A

AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier

Chemistry Paper 1H

8464/C/1H

Monday 22 May 2023 **Morning**

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

JUN238464C1H01

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.**
- **Answer ALL questions in the spaces provided.**
- **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 70.**
- **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 carbon dioxide.

Carbon dioxide is soluble in water and forms an acidic solution.

0 1 . 1

Which ion makes the solution acidic? [1 mark]

0 1 . 2

Name an indicator that could be used to test if the solution is acidic.

Give the result of the test. [2 marks]

Indicator _____

_____

Result _____

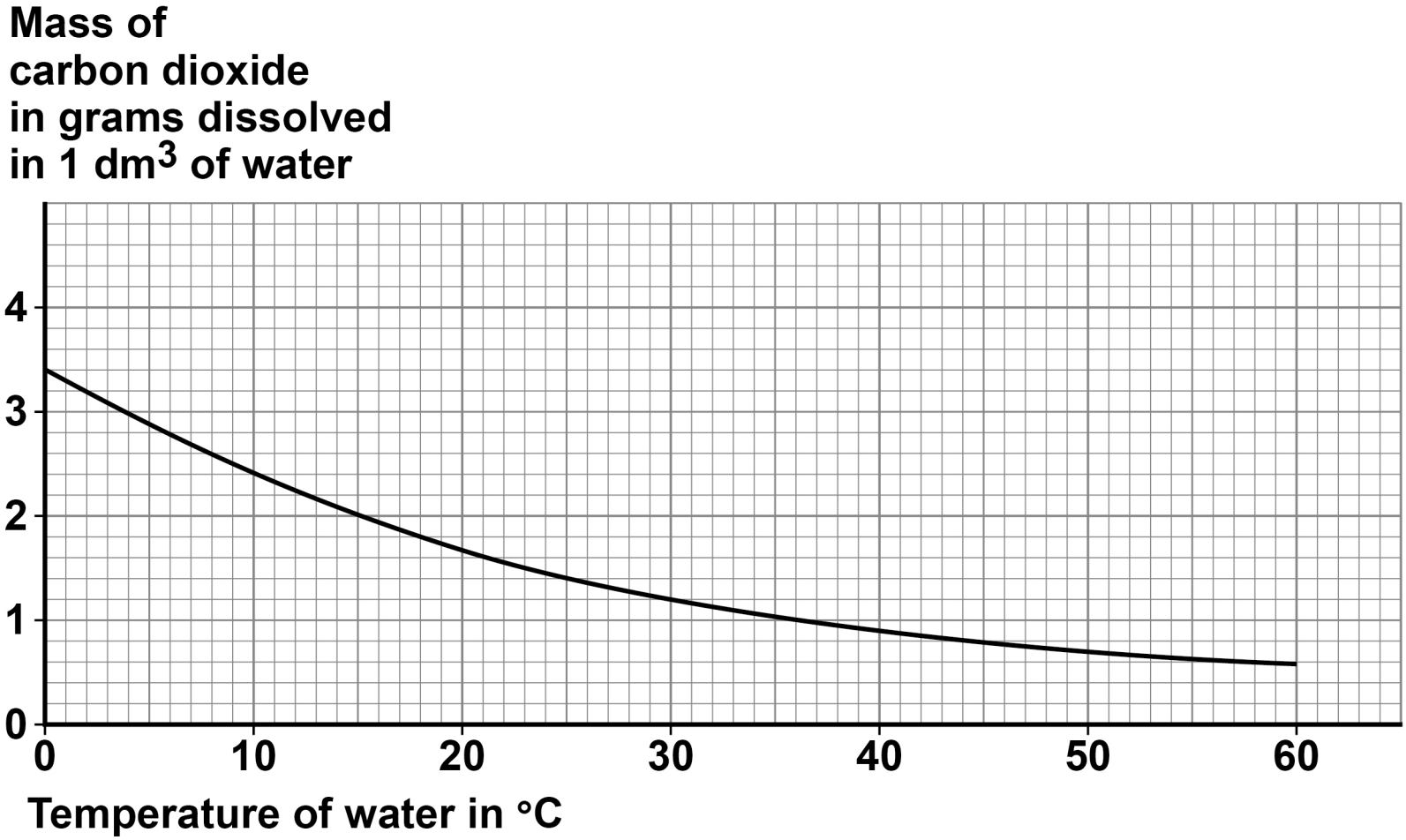
_____

_____

[Turn over]

FIGURE 1 shows the mass of carbon dioxide that will dissolve in 1 dm^3 of water at different temperatures.

FIGURE 1



0 7

0 1 . 3

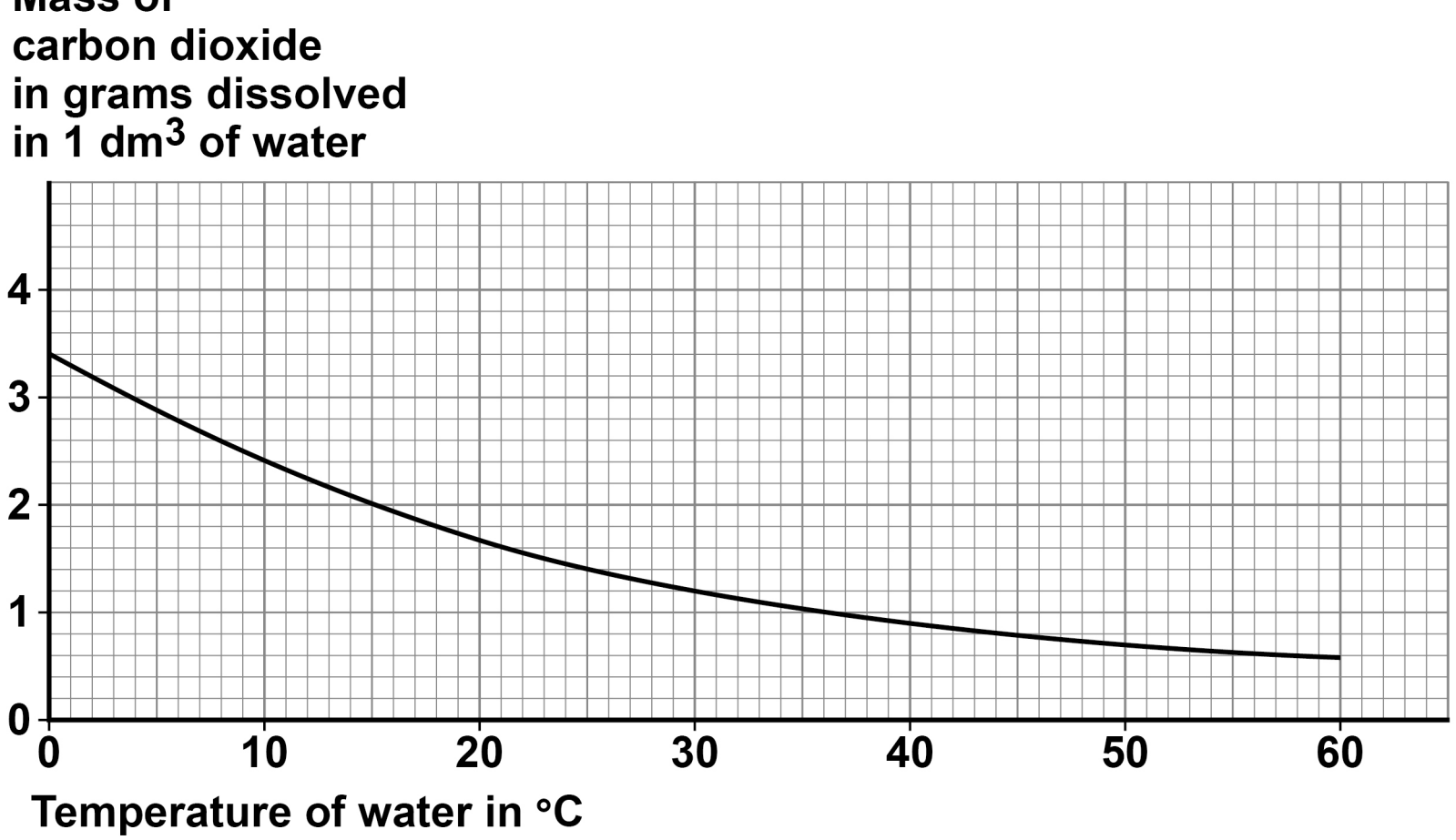
How does the solubility of carbon dioxide change as the temperature of the water increases? [1 mark]

Tick (✓) ONE box.

- ☐ **The solubility decreases**
- ☐ **The solubility does not change**
- ☐ **The solubility increases**

[Turn over]

REPEAT OF FIGURE 1



0 1 . 4

Carbon dioxide dissolves in water to form an acidic solution.

How does the pH of the solution change as the temperature of the water increases?

Use FIGURE 1. [1 mark]

Tick (✓) ONE box.

- ☐ **pH of the solution decreases**
- ☐ **pH of the solution does not change**
- ☐ **pH of the solution increases**

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Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:

$$CaCO_3(s) + 2\,HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(x)$$

0 1 . 5

What is the state symbol (x) in the equation? [1 mark]

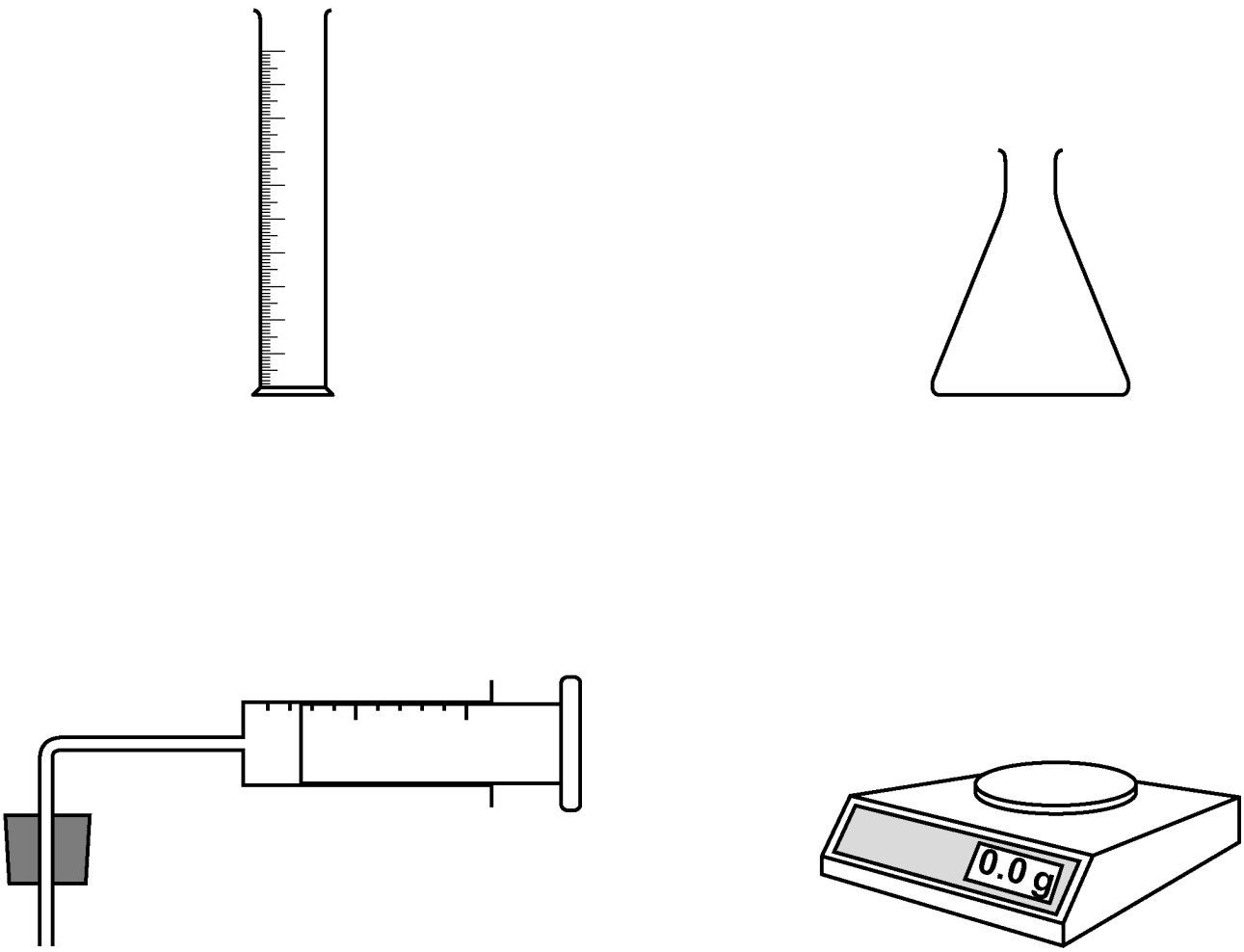
Tick (✓) ONE box.

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

0 1 . 6

FIGURE 2 shows equipment a student used for an investigation.

FIGURE 2



Gas syringe

The student investigated the volume of carbon dioxide produced when different masses of calcium carbonate react with hydrochloric acid.

Describe a method the student could use. [6 marks]

12

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[Turn over]

0 2

Lithium hydroxide reacts with sulfuric acid to produce lithium sulfate.

The equation for the reaction is:

$$2\ LiOH + H_2SO_4 \longrightarrow Li_2SO_4 + 2\ H_2O$$

0 2 . 1

What type of reaction is this? [1 mark]

0 2 . 2

Calculate the relative formula mass (M_r) of sulfuric acid (H_2SO_4).

Relative atomic masses (A_r): H = 1 O = 16 S = 32

[2 marks]

Relative formula mass (M_r) = _____

[Turn over]

0 2 . 3

Calculate the percentage by mass of oxygen in lithium sulfate (Li_2SO_4).

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): Li_2SO_4 = 110

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

Percentage by mass of oxygen (2 significant figures) =

_____ %

[Turn over]

0 2 . 4

A solution of lithium sulfate contains 0.30 g of lithium sulfate in 25 cm^3.

Calculate the concentration of lithium sulfate in g/dm^3. [3 marks]

Concentration = _____ g/dm^3

10

0 3

Sodium is in Group 1 of the periodic table.

Sodium reacts with oxygen to produce sodium oxide.

0 3 . 1

Balance the equation for the reaction. [1 mark]

$$\_\_\_\_ Na + O_2 \longrightarrow \_\_\_\_ Na_2O$$

[Turn over]

0 3 . 2

Explain what happens to sodium atoms and to oxygen atoms when sodium reacts with oxygen to produce sodium oxide (Na_2O).

Answer in terms of electrons. [4 marks]

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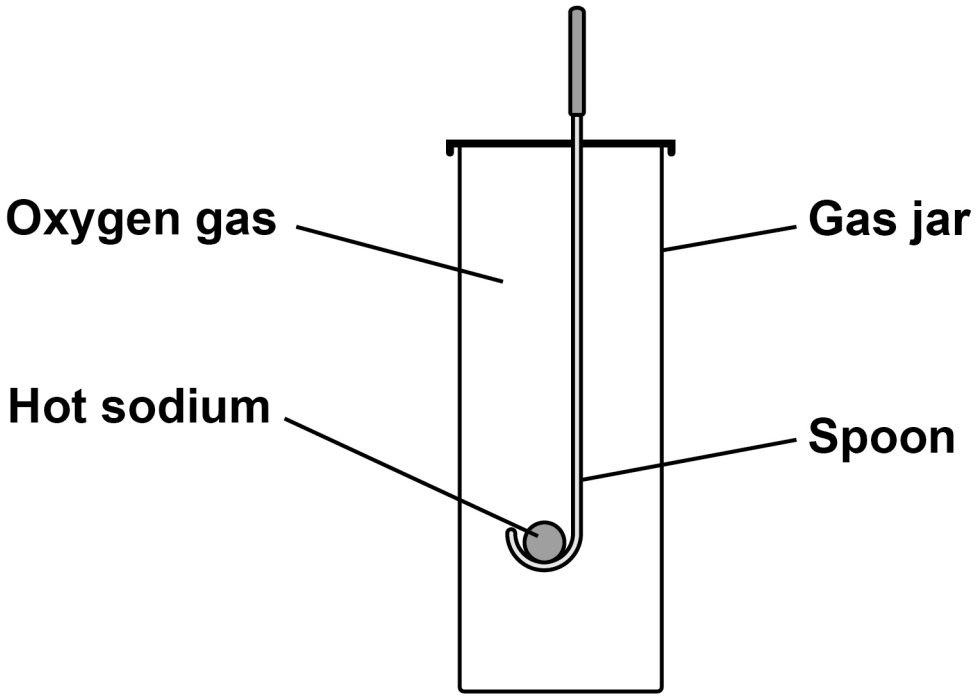
[Turn over]

0 3 . 3

Sodium burns in a gas jar of oxygen.

FIGURE 3 shows the apparatus.

FIGURE 3



Give TWO observations seen during the reaction.
[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 3 . 4

Describe TWO differences in the observations if potassium is used instead of sodium. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

9

[Turn over]

0 4

Group 7 elements are known as the halogens.

All atoms of Group 7 elements contain protons, neutrons and electrons.

0 4 . 1

What is the order of discovery of the proton, neutron and electron? [1 mark]

Tick (✓) ONE box.

- ☐ electron → neutron → proton
- ☐ electron → proton → neutron
- ☐ neutron → proton → electron
- ☐ proton → electron → neutron

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[Turn over]

0 4 . 2

TABLE 1 shows the mass of a proton and of an electron.

TABLE 1

Name of particle	Mass in kg
Proton	1.673×10^{-27}
Electron	9.109×10^{-31}

Calculate how many times heavier a proton is than an electron. [2 marks]

Times heavier a proton is than an electron = _____

A bromine atom can be represented as $^{81}_{35}Br$.

0 4 . 3

What is the number of neutrons in this bromine atom?
[1 mark]

_____

0 4 . 4

What is the number of electrons in a bromide ION?
[1 mark]

_____

[Turn over]

0 4 . 5

Chlorine has two isotopes.

TABLE 2 shows the percentage abundance of the two isotopes of chlorine.

TABLE 2

ISOTOPE	PERCENTAGE (%) ABUNDANCE
$^{35}_{17}Cl$	75.77
$^{37}_{17}Cl$	24.23

Calculate the relative atomic mass (A_r) of chlorine.

Give your answer to 2 decimal places. [3 marks]

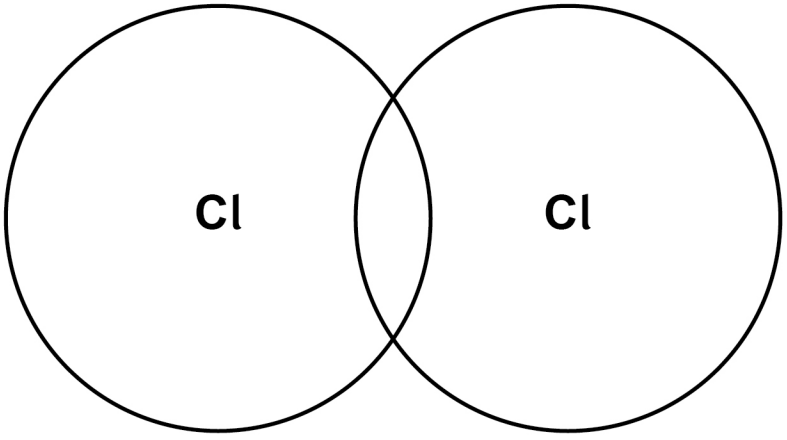
Relative atomic mass (2 decimal places) = _____

0 4 . 6

FIGURE 4 shows the outer shells in one molecule of chlorine (Cl_2).

Complete the dot and cross diagram to show the electrons in the outer shells. [2 marks]

FIGURE 4



[Turn over]

10

0 5

During electrolysis ions are discharged at the electrodes to produce elements.

A student investigates the electrolysis of sodium chloride.

0 5 . 1

Why does solid sodium chloride NOT conduct electricity? [1 mark]

_____

_____

_____

0 5 . 2

Sodium chloride solution conducts electricity.

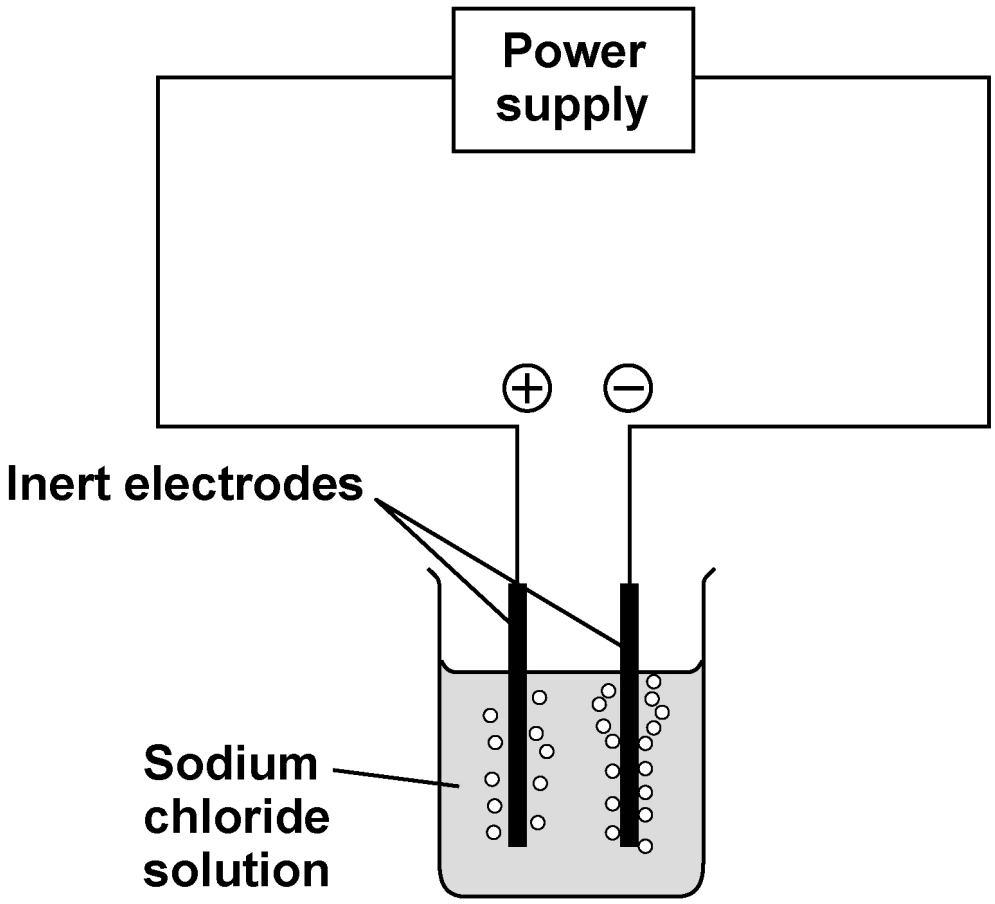
Complete the sentence. [1 mark]

Sodium chloride ALSO conducts electricity when

_____ .

FIGURE 5 shows the apparatus for the electrolysis of sodium chloride solution.

FIGURE 5



0 5 . 3

Suggest an element that could be used to make the inert electrodes. [1 mark]

0 5 . 4

Complete the half equation for the production of chlorine (Cl_2) at the positive electrode. [2 marks]

____ Cl^- $\longrightarrow$ _____ + _____

0 5 . 5

Sodium chloride solution has a pH of 7

During the electrolysis of sodium chloride solution:

- **hydrogen gas is produced at the negative electrode**
- **the pH of the solution increases.**

Explain why. [4 marks]

[Turn over]

9

0 6

Acids react with some metals to produce soluble salts.

A student adds magnesium to hydrochloric acid until no more acid reacts and excess magnesium remains.

The equation for the reaction is:

$$Mg(s) + 2\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

0 6 . 1

Describe how solid magnesium chloride is obtained from the reaction mixture. [2 marks]

0 6 . 2

The reaction between magnesium and hydrochloric acid is a redox reaction.

Explain what happens to the magnesium atoms in this reaction. [2 marks]

[Turn over]

0 6 . 3

0.72 g of magnesium is added to 100 cm^3 of hydrochloric acid.

The hydrochloric acid is in excess.

Calculate the concentration of the magnesium chloride ($MgCl_2$) solution produced in g/dm^3.

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): $MgCl_2$ = 95

[6 marks]

Concentration = _____ g/dm^3

[Turn over]

10

0 7

This question is about structure and properties.

0 7 . 1

Which pair of substances BOTH contain atoms in hexagonal rings? [1 mark]

Tick (✓) ONE box.

- ☐ **Diamond and graphite**
- ☐ **Fullerenes and graphene**
- ☐ **Nanotubes and silica**

0 7 . 2

Explain why the structure of copper allows the conduction of thermal energy. [3 marks]

0 7 . 3

Explain why copper oxide (CuO) has a high melting point. [3 marks]

0 7 . 4

Explain why water (H_2O) has a low melting point.
[3 marks]

END OF QUESTIONS

10

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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For Examiner's Use	
Question	Mark
1	
2	
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