

Stage 1 

Understanding number: unit conversion



Introduction

Unit conversion is very important in chemistry and in everyday life. Using the wrong amount of a substance could 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 1 litre of chemical to treat a fish tank instead of 1 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.

Identify the conversion factor

1. For each pair of units, write down the conversion factor and state whether you would multiply or divide to convert from the first unit to the second unit.

- a) kg to g
- b) mm to m
- c) μm to nm
- d) cm^3 to dm^3

2. Convert the following and show your workings.

- a) 4.5 kg to g
- b) 250 cm^3 to dm^3
- c) 6200 mm to m
- d) 0.75 g to mg

Identify the conversion factor – answers

Question 1:

- a) Conversion factor: $1 \text{ kg} = 1000 \text{ g}$. Multiply (by 1000).
- b) Conversion factor: $1 \text{ m} = 1000 \text{ mm}$. Divide (by 1000).
- c) Conversion factor: $1 \text{ }\mu\text{m} = 1000 \text{ nm}$. Multiply (by 1000).
- d) Conversion factor: $1 \text{ dm}^3 = 1000 \text{ cm}^3$. Divide (by 1000).

Question 2:

- a) Conversion factor: $1 \text{ kg} = 1000 \text{ g}$, g is smaller, the answer gets bigger, so we multiply. $4.5 \times 1000 = 4500 \text{ g}$.
- b) Conversion factor: $1 \text{ dm}^3 = 1000 \text{ cm}^3$, dm^3 is bigger, the answer gets smaller, so we divide. $250 \div 1000 = 0.25 \text{ dm}^3$.
- c) Conversion factor: $1 \text{ m} = 1000 \text{ mm}$, m is bigger, the answer gets smaller, so we divide. $6200 \div 1000 = 6.2 \text{ m}$.
- d) Conversion factor: $1 \text{ g} = 1000 \text{ mg}$, mg is smaller, the answer gets bigger, so we multiply. $0.75 \times 1000 = 750 \text{ mg}$.

Using the correct units

Look at the scenario below, the student's answer is not correct. Identify the mistake and give the correct answer.

A student wants to calculate the concentration of a solution. They have **0.5 mol** of sodium chloride dissolved in **500 cm³** of water.

The formula to calculate concentration is:

$$\text{concentration} = \frac{\text{moles}}{\text{volume}} \quad (\text{volume must be in dm}^3)$$

The student writes:

$$\text{concentration} = \frac{0.5}{500} = 0.001 \text{ mol/dm}^3$$

Using the correct units – answers

Step 1: convert the volume from cm^3 to dm^3

- Conversion factor: $1 \text{ dm}^3 = 1000 \text{ cm}^3$
- Is the unit getting bigger or smaller? dm^3 is bigger than cm^3 .
- Is the answer getting bigger or smaller? Smaller (fewer dm^3 than cm^3).
- Do we multiply or divide? Divide by 1000.
- $500 \div 1000 = 0.5 \text{ dm}^3$

Step 2: calculate concentration

$$\text{concentration} = \frac{\text{moles}}{\text{volume}}$$
$$\text{concentration} = \frac{0.5}{0.5} = 1 \text{ mol/dm}^3$$

The correct answer is 1 mol/dm^3 .

Using the correct units 2

Look at the scenario below, the learner's answer is not correct. Identify their mistake and give the correct answer.

A learner calculates the density of a metal block using the correct equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

The mass of the metal block is 2400 mg and its volume is 6.0 cm³.

The learner writes that density is $2400 \div 6.0 = 400 \text{ g/cm}^3$.

Using the correct units 2 – answer

The learner used the mass in mg (2400 mg) instead of converting it to grams first. The density unit is g/cm^3 , so the mass must be in grams.

Step 1: convert the mass from mg to g

- Conversion factor: $1 \text{ g} = 1000 \text{ mg}$
- Is the unit getting bigger or smaller? g is bigger than mg.
- Is the answer getting bigger or smaller? Smaller (fewer grams than milligrams)
- Do we multiply or divide? Divide by 1000
- $2400 \div 1000 = 2.4 \text{ g}$

Step 2: calculate density

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{density} = \frac{2.4}{6.0} = 0.4 \text{ g/cm}^3$$

The correct answer is 0.4 g/cm^3 .

Discussing unit conversion

A learner needs to calculate the concentration of a solution. They measure out 0.25 dm^3 of water and dissolve 5.0 g of salt in it. They need to convert the volume to cm^3 before using it in a different calculation.

Three learners are discussing how to convert the volume.

Which learner is correct? Explain why the other two learners are wrong.

The answer is 25 cm^3 . There are 100 cm in 1 dm , so there are 100 cm^3 in 1 dm^3 . I multiply by 100
 $0.25 \times 100 = 25 \text{ cm}^3$.

Learner A

The answer is 250 cm^3 . Volumes are cubed, so $1 \text{ dm}^3 = 10 \times 10 \times 10 = 1000 \text{ cm}^3$. I multiply by 1000
 $0.25 \times 1000 = 250 \text{ cm}^3$

Learner B

The answer is 2500 cm^3 . I need to make the number bigger because cm^3 is a smaller unit, so I multiply by $10,000$.

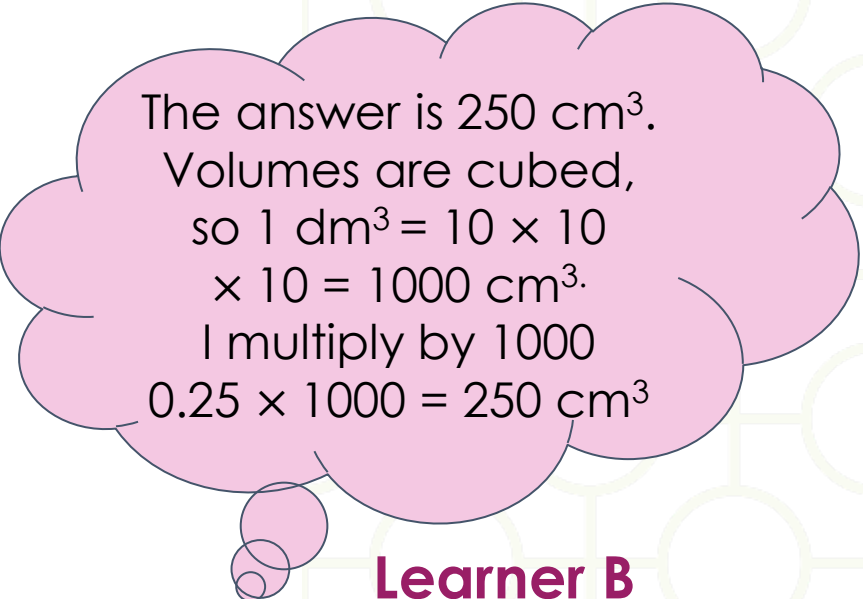
Learner C

Discussing unit conversion – answer

Learner B is correct.

Learner A is incorrect. Learner A got 25 cm^3 by multiplying by 100. This is wrong because they confused the cm-to-m relationship ($100 \text{ cm} = 1 \text{ m}$) with the cm-to-dm relationship. There are only 10 cm in 1 dm. Volumes are cubed:
 $1 \text{ dm}^3 = 10 \times 10 \times 10 = 1000 \text{ cm}^3$, not 100 cm^3 .

Learner C is incorrect. They got 2500 cm^3 by multiplying by 10,000. This is wrong because $1 \text{ dm}^3 = 10 \times 10 \times 10 = 1000 \text{ cm}^3$, not 10,000 cm^3 . Learner C multiplied by 10,000 instead of 1000.



The answer is 250 cm^3 .
Volumes are cubed,
so $1 \text{ dm}^3 = 10 \times 10 \times 10 = 1000 \text{ cm}^3$.
I multiply by 1000
 $0.25 \times 1000 = 250 \text{ cm}^3$

Learner B