

GCSE Chemistry (9 – 1)

Titration Calculations

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	/12
2	/12
3	/6
4	/12
5	/6
6	/6
Total	/54
%	
Grade	

Information

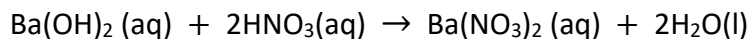
- The maximum mark for this paper is 54 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



Section 1: Determining an unknown concentration

1. For each of the following questions determine the concentration giving each answer to 3 significant figures.

- a) 25.0 cm³ of 0.300 mol/dm³ barium hydroxide solution reacted with 21.3 cm³ of Nitric acid.
Calculate the concentration of the nitric acid in mol/dm³.



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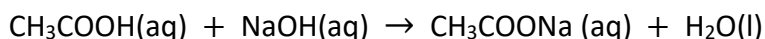
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Concentration = ... mol/dm³
(3 marks)

- b) 22.0 cm³ of 0.20 mol/dm³ sodium hydroxide reacted with 27 cm³ of a solution of ethanoic acid.
Calculate the concentration of the ethanoic acid in mol/dm³.



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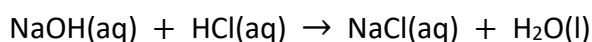
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Concentration = ... mol/dm³
(3 marks)

- c) 25 cm³ of sodium hydroxide solution reacted with 22.2 cm³ of 0.500 mol/dm³ hydrochloric acid.
Calculate the concentration of the sodium hydroxide solution in mol/dm³.



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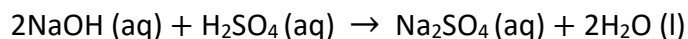
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Concentration = ... mol/dm³
(3 marks)

- d) 20 cm³ of sodium hydroxide solution reacted with 25.0 cm³ of 0.200 mol/dm³ sulphuric acid.
Calculate the concentration of the sodium hydroxide solution in mol/dm³.



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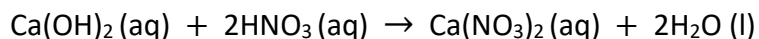
Concentration = ... mol/dm³
(3 marks)

(Total for Question 1 is 12 marks)

2. For each of following questions determine the missing concentration.

- a) 25.0 cm³ of 0.150 mol/dm³ calcium hydroxide solution reacted with 30.6 cm³ nitric acid.

Calculate the concentration of the nitric acid in mol/dm³.



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Concentration = ... mol/dm³

(3 marks)

- b) 22.5 cm³ of sodium hydroxide solution reacted with 26.0 cm³ of 0.100 mol/dm³ hydrochloric acid.

Calculate the concentration of the sodium hydroxide solution in mol/dm³.

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Concentration = ... mol/dm³

(3 marks)

- c) A solution is made by dissolving calcium chloride in water. 11.1 g of calcium chloride are dissolved in water. The volume of the solution is made up to 500 cm³.

Calculate the concentration in mol/dm³ of calcium chloride, CaCl₂ in this solution.

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Concentration = ... mol/dm³

(3 marks)

- d) 25 cm³ of sodium hydroxide solution reacted with 23.2 cm³ of 0.1 mol/dm³ hydrochloric acid.

Calculate the concentration of this sodium hydroxide solution, NaOH, in mol/dm³.

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Concentration = ...

(3 marks)

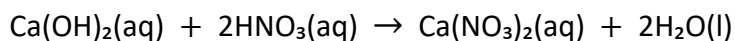
(Total for Question 2 is 12 marks)

3. A student needed to determine the concentration of a sample of limewater, calcium hydroxide solution, Ca(OH)_2 .

The student used a pipette to measure out 25.0 cm^3 of the limewater into a conical flask, adding a few drops of phenolphthalein indicator. They then titrated this against nitric acid (HNO_3) from a burette. The indicator turned from pink to colourless at the end point.

The concentration of the nitric acid was 12.6 g/dm^3 .

The balanced chemical equation for the reaction is:



The student's titration results are shown in the table below.

Titration Number	Final burette reading (cm^3)	Initial burette reading (cm^3)	Volume of HNO_3 added (cm^3)
1	25.50	0.00	25.50
2	24.60	0.10	24.50
3	49.70	25.10	24.60
4	24.95	0.80	24.15

Calculate the concentration of the calcium hydroxide (Ca(OH)_2) solution in **mol/dm^3** .

Relative atomic masses: H = 1; N = 14; O = 16

Give your answer to 3 significant figures.

Concentration = ...

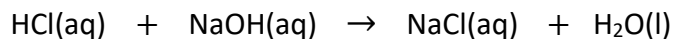
(6 marks)

(Total for Question 3 is 6 marks)

Section 2: Determining an unknown volume

4. For each of the following questions determine the volume giving each answer to **3 significant figures**.

- a) Find the volume of a 1.0 mol/dm^3 hydrochloric acid that reacts with 23.5 cm^3 of 1.25 mol/dm^3 sodium hydroxide.



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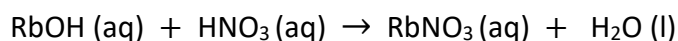
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Volume = ...

(3 marks)

- b) What volume of 0.2 mol/dm^3 rubidium hydroxide reacts with 18.0 cm^3 of 0.320 mol/dm^3 nitric acid?



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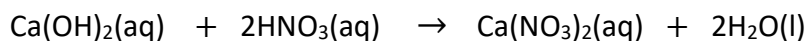
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Volume = ...

(3 marks)

c) What volume of 0.520 mol/dm³ calcium hydroxide neutralises 28.0 cm³ of 0.20 mol/dm³ nitric acid?



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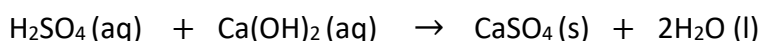
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Volume = ...

(3 marks)

d) What volume of 0.450 mol/dm³ calcium hydroxide neutralises 26.0 cm³ of 0.150 mol/dm³ sulfuric acid?



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Volume = ...

(3 marks)

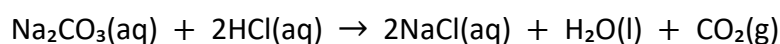
(Total for Question 4 is 12 marks)

5. A student was given a sample of sodium carbonate solution (Na_2CO_3) of a known concentration, but with an unknown volume.

To determine its volume, the student titrated it with hydrochloric acid (HCl) of concentration 0.200 mol/dm^3 .

The student placed the unknown volume of sodium carbonate solution in a conical flask with a few drops of methyl orange indicator. The hydrochloric acid was added from a burette.

The **balanced** chemical equation for the reaction is:



The student's titration results are shown in the table below.

Titration Number	Final burette reading (cm^3)	Initial burette reading (cm^3)	Volume of HCl added (cm^3)
1	21.50	0.00	21.50
2	42.30	21.50	20.80
3	23.70	2.50	21.20
4	44.60	23.80	20.80

The concentration of the sodium carbonate (Na_2CO_3) solution was 0.125 mol/dm^3 .

Using the student's results, calculate the unknown volume of the sodium carbonate solution that was in the conical flask.

Give your answer in cm^3 to 3 significant figures.

Volume = ...

(6 marks)

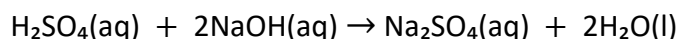
(Total for Question 5 is 6 marks)

6. A laboratory technician prepared a stock solution of sulfuric acid (H_2SO_4) by dissolving a quantity of pure acid in a large beaker of water. The technician knew that the final solution contained exactly **0.110 moles** of H_2SO_4 , but they forgot to measure and record the final volume of the solution they had made.

To determine this unknown volume, the technician first had to find the concentration of their acid. They did this by titrating it against a standard solution of sodium hydroxide (NaOH) with a known concentration of **10.0 g/dm³**.

The technician used a pipette to measure **25.0 cm³** of the sodium hydroxide solution into a conical flask and added a few drops of methyl orange indicator. The sulfuric acid was added from a burette.

The balanced chemical equation for the reaction is:



The technician's titration results are shown in the table below.

Titration Number	Final burette reading (cm ³)	Initial burette reading (cm ³)	Volume of H_2SO_4 added (cm ³)
1	22.50	0.00	22.50
2	44.50	22.50	22.00
3	21.90	0.00	21.90
4	37.50	15.50	22.00

Using the information and the technician's **concordant** volumes, calculate the original volume of the sulfuric acid stock solution. Relative atomic masses: H = 1; O = 16; Na = 23

Give your answer in dm³ to 3 significant figures.

Volume = ...

(6 marks)

(Total for Question 6 is 6 marks)