A

AQA

Surname _____

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Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
CHEMISTRY

H

Higher Tier Paper 1

8462/1H

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

For this paper you must have:
- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

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0 1

This question is about carbon and its compounds.

Fullerenes are molecules of carbon atoms.

The first fullerene to be discovered was Buckminsterfullerene (C_{60}).

0 1 . 1

What shape is a Buckminsterfullerene molecule? [1 mark]

0 1 . 2

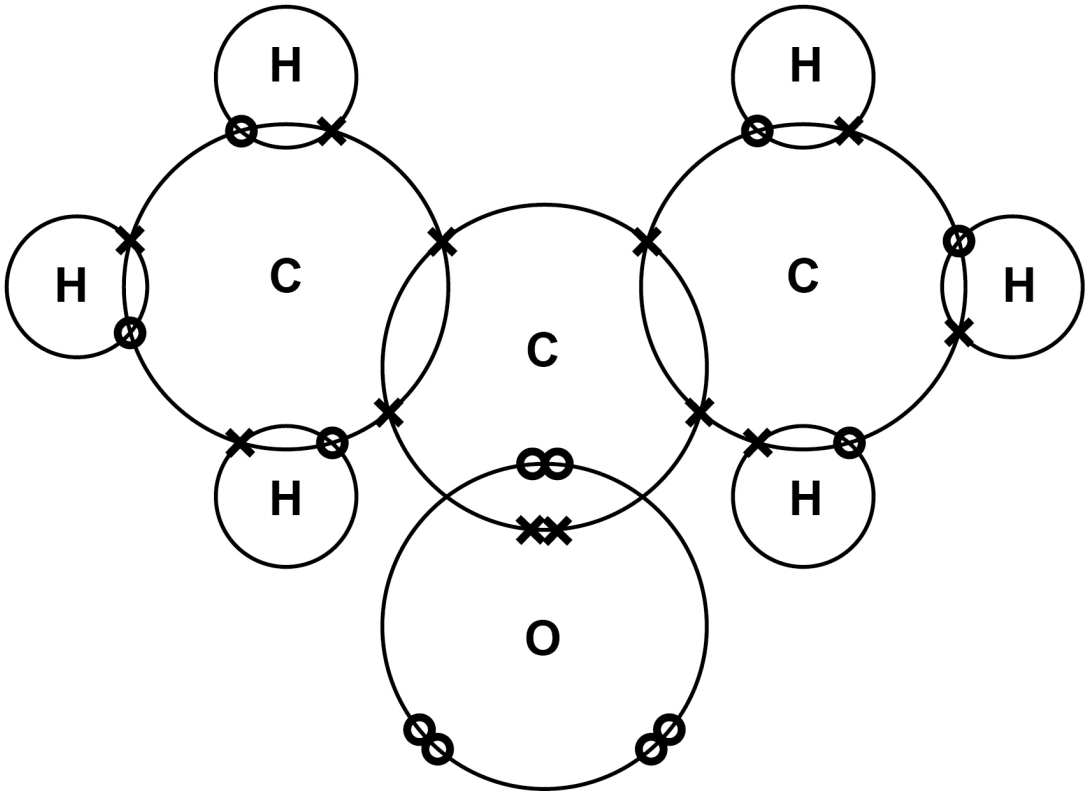
Give ONE use of a fullerene. [1 mark]

[Turn over]

Propanone is a compound of carbon, hydrogen and oxygen.

FIGURE 1 shows the dot and cross diagram for a propanone molecule.

FIGURE 1



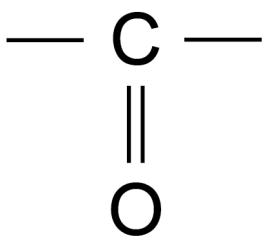
0 1 . 3

Complete FIGURE 2 to show a propanone molecule.

Use a line to represent each single bond.

Use FIGURE 1. [1 mark]

FIGURE 2



0 1 . 4

Determine the molecular formula of propanone.

Use FIGURE 1. [1 mark]

Molecular formula = _____

[Turn over]

0 1 . 5

Propanone is a liquid with a low boiling point.

Why does propanone have a low boiling point?
[1 mark]

Tick (✓) ONE box.

☐ **The covalent bonds are strong.**

☐ **The covalent bonds are weak.**

☐ **The intermolecular forces are strong.**

☐ **The intermolecular forces are weak.**

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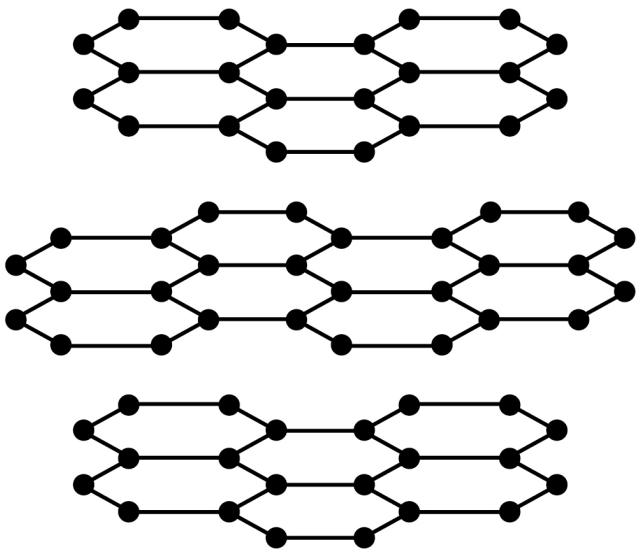
[Turn over]

0 1 . 6

FIGURE 3 represents the structure of graphite.

FIGURE 3



Explain why graphite is:

- **a good electrical conductor**
- **soft and slippery.**

You should answer in terms of structure and bonding.
[6 marks]

[Turn over]

11

0 2

This question is about atomic structure and the periodic table.

Gallium (Ga) is an element that has two isotopes.

0 2 . 1

Give the meaning of 'isotopes'.

You should answer in terms of subatomic particles.
[2 marks]

0 2 . 2

TABLE 1 shows the mass numbers and percentage abundances of the isotopes of gallium.

TABLE 1

Mass number	Percentage abundance (%)
69	60
71	40

Calculate the relative atomic mass (A_r) of gallium.

Give your answer to 1 decimal place. [2 marks]

Relative atomic mass (1 decimal place) =

[Turn over]

Gallium (Ga) is in Group 3 of the modern periodic table.

0 2 . 3

Give the numbers of electrons and neutrons in an atom of the isotope $^{69}_{31}Ga$ [2 marks]

Number of electrons _____

Number of neutrons _____

0 2 . 4

What is the most likely formula of a gallium ion?
[1 mark]

Tick (✓) ONE box.

☐ **Ga^{+}**

☐ **Ga^{-}**

☐ **Ga^{3+}**

☐ **Ga^{3-}**

0 2 . 5

Gallium was discovered six years after Mendeleev published his periodic table.

Give TWO reasons why the discovery of gallium helped Mendeleev's periodic table to become accepted.
[2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

9

0 3

This question is about the extraction of metals.

Element R is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:

$$3\,H_2 + RO_3 \longrightarrow R + 3\,H_2O$$

0 3 . 1

The sum of the relative formula masses (M_r) of the reactants ($3\,H_2 + RO_3$) is 150

Calculate the relative atomic mass (A_r) of R.

Relative atomic masses (A_r): H = 1 O = 16
[2 marks]

Relative atomic mass (A_r) of R = _____

0 3 . 2

Identify element R.

You should use:

- **your answer to QUESTION 03.1**
- **the periodic table.**

[1 mark]

Identity of R = _____

[Turn over]

0 3 . 3

Carbon is used to extract tin (Sn) from tin oxide (SnO_2).

The equation for the reaction is:

$$SnO_2 + C \longrightarrow Sn + CO_2$$

Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses (A_r):
C = 12 O = 16 Sn = 119
[3 marks]

Percentage atom economy = _____ %

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[Turn over]

0 3 . 4

Tungsten (W) is a metal.

Tungsten is extracted from tungsten oxide (WO_3).

All other solid products from the extraction method must be separated from the tungsten.

TABLE 2 shows information about three possible methods to extract tungsten from tungsten oxide.

TABLE 2

Method	Reactant	Relative cost of reactant	Products
1	Carbon	Low	Tungsten solid Carbon dioxide gas Tungsten carbide solid
2	Hydrogen	High	Tungsten solid Water vapour
3	Iron	Low	Tungsten solid Iron oxide solid

Evaluate the three possible methods for extracting tungsten from tungsten oxide. [4 marks]

10

0 4

This question is about Group 1 elements.

0 4 . 1

Give TWO observations you could make when a small piece of potassium is added to water. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

0 4 . 2

Complete the equation for the reaction of potassium with water.

You should balance the equation. [2 marks]

$$K + \quad H_2O \longrightarrow \quad +$$

0 4 . 3

Explain why the reactivity of elements changes going down Group 1. [4 marks]

[Turn over]

Sodium reacts with oxygen to produce the ionic compound sodium oxide.

Oxygen is a Group 6 element.

0 4 . 4

Draw a dot and cross diagram to show what happens when atoms of sodium and oxygen react to produce sodium oxide. [4 marks]

DIAGRAM

0 4 . 5

Why is oxygen described as being reduced in the reaction between sodium and oxygen? [1 mark]

0 4 . 6

Explain why sodium oxide has a high melting point. [3 marks]

0 5

This question is about salts.

0 5 . 1

Name the salt produced by the neutralisation of hydrochloric acid with potassium hydroxide. [1 mark]

_____

_____

0 5 . 2

Write an ionic equation for the neutralisation of hydrochloric acid with potassium hydroxide. [1 mark]

_____ **+** _____ ⟶

_____

0 5 . 3

Soluble salts can be produced by reacting dilute hydrochloric acid with an insoluble solid.

Copper, copper carbonate and copper oxide are insoluble solids.

Which of these insoluble solids can be used to make a copper salt by reacting the solid with dilute hydrochloric acid? [1 mark]

Tick (✓) ONE box.

- ☐ **Copper and copper carbonate only**
- ☐ **Copper and copper oxide only**
- ☐ **Copper carbonate and copper oxide only**
- ☐ **Copper, copper carbonate and copper oxide**

[Turn over]

A student makes crystals of magnesium sulfate.

This is the method used.

1. **Add sulfuric acid to a beaker.**
2. **Warm the sulfuric acid.**
3. **Add a spatula of magnesium oxide to the beaker.**
4. **Stir the mixture.**
5. **Repeat steps 3 and 4 until there is magnesium oxide remaining in the beaker.**
6. **Filter the mixture.**
7. **Evaporate the filtrate gently until crystals start to form.**
8. **Leave the solution to finish crystallising.**

0 5 . 4

Give ONE reason for:

- **step 2**
- **step 5**
- **step 6.**

[3 marks]

Step 2 _____

_____

_____

Step 5 _____

_____

_____

Step 6 _____

_____

_____

0 5 . 5

How should the filtrate be evaporated gently in STEP 7? [1 mark]

_____

_____

_____

[Turn over]

0 5 . 6

Iron chloride is produced by heating iron in chlorine gas.

The equation for the reaction is:

$$2\,Fe + 3\,Cl_2 \longrightarrow 2\,FeCl_3$$

Calculate the volume of chlorine needed to react with 14 g of iron.

You should calculate:

- **the number of moles of iron used**
- **the number of moles of chlorine that react with 14 g of iron**
- **the volume of chlorine needed.**

Relative atomic mass (A_r): Fe = 56

The volume of 1 mole of gas = 24 dm^3 [3 marks]

Volume of chlorine = _____ **dm^3**

[Turn over]

10

0 6

This question is about metals.

0 6 . 1

TABLE 3 shows information about four substances.

TABLE 3

Substance	Melting point in °C	Boiling point in °C	Does it conduct electricity in the solid state?	Does it conduct electricity in the liquid state?
A	–117	79	No	No
B	801	1413	No	Yes
C	1535	2750	Yes	Yes
D	1610	2230	No	No

Which substance could be a metal? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

0 6 . 2

Explain why alloys are harder than pure metals.
[3 marks]

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[Turn over]

0 6 . 3

A student wants to compare the reactivity of an unknown metal, Q, with that of zinc.

Both metals are more reactive than silver.

The student is provided with:

- **silver nitrate solution**
- **metal Q powder**
- **zinc powder**
- **a thermometer**
- **normal laboratory equipment.**

No other chemicals are available.

Describe a method the student could use to compare the reactivity of metal Q with that of zinc.

Your method should give valid results. [4 marks]

[Turn over]

8

0 7

This question is about chemical reactions and electricity.

0 7 . 1

Electrolysis and chemical cells both involve chemical reactions and electricity.

Explain the difference between the processes in electrolysis and in a chemical cell. [2 marks]

0 7 . 2

A teacher demonstrates the electrolysis of molten lead bromide.

Bromine is produced at the positive electrode.

Complete the half equation for the production of bromine.

You should balance the half equation. [2 marks]

$$Br^- \longrightarrow \quad +$$

0 7 . 3

Two aqueous salt solutions are electrolysed using inert electrodes.

Complete TABLE 4 to show the product at each electrode. [3 marks]

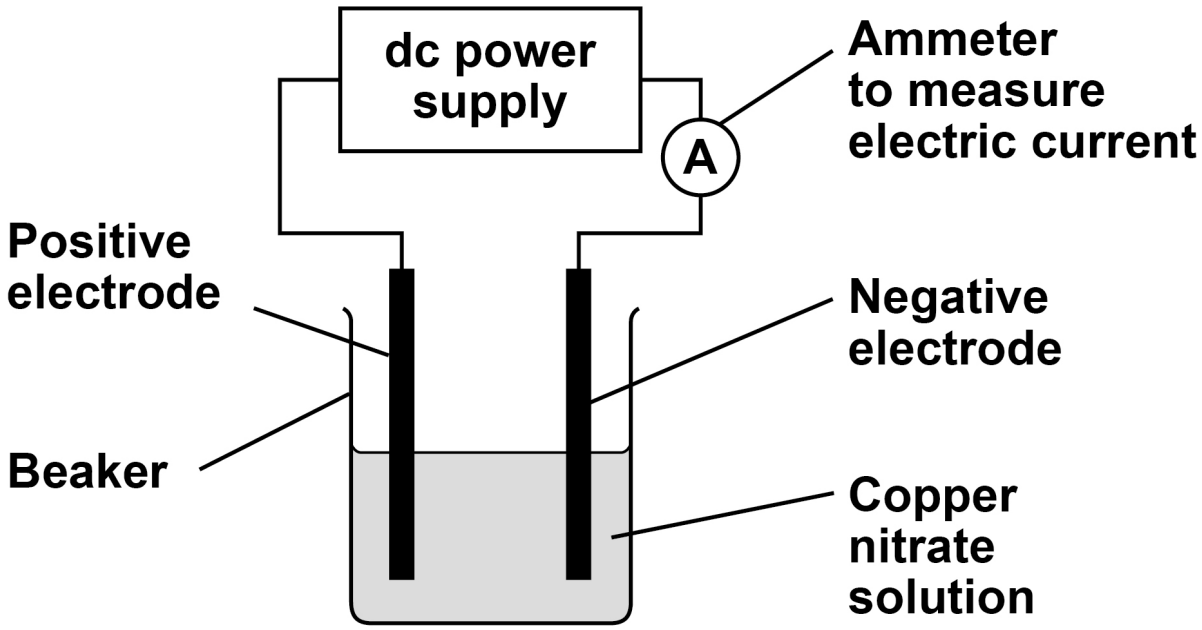
TABLE 4

Salt solution	Product at positive electrode	Product at negative electrode
Copper nitrate		copper
Potassium iodide		

Some students investigated the electrolysis of copper nitrate solution using inert electrodes.

FIGURE 4 shows the apparatus.

FIGURE 4



The students investigated how the mass of copper produced at the negative electrode varied with:

- **time**
- **current.**

This is the method used.

1. **Weigh the negative electrode.**
2. **Set up the apparatus shown in FIGURE 4.**
3. **Adjust the power supply until the ammeter shows a current of 0.3 A**
4. **Switch off the power supply after 5 minutes.**
5. **Rinse the negative electrode with water and allow to dry.**
6. **Reweigh the negative electrode.**
7. **Repeat steps 1 to 6 for different times.**
8. **Repeat steps 1 to 7 at different currents.**

[Turn over]

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0 7 . 4

Some of the copper produced did not stick to the negative electrode but fell to the bottom of the beaker.

Suggest how the students could find the total mass of copper produced. [4 marks]

[Turn over]

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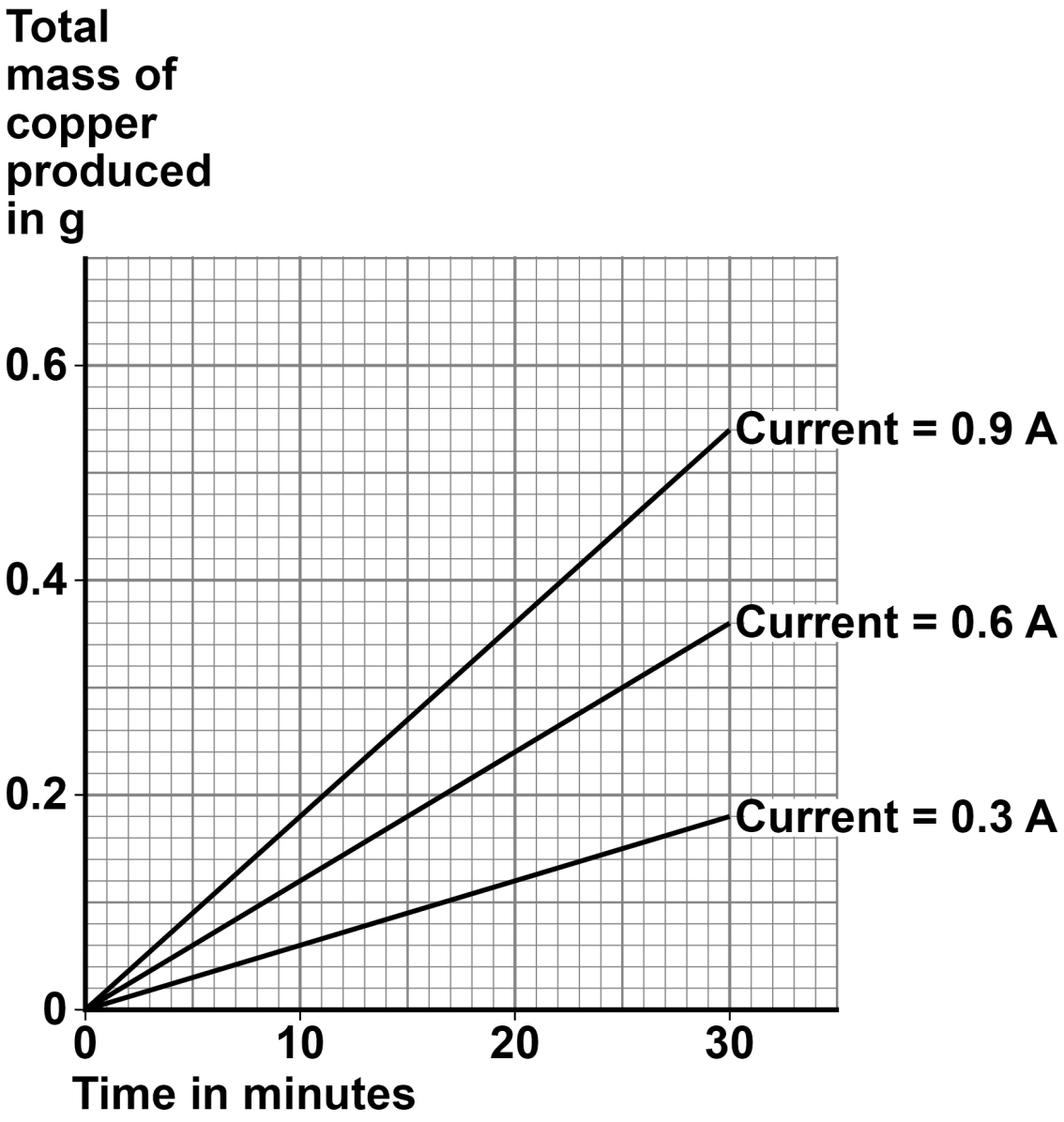
[Turn over]

The students plotted their results on a graph.

FIGURE 5 shows the graph.

FIGURE 5



A student correctly concluded that the total mass of copper produced is directly proportional both to the time and to the current.

0 7 . 5

How do the results in FIGURE 5 support the conclusion that the total mass of copper produced is directly proportional to the time? [1 mark]

0 7 . 6

How do the results in FIGURE 5 support the conclusion that the total mass of copper produced is directly proportional to the current?

Use data from FIGURE 5 in your answer. [1 mark]

[Turn over]

0 7 . 7

Copper nitrate solution is blue.

Suggest why the blue colour of the copper nitrate solution fades during the electrolysis. [1 mark]

0 7 . 8

Determine the number of atoms of copper produced when copper nitrate solution is electrolysed for 20 minutes at a current of 0.6 A

Give your answer to 3 significant figures.

Use FIGURE 5, on page 48.

Relative atomic mass (A_r): Cu = 63.5

The Avogadro constant = 6.02×10^{23} per mole
[3 marks]

Number of atoms (3 significant figures) =

[Turn over]

17

0 8

This question is about the reaction between hydrogen sulfide (H_2S) and oxygen.

The equation for the reaction is:

$$2\ H_2S(g) + 3\ O_2(g) \longrightarrow 2\ H_2O(g) + 2\ SO_2(g)$$

0 8 . 1

What does $H_2O(g)$ represent? [1 mark]

0 8 . 2

Calculate the volume of oxygen required to react with 50 cm^3 of hydrogen sulfide. [1 mark]

Volume = _____ cm^3

0 8 . 3

FIGURE 6 shows part of the reaction profile for the reaction.

The reaction is exothermic.

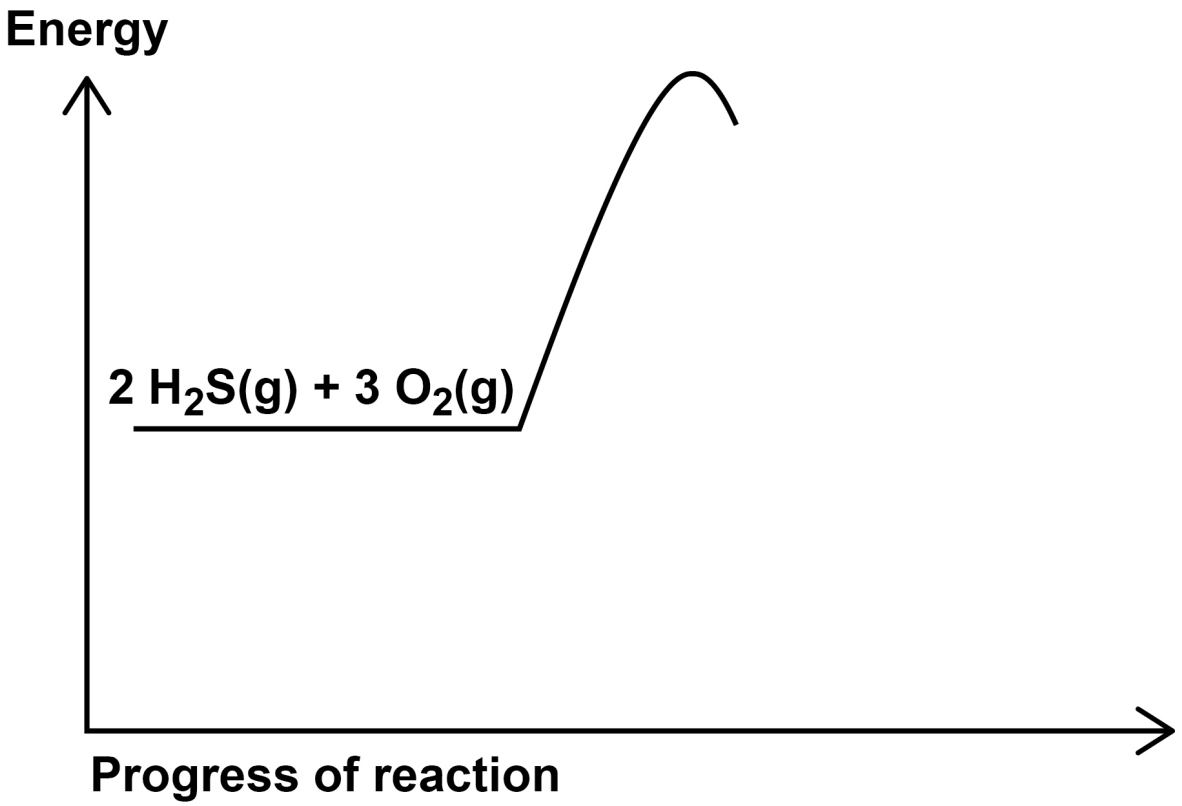
Complete FIGURE 6.

You should:

- **complete the profile line**
- **label the activation energy**
- **label the overall energy change.**

[3 marks]

FIGURE 6



[Turn over]

0 8 . 4

FIGURE 7 shows the displayed formula equation for the reaction of hydrogen sulfide with oxygen.

FIGURE 7

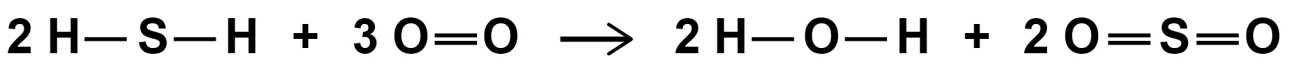


TABLE 5 shows some of the bond energies.

TABLE 5

Bond	H—S	O=O	H—O	S=O
Energy in kJ / mol	364	498	464	X

In the reaction the energy released forming new bonds is 1034 kJ/mol greater than the energy needed to break existing bonds.

Calculate the bond energy X for the S=O bond.

Use FIGURE 7 and TABLE 5. [5 marks]

X = _____ kJ/mol

10

[Turn over]

0 9

This question is about acids.

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

0 9 . 1

A solution is made by dissolving 1 g of hydrogen chloride in 1 dm^3 of water.

Which is the correct description of this solution?
[1 mark]

Tick (✓) ONE box.

- ☐ **A concentrated solution of a strong acid**
- ☐ **A concentrated solution of a weak acid**
- ☐ **A dilute solution of a strong acid**
- ☐ **A dilute solution of a weak acid**

[Turn over]

0 9 . 2

Which solution would have the lowest pH? [1 mark]

Tick (✓) ONE box.

☐ **0.1 mol/dm^3 ethanoic acid solution**

☐ **0.1 mol/dm^3 hydrogen chloride solution**

☐ **1.0 mol/dm^3 ethanoic acid solution**

☐ **1.0 mol/dm^3 hydrogen chloride solution**

A student investigated the concentration of a solution of sodium hydroxide by titration with a 0.0480 mol/dm^3 ethanedioic acid solution.

This is the method used.

1. **Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a 25.0 cm^3 pipette.**
2. **Add two drops of indicator to the sodium hydroxide solution.**

3. Fill a burette with the 0.0480 mol/dm^3 ethanedioic acid solution to the 0.00 cm^3 mark.
4. Add the ethanedioic acid solution to the sodium hydroxide solution until the indicator changes colour.
5. Read the burette to find the volume of the ethanedioic acid solution used.

0 9 . 3

Suggest TWO improvements to the method that would increase the accuracy of the result. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

0 9 . 4

Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($H_2C_2O_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

Relative formula mass (M_r): $H_2C_2O_4$ = 90 [2 marks]

Mass = _____ g

0 9 . 5

The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:

$$H_2C_2O_4 + 2\,NaOH \longrightarrow Na_2C_2O_4 + 2\,H_2O$$

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

Concentration = _____ mol/dm^3

END OF QUESTIONS

9

Additional page, if required.
Write the question numbers in the left-hand margin.

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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