A

Surname ________________________

Other Names ________________________

Centre Number ________________________

Candidate Number ________________________

Candidate Signature ________________________

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

F

Foundation Tier

Chemistry Paper 2F

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]

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

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

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]

0 1 . 2

What is used to test for oxygen gas? [1 mark]

Tick (✓) ONE box.

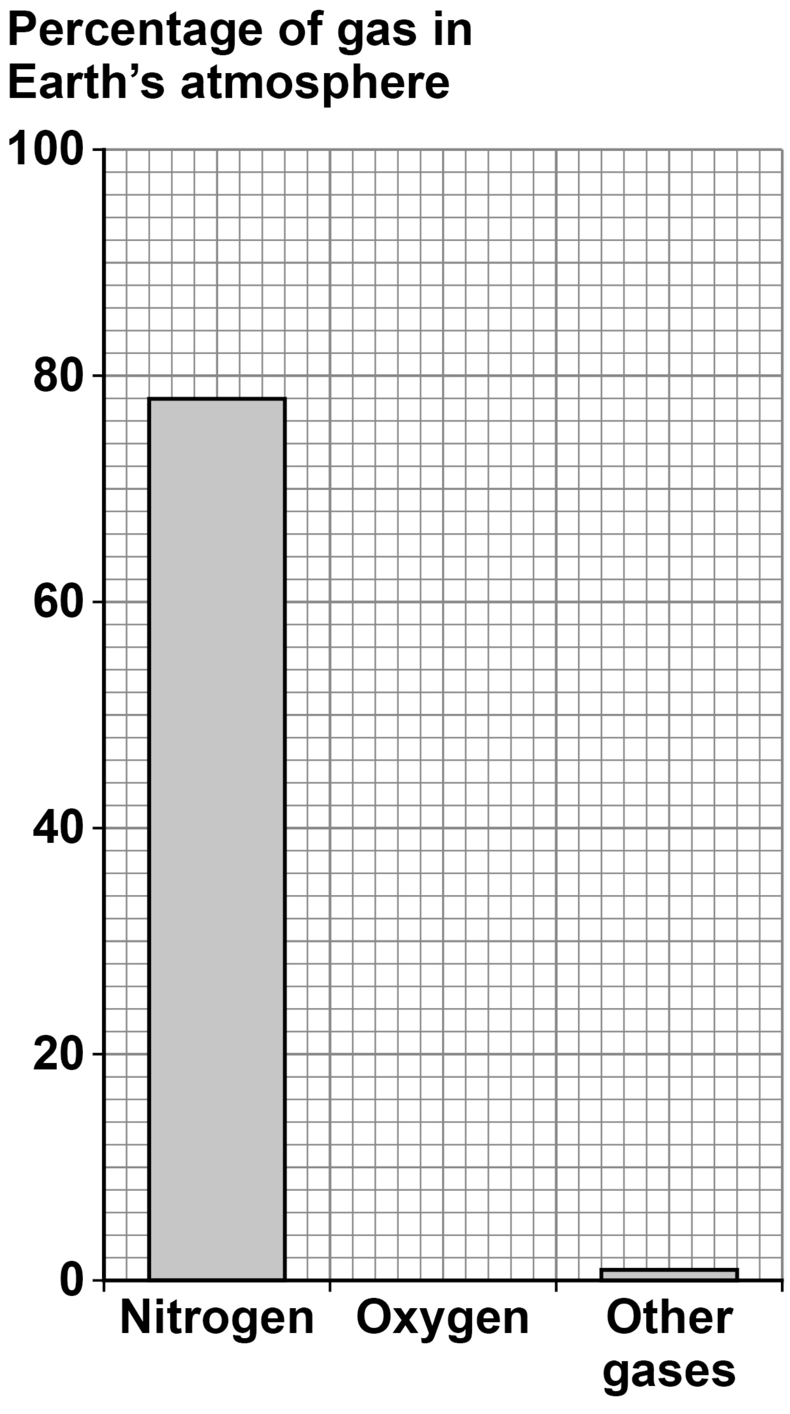
☐ **A burning splint**

☐ **A glowing splint**

☐ **Damp litmus paper**

☐ **Limewater**

FIGURE 1



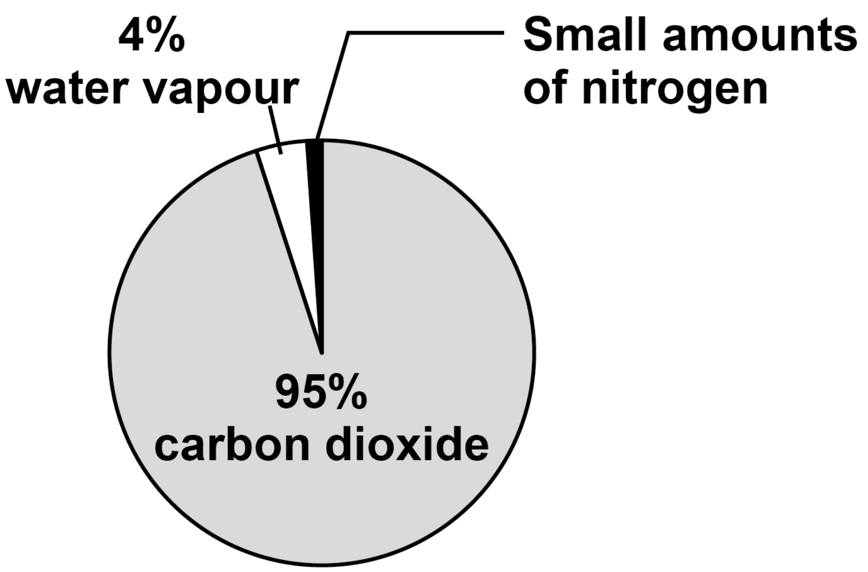
[Turn over]

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

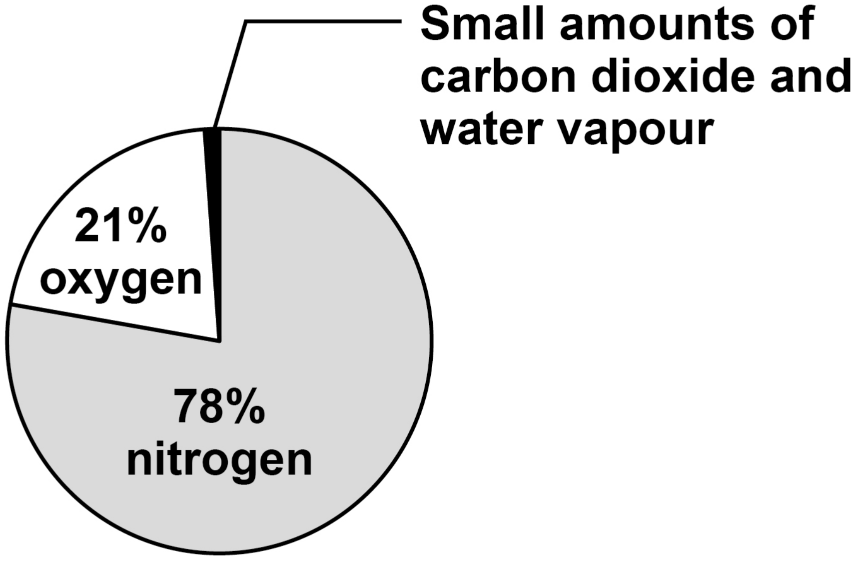
FIGURE 2 shows the composition of the Earth's early atmosphere and of the Earth's atmosphere today.

FIGURE 2

Earth's early atmosphere



Earth's atmosphere today



01.3

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

Complete the sentences.

Choose answers from the list.

Use FIGURE 2.

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

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

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

______________________________ .

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**

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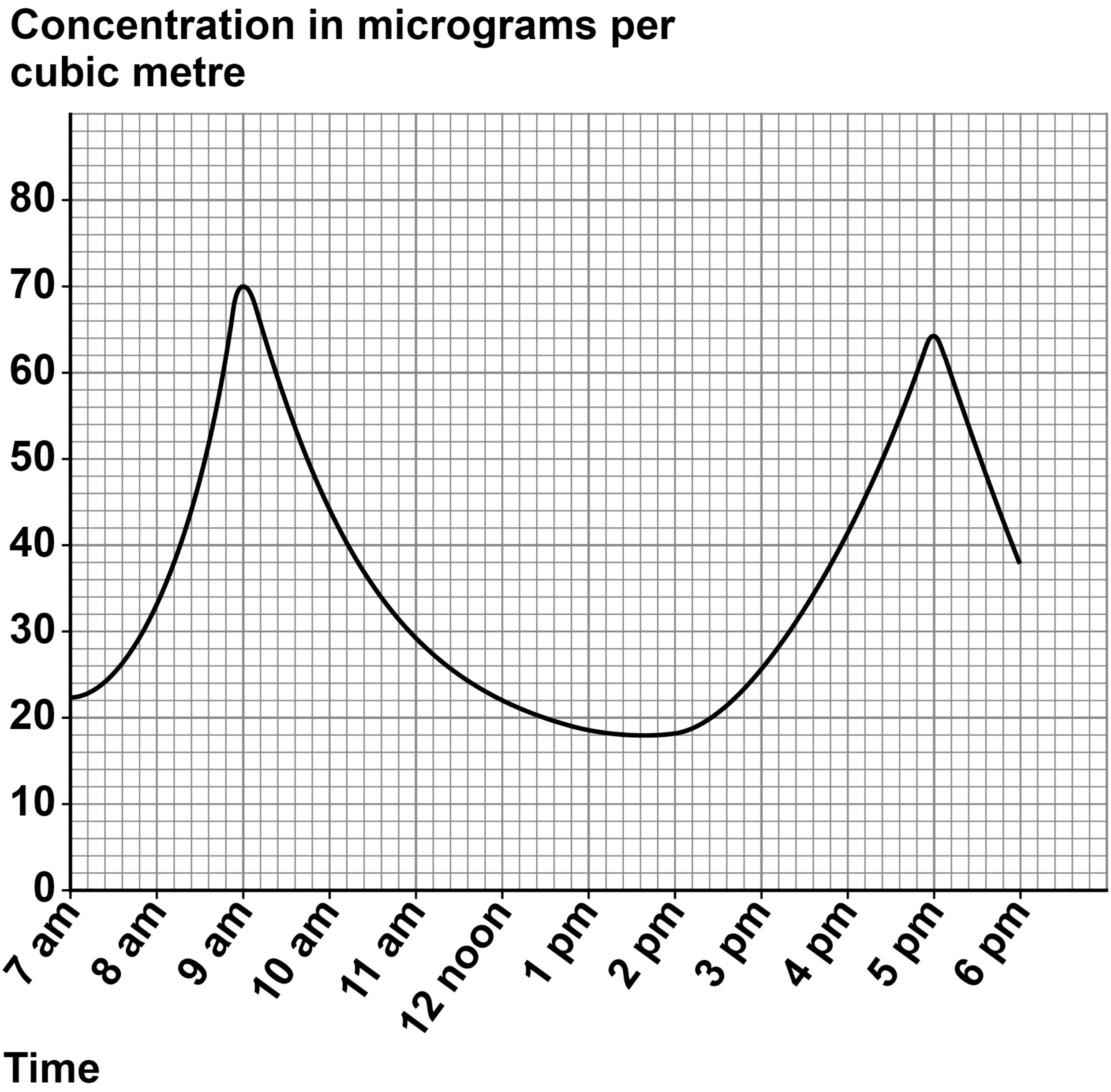
[Turn over]

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

FIGURE 3 shows the concentration of oxides of nitrogen in the atmosphere during one day in a city.

FIGURE 3



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]

____

0 2 . 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.

0 2 . 3

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

____

0 2 . 4

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

1 ____

____

____

2 ____

____

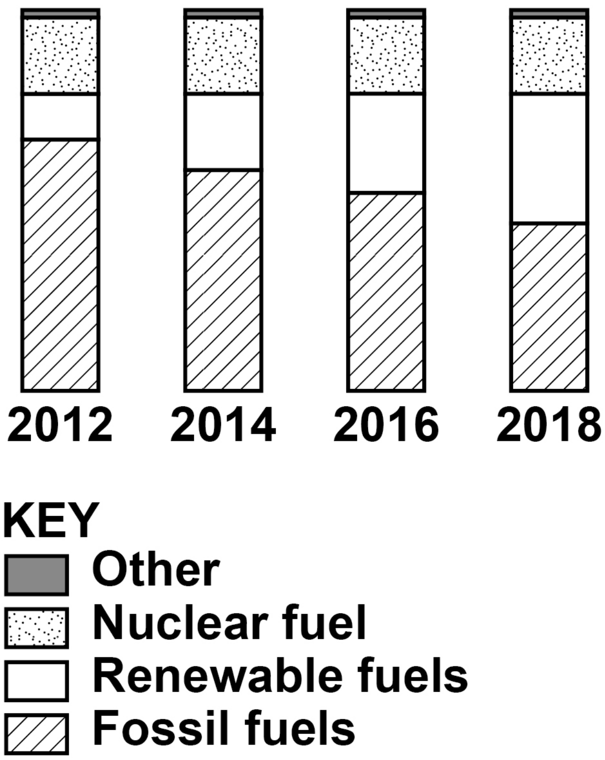
____

[Turn over]

0 2 . 5

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

FIGURE 4



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

[Turn over]

8

0 3

This question is about ammonia and its compounds.

A student heated a sample of ammonium chloride.

The equation for the reaction is:

$$NH_4Cl \rightleftharpoons NH_3 + HCl$$

ammonium chloride → **ammonia**

0 3 . 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)**

0 3 . 3

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

____

____

____

[Turn over]

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

_____________________________ .

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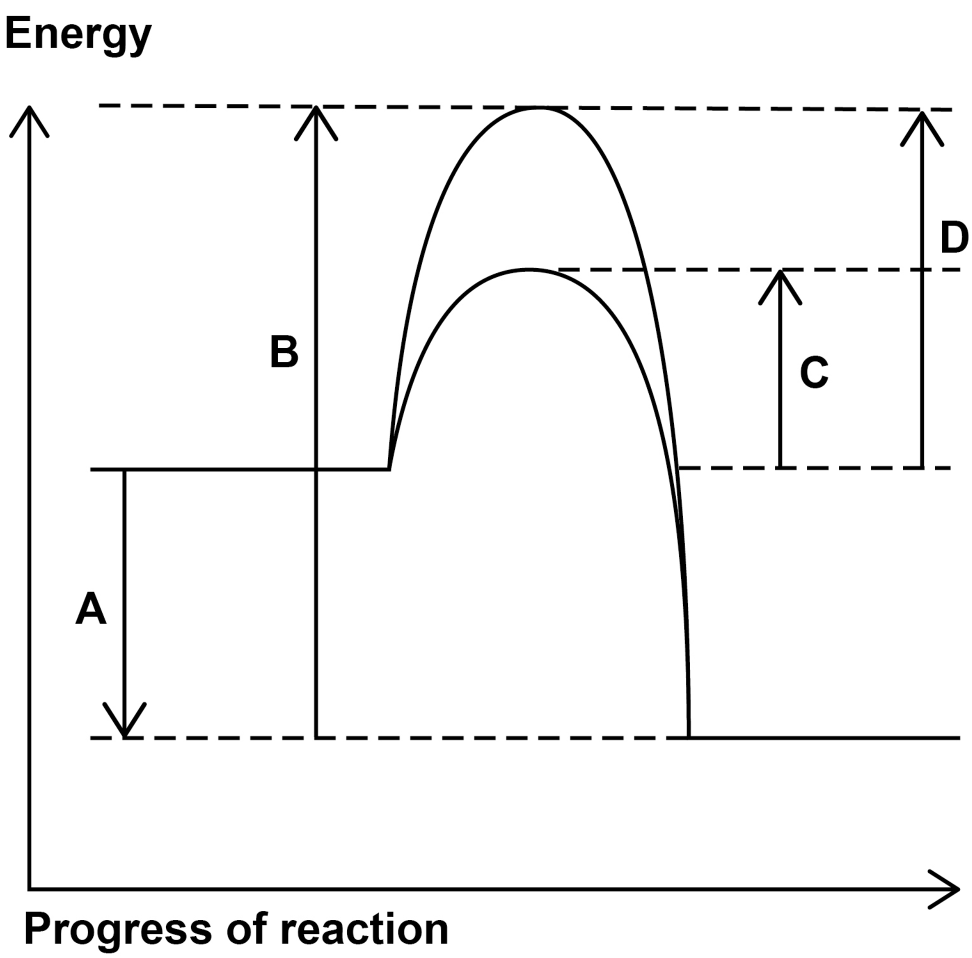
[Turn over]

The industrial process to produce ammonia uses a catalyst.

0 3 . 6

FIGURE 5 shows the reaction profile for the reaction with and without a catalyst.

FIGURE 5



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

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

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

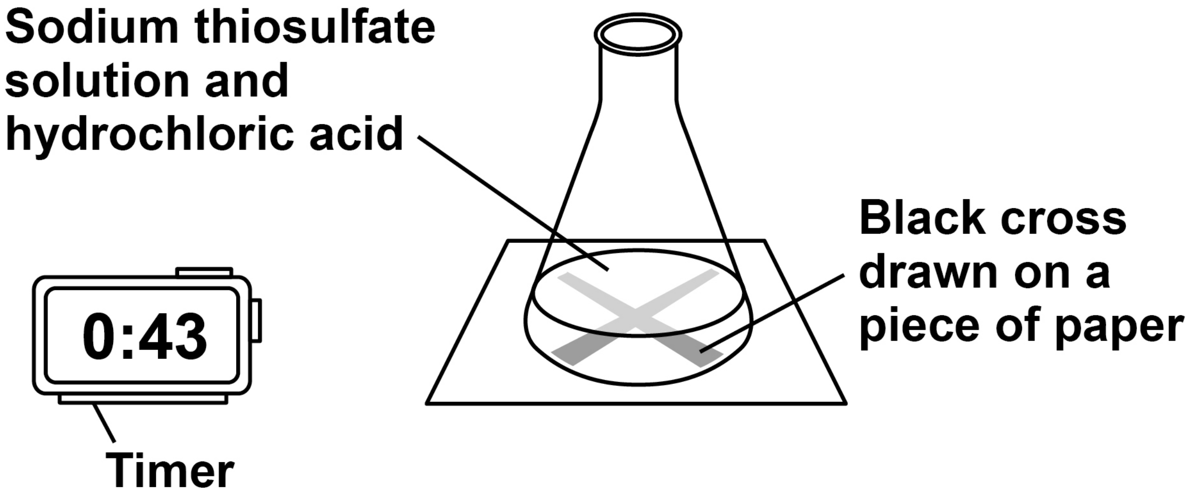
0 4

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



[Turn over]

This is the method used.

1. **Pour 50 cm^3 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^3 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

Draw ONE line from each type of variable to the correct example of the variable in this investigation. [2 marks]

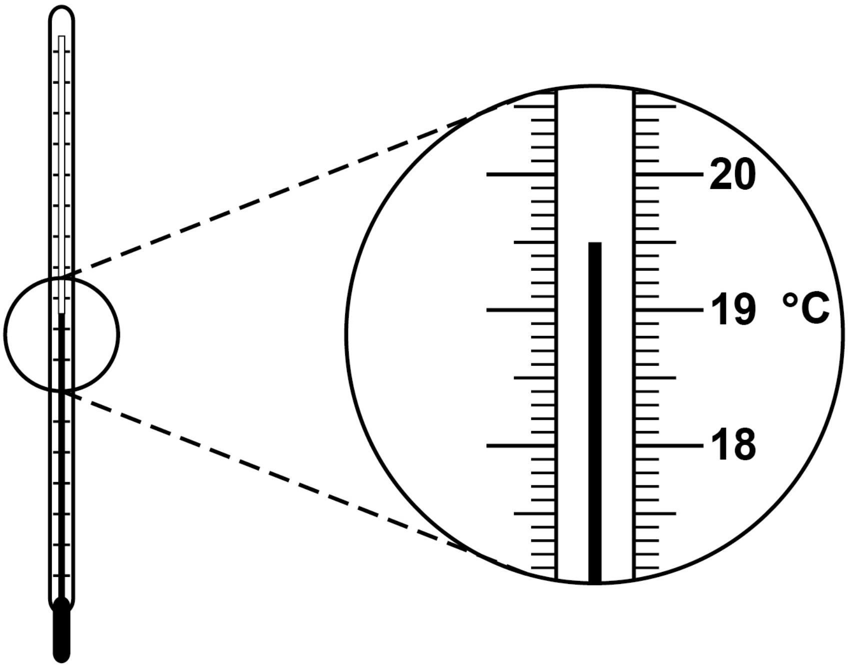
Type of variable	Example of variable
	Concentration of sodium thiosulfate solution
Dependent	
	Temperature of reaction mixture
	Time taken for the cross to no longer be seen
Independent	
	Volume of acid
	Volume of the flask

[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

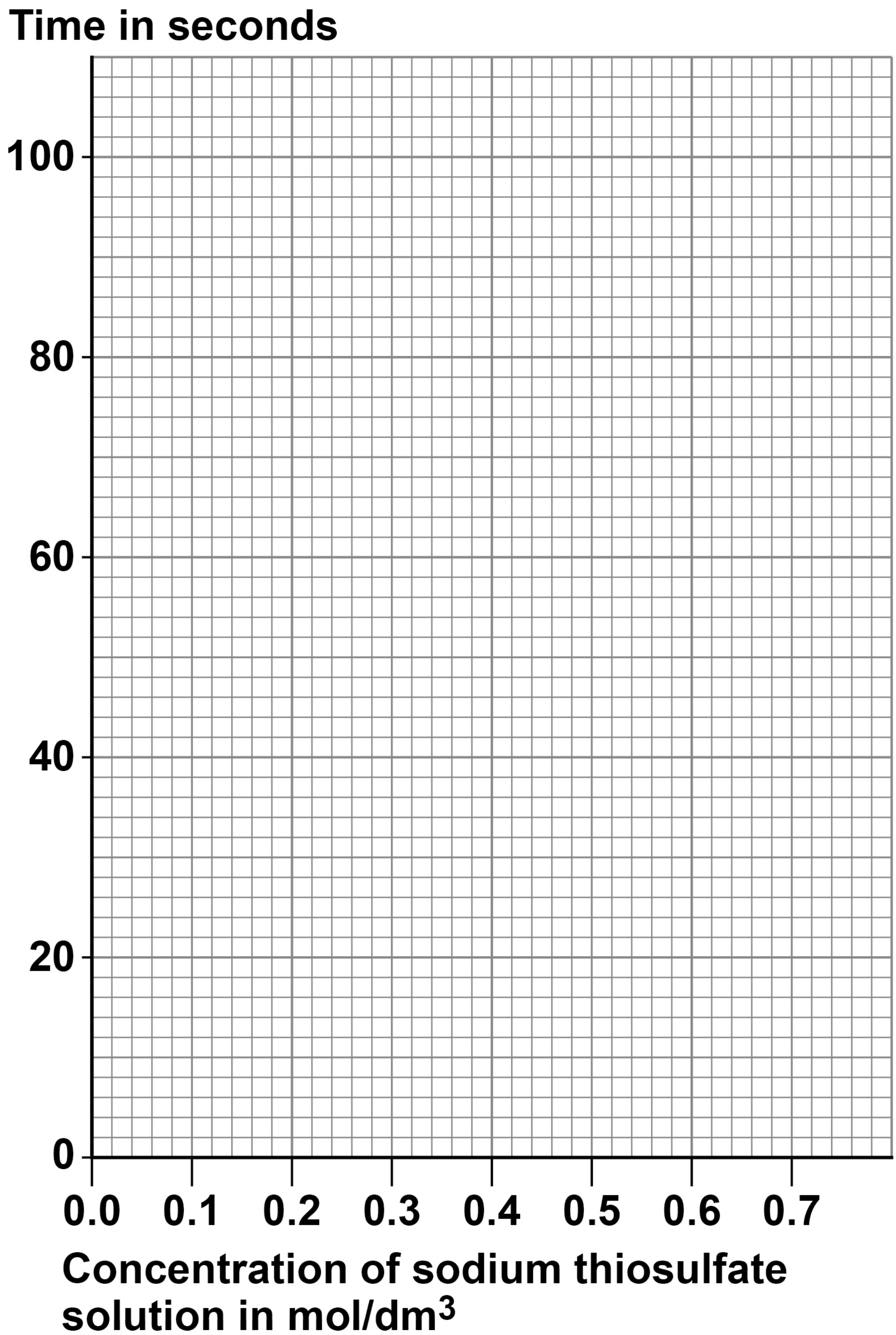
Concentration of sodium thiosulfate solution in mol/dm^3	Time in seconds
0.1	82
0.2	40
0.3	20
0.4	13
0.5	10
0.6	8

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



[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 mol/dm^3

Use your graph in FIGURE 8, on page 29. [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:

$$\text{mean rate of reaction} = \frac{\text{mass of sulfur produced in grams}}{\text{time in seconds}}$$

[2 marks]

____

____

____

____

Mean rate of reaction = ________________________

04.7

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 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]

Mean time for the reaction (3 significant figures) =

_________________________ s

[Turn over]

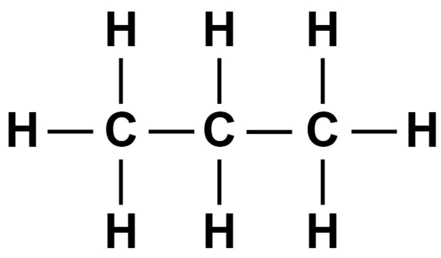
14

0 5

This question is about hydrocarbons.

FIGURE 9 shows a hydrocarbon.

FIGURE 9



0 5 . 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]

---

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.

☐ $\dfrac{24 \times 30}{100}$

☐ $\dfrac{100 \times 30}{24}$

☐ $\dfrac{24 \times 100}{30}$

☐ $\dfrac{24}{30 \times 100}$

[Turn over]

0 5 . 5

TABLE 3 shows boiling points of some hydrocarbons.

TABLE 3

Formula of hydrocarbon	Boiling point in °C
C_2H_6	–89
C_4H_{10}	0
C_6H_{14}	69
C_8H_{18}	125
$C_{10}H_{22}$	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]

0 5 . 7

Balance the equation for the cracking of C_6H_{14}
[1 mark]

$$C_6H_{14} \longrightarrow C_2H_6 + \_\_\_\_\_ \ C_2H_4$$

0 5 . 8

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

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

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

Advantage of wood 1 ______________________________

____

____

Advantage of wood 2

Advantage of wood 3

[Turn over]

11

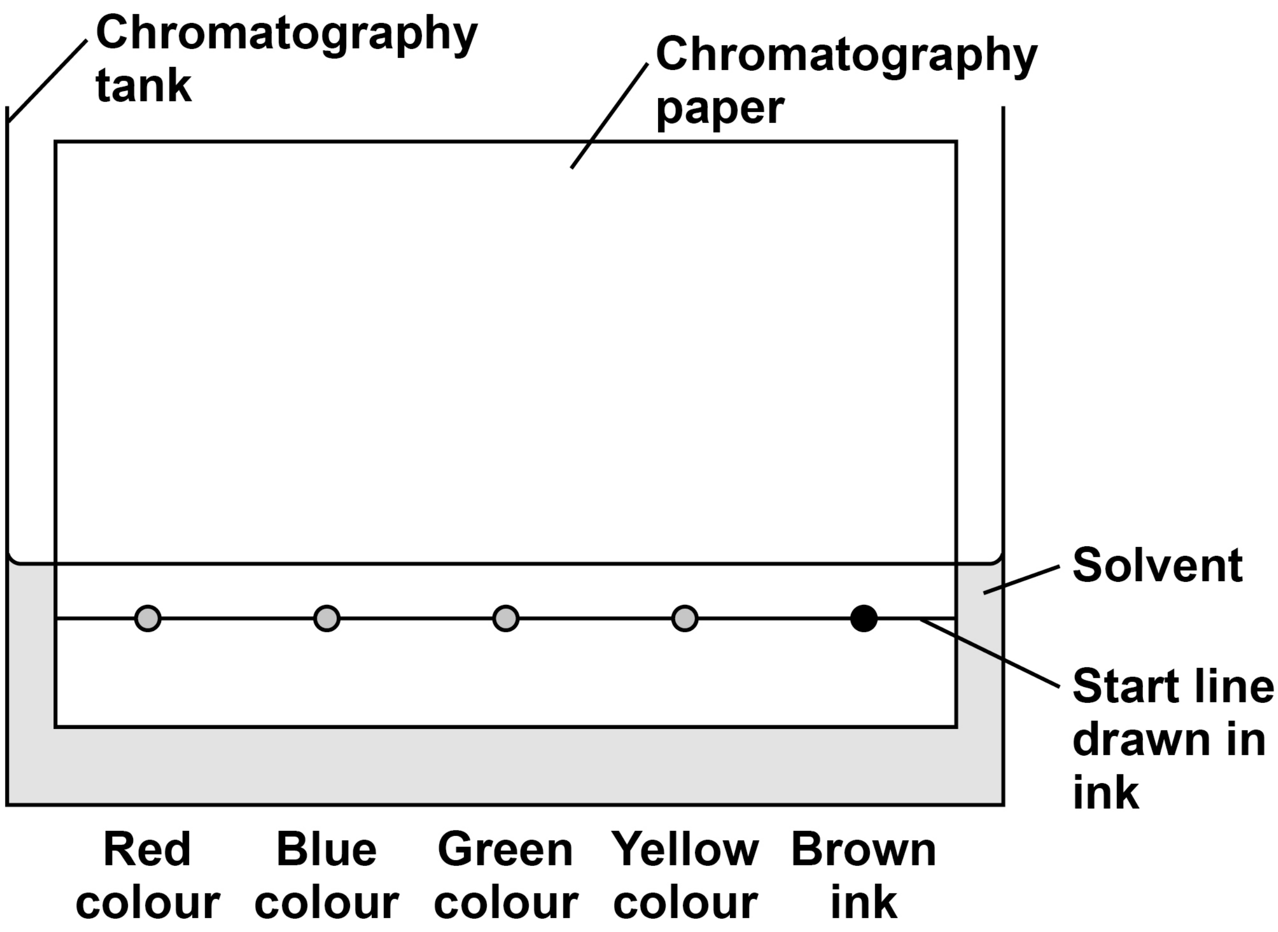
0 6

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

0 6 . 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 ______________________________

____

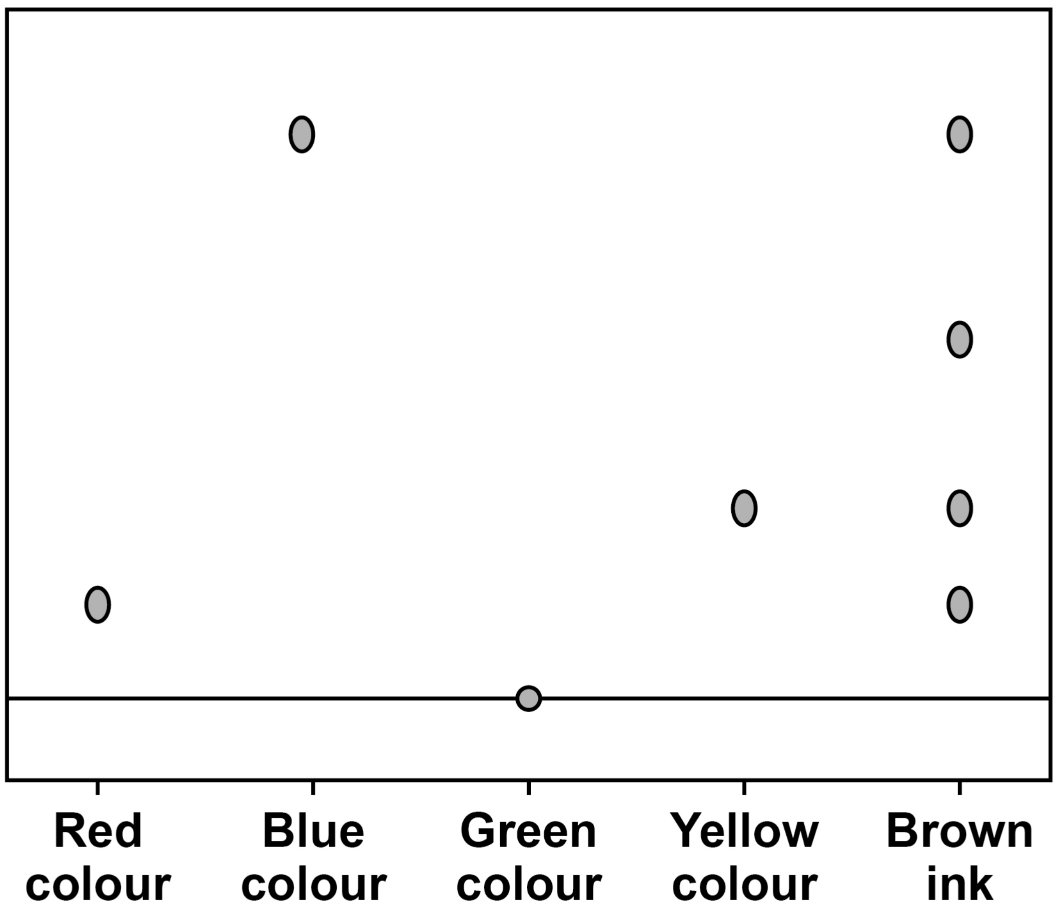
____

[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.**

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]

Distance moved by solvent = ____________________ cm

[Turn over]

10

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]

[Turn over]

A scientist produced potable water from 150 cm^3 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

07.3

The salty water contains sodium chloride.

The scientist collected 2.40 g of sodium chloride from 150 cm^3 of salty water.

Calculate the concentration of sodium chloride in grams per dm^3 [3 marks]

Concentration of sodium chloride =

______________________ g/dm^3

END OF QUESTIONS

10

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.

Additional page, if required.

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