length AD = $3\frac{4}{16}\text{ in} = 3\frac{1}{4}\text{ in}$

Written as a decimal, the length AD is 3.25 inches.
To convert to mm, use conversion ratio 1 in = 25.4 mm.
$3.25\text{ in}\bullet\frac{25.4\text{ mm}}{1\text{ in}} = 82.55\text{ mm}$ or 83 mm.

c. $AB = 1\frac{12}{16}"$ and $CD = \frac{14}{16}"$. To find the difference, subtract the fractions.

Express length *AB* as an improper fraction. $AB = 1\frac{12}{16}" = \frac{28}{16}"$

Subtracting the fractions gives:
$\frac{28}{16}" - \frac{14}{16}" = \frac{14}{16}" = \frac{7}{8}"$

Converting to metric gives:
$\frac{7}{8}\text{ in}\bullet\frac{25.4\text{ mm}}{1\text{ in}} \doteq 22\text{ mm}$

Question 2, page 42

a. $0.001\text{ in}\bullet\frac{25.4\text{ mm}}{1\text{ in}} = 0.0254\text{ mm}$ or 0.03 mm

b. $4.9\text{ m}\bullet\frac{3.281\text{ ft}}{1\text{ m}} \doteq 16\text{ ft}$

c. 26 mi and 385 yd to km.

First convert yd to miles:

$385\text{ yd}\bullet\dfrac{1\text{ mi}}{1760\text{ yd}}=0.21875\text{ mi}$

$26\text{ mi}+0.21875\text{ mi}=26.21875\text{ mi}$

Next, convert miles to km: $26.21875\text{ mi}\bullet\dfrac{1.609\text{ km}}{1\text{ mi}}\doteq 42.19\text{ km}$

d. $3\frac{7}{8}\text{ in}=3.875\text{ in}\bullet\dfrac{2.54\text{ cm}}{1\text{ in}}$

$\doteq 9.84\text{ cm}$

Question 4, page 43

a. Measure the width of the closet in the diagram with a ruler and then see how many times it fits across the width of the suite. The width of the entire suite is approximately 3.5 closet widths. Since the total width of the suite is 2.8 m + 2.6 m = 5.4 m, the width of the closet is approximately $\dfrac{5.4\text{ m}}{3.5}\doteq 1.54\text{ m}$.

b. The width of the suite in the diagram is 3.6 cm. The actual width of the suite is 5.4 m or 540 cm.

The scale is 3.6 : 540 or 1 : 150.

c. The width of the closet in the diagram measures 1 cm. Applying the 1 : 150 scale, the closet is actually $1\text{ cm}\bullet 150=150\text{ cm}$ or 1.5 m wide, which is very close to the estimate in part a.

d. The dimensions are given as 2.8 m by 3.9 m.

$2.8\text{ m}\bullet\dfrac{3.281\text{ ft}}{1\text{ m}}\doteq 9.2\text{ ft}$

$3.9\text{ m}\bullet\dfrac{3.281\text{ ft}}{1\text{ m}}\doteq 12.8\text{ ft}$

Question 5, page 43

The first three units are given in metres, so convert them to yards using 1 m = 1.094 yd.

$365\text{ m}\bullet\dfrac{1.094\text{ yd}}{1\text{ m}}\doteq 399\text{ yd}$

$3745\text{ m}\bullet\dfrac{1.094\text{ yd}}{1\text{ m}}\doteq 4097\text{ yd}$ (Converting to miles gives $4097\text{ yd}\bullet\dfrac{1\text{ mi}}{1760\text{ yd}}\doteq 2.3\text{ mi}$)

$3491\text{ m} \cdot \frac{1.094\text{ yd}}{1\text{ m}} \doteq 3819\text{ yd}$ (Converting to miles gives $3819\text{ yd} \cdot \frac{1\text{ mi}}{1760\text{ yd}} \doteq 2.17\text{ mi}$)

100 cm can be converted to inches using 1 cm = 0.3937 in, so $100\text{ cm} \cdot \frac{0.3937\text{ in}}{1\text{ cm}} \doteq 39.4\text{ in}$.

Question 7, page 44

a. 3.5 ft per dog and 13 dogs gives $13 \cdot 3.5\text{ ft} = 45.5\text{ ft}$ of rope in total.

b. Feet convert nicely to metres using the conversion 1 ft = 0.3048 m.
$45.5\text{ ft} \cdot \frac{0.3048\text{ m}}{1\text{ ft}} \doteq 13.9\text{ m}$
13.9 m of rope is required.

Question 8, page 45

Convert the miles to km using 1 mi = 1.609 km. $28\text{ mi} \cdot \frac{1.609\text{ km}}{1\text{ mi}} \doteq 45.1\text{ km}$

The total distance is $45.1\text{ km} + 130\text{ km} = 175.1\text{ km}$.

Question 10, page 45

1 km = 0.6214 miles. Convert the distance travelled by Margaux to miles.

$164\text{ km} \cdot \frac{0.6214\text{ mi}}{1\text{ km}} \doteq 102\text{ mi}$

Comparing the two distances when both are expressed in miles, it can be seen that Penny traveled farther.

Question 12, page 45

The equatorial radius of the Earth is approximately 6380 km, which can be converted to miles as follows:

$6380\text{ km} \cdot \frac{0.6214\text{ mi}}{1\text{ km}} \doteq 3964.5\text{ mi}$. So, if you are standing on the North Pole you are

3964.5 mi – 13 mi = 3951.5 mi from the centre of the Earth.