

Stage 1 

Understanding number: unit conversion



Introduction

Unit conversion is important in chemistry and in everyday life. Using the wrong amount of a substance can lead to serious and expensive mistakes.

For example, if you used 50 mg of butter instead of 50 g when baking a cake, the cake would turn out very dry and hard.

In the same way, if someone added one litre of chemical to treat a fish tank instead of one millilitre, it could harm the fish.



Learning objectives

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



Lesson questions

Today, we will be covering the maths skills needed to answer the following questions:

1. The **diameter** of gold nanoparticles used in biosensors is 20 nanometres (nm). Convert the diameter of one gold nanoparticle into micrometres (μm).
2. A student used titration to find the reacting volumes of hydrochloric acid and sodium hydroxide solution. They began by measuring out 0.05 dm^3 of sodium hydroxide solution and placed it into a conical flask. Convert this **volume** into cm^3 .



Types of units

In science and maths, the most common units include those for length, mass and volume.

Look at these units and place them under the correct heading:

g m kg km ml cm mg L dm³ mm dm³ µm t nm

Volume	Mass	Length



Types of units – answer

Volume	Mass	Length
ml	g	m
L	kg	km
dm ³	mg	cm
dm ³	t	µm
		mm
		nm



Prefix check

Do you know what the prefix is for each of these symbols?

Symbol	Prefix	Value	Power of 10
M		1000 000	10^6
k	kilo	1000	10^3
	base unit	1	10^0
d		0.1	10^{-1}
c		0.01	10^{-2}
m		0.001	10^{-3}
μ		0.000001	10^{-6}
n		0.0000000001	10^{-9}



Prefix check – answer

Symbol	Prefix	Value	Power of 10
M	mega	1000 000	10^6
k	kilo	1000	10^3
	base unit	1	10^0
d	deci	0.1	10^{-1}
c	centi	0.01	10^{-2}
m	milli	0.001	10^{-3}
μ	micro	0.000001	10^{-6}
n	nano	0.000000001	10^{-9}



Unit names and symbols

Complete the columns to show the unit names and symbols in brackets.

Symbol	Prefix	Length	Mass	Volume
k	kilo	kilometre (km)		
	base unit	metre (m)	gram (g)	cubic metre
d	deci			
c	centi			
m	milli		milligram (mg)	
μ	micro			
n	nano			cubic nanometre (nm ³)



Unit names and symbols

Symbol	Prefix	Length	Mass	Volume
k	kilo	kilometre (km)	kilogram (kg)	cubic kilometre (km ³)
	base unit	metre (m)	gram (g)	cubic metre (m ³)
d	deci	decimetre (dm)	decigram (dg)	cubic decimetre (dm ³)
c	centi	centimetre (cm)	centigram (cg)	cubic centimetre (cm ³)
m	milli	millimetre (mm)	milligram (mg)	cubic millimetre (mm ³)
μ	micro	micrometre (μm)	microgram (μg)	cubic micrometre (μm ³)
n	nano	nanometre (nm)	nanogram (ng)	cubic nanometre (nm ³)

Conversion factor

What is a conversion factor?

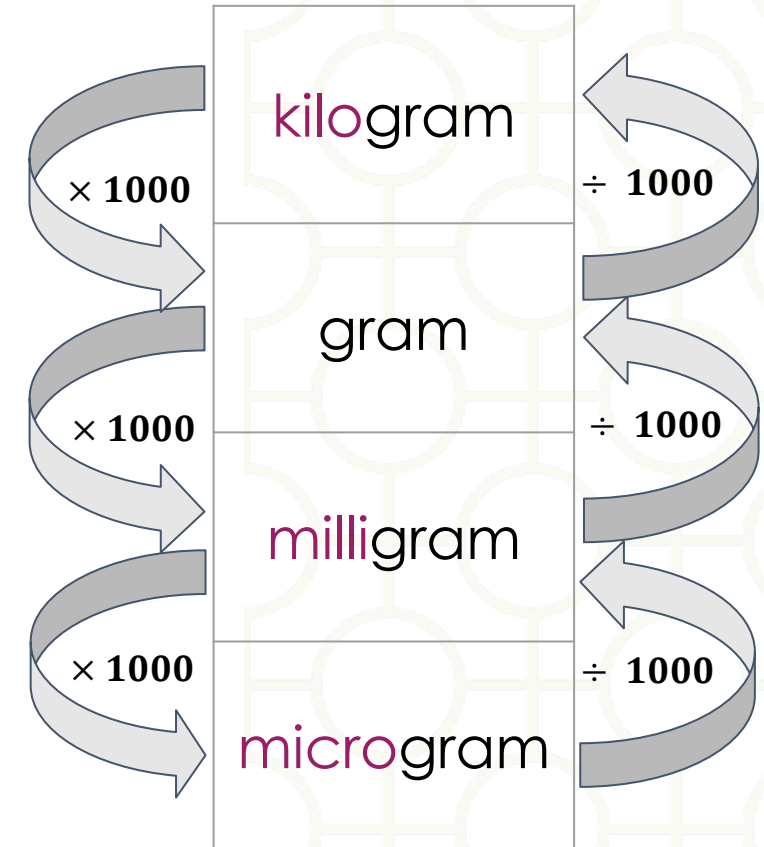
A conversion factor is the number you multiply or divide by to convert a measurement from one unit to another.

When we convert from a **smaller unit** into a **larger unit**, we **divide** by the conversion factor.

- Will the number get bigger or smaller?

When we convert from a **larger unit** to a **smaller unit**, we **multiply** by the conversion factor.

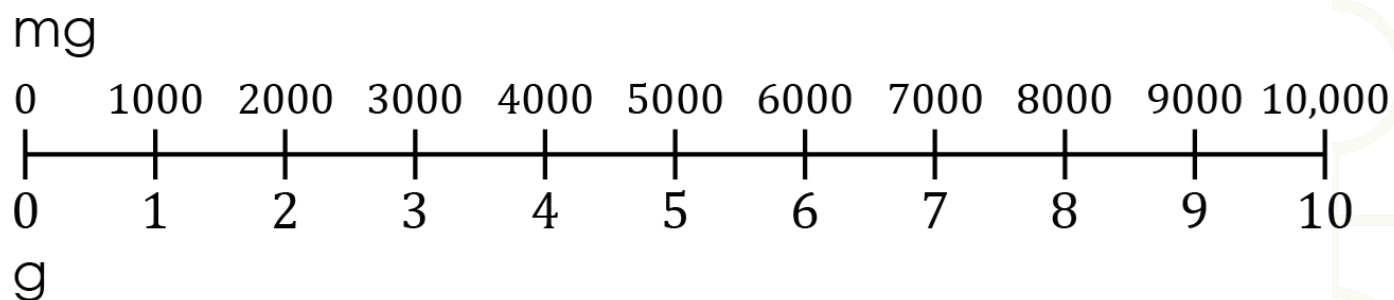
- Will the number get bigger or smaller?



Number line

A number line can be used to help with unit conversions.

What is 1 g **equivalent** to in mg?



Use the number line to complete the following unit conversions:

- a) Convert 2000 mg into g
- b) Convert 8 g into mg
- c) Convert 10 g into mg
- d) Convert 2.5 g into mg
- e) Convert 500 mg into g



Number line – answers

- a) 2 g
- b) 8000 mg
- c) 10 000 mg
- d) 2500 mg
- e) 0.5 g

Convert 350 g into kg

Identify the conversion factor

Conversion factor is 1000 as $1 \text{ kg} = 1000 \text{ g}$

Is the **unit** going to become larger or smaller? Is the answer going to be larger or smaller?

The unit is going to become larger so the number will be smaller

Do we multiply or divide by the conversion factor?

Going from a small unit (g) to a larger unit (kg) then we divide

Calculate

$$350 \div 1000 = 0.35 \text{ kg}$$

Carry out a sense check

0.35 kg is smaller than 350 g, so this makes sense.

Convert 0.45 L into ml

Identify the conversion factor

Is the **unit** going to become larger or smaller? Is the answer going to be larger or smaller?

Do we multiply or divide by the conversion factor?

Calculate

Carry out a sense check

Convert 350 g into kg	Convert 0.45 l into ml
Identify the conversion factor Conversion factor is 1000 as 1 kg = 1000 g Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? The unit is going to become larger so the number will be smaller Do we multiply or divide by the conversion factor? Going from a small unit (g) to a larger unit (kg) then we divide Calculate $350 \div 1000 = 0.35 \text{ kg}$ Carry out a sense check: 0.35 is a smaller number than 350 so this makes sense.	Identify the conversion factor Conversion factor is 1000 as 1 L = 1000 ml Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? The unit is going to be smaller and so the number will be larger Do we multiply or divide by the conversion factor? Going from a larger unit (L) to a smaller one (ml) so we multiply Calculate $0.45 \times 1000 = 450 \text{ ml}$ Carry out a sense check 450 is larger than 0.45 so this makes sense.



Converting volume units

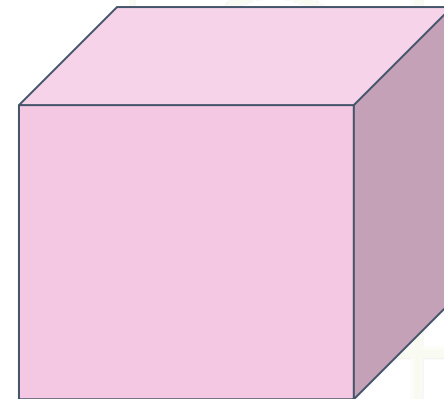
The units for volume can be confusing as there are different units used.

Can you remember any units which are used for measuring volume?

Relationship between units	Conversion factor
1 litre (L) = 1000 millilitres (ml)	1000
1 dm³ = 1 litre	1 (they are equivalent)
1 dm ³ = 1000 cm ³	1000
1 cm³ = 1 ml	1 (they are equivalent)

This cube has sides which measure 10 cm.

What is the volume of this cube in dm³?



Convert 0.25 dm^3 into cm^3	Convert 150 cm^3 into dm^3
Identify the conversion factor 1000 ($1 \text{ dm}^3 = 1000 \text{ cm}^3$) Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? cm^3 is smaller than dm^3 so, the answer will be larger Do we multiply or divide by the conversion factor? Multiply Calculate $0.25 \times 1000 = 250 \text{ cm}^3$ Carry out a sense check 250 is larger than 0.25 so this makes sense.	Identify the conversion factor Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? Do we multiply or divide by the conversion factor? Calculate Carry out a sense check

Convert 0.25 dm ³ into cm ³	Convert 150 cm ³ into dm ³
Identify the conversion factor 1000 (1 dm³ = 1000 cm³) Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? cm³ is smaller than dm³ so, the answer will be larger Do we multiply or divide by the conversion factor? Multiply Calculate 0.25 × 1000 = 250 cm³ Carry out a sense check 250 is larger than 0.25 so this makes sense.	Identify the conversion factor Conversion factor is 1000. Is the unit going to become larger or smaller? Is the answer going to be larger or smaller? dm³ is a bigger unit than cm³ so, the answer will be smaller. Do we multiply or divide by the conversion factor? Divide Calculate 150 ÷ 1000 = 0.15 dm³ Carry out a sense check 0.15 is smaller than 150, so this makes sense.



Chemistry context

A student has 2.5 litres of a solution. They need the volume in cm^3 .

How many cm^3 of solution do they have?



Chemistry context – answer

2.5 litres is equivalent to 2.5 dm^3

$$2.5 \times 1000 = 2500 \text{ cm}^3$$

Returning to the lesson questions

1. The **diameter** of gold nanoparticles used in biosensors is 20 nanometres (nm). Convert the diameter of one gold nanoparticle into micrometres (μm).
2. A student used titration to find the reacting volumes of hydrochloric acid and sodium hydroxide solution.

They began by measuring out 0.05 dm^3 of sodium hydroxide solution and placed it into a conical flask.

Convert this **volume** into cm^3 .

Returning to the lesson questions – answers

1. **Step 1:** Conversion factor is **1000** (as 1 μm is equivalent to 1000 nm).

Step 2: We are moving to a larger unit, so the answer will be smaller.

Step 3: We divide.

Step 4: $20 \div 1000 = 0.02 \mu\text{m}$

2. **Step 1:** Conversion factor is **1000** ($1 \text{ dm}^3 = 1000 \text{ cm}^3$)

Step 2: We are moving from dm^3 to cm^3 so we are going to a smaller unit, and the number will be larger.

Step 3: We multiply.

Step 4: $0.05 \times 1000 = 50 \text{ cm}^3$

Acknowledgements

Image of chocolate cake on slide 2 © Lumora Pixels/Shutterstock

Image of fish tank on slide 2 © Solarisys/Shutterstock