

Concentration of solutions

4.3.2.5 · Quantitative chemistry · revision notes

Concentration tells you how much solute is dissolved in a given volume of solution. Here it is measured in grams per dm^3 (g/dm^3). You must calculate concentrations and masses of solute, and convert cm^3 to dm^3 .

Key facts

- Concentration (g/dm^3) = mass (g) $\div$ volume (dm^3)
- Volume (dm^3) = mass $\div$ concentration
- $\text{cm}^3 \rightarrow \text{dm}^3$: divide by 1000
- Mass (g) = concentration $\times$ volume (dm^3)
- $1 \text{ dm}^3 = 1000 \text{ cm}^3$

Notes

What concentration means

- Many reactions take place in **solutions**. A solution is a **solute** dissolved in a **solvent**.
- The **concentration** of a solution can be measured as the mass of solute per volume of solution, in **g/dm^3** .
- $1 \text{ dm}^3 = 1000 \text{ cm}^3$ (1 litre). To convert cm^3 to dm^3 , divide by 1000.

Calculations

- concentration (g/dm^3) = mass of solute (g) $\div$ volume of solution (dm^3)
- mass of solute (g) = concentration (g/dm^3) $\times$ volume (dm^3)
- Example: 5.0 g of sodium chloride is dissolved to make 250 cm^3 of solution. Volume = $250 \div 1000 = 0.250 \text{ dm}^3$. Concentration = $5.0 \div 0.250 = 20 \text{ g}/\text{dm}^3$.
- Example: the mass of solute in 50 cm^3 of a $40 \text{ g}/\text{dm}^3$ solution = $40 \times 0.050 = 2.0 \text{ g}$.

How to answer each type of question

Calculate the concentration

2 to 3 marks

Grade 5

1. Convert the volume to dm^3 ($\div 1000$).
2. Divide the mass in grams by the volume in dm^3 .
3. Give the unit, g/dm^3 .

Example. A student dissolved 3.0 g of copper sulfate in water to make 200 cm^3 of solution. Calculate the concentration of the solution in g/dm^3 . [3 marks]

Model answer. volume = $200 \div 1000 = 0.200 \text{ dm}^3$ (1)
concentration = $3.0 \div 0.200$ (1)
= 15 g/dm^3 (1)

Don't lose marks

- ✗ Using the volume in cm^3 without dividing by 1000, which makes the concentration 1000 times too small.
- ✗ Multiplying by 1000 instead of dividing when converting cm^3 to dm^3 .
- ✗ Using the volume of water added instead of the final volume of the solution.
- ✗ Leaving out the unit, or writing g/cm^3 instead of g/dm^3 .

More tips

Memory tricks

- Formula triangle: mass on top, concentration $\times$ volume underneath.
- Unit check: $\text{g} \div \text{dm}^3 = \text{g/dm}^3$. If the units do not come out right, the formula is upside down.
- A dm^3 is 1000 times bigger than a cm^3 , so the number in dm^3 is always 1000 times smaller.
- Sense check: if the volume is less than 1 dm^3 , the concentration is a bigger number than the mass.

Exam technique

- Write the conversion to dm^3 as its own line of working: it is often a mark.
- Give the unit g/dm^3 with every concentration.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Recall the unit of concentration

Mass of solute per volume of solution, usually grams per dm^3 (g/dm^3).

Grade 4

Convert cm^3 to dm^3

Divide by 1000, e.g. $250 \text{ cm}^3 = 0.250 \text{ dm}^3$.

Grade 5

Calculate concentration in g/dm^3

Concentration = mass of solute (g) $\div$ volume of solution (dm^3).

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