



Please write clearly in block capitals.

Centre number

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Candidate number

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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.

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.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	



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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
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Which ion makes the solution acidic?

[1 mark]

0	1	.	2
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Name an indicator that could be used to test if the solution is acidic.

Give the result of the test.

[2 marks]

Indicator _____

Result _____

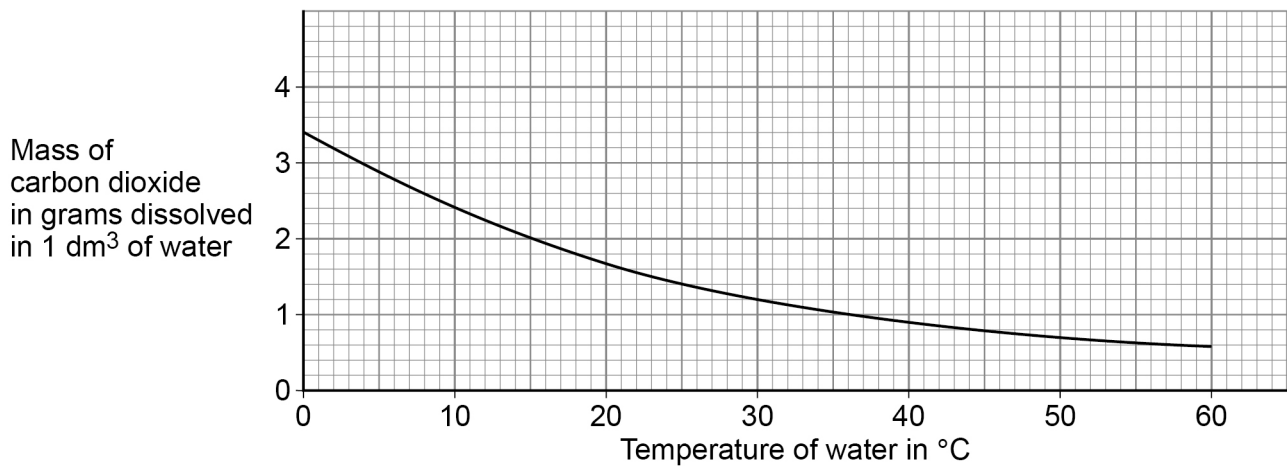
Question 1 continues on the next page

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Figure 1 shows the mass of carbon dioxide that will dissolve in 1 dm³ 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



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.

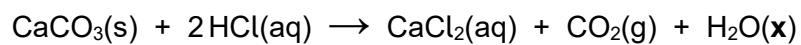
pH of the solution decreases

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:



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

[1 mark]

Tick (✓) **one** box.

(aq)

(g)

(l)

(s)

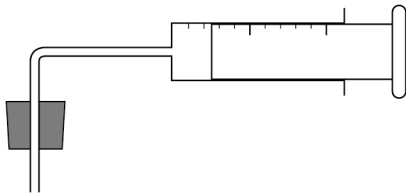
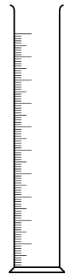
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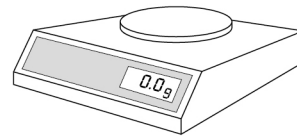


0 1 . 6 Figure 2 shows equipment a student used for an investigation.

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]

12

Turn over for the next question

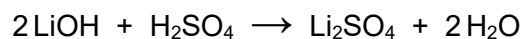
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0 2

Lithium hydroxide reacts with sulfuric acid to produce lithium sulfate.

The equation for the reaction is:

**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) = _____



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) = _____ %

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

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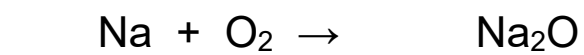
0 3

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]**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.

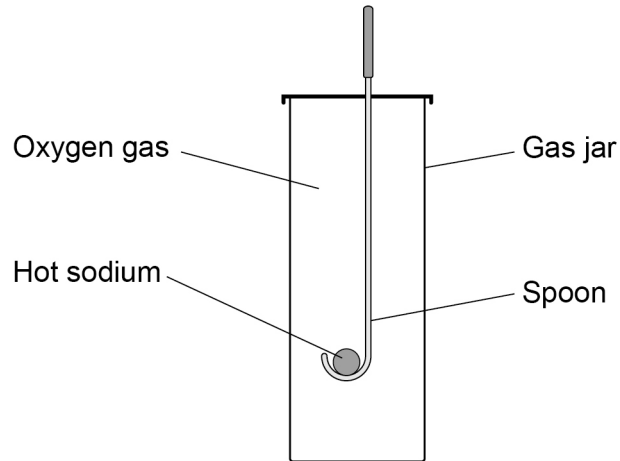
[4 marks]



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 _____



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	1.673×10^{-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 ${}_{35}^{81}\text{Br}$.

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
${}_{17}^{35}\text{Cl}$	75.77
${}_{17}^{37}\text{Cl}$	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 ►



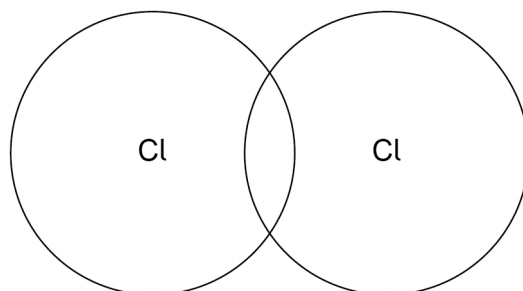
0 4 . 6

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



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]

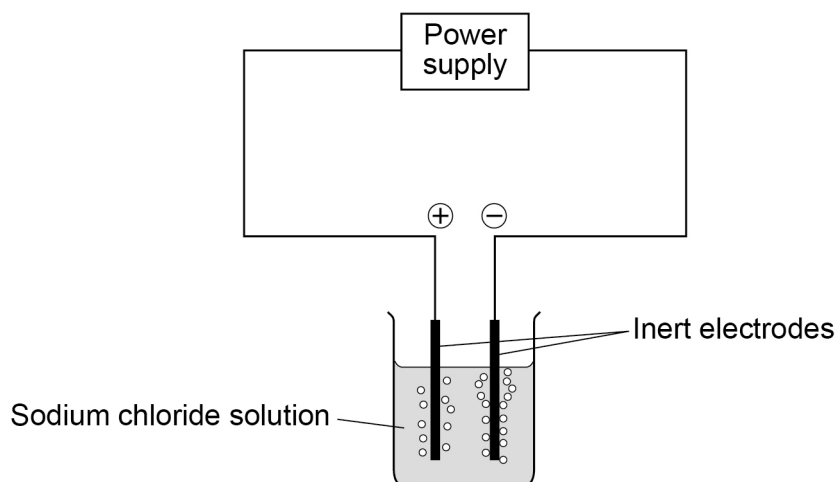
Sodium chloride **also** conducts electricity when _____ .

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]



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]

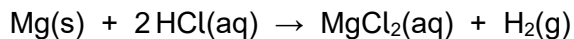
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0 6

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:

**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]



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

10

Turn over for the next question

Turn over ►



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 (H₂O) has a low melting point.**[3 marks]**

10**END OF QUESTIONS**

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