



Unit conversion

Learning objectives

- 1 Recognise the units of measurement we use in chemistry.
- 2 Convert between different units of measurement.
- 3 Know when we need to convert between units.

Introduction

In chemistry, we measure many different quantities, such as mass, volume and length. Each quantity has a standard unit, but measurements can also be expressed in larger or smaller versions of that unit. For example, mass can be measured in kilograms (kg), grams (g) and milligrams (mg). Volume can be measured in litres (L), millilitres (ml), cubic centimetres (cm³) and cubic decimetres (dm³).

While litres are used in mathematics and everyday labelling of measuring equipment, cubic decimetres (dm³) are the preferred unit for chemical calculations. These units have the same value, where 1 litre (L) is equal to 1 dm³ and 1 millilitre (ml) is equivalent to 1 cubic centimetre (cm³).

Knowing how to convert between units is essential because some equations in chemistry only work if you use a specific unit. For example, the concentration formula uses volume in dm³ so if you put in cm³ by mistake, the answer will be 1000 times too large or too small.

You need to convert to the same unit when you want to compare values that have been measured in different units. The table below shows the most important units for secondary phase chemistry. You may come across many others, but these are the most common.

Prefix	Symbol	What the prefix means	Example
kilo	k	× 1000 (one thousand times bigger than the base unit)	1 kg = 1000 g
deci	d	0.1 × base unit (one tenth of the base unit)	1 dm = 0.1 m
centi	c	0.01 × base unit (one hundredth of the base unit)	1 cm = 0.01 m
		base unit (such as g or m)	1 m = 1 m
milli	m	0.001 × base unit (one thousandth of the base unit)	1 mg = 0.001 g
micro	μ	0.000001 × base unit (one millionth of the base unit)	1 μg = 0.000001 g
nano	n	0.000000001 × base unit (one billionth of the base unit)	1 nm = 0.000000001 m



How to convert between units

Step 1: Identify the conversion factor (how many of the smaller units fit into one of the larger units).

Step 2: If you are converting to a **smaller** unit (e.g. kg into g), **multiply** by the conversion factor.

Step 3: If you are converting to a **larger** unit (e.g. cm^3 into dm^3), **divide** by the conversion factor.

Worked example 1

Convert 2400 cm^3 into dm^3 .

Conversion factor: There are 1000 cm^3 in 1 dm^3 .

We are converting to a larger unit, so we divide by the conversion factor.

$$2400 \div 1000 = 2.4 \text{ dm}^3$$

Worked example 2

Convert 0.35 g into mg .

Conversion factor: There are 1000 mg in 1 g .

We are converting to a smaller unit, so we multiply by the conversion factor.

$$0.35 \times 1000 = 350 \text{ mg}$$



Questions

1. Convert the following measurements. Show your working.

(a) 3.5 kg into g

(b) 250 mg into g

(c) 4200 cm³ into dm³

(d) 0.6 dm³ into cm³

(e) 2.12 L into dm³

(f) 85 cm into m

2. A learner measures the length of one side of a cube as 30 mm. Calculate the surface area of the cube in cm². Show your working.



3.

(a) In a rate of reaction experiment, a learner measures one face of a marble chip as 8 mm by 5 mm. Calculate the area of this face. Show your working.

(b) Convert the surface area from part (a) into cm^2 . Show your working.

4. A learner added 32.50 cm^3 of hydrochloric acid to a beaker. Convert this volume into dm^3 . Show your working.

5. A learner weighs out 2.40 g of copper sulfate using a digital balance.

(a) Convert 2.40 g into kg

(b) Convert 2.40 g into mg

(c) Which of these units (mg, g or kg) do you think is most suitable to use in the results table for the learner's experiment? Explain why you chose this unit.



6. A reaction releases 8.4 kJ of energy. A scientist looks up the expected value online and finds an answer of 8400 J.

(a) Write kJ in words.

(b) Write J in words.

(c) Do the experimental values and the online values match? Explain your answer.

(d) A second reference source quotes the value for the reaction in megajoules.

1 MJ = 1 000 000 J

Convert 8.4 kJ into MJ
