A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE
CHEMISTRY

F

Foundation Tier Paper 1

8462/1F

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

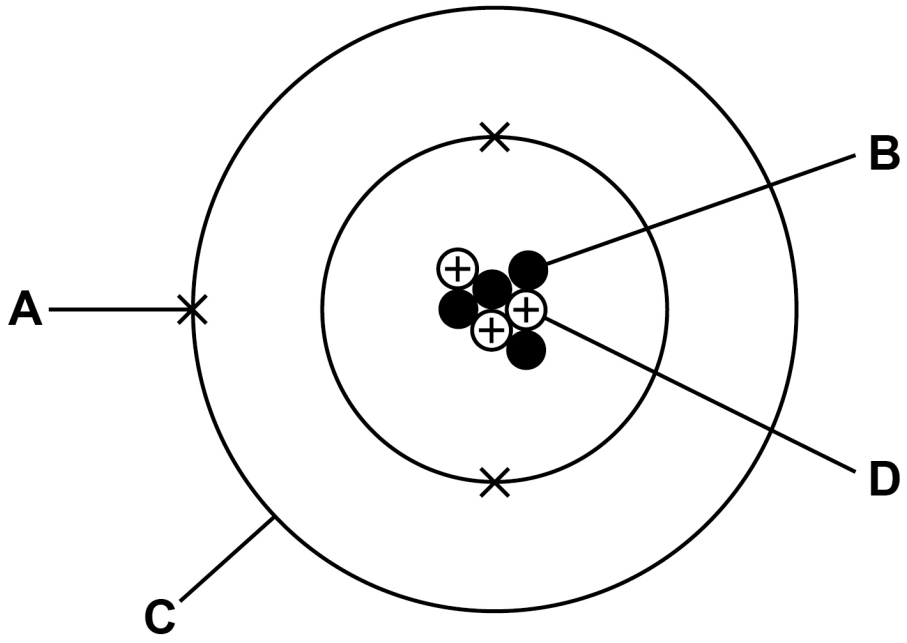
0 1

This question is about atoms.

0 1 . 1

FIGURE 1 represents an atom of an element.

FIGURE 1



Draw ONE line from each name to the correct label.
[2 marks]

NAME	LABEL
Neutron	A
Proton	B
	C
	D

[Turn over]

0 1 . 2

An atom of element Y has:

- **an atomic number of 9**
- **a mass number of 19.**

Give the number of electrons and the number of neutrons in this atom.

Choose answers from the list. [2 marks]

- **1**
- **9**
- **10**
- **19**
- **28**

Number of electrons _____

Number of neutrons _____

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[Turn over]

TABLE 1 shows information about two isotopes of element Z.

TABLE 1

	Mass number	Percentage abundance (%)
Isotope A	39	93.3
Isotope B	41	6.7

0 1 . 3

Calculate the relative atomic mass (A_r) of element Z.

Use TABLE 1 and the equation:

$$A_r = \frac{\text{(mass number} \times \text{percentage) of isotope A + (mass number} \times \text{percentage) of isotope B}}{100}$$

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

A_r (3 significant figures) = _____

[Turn over]

0 1 . 4

Suggest the identity of element Z.

Use the periodic table. [1 mark]

Element Z _____

0 1 . 5

Complete the sentence.

Choose the answer from the list. [1 mark]

- **electrons**
- **neutrons**
- **protons**

Isotopes of the same element have different mass numbers because the isotopes have different numbers of _____ **.**

9

0 2

This question is about elements, compounds and mixtures.

0 2 . 1

Which type of substance is hydrogen? [1 mark]

Tick (✓) ONE box.

- ☐ **Element**
- ☐ **Compound**
- ☐ **Mixture**

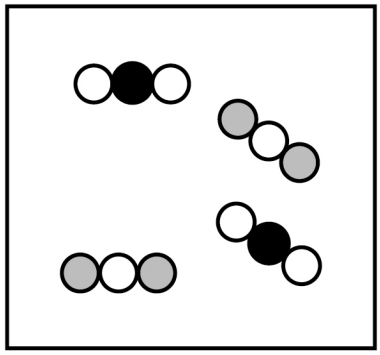
[Turn over]

The diagrams in FIGURE 2 represent different substances.

○ ● and ○ represent atoms of three different elements.

FIGURE 2

A



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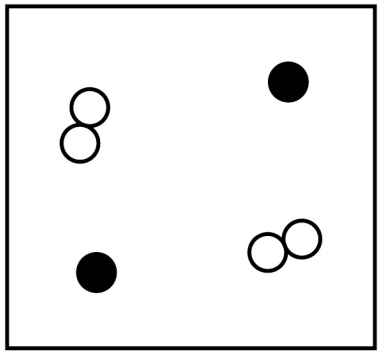

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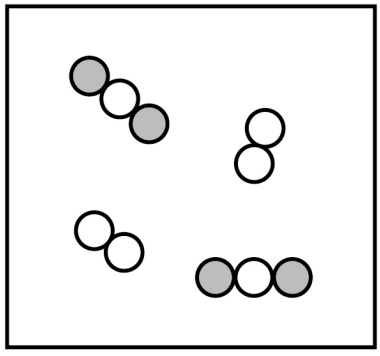

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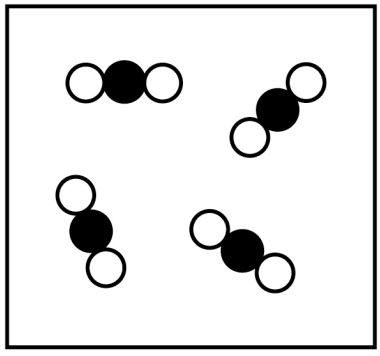


Use FIGURE 2 to answer questions 02.2 and 02.3.

0 2 . 2

Which diagram represents a mixture of compounds?
[1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

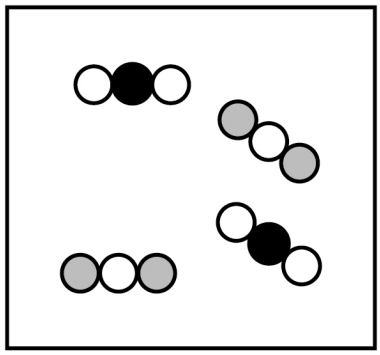
☐ **C**

☐ **D**

[Turn over]

REPEAT OF FIGURE 2

A



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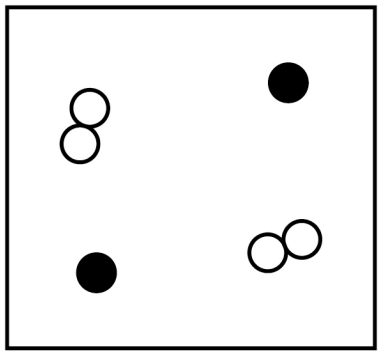

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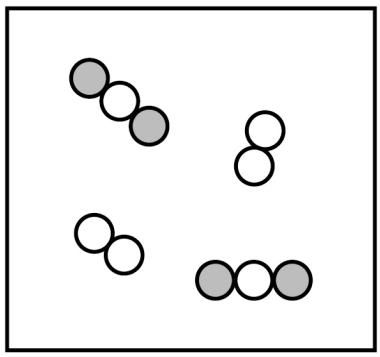
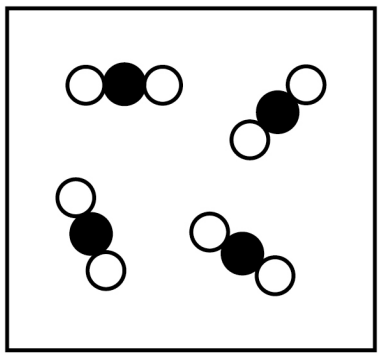


D



0 2 . 3

Which diagram represents a mixture of elements?
[1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

Substances can be separated from mixtures by using different methods.

0 2 . 4

Complete the sentence. [1 mark]

Sand can be separated from a mixture of sand and water by _____ .

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[Turn over]

A mixture of four liquids was fractionally distilled.

FIGURE 3 shows the apparatus used.

FIGURE 3

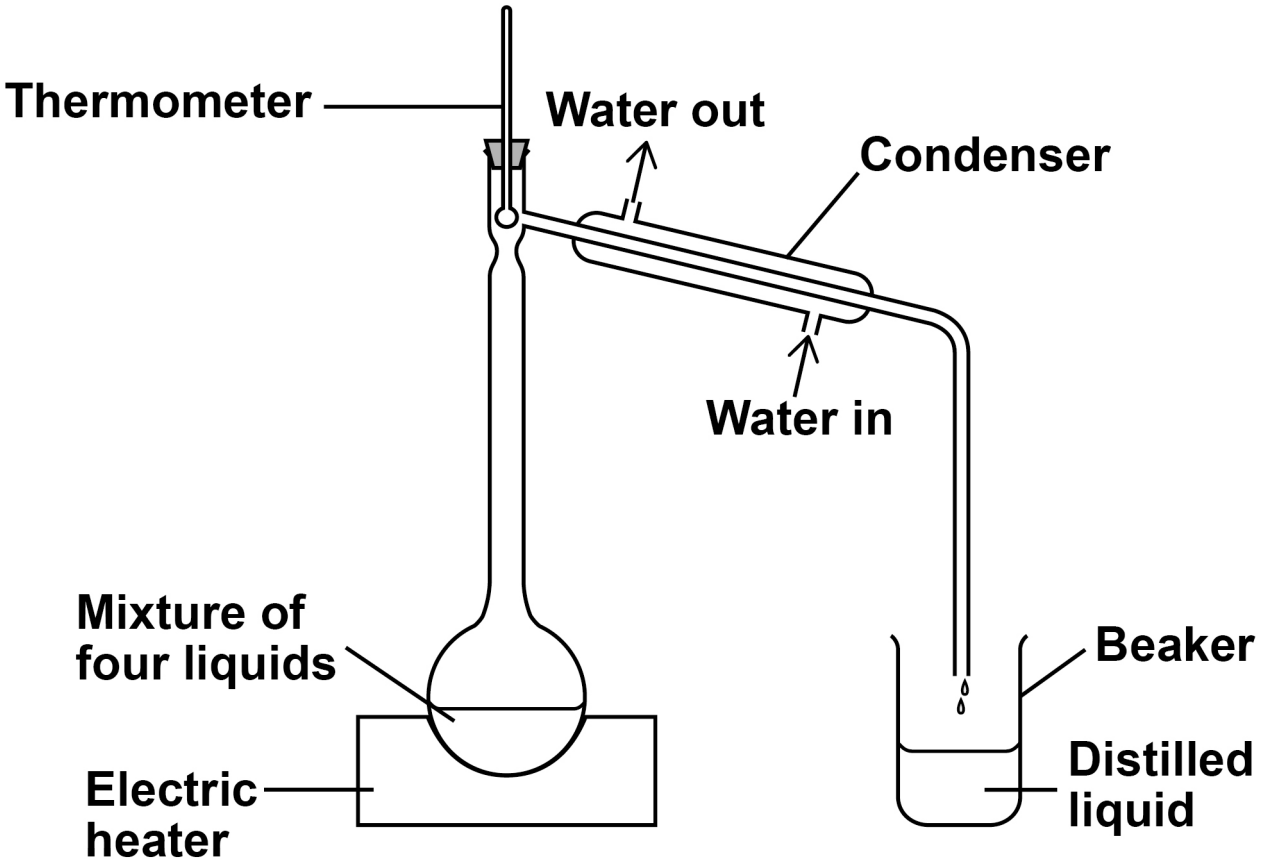

TABLE 2 shows the boiling points of the four liquids in the mixture.

TABLE 2

Liquid	Boiling point in °C
A	97
B	138
C	78
D	118

0 2 . 5

Which liquid in TABLE 2 would distil and be collected in the beaker first? [1 mark]

Liquid _____

0 2 . 6

Suggest what would happen to the temperature of the water as the water flows through the condenser.
[1 mark]

_____

_____

_____

[Turn over]

0 2 . 7

Describe how to obtain sodium chloride crystals from sodium chloride solution by crystallisation. [2 marks]

_____

_____

_____

_____

_____

_____

8

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[Turn over]

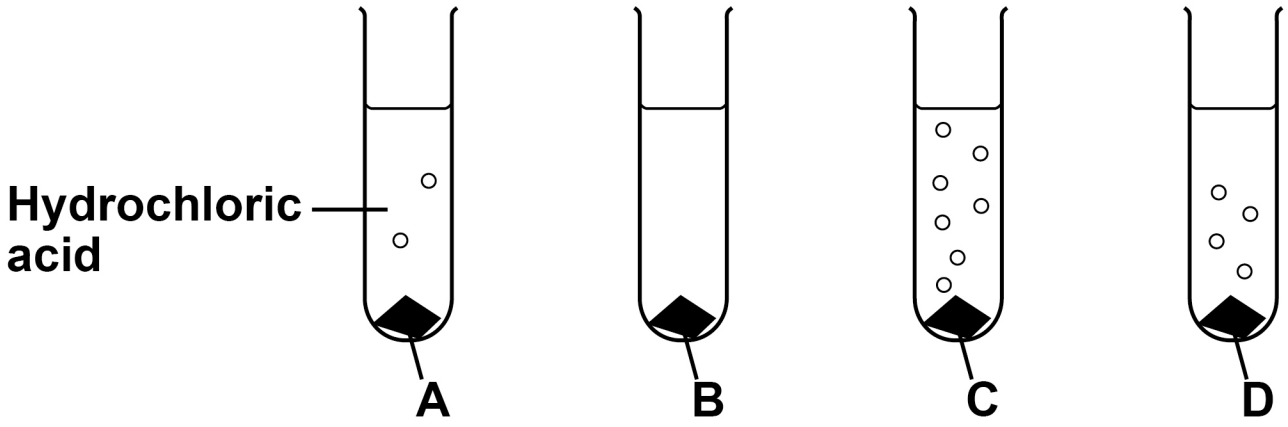
0 3

This question is about acids.

A student added four metals, A, B, C and D to hydrochloric acid.

FIGURE 4 shows the rate of bubbling in each tube.

FIGURE 4



Use FIGURE 4 to answer questions 03.1 and 03.2.

0 3 . 1

Which metal is copper? [1 mark]

Tick (✓) ONE box.

☐ **A**

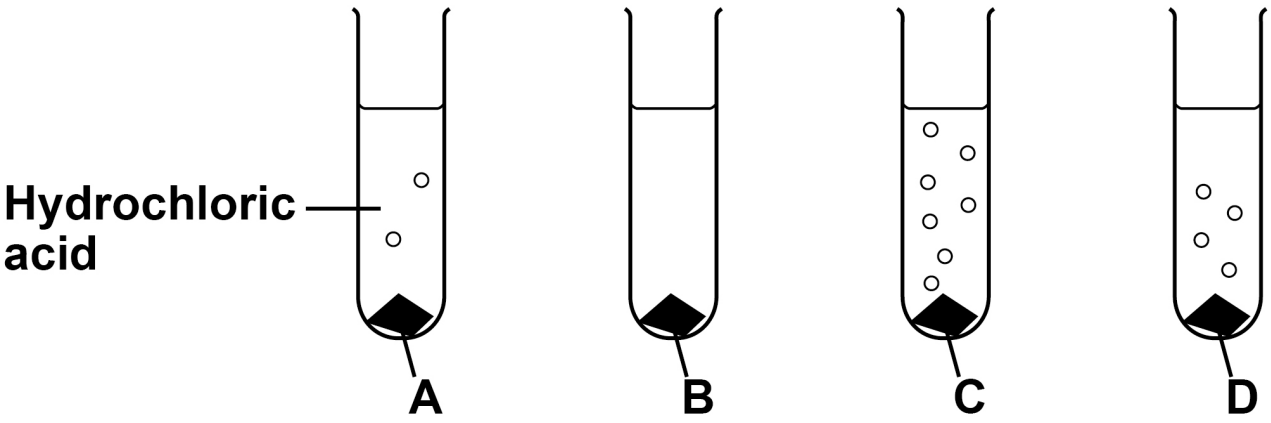
☐ **B**

☐ **C**

☐ **D**

[Turn over]

REPEAT OF FIGURE 4



0 3 . 2

Which metal is the most reactive? [1 mark]

Tick (✓) ONE box.

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

0 3 . 3

A metal oxide reacts with an acid to produce zinc sulfate and water.

Name the metal oxide and the acid used in this reaction. [2 marks]

Name of metal oxide _____

Name of acid _____

[Turn over]

0 3 . 4

Universal indicator is used to measure the pH of a solution.

Draw ONE line from each pH to the colour of universal indicator in a solution with that pH. [2 marks]

pH	Colour of universal indicator
	Blue
1	Green
	Purple
7	Red
	Yellow

A student reacts an acid with an alkali in a titration.

0 3 . 5

What is the type of reaction when an acid reacts with an alkali? [1 mark]

Tick (✓) ONE box.

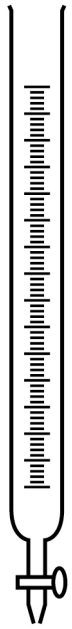
- ☐ **Combustion**
- ☐ **Decomposition**
- ☐ **Neutralisation**

[Turn over]

0 3 . 6

FIGURE 5 shows a piece of equipment used to measure the volume of the acid in the titration.

FIGURE 5



What is the name of this piece of equipment? [1 mark]

Tick (✓) ONE box.

- ☐ **Burette**
- ☐ **Pipette**
- ☐ **Syringe**
- ☐ **Tube**

[Turn over]

8

This question is about the periodic table.

FIGURE 6 shows an early version of the periodic table published by a scientist.

FIGURE 6

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

0 4 . 1

The scientist left gaps in the periodic table in FIGURE 6.

Each gap is represented by a question mark (?).

Give ONE reason why the scientist left gaps in this periodic table. [1 mark]

[Turn over]

0 4 . 2

Which scientist published the periodic table in FIGURE 6? [1 mark]

Tick (✓) ONE box.

- ☐ **Bohr**
- ☐ **Chadwick**
- ☐ **Mendeleev**

0 4 . 3

The modern periodic table is different from the periodic table in FIGURE 6, on page 30.

One extra group of elements has been added.

What is the name of the extra group of elements in the modern periodic table?
[1 mark]

Tick (✓) ONE box.

- ☐ **Alkali metals**
- ☐ **Halogens**
- ☐ **Noble gases**

0 4 . 4

Why do the elements in Group 1 of the modern periodic table have similar chemical properties? [1 mark]

Tick (✓) ONE box.

- ☐ **The elements all form negative ions.**
- ☐ **The elements all have one electron in the outer shell.**
- ☐ **The elements all have the same number of shells.**

0 4 . 5

TABLE 3, on the opposite page, shows the melting points of the first five elements going down Group 1.

TABLE 3

Element	Melting point in °C
Lithium	181
Sodium	98
Potassium	X
Rubidium	39
Caesium	29

Predict value X. [1 mark]

X = _____ °C

0 4 . 6

Give ONE observation you would see when a small piece of potassium is added to water. [1 mark]

_____

_____

_____

[Turn over]

0 4 . 7

TABLE 4 shows information about the first five elements going down Group 7.

TABLE 4

Element	State at 150 °C	Symbol	Formula of the compound with hydrogen
Fluorine	gas	F	HF
Chlorine	_____	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	_____

Complete TABLE 4. [2 marks]

0 4 . 8

The elements in Group 7 consist of molecules.

What is the formula of a molecule of bromine? [1 mark]

Tick (✓) ONE box.

- ☐ **Br**
- ☐ **Br_2**
- ☐ **Br^2**
- ☐ **2Br**

[Turn over]

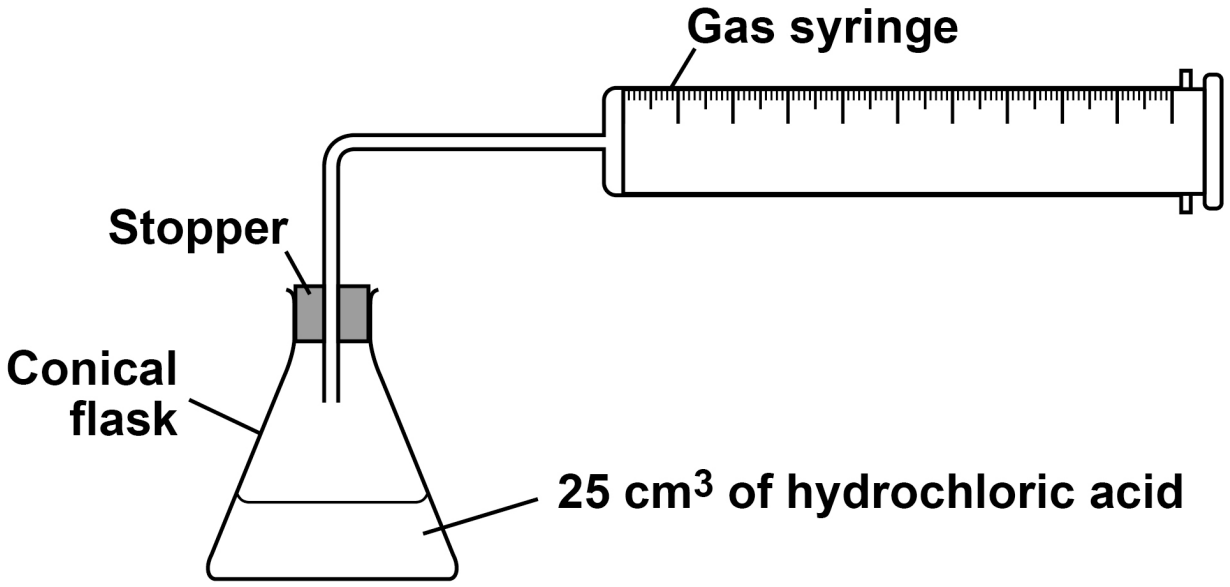
9

0 5

A student investigated the reaction of magnesium with hydrochloric acid.

FIGURE 7 shows the apparatus used.

FIGURE 7



This is the method used.

1. **Set up the apparatus as shown in FIGURE 7.**
2. **Cut 10 mm of magnesium ribbon.**
3. **Remove the stopper.**
4. **Add the magnesium ribbon to the conical flask.**
5. **Replace the stopper as quickly as possible.**

6. Record the final reading on the gas syringe when the reaction has stopped.
7. Repeat steps 1 to 6 three more times.
8. Repeat steps 1 to 7 with different lengths of magnesium ribbon.

0 5 . 1

Which gas is produced when magnesium reacts with hydrochloric acid? [1 mark]

Tick (✓) ONE box.

- ☐ Carbon dioxide
- ☐ Chlorine
- ☐ Hydrogen
- ☐ Oxygen

[Turn over]

0 5 . 2

What was the independent variable in the investigation? [1 mark]

0 5 . 3

Give ONE control variable in the investigation. [1 mark]

TABLE 5 shows the results for one length of magnesium ribbon.

TABLE 5

	Trial 1	Trial 2	Trial 3	Trial 4
Volume of gas produced in cm^3	19	36	37	32

One of the results was anomalous.

0 5 . 4

Which trial in TABLE 5 gave an anomalous result? [1 mark]

Trial _____

0 5 . 5

Suggest ONE reason for the anomalous result in TABLE 5. [1 mark]

_____

_____

_____

[Turn over]

0 5 . 6

TABLE 6 shows the mean volume of gas produced for each length of magnesium ribbon.

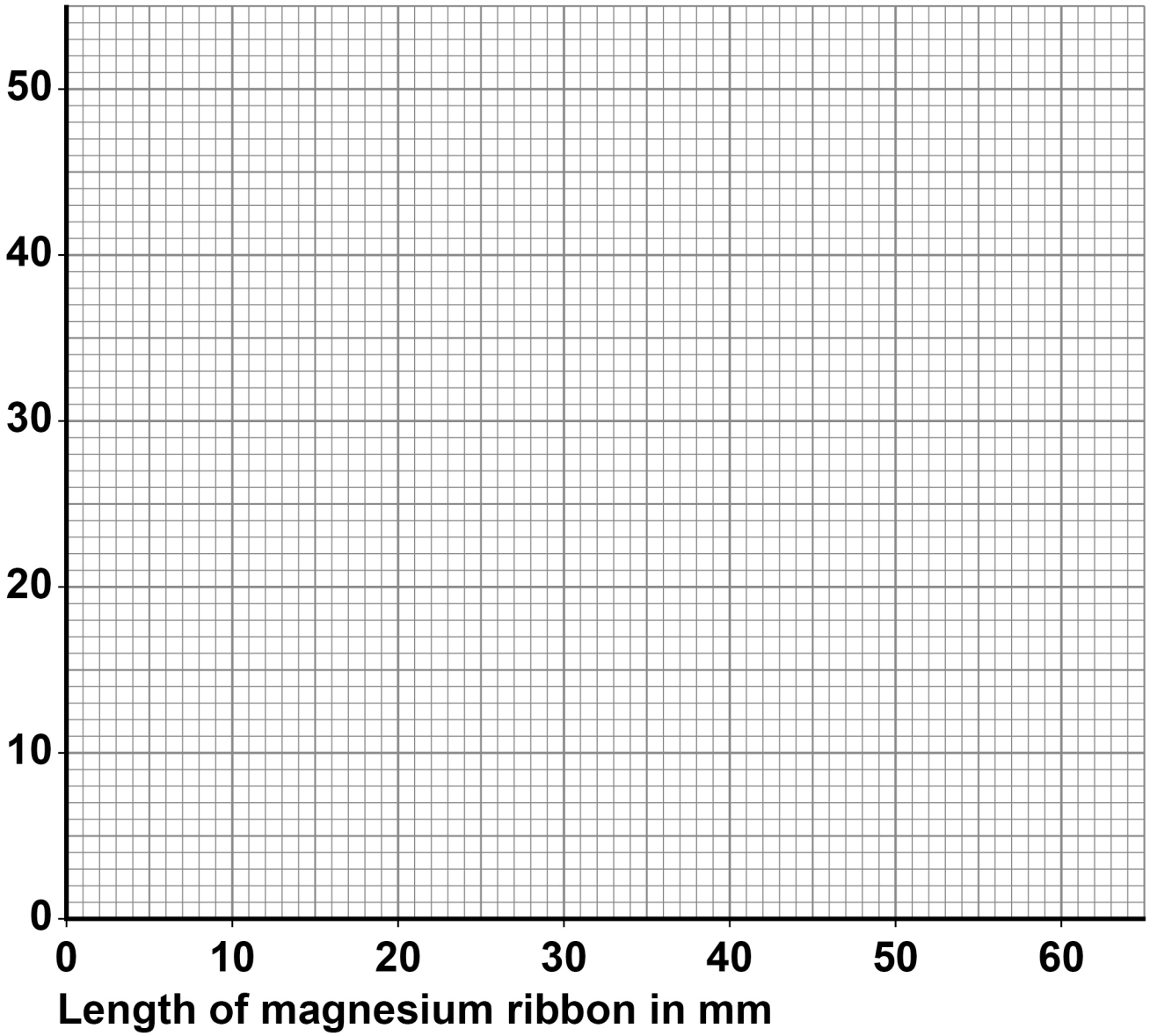
TABLE 6

Length of magnesium ribbon in mm	10	20	30	40	50	60
Mean volume of gas produced in cm^3	7	14	21	28	35	42

Plot the data from TABLE 6 on FIGURE 8, on the opposite page.

Draw a line of best fit. [3 marks]

FIGURE 8



[Turn over]

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0 5 . 7

Complete the sentence. [1 mark]

As the length of the magnesium ribbon increases, the mean volume of gas produced _____ .

[Turn over]

9

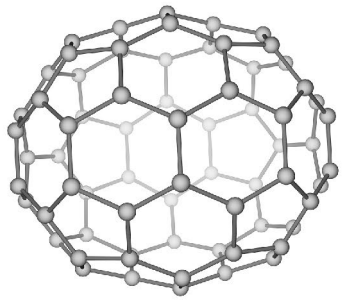
0 6

This question is about carbon and compounds of carbon.

FIGURE 9 shows diagrams that represent different structures.

FIGURE 9

A



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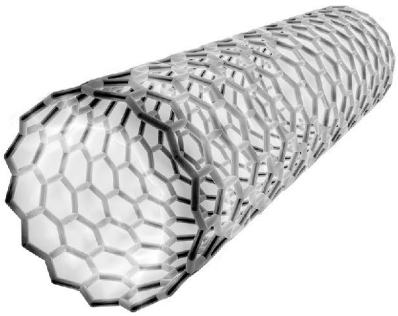

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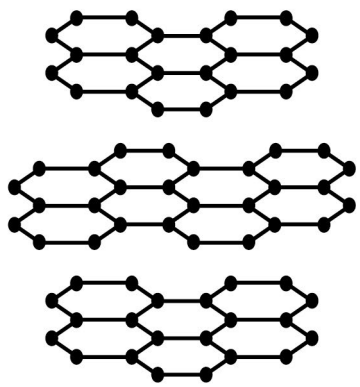
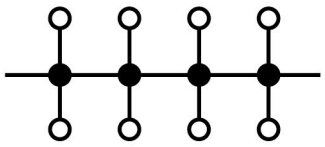


D



Use FIGURE 9 to answer questions 06.1 and 06.2.

0 6 . 1

Which diagram represents graphite? [1 mark]

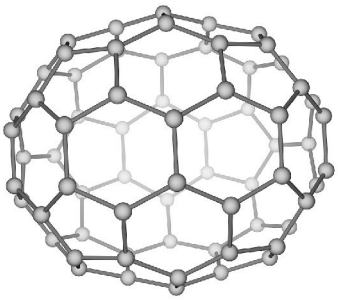
Tick (✓) ONE box.

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

[Turn over]

REPEAT OF FIGURE 9

A



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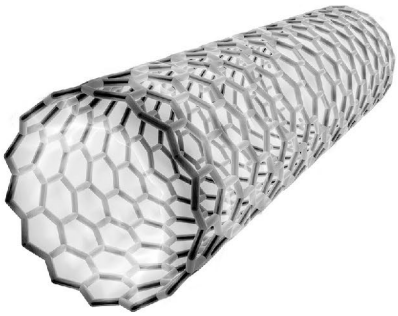

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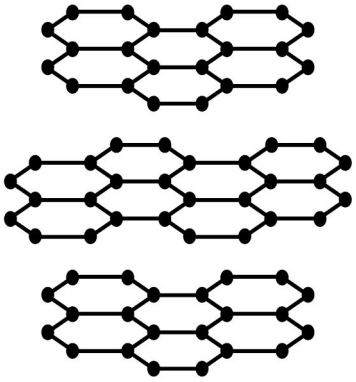

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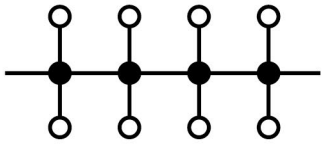


0 6 . 2

Which diagram represents poly(ethene)? [1 mark]

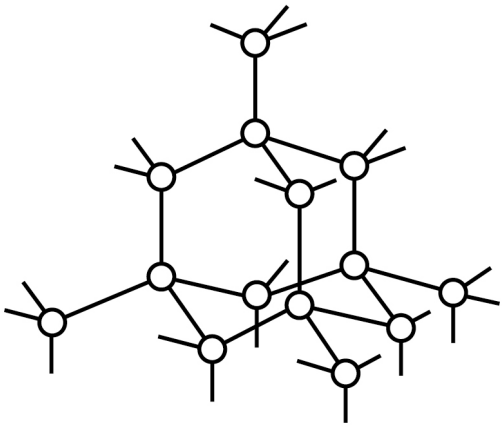
Tick (✓) ONE box.

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

[Turn over]

FIGURE 10 represents the structure of diamond.

FIGURE 10



KEY

○ **Carbon atom**

0 6 . 3

How many covalent bonds does each carbon atom form in diamond? [1 mark]

0 6 . 4

Which is a property of diamond? [1 mark]

Tick (✓) ONE box.

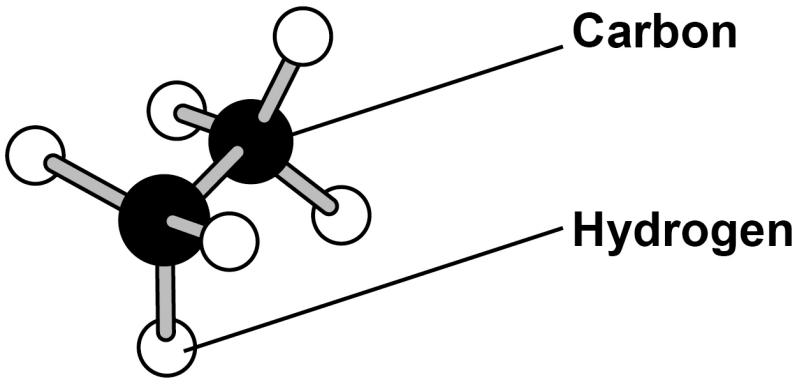
- ☐ **Conducts electricity**
- ☐ **Low melting point**
- ☐ **Very hard**

[Turn over]

0 6 . 5

FIGURE 11 shows a model of a molecule.

FIGURE 11



Complete the molecular formula of the molecule.
[1 mark]

Molecular formula = C _____ H _____

Carbonic acid is a compound of carbon.

The formula of carbonic acid is H_2CO_3

0 6 . 6

Which ion is produced by carbonic acid in aqueous solution? [1 mark]

Tick (✓) ONE box.

- ☐ H^+
- ☐ OH^-
- ☐ O^{2-}

[Turn over]

0 6 . 7

Calculate the relative formula mass (M_r) of carbonic acid (H_2CO_3).

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

Relative formula mass (M_r) = _____

8

0 7

This question is about small particles.

0 7 . 1

Coarse particles, fine particles and nanoparticles are all small particles.

Which is the largest particle? [1 mark]

Tick (✓) ONE box.

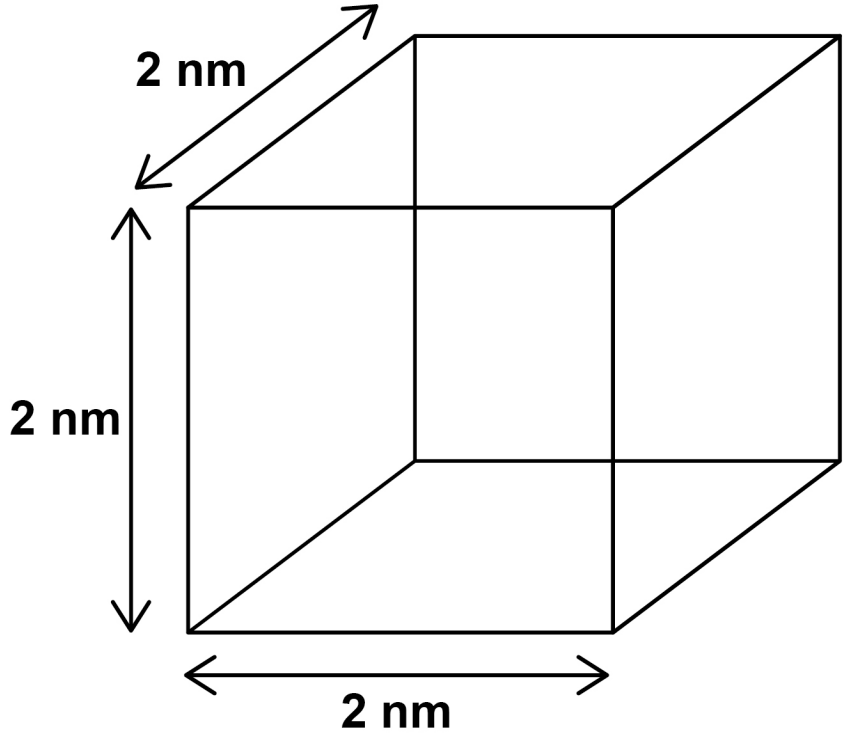
- ☐ **Coarse particle**
- ☐ **Fine particle**
- ☐ **Nanoparticle**

[Turn over]

0 7 . 2

FIGURE 12 shows a cubic nanoparticle.

FIGURE 12



The surface area of the cubic nanoparticle is 24 nm^2.

Calculate:

- **the volume of the cubic nanoparticle**
- **the simplest surface area : volume ratio of the cubic nanoparticle.**

[4 marks]

Volume = _____ nm^3

Simplest surface area : volume ratio = _____ : 1

[Turn over]

0 7 . 3

Catalysts made of nanoparticles are often more effective than catalysts made of normal sized particles.

Complete the sentences. [2 marks]

Compared with normal sized particles, the surface area to volume ratio of nanoparticles is

_____ .

This means that the mass of a nanoparticle catalyst needed to have the same effect as the same catalyst made of normal sized particles is

_____ .

0 7 . 4

Silver nanoparticles can be added to the material used to make socks.

Some facts about silver and bacteria are:

- **silver nanoparticles are small enough to be breathed in**
- **silver is very expensive**
- **silver can kill bacteria**
- **bacteria can cause infections**
- **bacteria can break down sweat to produce unpleasant smells.**

Suggest ONE advantage and ONE disadvantage of wearing socks containing silver nanoparticles.
[2 marks]

Advantage _____

_____

_____

Disadvantage _____

_____

_____

0 7 . 5

An atom has a radius of 1×10^{-10} m.

A spherical nanoparticle has a radius of 1×10^{-8} m.

How many times larger is the radius of the nanoparticle than the radius of the atom? [1 mark]

Tick (✓) ONE box.

- ☐ **2 times**
- ☐ **10 times**
- ☐ **100 times**
- ☐ **200 times**

10

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[Turn over]

0 8

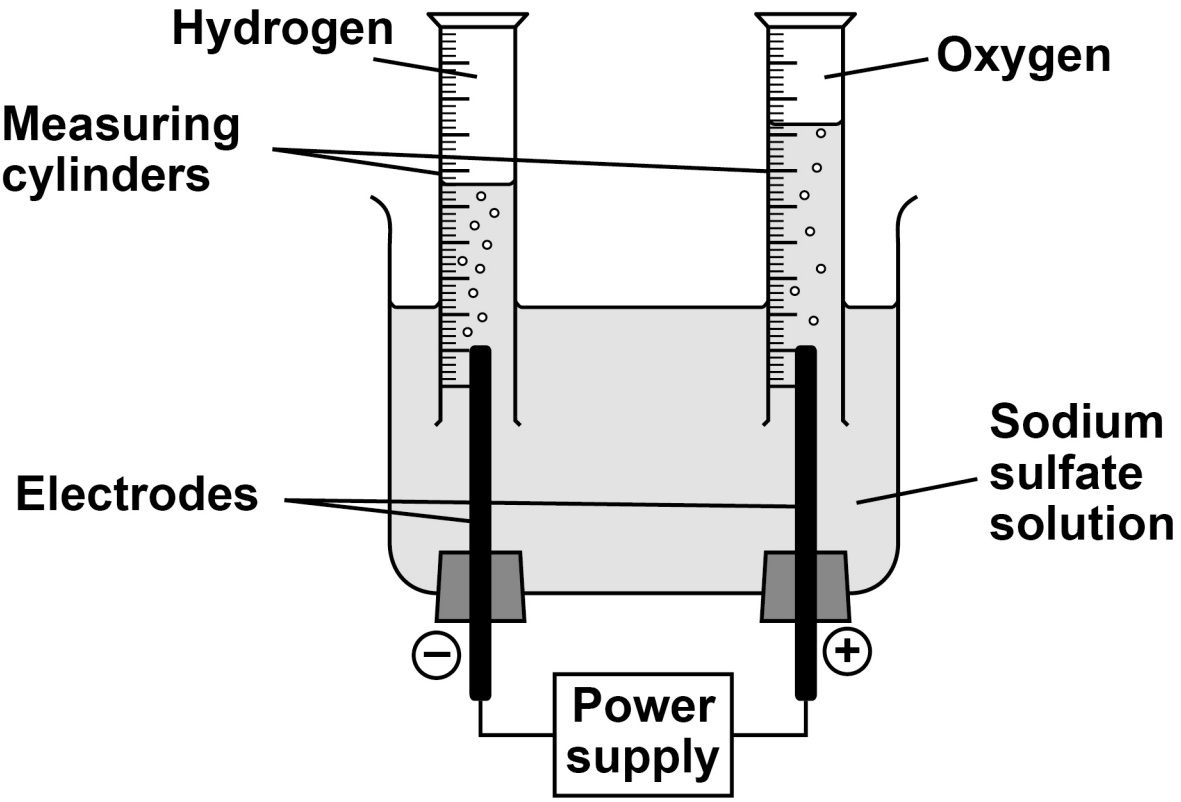
This question is about electrolysis.

Ionic compounds decompose when they are electrolysed.

A student electrolyses sodium sulfate solution.

FIGURE 13 shows the apparatus used.

FIGURE 13



0 8 . 1

Sodium sulfate solution contains:

- **hydrogen ions**
- **hydroxide ions**
- **sodium ions**
- **sulfate ions.**

Oxygen is produced at the positive electrode.

Which ions are discharged at the positive electrode to produce oxygen? [1 mark]

Tick (✓) ONE box.

☐ **Hydrogen ions**

☐ **Hydroxide ions**

☐ **Sodium ions**

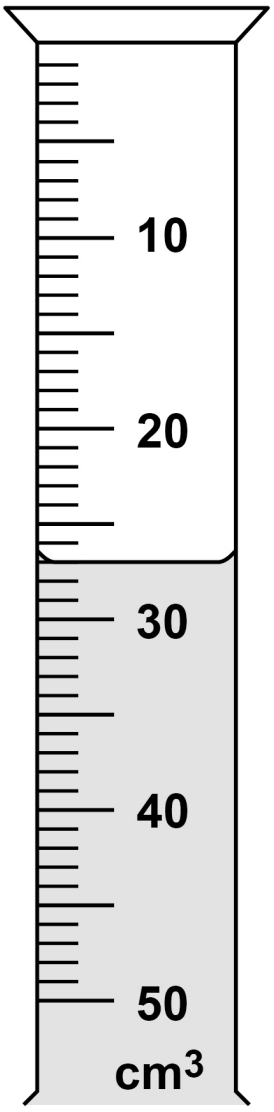
☐ **Sulfate ions**

[Turn over]

0 8 . 2

FIGURE 14 shows one of the measuring cylinders during the electrolysis.

FIGURE 14



What is the volume of gas in the measuring cylinder? [1 mark]

Volume of gas = _____ cm^3

0 8 . 3

Ionic compounds can be electrolysed when molten or dissolved in water.

Why can ionic compounds NOT be electrolysed when solid?

You should answer in terms of ions. [1 mark]

_____

_____

_____

[Turn over]

0 8 . 4

TABLE 7 shows the products of electrolysis of two molten compounds.

TABLE 7

Molten compound	Product at negative electrode	Product at positive electrode
Potassium iodide	Potassium	_____
Zinc bromide	_____	Bromine

Complete TABLE 7. [2 marks]

0 8 . 5

The electrolysis of molten sodium chloride is used to extract sodium metal.

Why is sodium metal extracted by electrolysis instead of by reduction with carbon? [1 mark]

Tick (✓) ONE box.

- ☐ **Carbon conducts electricity.**
- ☐ **Carbon is less reactive than sodium.**
- ☐ **Carbon reduction uses more energy.**

[Turn over]

0 8 . 6

What is the state symbol for molten sodium chloride?
[1 mark]

Tick (✓) ONE box.

- ☐ **(aq)**
- ☐ **(g)**
- ☐ **(l)**
- ☐ **(s)**

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[Turn over]

0 8 . 7

Titanium can be produced from titanium oxide by electrolysis.

The equation for the reaction is:

$$TiO_2 \longrightarrow Ti + O_2$$

Calculate the percentage atom economy for the production of titanium from titanium oxide by electrolysis.

Use the equation:

Percentage atom economy =

$$\frac{\text{Relative atomic mass of desired product}}{\text{Relative formula mass of reactant}} \times 100$$

Relative atomic mass (A_r): Ti = 48

Relative formula mass (M_r): TiO_2 = 80

[2 marks]

Percentage atom economy = _____ %

[Turn over]

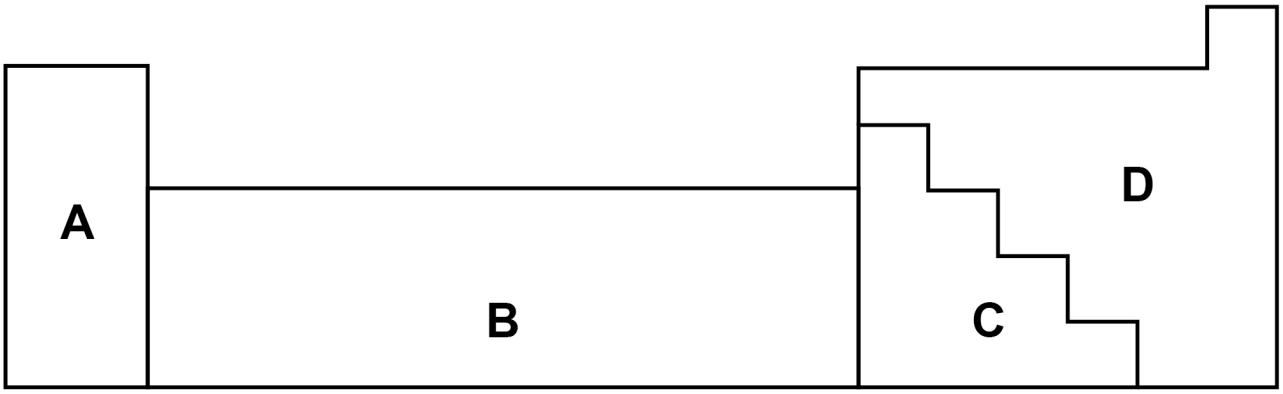
9

0 9

This question is about metals and non-metals.

FIGURE 15 shows an outline of part of the periodic table.

FIGURE 15



0 9 . 1

Element Q is a dull solid with a melting point of 44 °C.

Element Q does not conduct electricity.

Which section of the periodic table in FIGURE 15 is most likely to contain element Q? [1 mark]

Tick (✓) ONE box.

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

[Turn over]

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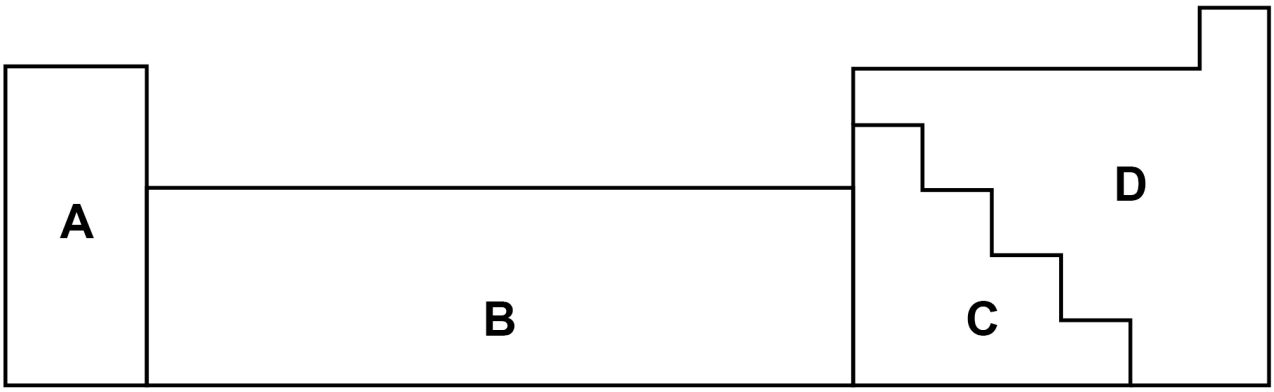
REPEAT OF FIGURE 15



0 9 . 2

Element R forms ions of formula R^{2+} and R^{3+}

Which section of the periodic table in FIGURE 15 is most likely to contain element R? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

0 9 . 3

Give TWO differences between the physical properties of the elements in Group 1 and those of the transition elements. [2 marks]

1 _____

_____

_____

2 _____

_____

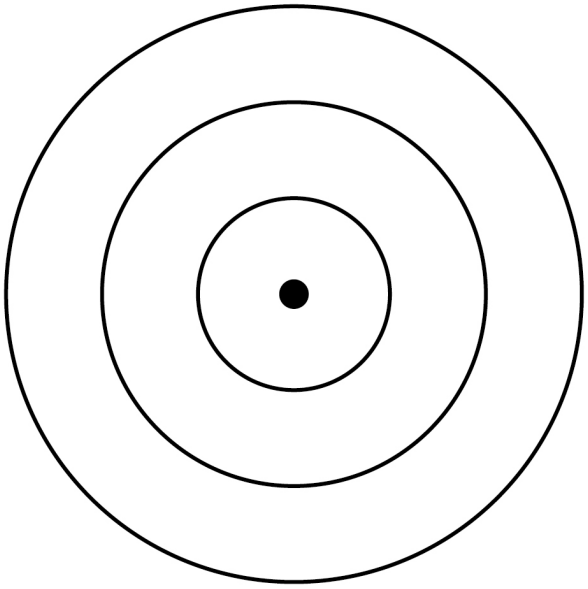
_____

0 9 . 4

Complete FIGURE 16 to show the electronic structure of an aluminium atom.

Use the periodic table. [1 mark]

FIGURE 16



[Turn over]

0 9 . 5

Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons. [3 marks]

0 9 . 6

Name the type of bonding in compounds formed between metals and non-metals. [1 mark]

0 9 . 7

Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer. [4 marks]

1 0

Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.

The equation for the reaction is:

$$Na_2CO_3(s) + 2\,HCl(aq) \longrightarrow$$

$$2\,NaCl(aq) + CO_2(g) + H_2O(l)$$

A student investigated the effect of changing the mass of sodium carbonate powder on the highest temperature reached by the reaction mixture.

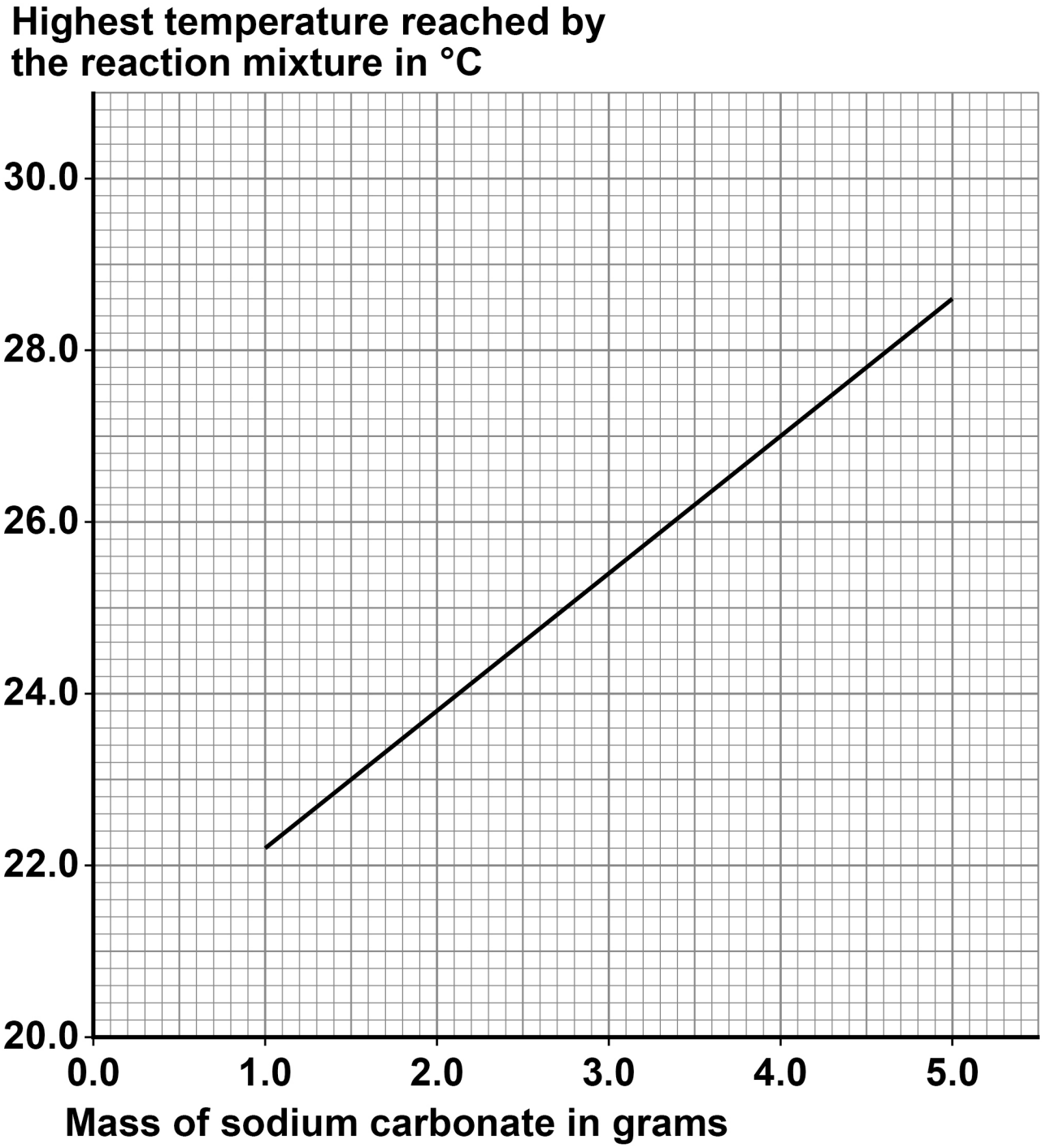
1 0 . 1

Plan a method to investigate the effect of changing the mass of sodium carbonate powder on the highest temperature reached. [6 marks]

[Turn over]

FIGURE 17 shows a line of best fit drawn through the student's results.

FIGURE 17



1 0 . 2

Determine the gradient of the line of best fit in FIGURE 17.

Use the equation:

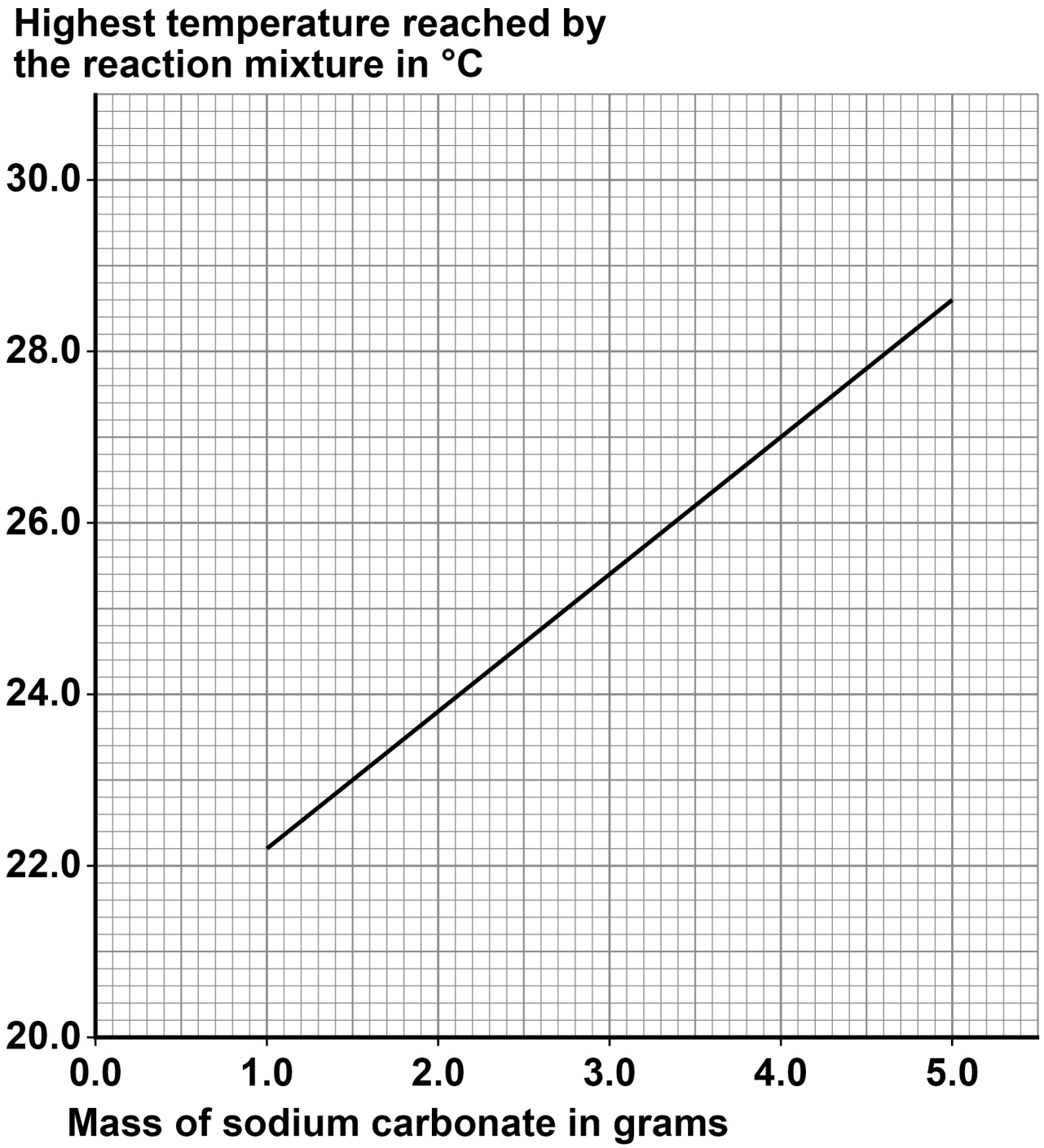
$$\text{Gradient} = \frac{\text{Change in highest temperature}}{\text{Change in mass}}$$

Give the unit. [5 marks]

Gradient = _____ **Unit** _____

[Turn over]

REPEAT OF FIGURE 17



1 0 . 3

The initial temperature of the reaction mixture is where the line of best fit would meet the y-axis.

Determine the initial temperature of the reaction mixture.

Show your working on FIGURE 17. [2 marks]

Initial temperature of the reaction mixture =

_____ **°C**

[Turn over]

1 0 . 4

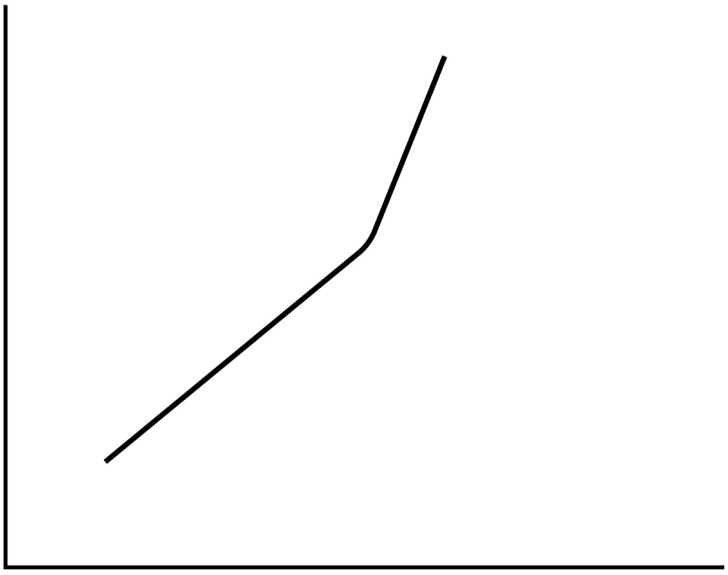
Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

Which sketch graph shows the results obtained when sodium carbonate was added until in excess? [1 mark]

Tick (✓) ONE box.

☐ **A**

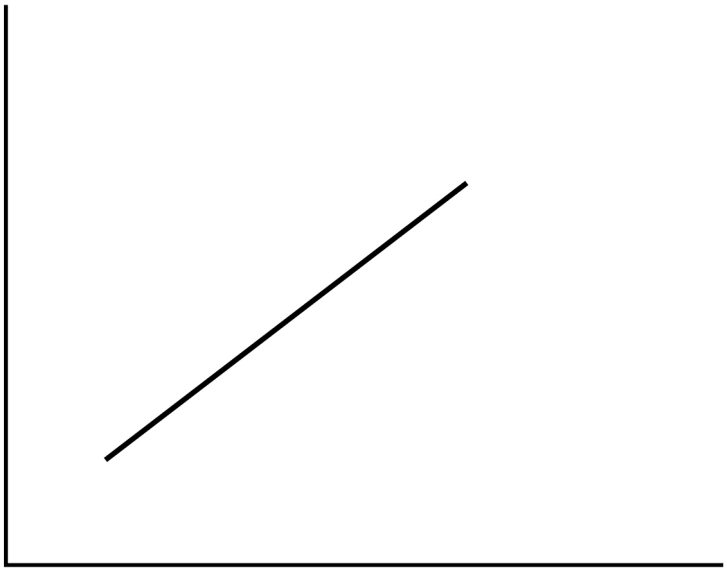
Highest temperature reached by the reaction mixture in °C



Mass of sodium carbonate in grams

B

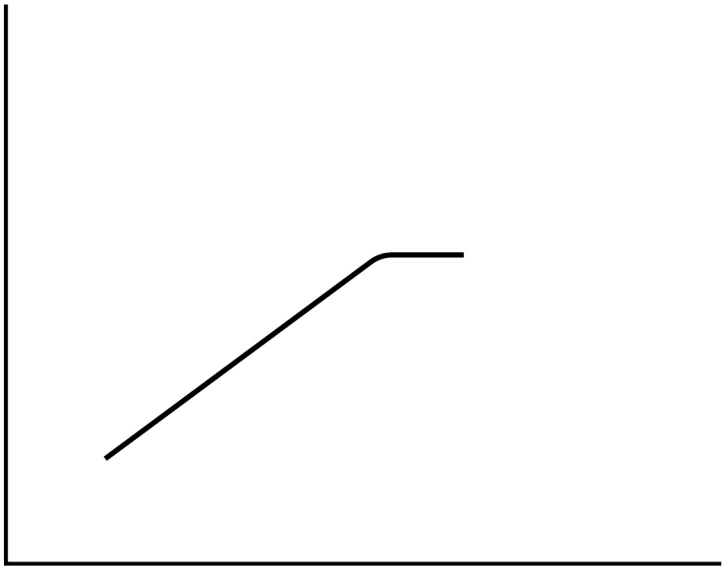
Highest temperature reached by the reaction mixture in °C



Mass of sodium carbonate in grams

C

Highest temperature reached by the reaction mixture in °C

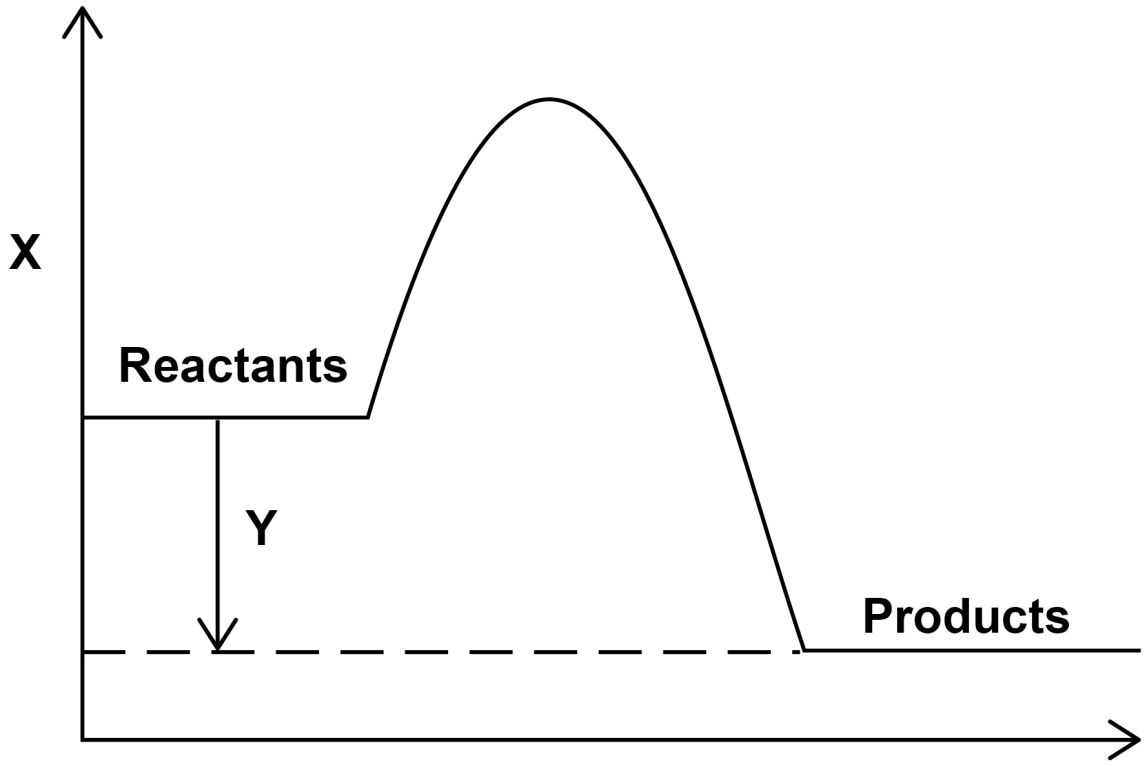


Mass of sodium carbonate in grams

[Turn over]

FIGURE 18 shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

FIGURE 18



1 0 . 5

What do labels X and Y represent on FIGURE 18?
[2 marks]

X _____

Y _____

1 0 . 6

How does the reaction profile show that the reaction is exothermic?

Use FIGURE 18. [1 mark]

END OF QUESTIONS

17

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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Question	Mark
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