

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 2H

Tuesday 13 June 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	
TOTAL	



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

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



0 1

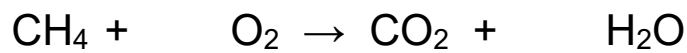
The combustion of fuels is a source of atmospheric pollutants.

0 1 . 1

Methane is a fuel.

Balance the equation for the combustion of methane.

[1 mark]



0 1 . 2

Many fuels are mixtures.

Petrol and diesel are mixtures of hydrocarbons.

Table 1 shows properties of petrol and of diesel.

Table 1

	Petrol	Diesel
Range of number of carbon atoms in a hydrocarbon molecule	4 to 12	12 to 20
Range of boiling points in °C	40 to 205	250 to 350

Compare the properties of petrol and diesel.

Use **Table 1**.

[2 marks]

Turn over ►



0 1 . 3

The gases released when a fuel is burned in car engines may include:

- oxides of nitrogen
- carbon monoxide
- water vapour.

Which chemical element do all these gases contain?

[1 mark]

Tick (✓) **one** box.

Carbon

☐

Hydrogen

☐

Nitrogen

☐

Oxygen

☐

0 1 . 4

When diesel burns in car engines, oxides of nitrogen are produced.

Where does the nitrogen come from?

[1 mark]

0 1 . 5

When diesel burns, particulates may be produced.

What environmental effect do particulates from burning diesel cause?

[1 mark]



0 1 . 6

Carbon monoxide may be produced when diesel burns.

Give **one** reason why carbon monoxide is difficult to detect.

[1 mark]

0 1 . 7

Explain why water vapour and **not** liquid water is produced when diesel burns.

[2 marks]

0 1 . 8

Sulfur is a common impurity in diesel.

Explain why this causes an environmental problem.

[3 marks]

12

Turn over ►



0 2

Chromatography is used to separate mixtures.

Chromatography involves a mobile phase and one other phase.

0 2 . 1

What is the other phase in chromatography?

[1 mark]

Tick (✓) **one** box.

Moving phase

☐

Recycled phase

☐

Stationary phase

☐

Viscous phase

☐**0 2 . 2**

Why do the substances in the mixture separate in the mobile phase?

[1 mark]

0 2 . 3

How many spots will be produced on the chromatogram of a pure compound?

[1 mark]

Number of spots = _____



0	2	.	4
---	---	---	---

In a chromatography experiment, a blue colour moved 4.77 cm.

The solvent moved 5.30 cm.

Calculate the R_f value for the blue colour.

[2 marks]

R_f value = _____

Question 2 continues on the next page

Turn over ►



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

- separate the colours in black ink
- identify the colours from their R_f values.

[6 marks]

[illegible]

11



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0	3
---	---

Crude oil is a mixture of many different compounds.

0	3	.	1
---	---	---	---

Give **two** reasons why crude oil is **not** a formulation.

[2 marks]

1 _____

2 _____

0	3	.	2
---	---	---	---

Describe how crude oil is separated into fractions.

[4 marks]

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

The fractions from crude oil contain alkanes.

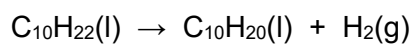
Explain why alkanes are cracked.

[2 marks]



Cracking produces a mixture of products.

0 3 . 4 An equation for cracking decane ($C_{10}H_{22}$) is:



Describe a test to identify the gas produced in the reaction.

[2 marks]

Test _____

Result _____

0 3 . 5 Alkenes are produced in cracking.

The general formula for the homologous series of alkenes is C_nH_{2n}

Which formula represents an alkene?

[1 mark]

Tick (✓) **one** box.

C_2H_2 ☐

C_2H_4 ☐

C_2H_6 ☐

C_3H_8 ☐

Turn over for the next question

Turn over ►

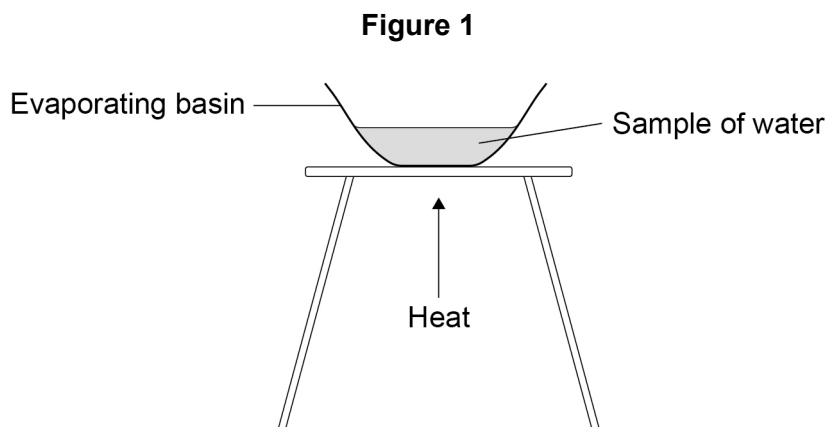


0	4
---	---

Some types of water contain dissolved substances.

A student investigated the mass of dissolved solids in distilled water and in sea water.

Figure 1 shows the apparatus.



This is the method used.

1. Weigh an evaporating basin.
2. Add 20 cm³ of distilled water to the evaporating basin.
3. Weigh the evaporating basin and the water sample.
4. Heat the water sample for 2 minutes.
5. Weigh the evaporating basin and contents.
6. Repeat steps 1 to 5 two more times.
7. Repeat steps 1 to 6 with sea water.

0	4
---	---

1

The method used by the student did **not** give valid results.

Describe **one** improvement the student could make to obtain valid results.

[1 mark]



A different student used a method which gave valid results.

0 4 . 2 Table 2 shows the results.

Table 2

	Mass of dissolved solids in grams			
Type of water	Test 1	Test 2	Test 3	Mean
Distilled water	0.00	0.00	0.00	0.00
Sea water	0.30	X	0.26	0.29

Calculate the value **X** for the mass of dissolved solids in sea water in **Test 2**.

[2 marks]

Mass **X** = _____ g

0 4 . 3 The student concludes that distilled water is pure.

Describe a test to confirm that distilled water is pure.

[2 marks]

Test _____

Result _____

Turn over ►

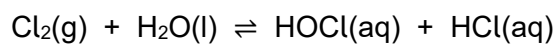


Tap water is potable.

A stage in the production of potable water is sterilising.

A gas is used to sterilise water.

The equation for the reaction is:



0 4 . 4

What is meant by the symbol $\rightleftharpoons$?

[1 mark]

0 4 . 5

The reaction is at equilibrium.

The reaction is exothermic.

What happens to the equilibrium position when the temperature is increased?

[1 mark]

Tick (✓) **one** box.

Shifts towards the left-hand side

☐

Stays in the same place

☐

Shifts towards the right-hand side

☐

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

Describe a test to identify the gas used to sterilise water.

[2 marks]

Test _____

Result _____

0	4	.	7
---	---	---	---

Another stage in the production of potable water is filtering.

Explain why potable water contains dissolved solids after filtering.

[2 marks]

11

Turn over for the next question**Turn over ►**

0 5

An increase of greenhouse gases in the Earth's atmosphere is causing global warming.

Global warming is causing global climate change.

0 5 . 1

Give **one** effect of global climate change.

[1 mark]

0 5 . 2

Explain how greenhouse gases cause global warming.

[4 marks]

0 5 . 3

Explain how planting trees reduces global warming.

[3 marks]



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



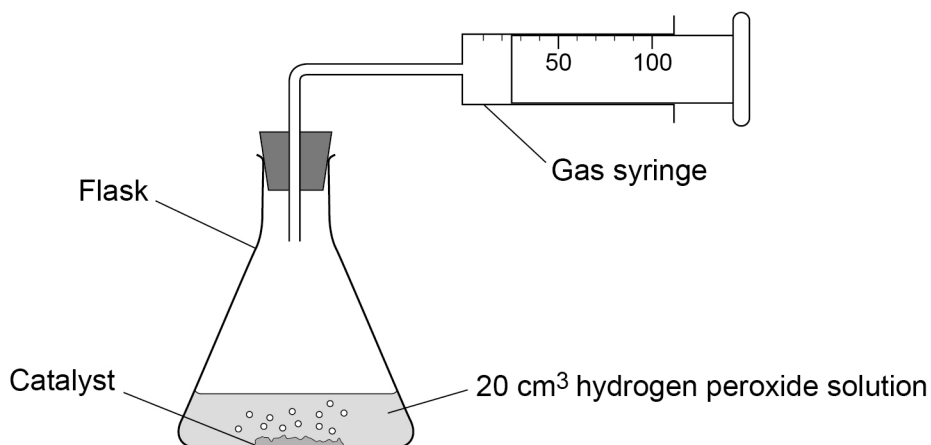
0	6
---	---

A student investigated the rate of decomposition of hydrogen peroxide using three different catalysts:

- manganese dioxide
- copper oxide
- zinc oxide.

Figure 2 shows the apparatus.

Figure 2



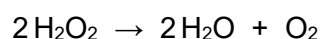
This is the method used.

1. Measure 20 cm³ of hydrogen peroxide solution into a flask.
2. Add 0.5 g of manganese dioxide catalyst to the flask.
3. Attach a gas syringe to the flask.
4. Measure the volume of oxygen produced every 30 seconds for 180 seconds.
5. Repeat steps 1 to 4 two more times.
6. Repeat steps 1 to 5 using copper oxide catalyst.
7. Repeat steps 1 to 5 using zinc oxide catalyst.



0 6 . 1

The equation for the decomposition of hydrogen peroxide is:



Describe a test to identify the gas produced in the reaction.

[2 marks]

Test _____

Result _____

0 6 . 2

Using 10 cm³ of hydrogen peroxide solution gives less accurate results than using 20 cm³ of hydrogen peroxide solution of the same concentration.

Explain why.

[2 marks]

0 6 . 3

Suggest **one** possible source of systematic error in the investigation.

[1 mark]

Question 6 continues on the next page

Turn over ►



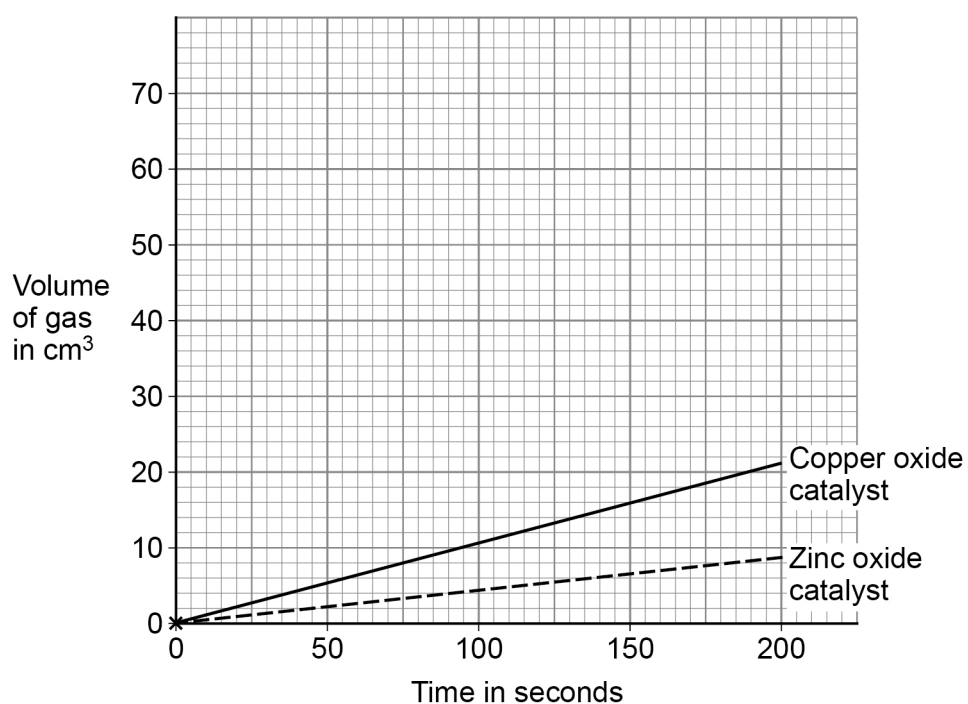
Table 3 shows the results for manganese dioxide catalyst.

Table 3

Time in seconds	0	30	60	90	120	150	180
Volume of gas in cm ³	0	22	38	41	54	58	60

Figure 3 shows a graph of the results with copper oxide catalyst and with zinc oxide catalyst.

Figure 3



0 6 . 4 Complete **Figure 3**.

You should:

- plot the data from **Table 3**
- draw a line of best fit.

The first point has been plotted for you.

[3 marks]



0 6 . 5 Which catalyst gives the fastest **rate** of reaction?

Give **one** reason for your answer.

Use the completed **Figure 3**.

[2 marks]

Catalyst _____

Reason _____

0 6 . 6 The rate of reaction is **not** dependent on the volume of hydrogen peroxide solution.

Explain why.

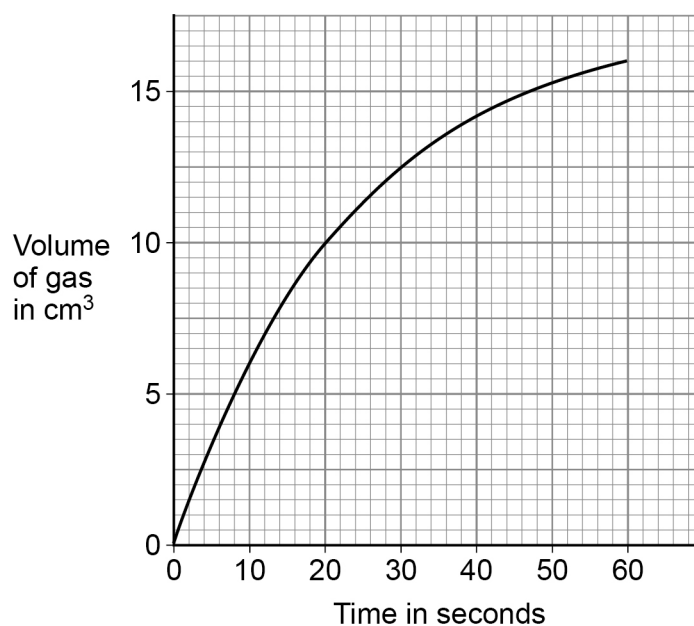
[2 marks]

Question 6 continues on the next page

Turn over ►



0 6 . 7

Figure 4 shows the results from a different investigation.**Figure 4**

Determine the rate of reaction at 20 seconds.

Show your working on **Figure 4**.

Give your answer to 3 significant figures.

[5 marks]

Rate (3 significant figures) = _____ cm³/s**END OF QUESTIONS**

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



*Do not write
outside the
box*

[illegible]

*Do not write
outside the
box*

[illegible]

[illegible]

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Copyright information

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2023 AQA and its licensors. All rights reserved.



2 8



2 3 6 6 8 4 6 4 / C / 2 H

IB/M/Jun23/8464/C/2H