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 11 June 2024 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.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| **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*

**There are no questions printed on this page**

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

*Do not write outside the box*

**0 1** Alkanes and alkenes are hydrocarbons.

**0 1 . 1** Define the term 'hydrocarbon'.

**[1 mark]**

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

Determine the formula of the alkane with 10 carbon atoms.

**[1 mark]**

Formula = _____

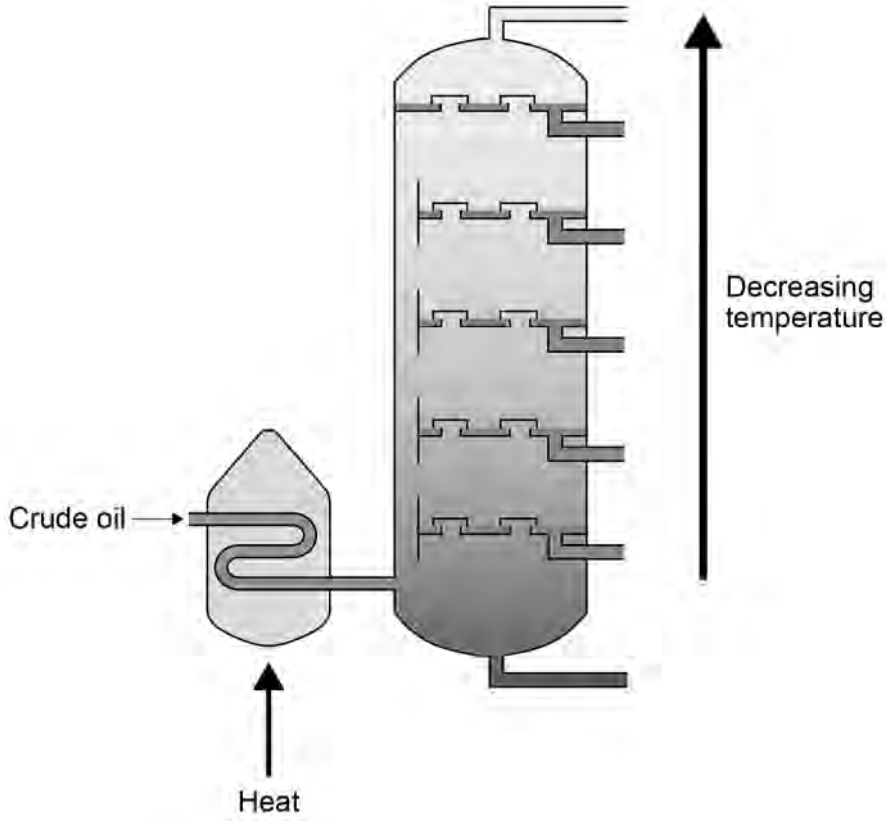
**Question 1 continues on the next page**

*Do not write outside the box*

**0 1 . 3** Crude oil is a mixture of hydrocarbons.

**Figure 1** represents industrial equipment used to separate crude oil into fractions.

**Figure 1**




Explain how crude oil is separated into fractions.

Use **Figure 1**.

**[4 marks]**

*Do not write outside the box*

**0 1 . 4** The alkane molecule $C_{14}H_{30}$ can be cracked to produce smaller molecules.

Balance the equation for the reaction.

**[1 mark]**

$$C_{14}H_{30} \rightarrow C_8H_{18} + \_\_\_\_ C_3H_6$$

**Question 1 continues on the next page**

*Do not write outside the box*

Propene ($C_3H_6$) is an alkene.

**0 1 . 5** Describe the test for alkenes.

Give the result.

**[2 marks]**

Test _____

_____

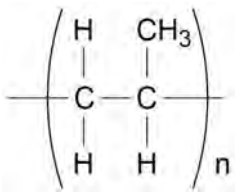
Result _____

_____

**0 1 . 6** Poly(propene) is made from propene.

**Figure 2** represents the repeating unit of poly(propene).

**Figure 2**




What type of substance is poly(propene)?

**[1 mark]**

_____

**10**

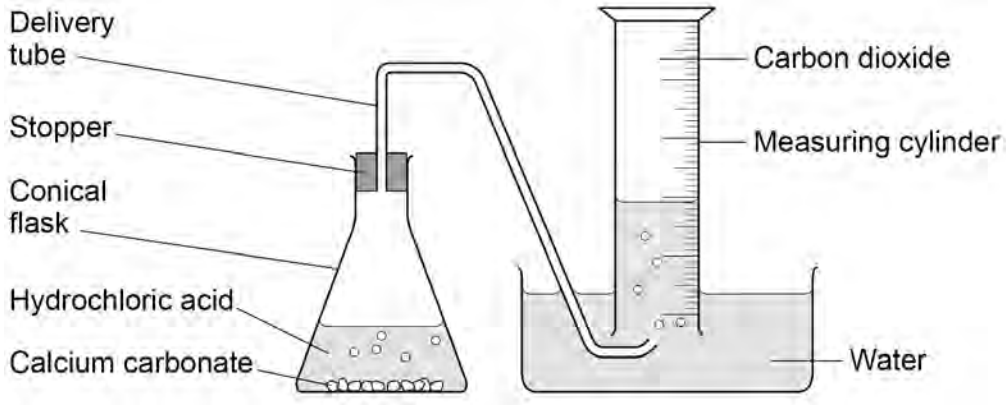
*Do not write outside the box*

**0 2** Some factors affect the rates of chemical reactions.

**0 2 . 1** A student investigated the effect of changing the particle size of calcium carbonate on the rate of reaction with hydrochloric acid.

**Figure 3** shows the apparatus.

**Figure 3**




Describe a method the student could use to produce valid results.

**[6 marks]**

*Do not write outside the box*

**0 2 . 2** The student investigated the effect of increasing the temperature on the rate of a reaction.

Explain the effect of increasing the temperature on the rate of a reaction.

Refer to particles and collisions in your answer.

**[3 marks]**

*Do not write outside the box*

Catalysts affect the rate of reactions.

**0 2 . 3** What is meant by a 'catalyst'?

**[2 marks]**

**0 2 . 4** What are catalysts in biological systems called?

**[1 mark]**

12

**Turn over for the next question**

*Do not write outside the box*

**0 3** Some fractions of crude oil are processed to produce fuel for transport.

**0 3 . 1** Describe how crude oil was formed.

**[4 marks]**

*Do not write outside the box*

Transport is a source of atmospheric pollutants.

**0 3 . 2** Suggest how sulfur dioxide can be produced by transport.

**[2 marks]**

**0 3 . 3** Give **two** problems caused by sulfur dioxide as an atmospheric pollutant.

**[2 marks]**

1

2

**Question 3 continues on the next page**

*Do not write outside the box*

**0 3 . 4** Describe how carbon monoxide can be produced by transport.

**[2 marks]**

**0 3 . 5** Catalytic converters are fitted to car exhausts to reduce the amount of pollution from cars.

Carbon monoxide and nitrogen dioxide ($NO_2$) react in a catalytic converter.

Nitrogen and carbon dioxide are produced.

Write a balanced equation for the reaction.

**[2 marks]**

_____ + _____ → _____ + _____

**12**

*Do not write outside the box*

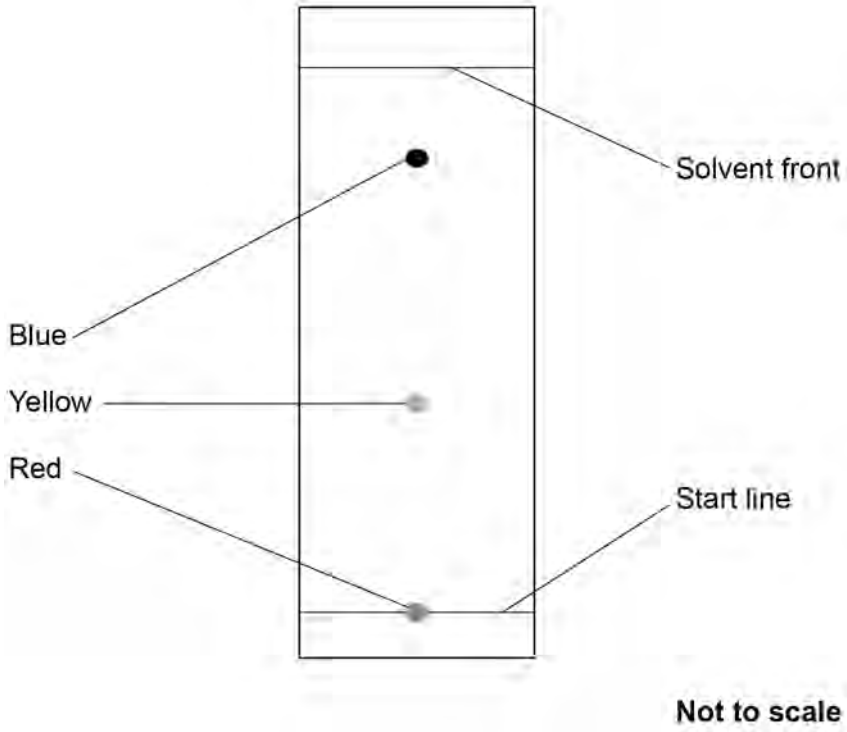
**0 4** Printer ink is a mixture of chemicals.

A student used chromatography to investigate the colours in a printer ink.

The student put a spot of the printer ink on the start line.

**Figure 4** shows the results.

**Figure 4**




**0 4 . 1** Explain why the red colour did **not** move from the start line.

**[2 marks]**

**Question 4 continues on the next page**

*Do not write outside the box*

**0 4 . 2** The blue colour moved 6.4 cm up the chromatogram.

The $R_f$ value of the blue colour is 0.87

Calculate the distance moved by the solvent.

Give your answer to 2 significant figures.

**[4 marks]**

Distance moved by the solvent (2 significant figures) = _____ cm

*Do not write outside the box*

There were four colours in the printer ink.

**0 4 . 3** Suggest **one** reason why only three colours were visible on the chromatogram.

**[1 mark]**

**0 4 . 4** Suggest how the student could use chromatography to show there were four colours in the printer ink.

**[1 mark]**

**8**

**Turn over for the next question**

*Do not write outside the box*

**0 5** Sulfuric acid is produced by an industrial process.

In the process, sulfur dioxide ($SO_2$) reacts with oxygen ($O_2$) to produce sulfur trioxide ($SO_3$).

The equation for the reversible reaction is:

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

The forward reaction releases 198 kJ/mol of energy.

**0 5 . 1** What is the amount of energy transferred during the reverse reaction?

**[1 mark]**

Tick (✓) **one** box.

< 198 kJ/mol ☐

= 198 kJ/mol ☐

> 198 kJ/mol ☐

**0 5 . 2** The concentration of oxygen is increased.

What is the effect on the position of the equilibrium?

**[1 mark]**

Tick (✓) **one** box.

Equilibrium position shifts to the left ☐

Equilibrium position does not change ☐

Equilibrium position shifts to the right ☐

*Do not write outside the box*

**0 5 . 3** The pressure is decreased.

What is the effect on the position of the equilibrium?

**[1 mark]**

Tick (✓) **one** box.

Equilibrium position shifts to the left ☐

Equilibrium position does not change ☐

Equilibrium position shifts to the right ☐

**0 5 . 4** The temperature is increased.

What is the effect on the position of the equilibrium?

**[1 mark]**

Tick (✓) **one** box.

Equilibrium position shifts to the left ☐

Equilibrium position does not change ☐

Equilibrium position shifts to the right ☐

**0 5 . 5** A catalyst is used in the reaction.

Suggest what effect the catalyst has on the position of the equilibrium.

Give **one** reason for your answer.

**[2 marks]**

Effect _____

_____

Reason _____

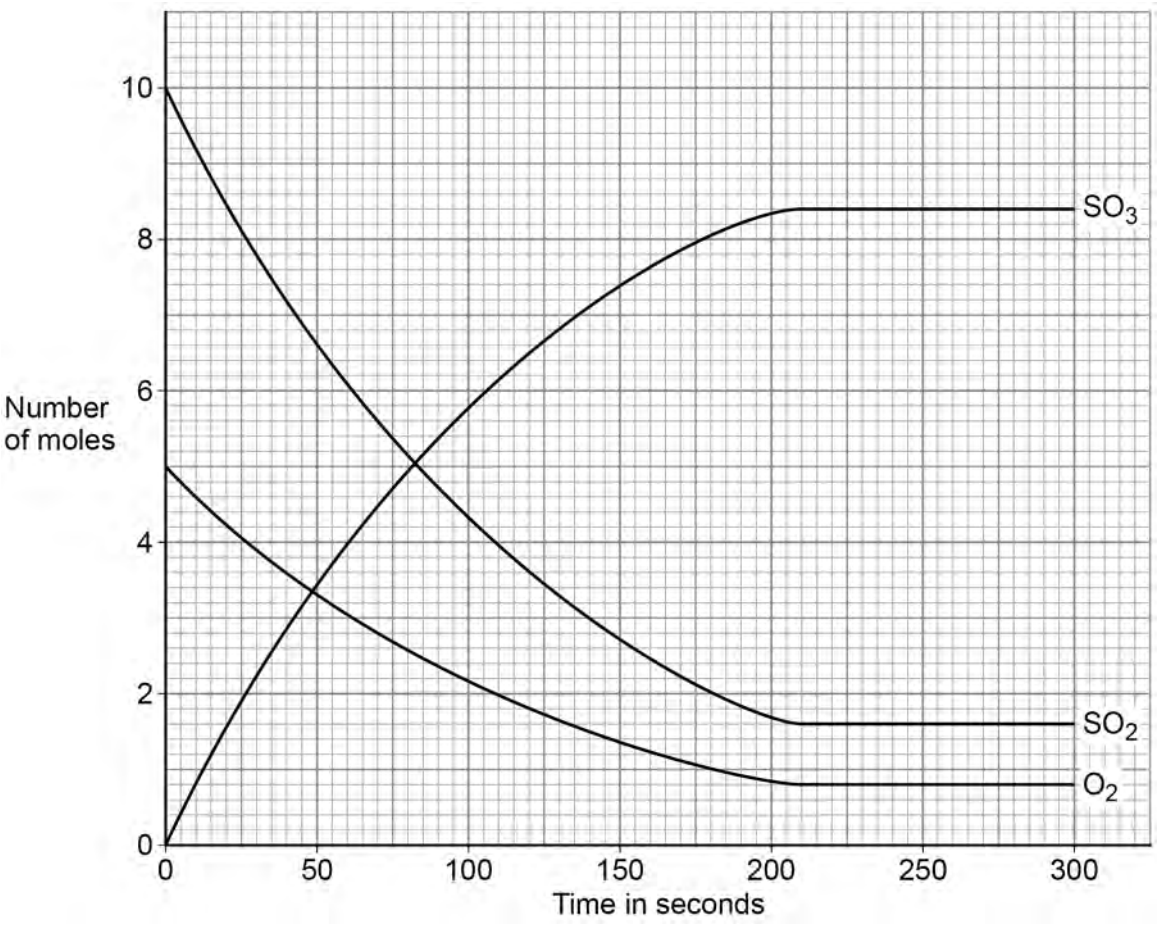
_____

*Do not write outside the box*

A scientist measured how the number of moles of sulfur dioxide, oxygen and sulfur trioxide varied with time during the reaction.

**Figure 5** shows the results.

**Figure 5**



*Do not write outside the box*

**0 5 . 6** Determine the time taken for the reaction to reach equilibrium.

Explain your answer.

Use **Figure 5**.

**[3 marks]**

Time _____ s

Explanation _____

_____

_____

_____

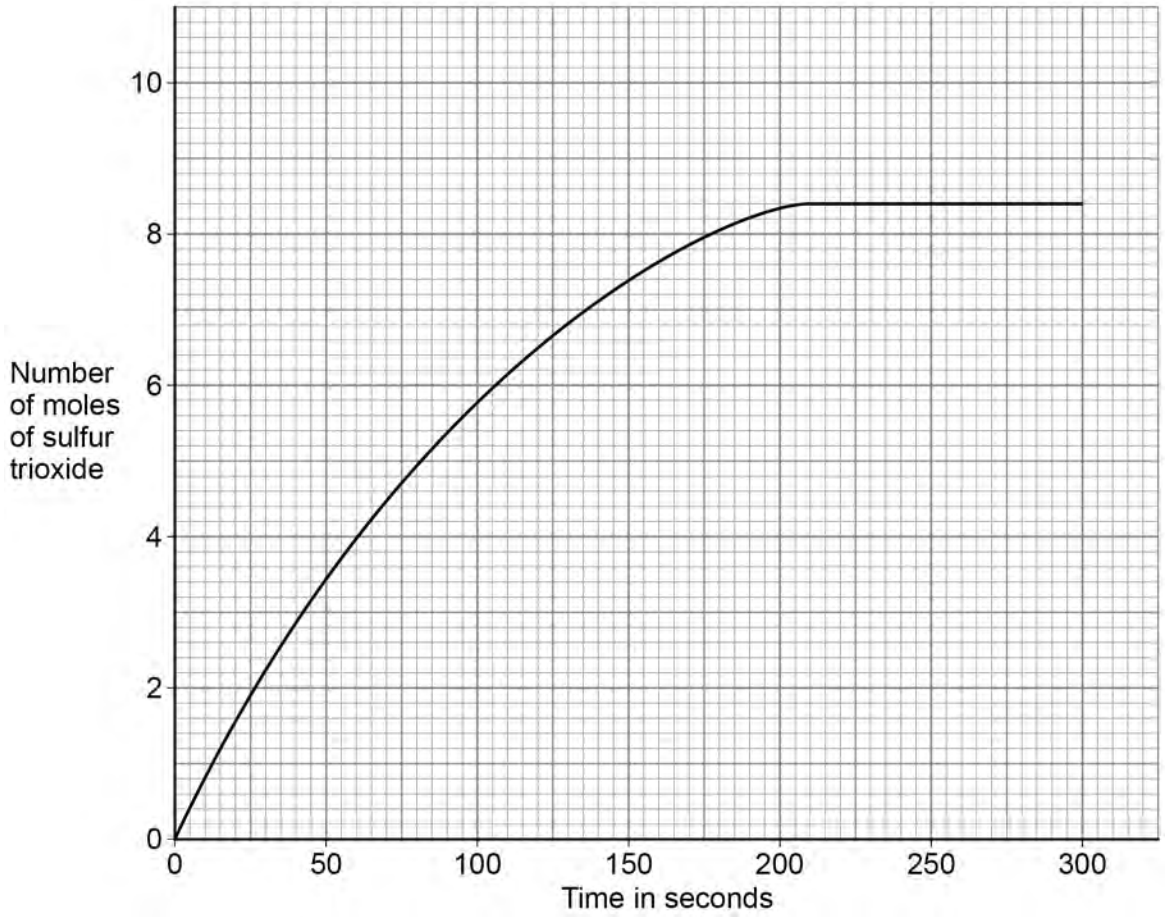
_____

**Question 5 continues on the next page**

*Do not write outside the box*

**0 5 . 7** **Figure 6** shows the results for sulfur trioxide.

**Figure 6**




Determine the rate of reaction at 60 seconds.

**[4 marks]**

Rate = _____ mol/s

13

*Do not write outside the box*

**0 6** The Earth's natural resources are used to manufacture useful products.

One useful product is potable water.

Potable water can be produced from sea water by distillation.

**0 6 . 1** Give **one disadvantage** of using distillation to produce potable water.

**[1 mark]**

**0 6 . 2** Describe **one** other method to produce potable water from sea water.

**[2 marks]**

**Question 6 continues on the next page**

*Do not write outside the box*

A student investigated the mass of dissolved solids in a 100 $cm^3$ sample of sea water.

This is the method used.

1. Weigh an evaporating basin.

2. Measure 100 $cm^3$ of sea water.

3. Pour the sea water into the evaporating basin.

4. Heat the evaporating basin.

5. Weigh the evaporating basin and contents.

6. Calculate the mass of dissolved solids in the sea water.

**0 6 . 3** Explain how repeating steps 4 and 5 would improve this method.

**[2 marks]**

**0 6 . 4** The total mass of dissolved solids in a 100 $cm^3$ sample of sea water is 3.50 g.

The percentage of sodium chloride in the dissolved solids is 77.8%.

Calculate the mass of sodium chloride dissolved in the 100 $cm^3$ sample of sea water.

**[2 marks]**

Mass of sodium chloride = _____ g

*Do not write outside the box*

Biological methods are used to extract metal compounds from metal ores.

**0 6 . 5** One method of producing copper from low-grade copper ores is by using bacteria.

The bacteria produce leachate solutions that contain copper compounds.

Give **two** methods that can be used to extract copper from these leachate solutions.

**[2 marks]**

1 _____

_____

2 _____

_____

**Question 6 continues on the next page**

*Do not write outside the box*

Phytomining uses plants to absorb metal compounds from low-grade ores.

**0 6 . 6** Describe how the metal compounds are obtained from the plants.

**[3 marks]**

**0 6 . 7** Nickel is produced by phytomining.

One hectare of plants produces 215 kg of nickel.

Determine the area required to produce 750 kg of nickel.

Give your answer in $m^2$.

One hectare = 10 000 $m^2$

**[3 marks]**

Area required = _____ $m^2$

**15**

**END OF QUESTIONS**

*Do not write outside the box*

**There are no questions printed on this page**

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

*Do not write outside the box*

| Question number | **Additional page, if required.**<br>**Write the question numbers in the left-hand margin.** |
|---|---|
| | |

*Do not write outside the box*

| Question number | **Additional page, if required.**<br>**Write the question numbers in the left-hand margin.** |
|---|---|
| | |

*Do not write outside the box*

| Question number | **Additional page, if required.**<br>**Write the question numbers in the left-hand margin.** |
|---|---|
| | |
| | **Copyright information**<br><br>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.<br><br>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.<br><br> |