



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier

Chemistry Paper 2H

8464/C/2H

Wednesday 12 June 2019 Morning

Time allowed: 1 hour 15 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.**
- **Answer ALL questions in the spaces provided.**
- **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
---	---

Water that is safe to drink contains dissolved substances.

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

What do we call water that is safe to drink? [1 mark]

Tick (✓) ONE box.

Desalinated

Filtered

Fresh

Potable

01.2

Describe a test for pure water.

Give the result of the test if the water is pure. [2 marks]

Test _____

Result _____

[Turn over]

[Turn over]

01.4

**A sample of river water contains
125 mg per dm^3 of dissolved solids.**

**Calculate the mass of dissolved solids in
grams in 250 cm^3 of this sample of river
water.**

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



Mass of dissolved solids = _____ g

[Turn over]

01.5

A water company allows a maximum of 500 mg per dm³ of sulfate ions in drinking water.

A sample of drinking water contains 44 mg per dm³ of sulfate ions.

Calculate the percentage (%) of the maximum allowed mass of sulfate ions in the sample of drinking water. [2 marks]

Percentage (%) of the maximum allowed

mass = _____ %

[Turn over]

13



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02

This question is about atmospheric pollutants from fuels.

02.1

Fuel burns in a car engine.

Describe how oxides of nitrogen are produced in a car engine. [2 marks]

[Turn over]

TABLE 1

Car	Mass of CO₂ produced during manufacture in kg	Mass of CO₂ produced when driving in kg per km	Total mass of CO₂ produced from manufacture and 40 000 km driving in kg	Total mass of CO₂ produced from manufacture and 100 000 km driving in kg
Car A	14 000	0.123	18 920	26 300
Car B	20 000	0.085	23 400	28 500
Car C	23 000	0.044	24 760	27 400



02.2

TABLE 1, on page 14, shows the carbon footprint during the manufacture and use of three cars.

Evaluate the carbon footprint of the cars.

Use information from TABLE 1. [6 marks]

15

[Turn over]



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[Turn over]

8



03

This question is about chromatography of food colouring.

03.1

Food colouring is a formulation.

What is a formulation? [1 mark]

03.2

Explain how paper chromatography separates the dyes in a food colouring.

Do NOT give details of how to do the experiment. [2 marks]

[Turn over]

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

**Explain how the student could tell from the chromatogram that the food colouring contained more than one dye.
[2 marks]**

0 3 . 4

Explain how the student could use chromatography to identify unknown dyes in the food colouring. [3 marks]

[Turn over]

8

04

This question is about copper and fuels.

04.1

Copper is extracted from low-grade ores by phytomining.

Describe how copper metal is produced by phytomining. [4 marks]

[Turn over]

04.2

Another method of extracting copper from low-grade ores is bioleaching.

A solution of copper sulfate (CuSO_4) produced by bioleaching has a concentration of 0.319 g/dm^3

Relative atomic masses (A_r):

$\text{Cu} = 63.5$ $\text{O} = 16$ $\text{S} = 32$

Calculate the number of moles of copper that can be produced from 1 dm^3 of this solution. [3 marks]

Number of moles of copper =

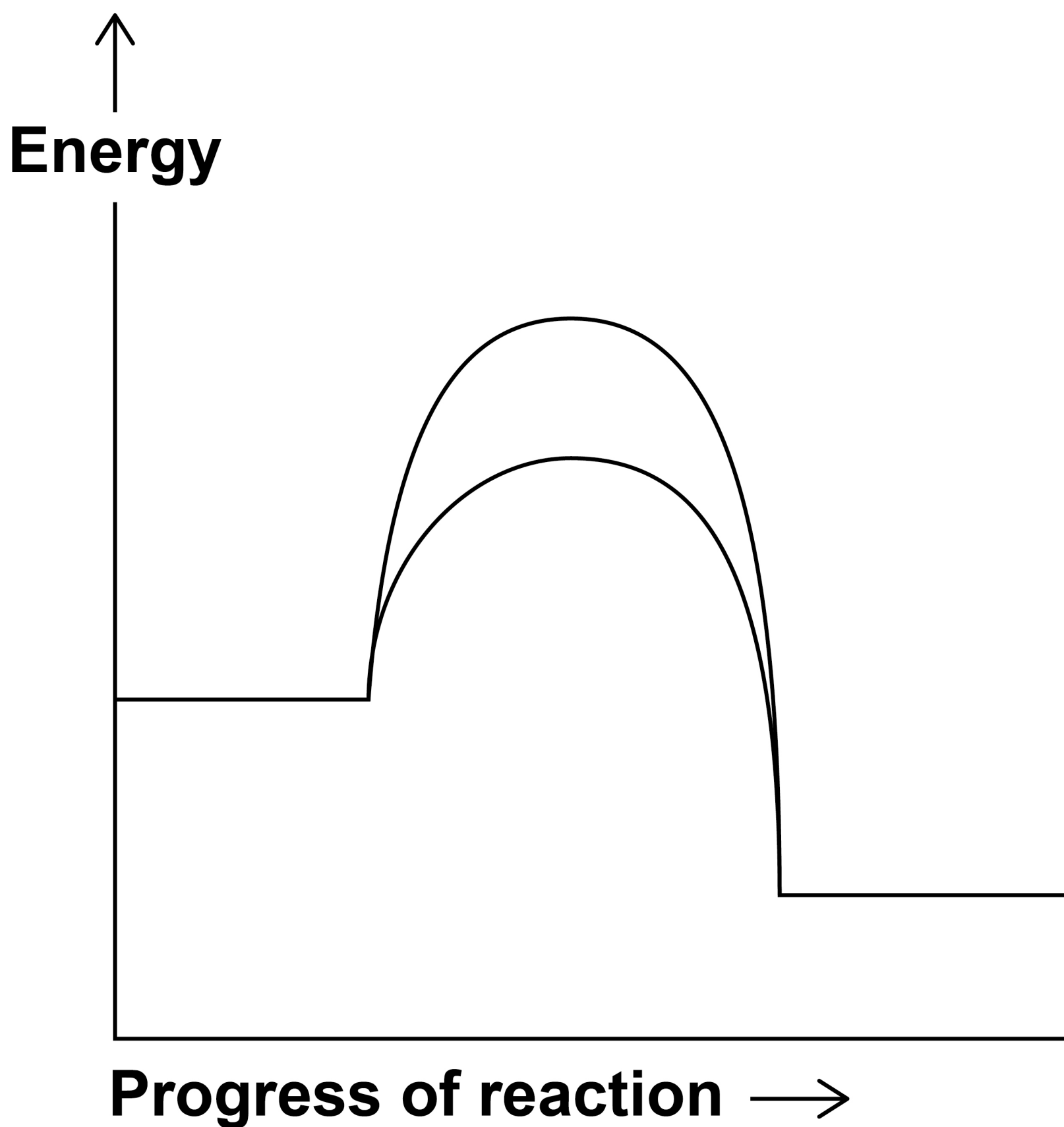
_____ mol

[Turn over]

Copper is used as a catalyst.

FIGURE 1 shows reaction profiles for a reaction with and without a catalyst.

FIGURE 1



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

**How do the reaction profiles show that using a catalyst does NOT affect the overall energy change for the reaction?
[1 mark]**

Tick (✓) ONE box.

- Both reaction profiles show exothermic reactions.**
- Both reaction profiles start at the same energy level and end at the same energy level.**
- Both reaction profiles show the activation energy.**
- The activation energy for the uncatalysed reaction is much lower than for the catalysed reaction.**

[Turn over]



04.4

Copper is a catalyst in a reaction to produce ethanol from carbon dioxide.

Ethanol (C₂H₅OH) is used as a fuel.

Suggest why producing ethanol from carbon dioxide is sustainable. [2 marks]

04.5

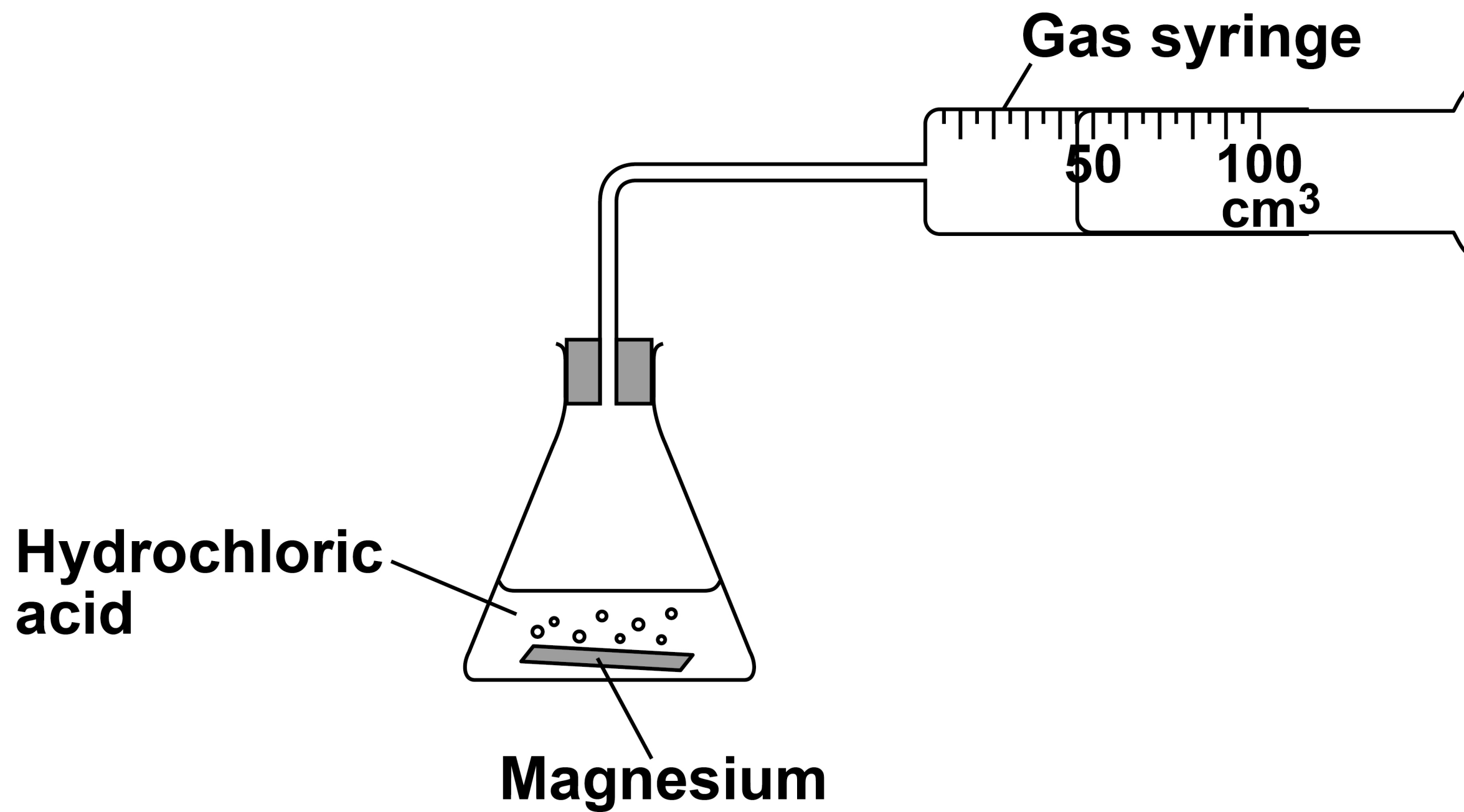
Chemistry plays an important role in sustainable development.

**What is sustainable development?
[2 marks]**

[Turn over]

12

FIGURE 2



0 5

This question is about magnesium.

A student investigated the rate of the reaction between magnesium and hydrochloric acid.

FIGURE 2, on page 32, shows the apparatus.

33

[Turn over]



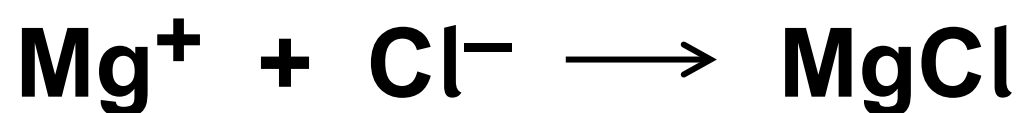
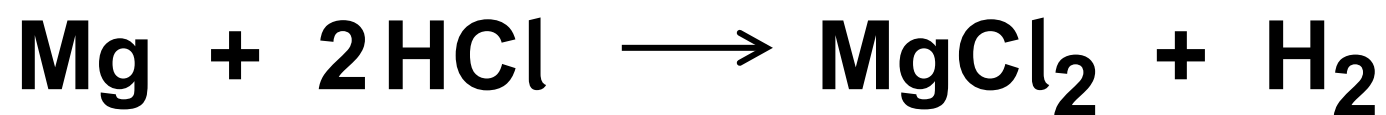
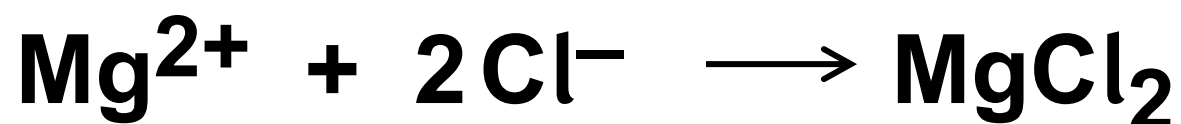
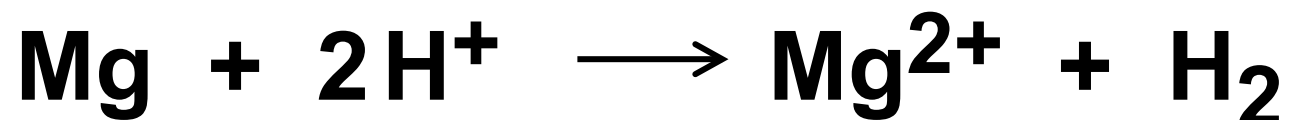
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0	5	.	1
---	---	---	---

Which is the correct ionic equation for the reaction? [1 mark]

Tick (✓) ONE box.



[Turn over]

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0	5	.	2
---	---	---	---

**What happens in the reaction between magnesium and hydrochloric acid?
[1 mark]**

Tick (✓) ONE box.

Electron sharing

Electron transfer

Proton transfer

[Turn over]

0 5 . 3

TABLE 2 shows the student's results.

TABLE 2

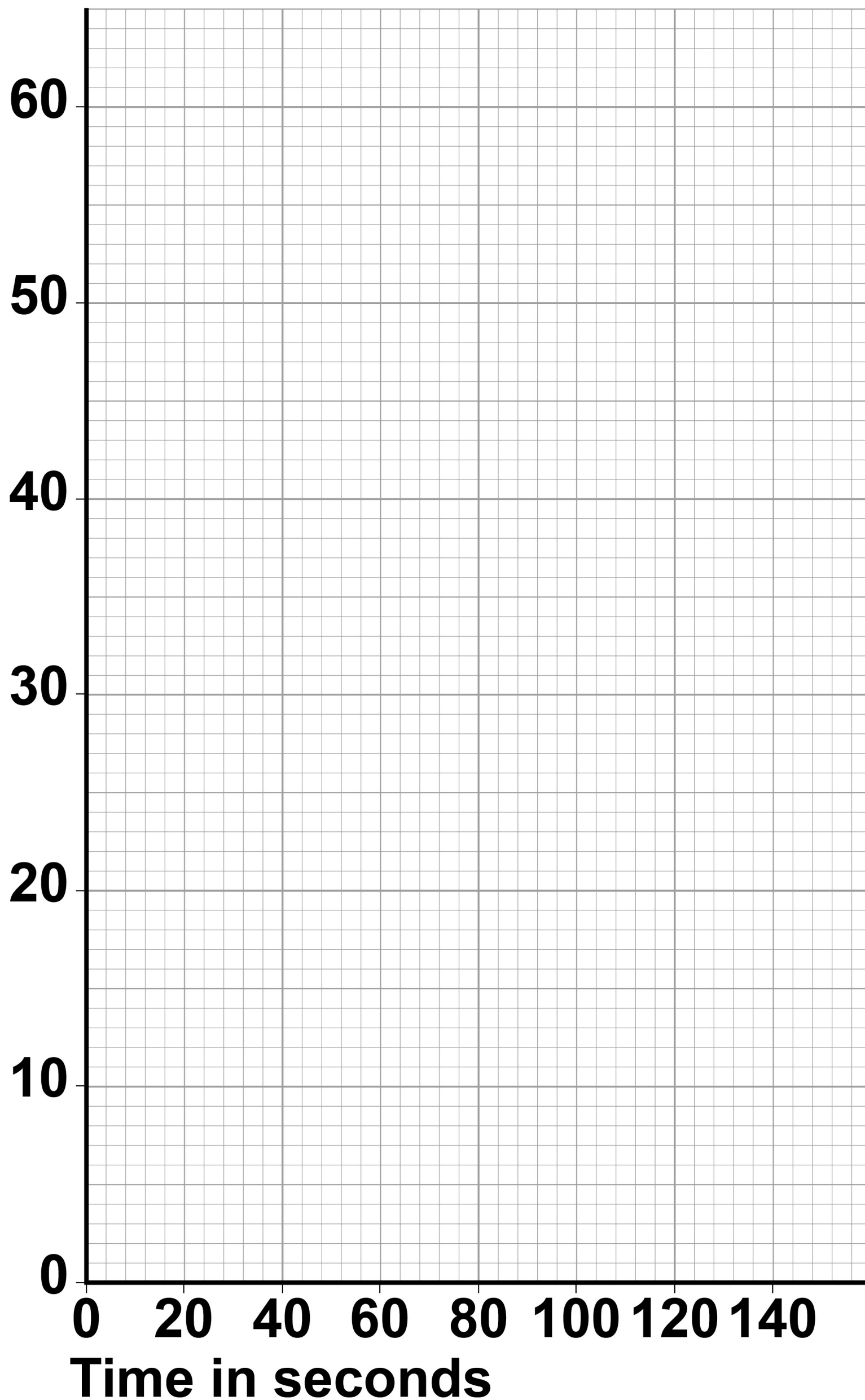
Time in seconds	0	10	35	50	95	120	140
Volume of gas in cm³	0.0	12.5	36.0	43.5	59.0	60.0	60.0

Plot the data from TABLE 2 on FIGURE 3, on the opposite page.

Draw a line of best fit. [3 marks]

FIGURE 3

Volume of gas in cm³



[Turn over]



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0	5	.	4
---	---	---	---

Describe the changes in the rate of this reaction. [3 marks]

[Turn over]



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0 5 . 5

Explain why the rate of this reaction changes.

Give your answer in terms of collision theory. [3 marks]

[Turn over]

11

0	6
---	---

This question is about oxygen (O_2) and sulfur dioxide (SO_2).

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

**Give the test and result for oxygen gas.
[2 marks]**

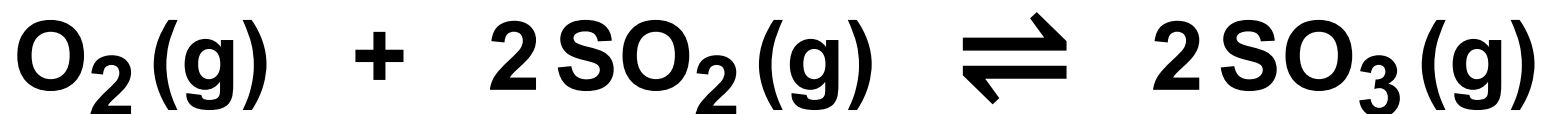
Test _____

Result _____



0	6	.	2
---	---	---	---

The reaction between oxygen and sulfur dioxide is at equilibrium.



Some of the sulfur trioxide (SO_3) is removed.

Explain what happens to the position of the equilibrium. [2 marks]

[Turn over]



06.3

Sulfur dioxide is an atmospheric pollutant.

Sulfur dioxide pollution is reduced by reacting calcium oxide with sulfur dioxide to produce calcium sulfite.



7.00 g of calcium oxide reacts with an excess of sulfur dioxide.

Relative atomic masses (A_r):

O = 16 S = 32 Ca = 40

Calculate the mass of calcium sulfite produced. [4 marks]

Mass of calcium sulfite produced =
_____ g

[Turn over]

0	7
---	---

This question is about hydrocarbons and crude oil.

0	7	.	1
---	---	---	---

Hydrocarbon fuels are produced from crude oil.

Describe how crude oil is separated into fractions. [4 marks]

[Turn over]

Butane is a hydrocarbon.

07.2

Two equations for the combustion of butane are:

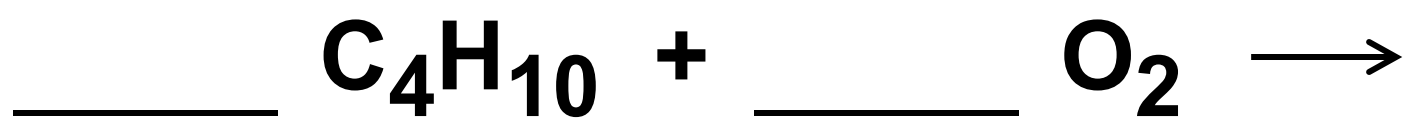
- $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \longrightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$
- $2\text{C}_4\text{H}_{10} + 5\text{O}_2 \longrightarrow 8\text{C} + 10\text{H}_2\text{O}$

Why are different products formed?
[1 mark]

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

One other product of the combustion of butane is carbon monoxide.

Balance the equation. [1 mark]



[Turn over]

07.4

Carbon dioxide is a greenhouse gas.

**Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter.
[4 marks]**

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

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