

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**

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.**
- **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



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]

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

[Turn over]





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[Turn over]



0 2

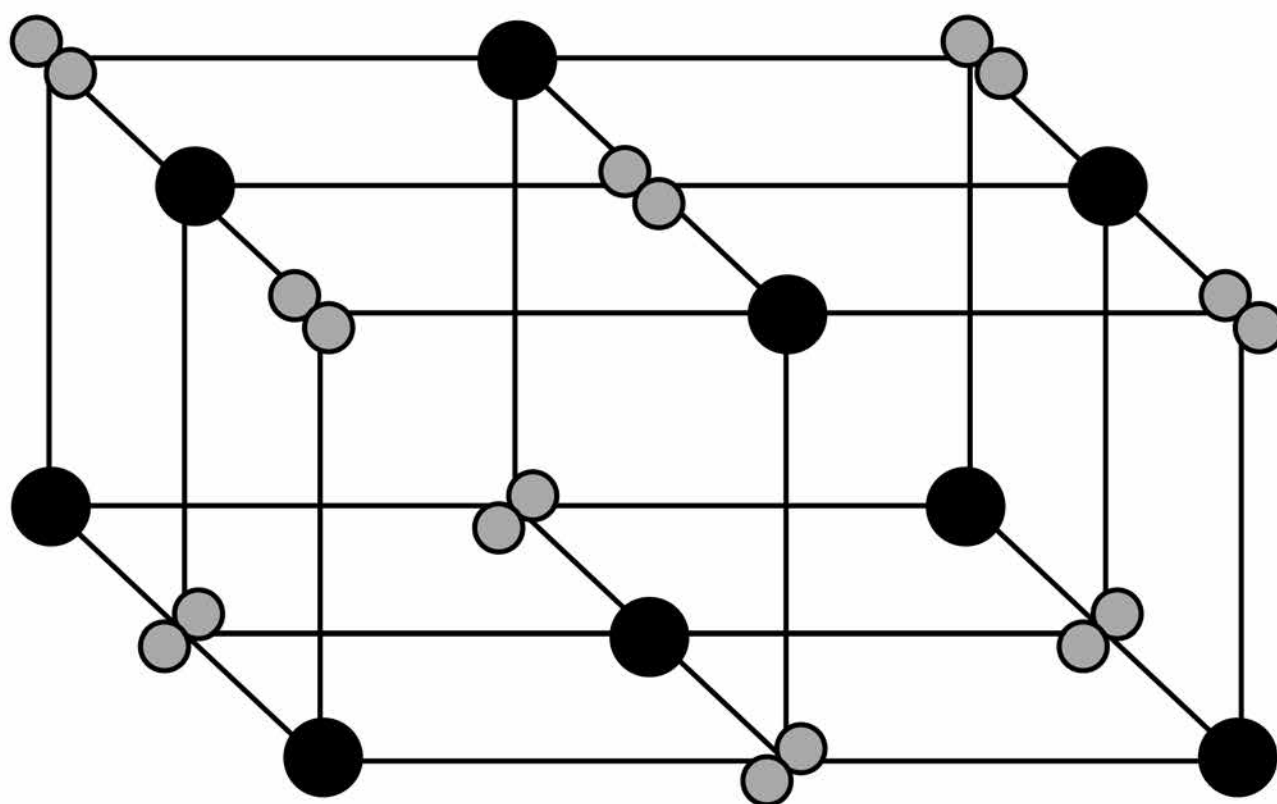
This question is about metals and metal compounds.

0 2 . 1

Iron pyrites is an ionic compound.

FIGURE 1 shows a structure for iron pyrites.

FIGURE 1



KEY

● Fe

○ S

9

Determine the formula of iron pyrites.

Use FIGURE 1. [1 mark]

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

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

Number of protons _____

Number of neutrons _____

Number of electrons _____

[Turn over]



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]

[Turn over]

0 2 . 5 An equation for the reaction is:



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

Relative atomic masses (A_r):

$$\text{C} = 12 \quad \text{Ni} = 59$$

Relative formula mass (M_r):

$$\text{NiO} = 75$$

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

13

Percentage atom economy =

%

11

[Turn over]



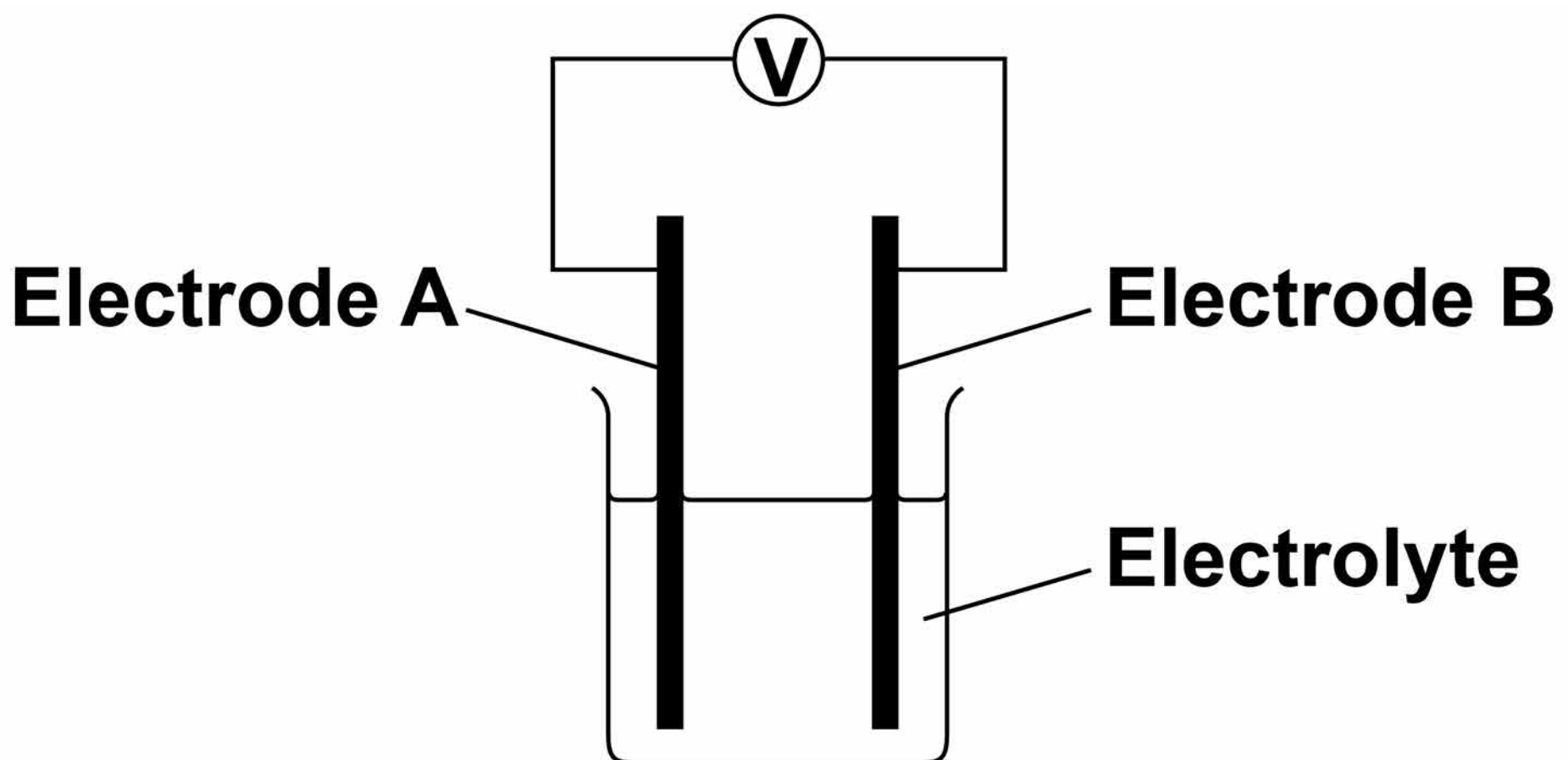
03

Chemical reactions can produce electricity.

03.1

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
<input type="checkbox"/>	Copper	Copper	Sodium chloride solution
<input type="checkbox"/>	Zinc	Zinc	Water
<input type="checkbox"/>	Copper	Zinc	Sodium chloride solution
<input type="checkbox"/>	Copper	Zinc	Water

[Turn over]



Alkaline batteries are non-rechargeable.

03.2 Why do alkaline batteries eventually stop working? [1 mark]

03.3 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]



[Turn over]



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



03.5 TABLE 1, on page 18, shows data about different ways to power electric cars.

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]

[Turn over]



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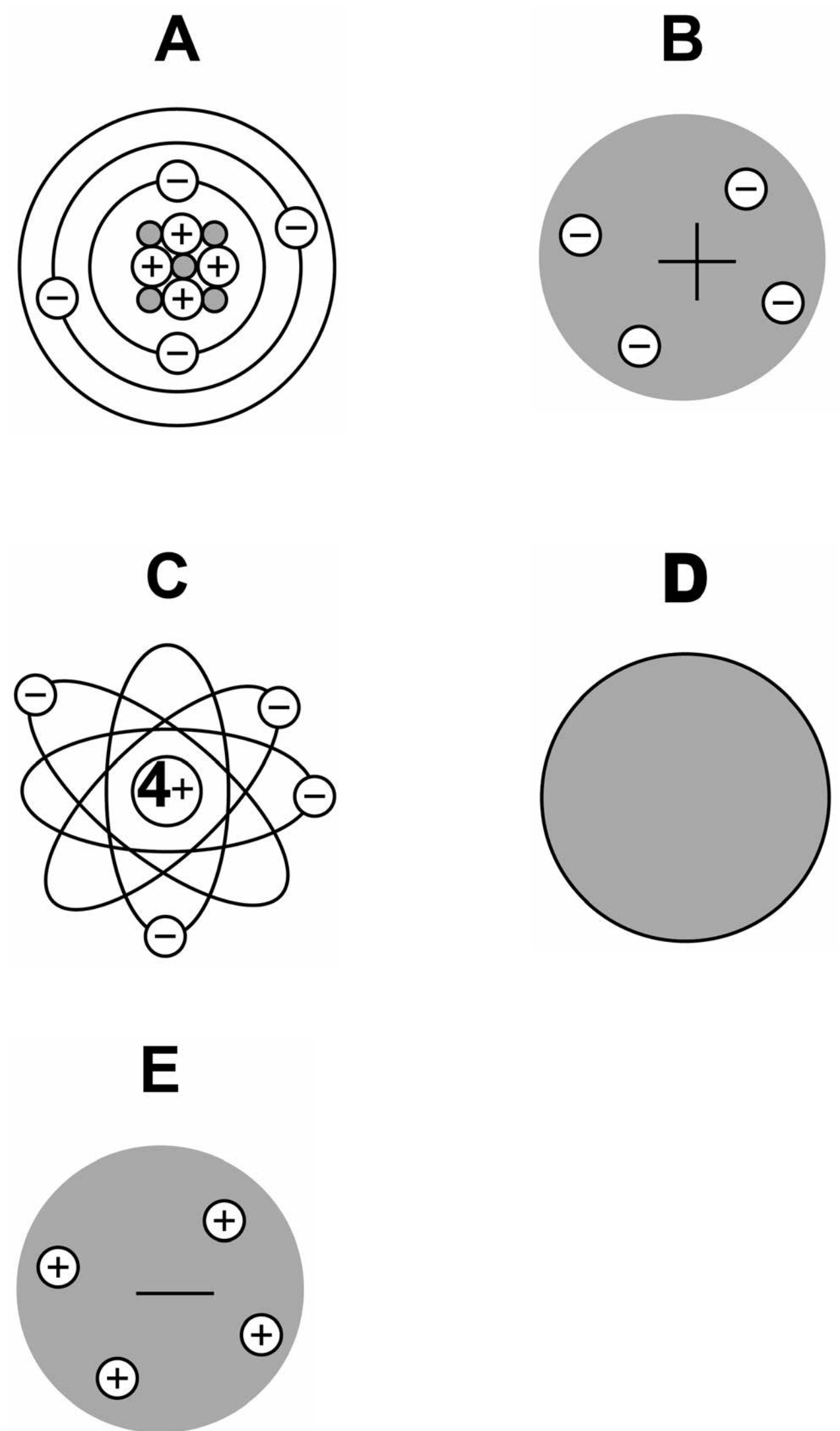
[Turn over]



04

FIGURE 3 represents different models of the atom.

FIGURE 3



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

Tick ONE box.

A	B	C	D	E
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[Turn over]



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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

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

04.6

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

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

8

[Turn over]



0 5

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

TABLE 2 shows the student's results.

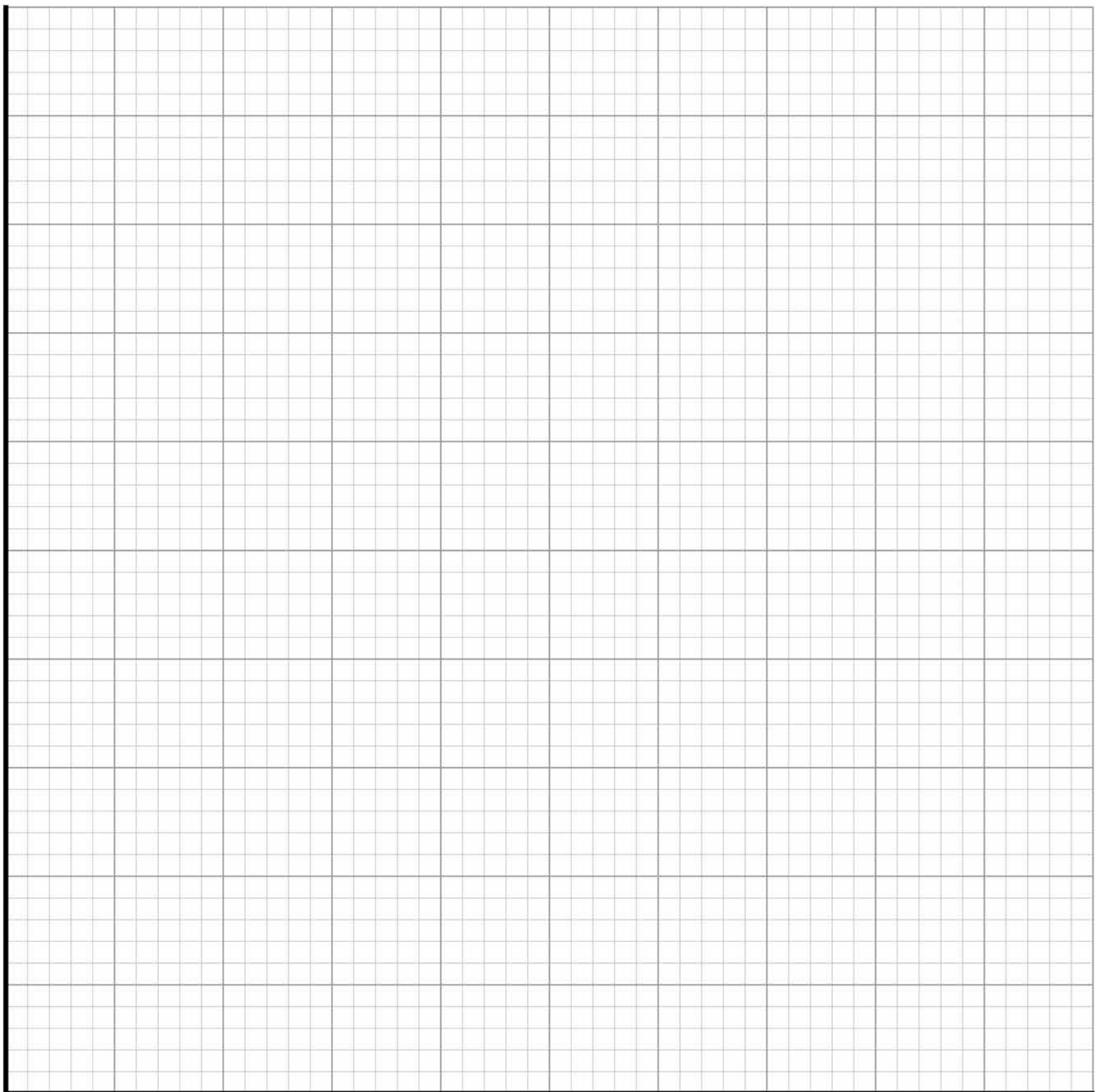
TABLE 2

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

**Temperature
increase
in °C**



Metal



[Turn over]

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.

31

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

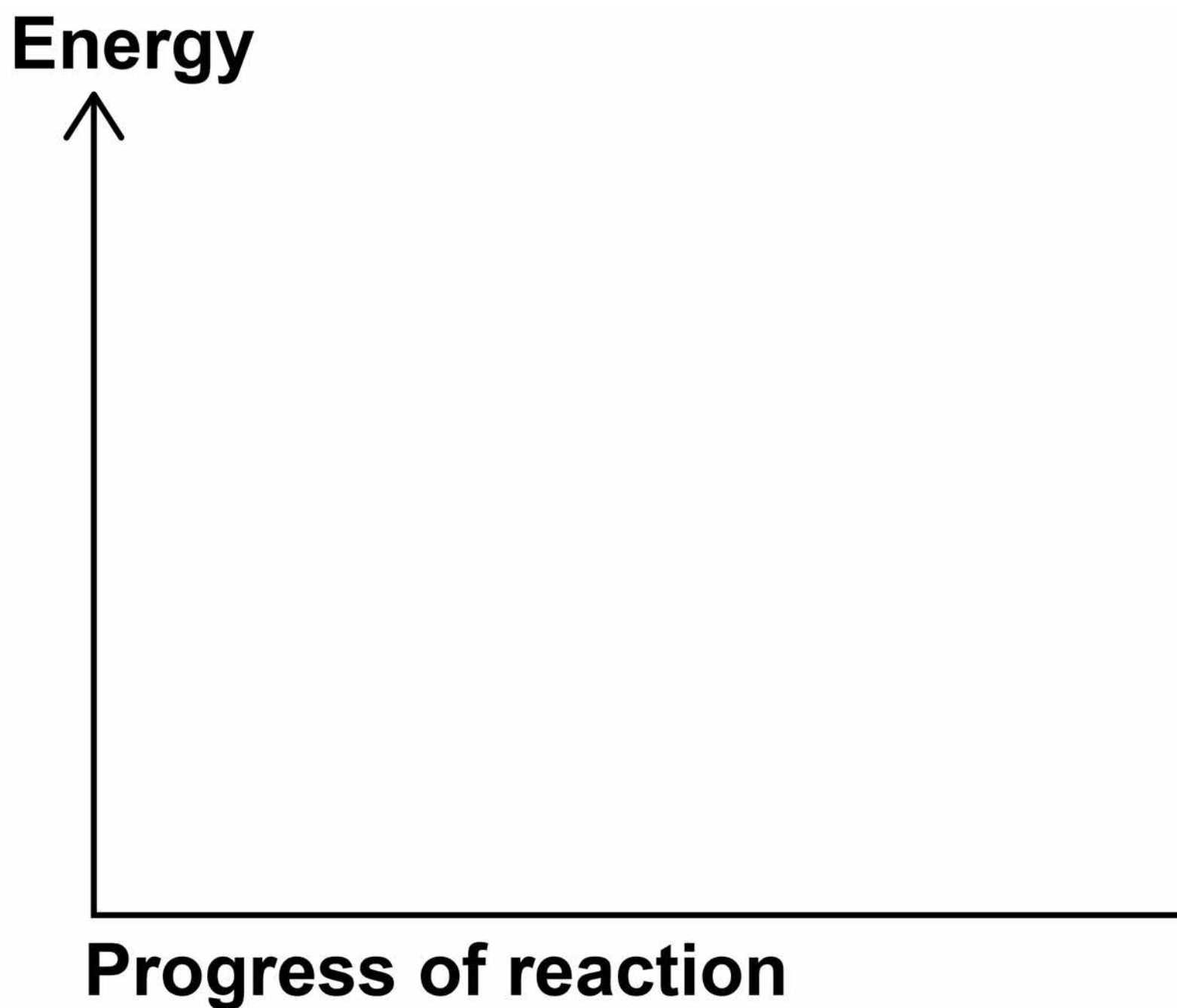
Your method should give valid results. [4 marks]

[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



10



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[Turn over]

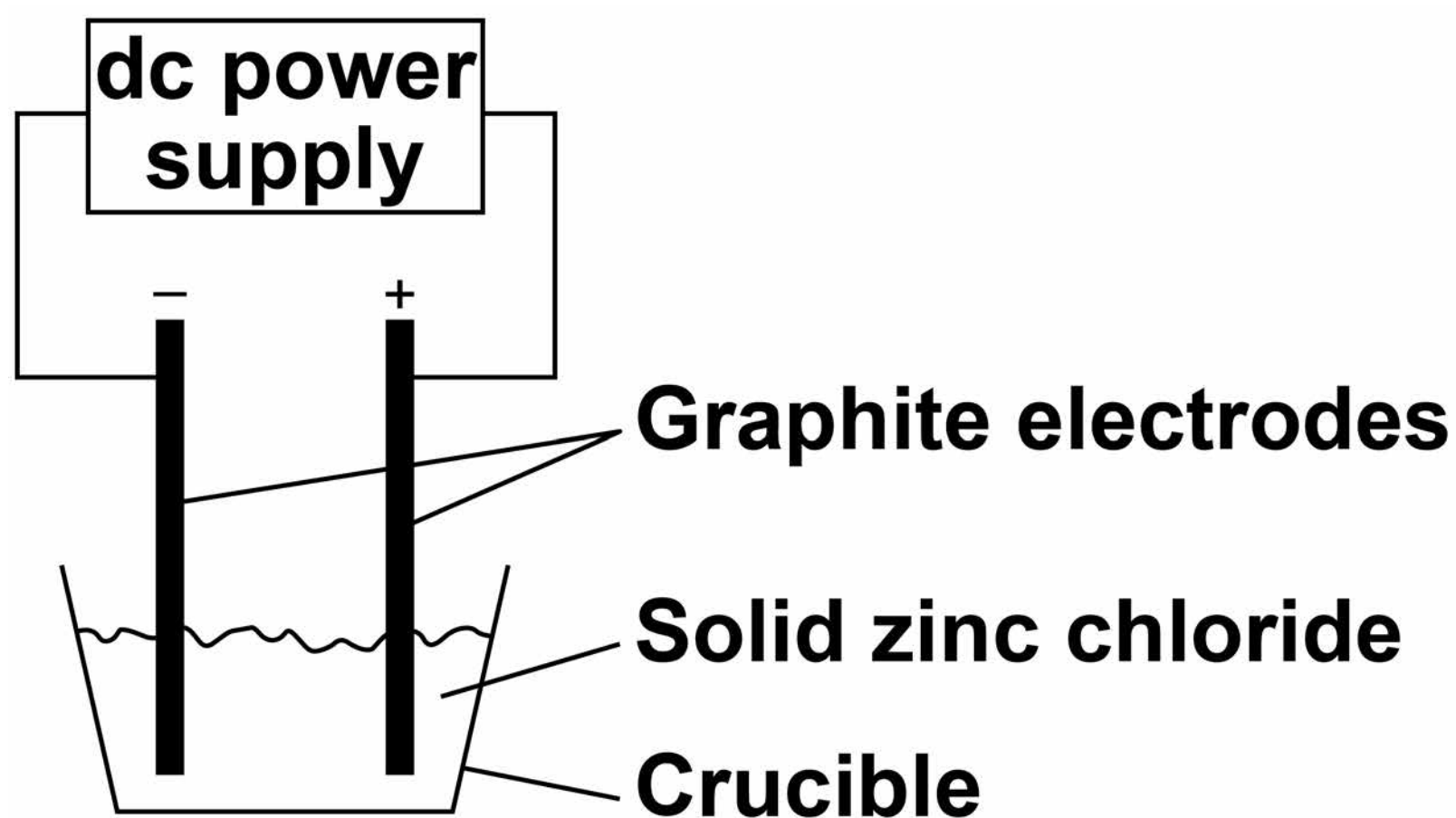


0	6
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A student investigated the electrolysis of different substances.

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]

[Turn over]

0 6 . 2 Explain why graphite conducts electricity.

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

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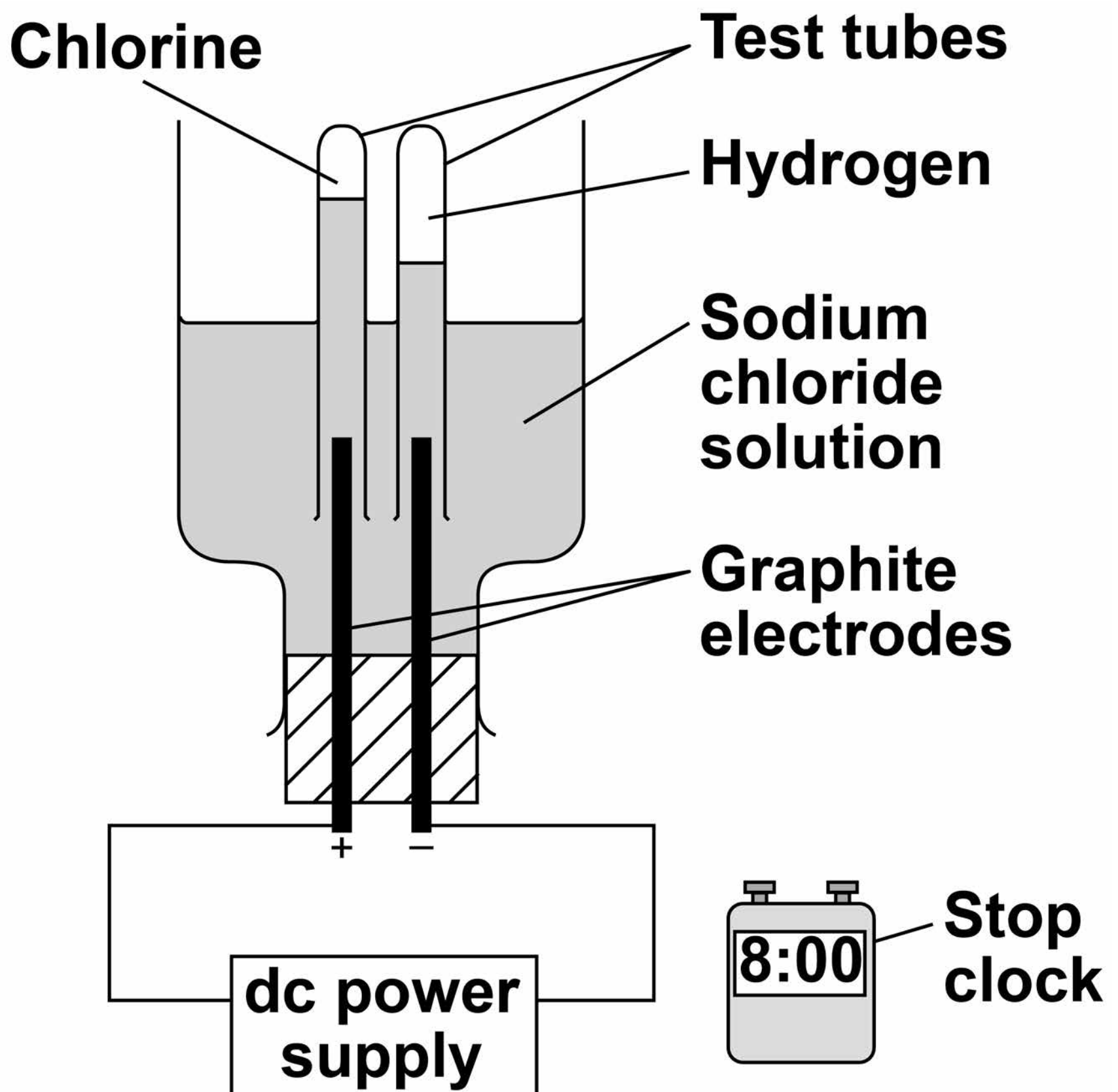
[Turn over]



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]

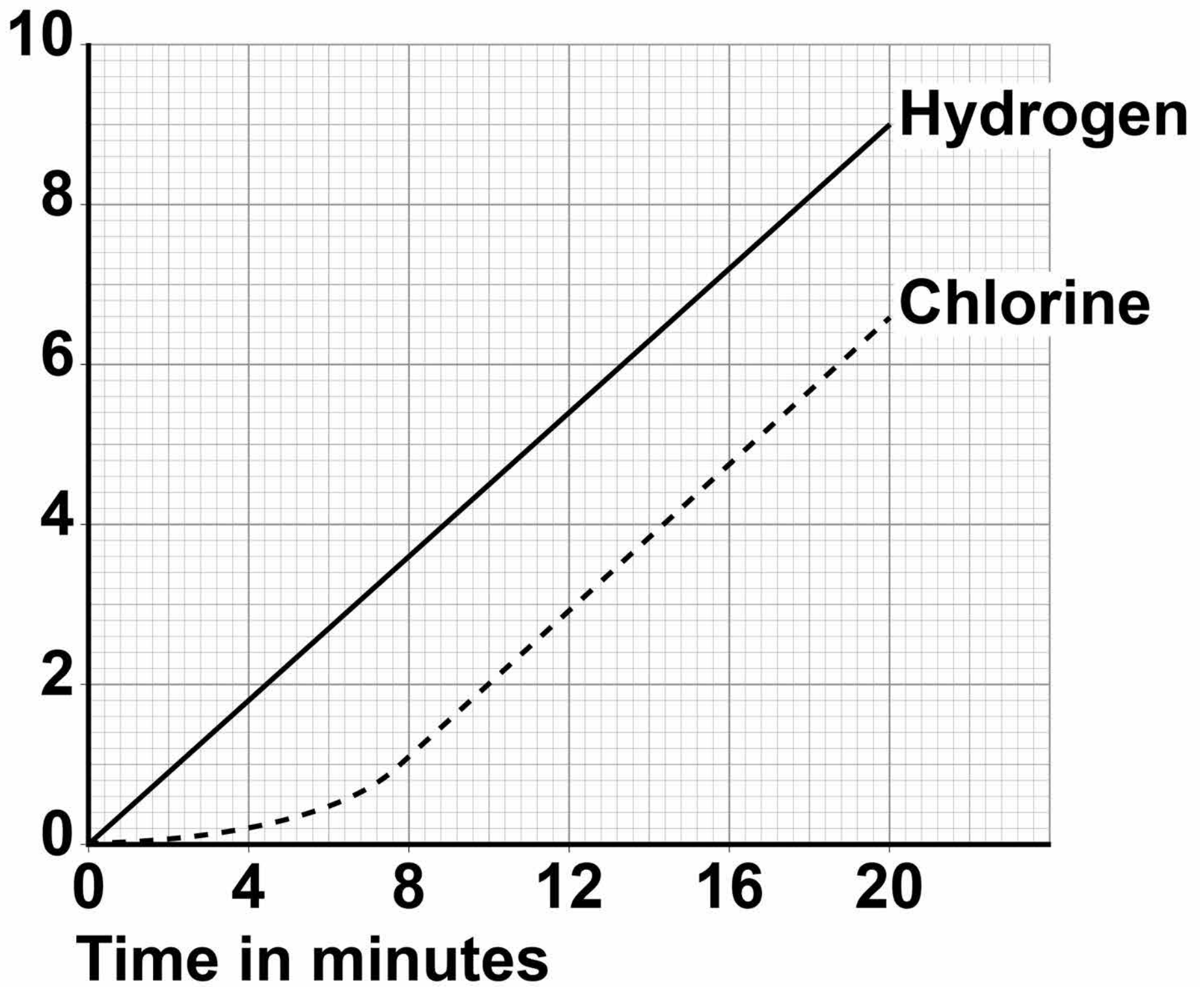
Another student used the correct apparatus.

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

FIGURE 8, on page 41, shows the student's results.

FIGURE 8

Volume
of gas
collected
in cm^3



[Turn over]



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

Use values from FIGURE 8 on page 41. [3 marks]

[Turn over]

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]

06.6 Calculate the amount in moles of chlorine collected after 20 minutes.

Use **FIGURE 8** on page 41.

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

[Turn over]



0	7
---	---

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

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

07.2 Explain why chlorine is more reactive than iodine. [3 marks]

[Turn over]



07.3 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]

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[Turn over]



07.4 Bromine reacts with methane in sunlight.

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

FIGURE 9

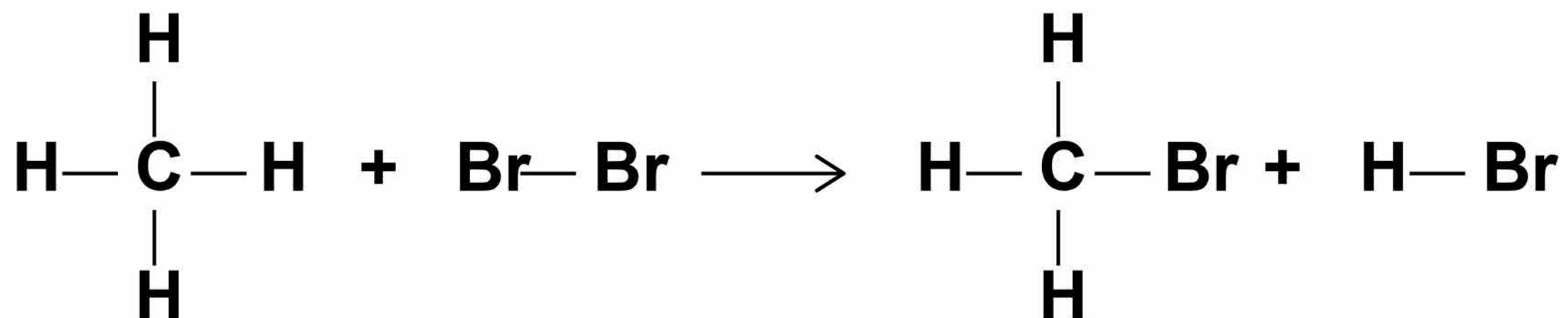


TABLE 3 shows the bond energies and the overall energy change in the reaction.

TABLE 3

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

[Turn over]



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

Use FIGURE 9 on page 50 and TABLE 3 on page 51. [4 marks]

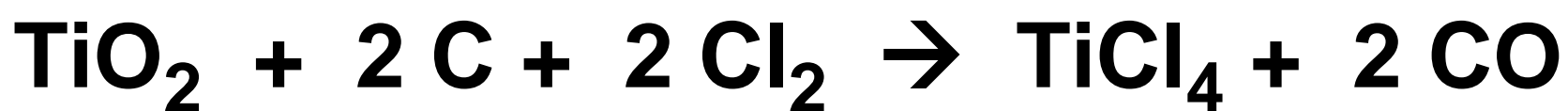
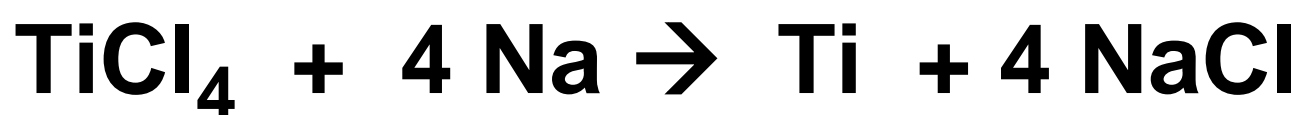
53

Bond energy $X =$ _____ kJ/mol

11

[Turn over]



0 8**Titanium is a transition metal.****Titanium is extracted from titanium dioxide in a two stage industrial process.****STAGE 1****STAGE 2****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]

[Turn over]



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.

08.5 Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction? [1 mark]

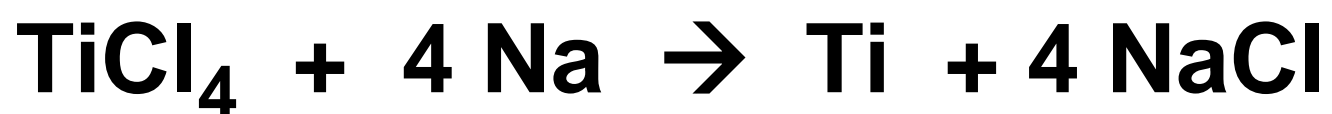
08.6 Complete the half equation for the oxidation reaction. [1 mark]



[Turn over]

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

The equation for the reaction is:



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]

[Turn over]

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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

[Turn over]



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/dm³ solution of hydrochloric acid has a pH of 3.0

What is the pH of a 1.0×10^{-5} mol/dm³ solution of hydrochloric acid? [1 mark]

pH = _____

[Turn over]

A student titrated 25.0 cm³ portions of dilute sulfuric acid with a 0.105 mol/dm³ sodium hydroxide solution.

09.3 TABLE 4 shows the student's results.

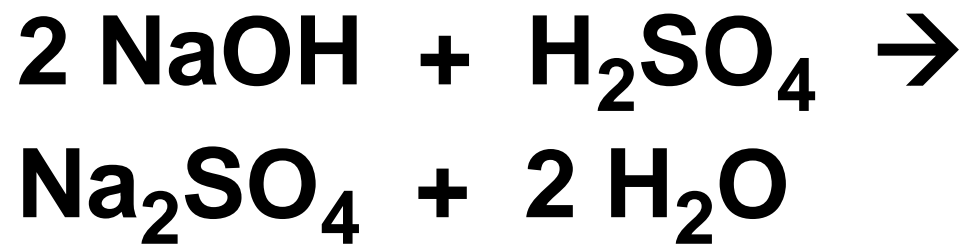
TABLE 4

	Volume of sodium hydroxide solution in cm³
Titration 1	23.50
Titration 2	21.10
Titration 3	22.10
Titration 4	22.15
Titration 5	22.15



65

The equation for the reaction is:



Calculate the concentration of the sulfuric acid in mol/dm³

Use only the student's concordant results.

**Concordant results are those within 0.10 cm³ of each other.
[5 marks]**

[Turn over]



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Concentration of sulfuric acid =
_____ **mol/dm³**

[Turn over]

09.4 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

12

END OF QUESTIONS



There are no questions printed on this page

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Question	Mark
1	
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TOTAL	

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