AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 1

Time allowed: 1 hour 45 minutes

Materials

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or 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.

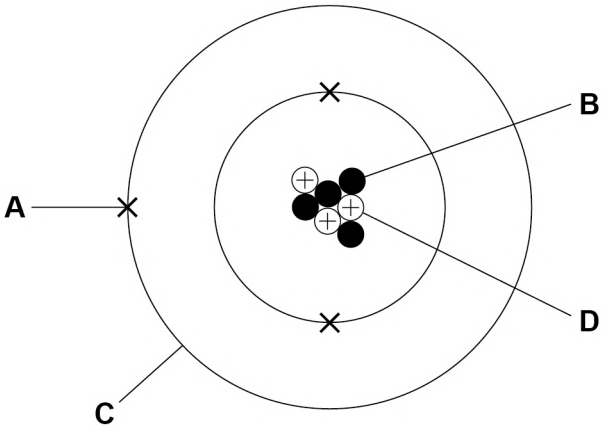
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

Do not write outside the box

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	B
Proton	D

Do not write outside the box

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 box.

[2 marks]

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

Number of electrons 9

Number of neutrons 10

Question 1 continues on the next page

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:

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

Give your answer to 3 significant figures.

[3 marks]

(relative atomic mass = $\frac{(39 \times 93.3) + (41 \times 6.7)}{100}$

= 39.134

A_r (3 significant figures) = 39.1

Do not write outside the box

0 1 . 4 Suggest the identity of element **Z**.

Use the periodic table.

[1 mark]

Element **Z** potassium / K

0 1 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons	**neutrons**	**protons**

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

9

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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 ☑

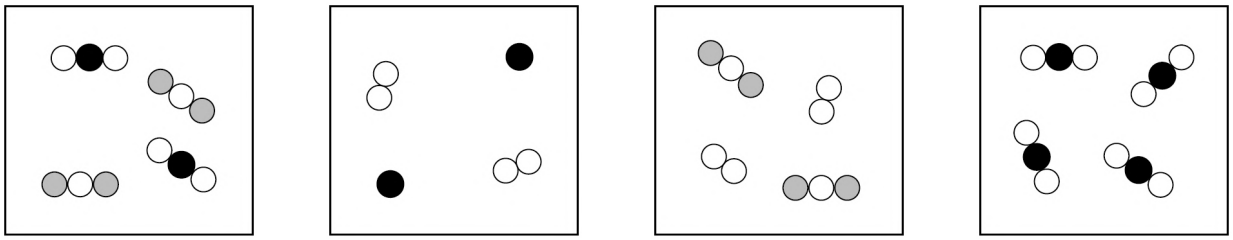
Compound ☐

Mixture ☐

The diagrams in **Figure 2** represent different substances.

○ ● and ○ represent atoms of three different elements.

Figure 2



A **B** **C** **D**

Use **Figure 2** to answer questions **02.2** and **02.3**.

0 2 . 2 Which diagram represents a mixture of compounds?

[1 mark]

A ☑ **B** ☐ **C** ☐ **D** ☐

0 2 . 3 Which diagram represents a mixture of elements?

[1 mark]

A ☐ **B** ☑ **C** ☐ **D** ☐

Do not write outside the box

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

filtration.

A mixture of four liquids was fractionally distilled.

Figure 3 shows the apparatus used.

Figure 3

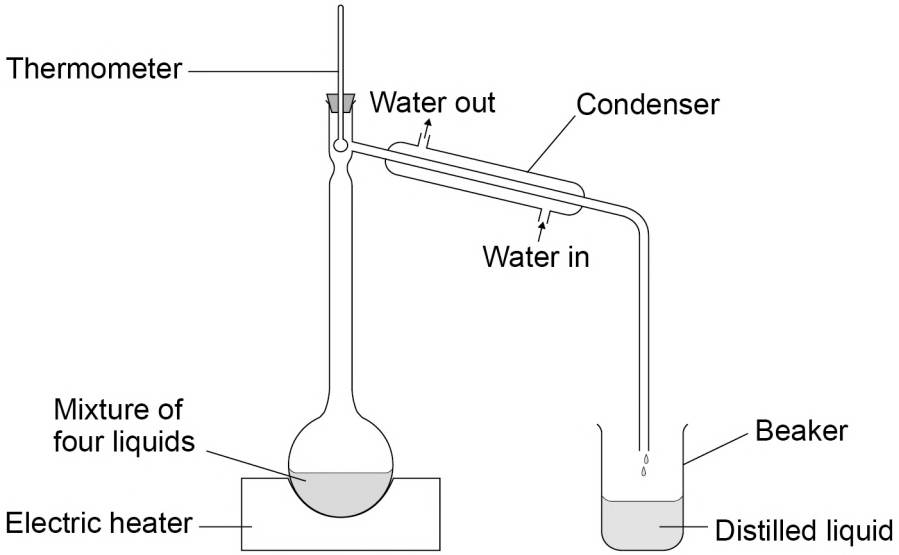


Table 2 shows the boiling points of the four liquids in the mixture.

Table 2

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

Do not write outside the box

0 2 . 5 Which liquid in **Table 2** would distil and be collected in the beaker first?

[1 mark]

Liquid C

0 2 . 6 Suggest what would happen to the temperature of the water as the water flows through the condenser.

[1 mark]

increase

0 2 . 7 Describe how to obtain sodium chloride crystals from sodium chloride solution by crystallisation.

[2 marks]

heat (the solution) until crystallisation point is reached

leave the solution (to cool / crystallise)

8

Turn over for the next question

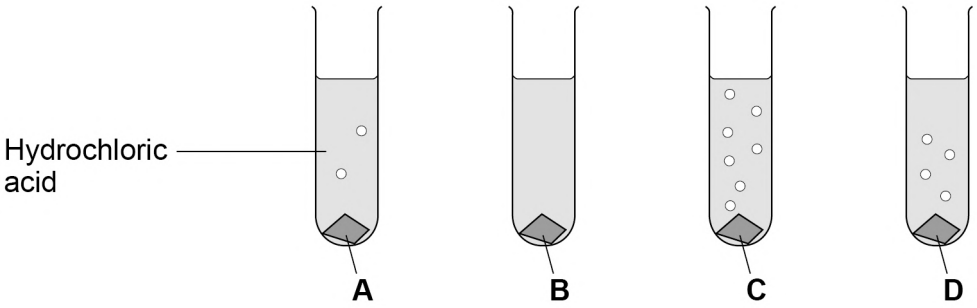
Do not write outside the box

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** ☐

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 zinc (oxide)

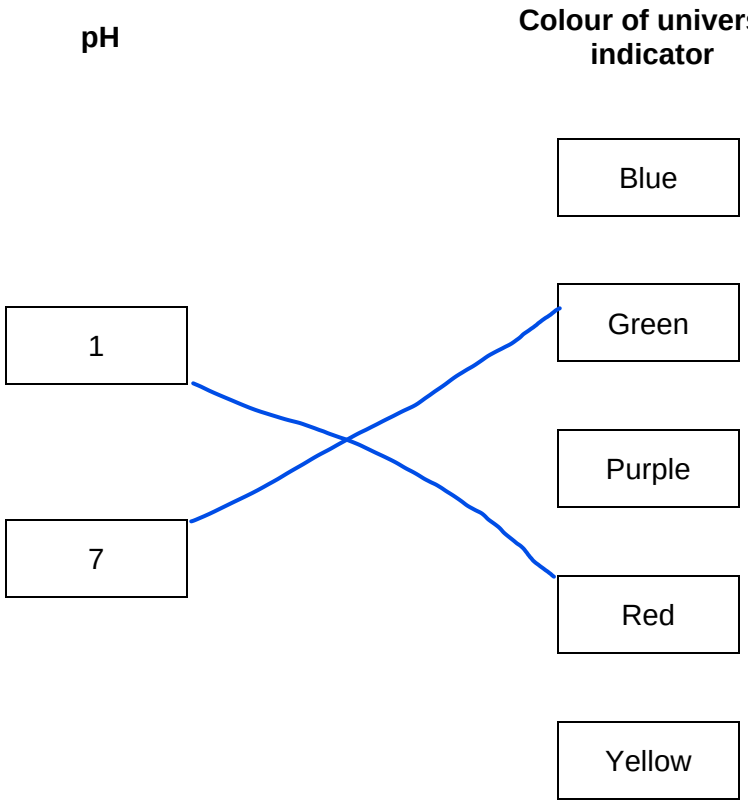
Name of acid sulfuric (acid)

Do not write outside the box

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]



Question 3 continues on the next page

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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 ☑

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 ☐

8

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 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]

for elements that had not been discovered (at that time)

0 4 . 2 Which scientist published the periodic table in **Figure 6**?

[1 mark]

Tick (✓) **one** box.

Bohr ☐

Chadwick ☐

Mendeleev ☑

Do not write outside the box

0 4 . 3 The modern periodic table is different from the periodic table in **Figure 6**.

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. ☐

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 **Table 3** 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 = 63 °C

0 4 . 6 Give **one** observation you would see when a small piece of potassium is added to water.

[1 mark]

• moves (on the surface)

Do not write outside the box

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	gas	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	HAt

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 ☐

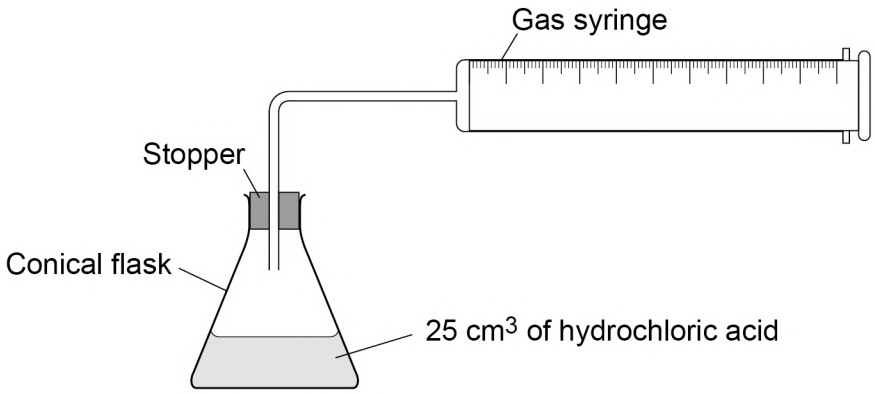
2Br ☐

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.

Do not write outside the box

0 5 . 1 Which gas is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

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

0 5 . 2 What was the independent variable in the investigation?

[1 mark]

length of magnesium ribbon

0 5 . 3 Give **one** control variable in the investigation.

[1 mark]

volume of (hydrochloric) acid

Question 5 continues on the next page

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 1

0 5 . 5 Suggest **one** reason for the anomalous result in **Table 5**.

[1 mark]

some gas escaped before the stopper was put in

Do not write outside the box

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

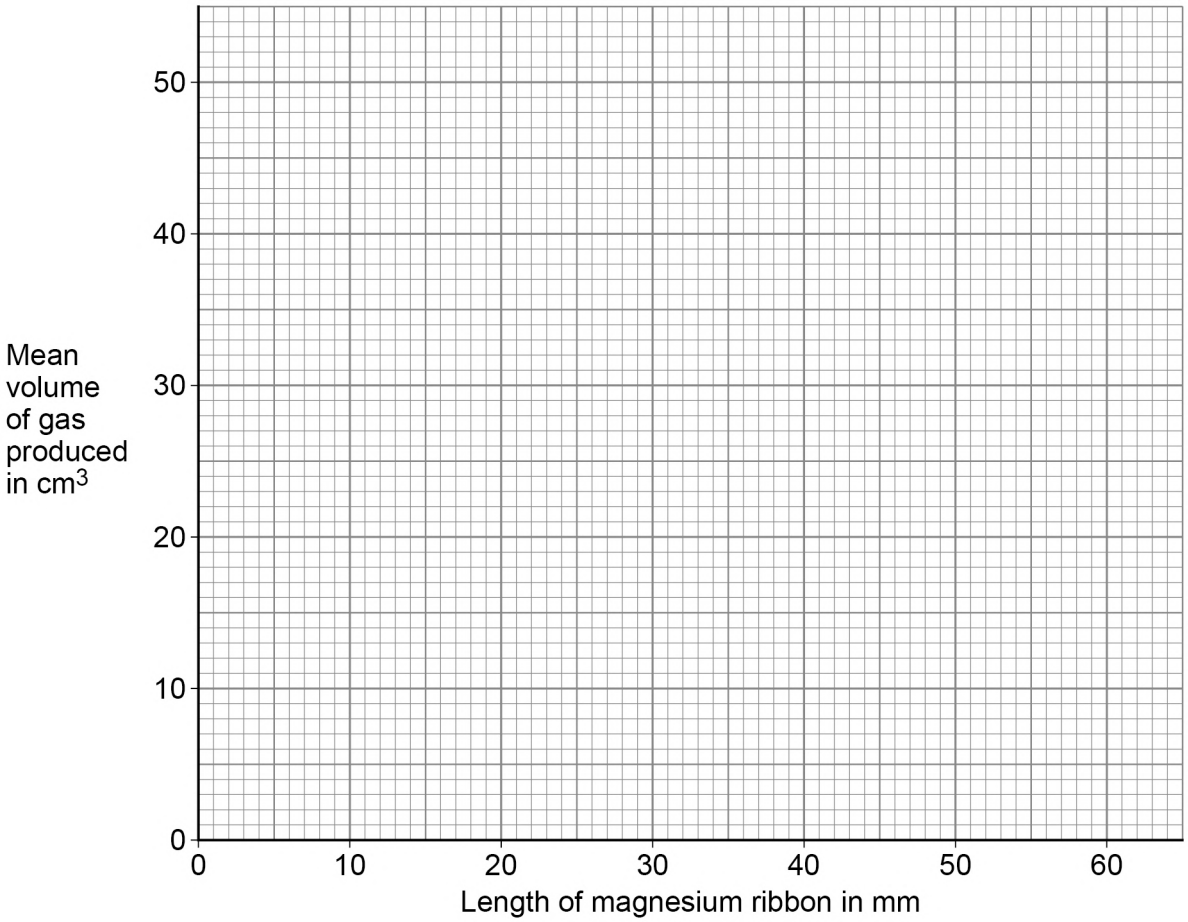
Plot the data from **Table 6** on **Figure 8**.

Draw a line of best fit.

[3 marks]

all six points correctly plotted
line of best fit

Figure 8



0 5 . 7 Complete the sentence.

[1 mark]

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

increases .

9

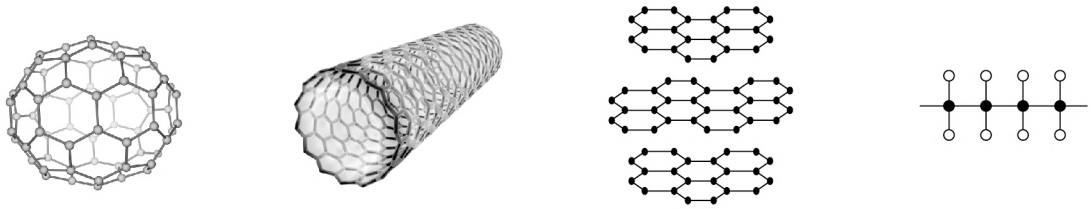
Turn over ►

Do not write outside the box

0 6 This question is about carbon and compounds of carbon.

Figure 9 shows diagrams that represent different structures.

Figure 9



A **B** **C** **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** ☐

0 6 . 2 Which diagram represents poly(ethene)?

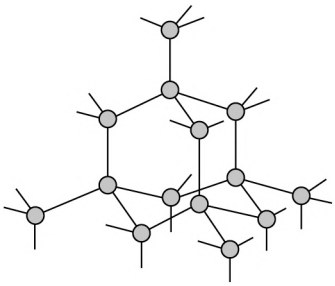
[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☑

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]

four

0 6 . 4 Which is a property of diamond?

[1 mark]

Tick (✓) **one** box.

Conducts electricity ☐

Low melting point ☐

Very hard ☑

Question 6 continues on the next page

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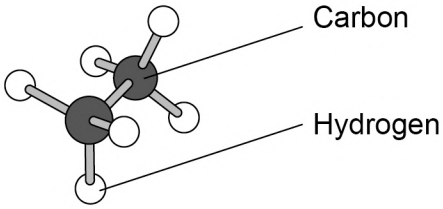
0 6 . 5 **Figure 11** shows a model of a molecule.

Figure 11



Complete the molecular formula of the molecule.

[1 mark]

Molecular formula = C 2 H 6

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-} ☐

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]

(Mr =)
(1 × 2) + 12 + (16 × 3)

Relative formula mass (M_r) = 62

8

Do not write outside the box

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.

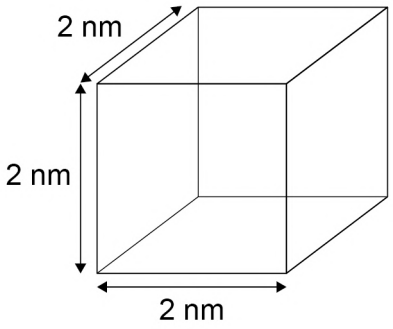
Coarse particle ☑

Fine particle ☐

Nanoparticle ☐

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 =) 23
= 8 (nm3)

Volume = 8 nm^3

(surface area : volume)
= 24 : 8

Simplest surface area : volume ratio = 3 : 1

(

Do not write outside the box

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 high(er) / large(r).

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 lower/ less / smaller.

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 stops (unpleasant) smells

Disadvantage could be harmful if breathed in

Do not write outside the box

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

Turn over for the next question

Do not write outside the box

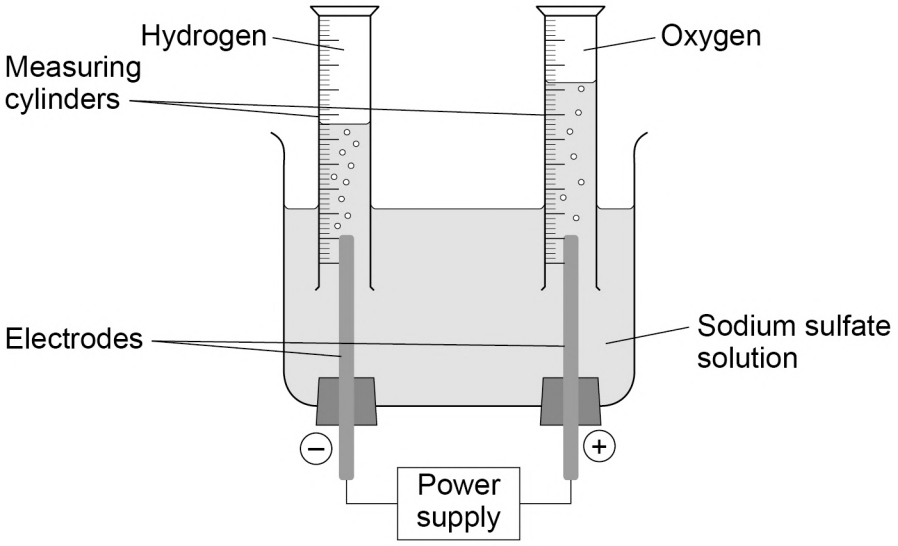
0 8 This question is about electrolysis.

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 ☑

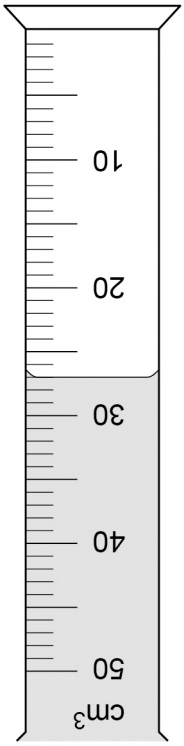
Sodium ions ☐

Sulfate ions ☐

Do not write outside the box

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 = 27 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]

ions cannot move (freely in a solid)

Do not write outside the box

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	iodine
Zinc bromide	zinc	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. ☐

0 8 . 6 What is the state symbol for molten sodium chloride?

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☑ (s) ☐

Do not write outside the box

0 8 . 7 Titanium can be produced from titanium oxide by electrolysis.

The equation for the reaction is:

$$TiO_2 \rightarrow Ti + O_2$$

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

Use the equation:

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

Relative atomic mass (A_r): Ti = 48

Relative formula mass (M_r): TiO_2 = 80

[2 marks]

(percentage atom economy =) $\frac{48}{80} \times 100$

Percentage atom economy = 60 %

9

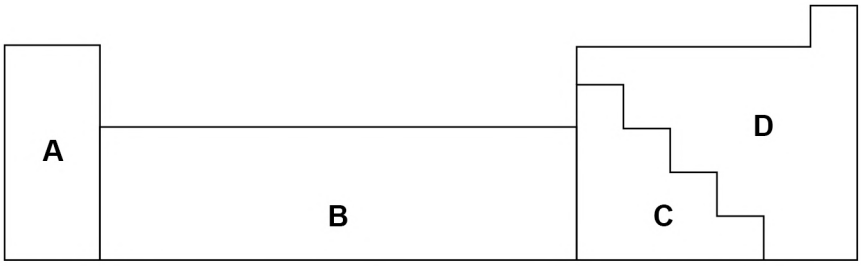
Turn over for the next question

Do not write outside the box

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** ☑

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** ☐

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 have lower melting / boiling points

2 • have lower densities

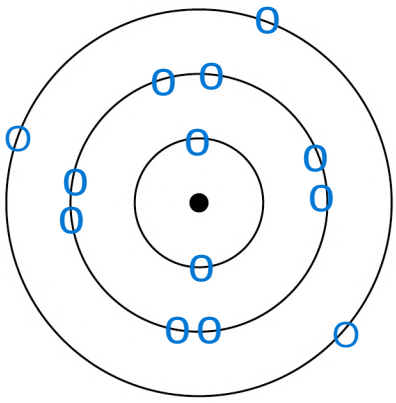
Do not write outside the box

0 9 . 4 Complete **Figure 16** to show the electronic structure of an aluminium atom.

Use the periodic table.

[1 mark]

Figure 16



0 9 . 5 Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

[3 marks]

delocalised electrons

(the electrons) carry (electrical) charge

(the electrons move) through the metal / aluminium / structure

0 9 . 6 Name the type of bonding in compounds formed between metals and non-metals.

[1 mark]

ionic

Do not write outside the box

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]

magnesium (atom) loseselectrons

oxygen (atom) gains electrons

two electrons (are transferred)

magnesium ions and oxide ions are formed

13

Do not write outside the box

1 0 Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.

The equation for the reaction is:

$$Na_2CO_3(s) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + CO_2(g) + H_2O(l)$$

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]

Indicative content

- measure volume of (hydrochloric) acid
- with a measuring cylinder
- pour (hydrochloric) acid into a suitable container eg polystyrene cup
- measure the initial temperature (of hydrochloric acid)
- with a thermometer
- add a known mass of sodium carbonate
- measured with a balance
- stir
- measure the highest temperature reached
- repeat with different masses of sodium carbonate

or

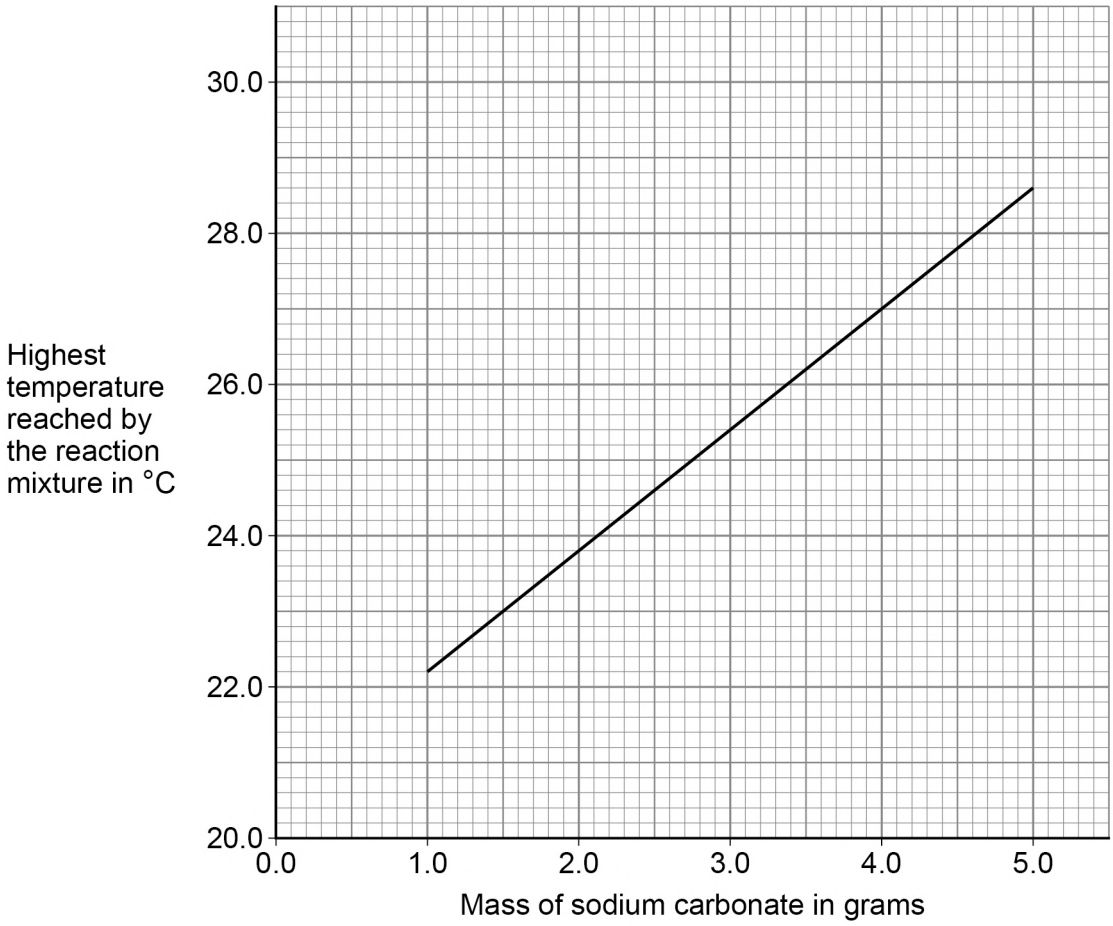
add successive masses of sodium carbonate to the same mixture

- repeat the whole investigation
- use the same starting temperature
- use the same volume of (hydrochloric) acid each time
- use the same concentration of (hydrochloric) acid each time

Do not write outside the box

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

Figure 17



Do not write outside the box

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]

change in highest temperature

corresponding change in mass

~~(gradient =)~~ $\frac{\text{change in highest temperature}}{\text{change in mass}}$

Gradient = 1.6 Unit $^{o}c/g$

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]

extrapolates line to the y-axis

Initial temperature of the reaction mixture = 20.6 (°C) °C

Turn over ►

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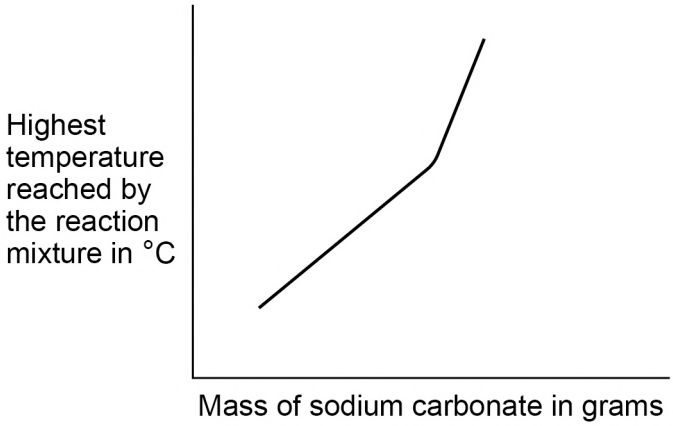
1 0 . 4 Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

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

[1 mark]

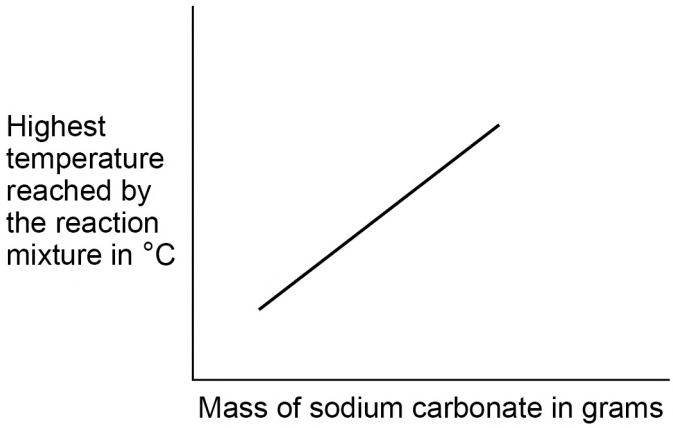
Tick (✓) **one** box.

A



☐

B



☐

C

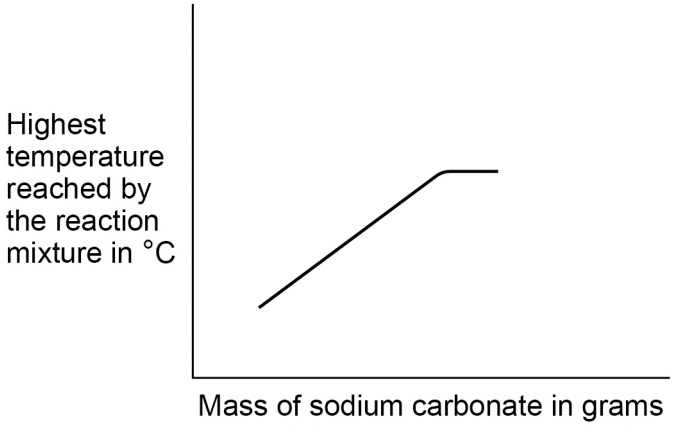


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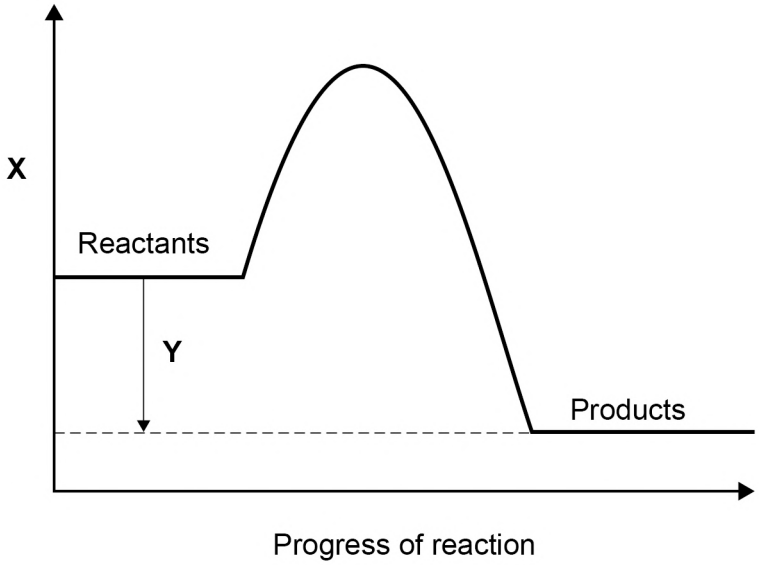
Figure 18 shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

Figure 18



1 0 . 5 What do labels **X** and **Y** represent on **Figure 18**?

[2 marks]

X (X) energy

Y (Y) (overall) energy change

1 0 . 6 How does the reaction profile show that the reaction is exothermic?

Use **Figure 18**.

[1 mark]

(level of) products is below (level of) reactants

17

END OF QUESTIONS

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