



**Surname** \_\_\_\_\_

**Forename(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**I declare this is my own work.**

**GCSE**

**COMBINED SCIENCE: TRILOGY**

**Higher Tier**

**Chemistry Paper 2H**

**H**

**8464/C/2H**

**Tuesday 11 June 2024      Morning**

**Time allowed: 1 hour 15 minutes**

**[Turn over]**



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

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**On the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.**

**MATERIALS**

**For this paper you must have:**

- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed).**

**[Turn over]**



## INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **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.**

**DO NOT TURN OVER UNTIL TOLD TO DO SO**



0 1

**Alkanes and alkenes are hydrocarbons.**

0 1 . 1

**Define the term 'hydrocarbon'. [1 mark]**

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

Determine the formula of the alkane with  
10 carbon atoms. [1 mark]

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Formula = \_\_\_\_\_

[Turn over]

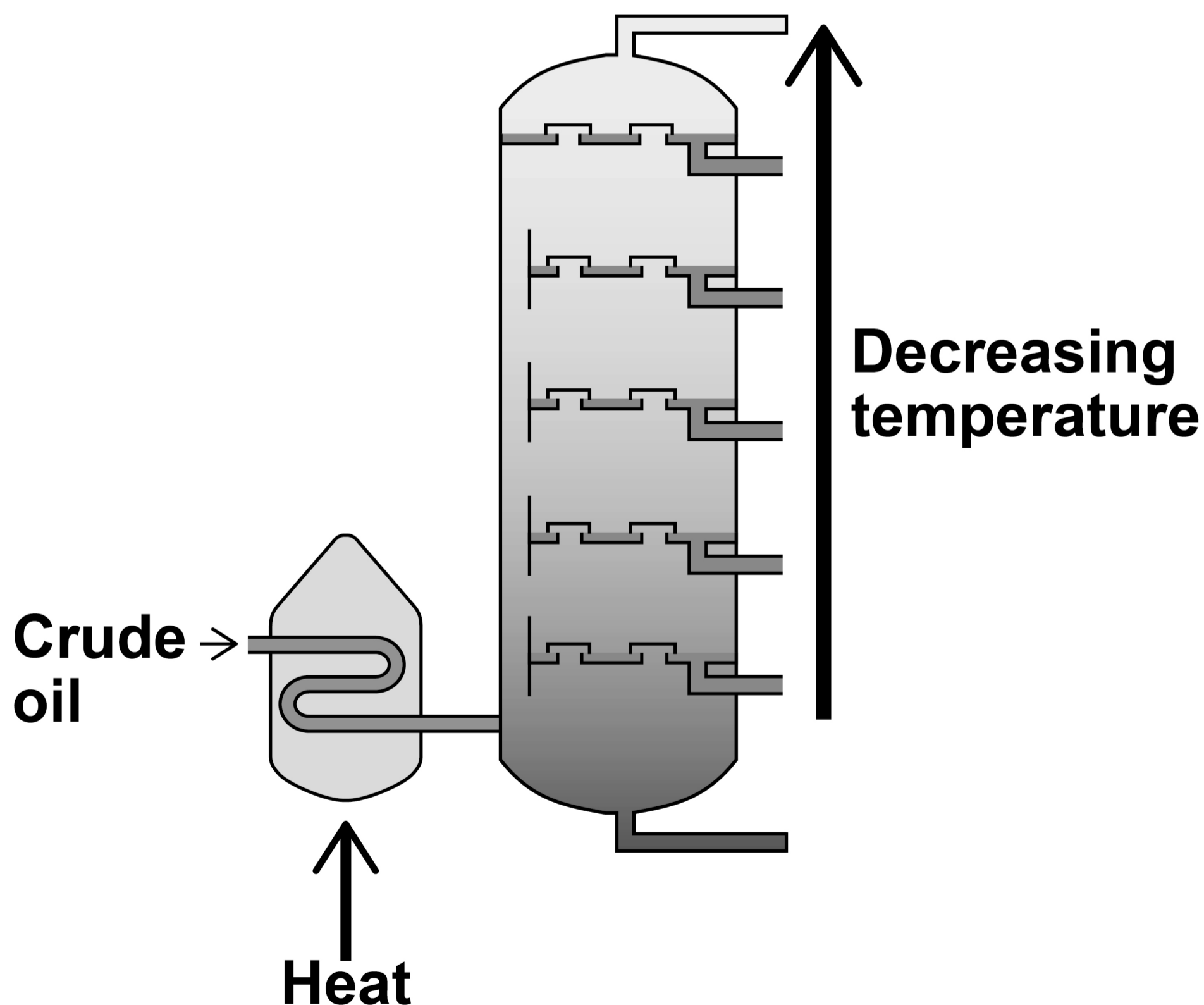


**01.3**

**Crude oil is a mixture of hydrocarbons.**

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

**FIGURE 1**





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

Balance the equation for the reaction.  
[1 mark]



**Propene (C<sub>3</sub>H<sub>6</sub>) is an alkene.**

**0 | 1 | . | 5**

**Describe the test for alkenes.**

**Give the result. [2 marks]**

**Test** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Result** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**[Turn over]**

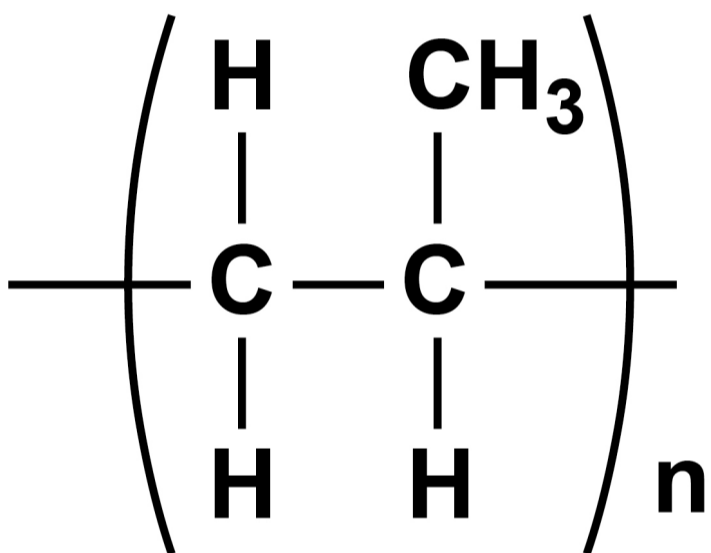


**01.6**

**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]**

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**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, on page 14, shows the apparatus.**

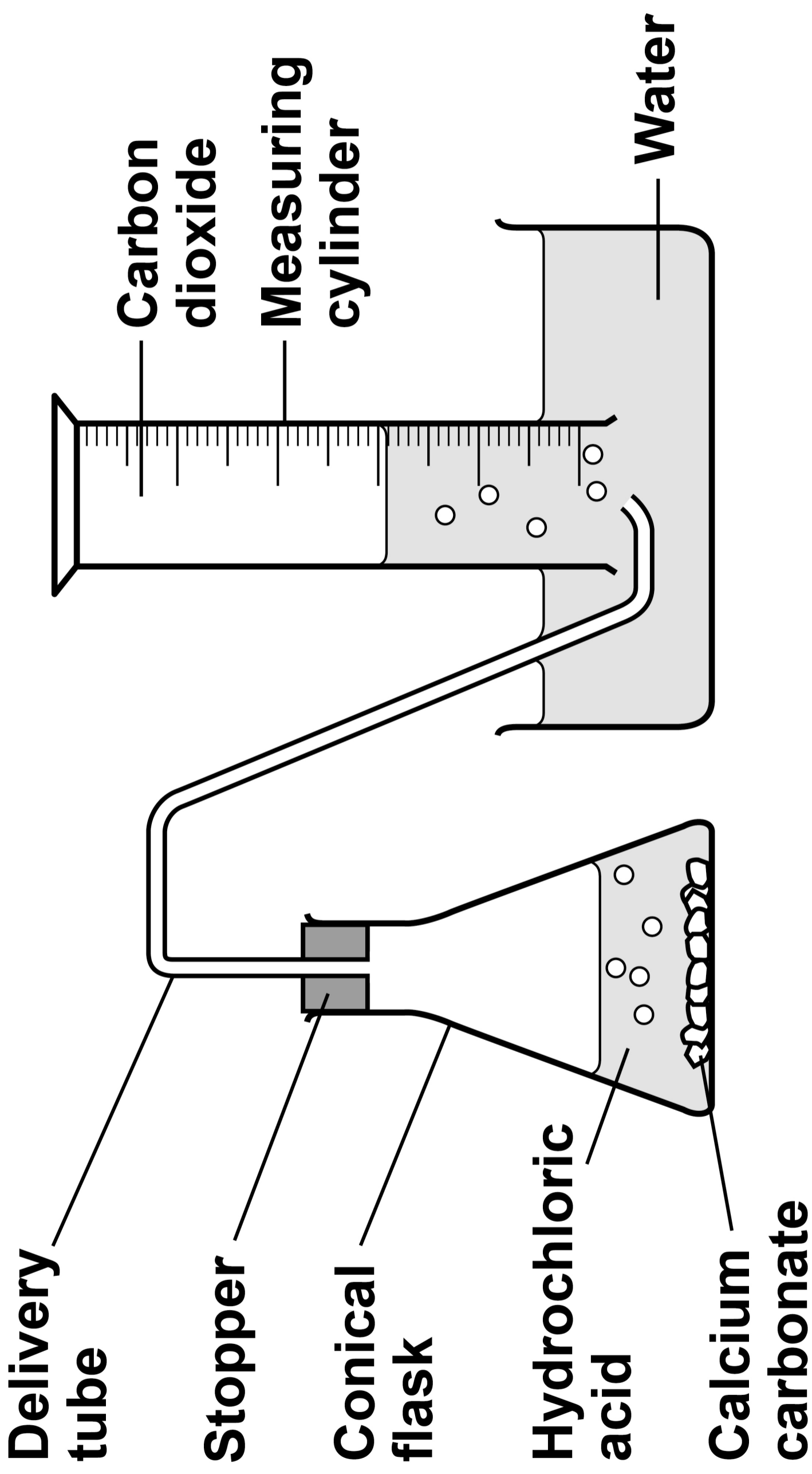
**[Turn over]**





1 4

**FIGURE 3**





1 5

**Describe a method the student could use to produce valid results. [6 marks]**

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**15**

**[Turn over]**

Vertical lines for writing.





1 7

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**[Turn over]**



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**Catalysts affect the rate of reactions.**

**0 2 . 3**

**What is meant by a 'catalyst'? [2 marks]**

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**[Turn over]**



**02.4**

**What are catalysts in biological systems called? [1 mark]**

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<b>12</b>





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**Transport is a source of atmospheric pollutants.**

**0 3 . 2**

**Suggest how sulfur dioxide can be produced by transport. [2 marks]**

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**0 3 . 3**

**Give TWO problems caused by sulfur dioxide as an atmospheric pollutant. [2 marks]**

**1** \_\_\_\_\_

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**2** \_\_\_\_\_

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**[Turn over]**



03.4

**Describe how carbon monoxide can be produced by transport. [2 marks]**

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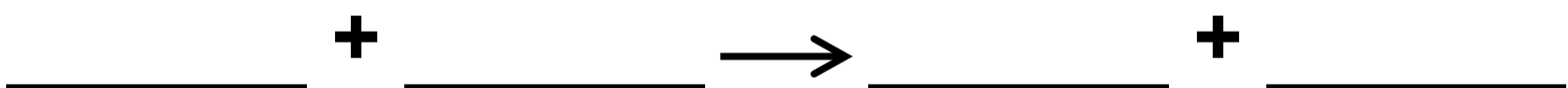
**03.5**

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

**Carbon monoxide and nitrogen dioxide (NO<sub>2</sub>) react in a catalytic converter.**

**Nitrogen and carbon dioxide are produced.**

**Write a balanced equation for the reaction. [2 marks]**



**[Turn over]**

12



0	4
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**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, on the opposite page, shows the results.**

0	4	.	1
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**Explain why the red colour did NOT move from the start line. [2 marks]**

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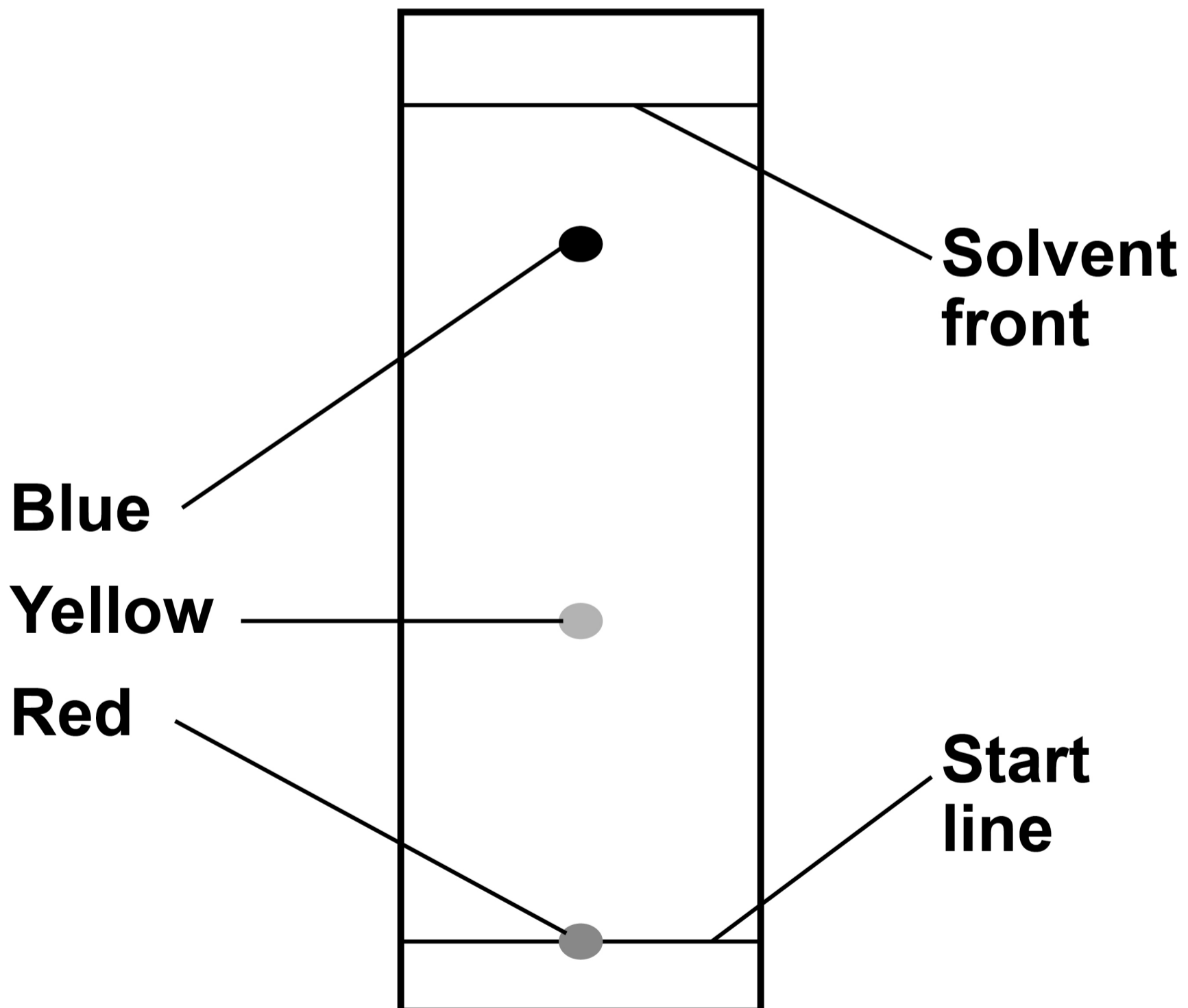


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**FIGURE 4**

**This figure is NOT drawn to scale.**



**[Turn over]**



**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]**

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**Distance moved by the solvent  
(2 significant figures) =**

**\_\_\_\_\_ cm**

**[Turn over]**



**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]**

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0	4	.	4
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**Suggest how the student could use chromatography to show there were four colours in the printer ink. [1 mark]**

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**[Turn over]**

8



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

**In the process, sulfur dioxide (SO<sub>2</sub>) reacts with oxygen (O<sub>2</sub>) to produce sulfur trioxide (SO<sub>3</sub>).**

**The equation for the reversible reaction is:**



**The forward reaction releases 198 kJ/mol of energy.**



0	5	.	1
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**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**

**[Turn over]**



**05.2**

**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**



0	5	.	3
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**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**

**[Turn over]**



0	5	.	4
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**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
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**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** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**[Turn over]**

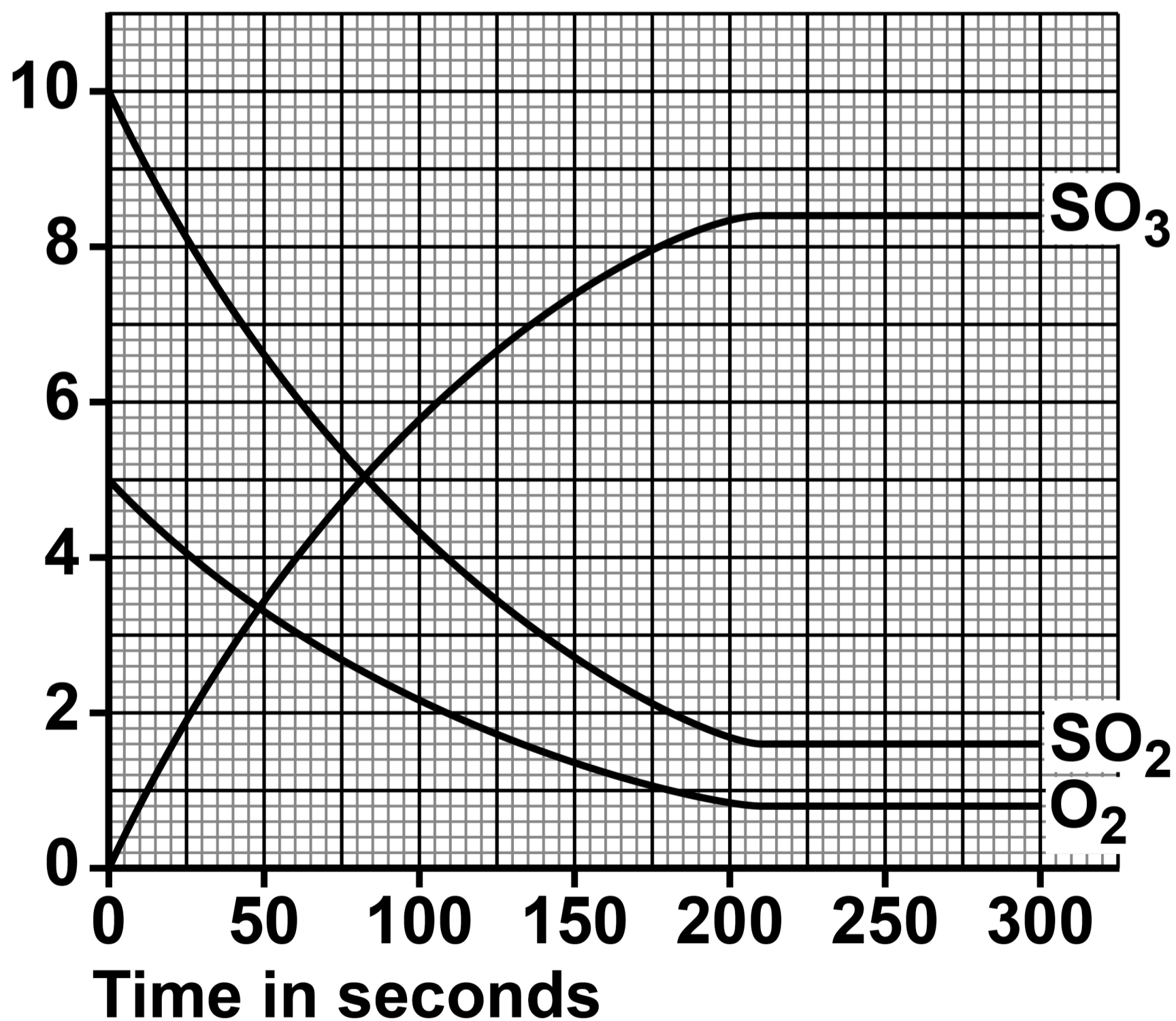


A scientist measured how the number of moles of sulfur dioxide, oxygen and sulfur trioxide varied with time during the reaction.

FIGURE 5 shows the results.

FIGURE 5

Number of moles



0 5 . 6

**Determine the time taken for the reaction to reach equilibrium.**

**Explain your answer.**

**Use FIGURE 5. [3 marks]**

**Time \_\_\_\_\_ s**

**Explanation**

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**[Turn over]**

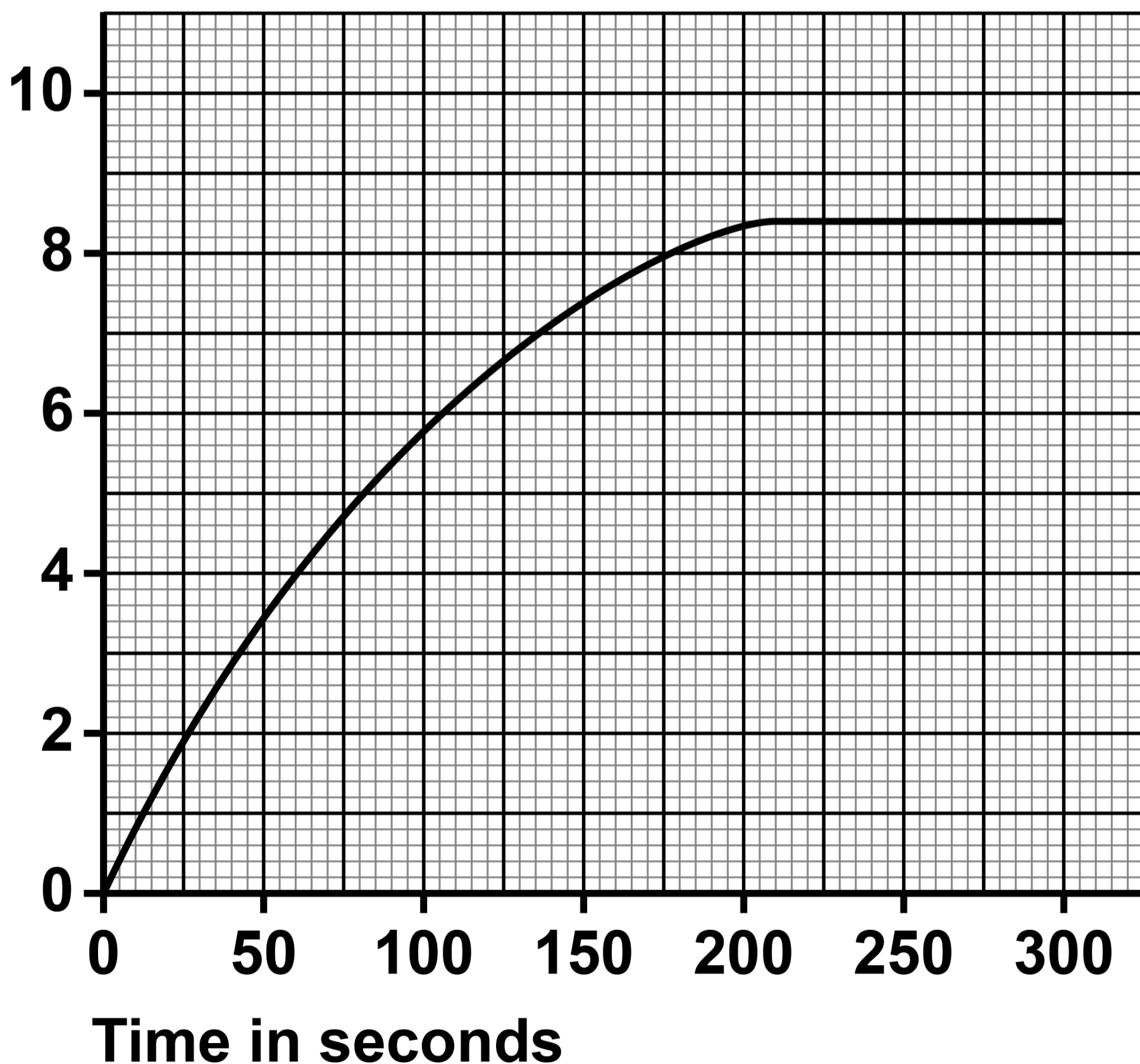


05.7

FIGURE 6 shows the results for sulfur trioxide.

## FIGURE 6

Number of moles  
of sulfur trioxide





0	6
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**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
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**Give ONE DISADVANTAGE of using distillation to produce potable water.  
[1 mark]**

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06.2

**Describe ONE other method to produce potable water from sea water. [2 marks]**

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**[Turn over]**



**A student investigated the mass of dissolved solids in a 100 cm<sup>3</sup> sample of sea water.**

**This is the method used.**

- 1. Weigh an evaporating basin.**
- 2. Measure 100 cm<sup>3</sup> 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
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**Explain how repeating steps 4 and 5 would improve this method. [2 marks]**

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**[Turn over]**



0	6	.	4
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The total mass of dissolved solids in a  $100 \text{ cm}^3$  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  $100 \text{ cm}^3$  sample of sea water. [2 marks]

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Mass of sodium chloride = \_\_\_\_\_ g



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**[Turn over]**



**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

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**[Turn over]**





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**[Turn over]**



06.7

**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<sup>2</sup>.**

**One hectare = 10 000 m<sup>2</sup>**

**[3 marks]**

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Area required = \_\_\_\_\_ m<sup>2</sup>

**END OF QUESTIONS**

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
<b>TOTAL</b>	

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**WP/M/CH/Jun24/8464/C/2H/G4005/V3**



5 6



2 4 6 G 8 4 6 4 / C / 2 H