GCSE Chemistry

Titration Practical

Question Paper

Time available: 62 minutes
Marks available: 58 marks

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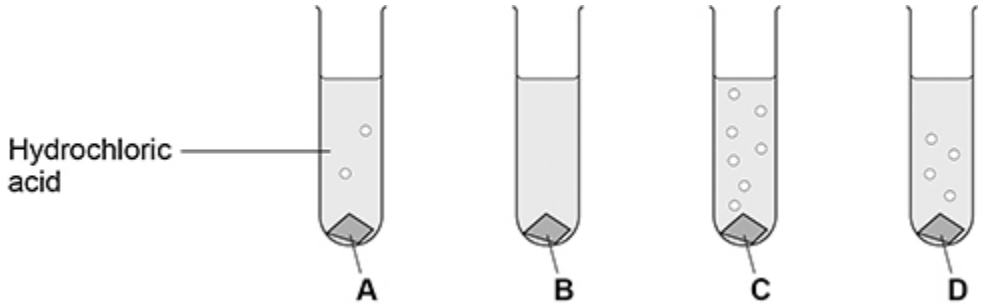
1. This question is about acids.

A student added four metals, **A**, **B**, **C** and **D** to hydrochloric acid.

Figure 1 shows the rate of bubbling in each tube.

Figure 1



Use **Figure 1** to answer parts (a) and (b).

(a) Which metal is copper?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which metal is the most reactive?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) A metal oxide reacts with an acid to produce zinc sulfate and water.

Name the metal oxide and the acid used in this reaction.

Name of metal oxide _____

Name of acid _____

(2)

(d) Universal indicator is used to measure the pH of a solution.

Draw **one** line from each pH to the colour of universal indicator in a solution with that pH.

pH	Colour of universal indicator
	Blue
1	Green
	Purple
7	Red
	Yellow

(2)

A student reacts an acid with an alkali in a titration.

(e) What is the type of reaction when an acid reacts with an alkali?

Tick (✓) **one** box.

- Combustion ☐
- Decomposition ☐
- Neutralisation ☐

(1)

(f) **Figure 2** shows a piece of equipment used to measure the volume of the acid in the titration.

Figure 2

What is the name of this piece of equipment?

Tick (✓) **one** box.

Burette ☐

Pipette ☐

Syringe ☐

Tube ☐

(1)

(Total 8 marks)

2. This question is about acids and alkalis.

(a) Which ion do acids produce in aqueous solution?

Tick (✓) **one** box.

H^+ ☐ OH^- ☐ O^{2-} ☐

(1)

(b) Acids react with alkalis.

What is the name of this type of reaction?

Tick (✓) **one** box.

Decomposition ☐

Electrolysis ☐

Neutralisation ☐

Redox ☐

(1)

(c) Balance the equation for the reaction between sulfuric acid and potassium hydroxide.

$$H_2SO_4 + \_\_\_\_ KOH \rightarrow K_2SO_4 + \_\_\_\_ H_2O$$

(1)

(d) Universal indicator turns purple in potassium hydroxide solution.

What is the pH of the solution?

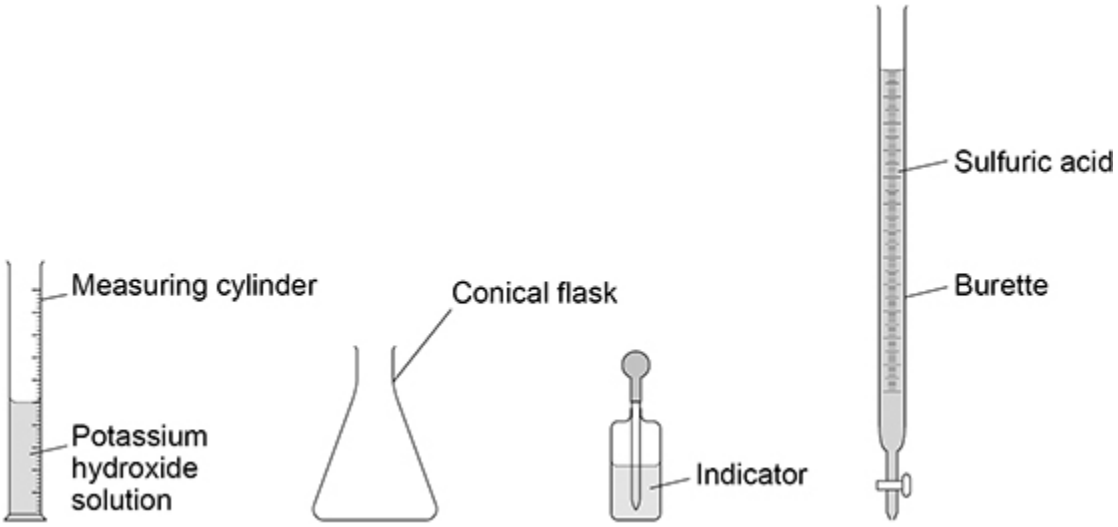
Tick (✓) **one** box.

1 ☐ 4 ☐ 7 ☐ 14 ☐

(1)

A student does a titration to find the volume of sulfuric acid that reacts with 25 cm^3 of potassium hydroxide solution.

The figure below shows the equipment used.



(e) The 25 cm^3 of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm^3 of potassium hydroxide solution more accurately?

Tick (✓) **one** box.

Beaker ☐

Evaporating basin ☐

Pipette ☐

Test tube ☐

(1)

(f) Describe how the student would use the equipment in the figure above to complete the titration.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 10 marks)

3. This question is about acids, bases and salts.

Zinc nitrate is a salt.

A student produces zinc nitrate using an acid and a base.

(a) Which acid should the student use to produce zinc nitrate?

Tick (✓) **one** box.

Hydrochloric acid ☐

Nitric acid ☐

Sulfuric acid ☐

(1)

(b) Which is a base the student could use to produce zinc nitrate?

Tick (✓) **one** box.

Zinc chloride ☐

Zinc oxide ☐

Zinc sulfate ☐

(1)

(c) Name the salt with the formula $MgBr_2$

_____

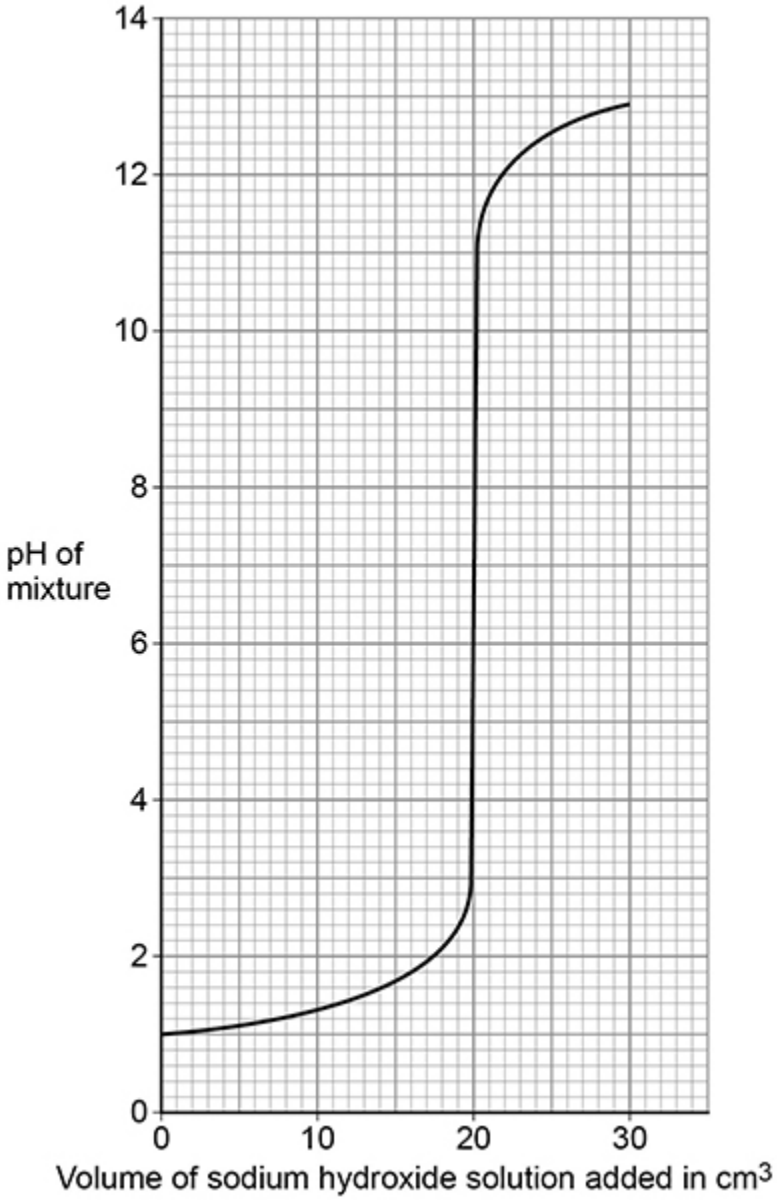
(1)

A student investigated how pH changes during a titration.

This is the method used.

1. Pour 25.0 cm^3 of hydrochloric acid into a beaker.
2. Measure the pH of the hydrochloric acid with a pH probe.
3. Add 1.0 cm^3 of sodium hydroxide solution from a burette.
4. Swirl the mixture.
5. Measure the pH of the mixture.
6. Repeat steps 3 to 5 until a total of 30.0 cm^3 of sodium hydroxide solution has been added.

The graph below shows the student's results.



(d) Describe how the pH of the mixture changes as sodium hydroxide solution is added to hydrochloric acid.

Use the data from the graph above in your answer.

_____

_____

_____

_____

_____

_____

(3)

(e) What volume of sodium hydroxide solution is needed to neutralise 25.0 cm^3 of hydrochloric acid?

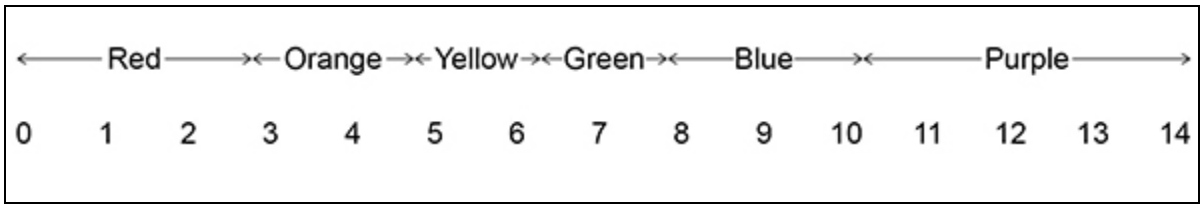
Use the graph above.

Volume = _____ cm^3

(1)

(f) **Figure 1** shows the colour of universal indicator at different pH values.

Figure 1



The student could have used universal indicator instead of a pH probe.

Determine the colour of universal indicator when 10.0 cm^3 of sodium hydroxide solution has been added to 25.0 cm^3 of hydrochloric acid.

Use the graph above and **Figure 1**.

Colour = _____

(1)

(g) The student used a pipette to measure 25.0 cm^3 of hydrochloric acid.

Figure 2 shows a pipette.

Figure 2

The pipette is labelled 25.0 ± 0.06 cm^3

Calculate the percentage uncertainty in the volume measured using this pipette.

Use the equation:

$$\text{percentage uncertainty} = \frac{\text{uncertainty}}{\text{volume measured}} \times 100$$

Percentage uncertainty = _____ %

(2)

(h) Give **one** advantage of using a pipette rather than using a measuring cylinder to measure the volume of hydrochloric acid.

(1)

(Total 11 marks)

4. This question is about citric acid ($C_6H_8O_7$).

Citric acid is a solid.

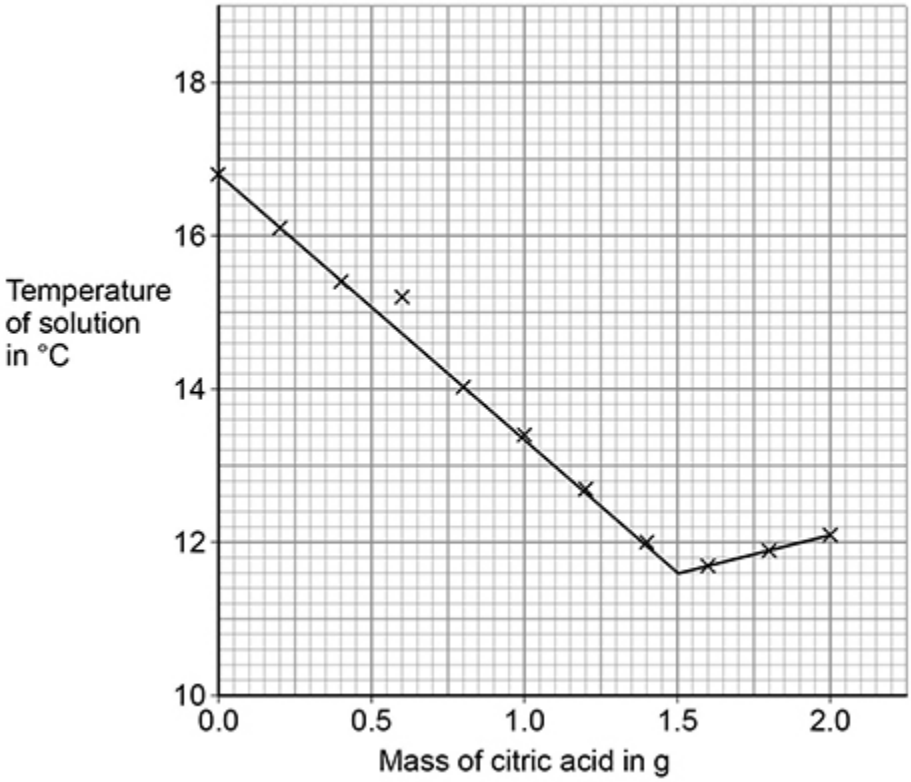
A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.
2. Measure the temperature of the sodium hydrogencarbonate solution.
3. Add 0.20 g of citric acid to the polystyrene cup.
4. Stir the solution.
5. Measure the temperature of the solution.
6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

The student plotted the results on a graph.

The student's graph is shown below.



(a) The graph shows an anomalous point when 0.60 g of citric acid was added. This was caused by the student making an error.

The student correctly:

- measured the mass of the citric acid
- read the thermometer
- plotted the point.

Suggest **one** reason for the anomalous point.

_____

_____

(1)

(b) Explain the shape of the graph in terms of the energy transfers taking place.

You should use data from the graph above in your answer.

_____

_____

_____

_____

_____

_____

(3)

(c) A second student repeated the investigation using a metal container instead of the polystyrene cup. The container and the cup were the same size and shape.

Sketch a line on above graph to show the second student's results until 1.00 g of citric acid had been added. The starting temperature of the solution was the same.

Explain your answer.

_____

_____

_____

_____

(3)

The student used a solution of citric acid to determine the concentration of a solution of sodium hydroxide by titration.

(d) The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3

Calculate the mass of citric acid ($C_6H_8O_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

Mass = _____ g

(3)

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

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a pipette.
2. Add a few drops of indicator to the flask.
3. Fill a burette with citric acid solution.

(e) Describe how the student would complete the titration.

(3)

(f) Give **two** reasons why a burette is used for the citric acid solution.

1 _____

2 _____

(2)

(g) 13.3 cm^3 of 0.0500 mol/dm^3 citric acid solution was needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The equation for the reaction is:

$$3\ NaOH + C_6H_8O_7 \rightarrow C_6H_5O_7Na_3 + 3\ H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

Concentration = _____ mol/dm^3

(3)

(Total 18 marks)

5. This question is about acids and alkalis.

(a) Which ion do all acids produce in aqueous solution?

Tick (✓) **one** box.

H^+ ☐

H^- ☐

O^{2-} ☐

OH^- ☐

(1)

(b) Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

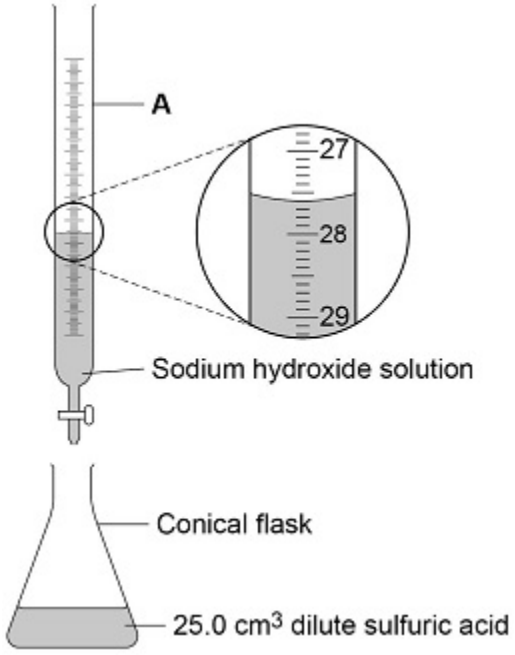
calcium hydroxide + _____ acid → calcium chloride + _____

(2)

A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm^3 of dilute sulfuric acid.

Figure 1 shows the apparatus the student uses.

Figure 1



Use **Figure 1** to answer parts (c) and (d).

(c) Name apparatus **A**.

_____

(1)

(d) What is the reading on apparatus **A**?

_____ cm^3

(1)

(e) The higher the concentration of a sample of dilute sulfuric acid, the greater the volume of sodium hydroxide needed to neutralise the acid.

The student tested two samples of dilute sulfuric acid, **P** and **Q**.

Describe how the student could use titrations to find which sample, **P** or **Q**, is more concentrated.

(6)

(Total 11 marks)