

# AQA Style

## GCSE CHEMISTRY

Higher Tier

Chemistry Paper 1

**H**

Time allowed: 1 hour 45 minutes

### Materials

- A ruler
- A pen and pencil
- A calculator
- Periodic Table of Elements

### Instructions and Information

- Answer all the questions using a black pen.
- Answer the questions in the space available and cross out any work you do not want to be marked.
- In any calculations make sure you show your working out.
- The marks for each question are shown in brackets.
- The maximum mark for the paper is 100.
- You must make your work as neat as possible and use good English in your answers.
- You should make sure you leave time to check your answers.

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
<b>Total</b>	

Name \_\_\_\_\_

Date \_\_\_\_\_

0 | 1

**Table 1** shows the melting and boiling points of the halogens.

**Table 1**

Halogen	Melting Point	Boiling Point
fluorine	-220	-188
chlorine	-101	-35
bromine	-7	59
iodine	114	184

0 | 1 . 1

Determine the state of chlorine at room temperature.

[1 mark]

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0 | 1 . 2

**Table 2** shows the melting and boiling points of the halogens.

**Table 2**

Halogen	Observation of Reaction
fluorine	explosive
chlorine	explosive in light, reacts slowly in the dark
bromine	only reacts at temperatures over 300°C in the presence of a catalyst

Explain the trend in reactivity.

[4 marks]

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0 1 . 3 Chlorine reacts with potassium bromide.

Complete the word equation to show the products of the reaction.

[2 marks]



0 1 . 4 What is the name of the type of reaction shown by the equation in **01.3**?

[1 mark]

\_\_\_\_\_

0 1 . 5 A student adds iodine to potassium bromide.

Explain what will happen.

[2 marks]

\_\_\_\_\_

\_\_\_\_\_

10

**Turn over for the next question**



0 2 . 2 We now know that atoms contain protons, neutrons and electrons.

A boron atom has the symbol  ${}^1_5\text{B}$ .

Determine the number of neutrons in an atom of boron.

[1 mark]

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number of neutrons = \_\_\_\_\_

0 2 . 3 There are two isotopes of boron.



Give **one** similarity and **one** difference between the two isotopes of boron.

[2 marks]

Similarity \_\_\_\_\_

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Difference \_\_\_\_\_

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0 2 . 4 The abundance of  ${}^{10}_5\text{B}$  is 20%.

The abundance of  ${}^{11}_5\text{B}$  is 80%.

Calculate the relative atomic mass of boron.

[2 marks]

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relative atomic mass = \_\_\_\_\_

0 3

**Table 3** describes the reactions of some metals in water and in acid at room temperature.

**Table 3**

<b>Metal</b>	<b>Reaction with Water</b>	<b>Reaction with Dilute Acid</b>
A	very slow reaction	fizzes
B	no reaction	no reaction
C	fizzes	violent reaction

0 3 . 1

Identify each metal.

Draw **one** line from each box.

[2 marks]

**Metal**

A

B

C

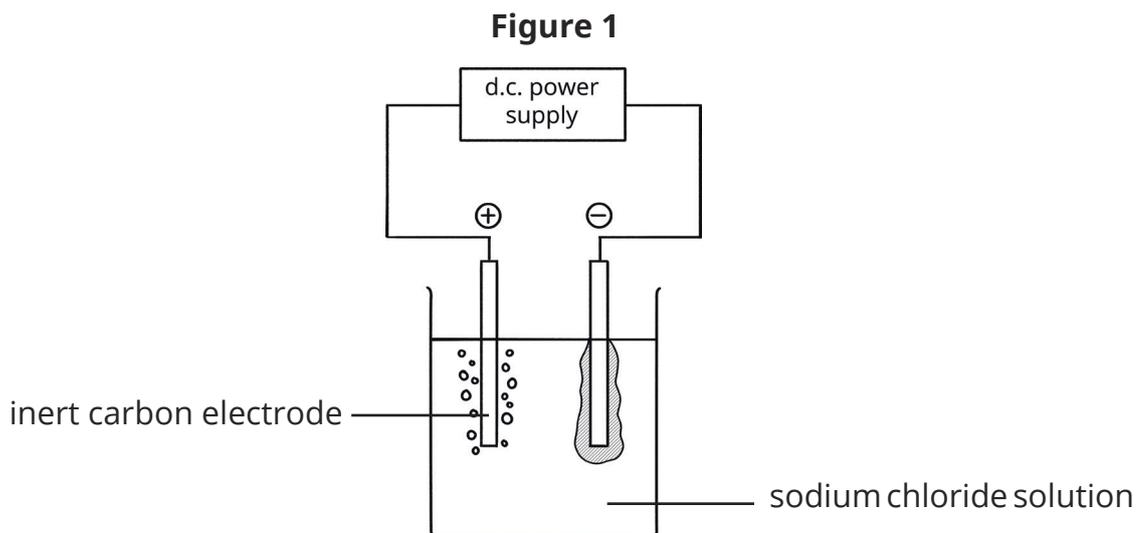
**Name**

copper

lithium

zinc

- 03.2 **Figure 1** shows the apparatus used for the electrolysis of  $100\text{cm}^3$  sodium chloride.



The sodium chloride solution has a concentration of  $300\text{ grams per dm}^3$ .  
Calculate the mass of sodium chloride used in the experiment.

[3 marks]

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mass of sodium chloride = \_\_\_\_\_g

- 03.3 An extra  $10\text{g}$  of solid sodium chloride is added to the solution.  
Describe how this will affect the concentration of the solution.

[1 mark]

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- 03.4 Name the gas produced at the positive electrode (anode).

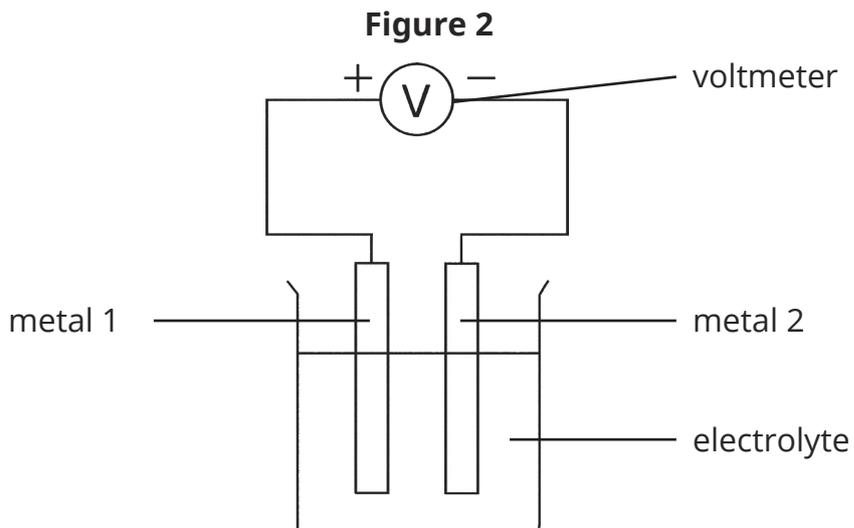
[1 mark]

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0 4

**Figure 2** shows a diagram of a simplified cell.



0 4 . 1

Which combination of metals would produce the highest reading on the voltmeter?

Tick **one** box.

copper and copper

[1 mark]

copper and iron

copper and magnesium

copper and zinc

0 4 . 2

Explain why water cannot be used as an electrolyte.

[3 marks]

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0 4 . 3 Explain why alkaline batteries eventually stop working.

[1 mark]

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0 4 . 4 Some cars are powered by batteries.

There are 11 188 locations across the UK where the car batteries can be recharged.

Explain why rechargeable batteries can be recharged.

[1 mark]

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0 4 . 5 Some cars are powered by hydrogen fuel cells.

There are only seven locations in the UK where cars with hydrogen fuel cells can be recharged. If there were more locations where hydrogen fuel cells could be recharged then more people could use them.

Give **two** benefits of using hydrogen fuel cells over rechargeable batteries.

[2 marks]

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8

0 5

This question is about carbon.

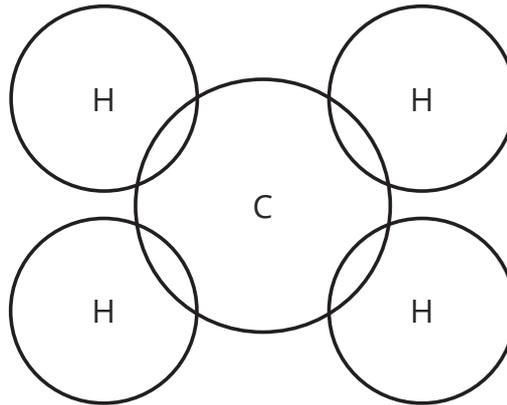
0 5 . 1

Methane is formed when a carbon atom forms bonds with four hydrogen atoms.

Complete the dot and cross diagram in **Figure 3** to show the bonds in methane.

You should only show the electrons in the outer shells.

[1 mark]

**Figure 3**

0 5 . 2

Calculate the percentage by mass of hydrogen in methane ( $\text{CH}_4$ ).

Relative atomic masses ( $A_r$ ): C = 12, H = 1

[3 marks]

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percentage by mass of hydrogen = \_\_\_\_\_%

0 5 . 3

Explain why methane is a gas at room temperature.

[3 marks]

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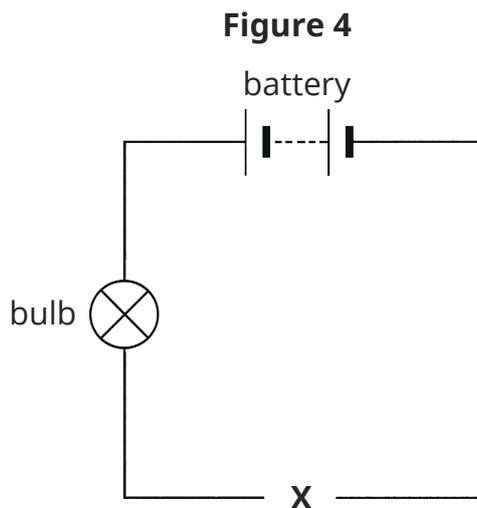
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05.4 Carbon can bond to other carbon atoms to form graphite and diamond.

A scientist set up an electrical circuit as shown in **Figure 4**.



The scientist placed the graphite core of a pencil in position **X** to complete the circuit. The bulb lit up.

They then placed a diamond in position **X**. The bulb did not light up.

Explain the scientist's observations.

[4 marks]

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0 6 Iron (III) chloride ( $\text{FeCl}_3$ ) is used to purify water.

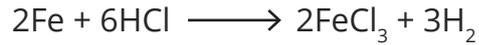
0 6 . 1 Name the type of bonding in iron (III) chloride.

[1 mark]

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0 6 . 2 Iron chloride can be made by reacting iron with hydrochloric acid.

The balanced equation for the reaction is:



A student uses 112g of iron in a reaction with 182.5g hydrochloric acid.

Relative atomic masses ( $A_r$ ): Cl = 35.5, Fe = 56, H = 1

Relative formula mass ( $M_r$ ): HCl = 36.5

Explain which reactant is the limiting reactant.

You must show your working.

[4 marks]

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**Question 6 continues on the next page.**

0 6 . 3 The ionic equation for the reaction is:



Which statement about the reaction between iron and hydrochloric acid is correct?

Tick **one** box.

[1 mark]

Hydrogen has been oxidised because the hydrogen atoms have gained electrons.

Hydrogen has been oxidised because the hydrogen atoms have lost electrons.

Iron has been oxidised because the iron atoms have gained electrons.

Iron has been oxidised because the iron atoms have lost electrons.

6

07

Magnesium chloride is used in medicine as a source of magnesium ions.

07.1

Magnesium chloride can be made by reacting magnesium carbonate ( $\text{MgCO}_3$ ) with hydrochloric acid.

The balanced equation for the reaction is:



A chemist uses 210g of magnesium carbonate in the reaction.

Relative atomic masses ( $A_r$ ): C = 12, Cl = 35.5, H = 1, Mg = 24, O = 16

Relative formula mass ( $M_r$ ): HCl = 36.5,  $\text{MgCO}_3$  = 84

Calculate the mass of hydrochloric acid needed for the magnesium carbonate to react completely.

[4 marks]

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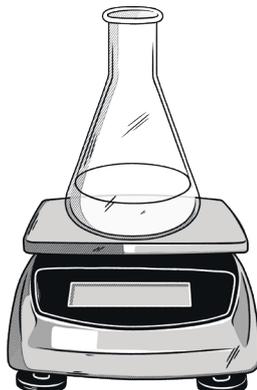
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mass = \_\_\_\_\_ g

**Question 7 continues on the next page.**

- 07.2 When the reaction was complete, the students measured the mass of the products. The equipment they used is shown in **Figure 5**.

**Figure 5**



The chemist's measurement of mass was 282.5g.

Explain why the mass was different to what the chemist expected.

[2 marks]

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0 8

Sulfuric acid and sodium hydroxide react in a neutralisation reaction.

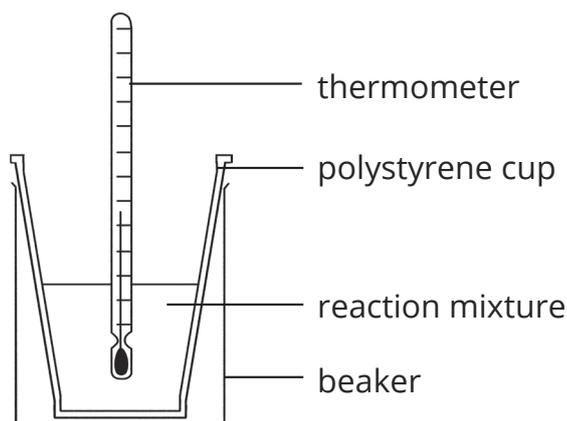
Some students investigated how the temperature change of the reaction mixture was affected by the volume of sodium hydroxide added.

They used the following method:

1. Pour  $30\text{cm}^3$  of dilute sulfuric acid into a polystyrene cup.
2. Measure the temperature of the acid using a thermometer.
3. Add  $5\text{cm}^3$  sodium hydroxide to the polystyrene cup and stir gently.
4. When the reading on the thermometer stops changing, record the maximum temperature reached.
5. Rinse out the polystyrene cup with water.
6. Repeat the experiment 5 more times, increasing the volume of the sodium hydroxide by  $5\text{cm}^3$  each time.

A diagram of the equipment is shown in **Figure 6**.

**Figure 6**



0 8 . 1

Explain why the students used a polystyrene cup.

[2 marks]

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0 8 . 2 Suggest **one** improvement the students could make to their method.

[1 mark]

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0 8 . 3 **Table 4** shows the students' results.

**Table 4**

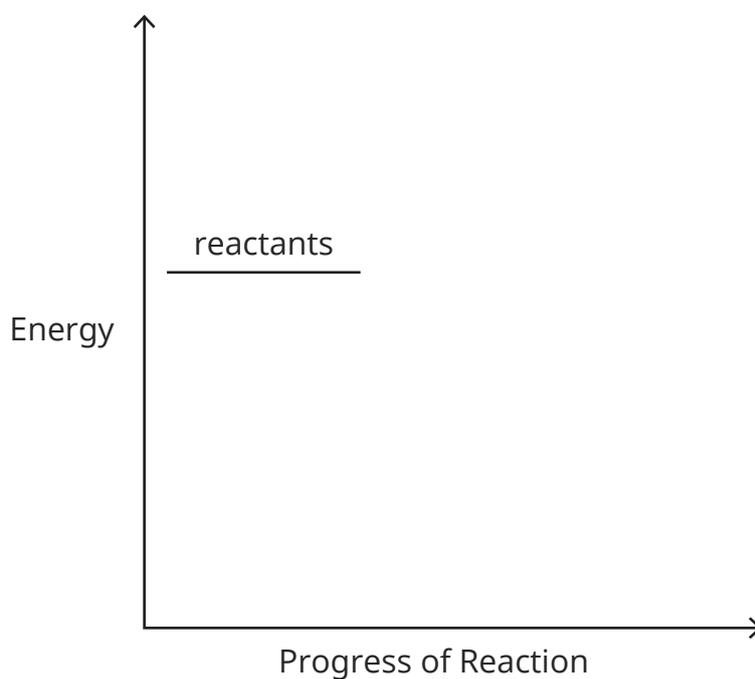
Volume of Sodium Hydroxide Added (cm <sup>3</sup> )	Start Temperature (°C)	Mean Maximum Temperature (°C)
5	19	22
10	19	23
15	19	24
20	20	26
25	20	27
30	20	28

**Figure 7** shows part of the reaction profile for the reaction between sulfuric acid and sodium hydroxide.

Complete the reaction profile in **Figure 7**.

[2 marks]

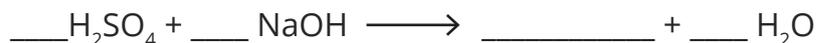
**Figure 7**



0 8 . 4 Complete the balanced symbol equation for the reaction.

The  $\text{SO}_4$  ion has a charge of 2-.

[2 marks]



0 8 . 5 Sulfuric acid is made in three stages.

In the final stage, sulfur trioxide reacts with water to make sulfuric acid.

The equation for the reaction is:

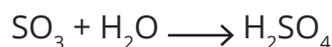


Figure 8 shows the displayed formulae for the reaction.

Figure 8

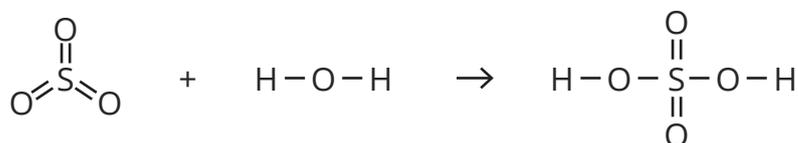


Table 5 shows the bond energies.

Table 5

Bond	Bond Energy (kJ/mol)
S=O	522
S-O	265
O-H	460

Calculate the overall energy change for the reaction.

[3 marks]

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overall energy change = \_\_\_\_\_ kJ/mol

0 8 . 6 Sulfuric acid is a strong acid.

Citric acid is a weak acid.

Explain why, for a given concentration, strong acids have a lower pH than weak acids.

[2 marks]

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0 8 . 7 A 0.1 mol/dm<sup>3</sup> solution of sulfuric acid has a pH of 1.

Distilled water is added to the solution until the concentration is 0.001 mol/dm<sup>3</sup>.

Determine the pH after the distilled water is added.

[2 marks]

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pH = \_\_\_\_\_

14

0 9 Copper is a transition metal.

0 9 . 1 Give **two** differences between the properties of copper and the properties of the Group 1 metals.

[2 marks]

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

0 9 . 2 Copper can be found in different minerals in the Earth's crust.

One of these minerals is cuprite, which contains copper (I) oxide (Cu<sub>2</sub>O).

Copper can be extracted from copper oxide using carbon.

The balanced equation for the reaction is:



Calculate the percentage atom economy for the production of copper in this reaction.

Relative atomic masses ( $A_r$ ): C = 12, Cu = 63.5

Relative formula mass ( $M_r$ ): Cu<sub>2</sub>O = 143

Give your answer to 3 significant figures.

[4 marks]

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

percentage atom economy = \_\_\_\_\_ %

0 9 . 3 Explain why carbon can be used to extract copper from copper oxide.

[2 marks]

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- 09.4 Copper can also be found in the ore chalcocite, which contains copper sulfide ( $\text{Cu}_2\text{S}$ ).

Copper can be produced by reacting copper sulfide with oxygen.

The balanced equation for the reaction is:



The atom economy for the production of copper in this reaction is 66.5%.

Explain why you might choose to extract copper from copper oxide ( $\text{Cu}_2\text{O}$ ) rather than copper sulfide ( $\text{Cu}_2\text{S}$ ).

[1 mark]

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- 09.5 The sulfur dioxide ( $\text{SO}_2$ ) can also be used to make sulfuric acid.

How will this affect the atom economy of the reaction?

[1 mark]

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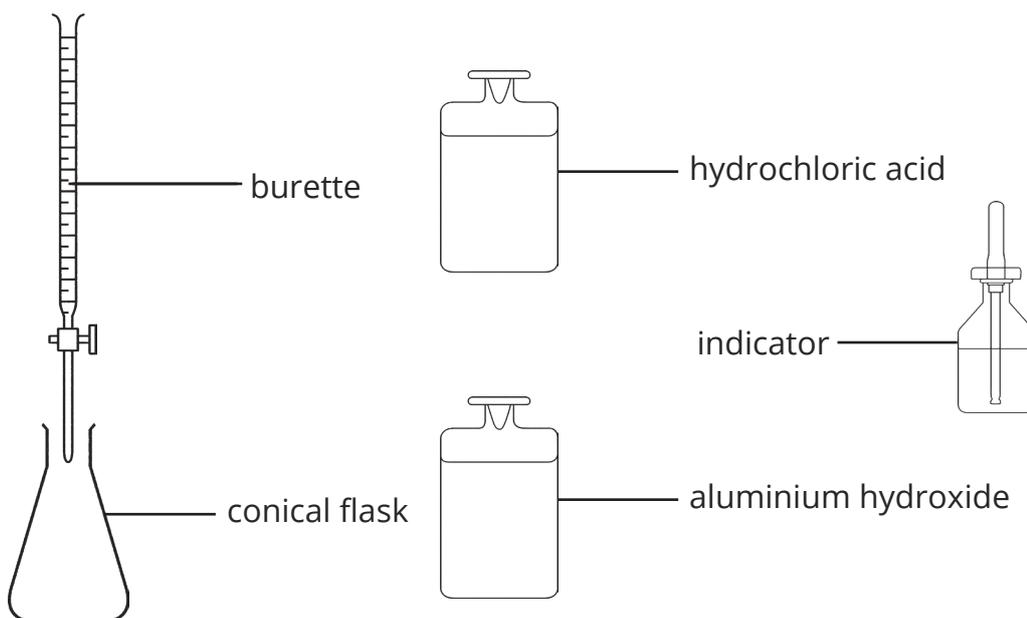
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1 | 0

A student carries out a titration using the equipment shown in **Figure 9**.

**Figure 9**



1 | 0 | 1

Describe how the student should use the equipment in **Figure 9** to find the volume of a  $0.20\text{mol/dm}^3$  aluminium hydroxide solution that reacts with  $300\text{cm}^3$  of hydrochloric acid.

You should include:

- any extra equipment they might use;
- any measurements that the student should make.

[6 marks]

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- 10.2 The student carried out five titrations. **Table 6** shows their results.

**Table 6**

	<b>Titration 1</b>	<b>Titration 2</b>	<b>Titration 3</b>	<b>Titration 4</b>	<b>Titration 5</b>
<b>Volume of aluminium hydroxide (cm<sup>3</sup>)</b>	32.90	33.10	34.10	33.15	33.10

Calculate the mean volume of aluminium hydroxide added.

Use only the student's concordant results.

Concordant results are those within 0.10cm<sup>3</sup> of each other.

[2 marks]

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mean volume = \_\_\_\_\_ cm<sup>3</sup>

- 10.3 The balanced equation for the reaction is:



Calculate the concentration of the hydrochloric acid in mol/dm<sup>3</sup>.

Use your answer from **10.2**.

(If you did not give an answer to **10.2** assume that the mean volume is 35.54cm<sup>3</sup>. This is not the correct answer to **10.2**.)

Give your answer to 2 significant figures.

[4 marks]

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concentration = \_\_\_\_\_ mol/dm<sup>3</sup>

**END OF QUESTIONS**