Lesson - Metric and imperial units, perimeter, area and volume

Year: Year 5

Hello, I am Otto! We measure the world in units. We use centimetres and metres for length, grams and kilograms for mass, and millilitres and litres for capacity. Some people also use inches, feet, pints and pounds. In this chapter you change between units, find the perimeter and area of shapes and begin to measure volume by counting cubes.

Starter activity

Find a ruler. Measure the length of your pencil in centimetres and then in millimetres. Now measure the width of your desk using a metre stick. Which unit was easiest to use for each? Notice how 10 mm make 1 cm and 100 cm make 1 m. Keep these facts in mind as you read the rules below.

Metric units

Definition: metric units

Metric units are based on 10, 100 and 1,000. For length we use millimetres (mm), centimetres (cm), metres (m) and kilometres (km). For mass we use grams (g) and kilograms (kg). For capacity we use millilitres (ml) and litres (l).

Length	Mass	Capacity
10 mm = 1 cm	1,000 g = 1 kg	1,000 ml = 1 l
100 cm = 1 m		1 l = 100 cl
1,000 m = 1 km		

Rule: changing between units

To change from a **bigger** unit to a **smaller** unit, **multiply** by 10, 100 or 1,000, because you need more small units. To change from a smaller unit to a bigger unit, **divide**.

Example 1

Change 3.5 km to metres, and 4,500 g to kilograms.

Kilometres to metres: bigger to smaller, so multiply by 1,000. 3.5 × 1,000 = **3,500 m**. Grams to kilograms: smaller to bigger, so divide by 1,000. 4,500 ÷ 1,000 = **4.5 kg**.

Example 2

A jug holds 2.4 litres of juice. How many 200 ml glasses can be filled?

2.4 l = 2.4 × 1,000 = 2,400 ml. 2,400 ÷ 200 = **12 glasses**.

Imperial units

Key fact: approximate equivalents

Some people in Britain still use **imperial units**. You should know these rough equivalents: 1 inch is about 2.5 cm; 1 foot is about 30 cm; 8 km is about 5 miles; 1 kg is about 2.2 pounds (lb); 1 pint is about 570 ml; 1 gallon is about 4.5 litres.

Example 3

A table is 3 feet long. About how long is it in centimetres? A recipe needs 2 pints of milk. About how many millilitres is that?

3 feet ≈ 3 × 30 = **90 cm**. 2 pints ≈ 2 × 570 = **1,140 ml**.

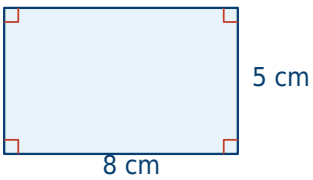
Watch out

The imperial equivalents are only approximate, so use the sign ≈ and say "about". Also, never mix units in a calculation. Change everything into the same unit first, for example change metres to centimetres before you add them to centimetres.

Perimeter

Definition: perimeter

The **perimeter** of a shape is the total distance around its edge. It is measured in units of length such as cm or m.



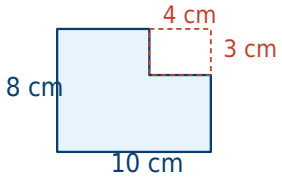
Rule: perimeter of a rectangle

A rectangle has two long sides and two short sides. Perimeter = 2 × (length + width). For the rectangle above: 2 × (8 + 5) = 2 × 13 = **26 cm**.

Example 4

A rectangular field is 120 m long and 80 m wide. How far is it round the field? How many times must Ravi run round to cover 1 km?

Perimeter = 2 × (120 + 80) = 2 × 200 = **400 m**. 1 km = 1,000 m, and 1,000 ÷ 400 = 2.5. Ravi must run round **2 and a half times**.



Example 5

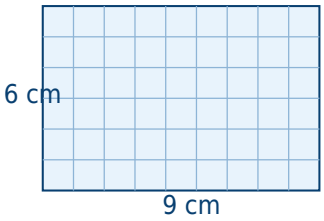
Find the perimeter of the L-shape above.

The shape is a 10 cm by 8 cm rectangle with a 4 cm by 3 cm corner removed. Cutting a corner out of a rectangle does not change the perimeter, so the perimeter is the same as the rectangle: 2 × (10 + 8) = **36 cm**. You can check by adding all six sides: 10 + 3 + 4 + 5 + 6 + 8 = 36.

Area

Definition: area

The **area** of a shape is the amount of flat space inside it. We measure it in square units, such as square centimetres (cm²) or square metres (m²). One square centimetre is a square with sides of 1 cm.



Rule: area of a rectangle

Area of a rectangle = length × width. The rectangle above is 9 cm by 6 cm, so its area is 9 × 6 = **54 cm²**. It is the same as counting the 54 small squares.

Method: area of a composite shape

1. Split the shape into rectangles, or imagine a bigger rectangle with a corner taken away.
2. Find the area of each part (or of the big rectangle and the corner).

3. Add the parts together, or subtract the missing corner.
4. Write the answer in square units.

Example 6

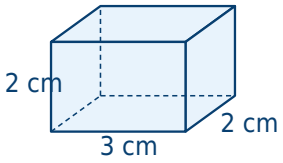
Find the area of the L-shape that is a 10 cm by 8 cm rectangle with a 4 cm by 3 cm corner removed.

Area of the big rectangle: $10 \times 8 = 80$ cm². Area of the corner removed: $4 \times 3 = 12$ cm². Area of the L-shape: $80 - 12 =$ **68 cm²**.

Volume

Definition: volume

Volume is the amount of space inside a solid shape. We estimate it by counting how many 1 cm cubes fit inside. A cube with edges of 1 cm has a volume of 1 cubic centimetre, written 1 cm³.



Example 7

A cuboid is made of 1 cm cubes. It is 3 cubes long, 2 cubes wide and 2 cubes high. What is its volume?

The bottom layer has $3 \times 2 = 6$ cubes. There are 2 layers, so $6 \times 2 =$ **12 cm³**.

Did you know?

The metric system was invented in France in the 1790s to give the world a single, simple set of measures based on 10. The metre was first defined as one ten-millionth of the distance from the North Pole to the equator. Britain used imperial measures for much longer and still uses miles on road signs today.

Otto's tip

Before you calculate, check the units. Write the unit with every answer: cm for perimeter, cm² for area and cm³ for volume. If your answer for an area has no little 2 on the unit, you may have found a perimeter instead!