

Measurement

Many practical problems involve measurements. In Britain there are two systems of measurement, the metric system and the Imperial measures system. Whilst many things are now measured using the metric system the Imperial system is still widely used.

Metric System

The advantage of the metric system over the imperial is the ease with which one unit can be converted to another.

The metric system is a decimal system and units are converted by multiplying or dividing by powers of 10 (e.g. 10, 100, 1000).

Each prefix to a standard measure (e.g. metre, gram, litre) indicates the relative size:

kilo (k) means 1000 x

hecto (H) means 100 x

deka (D) means 10 x

deci (d) means 1/10 x

centi (c) means 1/100 x

milli (m) means 1/1000 x

Multiplying/Dividing Numbers By 10, 100, 1 000 etc.

To multiply any whole number by 10 is easy; we simply put a zero on the end of the number, for example

(i) $3 \times 10 = 30$

(ii) 10×7 is the same as $7 \times 10 = 70$, since the order of the numbers is not important when multiplying.

Extending this idea a little further, to multiply a whole number by 100, we put two zeros on the end, and to multiply by 1 000 we put three zeros on the end, so that

(iii) $5 \times 100 = 500$

(iv) $9 \times 1000 = 9\ 000$

In actual fact we are moving the decimal point so many places to the right.

Multiplying by **10** moves the decimal point **one place to the right**.

Multiplying by **100** moves the decimal point **two** places to the right.

Multiplying by **1000** moves the decimal point **three** places to the right.

$2.96 \times 10 = 29.6$

$3.4 \times 1000 = 3\ 400$

$30.05 \times 100 = 3\ 005$

$6.9 \times 100 = 690$

Dividing Numbers By 10, 100, 1 000 etc.

Look at these examples:

(a) $150 \div 10 = 15$ (b) $680 \div 10 = 68$ (c) $400 \div 10 = 40$

The following pattern should be clear: If a number is divided by 10 it seems to lose the last 0. That is 150 becomes 15; 680 becomes 68 and 400 becomes 40.

$3\ 500 \div 100 = 35$ $95\ 000 \div 100 = 950$ $4\ 700 \div 100 = 47$
 $48\ 000 \div 1\ 000 = 48$ $8\ 150\ 000 \div 1\ 000 = 8\ 150$

When dividing by 10, 100 and 1000 we simply move the decimal point so many places to the left.

$234 \div 10 = 23.4$ $234 \div 100 = 2.34$
 $23.4 \div 10 = 2.34$ $23.4 \div 100 = 0.234$
 $74.9 \div 1000 = 0.0749$ $5008 \div 100 = 50.08$

Length

Standard unit - the metre (m)

Other units the millimetre (mm), the centimetre (cm), the kilometre (km).

Weight

Standard unit - the kilogram (kg)

Other units the milligram (mg), the gram (g), the tonne (T).

Capacity

Capacity measures how much something holds and volume measures how much space something occupies. (Volume is measured in m^3 , cm^3 or mm^3).

Standard unit - the litre (l)

Other units the millilitre (ml), the centilitre (cl).

The table below gives the common metric measures. You will be expected to know these and how to convert from one metric measure to another.

<i>Length</i>	<i>Weight</i>	<i>Capacity</i>
1 km = 1000 m	1 T = 1000 kg	1 l = 1000 ml
1 m = 100 cm	1 kg = 1000 g	1 l = 100 cl
1 cm = 10 mm	1 g = 1000 mg	1 cl = 10 ml

Examples

1. Convert 43 kilograms to grams.

Here we are converting from kg to grams. 1 gram is smaller than 1 kg so there will be more grams than kg in any weight. We need to multiply.

There are _____g in 1 kg,

so there are $43 \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ g

2. Convert 1 670 000 cm to km.

Here we are converting from cm to km. 1 km is much bigger than 1 cm so there will be less km than cm in any distance. We need to divide.

In the above table we do not have a direct conversion from cm to km, so we first convert from cm to m and then from m to km.

There are _____cm in 1 m so

$1\ 670\ 000\ \text{cm} = \underline{\hspace{2cm}} \div \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ m

There are _____ m in a km,

so _____m = _____ \div _____ = _____ km

Hence $1\ 670\ 000\ \text{cm} = \underline{\hspace{2cm}}$ km.

Exercise 4A

- | | |
|---------------------------|---------------------------|
| 1. Convert 25 km into cm. | 2. Convert 5 T into mg. |
| 3. Convert 9 l to cl. | 4. Convert 5500 ml to l. |
| 5. Convert 4500 g to kg. | 6. Convert 18000 mm to m. |

Imperial Measures

The Imperial system is sometimes referred to as the measurements of the Empire.

Length

Standard unit - the foot (ft)

Other units the inch (in), the yard (yd), the mile.

Weight

Standard unit - the pound (lb)

Other units the ounce (oz), the stone (st), the ton.

Capacity and Volume

Standard unit - the pint (pt)

Other units the fluid ounce (fl.oz), the quart (qt), the gallon (gal).

Some examples of Imperial measure conversions are:

<i>Length</i>		<i>Weight</i>		<i>Capacity</i>	
1 mile =	1760 yd	1 ton =	160 st	1 gal =	8 pt
1 yd =	3 ft	1 st =	14 lb	1 pt =	20 fl.oz
1ft =	12 in	1 lb =	16 oz		

Examples

1. Convert 2 miles to feet.

In the above table we do not have a direct conversion from miles to ft, so we first convert from miles to yd and then from yd to ft.

There are _____ yd in 1 mile so

$$2 \text{ miles} = \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ yd}$$

There are _____ ft in a yd,

$$\text{so } \underline{\hspace{2cm}} \text{ yd} = \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ ft}$$

$$\text{Hence } 2 \text{ miles} = \underline{\hspace{2cm}} \text{ ft.}$$

2. Convert 1600 stones to tons.

There are _____ st in 1 ton so

$$1 \text{ 600 st} = \underline{\hspace{2cm}} \div \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ ton}$$

Exercise 4B

- | | |
|-------------------------------------|-----------------------------------|
| 3. Convert 3 pints to fluid ounces. | 4. Convert 756 inches to yards. |
| 5. Convert 4 stones to ounces. | 6. Convert 1760 fl.oz to gallons. |

Converting Imperial to Metric and Vice Versa

You do not need to know exact conversion values, but will be expected to know the following approximate conversions:

<i>Metric</i>	<i>Imperial</i>
8 km	5 miles
1 m	39 in
2.5 cm	1 in
1 kg	2.2 lb
1 litre	$1\frac{3}{4}$ pints
4.5 litres	1 gallon

Examples

- Convert 25 kg to pounds.

Here we are converting from kg to pounds. 1 pound is smaller than 1 kg so there will be more pounds than kg in any weight. We need to multiply.

There are _____ lb in 1 kg,

so there are $25 \times$ _____ = _____ lb

- Convert 99 lb to kilograms.

There are _____ lb in 1 kg so

$99 \text{ lb} =$ _____ \div _____ = _____ kg

Exercise 4C

- Convert 640 miles to km.
- Convert 72 km to miles.
- Convert 22.5 miles to metres.
- Convert 68 litres into gallons.
- Convert 3.5 in into cm.
- Convert 17 pints into litres.
- Convert 176 oz to kg.
- Convert 4.8 metres into in.