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I declare this is my own work.

**GCSE
CHEMISTRY**

F

Foundation Tier Paper 1

8462/1F

Thursday 14 May 2020

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.
- 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 the elements in Group 7 of the periodic table.

TABLE 1 shows the melting points and boiling points of some of the elements.

TABLE 1

Element	Melting point in °C	Boiling point in °C
Fluorine	-220	-188
Chlorine	-101	-35
Bromine	-7	59

0 1 . 1

What is the state of bromine at 100 °C?

Use TABLE 1. [1 mark]

Tick (✓) ONE box.

Gas

Liquid

Solid



0 1 . 2 What temperature does chlorine gas condense at to form a liquid?

Use TABLE 1, on the opposite page. [1 mark]

Temperature = _____ °C

0 1 . 3 Complete the sentences. [2 marks]

Going down Group 7 the melting points

_____.

This is because the size of the molecules increases so the intermolecular forces

_____.

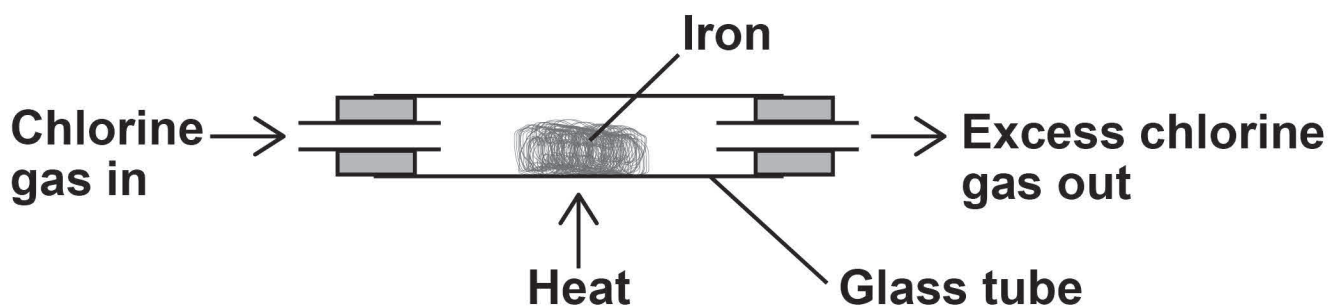
[Turn over]



A teacher investigated the reaction of iron with chlorine.

FIGURE 1 shows the apparatus used.

FIGURE 1



4 Why did the teacher do the investigation in a fume cupboard? [1 mark]

Tick (✓) ONE box.

Chlorine gas is coloured.

Chlorine gas is flammable.

Chlorine gas is toxic.



0 1 . 5 The word equation for the reaction is:

iron + chlorine \rightarrow iron chloride

Iron chloride is a solid.

The teacher weighed the glass tube and contents:

- **before the reaction**
- **after the reaction.**

What happened to the mass of the glass tube and contents during the reaction?

Give ONE reason for your answer. [2 marks]

The mass of the glass tube and contents

_____.

Reason _____

[Turn over]



The teacher repeated the investigation with bromine gas and with iodine gas.

TABLE 2 shows the results.

TABLE 2

ELEMENT	OBSERVATION
Chlorine	Iron burns vigorously with an orange glow
Bromine	Iron burns with an orange glow
Iodine	Iron slowly turns darker

0 1 . 6 Fluorine is above chlorine in Group 7.

Predict what you would observe when fluorine gas reacts with iron.

Use TABLE 2. [1 mark]



0 1 . 7 Balance the equation for the reaction between iron and bromine. [1 mark]



0 1 . 8 Calculate the relative formula mass (M_r) of FeBr_3

Relative atomic masses (A_r):

Fe = 56 Br = 80 [2 marks]

Relative formula mass (M_r) =

[Turn over]

11



0 2 This question is about models of the atom.

0 2 . 1 Atoms were first thought to be tiny spheres that could not be divided.

Which particle was discovered to change this model of the atom? [1 mark]

Tick (✓) ONE box.

Electron

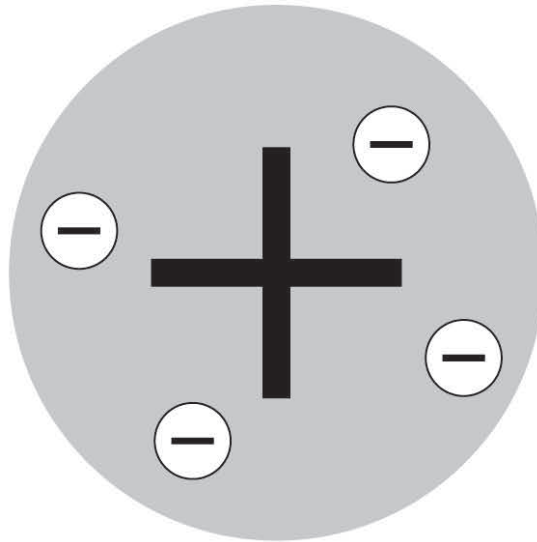
Neutron

Proton



02.2 FIGURE 2 shows another model of the atom.

FIGURE 2



What is the name of this model of the atom?
[1 mark]

[Turn over]



0 2 . 3 A scientist fired particles at gold atoms.

Some of these particles were scattered.

The results led to a different model of the atom.

Which type of particle was fired at the gold atoms? [1 mark]

Tick (✓) ONE box.

Alpha

Electron

Neutron

Proton



0 2 . 4 Which scientist first suggested that electrons orbit the nucleus at specific distances?
[1 mark]

Tick (✓) ONE box.

Bohr

Chadwick

Mendeleev

[Turn over]



02.5 The model of the atom used today has three subatomic particles:

- electrons
- neutrons
- protons.

Complete the sentences. [3 marks]

Atoms of the same element have the same atomic number because they have the same number of _____.

Atoms of the same element can have different mass numbers because they have different numbers of _____.

Atoms have no overall charge because they have the same number of _____ and _____.



0 2 . 6 The radius of a nucleus is approximately 1×10^{-14} m

The radius of an atom is approximately 1×10^{-10} m

A teacher uses a ball of radius 1 cm to represent the nucleus.

What could represent the atom on the same scale? [1 mark]

Tick (✓) ONE box.

A ball of radius 10 cm

A sports arena of radius 100 m

An island of radius 10 km

A planet of radius 1000 km

[Turn over]

8



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03

This question is about chemical reactions and energy.

Hydrogen reacts with oxygen to produce water.

This reaction releases energy.

03**.1**

Complete the word equation for the reaction.
[1 mark]

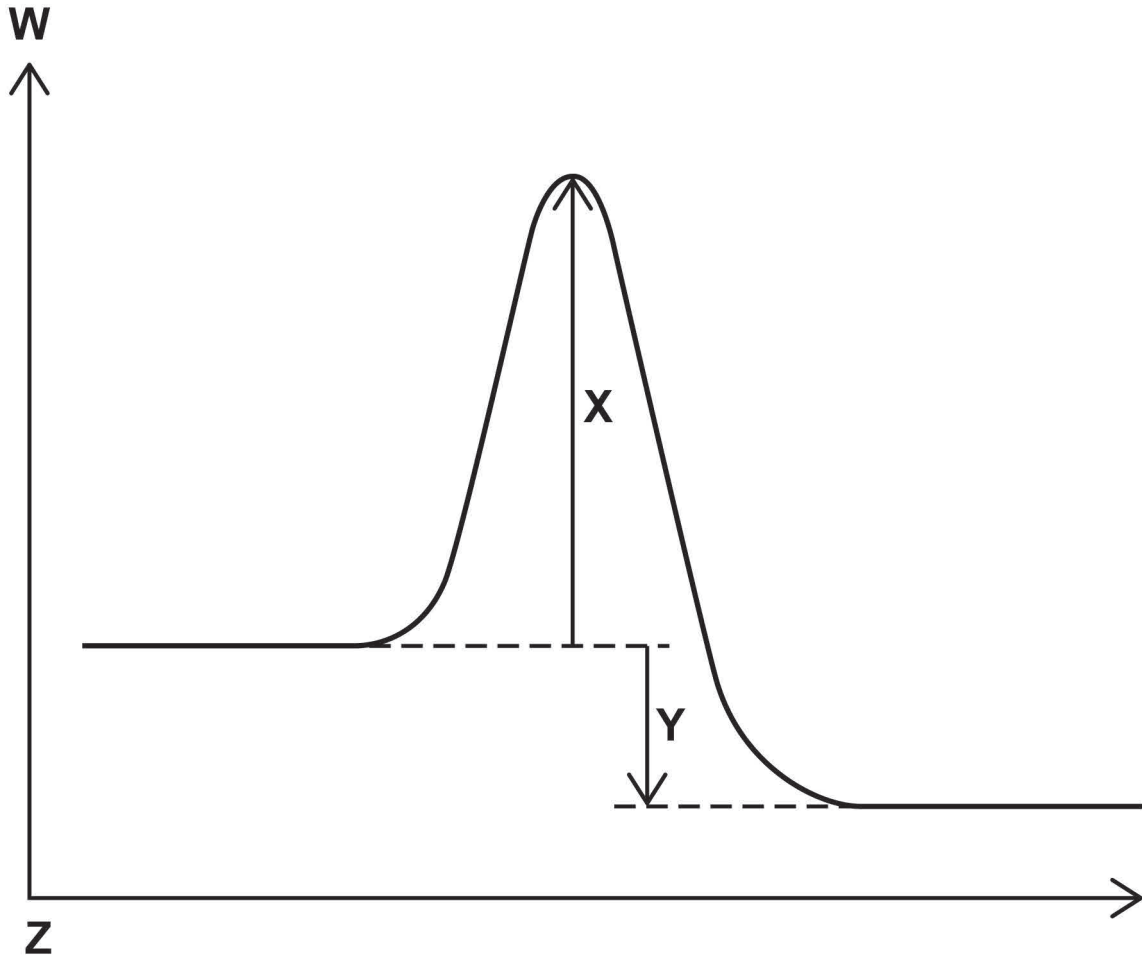
hydrogen + oxygen → _____

[Turn over]



03.2 FIGURE 3 shows a reaction profile for the reaction between hydrogen and oxygen.

FIGURE 3



What do the labels W, X, Y and Z represent?

Choose answers from the list. [4 marks]

- activation energy
- energy
- overall energy change
- products
- progress of reaction
- reactants

W _____

X _____

Y _____

Z _____

[Turn over]



03.3 The reaction between hydrogen and oxygen is used in a hydrogen fuel cell.

What is the reason for using this reaction in a fuel cell? [1 mark]

Tick (✓) ONE box.

To produce a change of state

To produce a potential difference

To produce a temperature change



- 03.4** A student investigated the voltage produced by a chemical cell.

The student used different metals as the electrodes in the cell.

The metals used were:

- copper
- iron
- magnesium

Which TWO metal electrodes would produce the greatest voltage when used in the chemical cell?

Give ONE reason for your answer. [2 marks]

Metals _____ and _____

Reason _____

[Turn over]

8



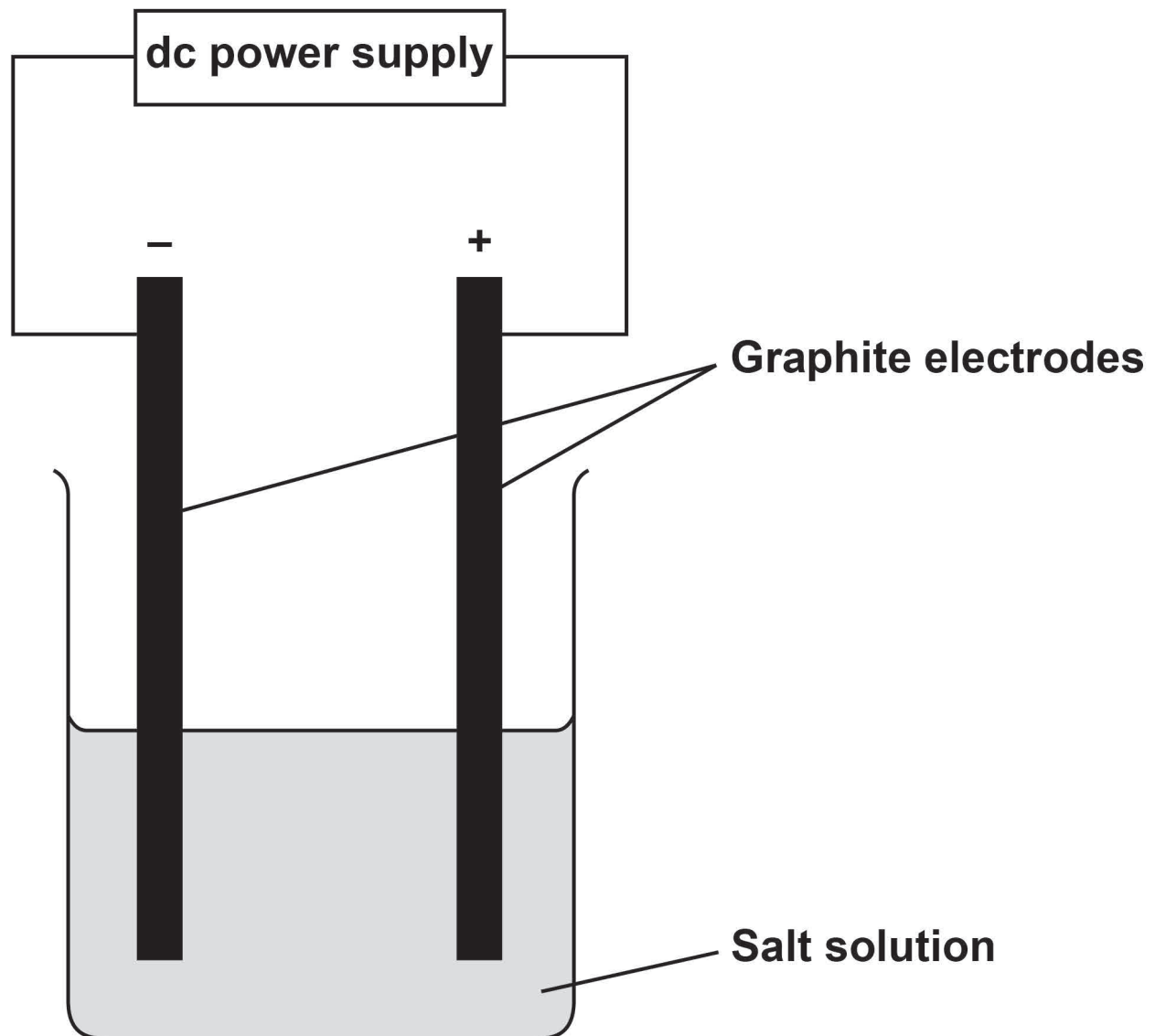
0 4 This question is about electrolysis.

A student investigated the hypothesis:

‘The electrolysis of a salt solution produces a metal at the negative electrode and a gas at the positive electrode.’

FIGURE 4 shows the apparatus used.

FIGURE 4



- 04.1** What observation would be made at each electrode if the hypothesis is correct?
[2 marks]

Observation if metal produced at the negative electrode _____

Observation if gas produced at the positive electrode _____

[Turn over]



TABLE 3 shows the student's results.

TABLE 3

Salt solution	Product at the negative electrode	Product at the positive electrode
Copper chloride	Copper	Chlorine
Potassium nitrate	Hydrogen	Oxygen
Silver nitrate	Silver	Oxygen

0 4 . 2 Which salt solution in TABLE 3 does NOT match the student's hypothesis?

Give ONE reason why. [2 marks]

Salt solution _____

Reason _____



04.3 Give TWO reasons why graphite is used for the electrodes. [2 marks]

1 _____

2 _____

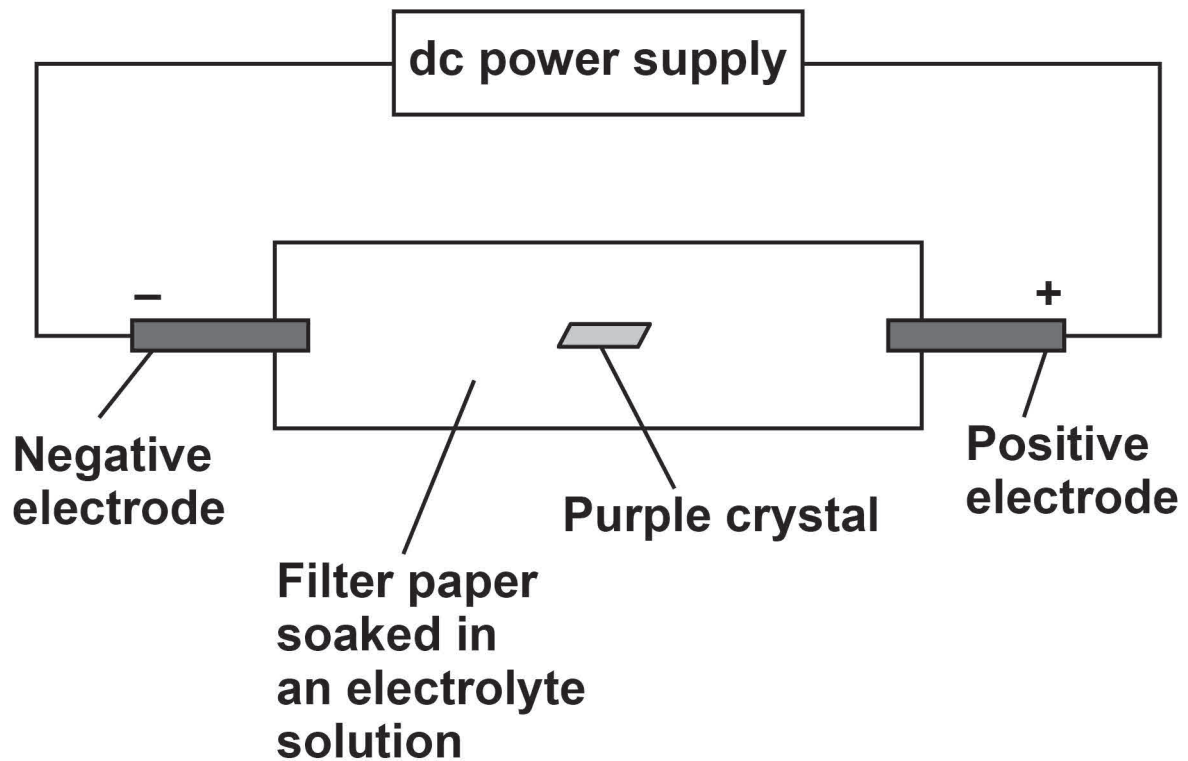
[Turn over]



A different student investigated what happens during electrolysis.

FIGURE 5 shows the apparatus.

FIGURE 5



The purple crystal contained:

- colourless positive ions
- purple coloured negative ions.

The purple crystal dissolved in the electrolyte solution.



0 4 . 4 What happens to the purple coloured ions?

Give ONE reason for your answer. [2 marks]

Tick (✓) ONE box.

The ions do not move.

The ions move towards the negative electrode.

The ions move towards the positive electrode.

Reason _____

[Turn over]

8



0 5 This question is about aluminium.

0 5 . 1 Aluminium is a metal.

Draw **ONE** line from each property of aluminium to the correct reason for that property. [2 marks]

PROPERTY

REASON

Conducts electricity

Aluminium has delocalised electrons

Aluminium has layers of atoms which can slide

Aluminium has strong metallic bonds

High melting point

Aluminium has weak intermolecular forces

Aluminium has a random arrangement of atoms



05.2 Aluminium can be used to make alloys.

What is meant by an 'alloy'? [1 mark]

Aluminium is extracted from bauxite.

Bauxite is a mixture which contains aluminium oxide.

05.3 Bauxite contains between 15% and 25% aluminium.

Aluminium oxide always contains 53% aluminium.

How does this show that bauxite is a mixture and NOT a compound? [1 mark]

[Turn over]

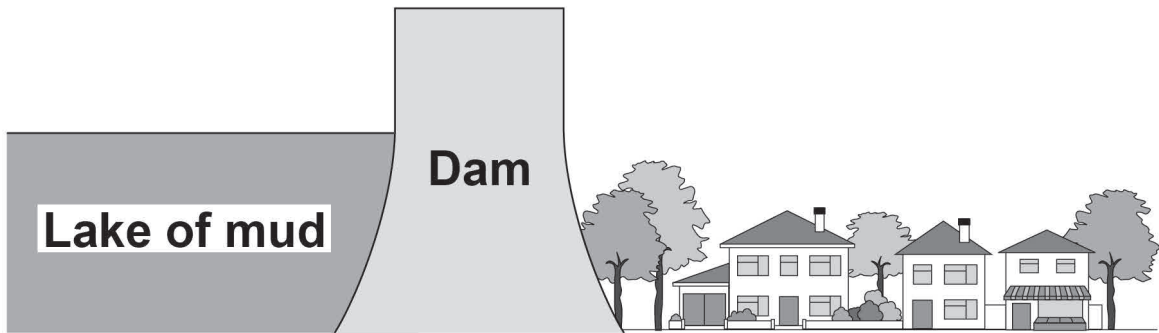


05.4 The waste material from the bauxite is stored in lakes of mud.

The lakes of mud are held in place by dams.

FIGURE 6 shows one of these lakes.

FIGURE 6



Suggest TWO possible problems with storing the waste material in lakes of mud. [2 marks]

1 _____

2 _____



Aluminium is extracted by electrolysis.

The aluminium oxide is mixed with cryolite and melted.

The mixture is then electrolysed.

0 5 . 5 The formula of cryolite is Na_3AlF_6

Give the total number of atoms in the formula.
[1 mark]

Number of atoms = _____

0 5 . 6 What is the reason for adding cryolite to the aluminium oxide? [1 mark]

Tick (✓) ONE box.

To increase the amount of aluminium extracted

To lower the melting point of the mixture

To reduce the amount of aluminium oxide needed

[Turn over]



05.7 Complete the sentences.

Choose answers from the list. [2 marks]

- aluminium
- carbon
- fluorine
- oxygen
- sodium

When the molten aluminium oxide and cryolite mixture is electrolysed the product at the positive electrode is

This product reacts with the positive electrode because the positive electrode is made of



05.8 A sample of bauxite contains 25% aluminium.

Calculate the maximum mass of aluminium that can be extracted from 300 000 kg of the sample of bauxite.

Give your answer in standard form. [3 marks]

Maximum mass (in standard form) =

_____ kg

[Turn over]

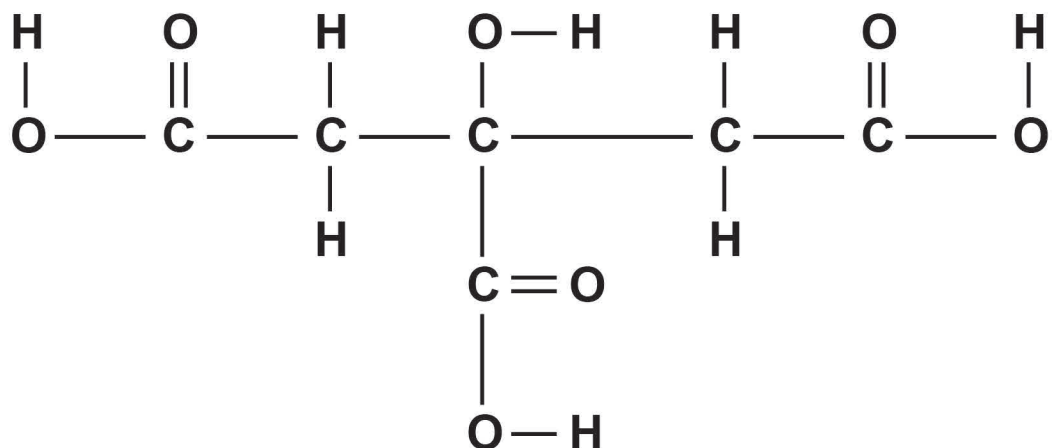
13



06 This question is about citric acid.

FIGURE 7 represents one molecule of citric acid.

FIGURE 7



06.1 Complete the molecular formula of citric acid.

Use **FIGURE 7**. [1 mark]

C_6H _____ O _____



06.2 What type of bonding is shown in **FIGURE 7**?
[1 mark]

Tick (✓) **ONE** box.

Covalent

Ionic

Metallic

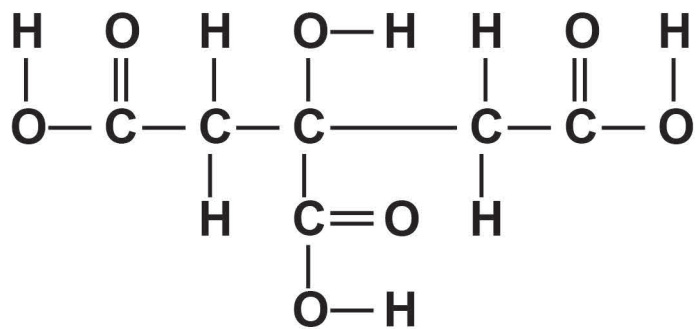
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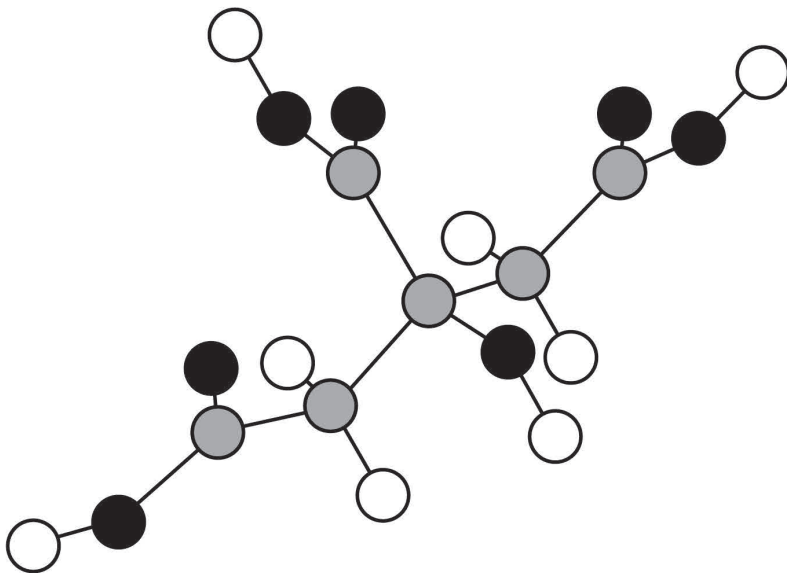
06.3 FIGURE 8 shows two representations of one molecule of citric acid, A and B.

FIGURE 8

A



B



Give TWO advantages of representation A compared with representation B. [2 marks]

Advantages of A:

1 _____

2 _____

[Turn over]



A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

Citric acid is a solid.

This is the method used.

- 1. Pour 25 cm³ of sodium hydrogencarbonate solution into a polystyrene cup.**
- 2. Measure the temperature of the sodium hydrogencarbonate solution.**
- 3. Add 0.25 g of citric acid to the cup.**
- 4. Stir the solution.**
- 5. Measure the temperature of the solution.**
- 6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.**

TABLE 4, on the opposite page, shows some of the student's results.



TABLE 4

Mass of citric acid added in g	Temperature of solution in °C
0.00	22.6
0.25	22.2
0.50	21.8
0.75	21.4
1.00	21.0
1.25	20.6

0 **6** . **4** How do the results in TABLE 4 show that the reaction is endothermic? [1 mark]

[Turn over]



REPEAT OF TABLE 4

Mass of citric acid added in g	Temperature of solution in °C
0.00	22.6
0.25	22.2
0.50	21.8
0.75	21.4
1.00	21.0
1.25	20.6

0 6 . 5 Three of the student's results are plotted on **FIGURE 9**, on the opposite page.

A line of best fit for these points is drawn.

Complete FIGURE 9.



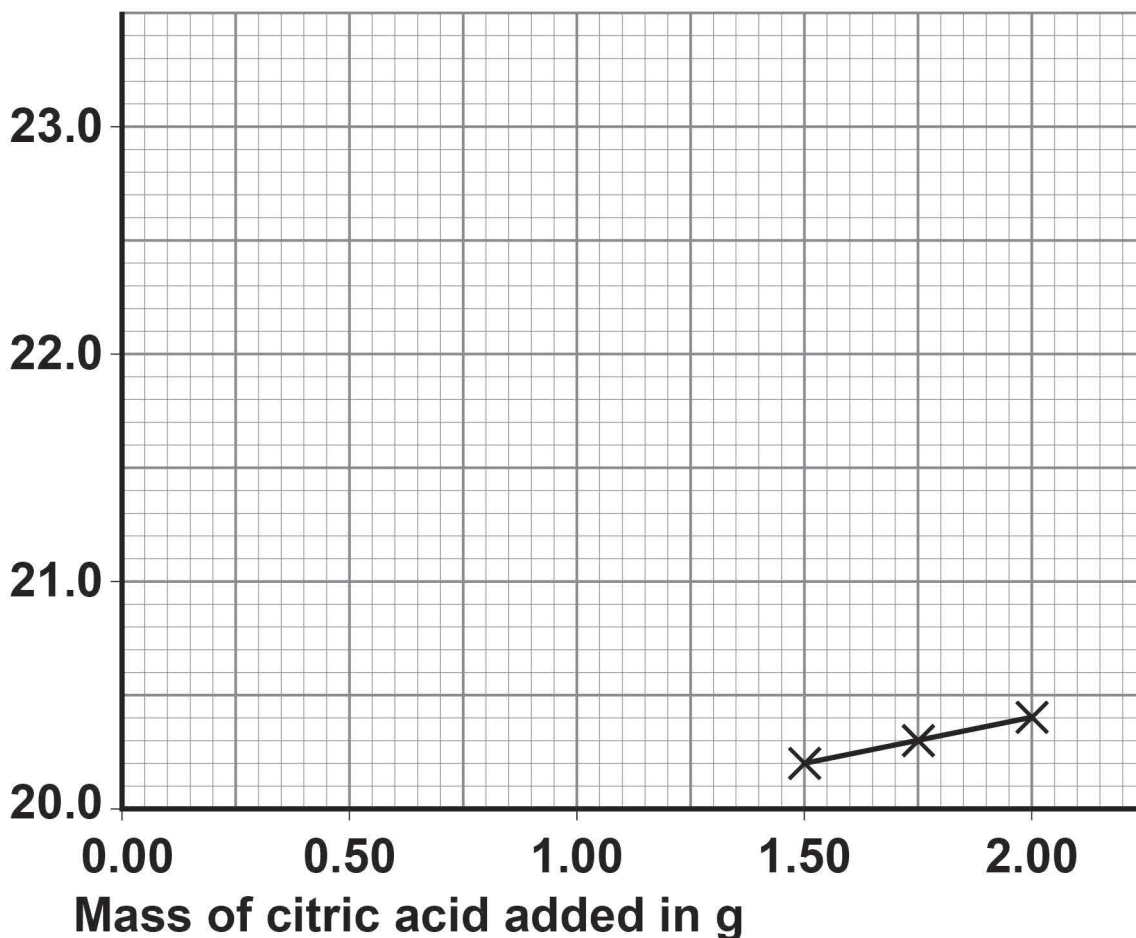
You should:

- plot the data from TABLE 4, on page 39, on FIGURE 9
- draw a line of best fit through the points you have plotted
- extend your line of best fit to meet the line of best fit already drawn on FIGURE 9.

[4 marks]

FIGURE 9

Temperature of
solution in °C



[Turn over]



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- 06.6** Determine the overall temperature change for the reaction.

Use FIGURE 9, on page 41. [2 marks]

Overall temperature change =

_____ °C

- 06.7** What is the dependent variable in this investigation? [1 mark]

Tick (✓) ONE box.

Mass of citric acid

Temperature of solution

Volume of solution

[Turn over]

12



07

This question is about acids, bases and salts.

Zinc nitrate is a salt.

A student produces zinc nitrate using an acid and a base.

07**.1**

Which acid should the student use to produce zinc nitrate? [1 mark]

Tick (✓) ONE box.

Hydrochloric acid

Nitric acid

Sulfuric acid



07.2 Which is a base the student could use to produce zinc nitrate? [1 mark]

Tick (✓) ONE box.

Zinc chloride

Zinc oxide

Zinc sulfate

07.3 Name the salt with the formula MgBr_2
[1 mark]

[Turn over]



A student investigated how pH changes during a titration.

This is the method used.

- 1. Pour 25.0 cm³ of hydrochloric acid into a beaker.**
- 2. Measure the pH of the hydrochloric acid with a pH probe.**
- 3. Add 1.0 cm³ of sodium hydroxide solution from a burette.**
- 4. Swirl the mixture.**
- 5. Measure the pH of the mixture.**
- 6. Repeat steps 3 to 5 until a total of 30.0 cm³ of sodium hydroxide solution has been added.**

FIGURE 10, on page 48, shows the student's results.

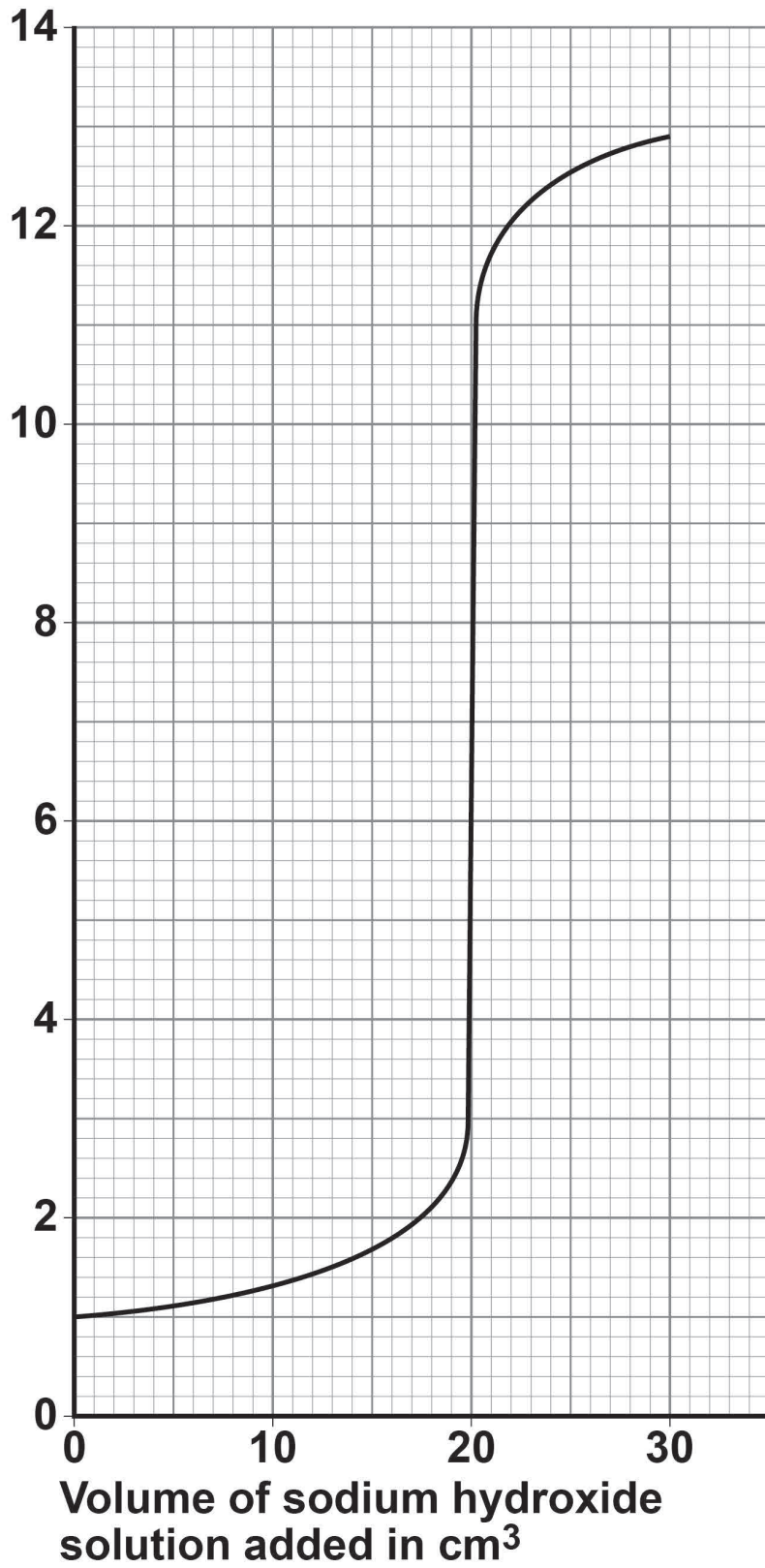


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[Turn over]



FIGURE 10

pH of
mixture

- 07.4** Describe how the pH of the mixture changes as sodium hydroxide solution is added to hydrochloric acid.

Use data from FIGURE 10, on the opposite page, in your answer. [3 marks]

- 07.5** What volume of sodium hydroxide solution is needed to neutralise 25.0 cm³ of hydrochloric acid?

Use FIGURE 10. [1 mark]

Volume = _____ cm³

[Turn over]



07 . 6 FIGURE 11 shows the colour of universal indicator at different pH values.

FIGURE 11



The student could have used universal indicator instead of a pH probe.

50

Determine the colour of universal indicator when 10.0 cm³ of sodium hydroxide solution has been added to 25.0 cm³ of hydrochloric acid.

Use FIGURE 10 and FIGURE 11. [1 mark]

Colour = _____



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[Turn over]



07.7

The student used a pipette to measure 25.0 cm^3 of hydrochloric acid.

FIGURE 12



The pipette is labelled $25.0 \pm 0.06 \text{ cm}^3$

Calculate the percentage uncertainty in the volume measured using this pipette.

Use the equation:

$$\text{percentage uncertainty} = \frac{\text{uncertainty}}{\text{volume measured}} \times 100$$

[2 marks]



Percentage uncertainty = _____ %

07.8

**Give ONE advantage of using a pipette rather than using a measuring cylinder to measure the volume of hydrochloric acid.
[1 mark]**

[Turn over]

11



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0 8 This question is about structure and bonding.

0 8 . 1 Which TWO substances have intermolecular forces between particles? [2 marks]

Tick (✓) TWO boxes.

Diamond

Magnesium

Poly(ethene)

Sodium chloride

Water

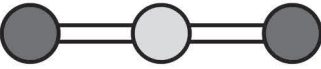
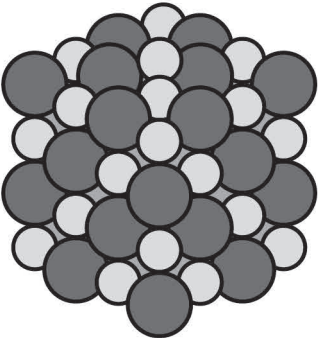
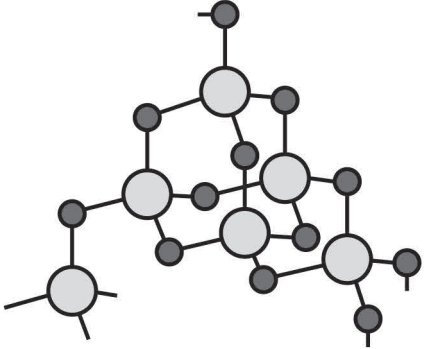
[Turn over]



08.2 TABLE 5 shows the structures of three compounds.

The diagrams are not drawn to scale.

TABLE 5

COMPOUND	STRUCTURE
Carbon dioxide	 <p>KEY</p> <p>● O ○ C</p>
Magnesium oxide	 <p>KEY</p> <p>● O²⁻ ○ Mg²⁺</p>
Silicon dioxide	 <p>KEY</p> <p>● O ○ Si</p>



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[Turn over]



0 9 This question is about metals and the reactivity series.

0 9 . 1 Which TWO statements are properties of most transition metals? [2 marks]

Tick (✓) TWO boxes.

They are soft metals.

They form colourless compounds.

They form ions with different charges.

They have high melting points.

They have low densities.



09.2 A student added copper metal to colourless silver nitrate solution.

The student observed:

- pale grey crystals forming
- the solution turning blue.

Explain how these observations show that silver is less reactive than copper. [3 marks]

[Turn over]



[Turn over]



09.4 Metal M has two isotopes.

TABLE 6 shows the mass numbers and percentage abundances of the isotopes.

TABLE 6

Mass number	Percentage abundance (%)
203	30
205	70

Calculate the relative atomic mass (A_r) of metal M.

Give your answer to 1 decimal place.
[2 marks]



Relative atomic mass (1 decimal place) =

[Turn over]

11

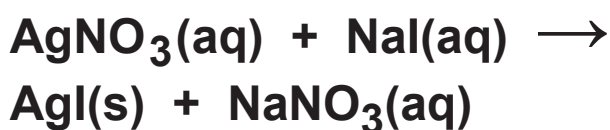


10

This question is about silver iodide.

Silver iodide is produced in the reaction between silver nitrate solution and sodium iodide solution.

The equation for the reaction is:

**10.1**

A student investigated the law of conservation of mass.

This is the method used.

- 1. Pour silver nitrate solution into a beaker labelled A.**
- 2. Pour sodium iodide solution into a beaker labelled B.**
- 3. Measure the masses of both beakers and their contents.**
- 4. Pour the solution from beaker B into beaker A.**
- 5. Measure the masses of both beakers and their contents again.**



TABLE 7 shows the student's results.

TABLE 7

	Mass before mixing in g	Mass after mixing in g
Beaker A and contents	78.26	108.22
Beaker B and contents	78.50	48.54

Explain how the results demonstrate the law of conservation of mass.

You should use data from TABLE 7 in your answer. [2 marks]

[Turn over]



- 10.2** Suggest how the student could separate the insoluble silver iodide from the mixture at the end of the reaction. [1 mark]

The student purified the separated silver iodide.

This is the method used.

1. Rinse the silver iodide with distilled water.
2. Warm the silver iodide.

- 10.3** Suggest ONE impurity that was removed by rinsing with water. [1 mark]



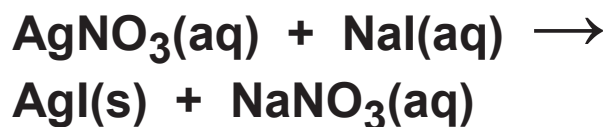
10.4 Suggest why the student warmed the silver iodide. [1 mark]

[Turn over]



- 10.5** Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:



Give your answer to 3 significant figures.

Relative formula masses (M_r):



[4 marks]



Percentage atom economy (3 significant figures) =

_____ %

10.6

Give ONE reason why reactions with a high atom economy are used in industry. [1 mark]

END OF QUESTIONS

10



Additional page, if required.

Write the question numbers in the left-hand margin.



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Question	Mark
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