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Surname _____

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GCSE **H**
COMBINED SCIENCE: SYNERGY

Higher Tier Paper 3 Physical sciences

8465/3H

Friday 7 June 2019 Afternoon

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]



J U N 1 9 8 4 6 5 3 H 0 1

For this paper you must have:

- **a ruler**
- **a protractor**
- **a scientific calculator**
- **the periodic table (enclosed)**
- **the Physics Equations Sheet (enclosed).**



INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **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



Answer ALL questions in the spaces provided.

0 1 Catalase is an enzyme.

0 1. **1** What type of molecule is an enzyme? [1 mark]

0 1. **2** Hydrogen peroxide decomposes in the presence of catalase.

This is the equation for the reaction:



Describe how the student could test for the gas produced. [2 marks]

Test

Result



A student investigated the effect of pH on the activity of catalase.

0 1 . 3 Describe how the student could use an indicator to measure the pH of a solution.
[2 marks]

[Turn over]

TABLE 1 shows the results.

TABLE 1

pH	Enzyme activity in arbitrary units
3.0	0
4.0	6
5.0	22
6.0	37
7.0	44
8.0	34
9.0	16
10.0	2

0 1 . 4 What is the optimum pH for catalase in this reaction?

Use TABLE 1. [1 mark]

Optimum pH = _____



0 1 . 5 How could the student find a more accurate value for the optimum pH? [1 mark]

Tick (✓) ONE box.

Decrease the hydrogen peroxide concentration

Increase the pH range

Increase the temperature to 60 °C

Use smaller pH intervals

[Turn over]



0 1 . 6 Explain the result for catalase at pH 3.0
[3 marks]

10

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[Turn over]



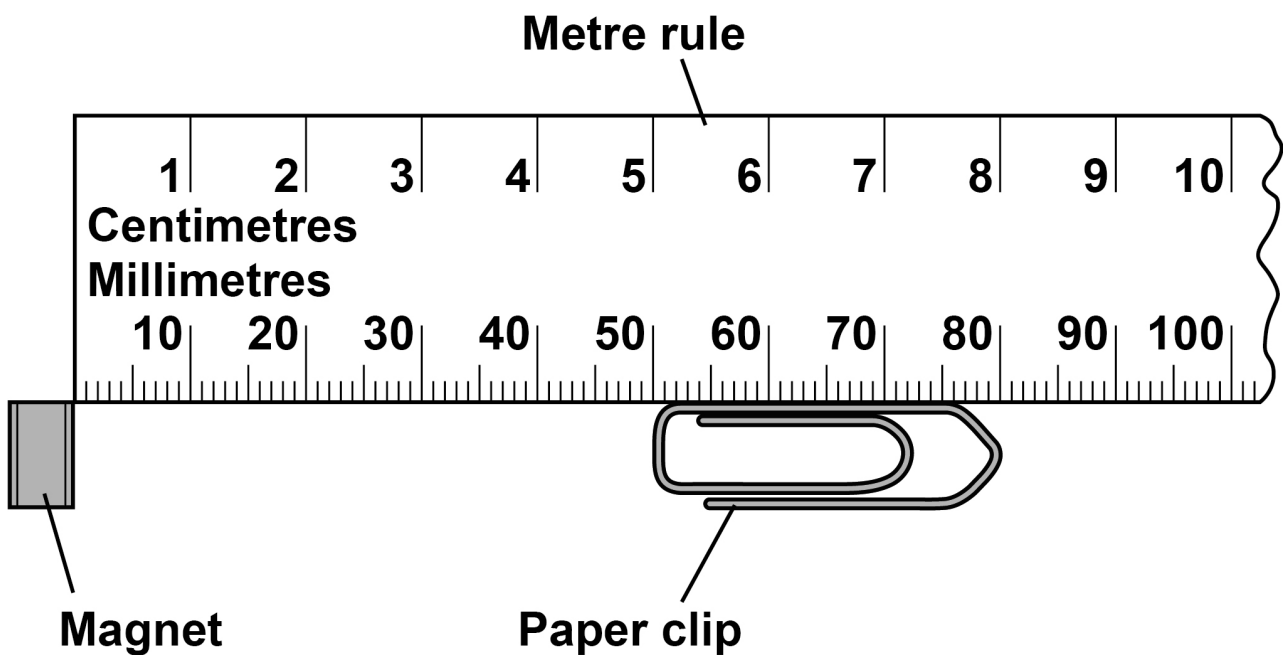
02

A student investigated magnets.

The student used a paper clip, metre rule and magnets.

FIGURE 1 shows the apparatus with one magnet.

FIGURE 1



02.1

Write down the resolution of the metre rule.
[1 mark]

Resolution = _____



0 2 . 2 Explain why the paper clip is attracted to the magnet. [2 marks]

[Turn over]



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The student placed the paper clip at different distances from the magnet.

She recorded the minimum distance at which the paper clip did not move towards the magnet.

She repeated the investigation using different numbers of magnets.

0 2 . 3 Suggest why the magnets used should be identical. [1 mark]

[Turn over]

TABLE 2 shows the results of the investigation.

TABLE 2

Number of magnets	Minimum distance at which paper clip did not move in cm
1	1.8
2	3.6
3	5.4
4	6.6
5	X
6	7.1
7	7.2
8	7.2

0 2 . 4 Predict the value X in TABLE 2. [1 mark]

X = _____ cm



**There is a resultant force on the paper clip.
The resultant force causes the paper clip to
accelerate towards the magnet.**

0 2 . 5 Write the equation which links acceleration,
mass and resultant force. [1 mark]

[Turn over]



0 2 . 6 The mass of the paper clip is 0.0012 kg

**Calculate the acceleration of the paper clip
when the resultant force on it is 0.000168 N**

Give the unit. [4 marks]

Acceleration = _____

Unit _____



The Earth has a magnetic field.

- 02.7** The magnetic field is probably caused by movements inside the Earth.

Name the part of the Earth in which the movements take place. [1 mark]

- 02.8** Give ONE piece of evidence to show that the Earth's magnetic field has changed over time. [1 mark]

12

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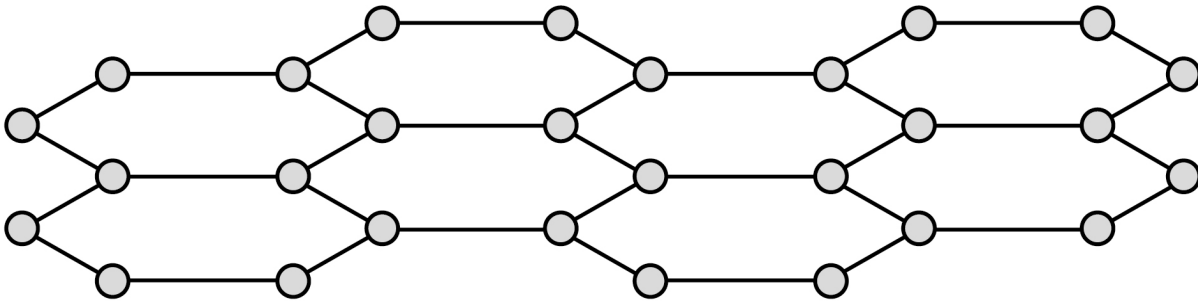


03 This question is about graphene and graphite.

Graphene is a single layer of graphite.

FIGURE 2 represents part of the structure of graphene.

FIGURE 2



03.1 Graphene is one atom thick. The diameter of the atom is 3.4×10^{-10} m

What is the thickness of a graphene layer in nanometres?

1 nm = 10^{-9} m [1 mark]

Tick (✓) ONE box.

0.034 nm

0.34 nm

3.4 nm

34 nm

[Turn over]



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03.2 Which is ONE use of graphene? [1 mark]

Tick (✓) ONE box.

As a detergent

As a solvent

In composites

To produce polymers

03.3 Graphene and graphite are used in electronics.

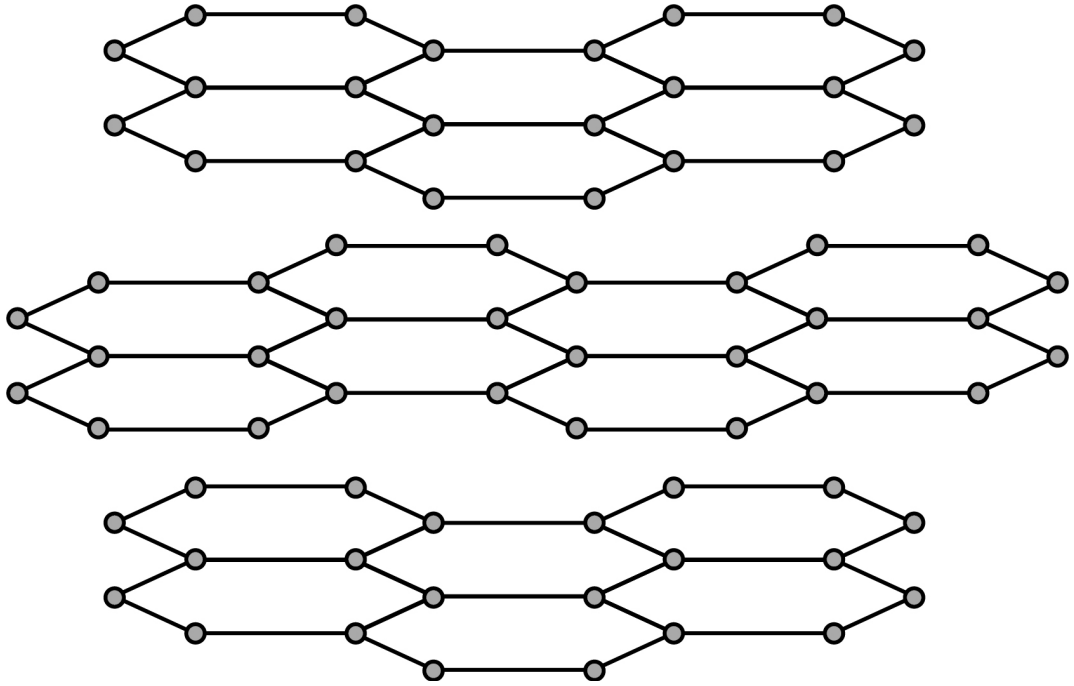
Suggest ONE reason why graphene is a more suitable material for use in electronics than graphite. [1 mark]

[Turn over]



03.4 FIGURE 3 represents part of the structure of graphite.

FIGURE 3



9



0 4 This question is about hydrocarbons.

0 4 . 1 When a hydrocarbon $C_{10}H_{22}$ is cracked, two substances are produced.

Complete the equation for the reaction.

[1 mark]



0 4 . 2 Explain why the hydrocarbon C_7H_{16} has a lower boiling point than $C_{10}H_{22}$

[2 marks]

[Turn over]



Ethanol is produced by reacting ethene with steam.

The equation for the reaction is:

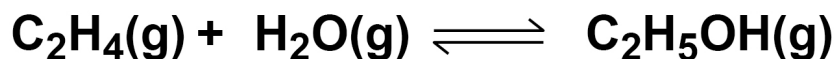
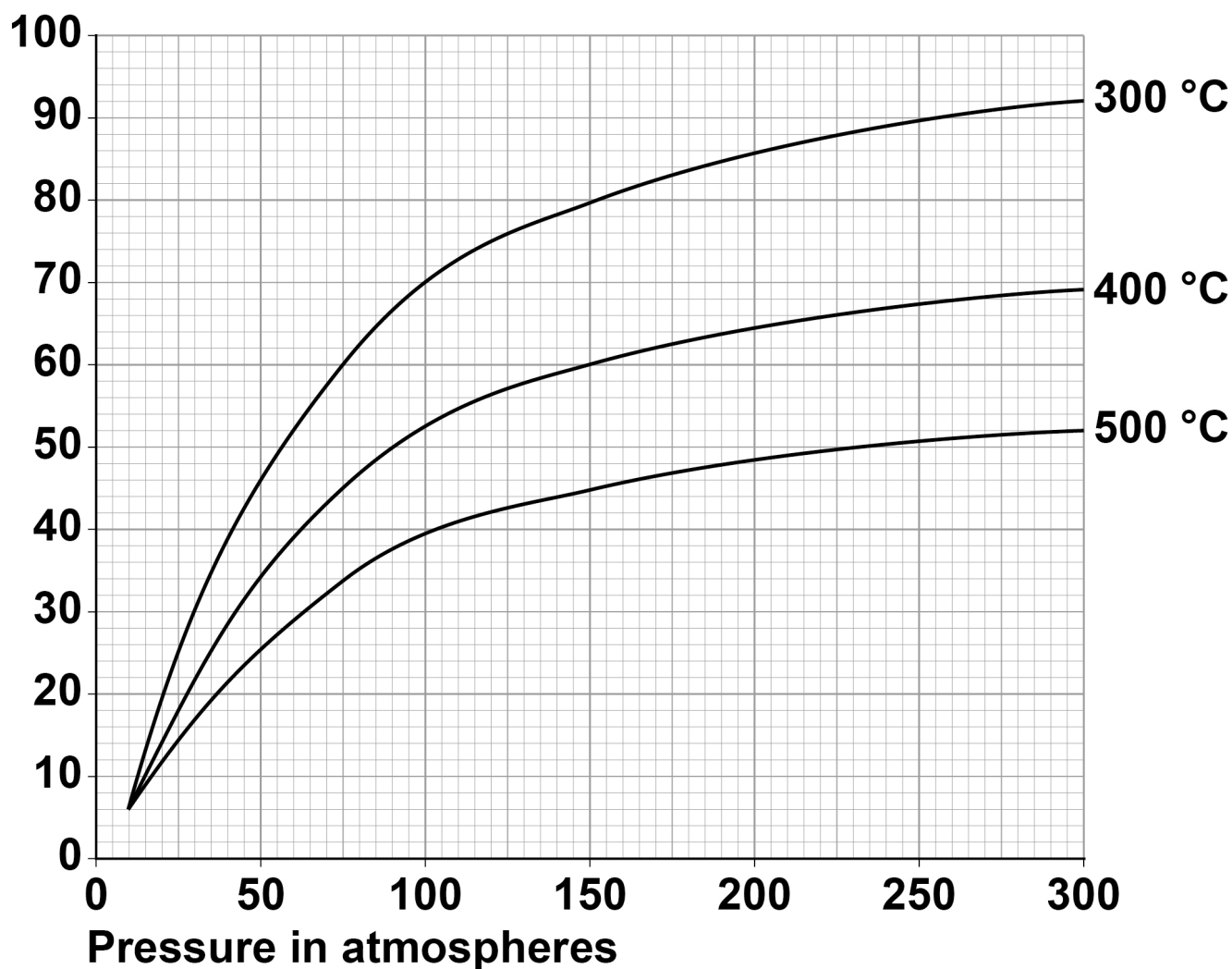


FIGURE 4 shows the percentage yield of ethanol using different reaction conditions.

FIGURE 4

Percentage
yield of
ethanol



0 4 . 3 Explain why changing the pressure affects the percentage yield of ethanol. [3 marks]

The forward reaction is exothermic.

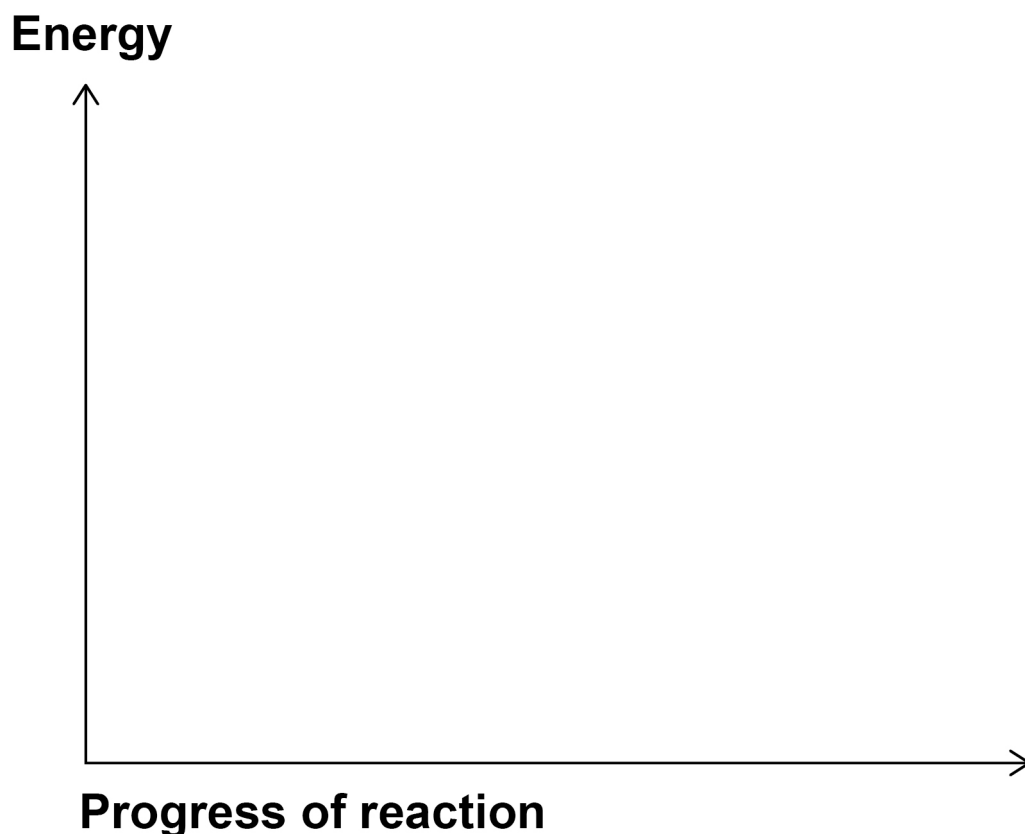
0 4 . 4 How does FIGURE 4 provide evidence for this? [1 mark]

[Turn over]



04.5 FIGURE 5 shows part of a reaction profile diagram.

FIGURE 5



A catalyst is used in the reaction to produce ethanol.

Complete FIGURE 5 to show how the catalyst increases the rate of this reaction.

**You should label the reaction profile diagram.
[4 marks]**



0 4 . 6 Suggest why the catalyst does NOT affect the yield of ethanol at equilibrium. [2 marks]

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[Turn over]



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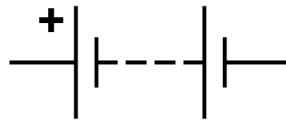
0 5

A student investigated how the resistance of a thermistor varies with temperature.

0 5 . 1

The student made measurements to determine the resistance of the thermistor at room temperature. He used an ammeter and a voltmeter.

Complete the circuit diagram to show a circuit the student could use. [3 marks]



[Turn over]



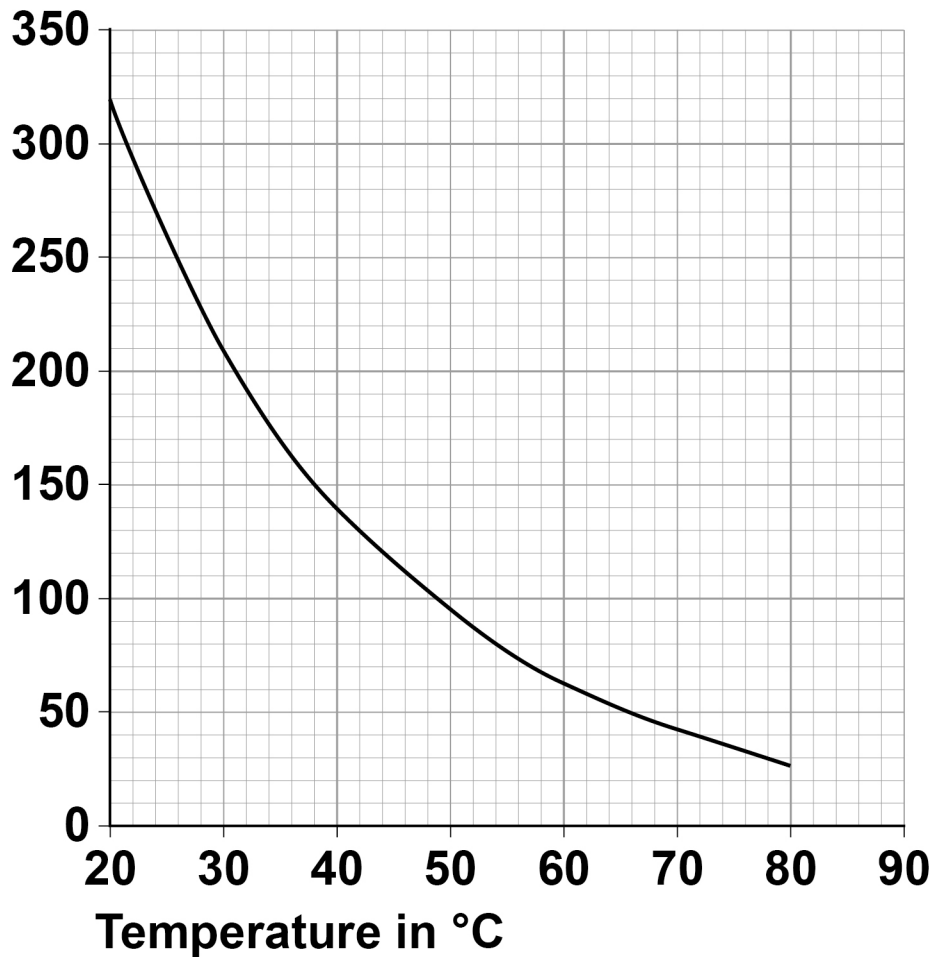
The student repeated the measurements with the thermistor at different temperatures.

He plotted a graph of resistance against temperature.

FIGURE 6 shows the graph.

FIGURE 6

Resistance
in ohms



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- 0 5 . 3** Explain how the graph shows that the thermistor is most sensitive to changes in temperature between 20 °C and 25 °C
[2 marks]

9

[Turn over]



0 6

A student investigated the rate of the reaction between magnesium and hydrochloric acid.

The student measured the volume of hydrogen gas produced.

0 6 . 1

How could the student collect and measure the volume of gas produced? [1 mark]



0 6 . 2 At the start of the investigation the volume of gas was 0 cm^3

The student took readings at 20-second intervals.

Readings for the volume of gas were 24 cm^3 , 44 cm^3 , 59 cm^3 , 70 cm^3 , 76 cm^3 and 79 cm^3

Draw a results table for the investigation.

Include the student's results in the table.
[3 marks]

[Turn over]

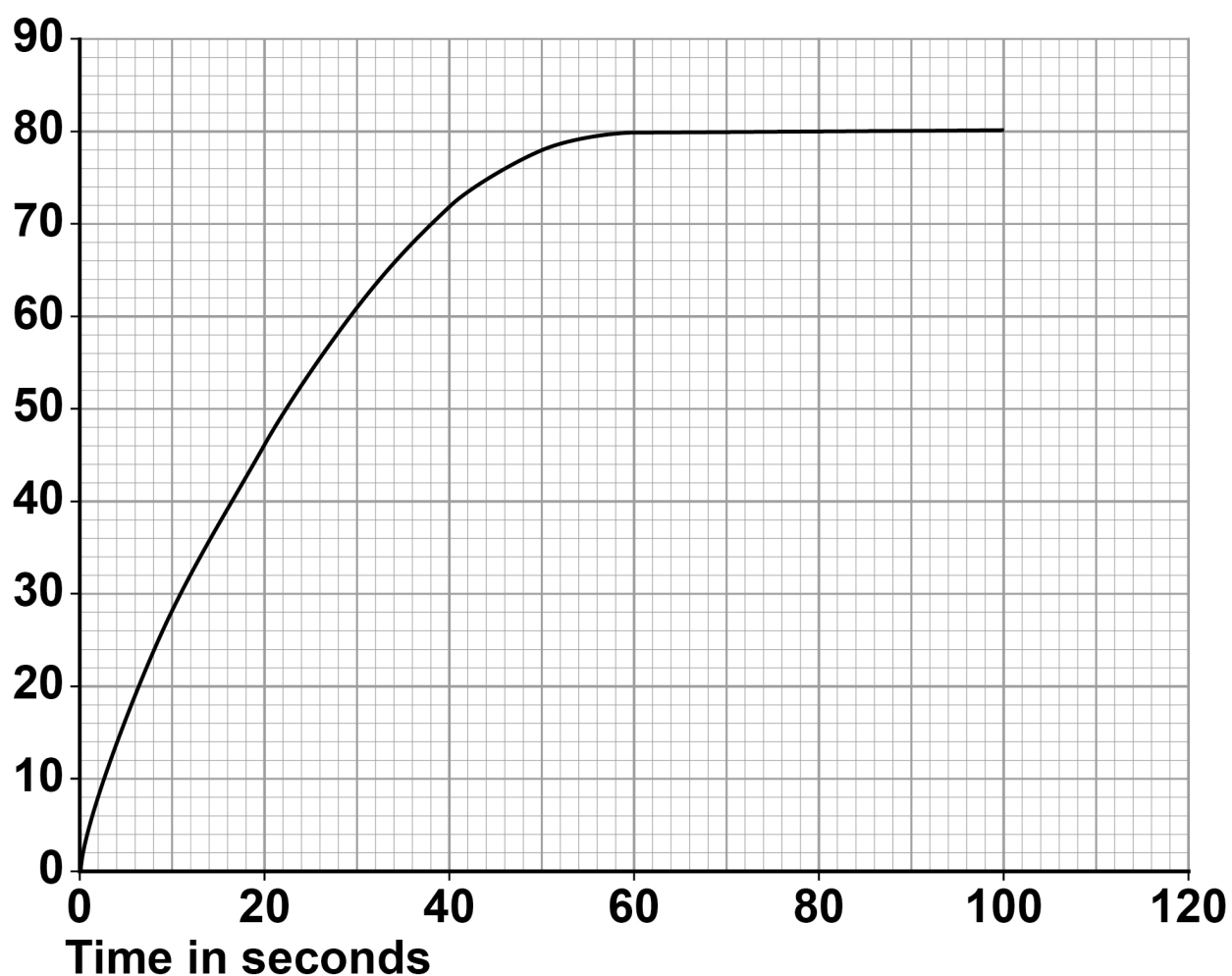


The student repeated the investigation at a higher temperature.

FIGURE 7 shows the results.

FIGURE 7

Volume of gas
produced in cm^3



06.3 Determine the rate of reaction at 30 seconds.

Show your working on FIGURE 7.

Give your answer to 2 significant figures.
[4 marks]

Rate = _____ cm^3/s

[Turn over]



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[Turn over]



- 07.2** The 1 kilogram mass consisted of 900 g platinum and 100 g iridium.

What was the ratio of platinum atoms to iridium atoms in the alloy?

Relative atomic masses (A_r): Pt = 195 Ir = 192
[1 mark]

Tick (✓) ONE box.

0.99 :1.00

8.86 :1.00

9.00 :1.00

9.14 :1.00

[Turn over]



The Avogadro constant is the number of atoms in 1 mole of a substance.

07.3 What is the value of the Avogadro constant?
[1 mark]

Tick (✓) ONE box.

6.02×10^{23} per mole

6.02×10^{24} per mole

6.02×10^{25} per mole

6.02×10^{26} per mole



07.4 Scientists could use a sample of silicon to define the Avogadro constant.

Copper is an impurity in the silicon sample.

There are 70 nanograms of copper in 1 g of the sample.

Calculate the mass of copper in grams in 1 kg of the sample.

Give your answer in standard form.

1 nanogram = 10^{-9} g [2 marks]

Mass of copper = _____ g

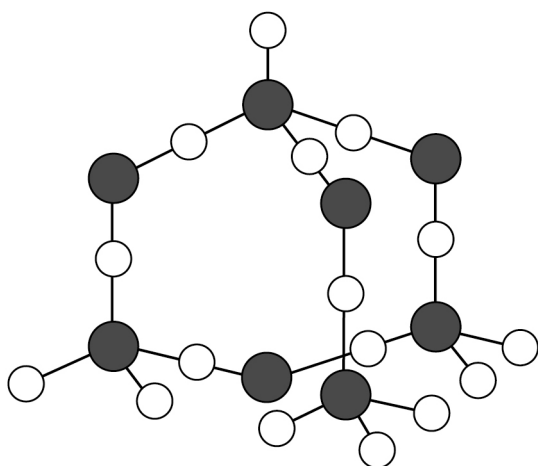
[Turn over]



Silicon mainly occurs in the Earth's crust as silicon dioxide.

FIGURE 8 represents part of the structure of silicon dioxide.

FIGURE 8



KEY

○ Oxygen atom (O)

● Silicon atom (Si)

07.5 Determine the empirical formula of silicon dioxide.

Use FIGURE 8. [1 mark]

Empirical formula = _____



07.6 Describe the structure and bonding in silicon dioxide. [3 marks]

11

[Turn over]



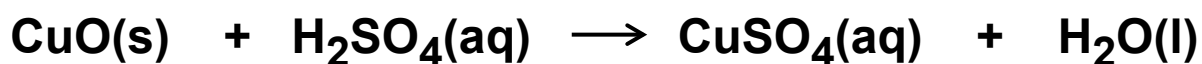
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0 8

A student planned to make copper sulfate crystals from excess copper oxide and dilute sulfuric acid.

The equation for the reaction is:

**0 8****. 1**

Why is it necessary to add excess copper oxide? [1 mark]

[Turn over]



08.2 This is the method used.

- 1. Add 25 cm³ of dilute sulfuric acid to a conical flask.**
- 2. Gently warm the dilute sulfuric acid.**
- 3. Add excess copper oxide to the dilute sulfuric acid.**
- 4. Stir the mixture.**
- 5. Heat to evaporate all the water from the mixture.**

Suggest TWO improvements to the method.

**Explain why each improvement is needed.
[4 marks]**

1 _____



2

[Turn over]



Number of moles in excess =

10

[Turn over]



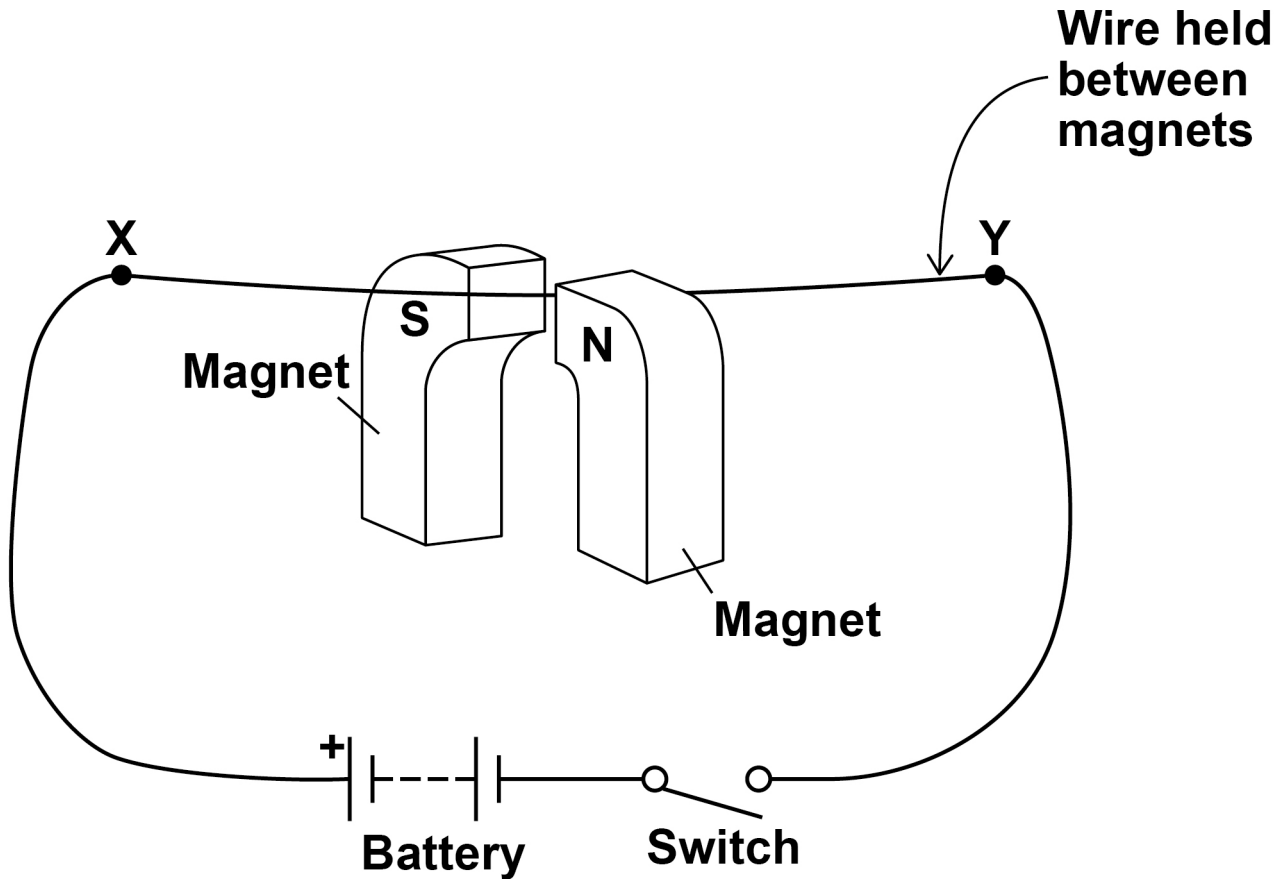
09

A student investigated the motor effect.

09.1

FIGURE 9 shows the apparatus used.

FIGURE 9



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09.2 Give TWO ways of reversing the direction of the movement of the wire. [2 marks]

1

2

[Turn over]



Electric motors use the motor effect.

Energy is supplied to the electric motor by a battery.

The battery is charged using a charger.

0 9 . 3 When the charger is connected to the battery, the potential difference across the battery is 15.0 V

The total energy stored when the battery is fully charged is 0.81 MJ

The average current used to charge the battery is 3.00 A

Calculate the time taken to fully charge the battery. [6 marks]

09.4 The charger is plugged into the mains electricity supply.

This is an alternating supply.

Give TWO other properties of the UK mains electricity supply. [2 marks]

1 _____

2 _____

15

END OF QUESTIONS



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Question	Mark
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