

1.3 Converting Between SI and Imperial Systems

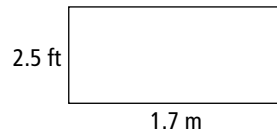
KEY IDEAS

- When solving problems involving measurement, it is necessary to work with the same units.
- You may need to convert units from one measurement system to another.
- Conversion Chart

Imperial	Metric
1 in.	2.54 cm (0.254 m)
1 ft	0.3048 m (30.48 cm)
1 yd	0.9144 m (defined as an exact conversion)
1 mi	1.609 km

Metric	Imperial
1 mm	0.0394 in.
1 cm	0.3937 in.
1 m	3.281 ft (39.37 in. or 1.094 yd)
1 km	0.6214 mi (3 280.84 ft)

- Conversions can be made using unit analysis or proportional reasoning.
Determine the perimeter of the rectangle.



Use unit analysis to convert 1.7 m to feet.
 $1 \text{ m} = 3.281 \text{ ft}$

$$(1.7 \text{ m})\left(\frac{3.281 \text{ ft}}{1 \text{ m}}\right) = 5.5777 \text{ ft}$$

Therefore, 1.7 m is approximately 5.58 ft.

The perimeter is:

$$P = 2(2.5) + 2(5.58)$$

$$P = 16.16$$

The perimeter of the rectangle is approximately 16.16 ft.

or Use proportional reasoning to convert 2.5 ft to metres.

Let x represent the number of metres in 2.5 ft.

$$1 \text{ ft} = 0.3048 \text{ m}$$

$$\frac{1 \text{ ft}}{0.3048 \text{ m}} = \frac{2.5 \text{ ft}}{x}$$

$$x = 0.762$$

Therefore, 2.5 ft is approximately 0.76 m.

The perimeter is:

$$P = 2(1.7) + 2(0.76)$$

$$P = 4.92$$

The perimeter of the rectangle is approximately 4.92 m.

Example

The land speed record is the fastest speed achieved on land by any wheeled vehicle. A turbofan-powered car holds the current record. The car reached a speed of 766.609 mph for one mile, breaking the sound barrier.

- Express the statement about the car's speed in kilometres per hour.
- At 15°C, the speed of sound is 1116 ft/s. This speed is given a measurement called Mach 1. How many miles per hour above Mach 1 was the car's top speed? How many kilometres per hour above Mach 1 was that speed?

Solution

- Convert 766.609 miles to kilometres using proportional reasoning.

$$1 \text{ mi} = 1.609 \text{ km}$$

Let x = the number of kilometres

$$\frac{1 \text{ mi}}{1.609 \text{ km}} = \frac{766.609 \text{ mi}}{x \text{ km}}$$

$$x \approx 1244.47 \text{ km}$$

Converting the measures to SI units, the statement would read: "The car reached a speed of 1244.47 km/h for 1.609 km, breaking the sound barrier."

- Convert 1116 ft/s to miles per hour using proportional reasoning.

$$1 \text{ mi} = 5280 \text{ ft} \text{ and } 1 \text{ h} = 3600 \text{ s.}$$

Let x = the number of feet in one hour or 3600 s.

$$\frac{1116 \text{ ft}}{1 \text{ s}} = \frac{x \text{ ft}}{3600 \text{ s}}$$

$$x = 4\,017\,600 \text{ ft}$$

Convert 4 017 600 ft to miles using unit analysis.

$$1 \text{ mi} = 5280 \text{ ft}$$

$$4\,017\,600 \text{ ft} \left(\frac{1 \text{ mi}}{5280 \text{ ft}} \right) = 760.91 \text{ mi}$$

Mach 1 is approximately 760.91 mph.

Therefore, the car exceeded Mach 1 by (766.609 mph – 760.91 mph) or 5.699 mph.

Convert 5.699 mi to kilometres using unit analysis.

$$1 \text{ mi} = 1.609 \text{ km}$$

$$5.699 \text{ mi} \left(\frac{1.609 \text{ km}}{1 \text{ mi}} \right) = 9.170 \text{ km}$$

The top speed of the car exceeded Mach 1 by 9.170 km/h.

A Practise

- Use your referent for an inch to estimate the total length of each line.
 - _____
 - _____
- Measure each of the lines in question 1. Express answers to the nearest eighth of an inch.

3. Use the following segment to complete parts a), b), and c).

X Y

- a) Measure segment XY to the nearest millimetre.
- b) Measure segment XY to the nearest $\frac{1}{16}$ in.
- c) Convert the answer in part a) to inches. Compare the conversion to your answer in part b). Are the answers the same? If not, explain a reason for the difference.
4. Convert each unit to the unit specified.
- a) The average growth rate for a teenage boy can be as high as $4\frac{1}{4}$ in. per year. (millimetre)
- b) The official distance of a marathon is 26 mi 385 yd. (hundredth of a kilometre)
- c) The length of a basketball court is 28.65 m. (tenth of a foot)
- d) The height of the model Easter egg in Vegreville, Alberta, is 163.2 in. (tenth of a centimetre)
5. The table lists tourist attractions in Saskatchewan. Complete the missing size for each item. Choose an appropriate unit for the conversion.

	Attraction	Size in SI	Size in Imperial
a)	Surveyor	height: 3.7 m	
b)	Tomahawk and Teepee		height: 39.4'
c)	Whooping Crane	wingspan: 2100 cm	
d)	Mac the Moose		height: 384"
e)	Wheat	height: 13.1 m	

B Apply

- ☆6. In a triathlon, competitors swim for 1.5 km, run a distance that is $6\frac{2}{3}$ times the length of the swim, and ride a bike for a distance that is 4 times the length of the run.
- a) Compute the length of each part of the triathlon to the nearest tenth of a kilometre.
- b) Compute the length of each part of the triathlon to the nearest tenth of a mile.
- c) What is the total distance of the competition in kilometres? in miles?
7. Use the list of rivers below that flow into the Arctic Ocean to answer the questions.

River	Length
Liard	1 019 556 yd
Smoky	492 000 m
Athabasca	1231 km
Peace	1195 mi

- a) Which river is longest?
- b) What is the total length, in kilometres, of the four rivers?
- c) How many times longer is the longest river than the shortest river?
- ☆8. Molly purchased a pattern to make a coat. The pattern gives the measurements for the amount of material needed in imperial units for two widths of fabric. The coat requires 2 yd of fabric 45" wide, or $1\frac{3}{4}$ yd of fabric 60" wide.
- a) Convert the measurements to SI units.
- b) If Molly chooses the first width, how many square metres of fabric will she buy? What is the area of the wider material? How do the two areas compare? Which width would you choose to end up with a lesser amount of fabric left over?

9. The relay that crisscrossed Canada to bring the torch to Vancouver for the 2010 Olympic Winter Games covered a total distance of approximately 28 000 mi. Torch bearers carried the flame for about 2240 of those miles.
- If each person in the relay carried the torch for 300 m, approximately how many people took part?
 - The relay started in Victoria on October 30, 2009, and ended in Vancouver on February 12, 2010. Approximately how far, to the nearest kilometre, was the torch carried each day? What assumptions are you making?
- d) Show how you can use mental mathematics to verify the reasonableness of your response in part a).
12. The screen of a cell phone measures $3.84 \text{ cm} \times 2.88 \text{ cm}$.
- What is the area of the screen in square millimetres? in square inches?
 - If the screen has a resolution of $160 \text{ pixels} \times 120 \text{ pixels}$, what is the size of a pixel in square millimetres? in square inches?

C Extend

★10. Savario is driving to Brandon, Manitoba, at a fairly constant speed. At 4:30 p.m., he is 240 km from his destination. At 7:00 p.m., he passes an old highway sign that gives the distance to Brandon as 25 mi. If Savario continues at the same rate of speed, will he arrive by 7:30 p.m.? If not, when will he arrive? What assumptions must you make?

11. a) Your cousins from the United States are driving to visit you in St. Walburg, Saskatchewan. The speedometer in their vehicle shows that they are travelling at 53 mph along a secondary road. Are they within the speed limit if the posted maximum speed is 80 km/h?
- b) The route your cousins are taking includes a stretch of four-lane highway where the maximum speed limit is 110 km/h. What will their speed be in miles per hour if they drive at the limit?
- c) Your cousins call you when they reach Turtleford. You tell them they are only 34 km from St. Walburg. How long will it take them to drive the remaining distance if they travel at an average speed of 45 mph?

D Create Connections

13. The adult height of a girl can be predicted using the formula:

$$\frac{(\text{father's height} - 5'' + \text{mother's height})}{2},$$

where the height of each parent is given in inches.

A boy's adult height can be predicted using the formula:

$$\frac{(\text{father's height} + 5'' + \text{mother's height})}{2},$$

where the height of each parent is given in inches.

- Suppose your father's height is 6 ft and your mother's height is 5 ft 5 in. Use the appropriate formula to predict your height as an adult measured in inches.
 - Convert the formula you used to work with SI units. Predict your height as an adult in SI units.
14. Using the conversion factor $1 \text{ ft} = 30.48 \text{ cm}$, show how to convert from a large imperial unit to a smaller SI unit.