AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 2H

Wednesday 12 June 2019 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.
- Fill in the boxes at the top of this page.
- 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.

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.

Do not write outside the box

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 ☑

0 1 . 2 Describe a test for pure water.

Give the result of the test if the water is pure.

[2 marks]

Test: boil (water)

Result: (boils) at 100°C

Do not write outside the box

0 1 . 3 Describe a method to determine the mass of dissolved solids in a 100 cm^3 sample of river water.

[4 marks]

Indicative content

• weigh container.

• measure volume (100 cm3) of water into container.

• evaporate / heat until dry.

• weigh container and remaining solids.

• determine mass of dissolved solids

0 1 . 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]

(conversion of cm3 to dm3)

(250 cm3 =) $\frac{250}{1000}$ or 0.25 (dm3)

(conversion of mg to g)

(125 mg =) $\frac{125}{1000}$ or 0.125 (g)

(0.25 × 0.125) = 0.03125

Mass of dissolved solids = 0.031 g

Turn over ►

Do not write outside the box

0 1 . 5 A water company allows a maximum of 500 mg per dm^3 of sulfate ions in drinking water.

A sample of drinking water contains 44 mg per dm^3 of sulfate ions.

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

[2 marks]

$\frac{44}{500} \times 100$

Percentage (%) of the maximum allowed mass = 8.8 %

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0 2 This question is about atmospheric pollutants from fuels.

0 2 . 1 Fuel burns in a car engine.

Describe how oxides of nitrogen are produced in a car engine.

[2 marks]

high temperatures (in the engine)

enable oxygen and nitrogen (from air) to react

Question 2 continues on the next page

Turn over ►

Do not write outside the box

0 2 . 2 **Table 1** shows the carbon footprint during the manufacture and use of three cars.

Table 1

Car	Mass of CO_2 produced during manufacture in kg	Mass of CO_2 produced when driving in kg per km	Total mass of CO_2 produced from manufacture and 40 000 km driving in kg	Total mass of CO_2 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

Evaluate the carbon footprint of the cars.

Use information from **Table 1**.

[6 marks]

Indicative content

Examples of relevant points might include:
• car C produces the most CO2 during manufacture
• car A produces the most CO2 per km when driving
• car C produces the most CO2 from manufacture and 40,000km when driving
• car B produces the most CO2 from manufacture and 100,000km when driving

Examples of linked statements might include:
• car A produces least CO2 during manufacture, but most CO2 per km
• car C produces most CO2 during manufacture, but least CO2 per km
• car A produces least CO2 during manufacture, but car C produces the least CO2 per km

Examples of judgements might include:
• overall car A has the smallest carbon footprint as it has the smallest CO2 production during manufacture, the smallest mass of CO2 after 40,000km of driving and the smallest mass of CO2 produced after 100,000km of driving.
• car A eventually (after 157,895km) will have the largest carbon footprint because the mass of carbon dioxide produced per km is highest.

8

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0 3 This question is about chromatography of food colouring.

0 3 . 1 Food colouring is a formulation.

What is a formulation?

[1 mark]

a mixture designed as a useful product

0 3 . 2 Explain how paper chromatography separates the dyes in a food colouring.

Do **not** give details of how to do the experiment.

[2 marks]

dyes distributed differently between the stationary and mobile phase

(so dyes) move up the paper at different speeds / rates

0 3 . 3 Explain how the student could tell from the chromatogram that the food colouring contained more than one dye.

[2 marks]

(because chromatogram has) different dots / colours

in a (vertical) column

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 Explain how the student could use chromatography to identify unknown dyes in the food colouring.

[3 marks]

run known dyes and food colouring (as a chromatogram)

compare distances moved or compare Rf values

(so) can identify those that move the same distance as known dyes

8

Do not write outside the box

0 4 This question is about copper and fuels.

0 4 . 1 Copper is extracted from low-grade ores by phytomining.

Describe how copper metal is produced by phytomining.

[4 marks]

growing plants (on low-grade ore)

plants are burnt (to produce ash)

(ash dissolved in acid to produce) solution of a copper compound

electrolysis (of solution of a copper compound)

0 4 . 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): Cu = 63.5 O = 16 S = 32

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

[3 marks]

Mr CuSO4 = 159.5

$$\frac{0.319}{159.5}$$

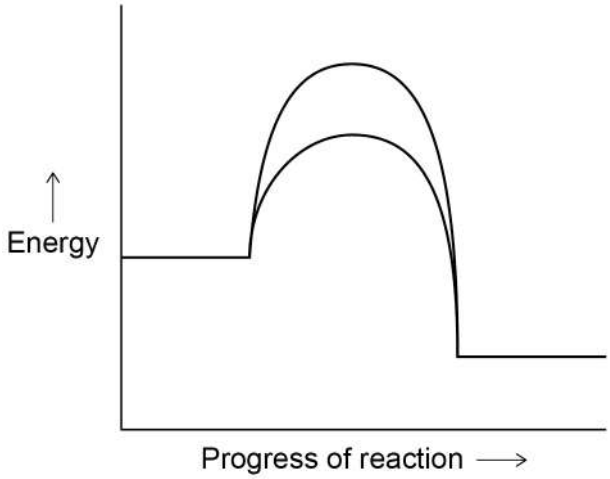
Number of moles of copper = 0.002 mol

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. ☐

Do not write outside the box

0 4 . 4 Copper is a catalyst in a reaction to produce ethanol from carbon dioxide.

Ethanol (C_2H_5OH) is used as a fuel.

Suggest why producing ethanol from carbon dioxide is sustainable.

[2 marks]

the amount of carbon dioxide used to produce the ethanol

is the same as the amount of carbon dioxide given off when the ethanol is burned

0 4 . 5 Chemistry plays an important role in sustainable development.

What is sustainable development?

[2 marks]

meets needs of current generation

without compromising needs of future generations

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Turn over for the next question

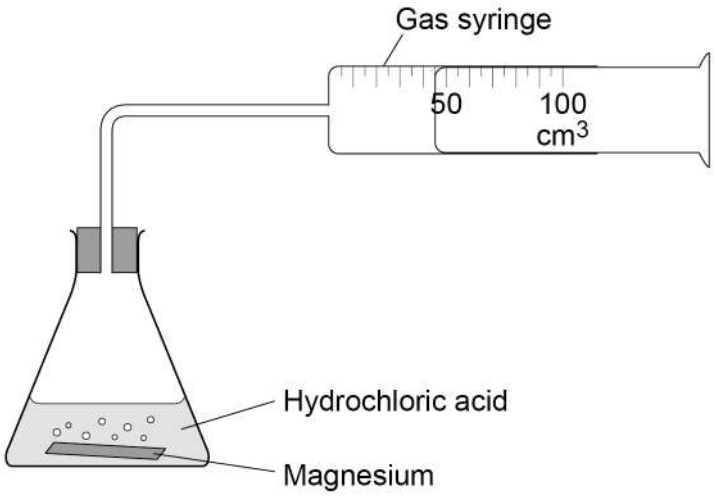
Do not write outside the box

0 5 This question is about magnesium.

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

Figure 2 shows the apparatus.

Figure 2



0 5 . 1 Which is the correct ionic equation for the reaction?

[1 mark]

Tick (✓) **one** box.

$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ ☑

$Mg^{2+} + 2Cl^- \rightarrow MgCl_2$ ☐

$Mg + 2HCl \rightarrow MgCl_2 + H_2$ ☐

$Mg^+ + Cl^- \rightarrow MgCl$ ☐

Do not write outside the box

0 5 . 2 What happens in the reaction between magnesium and hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Electron sharing ☐

Electron transfer ☑

Proton transfer ☐

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 **Table 2** shows the student's results.

Table 2

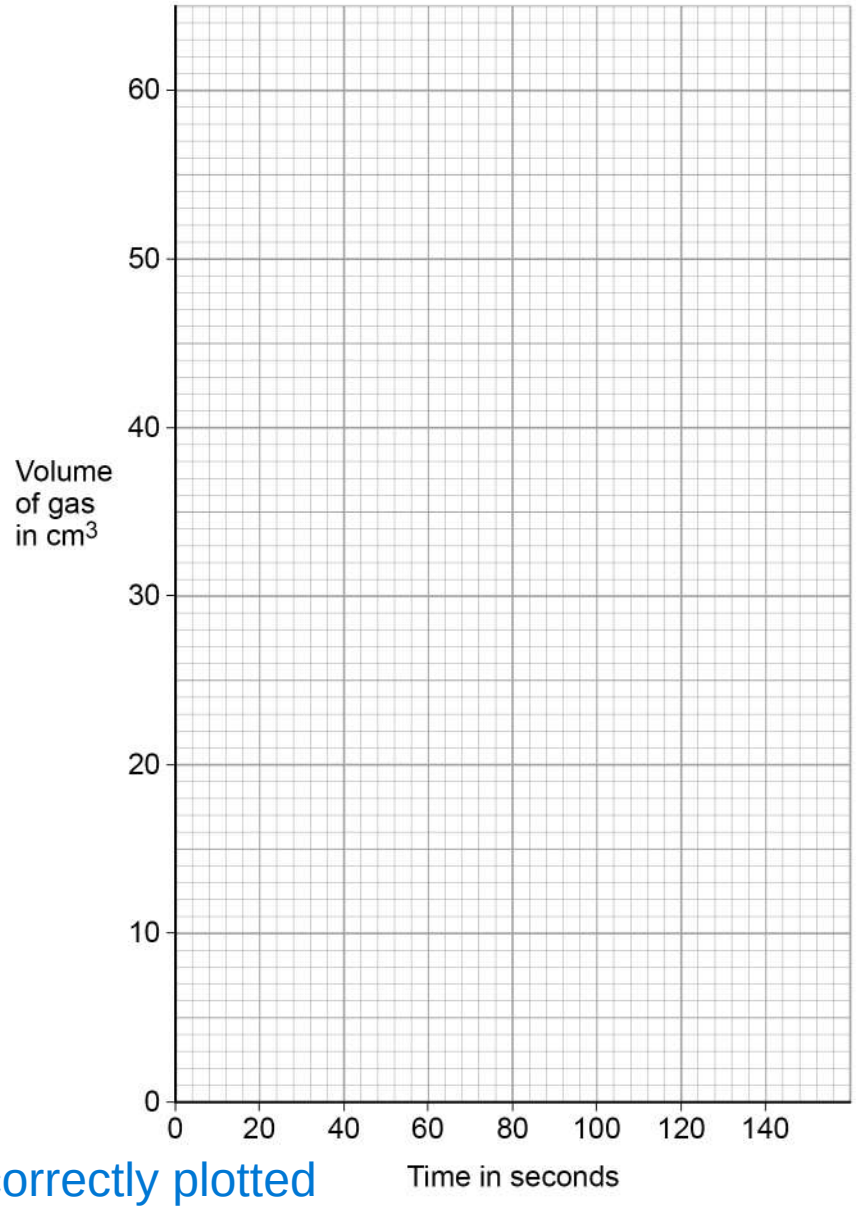
Time in seconds	0	10	35	50	95	120	140
Volume of gas in cm^3	0.0	12.5	36.0	43.5	59.0	60.0	60.0

Plot the data from **Table 2** on **Figure 3**.

Draw a line of best fit.

[3 marks]

Figure 3



all points correctly plotted
line of best fit

Do not write outside the box

0 5 . 4 Describe the changes in the rate of this reaction.

[3 marks]

(rate) decreases

(rate decrease) more slowly as time increases (in rate)

(rate) becomes zero at time read from graph

0 5 . 5 Explain why the rate of this reaction changes.

Give your answer in terms of collision theory.

[3 marks]

(rate decreases because) fewer particles (of acid / magnesium) as reaction progresses

(so) less frequent collisions

reaction stops due to limiting factor / reagent

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Turn over for the next question

Do not write outside the box

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 glowing splint

Result relights

0 6 . 2 The reaction between oxygen and sulfur dioxide is at equilibrium.

$$O_2(g) + 2SO_2(g) \rightleftharpoons 2SO_3(g)$$

Some of the sulfur trioxide (SO_3) is removed.

Explain what happens to the position of the equilibrium.

[2 marks]

equilibrium shifts to right-hand side

(because) concentration of SO3 decreases

Do not write outside the box

0 6 . 3 Sulfur dioxide is an atmospheric pollutant.

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

$$CaO + SO_2 \rightarrow CaSO_3$$

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]

(Mr CaO =) 56

(Mr CaSO3 =) 120

$$\frac{7}{56} \times 120$$

= 15(.0 g)

Mass of calcium sulfite produced = 15 g

8

Turn over for the next question

Do not write outside the box

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]

heat or vaporise (oil)

temperature gradient in column

(vapour) condenses (into fractions)

depending on boiling point of fraction

Butane is a hydrocarbon.

0 7 . 2 Two equations for the combustion of butane are:

- $2\,C_4H_{10} + 13\,O_2 \rightarrow 8\,CO_2 + 10\,H_2O$
- $2\,C_4H_{10} + 5\,O_2 \rightarrow 8\,C + 10\,H_2O$

Why are different products formed?

[1 mark]

different amounts of oxygen available

0 7 . 3 One other product of the combustion of butane is carbon monoxide.

Balance the equation.

[1 mark]

2 C_4H_{10} + 9 O_2 → 8 CO + 10 H_2O

Do not write outside the box

0 7 . 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]

short wavelength radiation which enters the atmosphere

is absorbed by materials and re-emitted

as a longer wavelength radiation

(the longer wavelength radiation is trapped by) a

greenhouse gas / carbon dioxide / methane which stops radiation

escaping (from the atmosphere)

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END OF QUESTIONS

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