AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

# GCSE
# COMBINED SCIENCE: TRILOGY

**H**

## Higher Tier
## Chemistry Paper 1H

Monday 22 May 2023 Morning Time allowed: 1 hour 15 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.
- 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.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| **TOTAL** | |

**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.

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**ANSWER IN THE SPACES PROVIDED**

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**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 _____

_____

**Question 1 continues on the next page**

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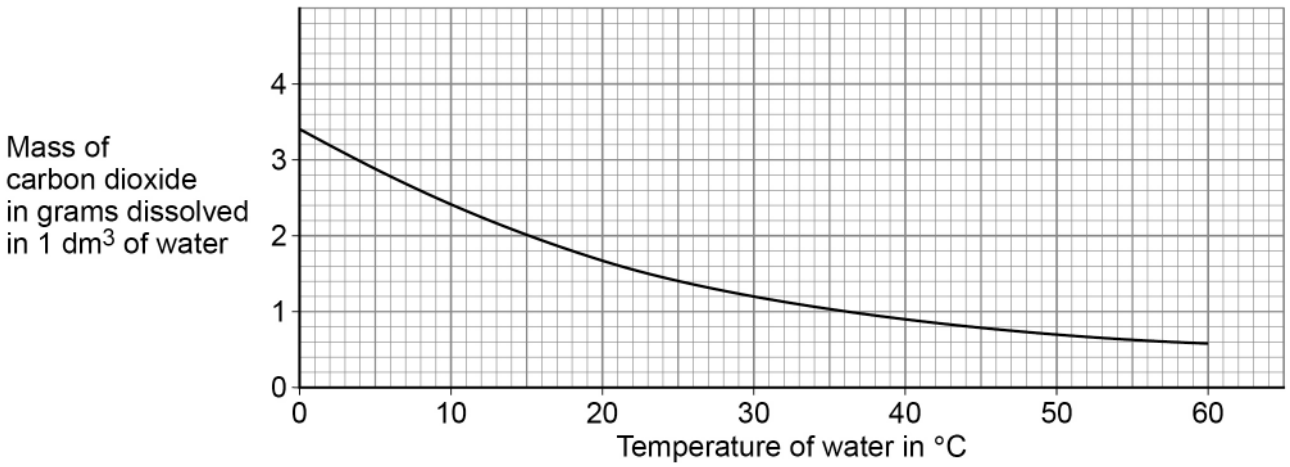
**Figure 1** shows the mass of carbon dioxide that will dissolve in 1 $dm^3$ of water at different temperatures.

**Figure 1**




**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 ☐

*Do not write outside the box*

**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 ☐

Calcium carbonate reacts with hydrochloric acid to produce carbon dioxide.

The equation for the reaction is:

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

**0 1 . 5** What is the state symbol (**x**) in the equation?

**[1 mark]**

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

**Question 1 continues on the next page**

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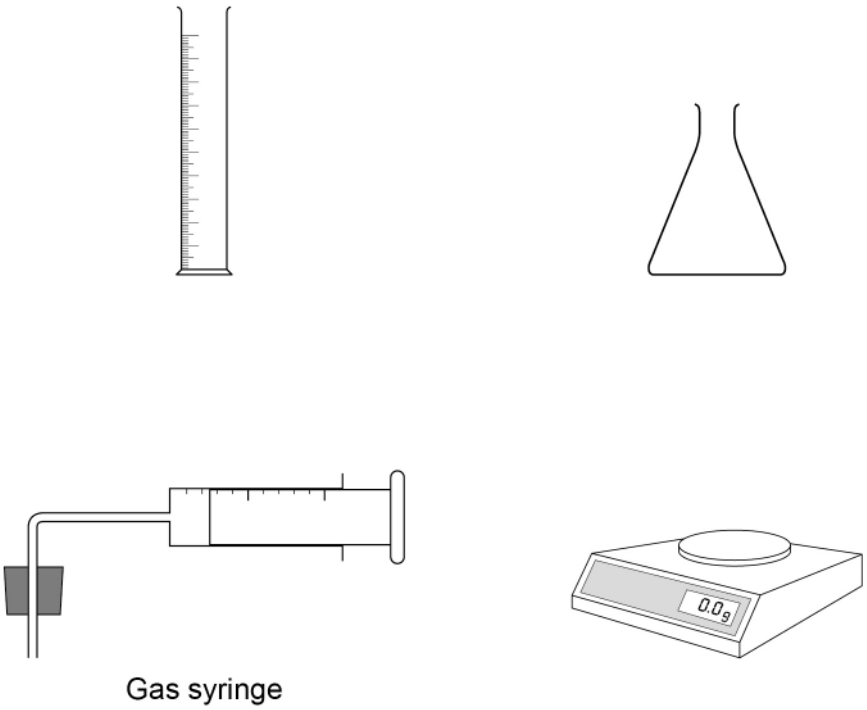
**0 1 . 6** **Figure 2** shows equipment a student used for an investigation.

**Figure 2**




Gas syringe

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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

**Turn over for the next question**

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**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 ($M_r$) = _____

*Do not write outside the box*

**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) = _____ %

**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**

**Turn over ►**

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**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]**

$$\_\_\_\ Na + O_2 \rightarrow \_\_\_\ Na_2O$$

**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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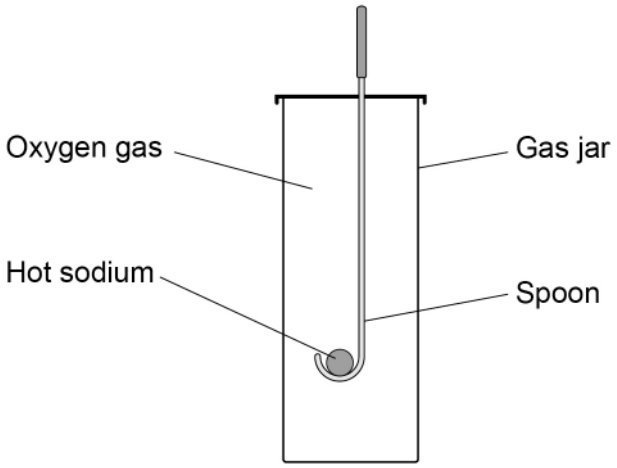
**0 3 . 3** Sodium burns in a gas jar of oxygen.

**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**

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**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 ☐

**0 4 . 2** **Table 1** shows the mass of a proton and of an electron.

**Table 1**

| Name of particle | Mass in kg |
|---|---|
| Proton | $1.673 \times 10^{-27}$ |
| Electron | $9.109 \times 10^{-31}$ |

Calculate how many times heavier a proton is than an electron.

**[2 marks]**

Times heavier a proton is than an electron = _____

*Do not write outside the box*

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]**

_____

**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) = _____

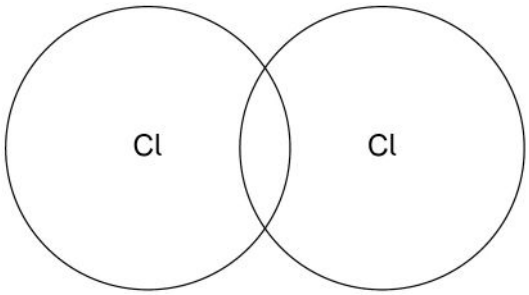
*Do not write outside the box*

**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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**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 _____ .

**Question 5 continues on the next page**

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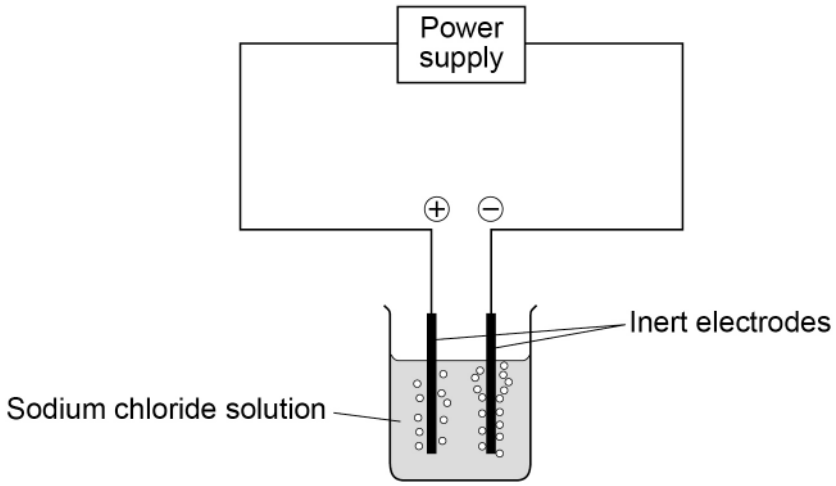
**Figure 5** shows the apparatus for the electrolysis of sodium chloride solution.

**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]**

$$\_\_\_\_\ Cl^- \rightarrow \_\_\_\_\_ + \_\_\_\_\_$$

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**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]**

9

**Turn over for the next question**

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**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:

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

**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]**

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**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 = _____ $g/dm^3$

**10**

**Turn over for the next question**

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**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]**

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**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]**

10

**END OF QUESTIONS**

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