



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 2H

Friday 13 June 2025

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 5 8 4 6 4 C 2 H 0 1

IB/M/Jun25/G4007/E7

8464/C/2H

0	1
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Dodecane is an alkane.

0	1	.	1
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The general formula for alkanes is C_nH_{2n+2}

A molecule of dodecane has 12 carbon atoms.

Complete the formula of dodecane.

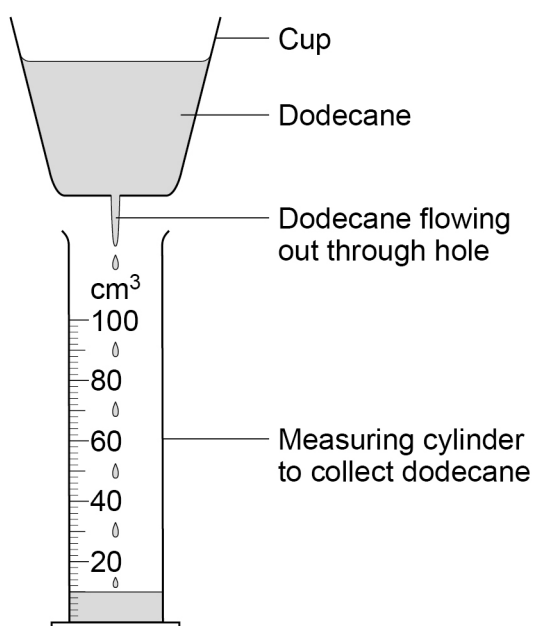
[1 mark]

C ____ H ____

A student investigated the effect of changing the temperature on the viscosity of dodecane.

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Add 100 cm³ of dodecane at 25 °C to the cup.
2. Immediately start a timer.
3. Stop the timer when 40 cm³ of dodecane has been collected in the measuring cylinder.
4. Record the time taken.
5. Repeat steps 1 to 4 using dodecane at different temperatures.

0 1 . 2 The student used a water bath to heat the dodecane.

Suggest **one** reason why the student used a water bath instead of a Bunsen burner to heat the dodecane.

[1 mark]

0 1 . 3 Give **one** control variable used in the investigation.

[1 mark]

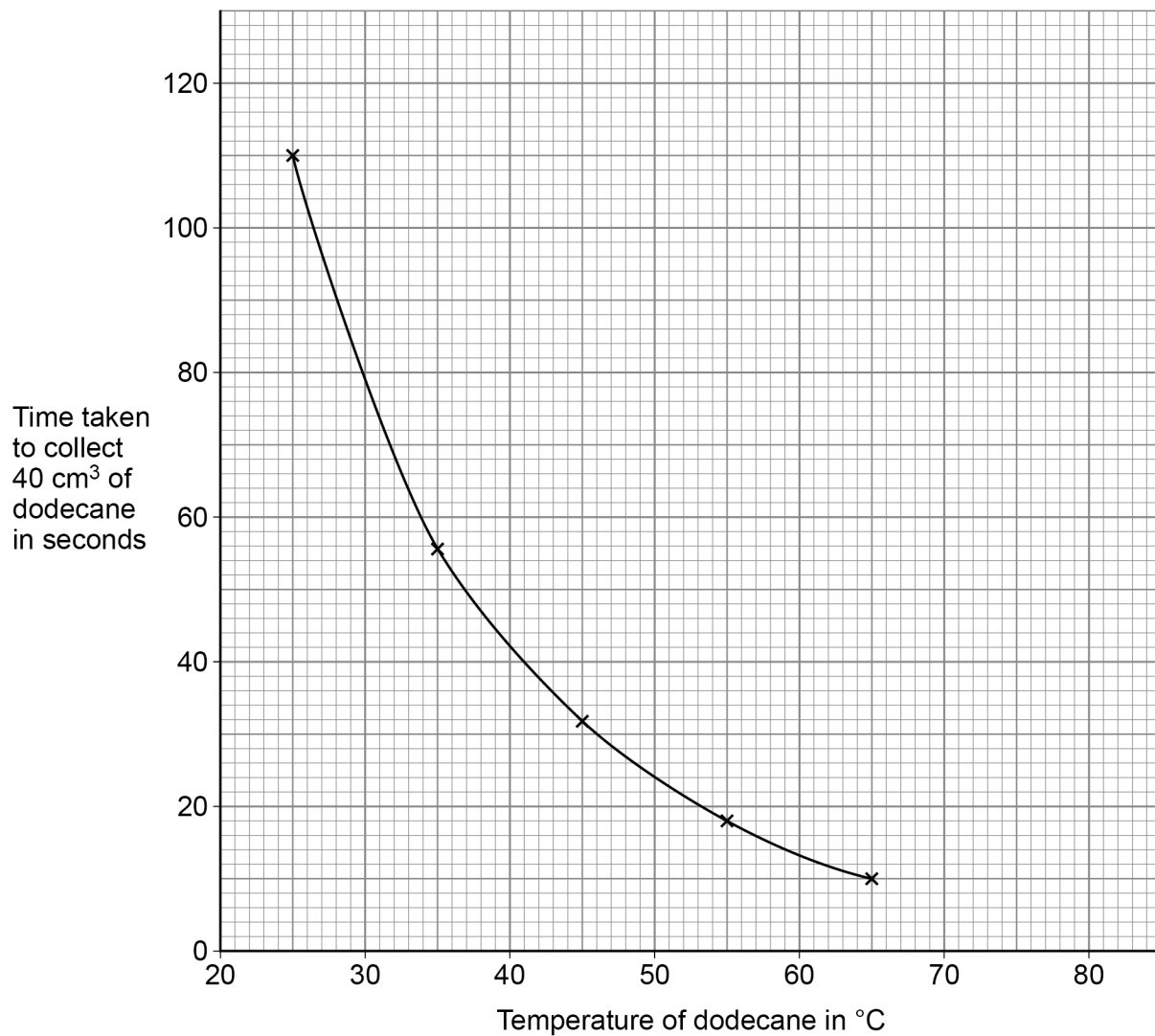
Question 1 continues on the next page

Turn over ►



Figure 2 shows the results.

Figure 2



0 1 . 4 Predict the time taken to collect 40 cm³ of dodecane at 75 °C.

You should extend the line of best fit on **Figure 2**.

[2 marks]

Time taken = _____ s



0 1 . 5

The higher the viscosity, the slower dodecane flows.

Explain how the trend in **Figure 2** shows the effect of an increase in temperature on the **viscosity** of dodecane.

[2 marks]

7

Turn over for the next question

Turn over ►



0 2

The proportions of most gases in the Earth's atmosphere have not changed much for the past 200 million years.

0 2**1**

About one-fifth of the atmosphere is oxygen.

Describe the test for oxygen gas.

Give the result of the test.

[2 marks]

Test _____

Result _____

0 2**2**

Table 1 shows the percentages of some gases in the Earth's early atmosphere and in the Earth's atmosphere today.

Table 1

Gas	Percentage (%) of gas in the atmosphere	
	Earth's early atmosphere	Earth's atmosphere today
Carbon dioxide	95	0.04
Nitrogen	3	78.0
Oxygen	Less than 1	21.0



You should refer to all three gases in **Table 1**.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

Give **two** ways to reduce methane emissions into the atmosphere.

- 1 _____
- 2 _____

The percentage of sulfur dioxide in the Earth's atmosphere increased between 1850 and 1980.

0 2 . 4

Describe how sulfur dioxide emissions are produced.

[2 marks]

0 2 . 5

Give **one** harmful effect of sulfur dioxide emissions.

[1 mark]

0 2 . 6

Suggest **one** reason why the percentage of sulfur dioxide in the Earth's atmosphere has decreased since 1980.

[1 mark]



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0	3
---	---

Crude oil is a finite resource found in rocks.

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

What is meant by a 'finite' resource?

[1 mark]

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

Most of the compounds in crude oil are hydrocarbons.

Define the term 'hydrocarbon'.

[1 mark]



0 3 . 3

Crude oil found in different areas has different compositions.

Table 2 shows the percentage (%) composition of crude oil from one area.

Table 2

Fraction	Percentage (%) of fraction
Petrol	31.3
Kerosene	13.4
Diesel oil	14.4
Heavy fuel oil	40.9

The volume of crude oil is measured in a unit called 'barrels'.

1 barrel = 159 dm³

Calculate the volume of **petrol** in dm³ in 90 barrels of crude oil.

Give your answer to 3 significant figures.

[4 marks]

Volume of petrol (3 significant figures) = _____ dm³

Turn over ►



0 3 . 4

Fractions from crude oil can be processed to produce many useful materials by the petrochemical industry.

Which is a useful material produced by the petrochemical industry?

[1 mark]

Tick (✓) **one** box.

Alloys

☐

Ceramics

☐

Fertilisers

☐

Lubricants

☐

0 3 . 5

Catalytic cracking is used to crack hydrocarbons.

Name **one** other method of cracking hydrocarbons.

[1 mark]

0 3 . 6

Alkanes are produced by cracking.

Hydrocarbon **Z** is a different type of hydrocarbon to alkanes.

Hydrocarbon **Z**:

- is also produced by cracking
- can be used to produce polymers.

Describe a test for hydrocarbon **Z**.

Give the result of the test.

[2 marks]

Test _____

Result _____

10



0	4
---	---

This question is about methanol.

0	4	.	1
---	---	---	---

Methanol is used in screenwash.

Screenwash is used to keep car windscreens clean.

Screenwash is a formulation.

Define the term 'formulation'.

[1 mark]

Question 4 continues on the next page

Turn over ►

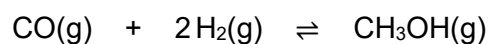


Carbon monoxide and hydrogen are used to produce methanol.

The conditions used in the production of methanol are:

- high temperature
- high pressure
- a catalyst.

The equation for the reaction is:



91 kJ/mol of energy is transferred during the exothermic forward reaction.

0 4 . 2

How much energy is transferred when methanol is decomposed into carbon monoxide and hydrogen?

[1 mark]

Tick (✓) **one** box.

< 91 kJ/mol

☐

91 kJ/mol

☐

> 91 kJ/mol

☐

0 4 . 3

A scientist developed a principle to predict the effect of changing conditions on a system at equilibrium.

What was the name of the scientist?

[1 mark]



0 4 . 4

What is the effect of increasing the temperature on the proportion of methanol in the equilibrium mixture?

[1 mark]

Tick (✓) **one** box.

The proportion of methanol decreases.

☐

The proportion of methanol stays the same.

☐

The proportion of methanol increases.

☐

0 4 . 5

What is the effect of using a catalyst on the proportion of methanol in the equilibrium mixture?

[1 mark]

Tick (✓) **one** box.

The proportion of methanol decreases.

☐

The proportion of methanol stays the same.

☐

The proportion of methanol increases.

☐

0 4 . 6

Explain the effect of increasing the pressure on the proportion of methanol in the equilibrium mixture.

[3 marks]

Turn over ►

0 4 . 7

Explain the effect of using a catalyst on the **rate** of production of methanol.**[3 marks]**

0 4 . 8

The catalyst allows the reaction to take place at a lower temperature.

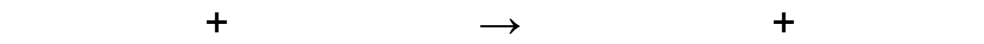
Explain **one** advantage of using a lower temperature in the production of methanol.Do **not** refer to the position of equilibrium in your answer.**[2 marks]**

0 4 . 9

Methanol (CH_3OH) can also be produced by reacting carbon dioxide with hydrogen.

Water is the other product of the reaction.

Write a balanced equation for the reaction.

[2 marks]

15



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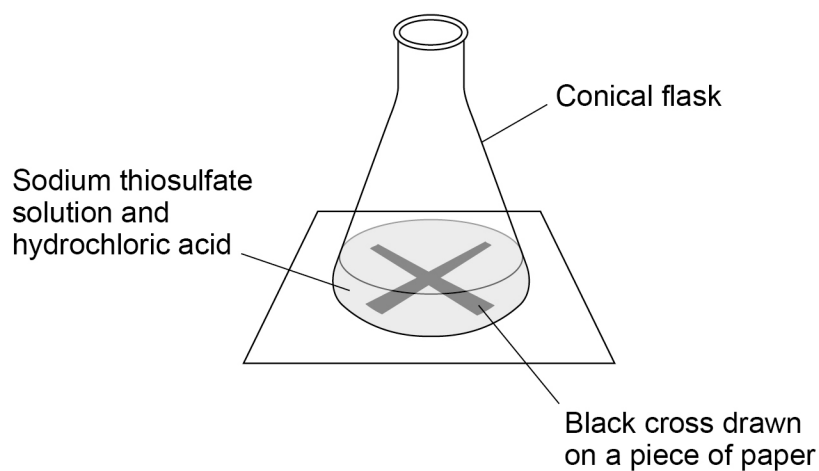
0	5
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Students investigated the effect of changing the concentration on the rate of chemical reactions.

A student reacted sodium thiosulfate solution with hydrochloric acid.

Figure 3 shows the apparatus.

Figure 3



This is the method used.

1. Measure 50 cm³ of sodium thiosulfate solution into a conical flask.
2. Put the conical flask on a black cross drawn on a piece of paper.
3. Add 10 cm³ of hydrochloric acid to the conical flask.
4. Start a timer.
5. Stop the timer when the cross is no longer visible.
6. Record the time taken.
7. Repeat steps 1 to 6 using different concentrations of sodium thiosulfate solution.

0 5 . 1

What is the dependent variable in this investigation?

[1 mark]

0 5 . 2

The equation for the reaction is:



The mixture becomes cloudy as the reaction takes place.

Explain why the mixture becomes cloudy.

[2 marks]

0 5 . 3

Explain the effect of changing the concentration of the sodium thiosulfate solution on the rate of reaction.

[3 marks]

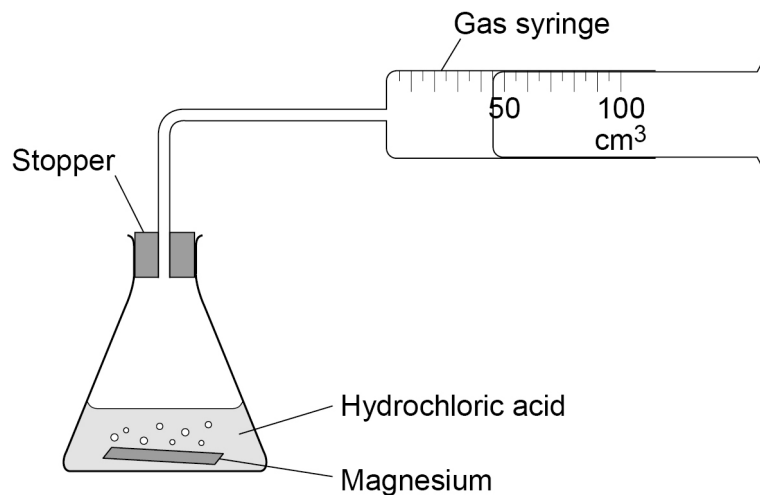
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A different student reacted magnesium with hydrochloric acid.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Measure 50 cm³ of hydrochloric acid into a conical flask.
2. Add 0.1 g of magnesium ribbon to the conical flask.
3. Insert the stopper into the conical flask as quickly as possible.
4. Start a timer.
5. Record the volume of gas collected every 20 seconds for 5 minutes.
6. Repeat steps 1 to 5 using different concentrations of hydrochloric acid.

0 5 . 4

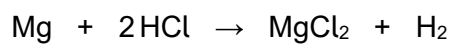
Why is the stopper inserted into the conical flask as quickly as possible in step 3?

[1 mark]



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

The equation for the reaction of magnesium with hydrochloric acid is:



Describe a test for the gas produced in the reaction.

Give the result of the test.

[2 marks]

Test _____

Result _____

Question 5 continues on the next page

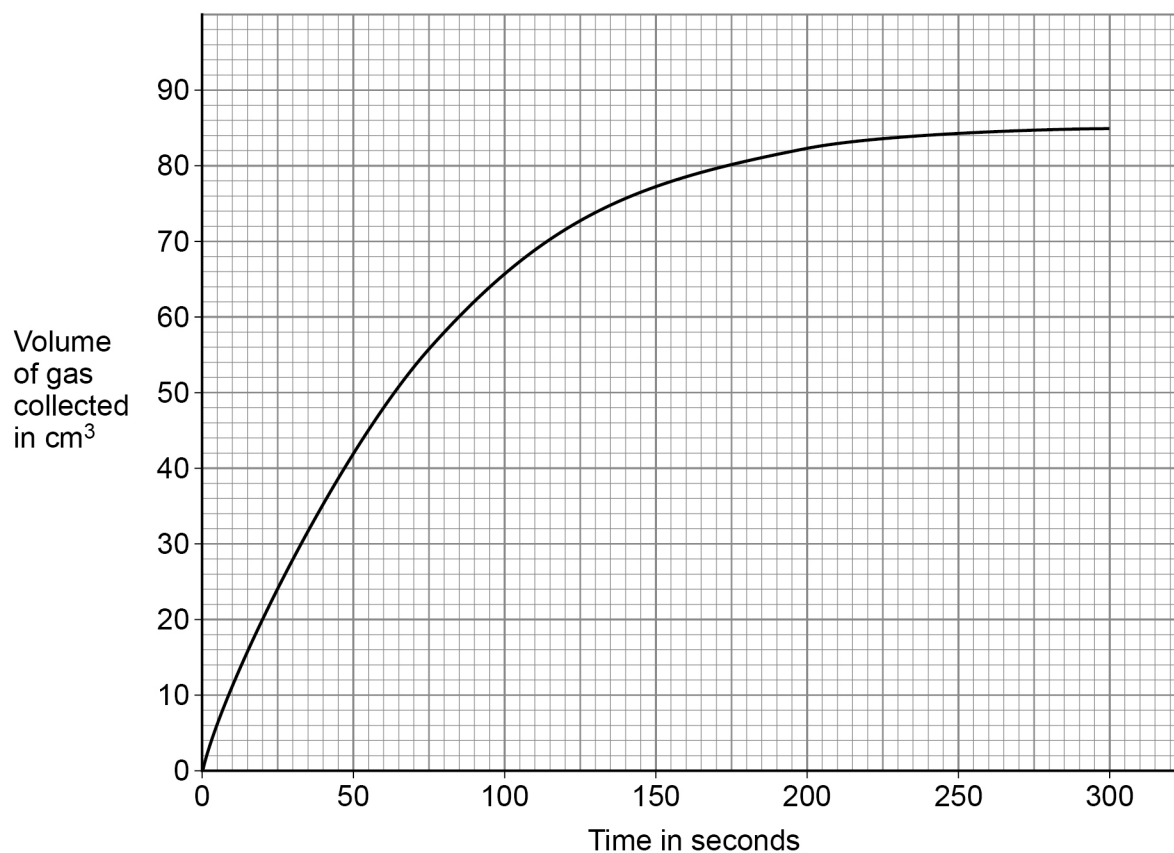
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0 5 . 6

Figure 5 shows the results for one concentration of hydrochloric acid.

Figure 5



Determine the rate of reaction at 75 seconds.

[4 marks]

Rate = _____ cm³/s

13



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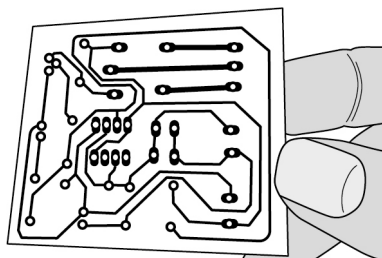


0 6

Gold is used in the printed circuit boards found in smartphones.

Figure 6 shows a printed circuit board.

Figure 6



A type of smartphone contains 1.73×10^{-4} moles of gold.

0 6

1

In one year, a manufacturer sold 2.48 million of this type of smartphone.

Calculate the total mass of gold contained in 2.48 million of these smartphones.

Give your answer in kilograms.

Relative atomic mass (A_r): Au = 197

[5 marks]

Total mass of gold = _____ kg



0 6 . 2 What is the total number of gold atoms in one of this type of smartphone?

The Avogadro constant = 6.02×10^{23} per mole

[1 mark]

Tick (✓) **one** box.

2.87×10^{-28}

☐

1.04×10^{20}

☐

3.48×10^{27}

☐

0 6 . 3 The materials in printed circuit boards can be recycled.

Bioleaching is one method used to extract gold from printed circuit boards.

Describe how bioleaching is used to extract gold.

[3 marks]

Question 6 continues on the next page

Turn over ►



0 6 . 4 Copper is also extracted using bioleaching.

Copper can also be extracted from low-grade ores using phytomining.

Phytomining has **not** been widely used to extract copper.

Suggest **two** reasons why.

[2 marks]

1 _____

2 _____

11

END OF QUESTIONS



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