

GCSE Chemistry (9 – 1)

Titration

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	/4
2	/11
3	/6
4	/7
5	/6
6	/14
Total	/48
%	
Grade	

Information

- The maximum mark for this paper is 48 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Titration is a laboratory method used to find the exact concentration of a solution by reacting it with a solution of known concentration.

Circle the letter of the correct answer for each of the following questions.

- a) A student needs to accurately measure exactly 25.0 cm^3 of sodium hydroxide solution to put into a conical flask. Which piece of apparatus should they use?

A

A burette

B

A measuring cylinder

C

A gas syringe

D

A pipette

(1 mark)

- b) During a titration of hydrochloric acid with sodium hydroxide, phenolphthalein is used as an indicator. The alkali (sodium hydroxide) is in the conical flask.

What is the correct colour change at the end-point?

A

Red to yellow

B

Colourless to pink

C

Pink to colourless

D

Blue to red

(1 mark)

- c) Why is it important to repeat a titration until **concordant** results are obtained?

A To ensure all the chemicals are used up.

B To increase the reliability of the results and calculate a mean.

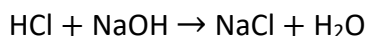
C To make the final colour of the indicator more intense.

D To check if the burette has been read correctly the first time.

(1 mark)

- d) A student titrates 25.0 cm^3 of 0.20 mol/dm^3 hydrochloric acid (HCl) against a solution of sodium hydroxide (NaOH) of unknown concentration.

The balanced equation for the reaction is:



The student finds that 18.50 cm^3 of NaOH is needed to neutralise the acid.

What is the concentration of the sodium hydroxide solution?

A

0.135 mol/dm^3

B

0.270 mol/dm^3

C

0.370 mol/dm^3

D

0.005 mol/dm^3

(1 mark)

(Total for Question 1 is 4 marks)

2. Titrations are a common procedure used to prepare pure salts from soluble reactants.

Sodium sulfate is a useful salt that can be made by a neutralisation reaction.

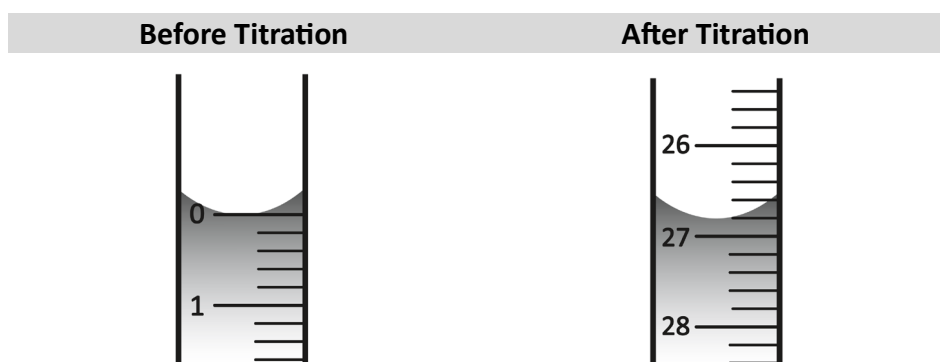
a) State the **name** of the acid and the alkali that are neutralised to make sodium sulfate.

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(2 marks)

b) A student carries out a titration using the reactants from part (a) and records the burette readings at the start and the end of the experiment.

The figure below shows the readings on the burette before and after the titration.



Determine the volume of solution added from the burette into the conical flask.

Give your answer to 2 decimal places.

Volume = ... cm³

(2 marks)

c) The concentration of the sodium hydroxide solution used in the titration was **8.0 g/dm³**.

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

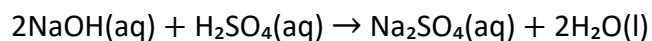
Relative atomic masses: Na = 23, O = 16, H = 1

Concentration of sodium hydroxide = ... mol/dm³

(3 marks)

- d) In a different titration, a student needs to find the volume of the 0.20 mol/dm^3 sodium hydroxide solution needed to fully neutralise 25.0 cm^3 of a different sulfuric acid solution with a concentration of 0.12 mol/dm^3 .

The balanced equation for the reaction is:



Calculate the volume of sodium hydroxide solution needed.

Give your answer in cm^3 .

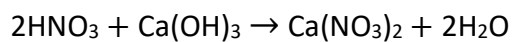
Volume of sodium hydroxide = ... cm^3

(4 marks)

(Total for Question 2 is 11 marks)

3. In a titration experiment, a student found that 21.50 cm³ of 0.200 mol/dm³ nitric acid (HNO₃) completely reacted with 25.0 cm³ of calcium hydroxide solution, Ca(OH)₂.

The equation for the reaction is:



Calculate the concentration of the calcium hydroxide solution in **mol/dm³** and in **g/dm³**.

Relative atomic masses (Ar): H = 1, O = 16, Ca = 40

Concentration in mol/dm³ = ... mol/dm³

Concentration in g/dm³ = ... g/dm³

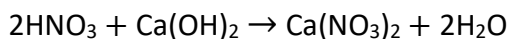
(6 marks)

(Total for Question 3 is 6 marks)

4. A student titrated 25.0 cm³ portions of dilute nitric acid with a 0.080 mol/dm³ calcium hydroxide solution. The table below shows the student's results.

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of calcium hydroxide solution (cm ³)	25.50	22.80	22.90	23.50	22.85

The equation for the reaction is:



- a) Calculate the concentration of the nitric acid in mol/dm³.

Use only the student's concordant results. Concordant results are those within 0.10 cm³ of each other.

Concentration of nitric acid = ... mol/dm³
(4 marks)

- b) Calculate the mass of calcium hydroxide in 50.0 cm³ of a 0.080 mol/dm³ solution.
Relative atomic masses: H = 1, O = 16, Ca = 40

.....
(1 mark)

- c) Explain why the student should use a pipette to measure the dilute nitric acid and a burette to measure the calcium hydroxide solution.

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(2 marks)

(Total for Question 4 is 7 marks)

- Describe a method the student could use with the apparatus and solutions in the figure below to accurately determine the concentration of the sulfuric acid solution.



[illegible]

(6 marks)

(Total for Question 5 is 6 marks)

6. A student used a solution of phosphoric acid to determine the concentration of a solution of potassium hydroxide by titration.

a) The student made 250 cm^3 of a solution of phosphoric acid of concentration 0.100 mol/dm^3 . Calculate the **mass** of phosphoric acid (H_3PO_4) required.

Relative atomic masses (Ar): H = 1 P = 31 O = 16

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Mass = ... g

(3 marks)

This is part of the method the student used for the titration.

Measure 25.0 cm^3 of the potassium hydroxide solution into a conical flask using a pipette.

Add a few drops of indicator to the flask. Fill a burette with phosphoric acid solution.

b) Describe how the student would complete the titration.

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(3 marks)

c) Give **two** reasons why a burette is used for the phosphoric acid solution.

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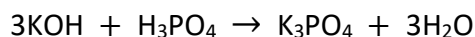
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(2 marks)

- d) 18.50 cm³ of 0.100 mol/dm³ phosphoric acid solution was needed to neutralise 25.0 cm³ of potassium hydroxide solution. The equation for the reaction is:



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

Concentration = ... mol/dm³

(3 marks)

- e) After the titration described in part (d), the student heated the resulting solution to evaporate the water and crystallise the potassium phosphate (K₃PO₄) salt.

Calculate the maximum theoretical mass of potassium phosphate that could be produced in this reaction. Relative atomic masses: K = 39, P = 31, O = 16

Mass = ... g

(3 marks)

(Total for Question 6 is 14 marks)