

GCSE Chemistry (9 – 1)

Converting Concentrations

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/20
2	/20
3	/10
4	/12
5	/14
Total	/76
%	
Grade	

Information

- The maximum mark for this paper is 76 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



The ability to convert between different concentrations is absolutely fundamental for quantitative chemistry.

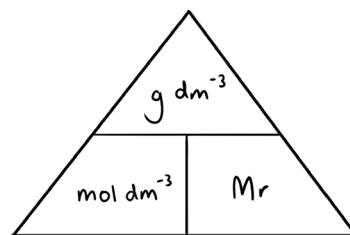
It is the key step that allows us to use the mass of a substance we can easily measure to find the amount in moles needed for accurate analysis and calculations, such as in titrations.

Skill 1: converting g/dm^3 to mol/dm^3

Example 1: A solution contains 10.0 g/dm^3 of sodium hydroxide (NaOH).

What is the concentration of the solution in mol/dm^3 ?

We use the equation: $\text{mol/dm}^3 = \text{g/dm}^3 \div \text{Mr}$



Step 1: find the Mr of NaOH.

$$23 + 16 + 1 = 40$$

Step 2: substitute the values into the equation and solve for the concentration in mol/dm^3 .

$$\text{mol/dm}^3 = \text{g/dm}^3 \div \text{Mr}$$

$$\text{mol/dm}^3 = 10.0 \div 40$$

$$\text{mol/dm}^3 = 0.25 \text{ mol/dm}^3$$

Task 1: converting g/dm^3 to mol/dm^3

1. Convert the concentrations of the following substances from g/dm^3 to mol/dm^3 .

- a. A solution of sodium chloride (NaCl) has a concentration of 29.25 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- b. A solution of potassium hydroxide (KOH) has a concentration of 14.0 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- c. A solution of hydrogen fluoride (HF) has a concentration of 4.0 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- d. A solution of pure water (H_2O) has a concentration of 1000 g/dm^3 .
Calculate its concentration in mol/dm^3 .

.....
(2 marks)

- e. A solution of nitric acid (HNO_3) has a concentration of 31.5 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- f. A solution of sulfuric acid (H_2SO_4) has a concentration of 49.0 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- g. A solution of calcium hydroxide (Ca(OH)_2) has a concentration of 3.7 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- h. A solution of magnesium nitrate ($\text{Mg(NO}_3)_2$) has a concentration of 14.8 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- i. A solution of ammonium sulfate ($(\text{NH}_4)_2\text{SO}_4$) has a concentration of 198 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

- j. A solution of hydrated copper(II) sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) has a concentration of 49.9 g/dm^3 .
Calculate the concentration in mol/dm^3 .

.....
(2 marks)

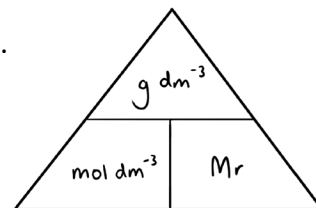
(Total for Question 1 is 20 marks)

Skill 2: converting mol/dm³ to g/dm³

Example 2. Convert 0.5 mol/dm³ into g/dm³ for a solution of sulfuric acid (H₂SO₄).

Step 1: find the Mr of H₂SO₄ = (1 × 2) + 32 + (16 × 4) = 98

Step 2: substitute the values into the equation and solve for the concentration in g/dm³.



$$\text{g/dm}^3 = \text{mol/dm}^3 \times \text{Mr}$$

$$\text{g/dm}^3 = 0.5 \times 98$$

$$\text{g/dm}^3 = 0.5 \times 98 = 49 \text{ g/dm}^3.$$

Task 2: converting mol/dm³ to g/dm³

2. Convert the concentrations of the following substances from mol/dm³ to g/dm³.

- a. A solution of sodium fluoride (NaF) has a concentration of 2.0 mol/dm³.
Calculate the concentration in g/dm³.

.....
(2 marks)

- b. A solution of potassium bromide (KBr) has a concentration of 0.5 mol/dm³.
Calculate the concentration in g/dm³.

.....
(2 marks)

- c. A solution of hydrochloric acid (HCl) has a concentration of 1.5 mol/dm³.
Calculate the concentration in g/dm³.

.....
(2 marks)

- d. A solution of nitric acid (HNO₃) has a concentration of 0.2 mol/dm³.
Calculate the concentration in g/dm³.

.....
(2 marks)

- e. A solution of calcium chloride (CaCl_2) has a concentration of 0.1 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

- f. A solution of dissolved carbon dioxide (CO_2) has a concentration of 0.05 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

- g. A solution of magnesium hydroxide (Mg(OH)_2) has a concentration of 0.25 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

- h. A solution of calcium nitrate ($\text{Ca(NO}_3)_2$) has a concentration of 0.15 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

- i. A solution of ammonium carbonate ($(\text{NH}_4)_2\text{CO}_3$) has a concentration of 0.020 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

- j. A solution of hydrated magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) has a concentration of 0.1 mol/dm^3 .
Calculate the concentration in g/dm^3 .

.....
(2 marks)

(Total for Question 2 is 20 marks)

Exam Style Questions

3. A student is preparing and analysing different salt solutions in the laboratory.

Relative Atomic Masses (Ar): H = 1, O = 16, Na = 23, S = 32, Cl = 35.5, K = 39

To perform these calculations, the student must first find the relative formula mass (Mr) of the compounds.

- a. Calculate the relative formula mass (Mr) of potassium sulfate (K_2SO_4).

Relative formula mass (Mr) = ...
(2 marks)

- b. The student finds a bottle of sodium chloride solution with the concentration written on the label.
The concentration of the sodium chloride (NaCl) solution is 70.2 g/dm^3 .
Calculate the concentration of this solution in mol/dm^3 .

Concentration = ...
(2 marks)

- c. The student needs to prepare a standard solution of sodium hydroxide.
Calculate the mass of sodium hydroxide (NaOH) required to make 1 dm^3 of a 0.50 mol/dm^3 solution.

Mass = ...
(2 marks)

- d. In another experiment, the student dissolves 4.9 g of sulfuric acid (H_2SO_4) in water. The final volume of the solution is 200 cm^3 .

Calculate the concentration of this sulfuric acid solution in mol/dm^3 .

Concentration = ... mol/dm^3
(4 marks)

(Total for Question 3 is 10 marks)

4. A student needs to prepare an accurate solution of sodium carbonate to use in a titration.
Relative Atomic Masses (Ar): H = 1, C = 12, O = 16, N = 14, Na = 23, Ca = 40
- a. The student needs to make 250 cm³ of a 0.10 mol/dm³ solution of sodium carbonate (Na₂CO₃).
Calculate the mass of sodium carbonate the student needs to weigh out.

Mass = ...

(3 marks)

- b. After the titration, the student needs to analyse a solution of nitric acid (HNO₃).
They find a bottle labelled with a concentration of 9.45 g/dm³.
Calculate the concentration of this nitric acid solution in mol/dm³.

Concentration = ... mol/dm³

(2 marks)

- c. The student is then asked to calculate the concentration of a limewater solution. Limewater is a solution of calcium hydroxide, Ca(OH)₂.
A sample of limewater with a volume of 50.0 cm³ was found to contain 0.037 g of dissolved calcium hydroxide. Calculate the concentration of the calcium hydroxide solution in mol/dm³.

Concentration = ... mol/dm³

(4 marks)

- d. Describe the key steps a student should take to prepare the **250 cm³** solution in part (a) accurately, after they have weighed the correct mass of sodium carbonate.

.....

.....

.....

.....

.....

(3 marks)

(Total for Question 4 is 12 marks)

5. A student performs a titration to find the concentration of a sulfuric acid solution.

Relative Atomic Masses (A_r): H = 1, O = 16, Na = 23, S = 32

- a. First, the student prepares a standard solution of sodium hydroxide (NaOH).
They dissolve 4.0 g of solid NaOH in water to make a 250 cm³ solution.
- i. Calculate the concentration of this sodium hydroxide solution in g/dm³.

Concentration = ... g/dm³

(2 marks)

- ii. Now calculate the concentration of the sodium hydroxide solution in mol/dm³. This value will be used in a later calculation.

Concentration = ... mol/dm³

(2 marks)

- b. The student then titrates 25.0 cm³ portions of the sulfuric acid (H₂SO₄) with their sodium hydroxide solution. The results are shown in the table.

Titration	Volume of NaOH added (cm ³)
Rough	25.60
1	25.10
2	25.00
3	25.10

- i. Calculate the mean titre of sodium hydroxide that should be used in the calculation.
Show your working.

Mean titre = ... cm³

(2 marks)

- ii. Write the **balanced** symbol equation for the reaction between sodium hydroxide and sulfuric acid.

.....

(2 marks)

- c. Using your answers from (a)(ii) and (b)(i), calculate the concentration of the sulfuric acid in mol/dm^3 .

Concentration of H_2SO_4 = ... mol/dm^3
(4 marks)

- d. Convert the concentration of sulfuric acid you calculated in part (c) into g/dm^3 .

Concentration of H_2SO_4 = ... g/dm^3
(2 marks)

(Total for Question 5 is 14 marks)