A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

CHEMISTRY

H

Higher Tier Paper 1

8462/1H

Thursday 17 May 2018 Morning

Time allowed: 1 hour 45 minutes

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

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

[Turn over]

J U N 1 8 8 4 6 2 1 H 0 1

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INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **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.**
- **In all calculations, show clearly how you work out your answer.**

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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

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0 1 **Soluble salts are formed by reacting metal oxides with acids.**

0 1 . 1 **Give ONE other type of substance that can react with an acid to form a soluble salt.**
[1 mark]

_____

_____

0 1 . 2 **Calcium nitrate contains the ions Ca^{2+} and NO_3^-**

Give the formula of calcium nitrate. [1 mark]

_____

_____

[Turn over]

0 1 . 3 **Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid. [6 marks]**

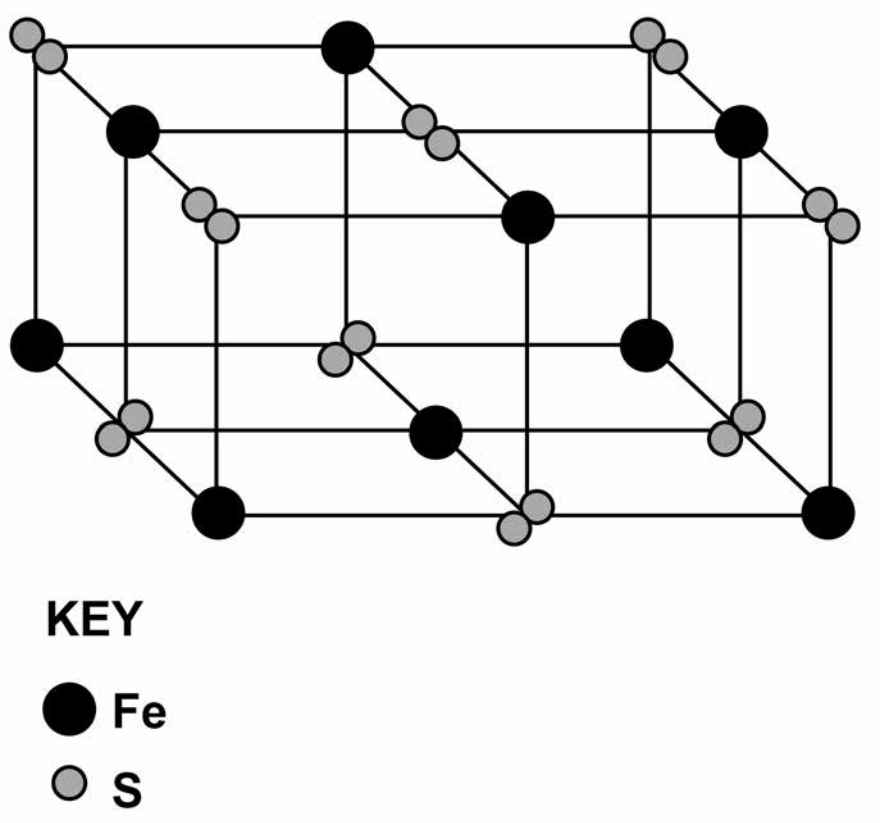
8

0 2 **This question is about metals and metal compounds.**

0 2 . 1 **Iron pyrites is an ionic compound.**

FIGURE 1 shows a structure for iron pyrites.

FIGURE 1



Determine the formula of iron pyrites.

Use FIGURE 1. [1 mark]

0 2 . 2 **An atom of iron is represented as $^{56}_{26}Fe$**

Give the number of protons, neutrons and electrons in this atom of iron. [3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 2 . 3 **Iron is a transition metal.**

Sodium is a Group 1 metal.

Give TWO differences between the properties of iron and sodium. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

Nickel is extracted from nickel oxide by reduction with carbon.

0 2 . 4 **Explain why carbon can be used to extract nickel from nickel oxide. [2 marks]**

0 2 . 5 **An equation for the reaction is:**

NiO + C → Ni + CO

Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

Relative formula mass (M_r): NiO = 75

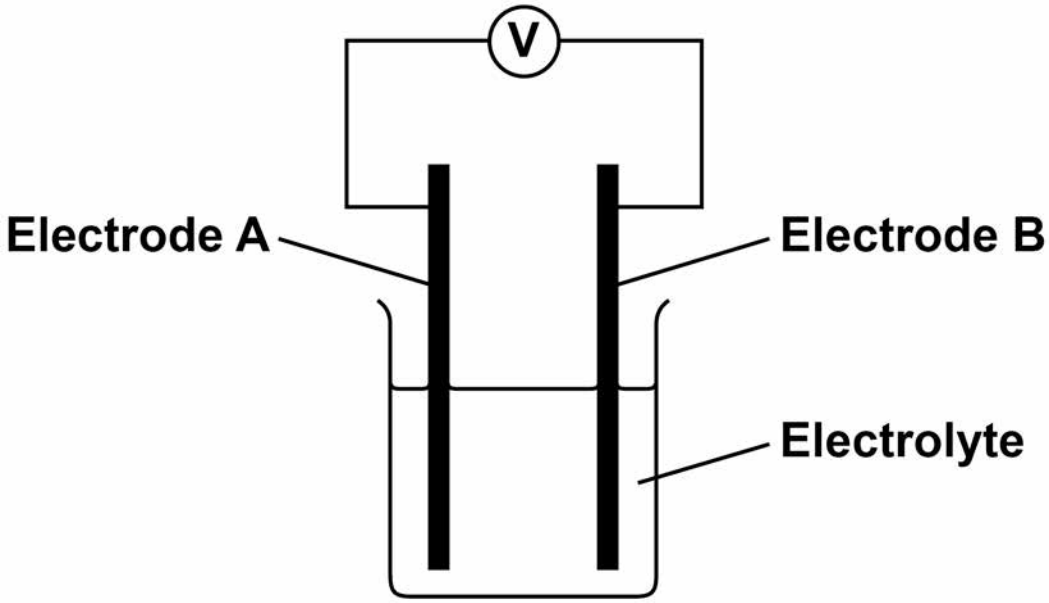
Give your answer to 3 significant figures.
[3 marks]

Percentage atom economy = _____ %

0 3 **Chemical reactions can produce electricity.**

0 3 . 1 **FIGURE 2 shows a simple cell.**

FIGURE 2



Which of these combinations would NOT give a zero reading on the voltmeter in FIGURE 2?
[1 mark]

Tick ONE box.

	Electrode A	Electrode B	Electrolyte
☐	Copper	Copper	Sodium chloride solution
☐	Zinc	Zinc	Water
☐	Copper	Zinc	Sodium chloride solution
☐	Copper	Zinc	Water

Alkaline batteries are non-rechargeable.

0 3 . 2 **Why do alkaline batteries eventually stop working? [1 mark]**

0 3 . 3 **Why can alkaline batteries NOT be recharged? [1 mark]**

Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

0 3 . 4 **Complete the balanced equation for the overall reaction in a hydrogen fuel cell. [2 marks]**

$$\_\_\_\_\_\ H_2 + \_\_\_\_\_ \rightarrow \_\_\_\_\_\ H_2O$$

[Turn over]

0 3 . 5 **TABLE 1 shows data about different ways to power electric cars.**

TABLE 1

	Hydrogen fuel cell	Rechargeable lithium-ion battery
Time taken to refuel or recharge in minutes	5	30
Distance travelled before refuelling or recharging in miles	Up to 415	Up to 240
Distance travelled per unit of energy in km	22	66
Cost of refuelling or recharging in £	50	3
Minimum cost of car in £	60 000	18 000

Evaluate the use of hydrogen fuel cells compared with rechargeable lithium-ion batteries to power electric cars.

Use TABLE 1 and your own knowledge.
[6 marks]

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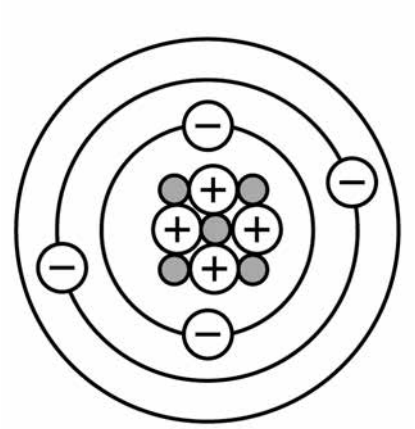
0 4 **FIGURE 3 represents different models of the atom.**

FIGURE 3

A



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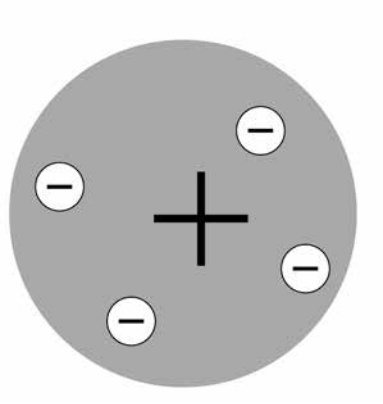

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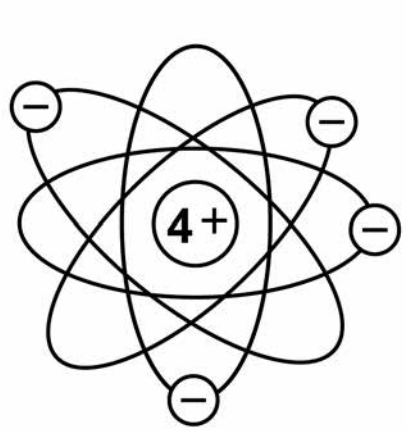

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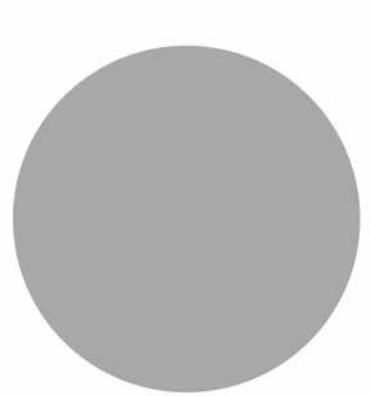

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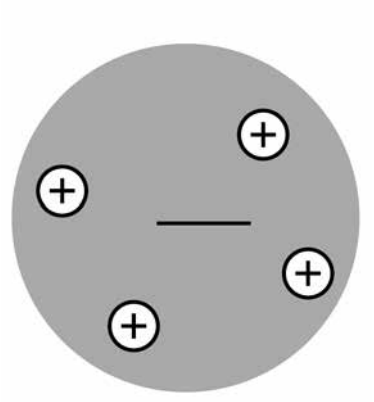

0 4 . 1 **Which diagram shows the plum pudding model of the atom? [1 mark]**

Tick ONE box.

A	B	C	D	E
☐	☐	☐	☐	☐

0 4 . 2 **Which diagram shows the model of the atom developed from the alpha particle scattering experiment? [1 mark]**

Tick ONE box.

A	B	C	D	E
☐	☐	☐	☐	☐

0 4 . 3 **Which diagram shows the model of the atom resulting from Bohr's work? [1 mark]**

Tick ONE box.

A	B	C	D	E
☐	☐	☐	☐	☐

[Turn over]

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0 4 . 4 **Define the mass number of an atom. [1 mark]**

_____

_____

_____

[Turn over]

0 4 . 5 **Element X has two isotopes. Their mass numbers are 69 and 71**

The percentage abundance of each isotope is:

- **60% of ^{69}X**
- **40% of ^{71}X**

Estimate the relative atomic mass of element X. [1 mark]

Tick ONE box.

☐ **< 69.5**

☐ **Between 69.5 and 70.0**

☐ **Between 70.0 and 70.5**

☐ **> 70.5**

0 4 . 6 **Chadwick's experimental work on the atom led to a better understanding of isotopes.**

Explain how his work led to this understanding. [3 marks]

0 5 **A student investigated the temperature change in displacement reactions between metals and copper sulfate solution.**

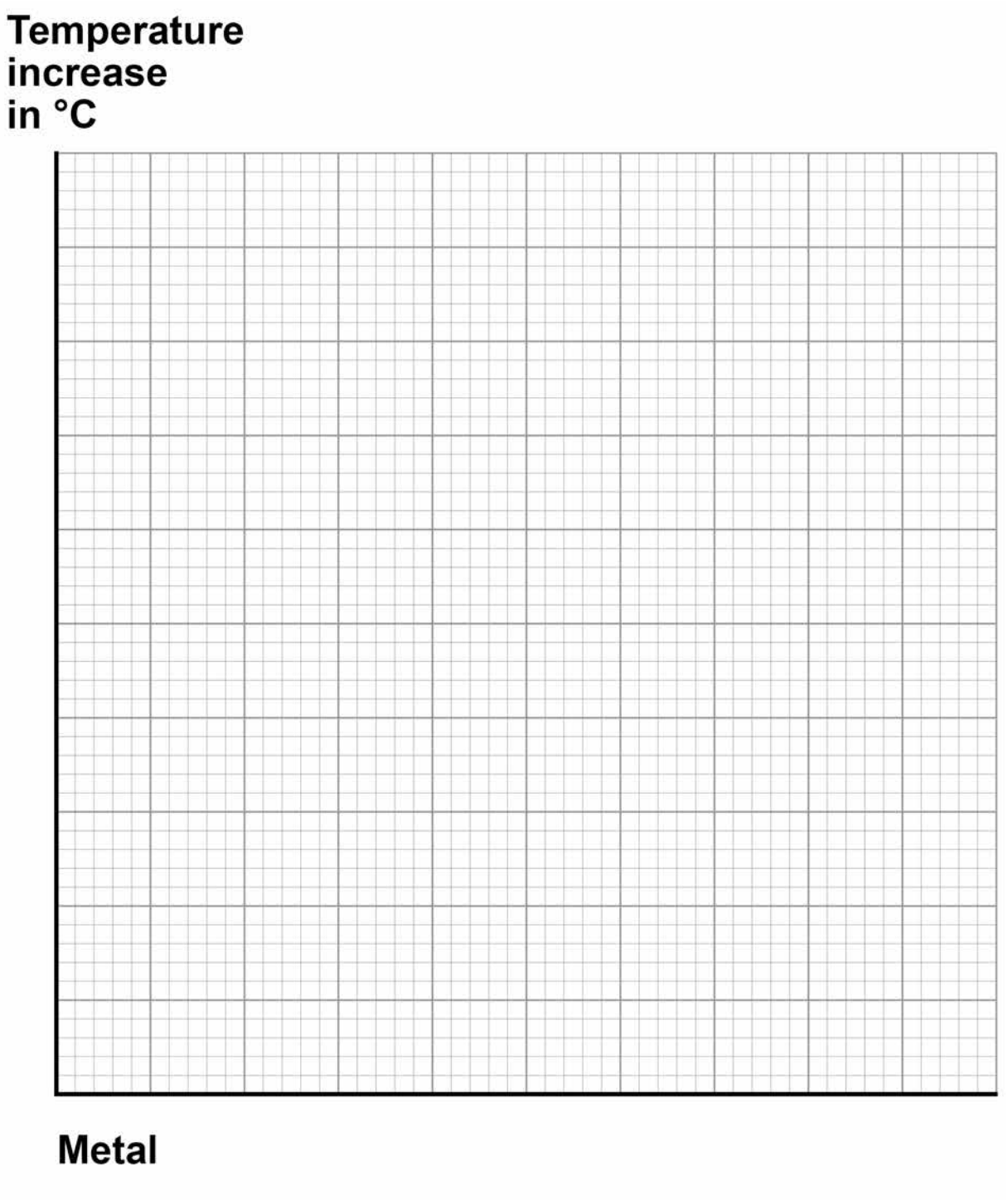
TABLE 2 shows the student's results.

TABLE 2

Metal	Temperature increase in °C
Copper	0
Iron	13
Magnesium	43
Zinc	17

0 5 . 1 **Plot the data from TABLE 2 on FIGURE 4 as a bar chart. [2 marks]**

FIGURE 4



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0 5 . 2 **The student concluded that the reactions between the metals and copper sulfate solution are endothermic.**

Give ONE reason why this conclusion is NOT correct. [1 mark]

0 5 . 3 **The temperature change depends on the reactivity of the metal.**

The student's results are used to place copper, iron, magnesium and zinc in order of their reactivity.

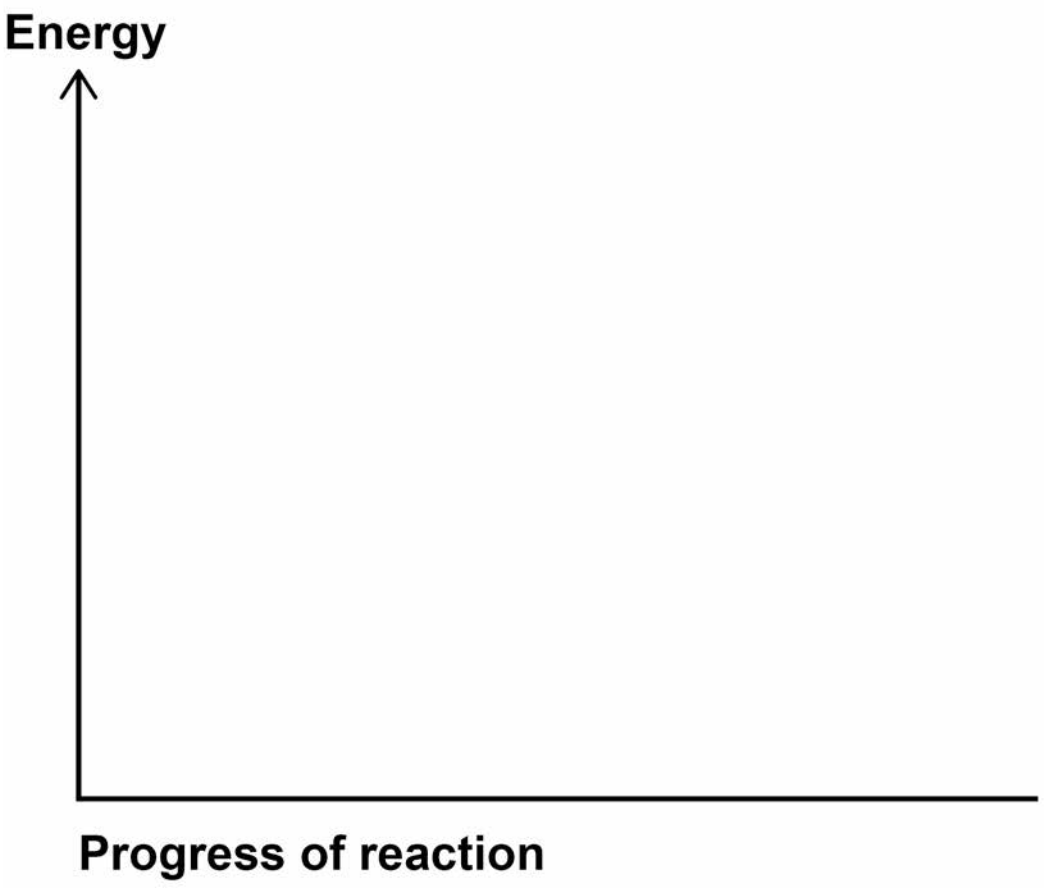
Describe a method to find the position of an unknown metal in this reactivity series.

Your method should give valid results.
[4 marks]

[Turn over]

0 5 . 4 **Draw a fully labelled reaction profile for the reaction between zinc and copper sulfate solution on FIGURE 5. [3 marks]**

FIGURE 5



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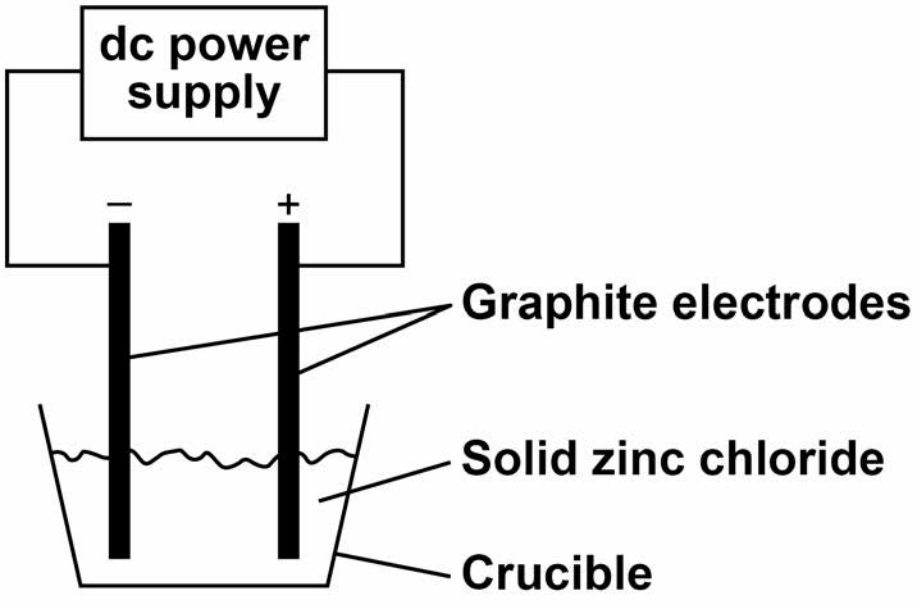
[Turn over]

0 6 **A student investigated the electrolysis of different substances.**

FIGURE 6 shows the apparatus.

FIGURE 6



0 6 . 1 **Explain why electrolysis would NOT take place in the apparatus shown in FIGURE 6. [2 marks]**

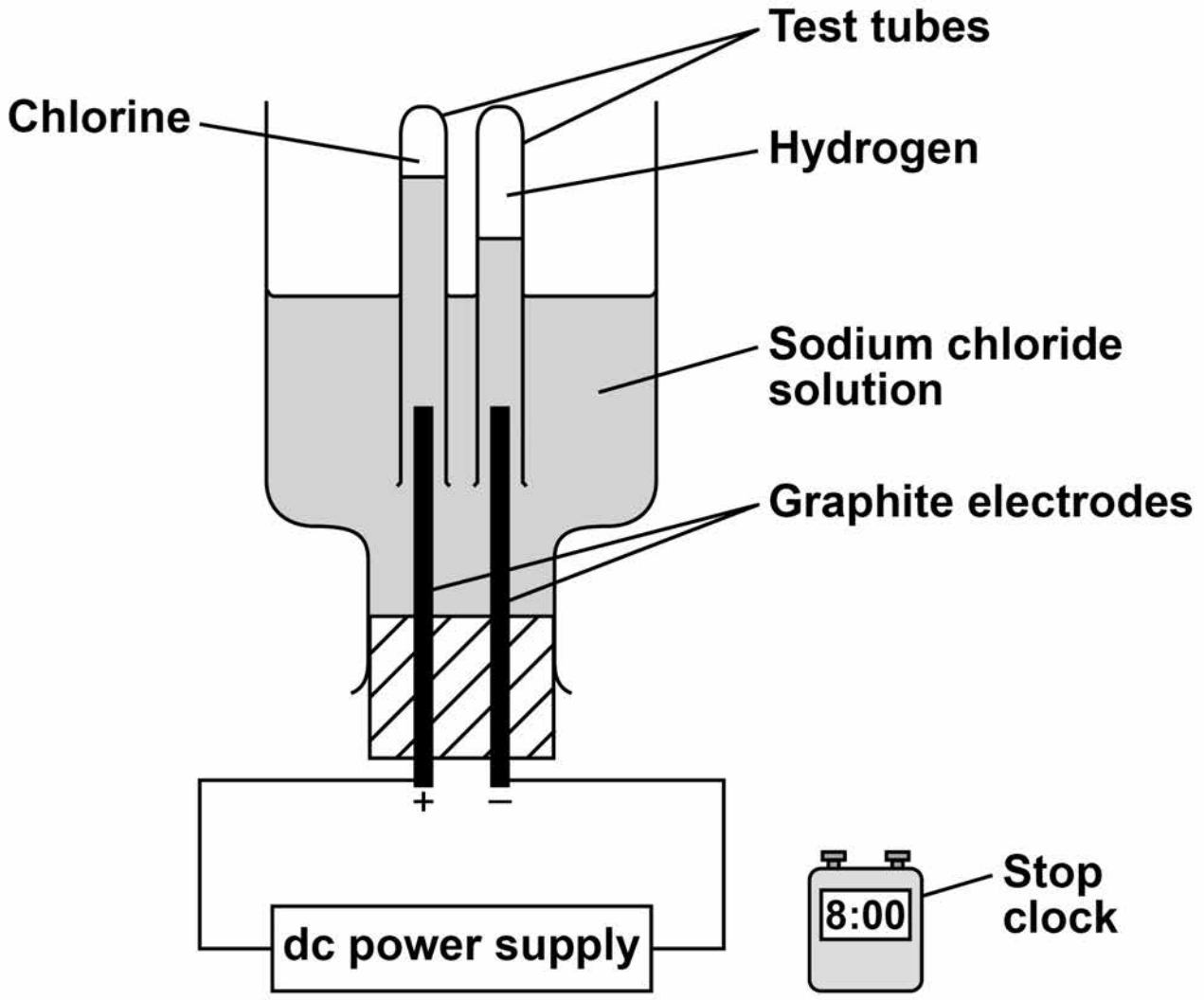
0 6 . 2 **Explain why graphite conducts electricity.**

Answer in terms of the structure and bonding in graphite. [3 marks]

The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

FIGURE 7 shows the apparatus.

FIGURE 7



0 6 . 3 **The student made an error in selecting the apparatus for this investigation.**

How should the apparatus be changed?

Give ONE reason for your answer. [2 marks]

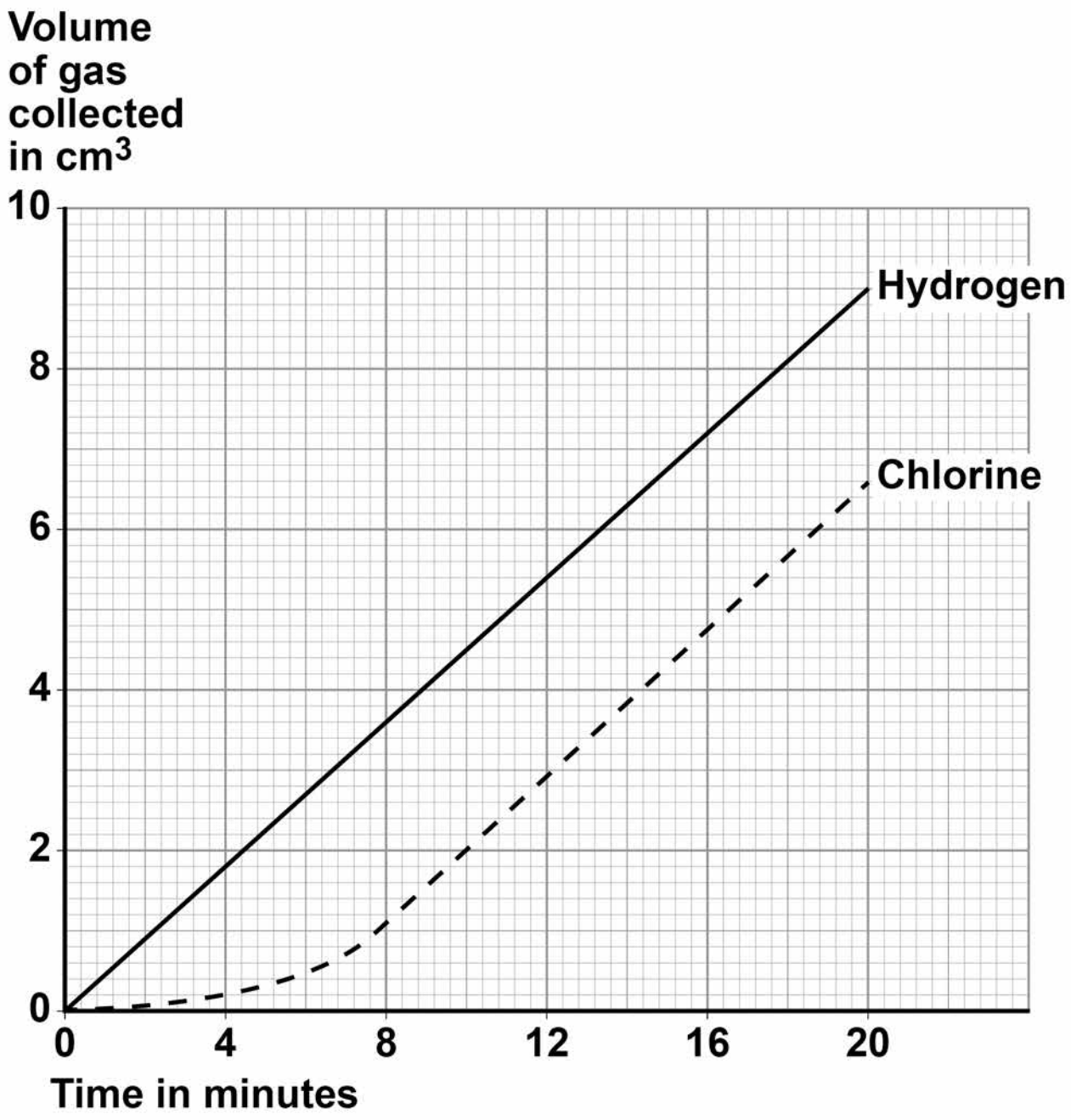
[Turn over]

Another student used the correct apparatus.

This student measured the volumes of gases collected every minute for 20 minutes.

FIGURE 8 shows the student's results.

FIGURE 8



0 6 . 4 Describe the trends shown in the results.

Use values from FIGURE 8. [3 marks]

0 6 . 5 **The number of moles of each gas produced at the electrodes is the same.**

No gas escapes from the apparatus.

Suggest ONE reason for the difference in volume of each gas collected. [1 mark]

0 6 . 6 **Calculate the amount in moles of chlorine collected after 20 minutes.**

Use FIGURE 8 on page 36.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Give your answer in standard form. [3 marks]

Moles of chlorine = _____ mol

14

0 7 **This question is about Group 7 elements.**

Chlorine is more reactive than iodine.

0 7 . 1 **Name the products formed when chlorine solution reacts with potassium iodide solution. [1 mark]**

0 7 . 2 **Explain why chlorine is more reactive than iodine. [3 marks]**

0 7 . 3 **Chlorine reacts with hydrogen to form hydrogen chloride.**

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.
[3 marks]

0 7 . 4 **Bromine reacts with methane in sunlight.**

FIGURE 9 shows the displayed formulae for the reaction of bromine with methane.

FIGURE 9

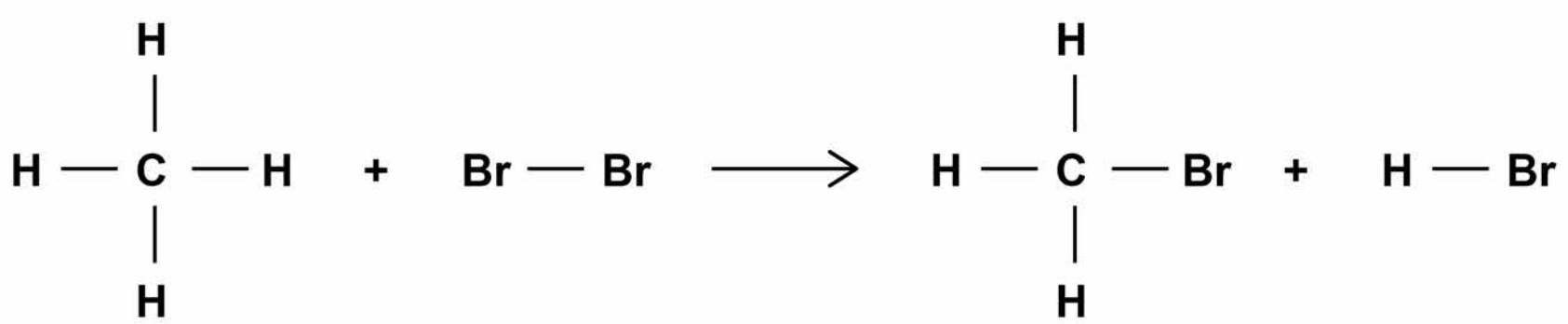


TABLE 3 shows the bond energies and the overall energy change in the reaction.

TABLE 3

	C—H	Br—Br	C—Br	H—Br	Overall energy change
Energy in kJ/mol	**412**	**193**	**X**	**366**	**– 51**

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Calculate the bond energy X for the C—Br bond.

Use FIGURE 9 on page 42 and TABLE 3 on page 43. [4 marks]

Bond energy X = _____ kJ/mol

11

0 8 **Titanium is a transition metal.**

Titanium is extracted from titanium dioxide in a two stage industrial process.

STAGE 1 $TiO_2 + 2\,C + 2\,Cl_2 \rightarrow TiCl_4 + 2\,CO$

STAGE 2 $TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$

0 8 . 1 **Suggest ONE hazard associated with STAGE 1. [1 mark]**

0 8 . 2 **Water must be kept away from the reaction in STAGE 2.**

Give ONE reason why it would be hazardous if water came into contact with sodium. [1 mark]

0 8 . 3 **Suggest why the reaction in STAGE 2 is carried out in an atmosphere of argon and NOT in air. [2 marks]**

0 8 . 4 **Titanium chloride is a liquid at room temperature.**

Explain why you would NOT expect titanium chloride to be a liquid at room temperature.
[3 marks]

In STAGE 2, sodium displaces titanium from titanium chloride.

0 8 . 5 **Sodium atoms are oxidised to sodium ions in this reaction.**

Why is this an oxidation reaction? [1 mark]

_____

_____

_____

0 8 . 6 **Complete the half equation for the oxidation reaction. [1 mark]**

Na → _____ + _____

[Turn over]

0 8 . 7 **In STAGE 2, 40 kg of titanium chloride was added to 20 kg of sodium.**

The equation for the reaction is:

$$TiCl_4 + 4\,Na \rightarrow Ti + 4\,NaCl$$

Relative atomic masses (A_r):
Na = 23 Cl = 35.5 Ti = 48

Explain why titanium chloride is the limiting reactant.

You MUST show your working. [4 marks]

0 8 . 8 **For a STAGE 2 reaction the percentage yield was 92.3%**

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced. [2 marks]

Mass of titanium = _____ kg

15

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0 9 **This question is about acids and alkalis.**

0 9 . 1 **Dilute hydrochloric acid is a strong acid.**

Explain why an acid can be described as both strong and dilute. [2 marks]

_____

_____

_____

_____

_____

_____

0 9 . 2 **A 1.0×10^{-3} mol/dm^3 solution of hydrochloric acid has a pH of 3.0**

What is the pH of a 1.0×10^{-5} mol/dm^3 solution of hydrochloric acid? [1 mark]

pH = _____

[Turn over]

A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

0 9 . 3 TABLE 4 shows the student's results.

TABLE 4

	Volume of sodium hydroxide solution in cm^3
Titration 1	23.50
Titration 2	21.10
Titration 3	22.10
Titration 4	22.15
Titration 5	22.15

The equation for the reaction is:

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

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other. [5 marks]

Concentration of sulfuric acid =

_____ **mol/dm^3**

[Turn over]

0 9 . 4 **Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.**
[2 marks]

0 9 . 5 **Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.**

Relative formula mass (M_r): NaOH = 40
[2 marks]

Mass of sodium hydroxide = _____ g

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END OF QUESTIONS

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For Examiner's Use	
Question	Mark
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TOTAL	