DRAFT SPECIMEN MATERIAL

GCSE CHEMISTRY

H

Higher Tier Chemistry 1H

Specimen 2018 Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- the periodic table (enclosed).

Instructions

- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice

In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

0 1 This question is about halogens and their compounds.

Table 1 shows the boiling points and some properties of some of the elements in Group 7 of the periodic table.

Table 1

Element	Boiling point in °C	Colour in aqueous solution
Fluorine	-188	colourless
Chlorine	-35	pale green
Bromine	X	orange
Iodine	184	brown

0 1 . 1 Why does iodine have a higher boiling point than chlorine?

[1 mark]

Tick **one** box.

- Iodine is ionic and chlorine is covalent ☐
- Iodine is less reactive than chlorine ☐
- The covalent bonds between iodine atoms are stronger ☐
- The forces between iodine molecules are stronger ☐

0 1 . 2 Predict the boiling point of bromine.

[1 mark]

A redox reaction takes place when aqueous chlorine is added to potassium iodide solution.

The equation for this reaction is:

$$Cl_2(aq) + 2\ KI(aq) \rightarrow I_2\ (aq) + 2\ KCl(aq)$$

0 1 . 3 Look at **Table 1**.

What is the colour of the final solution in this reaction?

[1 mark]

Tick **one** box.

- Brown ☐
- Orange ☐
- Pale green ☐
- Colourless ☐

0 1 . 4 What is the ionic equation for the reaction of chlorine with potassium iodide?

[1 mark]

Tick **one** box.

- $Cl_2 + 2\ K \rightarrow 2\ KCl$ ☐
- $2\ I^- + Cl_2 \rightarrow I_2 + 2\ Cl^-$ ☐
- $I^- + Cl \rightarrow I + Cl^-$ ☐
- $I^- + K^+ \rightarrow KI$ ☐

Question 1 continues on the next page

0 1 . 5 Why does potassium iodide solution conduct electricity?

[1 mark]

Tick **one** box.

- It contains a metal ☐
- It contains electrons which can move ☐
- It contains ions which can move ☐
- It contains water ☐

0 1 . 6 What are the products of electrolysing potassium iodide solution?

[1 mark]

Tick **one** box.

Product at cathode	**Product at anode**	
hydrogen	iodine	☐
hydrogen	oxygen	☐
potassium	iodine	☐
potassium	oxygen	☐

0 2 An atom of aluminium has the symbol $^{27}_{13}Al$.

0 2 . 1 Give the number of protons, neutrons and electrons in this atom of aluminium.

[3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 2 . 2 Aluminium is in Group 3 of the periodic table.

Why do the elements in Group 3 have similar chemical properties?

[1 mark]

_____

_____

Question 2 continues on the next page

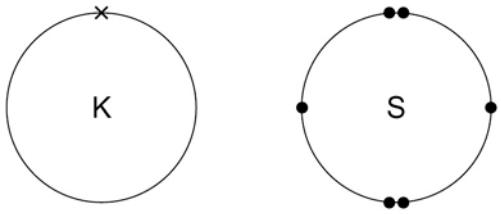
0 2 . 3 In the periodic table, Group 1 elements and the transition elements are metals.

Compare the chemical and physical properties of transition elements with Group 1 elements.

[6 marks]

0 3 **Figure 1** shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

Figure 1



0 3 . 1 Potassium forms an ionic compound with sulfur.

Describe what happens when **two** atoms of potassium react with **one** atom of sulfur.

Give your answer in terms of electron transfer.

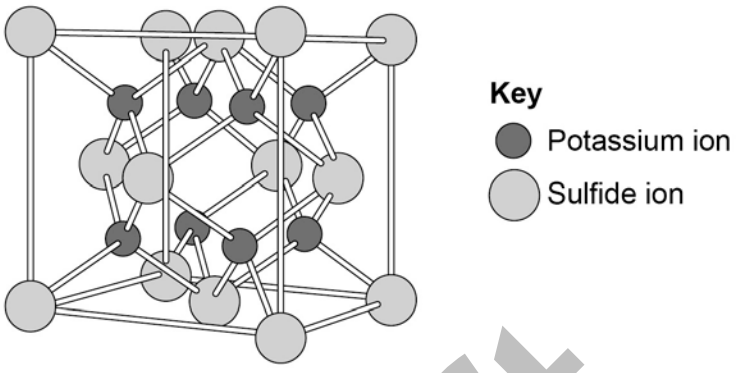
Give the formulae of the ions formed.

[5 marks]

Question 3 continues on the next page

0 3 . 2 The structure of potassium sulfide can be represented using the ball and stick model in **Figure 2**.

Figure 2



The ball and stick model is **not** a true representation of the structure of an ionic compound.

Give **one** reason why.

[1 mark]

0 3 . 3 The formula of another compound containing potassium and sulfur is $KHSO_4$

How many atoms are in one particle of $KHSO_4$?

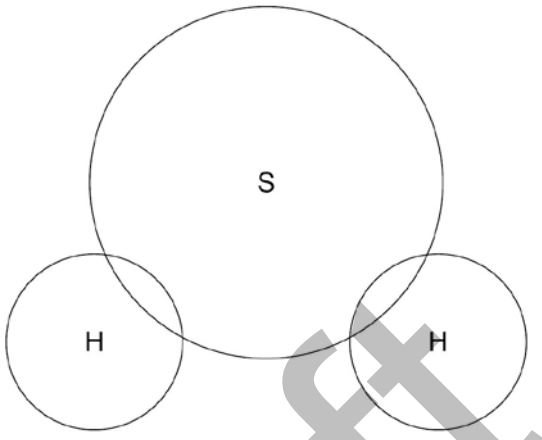
[1 mark]

0 3 . 4 Sulfur can also form covalent bonds.

Complete the dot and cross diagram to show the covalent bonding in a molecule of hydrogen sulfide.

Show the outer shell electrons only.

[2 marks]



0 3 . 5 Calculate the relative formula mass (M_r) of hydrogen sulfide H_2S

Relative atomic masses (A_r): hydrogen = 1; sulfur = 32

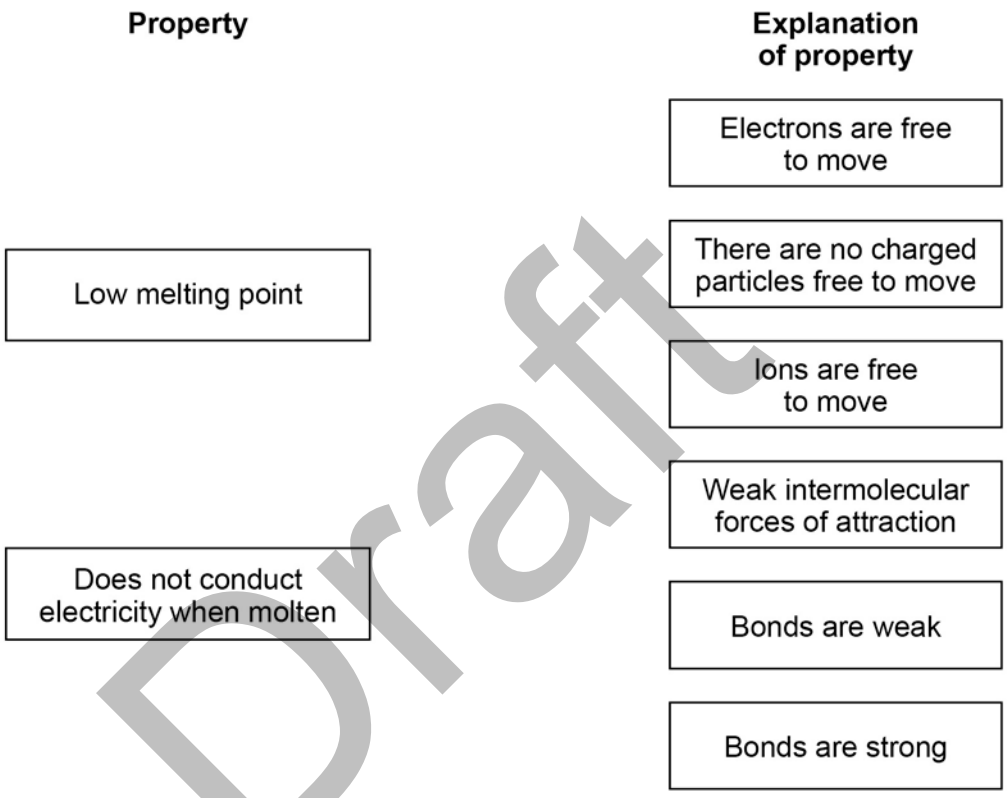
[1 mark]

Question 3 continues on the next page

0 3 . 6 Covalent compounds such as hydrogen sulfide have low melting points and do not conduct electricity when molten.

Draw **one** line from each property to the explanation of the property.

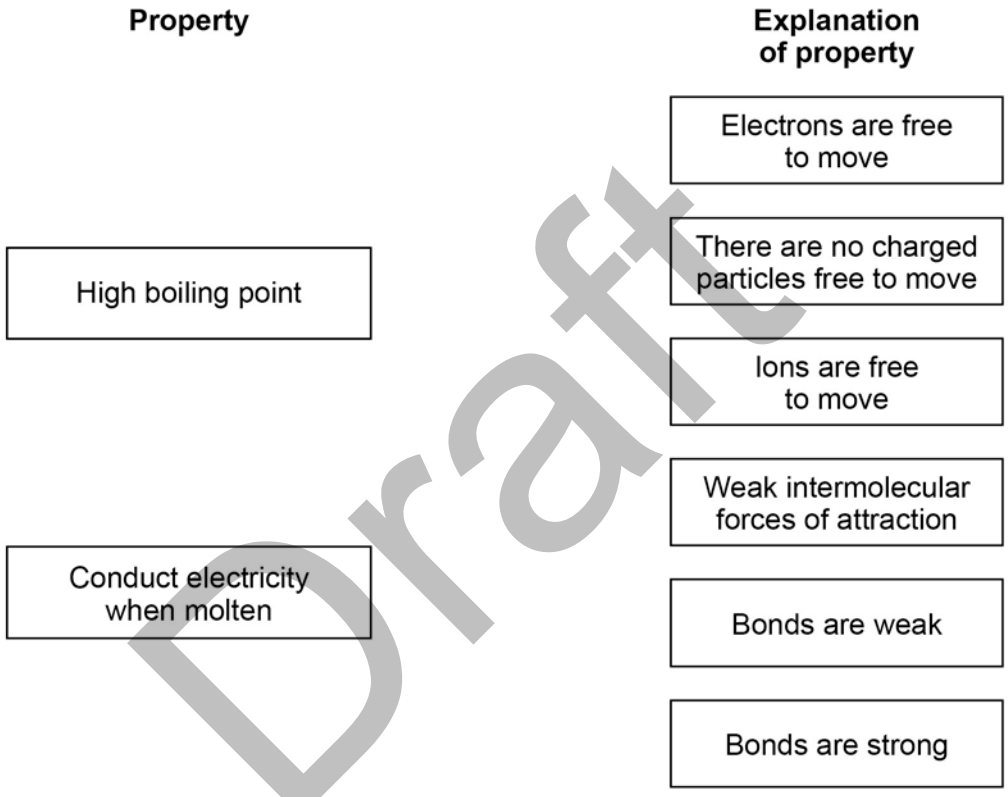
[2 marks]



0 3 . 7 Ionic compounds such as potassium sulfide have high boiling points and conduct electricity when dissolved in water.

Draw **one** line from each property to the explanation of the property.

[2 marks]



Turn over for the next question

0 4 Rock salt is a mixture of sand and salt.

Salt dissolves in water. Sand does not dissolve in water.

Some students separated rock salt.

This is the method used.

1. Place the rock salt in a beaker.
2. Add 100 cm^3 of cold water.
3. Allow the sand to settle to the bottom of the beaker.
4. Carefully pour the salty water into an evaporating dish.
5. Heat the contents of the evaporating dish with a Bunsen burner until salt crystals start to form.

0 4 . 1 Suggest **one** improvement to step 2 to make sure all the salt is dissolved in the water.

[1 mark]

0 4 . 2 The salty water in step 4 still contained very small grains of sand.

Suggest **one** improvement to step 4 to remove all the sand.

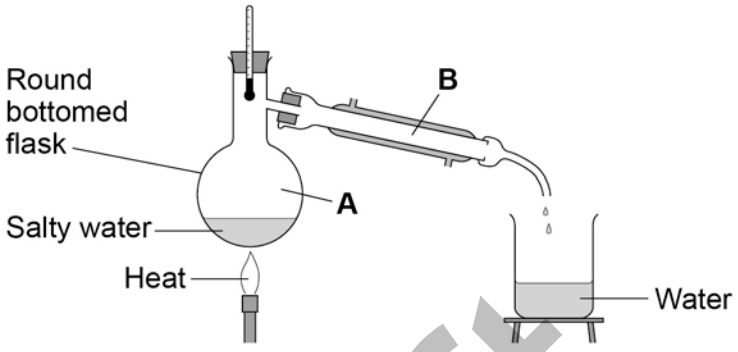
[1 mark]

0 4 . 3 Suggest **one** safety precaution the student should take in step 5.

[1 mark]

Another student removed water from salty water using the apparatus in **Figure 3**.

Figure 3



0 4 . 4 What is the name of this technique?

[1 mark]

Tick **one** box.

Chromatography	☐
Crystallisation	☐
Distillation	☐
Spectroscopy	☐

0 4 . 5 What change of state happens at **A**?

[1 mark]

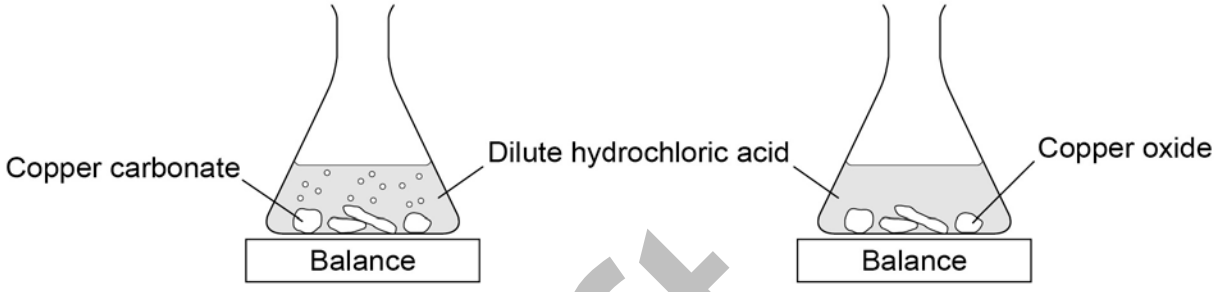
0 4 . 6 What change of state happens at **B**?

[1 mark]

0 5 A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

Figure 4 shows the apparatus the student used.

Figure 4



In both reactions one of the products is copper chloride.

The equations for the reactions are:

$$CuCO_3(s) + 2\ HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$

$$CuO(s) + 2\ HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$$

0 5 . 1 Explain what happens to the balance readings during each of the two reactions.

[4 marks]

Copper carbonate:

Copper oxide:

0 5 . 2 Describe how a sample of copper chloride crystals could be made from copper carbonate and dilute hydrochloric acid.

[4 marks]

0 5 . 3 A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:

$$CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$$

Relative atomic masses, A_r: H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

[4 marks]

Mass of copper carbonate = _____ g

Question 5 continues on the next page

0 5 . 4 The student produced 8.7 g of copper chloride rather than the 11.0 g he expected.

Calculate the percentage yield.

[1 mark]

Percentage yield = _____ %

0 5 . 5 Suggest **one** reason why the student obtained less than 11.0 g of copper chloride.

[1 mark]

0 5 . 6 Look at the two equations:

$$CuCO_3(s) + 2\ HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$

$$CuO(s) + 2\ HCl(aq) \rightarrow CuCl_2(aq) + H_2O$$

Compare the atom economies of the two reactions for making copper chloride.

You are **not** expected to calculate the atom economies of either reaction.

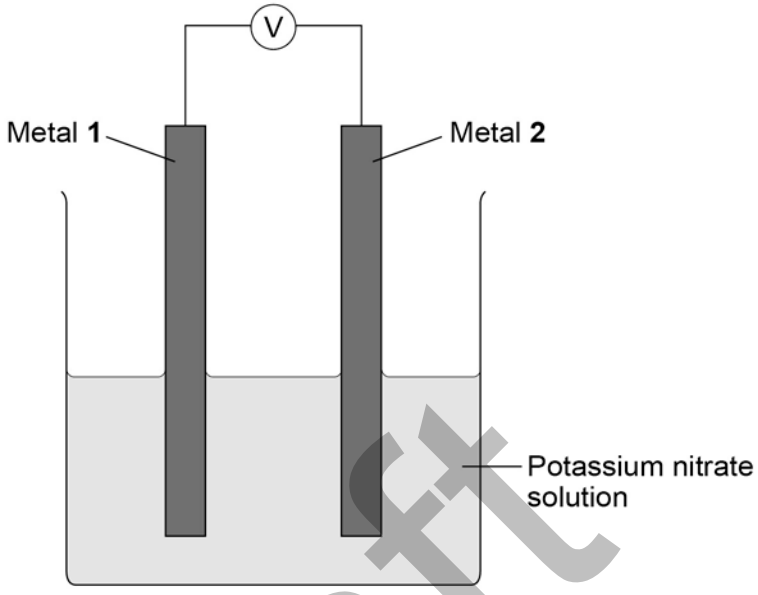
Give a reason for the difference.

[2 marks]

Turn over for the next question

0 6 A student investigated simple cells using the apparatus shown in **Figure 5**.

Figure 5



- If metal 2 is more reactive than metal 1 then the voltage measured is positive.
- If metal 1 is more reactive than metal 2 then the voltage measured is negative.
- The bigger the difference in reactivity of the two metals, the larger the voltage produced.

The student's results are shown in **Table 2**.

Table 2

Metal 2 / Metal 1	Cobalt	Magnesium	Nickel	Silver	Vanadium
Cobalt	0.0 V	2.1 V	not measured	-1.2 V	0.9 V
Magnesium		0.0 V	-2.1 V	-3.2 V	-1.2 V
Nickel			0.0 V	-1.2 V	0.9 V
Silver				0.0 V	2.0 V
Vanadium					0.0 V

0 6 . 1 In a simple cell, the more reactive metal undergoes oxidation.

Define oxidation.

[1 mark]

0 6 . 2 Look at **Table 2**.

Which one of the metals used was the most reactive?

Give a reason for your answer.

[2 marks]

0 6 . 3 Predict the voltage that would be obtained for a simple cell that has cobalt as metal **1** and nickel as metal **2**.

Explain your answer.

[3 marks]

0 6 . 4 The voltage of a Ni-Cd cell is 1.2 V.

How can a 6.0 V battery be made from Ni-Cd cells?

[2 marks]

0 6 . 5 Hydrogen fuel cells have been developed for cars.

What is produced by a hydrogen fuel cell to power the car?

[1 mark]

0 6 . 6 Write the **two** half equations for the reactions that occur at the electrodes in a hydrogen fuel cell.

[2 marks]

0 7 Sodium carbonate reacts with dilute hydrochloric acid:

$$Na_2CO_3 + 2\ HCl \rightarrow 2\ NaCl + H_2O + CO_2$$

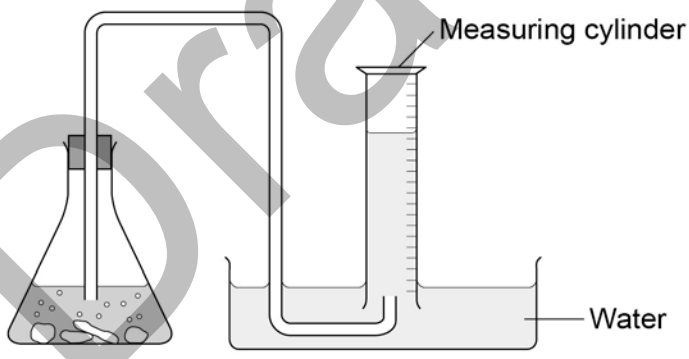
A student investigated the volume of carbon dioxide produced when different masses of sodium carbonate were reacted with dilute hydrochloric acid.

This is the method used.

1. Place a known mass of sodium carbonate in a conical flask.
2. Measure 10 cm^3 of dilute hydrochloric acid using a measuring cylinder.
3. Pour the acid into the conical flask.
4. Place the bung in the flask and collect the gas until the reaction is complete.

0 7 . 1 The student set up the apparatus as shown in **Figure 6**.

Figure 6



Identify the error in the way the student set up the apparatus.

Describe what would happen if the student used the apparatus shown.

[2 marks]

Question 7 continues on the next page

The student corrected the error.

The student's results are shown in **Table 3**.

Table 3

Mass of sodium carbonate in g	**Volume of carbon dioxide gas in cm^3**
0.07	16.0
0.12	27.5
0.23	52.0
0.29	12.5
0.34	77.0
0.54	96.0
0.59	96.0
0.65	96.0

0 7 . 2 The result for 0.29 g of sodium carbonate is anomalous.

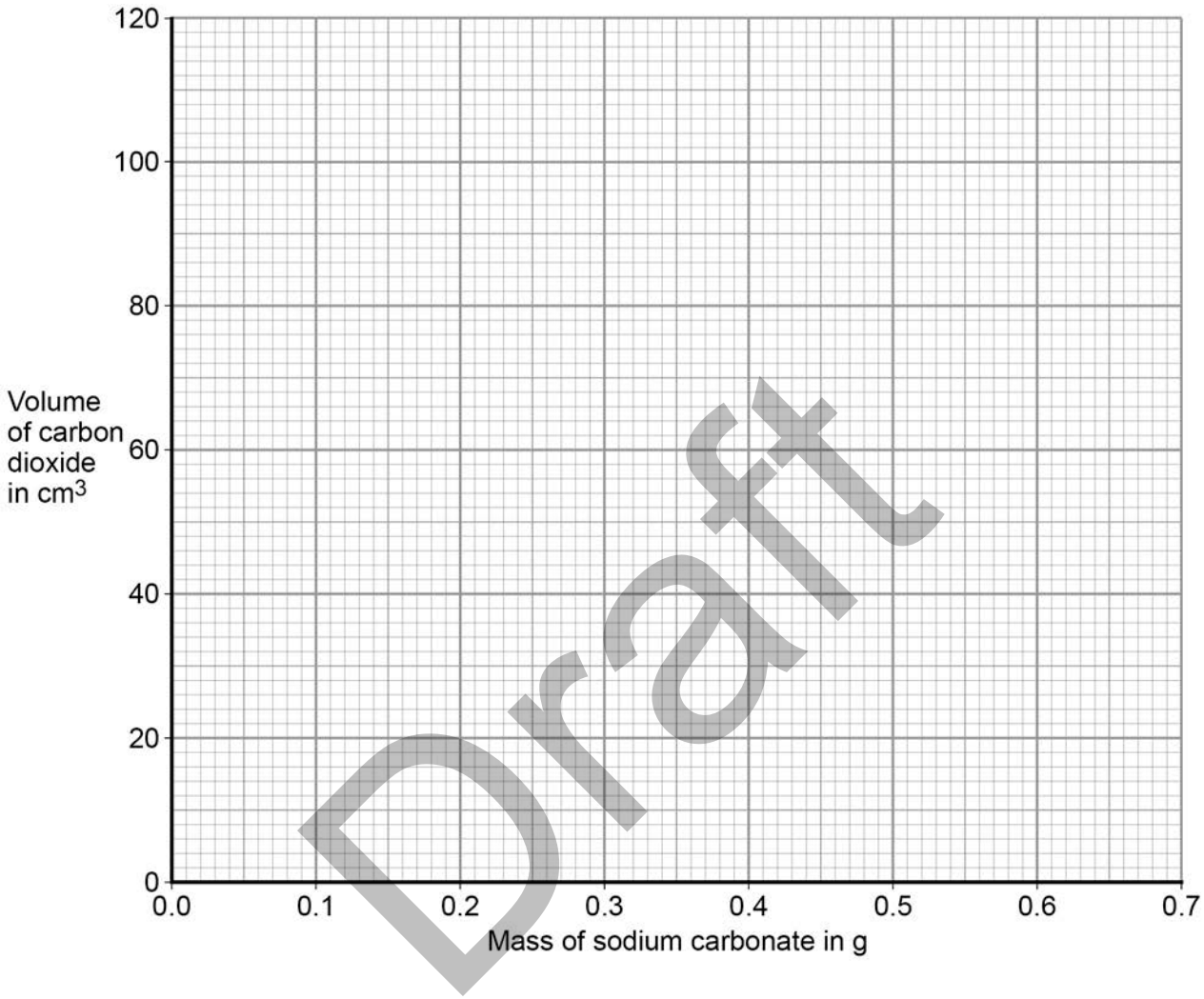
Suggest what may have happened to cause this anomalous result.

[1 mark]

0 7 . 3 Plot a graph of the results. Draw two **straight** lines of best fit.

The lines you have drawn must cross.

[4 marks]



0 7 . 4 Why does the volume of carbon dioxide collected stop increasing at 96 cm^3?

[1 mark]

0 7 . 5 What further work could the student do to be more certain about the minimum mass of sodium carbonate needed to produce 96 cm^3 of carbon dioxide?

[1 mark]

0 7 . 6 Suggest **one** improvement that could be made to the apparatus used that would give more accurate results.

Give a reason for your answer.

[2 marks]

0 7 . 7 One student said that the results of the experiment were wrong because the first few bubbles of gas collected were air.

A second student said this would make no difference to the results.

Explain why the second student was correct.

[2 marks]

0 8 Sodium hydroxide neutralises sulfuric acid.

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

0 8 . 1 Sulfuric acid is a strong acid.

What is meant by a strong acid?

[2 marks]

0 8 . 2 Write the ionic equation for any neutralisation reaction. Include state symbols.

[2 marks]

Question 8 continues on the next page

A student used a pipette to add 25.0 cm^3 of sodium hydroxide of unknown concentration to a conical flask.

The student carried out a titration to find out the volume of 0.100 mol/dm^3 sulfuric acid needed to neutralise the sodium hydroxide.

0 8 . 3 Describe how the student would complete the titration.

You should name a suitable indicator and give the colour change that would be seen.

[4 marks]

The student carried out four titrations. Her results are shown in **Table 4**.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4
Volume of 0.100 mol/dm^3 sulfuric acid in cm^3	28.25	27.85	27.05	27.15

0 8 . 4 Concordant results are within 0.10 cm^3 of each other.

Use the student's concordant results to work out the mean volume of 0.100 mol/dm^3 sulfuric acid added.

[2 marks]

0 8 . 5 The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sodium hydroxide.

Give your answer to three significant figures.

[5 marks]

Concentration = _____ mol/dm^3

0 8 . 6 The student repeated the titration using a pH probe instead of an indicator.

The pH changed from pH 13 to pH 3.

By what factor did the hydrogen ion concentration change?

[1 mark]

Tick **one** box.

10 ☐

100 ☐

1 000 000 ☐

10 000 000 000 ☐

0 9 This question is about the reaction of ethene and bromine.

The equation for the reaction is:

$$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$$

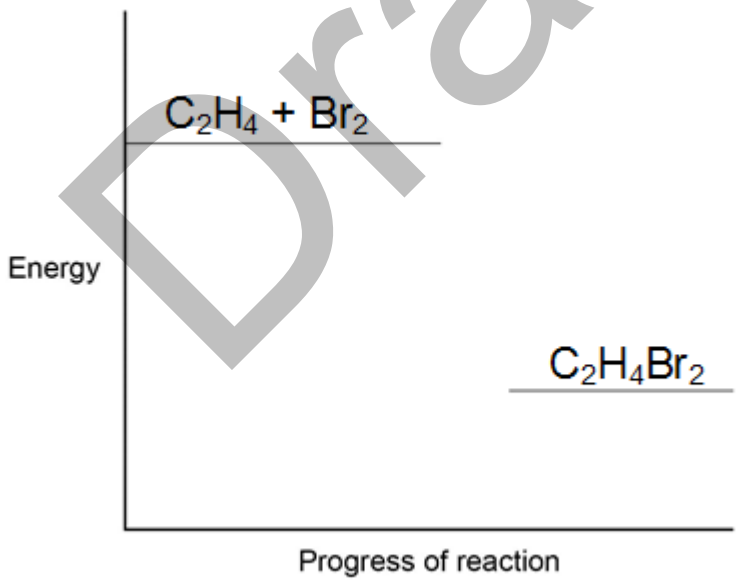
0 9 . 1 Complete the reaction profile in **Figure 7**.

Draw labelled arrows to show:

- The energy given out (ΔH).
- The activation energy.

[3 marks]

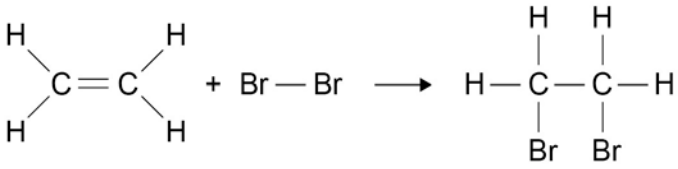
Figure 7



Question 9 continues on the next page

Figure 8 shows the displayed formulae for the reaction of ethene with bromine.

Figure 8



The bond enthalpies and the overall energy change are shown in **Table 5**.

Table 5

	C=C	C-H	C-C	C-Br	Overall energy change
Energy in kJ/mole	612	412	348	276	-95

0 9 . 2 Use the information in **Table 5** and **Figure 8** to calculate the bond energy for the Br-Br bond.

[3 marks]

_____ kJ/mole

0 9 . 3 Explain, in terms of bond energies, why the reaction is exothermic.

[2 marks]

END OF QUESTIONS

There are no questions printed on this page