



Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Chemistry Paper 1H

H

8464/C/1H

Monday 22 May 2023

Morning

Time allowed: 1 hour 15 minutes

[Turn over]



J U N 2 3 8 4 6 4 C 1 F 0 1

At the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

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
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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]



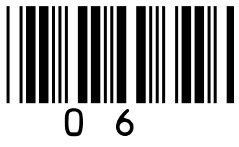


FIGURE 1, on the opposite page, shows the mass of carbon dioxide that will dissolve in 1 dm³ of water at different temperatures.

0 1 . 3

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

6

Tick (✓) ONE box.

The solubility decreases

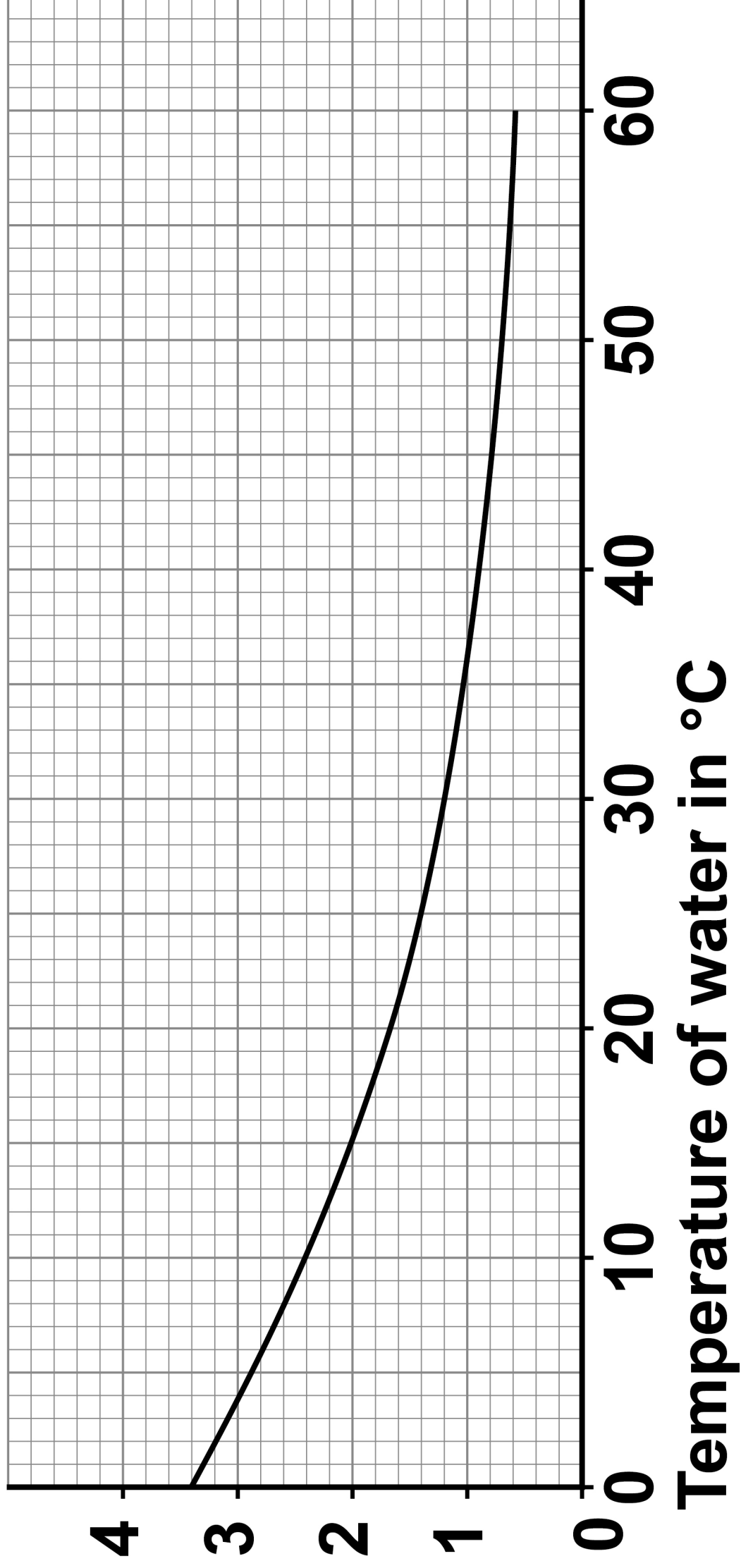
The solubility does not change

The solubility increases

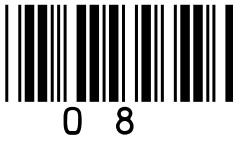


FIGURE 1

Mass of carbon dioxide in grams dissolved in 1 dm³ of water

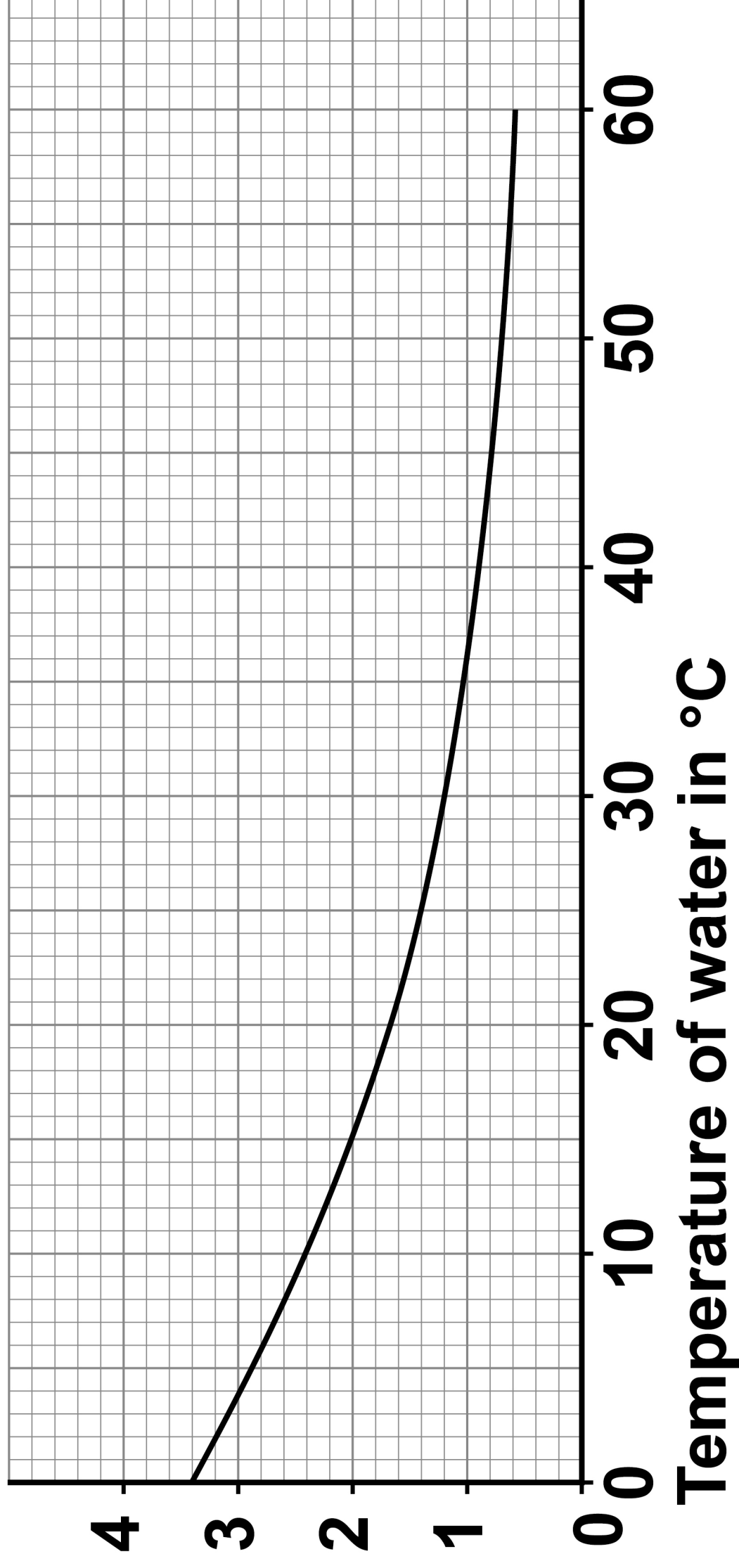


[Turn over]



REPEAT OF FIGURE 1

**Mass of
carbon dioxide
in grams dissolved
in 1 dm³ of water**





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.

9

pH of the solution decreases

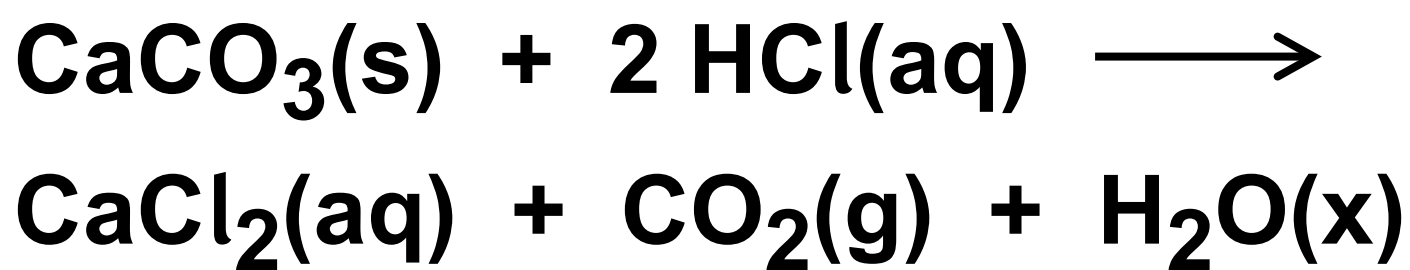
pH of the solution does not change

pH of the solution increases

[Turn over]

Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:



0	1	.	5
---	---	---	---

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

Tick (✓) ONE box.

(aq)

(g)

(l)

(s)

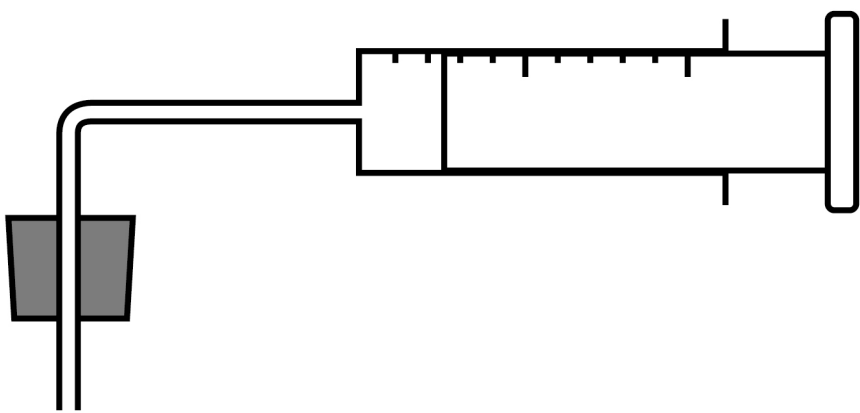
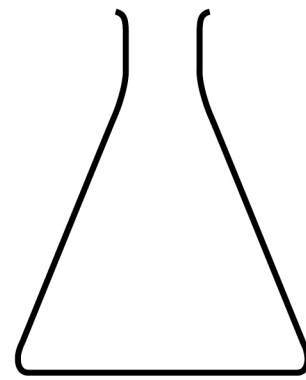
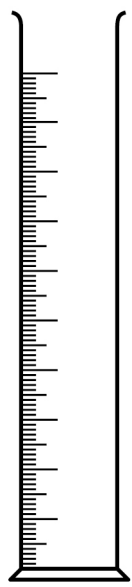
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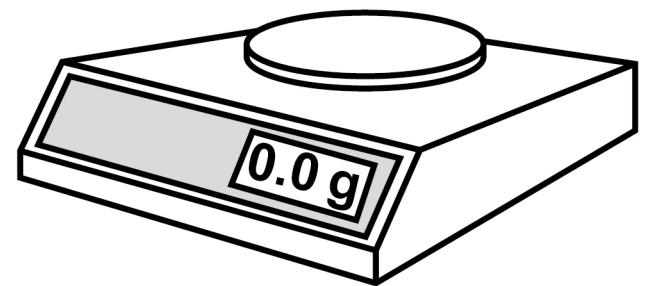
0 1 . 6

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]

[Turn over]



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:



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):

$\text{Li}_2\text{SO}_4 = 110$

**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 cm³.

Calculate the concentration of lithium sulfate in g/dm³. [3 marks]

Concentration = _____ g/dm³

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]



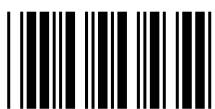
[Turn over]



03.2

Explain what happens to sodium atoms and to oxygen atoms when sodium reacts with oxygen to produce sodium oxide (Na₂O).

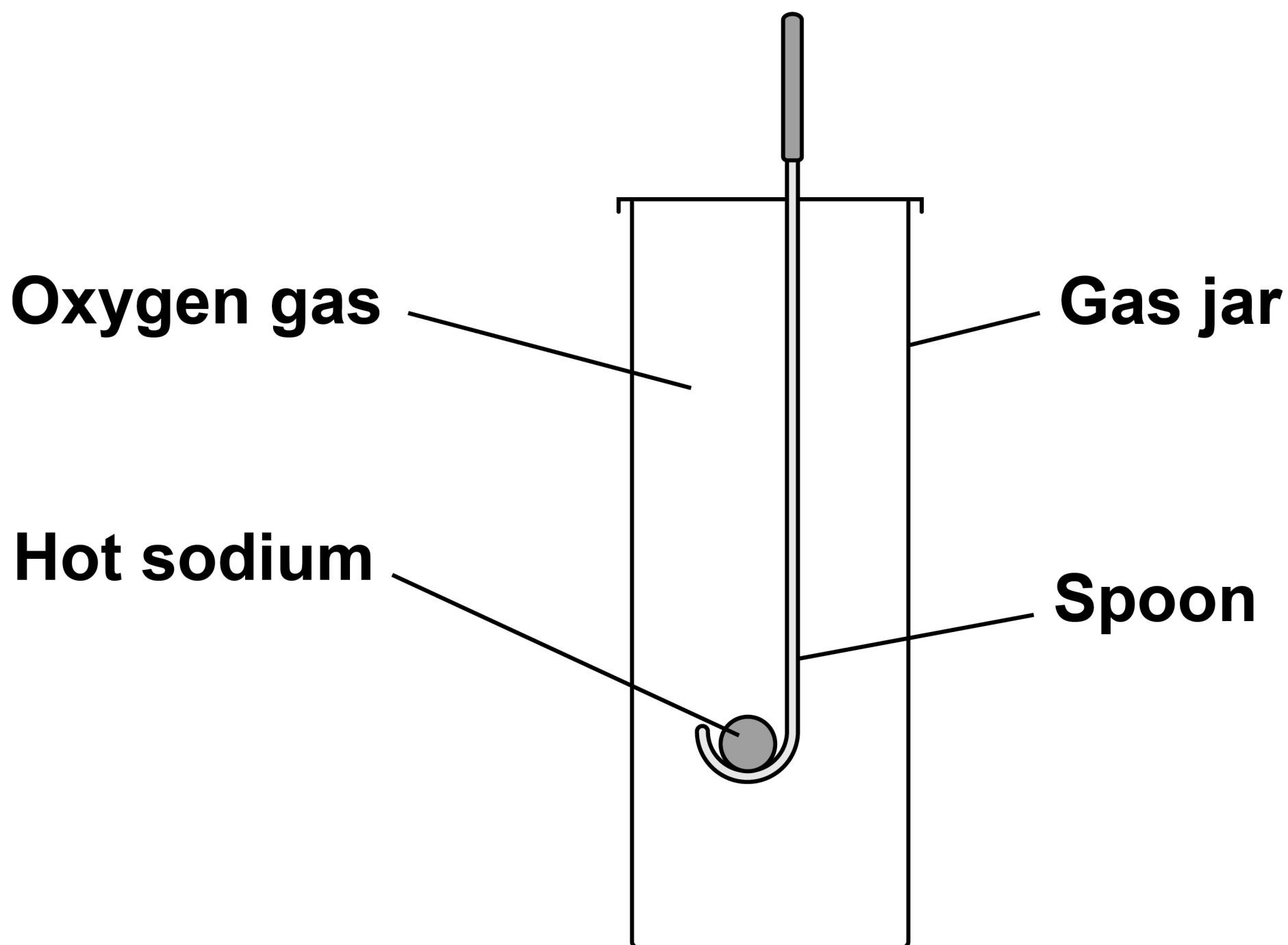
Answer in terms of electrons. [4 marks]



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[Turn over]



03.3**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 _____

[Turn over]



0	3	.	4
---	---	---	---

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

1 _____

2 _____

9



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 \longrightarrow **neutron** \longrightarrow **proton**

electron \longrightarrow **proton** \longrightarrow **neutron**

neutron \longrightarrow **proton** \longrightarrow **electron**

proton \longrightarrow **electron** \longrightarrow **neutron**

[Turn over]



04.2

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

TABLE 1

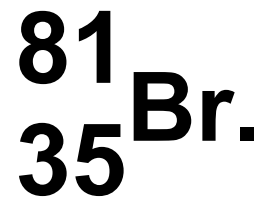
Name of particle	Mass in kg
Proton	1.673×10^{-27}
Electron	9.109×10^{-31}

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



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

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

[Turn over]



04.5

Chlorine has two isotopes.

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

TABLE 2

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

[Turn over]

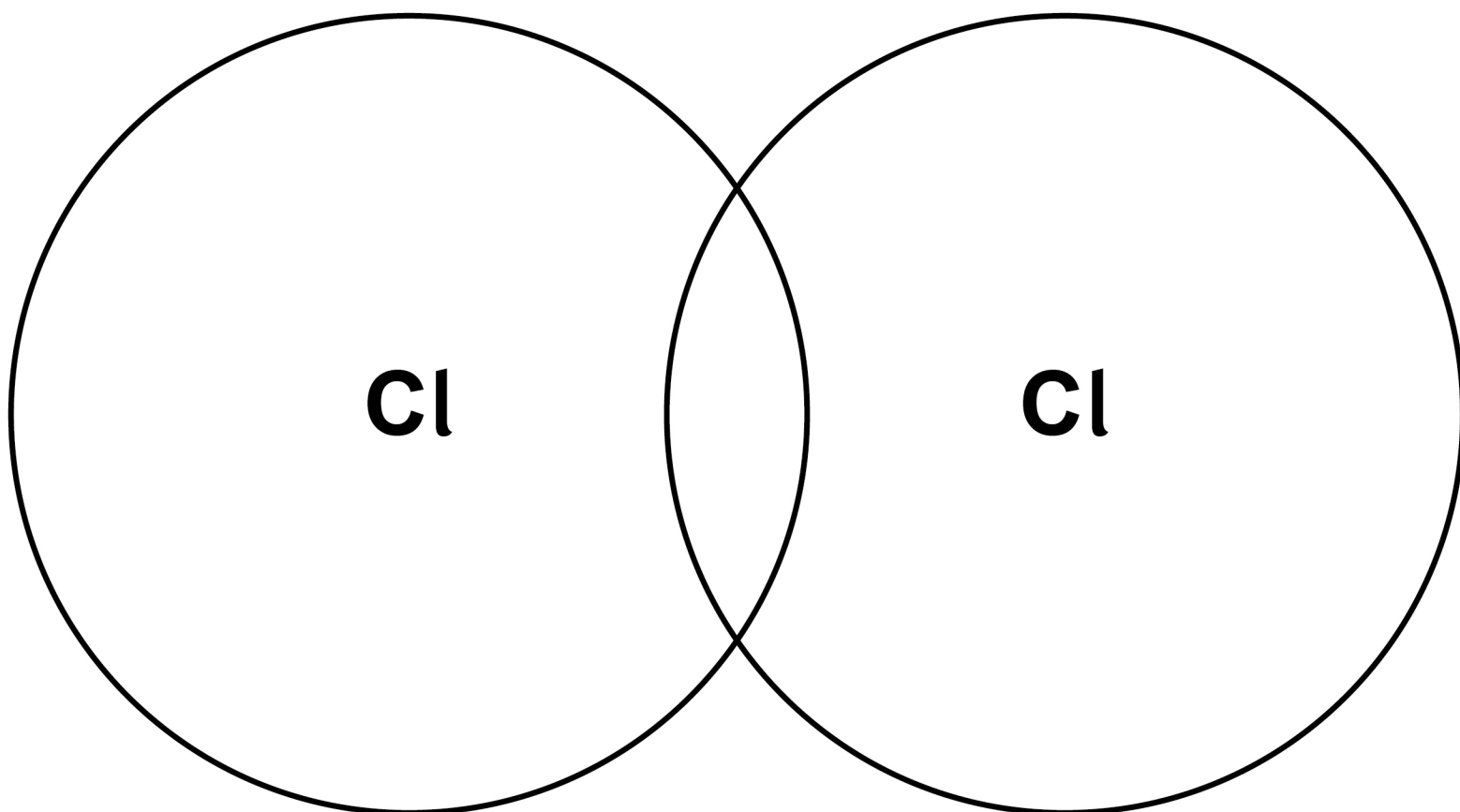


0	4	.	6
---	---	---	---

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



10



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[Turn over]



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]

05.2

Sodium chloride solution conducts electricity.

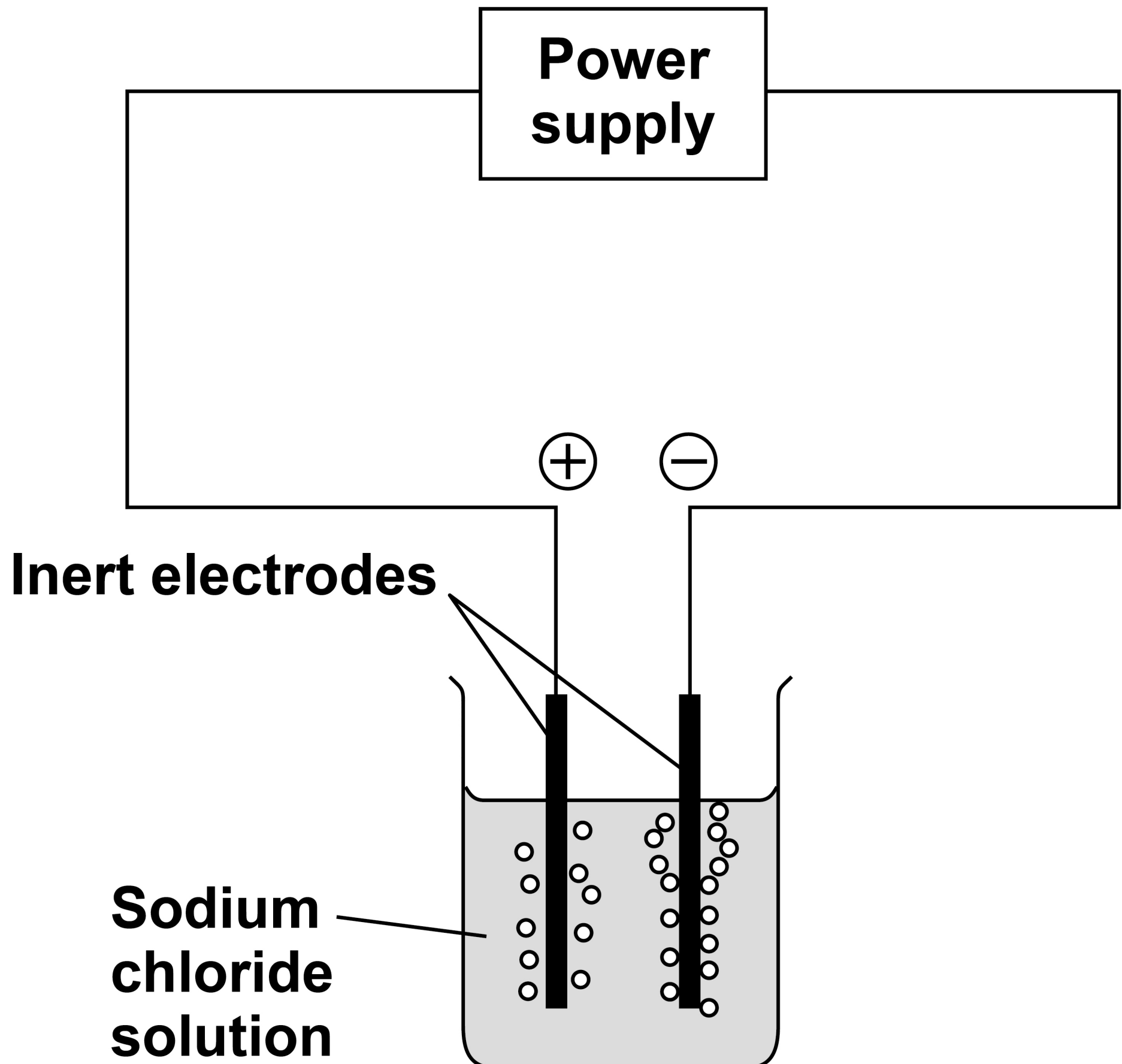
Complete the sentence. [1 mark]

Sodium chloride ALSO conducts electricity when _____.

[Turn over]

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 (Cl₂) at the positive electrode. [2 marks]



[Turn over]



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

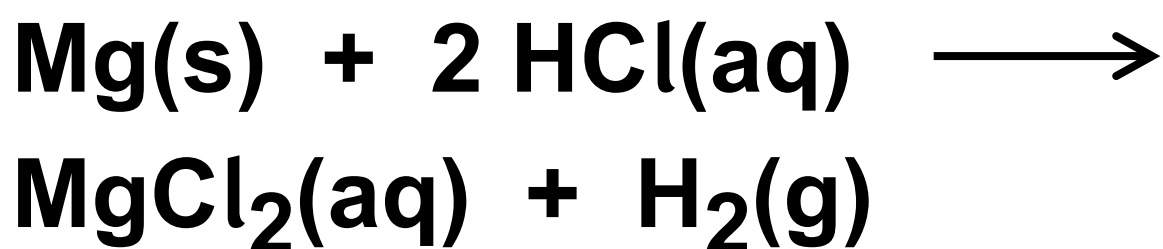


0	6
---	---

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:



0	6	.	1
---	---	---	---

Describe how solid magnesium chloride is obtained from the reaction mixture.

[2 marks]



06.2

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 cm³ of hydrochloric acid.

The hydrochloric acid is in excess.

Calculate the concentration of the magnesium chloride (MgCl₂) solution produced in g/dm³.

Relative atomic mass (A_r): Mg = 24

Relative formula mass (M_r): MgCl₂ = 95

[6 marks]



Concentration = _____ g/dm³

[Turn over]

<hr/>
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



07.2

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

[Turn over]



0	7	.	3
---	---	---	---

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



07.4

Explain why water (H₂O) has a low melting point. [3 marks]

END OF QUESTIONS

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10



Additional page, if required.

Write the question numbers in the left-hand margin.

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Additional page, if required.

Write the question numbers in the left-hand margin.



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Question	Mark
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