



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

**Other Names** \_\_\_\_\_

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

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

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

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

**GCSE**

**COMBINED SCIENCE: TRILOGY**

**Foundation Tier**

**Chemistry Paper 2F**

**F**

**8464/C/2F**

**Time allowed: 1 hour 15 minutes**

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**



**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.**
- **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
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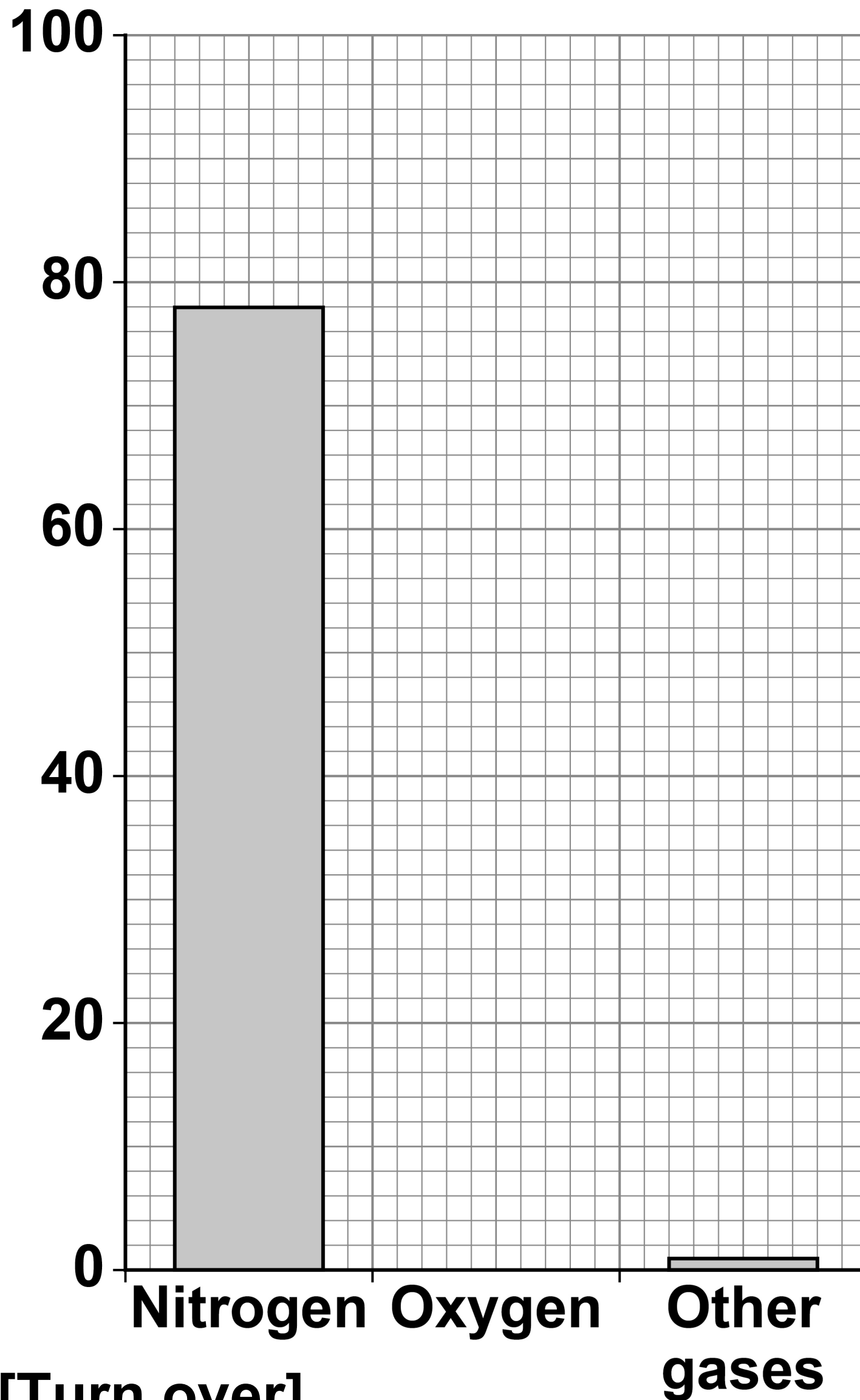
**This question is about the Earth's atmosphere.**

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

**The Earth's atmosphere contains 21% oxygen.**

**Draw the bar for oxygen on FIGURE 1, on the opposite page. [1 mark]**

**FIGURE 1**  
**Percentage of gas in**  
**Earth's atmosphere**



[Turn over]



0	1	.	2
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**What is used to test for oxygen gas?**  
**[1 mark]**

**Tick (✓) ONE box.**

☐

**A burning splint**

☐

**A glowing splint**

☐

**Damp litmus paper**

☐

**Limewater**



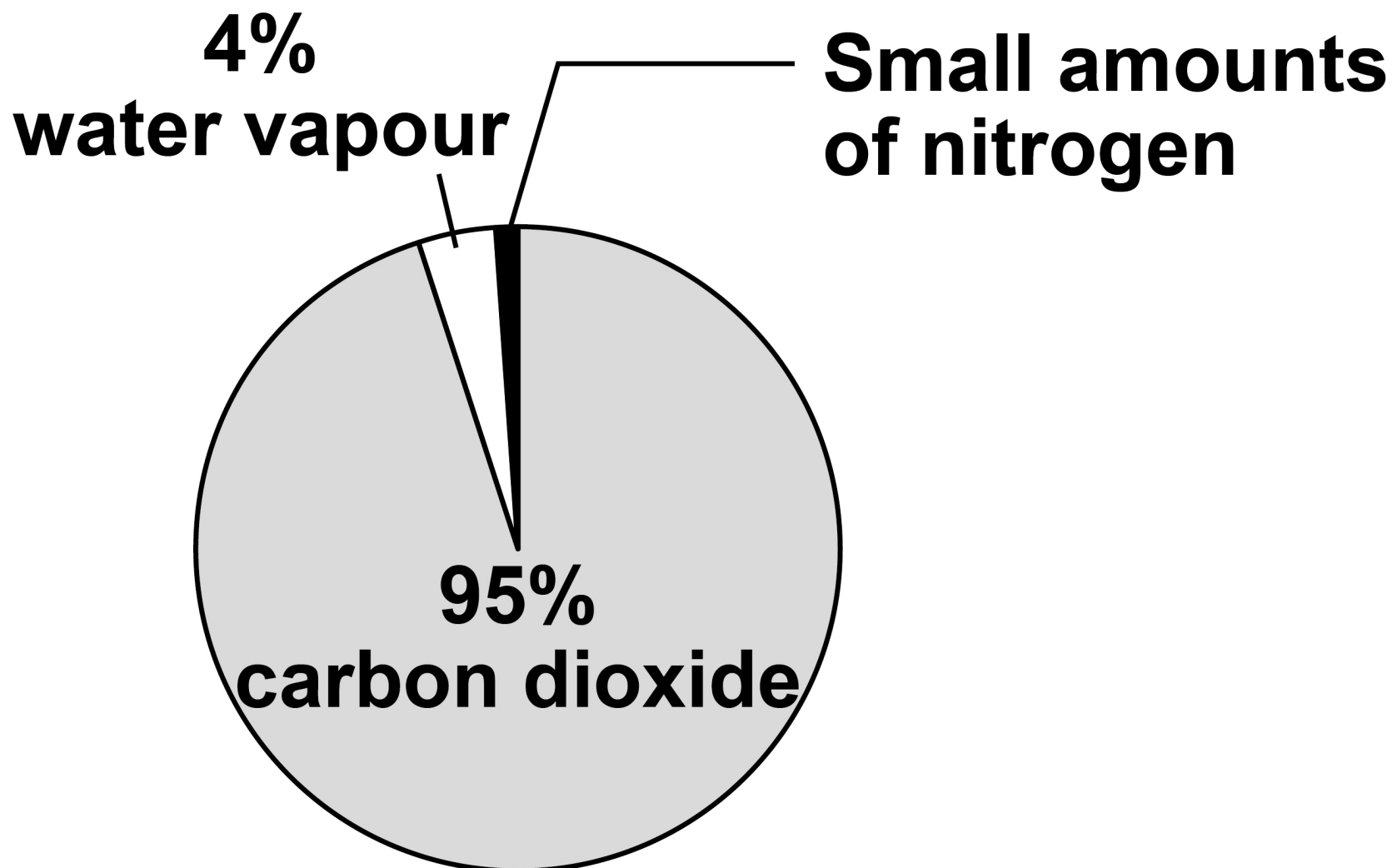
**The Earth's early atmosphere was very different from the Earth's atmosphere today.**

**FIGURE 2, on page 8, shows the composition of the Earth's early atmosphere and of the Earth's atmosphere today.**

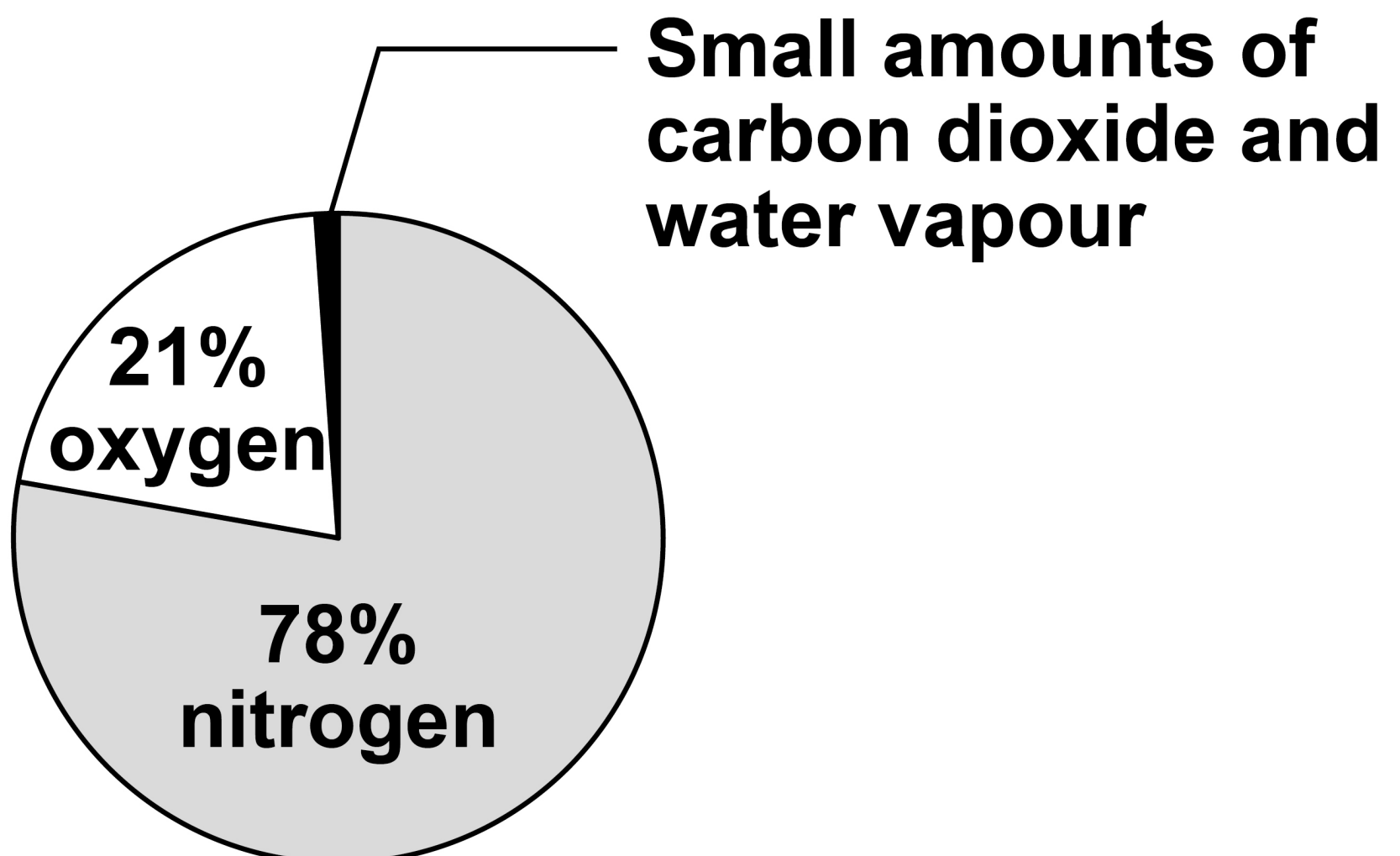
**[Turn over]**



**FIGURE 2**  
**Earth's early atmosphere**



**Earth's atmosphere today**





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

**The percentages of nitrogen and oxygen in the Earth's atmosphere today are different from the Earth's early atmosphere.**

**Complete the sentences on page 11.**

**Choose answers from the list below.**

**Use FIGURE 2.**

**Each answer can be used once, more than once or not at all. [2 marks]**

- **decreased**
- **increased**
- **stayed the same**

**[Turn over]**



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**Since the Earth's early atmosphere, the percentage of nitrogen in the Earth's atmosphere has \_\_\_\_\_ .**

**Since the Earth's early atmosphere, the percentage of oxygen in the Earth's atmosphere has \_\_\_\_\_ .**

**[Turn over]**



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

**The Earth's atmosphere today contains a small amount of carbon dioxide.**

**Why has the percentage of carbon dioxide decreased since the Earth's early atmosphere? [2 marks]**

**Tick (✓) TWO boxes.**

☐

**Dissolved in oceans**

☐

**Formation of sedimentary rocks**

☐

**Industrialisation**

☐

**Respiration**

☐

**Volcanic activity**



**Oxides of nitrogen are produced when nitrogen reacts with oxygen in car engines.**

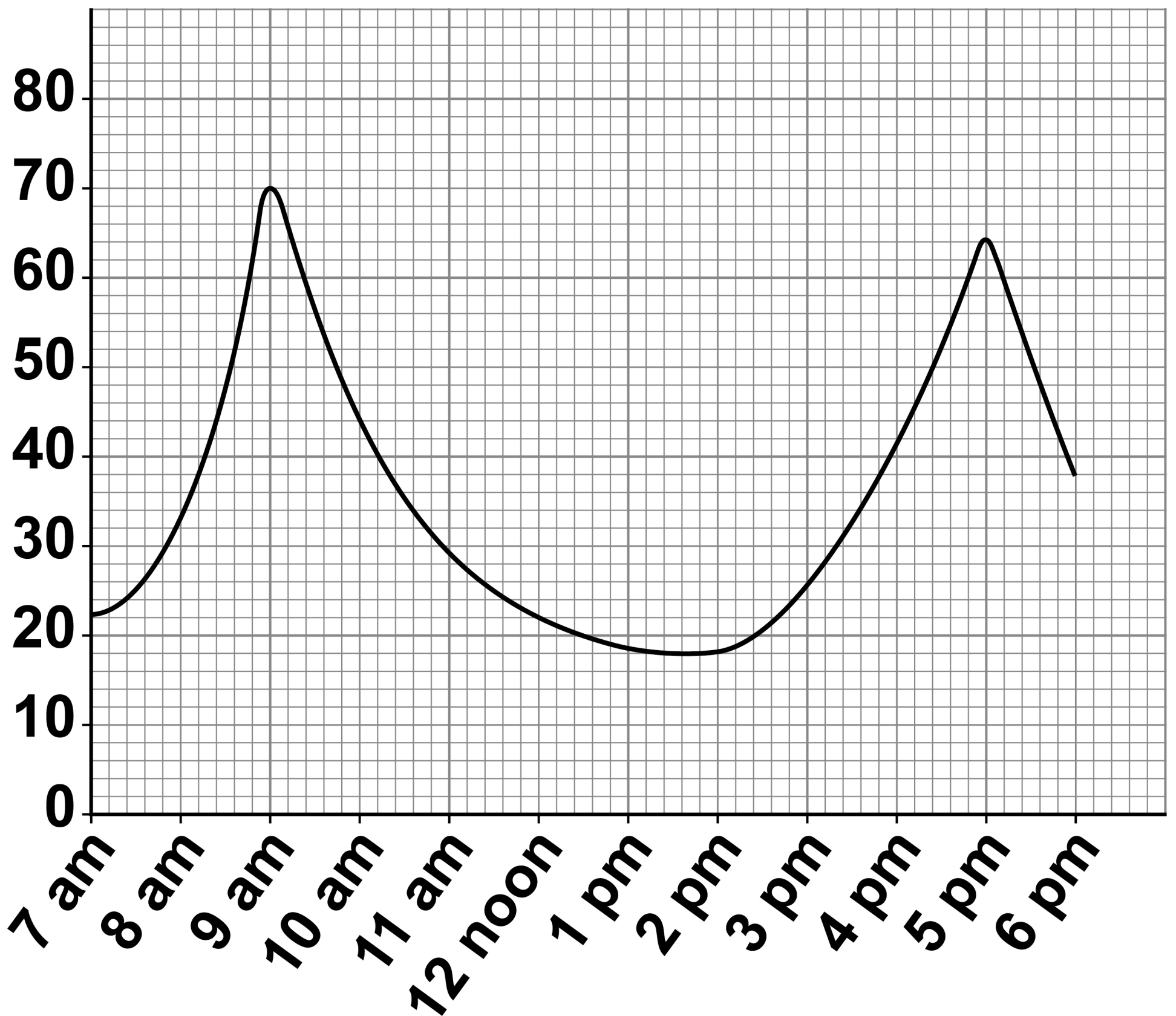
**FIGURE 3, on page 14, shows the concentration of oxides of nitrogen in the atmosphere during one day in a city.**

**[Turn over]**



**FIGURE 3**

**Concentration in micrograms per cubic metre**



**Time**



0	1	.	5
---	---	---	---

**Which TWO TIMES have the highest concentrations of oxides of nitrogen in the atmosphere? [2 marks]**

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

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

0	1	.	6
---	---	---	---

**Suggest why there are the highest concentrations of oxides of nitrogen at these times. [1 mark]**

---

---

---

**[Turn over]**

9



0	2
---	---

**This question is about fuels.**

**Coal deposits were formed from the remains of trees.**

0	2	.	1
---	---	---	---

**Name the process in the leaves of trees that uses carbon dioxide. [1 mark]**

---





**02.2**

**How is coal formed after trees die?**  
**[1 mark]**

**Tick (✓) ONE box.**

☐

**The trees are burned.**

☐

**The trees are compressed.**

☐

**The trees are melted.**

**Coal contains small amounts of sulfur.**

**02.3**

**Name the gas produced when sulfur burns in oxygen. [1 mark]**

---

**[Turn over]**



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

**Give TWO problems caused by the gas produced when sulfur burns in oxygen.  
[2 marks]**

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_



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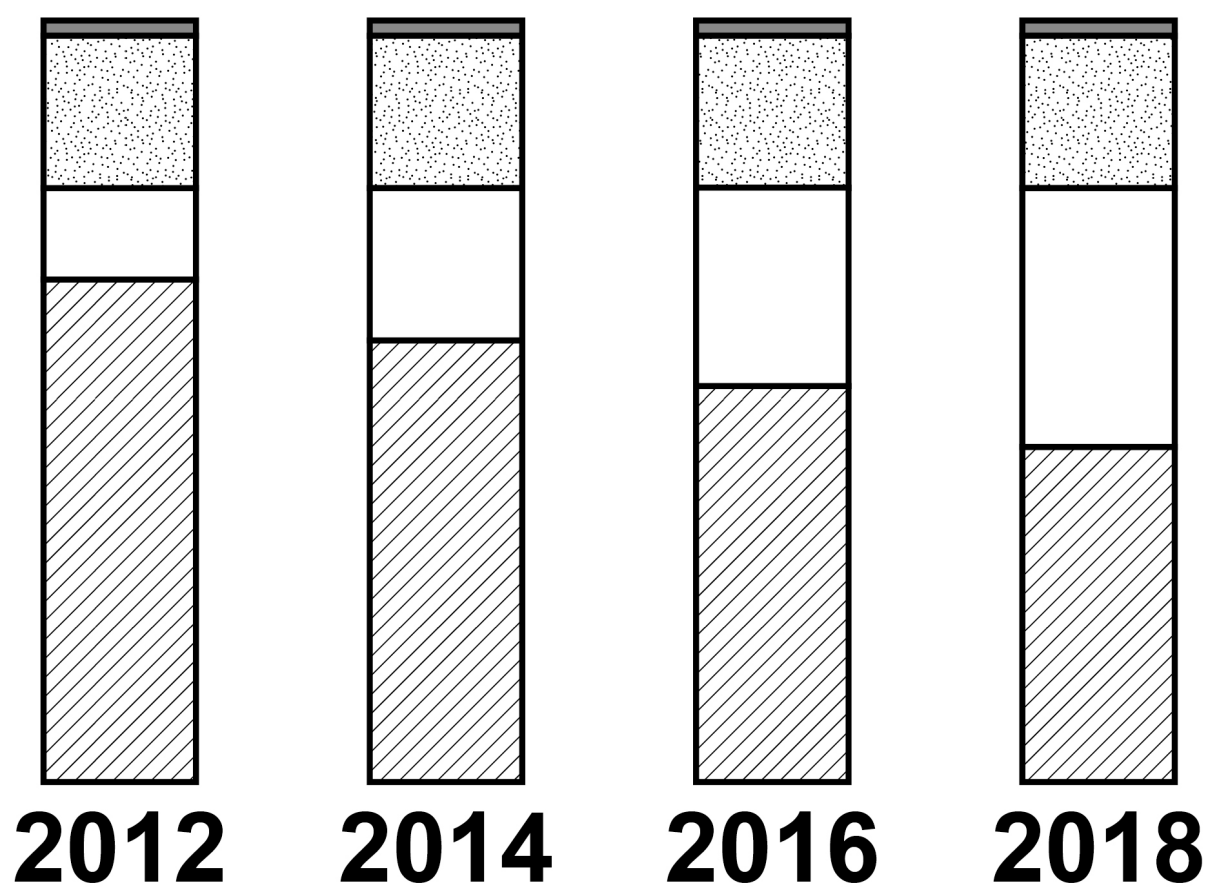
**[Turn over]**



02.5

**FIGURE 4** shows the relative amount of electricity generated from different fuel sources in the UK from 2012 to 2018.

**FIGURE 4**



**KEY**

-  Other
-  Nuclear fuel
-  Renewable fuels
-  Fossil fuels

**Describe what happens to the amounts of fuels used to generate electricity in the UK from 2012 to 2018. [3 marks]**

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**[Turn over]**

8

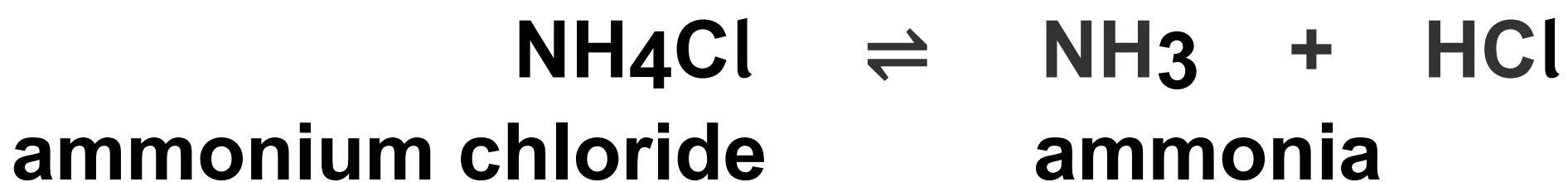


03

**This question is about ammonia and its compounds.**

**A student heated a sample of ammonium chloride.**

**The equation for the reaction is:**



03.1

**One product is ammonia.**

**What is the name of the product with the formula HCl? [1 mark]**

---



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

**Ammonia is a gas.**

**What is the state symbol for ammonia?**  
**[1 mark]**

**Tick (✓) ONE box.**

☐

**(aq)**

☐

**(g)**

☐

**(l)**

☐

**(s)**

**[Turn over]**



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

**How does the equation show that the reaction is reversible? [1 mark]**

---

---

---

0	3	.	4
---	---	---	---

**Complete the sentence. [1 mark]**

**The forward reaction is endothermic, so the reverse reaction is \_\_\_\_\_.**





0	3	.	5
---	---	---	---

**Complete the sentence.**

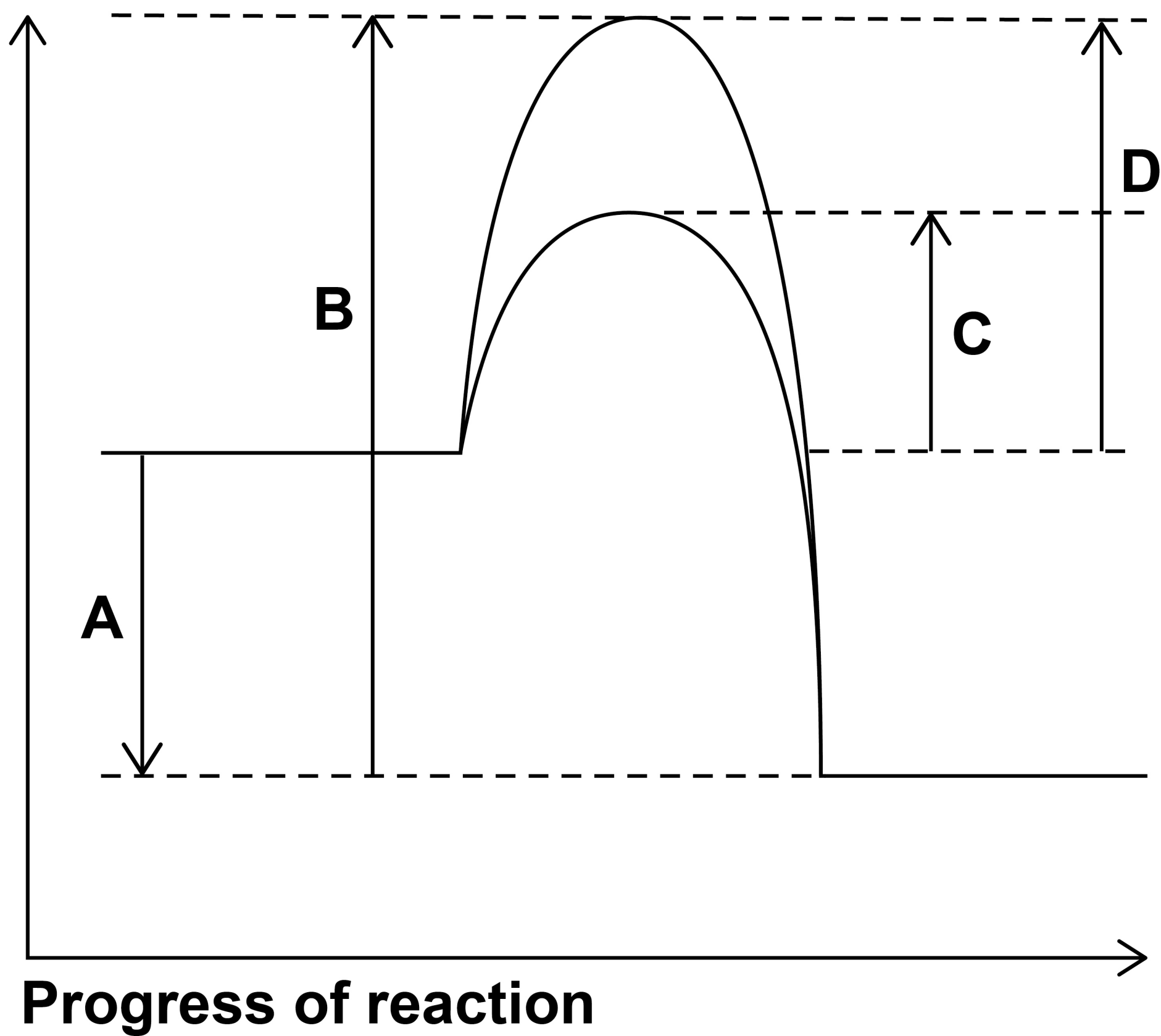
**Choose the answer from the list.**  
**[1 mark]**

- **concentration**
- **rate**
- **temperature**

**Equilibrium is reached when the forward and reverse reactions happen at exactly the same \_\_\_\_\_.**

**[Turn over]**



**FIGURE 5****Energy**

**The industrial process to produce ammonia uses a catalyst.**

**03.6**

**FIGURE 5, on the opposite page, shows the reaction profile for the reaction with and without a catalyst.**

**Which letter represents the activation energy for the reaction with a catalyst?**  
**[1 mark]**

**Tick (✓) ONE box.**

☐

**A**

☐

**B**

☐

**C**

☐

**D**

**[Turn over]**



0	3	.	7
---	---	---	---

**Give ONE reason why using a catalyst reduces costs.**

**Do NOT answer in terms of activation energy. [1 mark]**

---

---

---

0	3	.	8
---	---	---	---

**Ammonia is in a mixture that is used as a household cleaner.**

**What is a mixture that has been designed as a useful product called? [1 mark]**

---

---

8



0	4
---	---

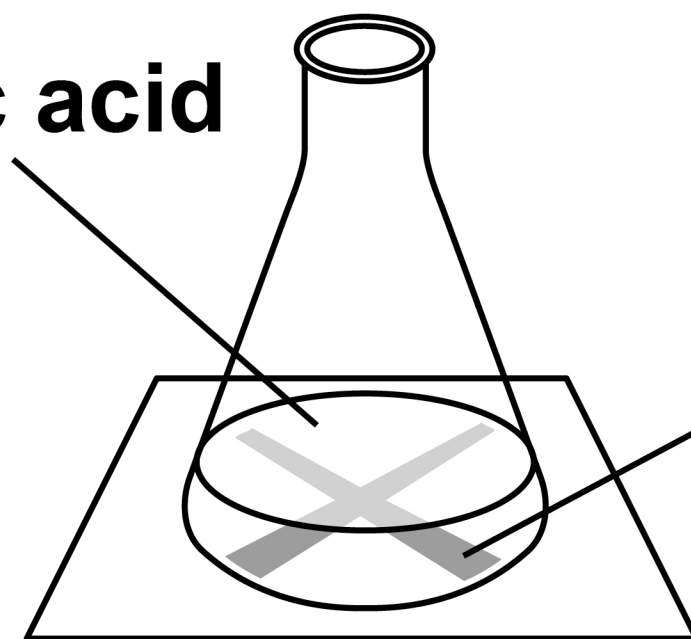
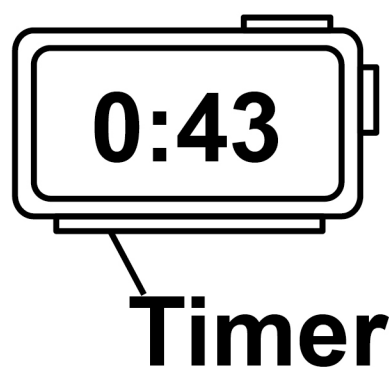
**A student investigates the effect of concentration on the rate of the reaction between sodium thiosulfate solution and hydrochloric acid.**

**FIGURE 6 shows the experiment.**

**The experiment was done in a fume cupboard.**

## **FIGURE 6**

**Sodium thiosulfate solution and hydrochloric acid**



**Black cross drawn on a piece of paper**

**[Turn over]**



**This is the method used.**

- 1. Pour 50 cm<sup>3</sup> of sodium thiosulfate solution into a conical flask.**
- 2. Put the conical flask on a black cross drawn on a piece of paper.**
- 3. Pour 10 cm<sup>3</sup> of hydrochloric acid into the conical flask and start a timer.**
- 4. Stop the timer when the cross can no longer be seen.**
- 5. Repeat the experiment with different concentrations of sodium thiosulfate solution.**

**0 4 . 1**

**On the opposite page, draw ONE line from each type of variable to the correct example of the variable in this investigation. [2 marks]**



**Type of variable**

**Example of variable**

**Dependent**

**Concentration of  
sodium thiosulfate  
solution**

**Temperature of  
reaction mixture**

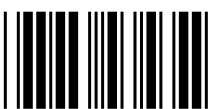
**Time taken for the  
cross to no longer  
be seen**

**Independent**

**Volume of acid**

**Volume of the  
flask**

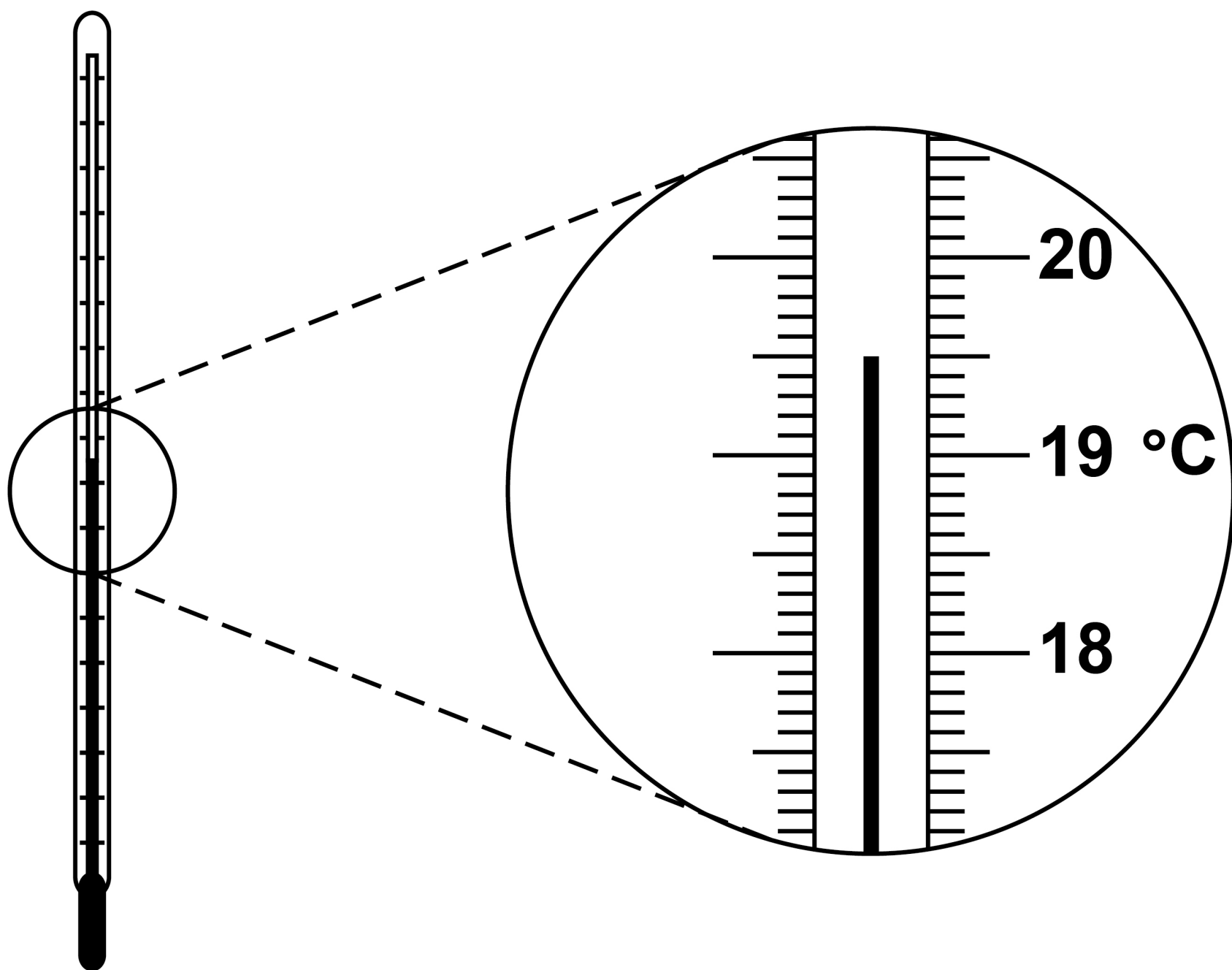
**[Turn over]**



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

The experiment is done at room temperature.

**FIGURE 7**



What is the temperature shown on the thermometer in **FIGURE 7**? [1 mark]

Temperature = \_\_\_\_\_ °C





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**[Turn over]**



**TABLE 1 shows the student's results.**

**TABLE 1**

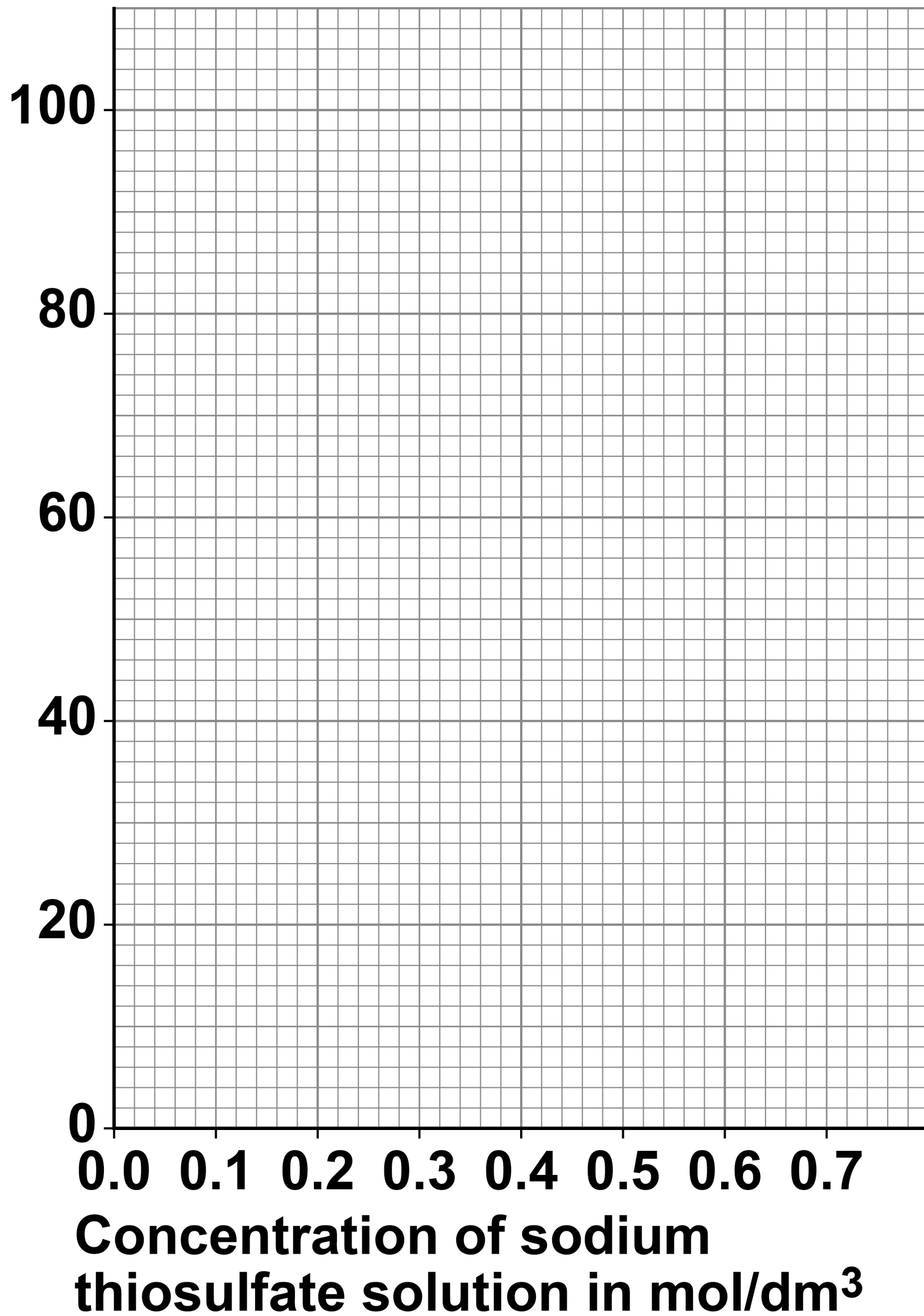
<b>Concentration of sodium thiosulfate solution in mol/dm<sup>3</sup></b>	<b>Time in seconds</b>
<b>0.1</b>	<b>82</b>
<b>0.2</b>	<b>40</b>
<b>0.3</b>	<b>20</b>
<b>0.4</b>	<b>13</b>
<b>0.5</b>	<b>10</b>
<b>0.6</b>	<b>8</b>

**0 4 . 3**

**Plot the data from TABLE 1 on FIGURE 8, on the opposite page.**

**Draw a line of best fit. [3 marks]**



**FIGURE 8****Time in seconds****[Turn over]**

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

**Predict the time taken for the cross to no longer be seen at a concentration of  $0.7 \text{ mol/dm}^3$**

**Use your graph in FIGURE 8, on page 35.  
[1 mark]**

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

0	4	.	5
---	---	---	---

**Complete the sentence. [1 mark]**

**As the concentration of sodium thiosulfate solution increases, the time taken for the cross to no longer be seen \_\_\_\_\_.**

**[Turn over]**



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

In one experiment 0.725 g of sulfur is produced in 20 seconds.

Calculate the mean rate of the reaction from 0 to 20 seconds.

Use the equation:

mean rate of reaction =

$$\frac{\text{mass of sulfur produced in grams}}{\text{time in seconds}}$$

[2 marks]

---

---

---

---

Mean rate of reaction = \_\_\_\_\_



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

**What is the unit for the mean rate of reaction calculated in Question 04.6?**  
**[1 mark]**

**Tick (✓) ONE box.**

☐

**g**

☐

**g/s**

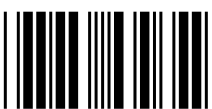
☐

**s**

☐

**s/g**

**[Turn over]**



0	4	.	8
---	---	---	---

The student did the experiment with  $0.15 \text{ mol/dm}^3$  sodium thiosulfate solution and repeated the experiment three more times.

TABLE 2 shows the results.

TABLE 2

	Test 1	Test 2	Test 3	Test 4
Time in seconds for the cross to no longer be seen	60.5	63.2	82.3	65.7

Calculate the mean time for this reaction.

Do NOT include the anomalous result in your calculation.

Give your answer to 3 significant figures.  
[3 marks]





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**Mean time for the reaction**  
**(3 significant figures) = \_\_\_\_\_ s**

**[Turn over]**

<b>14</b>

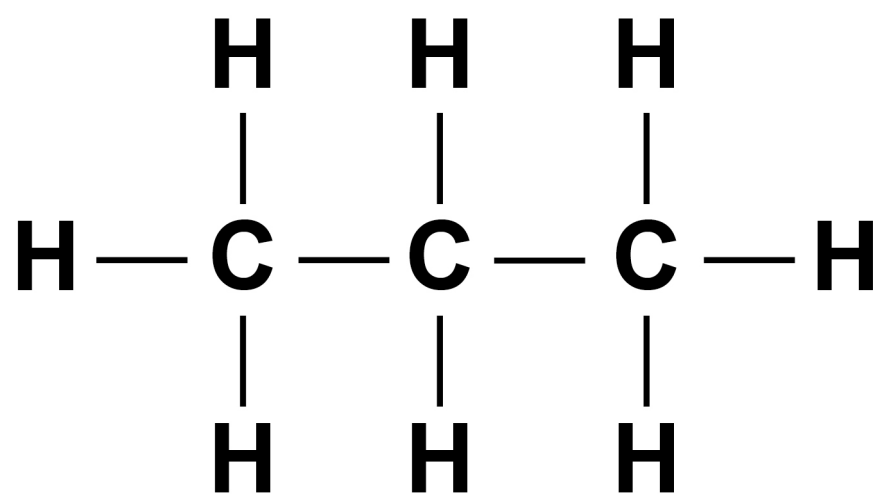


05

This question is about hydrocarbons.

FIGURE 9 shows a hydrocarbon.

FIGURE 9



05.1

Complete the formula for the hydrocarbon shown in FIGURE 9.  
[1 mark]

C \_\_\_\_\_ H \_\_\_\_\_



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

**What is the name of the hydrocarbon in FIGURE 9? [1 mark]**

---

0	5	.	3
---	---	---	---

**Which homologous series does the hydrocarbon in FIGURE 9 belong to? [1 mark]**

---

**[Turn over]**



0	5	.	4
---	---	---	---

30 g of another hydrocarbon contains  
24 g of carbon.

Which calculation gives the percentage  
of carbon in the hydrocarbon? [1 mark]

Tick (✓) ONE box.

<input type="checkbox"/>	$\frac{24 \times 30}{100}$
--------------------------	----------------------------

<input type="checkbox"/>	$\frac{100 \times 30}{24}$
--------------------------	----------------------------

<input type="checkbox"/>	$\frac{24 \times 100}{30}$
--------------------------	----------------------------

<input type="checkbox"/>	$\frac{24}{30 \times 100}$
--------------------------	----------------------------



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**[Turn over]**



05.5

TABLE 3 shows boiling points of some hydrocarbons.

TABLE 3

Formula of hydrocarbon	Boiling point in °C
C <sub>2</sub> H <sub>6</sub>	–89
C <sub>4</sub> H <sub>10</sub>	0
C <sub>6</sub> H <sub>14</sub>	69
C <sub>8</sub> H <sub>18</sub>	125
C <sub>10</sub> H <sub>22</sub>	174



**Describe how the boiling points change as the number of carbon atoms in the hydrocarbon increases. [1 mark]**

---

---

---

**Hydrocarbons can be cracked.**

**0 5 . 6**

**Give ONE condition used to crack hydrocarbons. [1 mark]**

---

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---

**[Turn over]**



0	5	.	7
---	---	---	---

**Balance the equation for the cracking of  $\text{C}_6\text{H}_{14}$**

**[1 mark]**



0	5	.	8
---	---	---	---

**Give ONE reason why hydrocarbons are cracked. [1 mark]**

---

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**[Turn over]**



0	5	.	9
---	---	---	---

**Window frames can be manufactured from wood or plastic.**

**TABLE 4 shows the results of a life cycle assessment (LCA) for making one wooden and one plastic window frame.**

**Both window frames are the same size.**

**TABLE 4**

**This item cannot be reproduced here  
due  
to third-party copyright restrictions**



**Give THREE advantages of using wood instead of plastic in the manufacture of window frames. [3 marks]**

**Advantage of wood 1** \_\_\_\_\_

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---

**Advantage of wood 2** \_\_\_\_\_

---

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**[Turn over]**



Advantage of wood 3 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



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**[Turn over]**



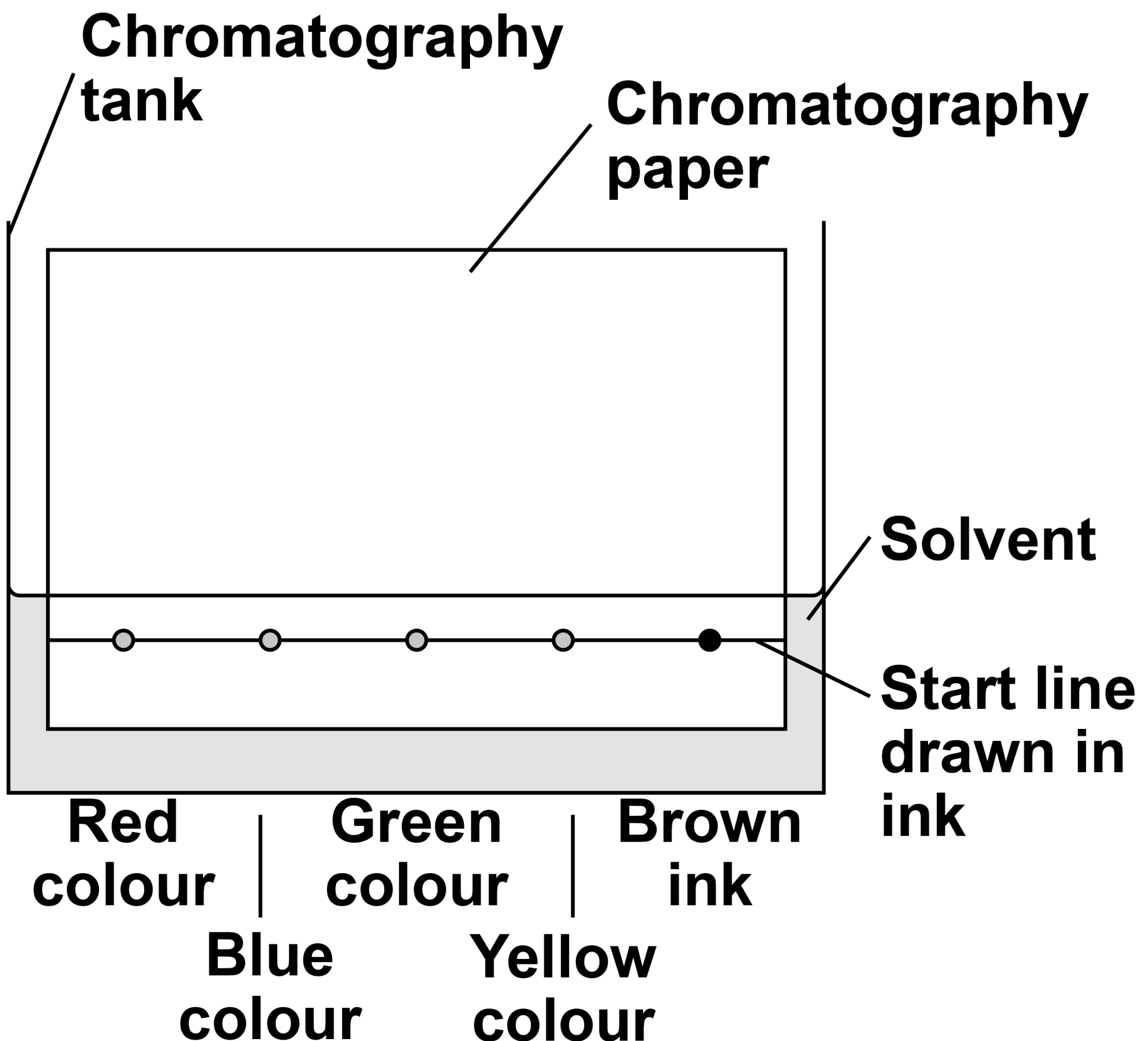
06

A student investigated the colours in a brown ink using chromatography.

06.1

FIGURE 10 shows the apparatus used.

FIGURE 10



**Give TWO errors made by the student.**

**Describe the problem each error would cause. [4 marks]**

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

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

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

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

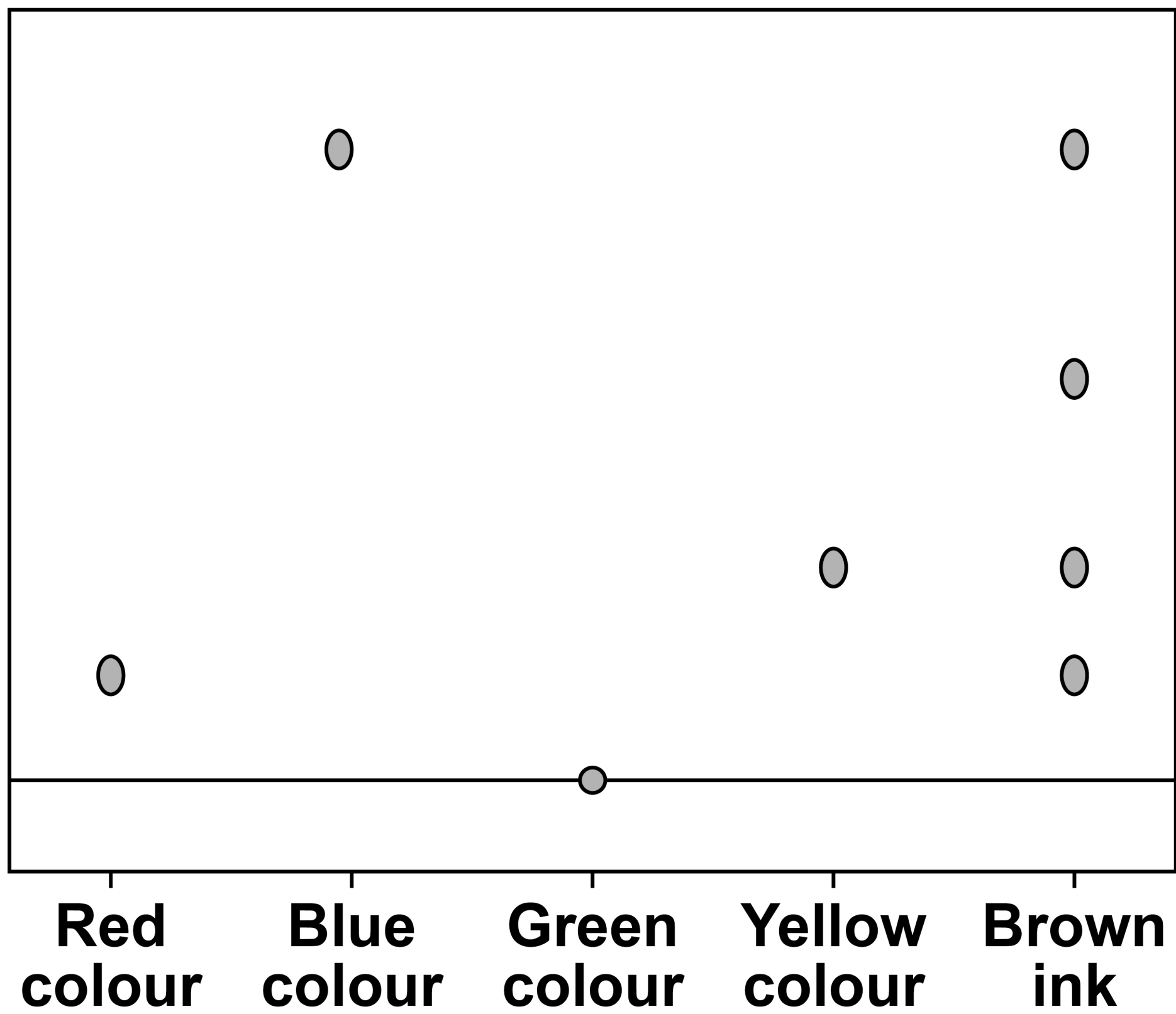
**[Turn over]**



A different student set up the apparatus correctly.

FIGURE 11 shows the results.

FIGURE 11





0	6	.	2
---	---	---	---

**Give TWO conclusions the student can make from FIGURE 11 about the four colours in the brown ink. [2 marks]**

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

**[Turn over]**



0	6	.	3
---	---	---	---

**Why was the green colour still on the start line at the end of the experiment?  
[1 mark]**

**Tick (✓) ONE box.**

☐

**The experiment was left for too long.**

☐

**The green colour was insoluble in the solvent.**

☐

**The green spot contained too many colours.**

☐

**The green spot was too small.**

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**[Turn over]**



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

**A student calculated the  $R_f$  value of a colour to be 0.24**

**The colour moved 1.8 cm from the start line.**

**Calculate the distance the solvent moved.**

**Use the equation:**

$$R_f = \frac{\text{distance moved by colour}}{\text{distance moved by solvent}}$$

**[3 marks]**

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**Distance moved by solvent = \_\_\_\_\_ cm**

**[Turn over]**

<b>10</b>



0	7	.	1
---	---	---	---

**Water that is safe to drink is called potable water.**

**Compare how easily potable water can be obtained from:**

- **waste water (sewage)**
- **ground water (fresh water).**

**[6 marks]**

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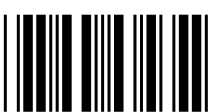
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**[Turn over]**



**A scientist produced potable water from 150 cm<sup>3</sup> of salty water.**

**07.2**

**Which process can be used to produce potable water from salty water? [1 mark]**

**Tick (✓) ONE box.**

☐

**Distillation**

☐

**Electrolysis**

☐

**Filtration**

☐

**Sterilisation**





0	7	.	3
---	---	---	---

**The salty water contains sodium chloride.**

**The scientist collected 2.40 g of sodium chloride from 150 cm<sup>3</sup> of salty water.**

**Calculate the concentration of sodium chloride in grams per dm<sup>3</sup>  
[3 marks]**

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**[Turn over]**



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**Concentration of sodium chloride =**  
**\_\_\_\_\_ g/dm<sup>3</sup>**

**END OF QUESTIONS**

<b>10</b>



**Additional page, if required.**  
**Write the question numbers in the left-hand margin.**


**Additional page, if required.  
Write the question numbers in the  
left-hand margin.**

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**Additional page, if required.  
Write the question numbers in the  
left-hand margin.**

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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