



Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

CHEMISTRY

F

Foundation Tier Paper 2

8462/2F

Tuesday 11 June 2024

Morning

Time allowed: 1 hour 45 minutes

[Turn over]



J U N 2 4 8 4 6 2 2 F 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).**

INSTRUCTIONS

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

[Turn over]



- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **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.**

INFORMATION

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**



- **In all calculations, show clearly how you work out your answer.**
- **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 hydrocarbons.

A hydrocarbon has the formula C_6H_{14}

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

Name the TWO elements in a hydrocarbon. [2 marks]

1 _____

2 _____



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

How many atoms are there in one molecule of C_6H_{14} ? [1 mark]

Tick (✓) ONE box.

2

6

14

20

[Turn over]



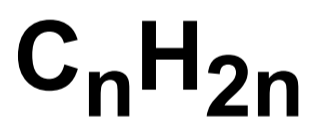
C_6H_{14} is a member of a homologous series.

0 1 . 3

What is the general formula for the homologous series that contains C_6H_{14} ?

[1 mark]

Tick (✓) ONE box.



01.4

Which homologous series has C_6H_{14} as a member? [1 mark]

Tick (✓) ONE box.

Alcohols

Alkanes

Alkenes

Carboxylic acids

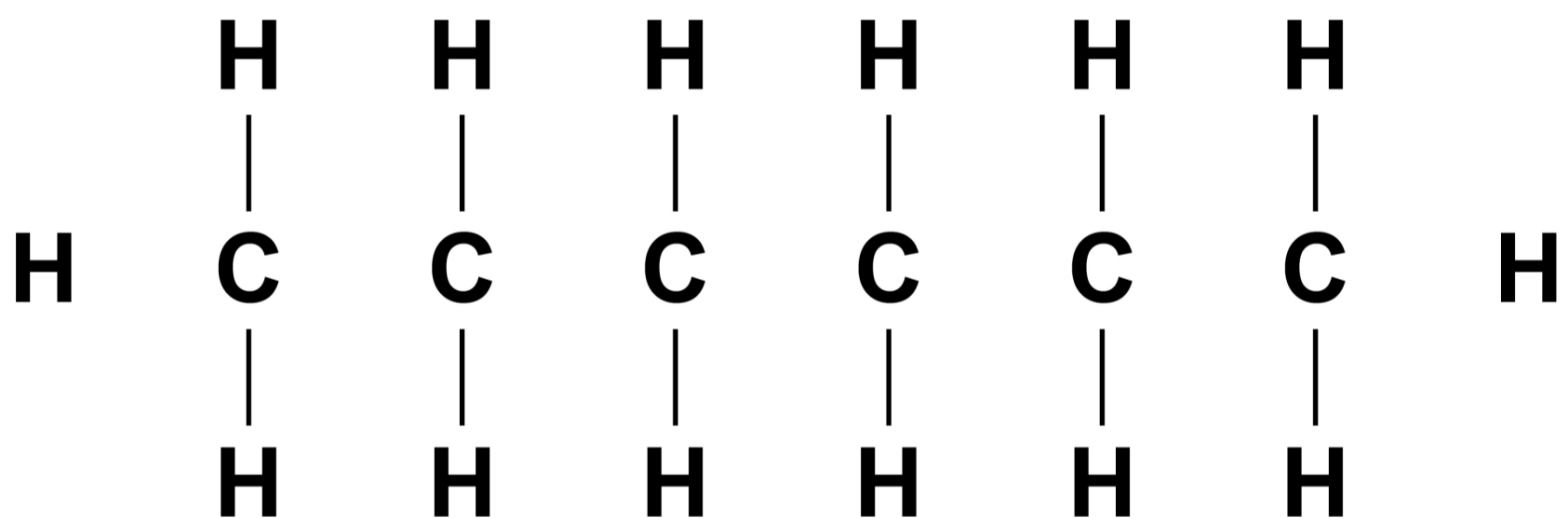
[Turn over]



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

Complete FIGURE 1 to show the displayed structural formula of C_6H_{14}
[1 mark]

FIGURE 1



01.6**Petrol contains C_6H_{14}** **Petrol is burned in car engines.****What general name is used to describe petrol when petrol is burned to release energy? [1 mark]**

[Turn over]

01.7

Atmospheric pollutants are formed when C_6H_{14} undergoes incomplete combustion.

Complete the sentences, on the opposite page.

Choose answers from the list. [2 marks]

- **ammonia**
- **carbon monoxide**
- **coal**
- **soot**
- **sulfur**
- **sulfur dioxide**



The solid atmospheric pollutant formed during incomplete combustion of C_6H_{14} is _____.

The gaseous atmospheric pollutant formed during incomplete combustion of C_6H_{14} is _____.

0 1 . 8

A different organic compound ($C_{12}H_{26}$) can be broken down to produce C_6H_{14} and one other compound.

Complete the equation for the reaction.
[1 mark]



[Turn over]



0	1	.	9
---	---	---	---

The percentage by mass of each element in C_6H_{14} is:

- 84% C
- 16% H

Complete FIGURE 2, on the opposite page.

You should:

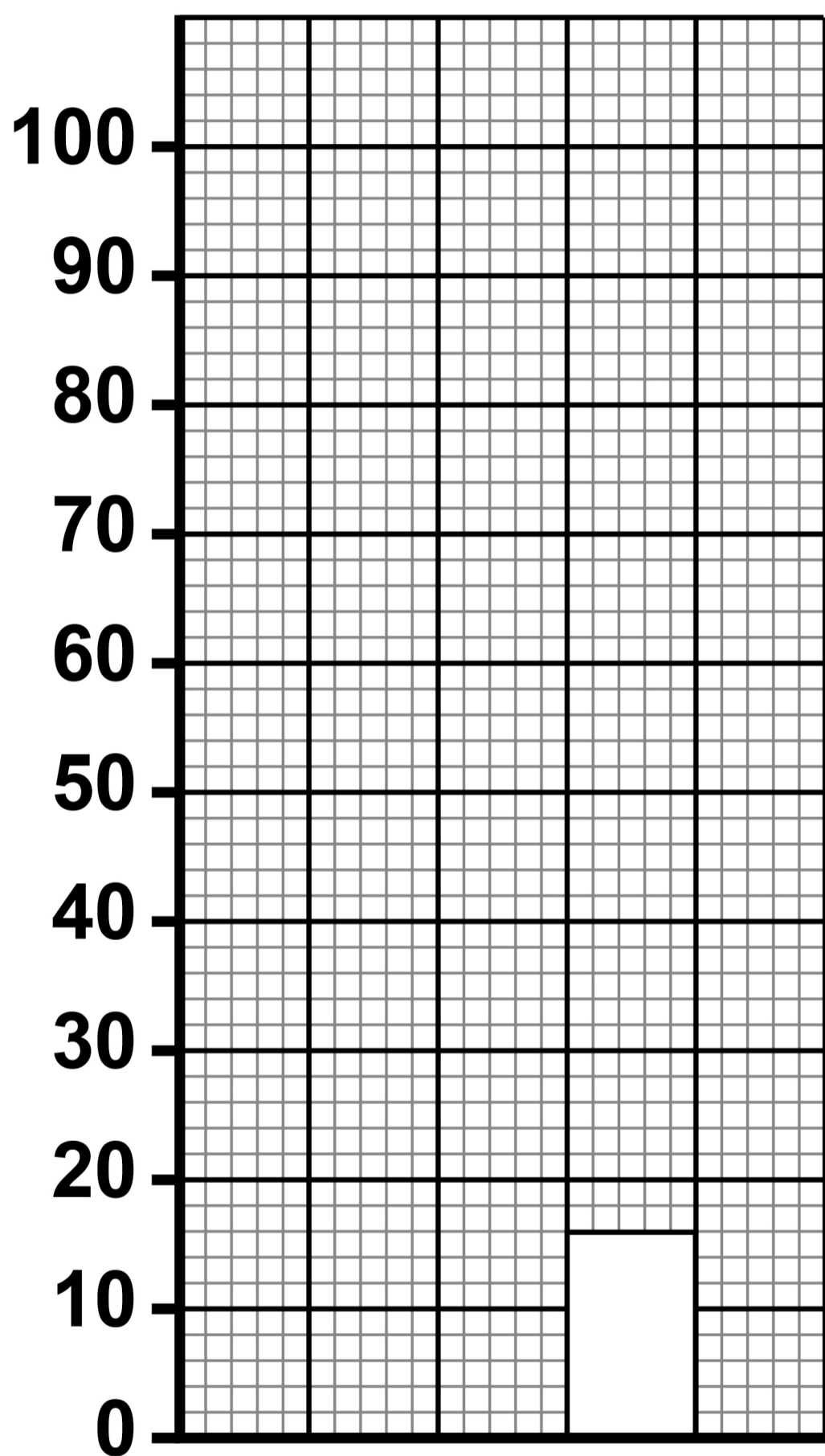
- label each element on the x-axis
- plot the percentage by mass of C in C_6H_{14}

[2 marks]



FIGURE 2

**Percentage (%) by mass
of each element in C₆H₁₄**



Element



[Turn over]



02

This question is about burning coal.

A power station has four coal-burning furnaces.

Each furnace burns 3000 kg of coal per minute.

TABLE 1, on the opposite page, shows some information about this coal burning power station.



TABLE 1

Number of furnaces in use	Mass of coal burned per minute in kilograms	Mass of sulfur dioxide produced per minute in kilograms	Mass of carbon dioxide produced per minute in kilograms
0	0	0	0
1	3000	100	7000
2	6000	200	14 000
3	9000	300	21 000
4	12 000	400	28 000

[Turn over]



02.1

Carbon dioxide is a greenhouse gas.

What is the effect on the rate of global climate change of using more furnaces in this power station?

Complete the sentence, on the opposite page.

Choose the answer from the list, on the opposite page.

[1 mark]



- **decreases**
- **stays the same**
- **increases**

Use TABLE 1, on page 17.

The rate of global climate change _____ . 19

[Turn over]



0 2 . 2

7000 kg of carbon dioxide are produced when 3000 kg of coal are burned.

Calculate the mass of carbon dioxide produced when 1 kilogram of coal is burned. [2 marks]

20

Mass of carbon dioxide = _____ kg



0 2 . 3

Complete the sentence. [1 mark]

Sulfur dioxide causes an environmental effect called acid

_____.

[Turn over]



TABLE 1 is repeated below.

Number of furnaces in use	Mass of coal burned per minute in kilograms	Mass of sulfur dioxide produced per minute in kilograms	Mass of carbon dioxide produced per minute in kilograms
0	0	0	0
1	3000	100	7000
2	6000	200	14 000
3	9000	300	21 000
4	12 000	400	28 000



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[Turn over]

0 2 . 4

FIGURE 3, on the opposite page, shows how the mass of sulfur dioxide produced per minute varies with the mass of coal burned per minute.

Complete FIGURE 3.

You should:

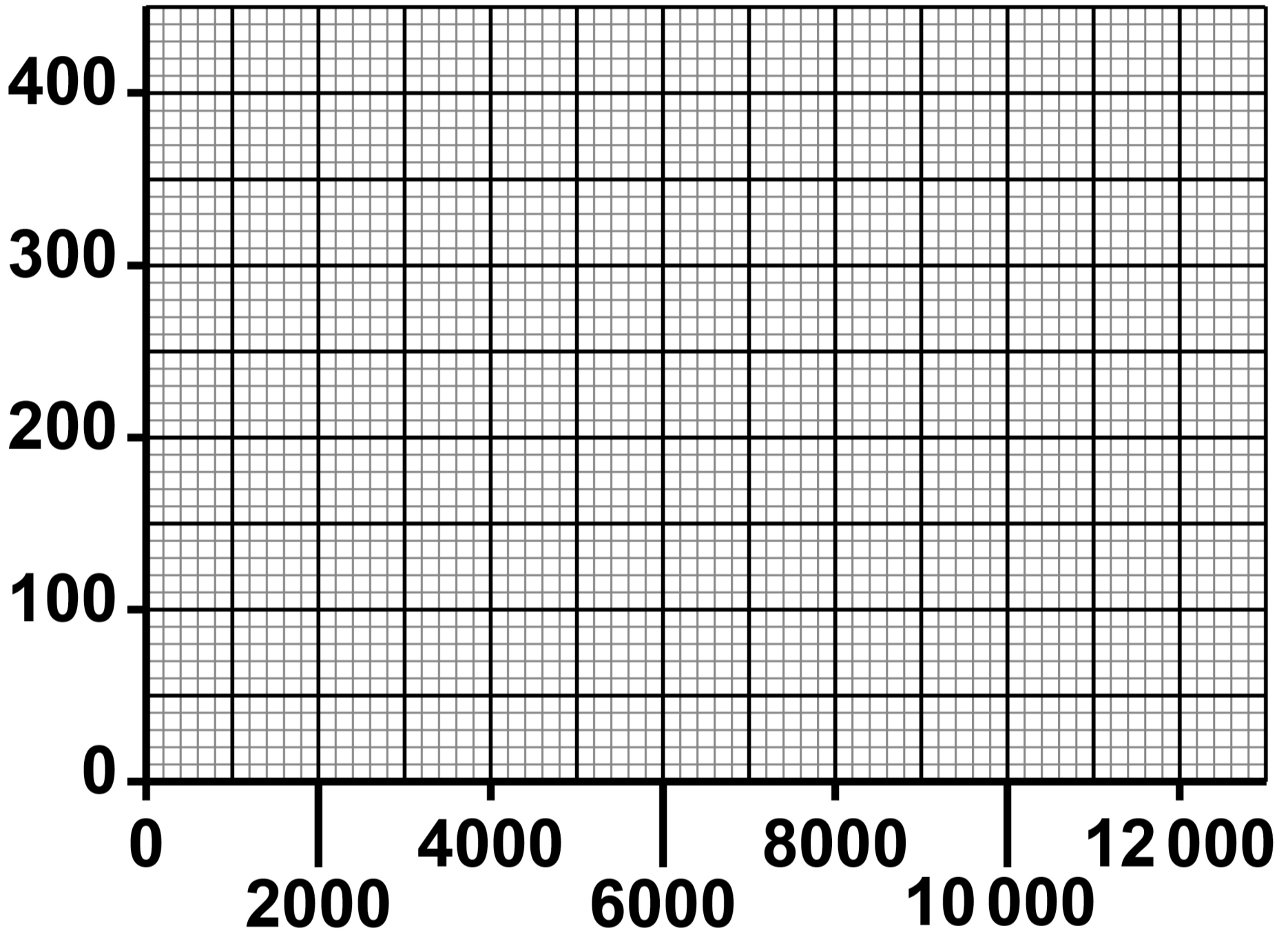
- **plot data from TABLE 1, on page 22, on FIGURE 3**
- **draw a line of best fit.**

[3 marks]



FIGURE 3

Mass of sulfur dioxide produced per minute in kilograms



Mass of coal burned per minute in kilograms

[Turn over]



0 2 . 5**Complete the sentence.****Use TABLE 1, on page 22, and FIGURE 3, on page 25. [1 mark]****As the mass of coal burned per minute increases, the mass of sulfur dioxide produced per minute**

0 2 . 6

This power station also releases particulates into the air.

Complete the sentence. [1 mark]

The release of particulates into the air causes global

[Turn over]

9

0	3
---	---

This question is about paper chromatography.

A student investigated substance Y using paper chromatography.

This is the method used.

- 1. Draw a start line in ink on a piece of chromatography paper.**
- 2. Put spots of four different dyes, A, B, C and D, and a spot of substance Y on the start line.**
- 3. Dip the paper into water so that the water level is below the start line.**
- 4. Wait until the water has risen to near the top of the paper.**



0 **3** . **1**

The student's method contains a mistake in STEP 1.

What is the mistake in STEP 1?

**Give ONE reason for your answer.
[2 marks]**

Mistake _____

Reason _____

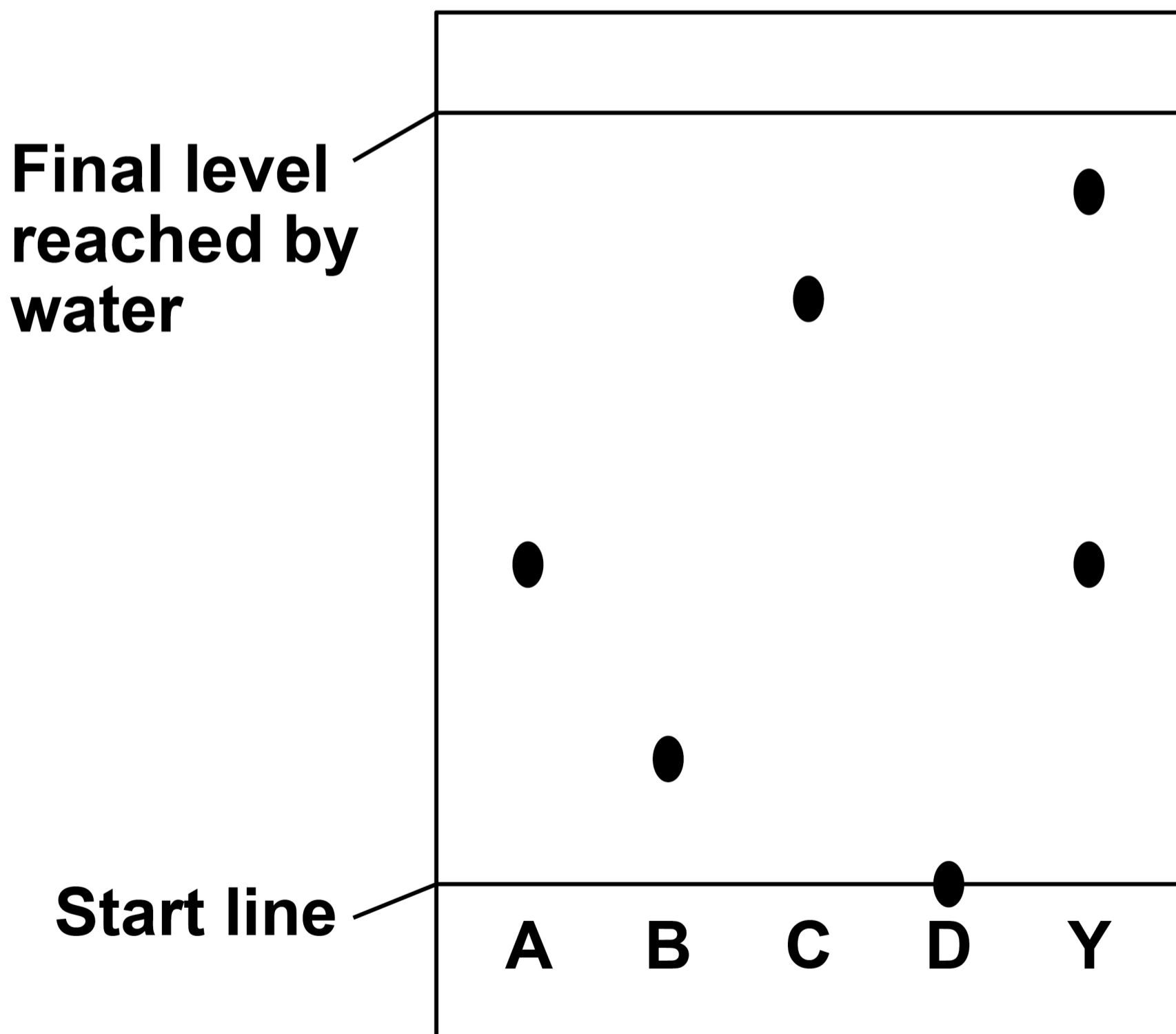
[Turn over]

A different student used a method which gave valid results.

FIGURE 4 shows the results.

FIGURE 4

The diagram is not drawn to scale.



0 3 . 2

How many different dyes are in substance Y?

Use FIGURE 4. [1 mark]

0 3 . 3

Which of the four dyes, A, B, C and D, could be in substance Y?

Give ONE reason for your answer.

Use FIGURE 4. [2 marks]

Dye _____

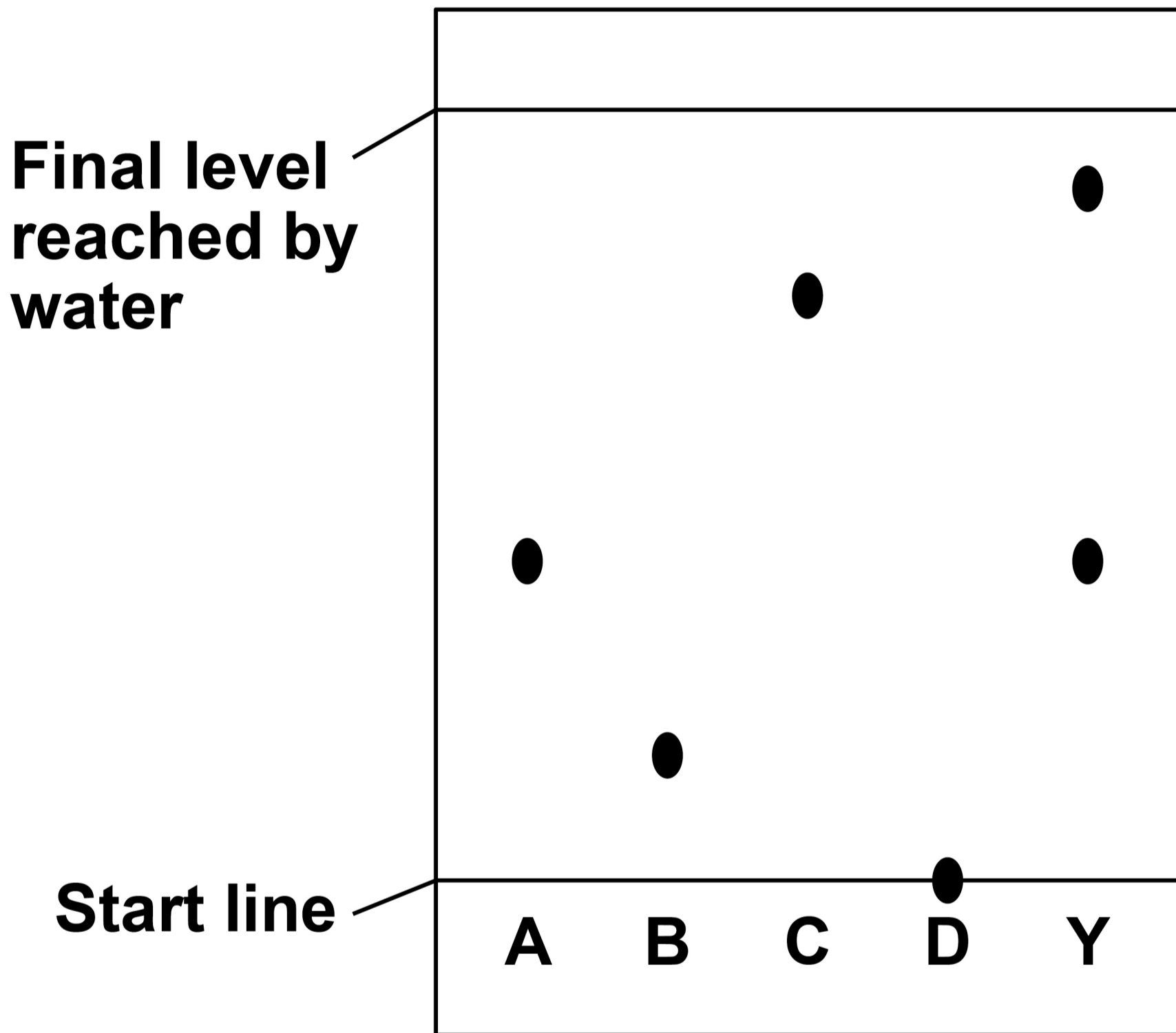
Reason _____

[Turn over]



REPEAT OF FIGURE 4

The diagram is not drawn to scale.



0 3 . 4

Suggest why dye D remained on the start line at the end of the investigation.

Use FIGURE 4. [1 mark]

[Turn over]



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

The student determined that:

- the distance moved by the water was 6.0 cm
- the distance moved by dye A was 2.4 cm.

Calculate the R_f value of dye A.

Use the equation:

$$R_f = \frac{\text{distance moved by dye A}}{\text{distance moved by water}}$$

[2 marks]

$R_f =$ _____



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

Complete the sentence.

Choose the answer from the list.

[1 mark]

- **solute**
- **solution**
- **solvent**

The water in STEP 3, on page 28, is used as a _____.

[Turn over]

9



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04

This question is about the Earth's atmosphere and naturally occurring polymers.

04.1

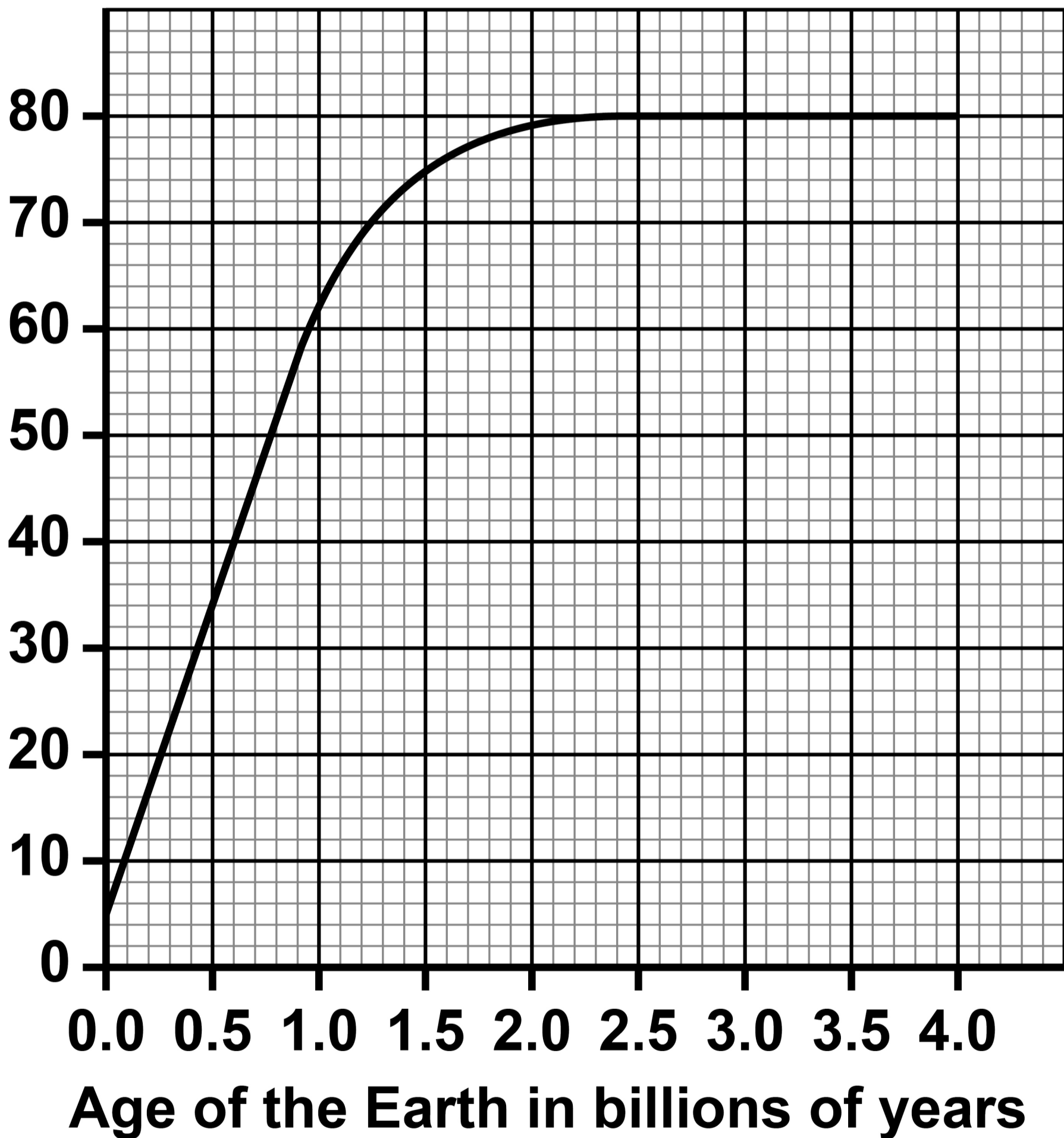
FIGURE 5, on page 38, shows how the estimated percentage of nitrogen in the Earth's atmosphere has changed since the Earth was formed.

[Turn over]



FIGURE 5

**Estimated percentage (%) of nitrogen
in the Earth's atmosphere**



The percentage of oxygen in the Earth's atmosphere has increased since the Earth was formed.

This is because of photosynthesis.

The word equation for the photosynthesis reaction is:

**carbon dioxide + water →
glucose + oxygen**



04.2

What happened to the percentage of carbon dioxide in the atmosphere when photosynthesis began? [1 mark]

Tick (✓) ONE box.

The percentage of carbon dioxide decreased.

The percentage of carbon dioxide stayed the same.

The percentage of carbon dioxide increased.

[Turn over]



04.3

The photosynthesis reaction takes in energy from the surroundings.

Complete the sentence.

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

- **carbon dioxide**
- **light**
- **water**

The source of the energy used in photosynthesis is



04.4

Which TWO produce oxygen by photosynthesis? [2 marks]

Tick (✓) TWO boxes.

Algae

Animals

Plants

Viruses

Yeast

[Turn over]



0 4 . 5

The glucose produced during photosynthesis can form naturally occurring polymers.

Which TWO are naturally occurring polymers that can be produced from glucose? [2 marks]

Tick (✓) TWO boxes.

Cellulose**DNA****Poly(propene)****Protein****Starch**

BLANK PAGE

[Turn over]



DNA molecules contain two polymer chains.

A DNA molecule has a relative formula mass (M_r) of approximately 140 000 000 000

0 4 . 6

What is the approximate relative formula mass (M_r) of the DNA molecule in standard form? [1 mark]

Tick (✓) ONE box.

1.4×10^9

1.4×10^{10}

1.4×10^{11}

1.4×10^{12}



04.7

What is the approximate relative formula mass (M_r) of each polymer chain in the DNA molecule? [1 mark]

Tick (✓) ONE box.

70 000 000 000**140 000 000 000****280 000 000 000****560 000 000 000**

[Turn over]



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

Complete the sentence. [1 mark]

The shape of a DNA molecule is a double

_____ .



0	4	.	9
---	---	---	---

How many different nucleotides are present in a molecule of DNA? [1 mark]

Tick (✓) ONE box.

1

2

3

4

[Turn over]

13



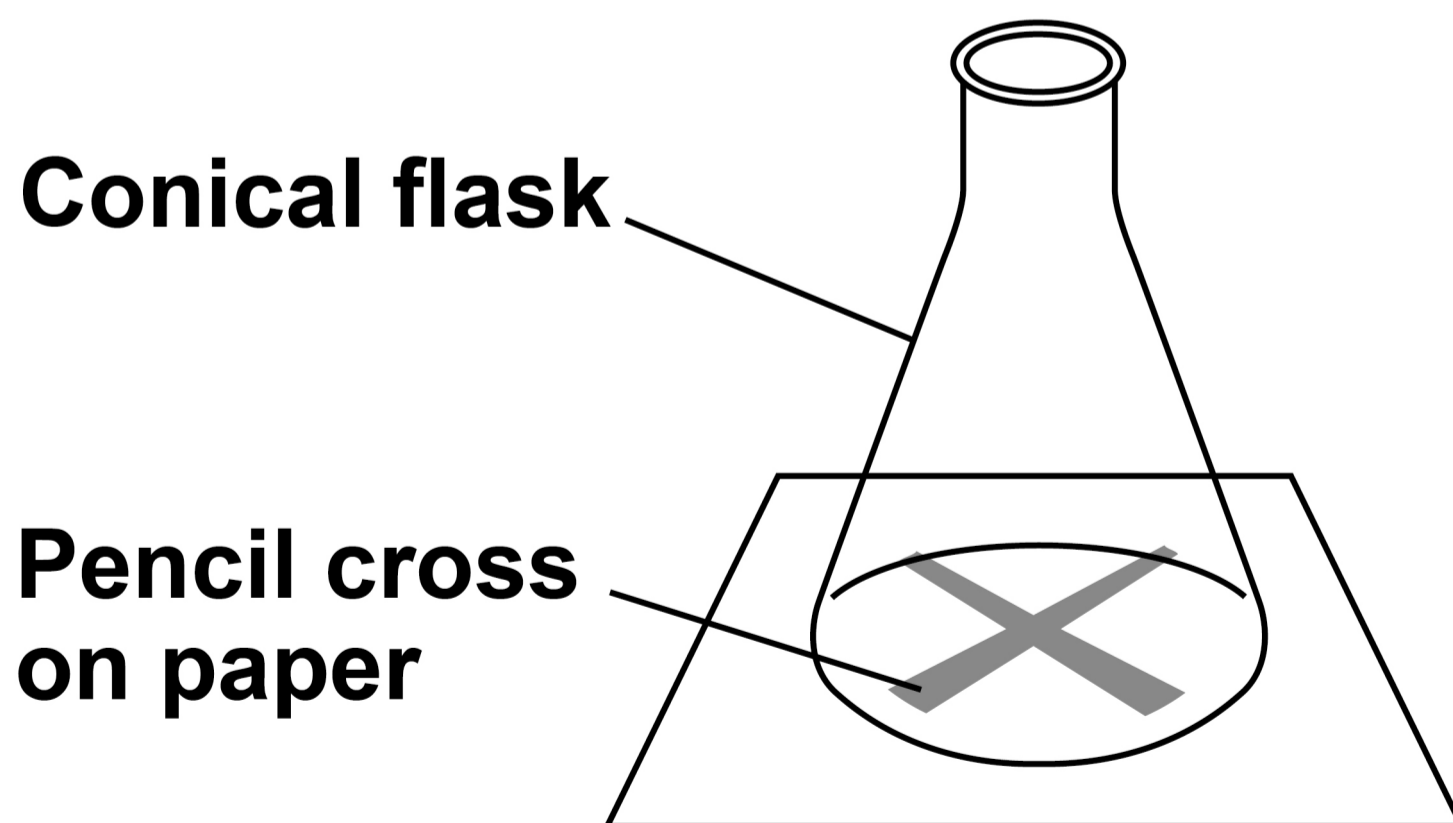
0	5
---	---

A student investigated the rate of the reaction of sodium thiosulfate solution with hydrochloric acid.

When sodium thiosulfate solution reacts with hydrochloric acid, the mixture becomes cloudy.

FIGURE 6 shows the apparatus.

FIGURE 6



This is the method used.

- 1. Put 75 cm^3 of sodium thiosulfate solution in a conical flask.**
- 2. Draw a pencil cross on paper.**
- 3. Put the conical flask on the pencil cross.**
- 4. Add 15 cm^3 of hydrochloric acid to the contents of the conical flask.**
- 5. Swirl the conical flask to mix the contents and immediately start a timer.**
- 6. Stop the timer when the pencil cross is no longer visible through the reaction mixture.**
- 7. Repeat steps 1 to 6 using different concentrations of sodium thiosulfate solution.**

[Turn over]



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0 5 . 1

Explain why a 50 cm³ conical flask is unsuitable to use in this method.

[2 marks]

0 5 . 2

Name a piece of equipment suitable for measuring the volume of sodium thiosulfate solution. [1 mark]

[Turn over]



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

The student measured the time taken for the pencil cross to be no longer visible for different concentrations of sodium thiosulfate solution.

Draw ONE line from each type of variable to the variable in this investigation, on the opposite page. [2 marks]



**TYPE OF
VARIABLE**

**VARIABLE IN THIS
INVESTIGATION**

**Dependent
variable**

**Concentration of
sodium thiosulfate
solution**

Size of conical flask

**Temperature of sodium
thiosulfate solution**

**Independent
variable**

**Time for pencil cross
to become no longer
visible**

**Volume of
hydrochloric acid**

[Turn over]



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

What effect will using a darker pencil cross have on the time taken for the cross to be no longer visible? [1 mark]

Tick (✓) ONE box.

The time taken will decrease.

The time taken will be the same.

The time taken will increase.



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[Turn over]



05.5**TABLE 2 shows the results.****TABLE 2**

Concentration of sodium thiosulfate solution in g/dm³	Time for cross to become no longer visible in seconds
8	120
16	60
24	40
32	30

Which concentration of sodium thiosulfate solution had the highest rate of reaction? [1 mark]

Tick (✓) ONE box.

8 g/dm³

16 g/dm³

24 g/dm³

32 g/dm³

[Turn over]



0	5	.	6
---	---	---	---

Increasing the concentration of sodium thiosulfate solution changes the rate of the reaction with hydrochloric acid.

Which TWO statements, below and on the opposite page, explain the effect of increasing the concentration?

[2 marks]

Tick (✓) TWO boxes.

The particles are closer together.

The particles are further apart.

The particles collide less frequently.

The particles collide more frequently.



The particles move faster.

The particles move slower.

[Turn over]



05.7

The effect on the time taken for the cross to disappear can also be investigated by:

- **changing the temperature of the hydrochloric acid**
- **changing the concentration of the hydrochloric acid.**

Complete the sentences, on the opposite page.

**Choose the answers from the list.
[2 marks]**

- **decreases**
- **stays the same**
- **increases**



If the temperature of the hydrochloric acid is INCREASED, the time taken for the cross to disappear

If the concentration of the hydrochloric acid is DECREASED, the time taken for the cross to disappear

[Turn over]

11

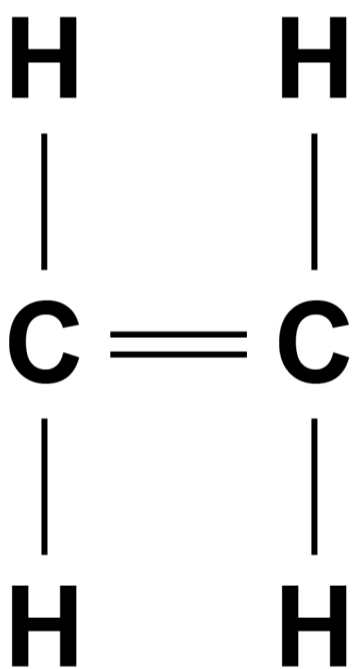


0	6
---	---

This question is about addition reactions.

FIGURE 7 shows the displayed structural formula of ethene.

FIGURE 7



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

Complete the sentence. [1 mark]

**When bromine water is added to ethene,
the bromine water changes from orange
to _____.**

[Turn over]



Chlorine reacts with ethene.

0 6 . 2

**What is used to identify chlorine?
[1 mark]**

Tick (✓) ONE box.

A lighted splint

Damp litmus paper

Limewater

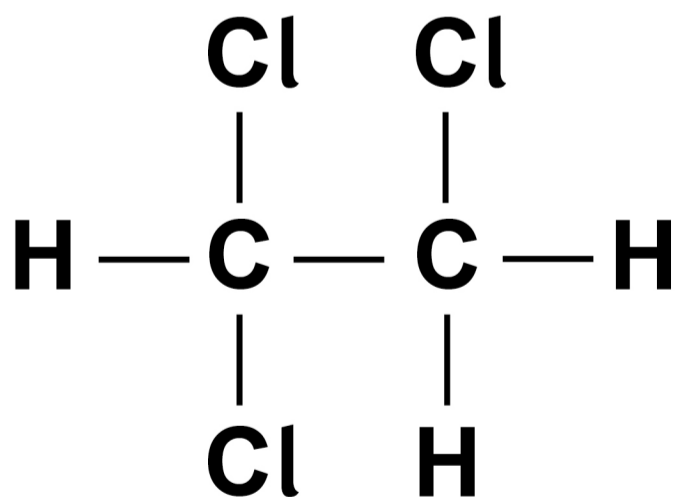
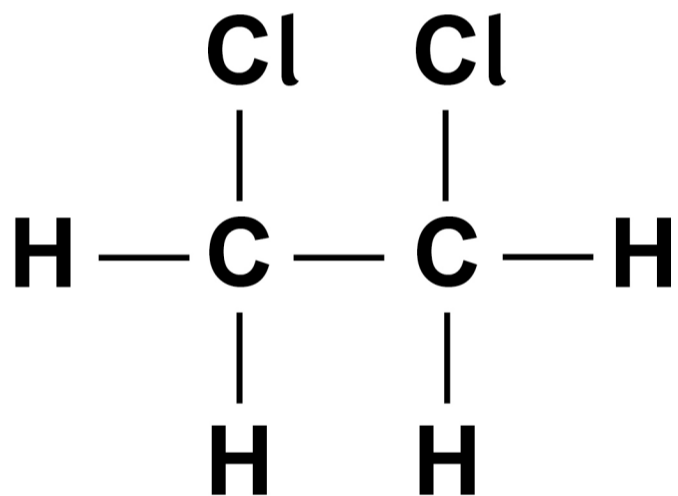
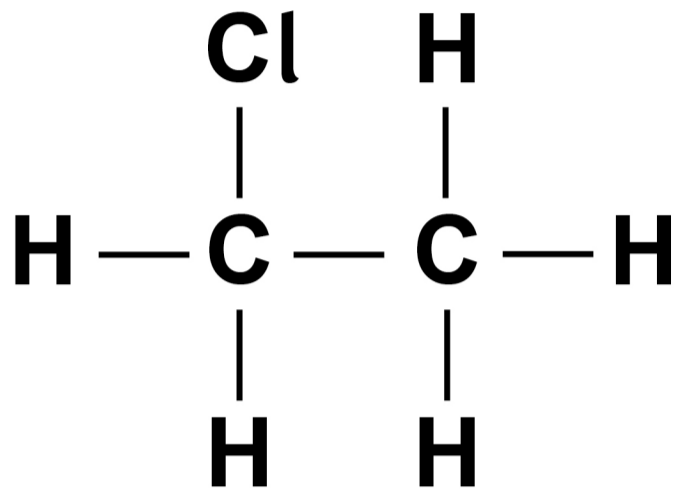
0 6 . 3

Which of the following shows the displayed structural formula of the compound produced when chlorine reacts with ethene?



Use FIGURE 7, on page 64. [1 mark]

Tick (✓) ONE box.



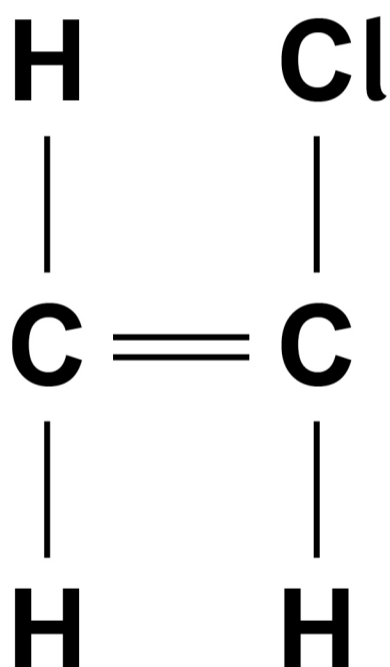
[Turn over]



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

Chloroethene can be used to produce a polymer called poly(chloroethene).

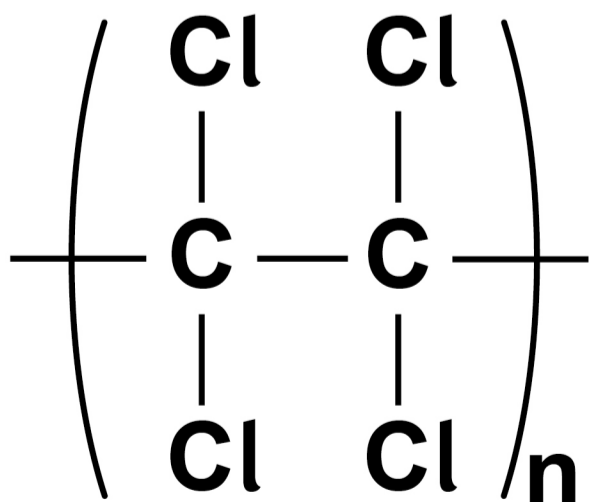
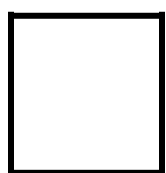
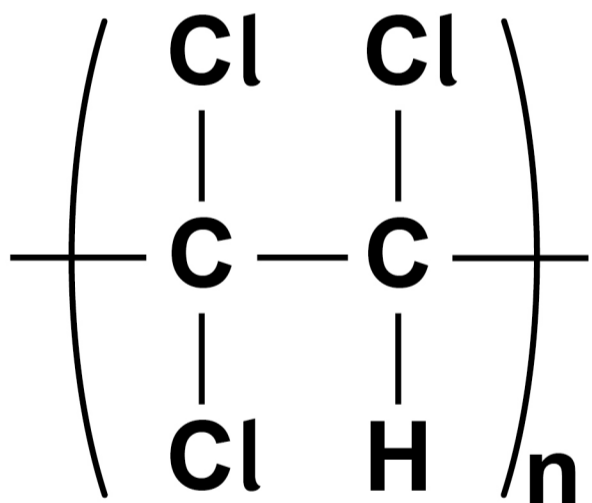
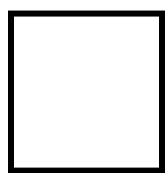
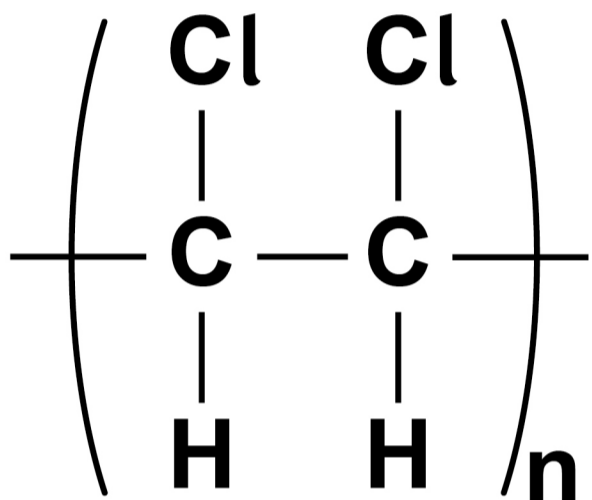
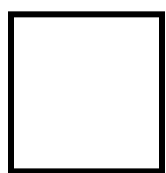
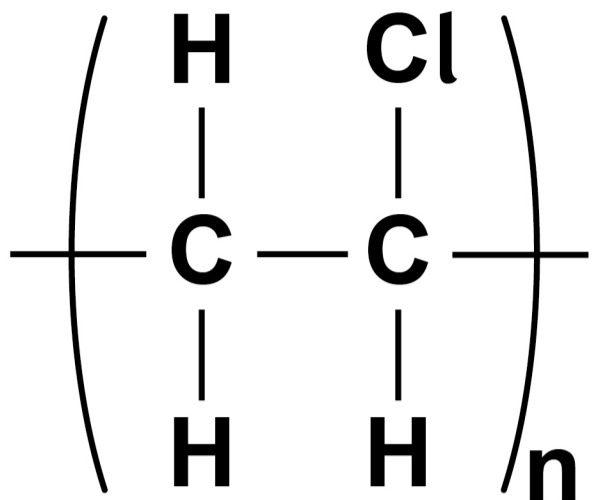
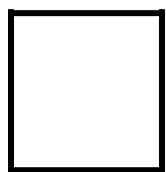
The displayed structural formula of chloroethene is



Which represents the structure of poly(chloroethene)? [1 mark]

Tick (✓) ONE box, on the opposite page.





[Turn over]





Ethene can be used to produce another polymer called poly(ethene).

TABLE 3 shows information about poly(chloroethene) and poly(ethene).

TABLE 3

	Poly(chloroethene)	Poly(ethene)
Density in g/cm ³	1.5	0.9
Temperature at which polymer completely melts in °C	260	120



0 6 . 5

Determine the simplest whole number ratio of the density of poly(chloroethene) : density of poly(ethene). [3 marks]

Simplest whole number ratio = _____ : _____

71

[Turn over]



0 6 . 6

Poly(ethene) AND poly(chloroethene) can both be used to make pipes.

Suggest why neither polymer is suitable for pipes carrying steam at a temperature of 300 °C.

Use TABLE 3, on page 70. [1 mark]



06.7

Poly(ethene) and paper can both be used to make shopping bags.

Poly(ethene) is produced from crude oil. Paper is produced from trees.

Suggest ONE reason why paper is more sustainable than poly(ethene) for making shopping bags. [1 mark]

73

[Turn over]

9

07

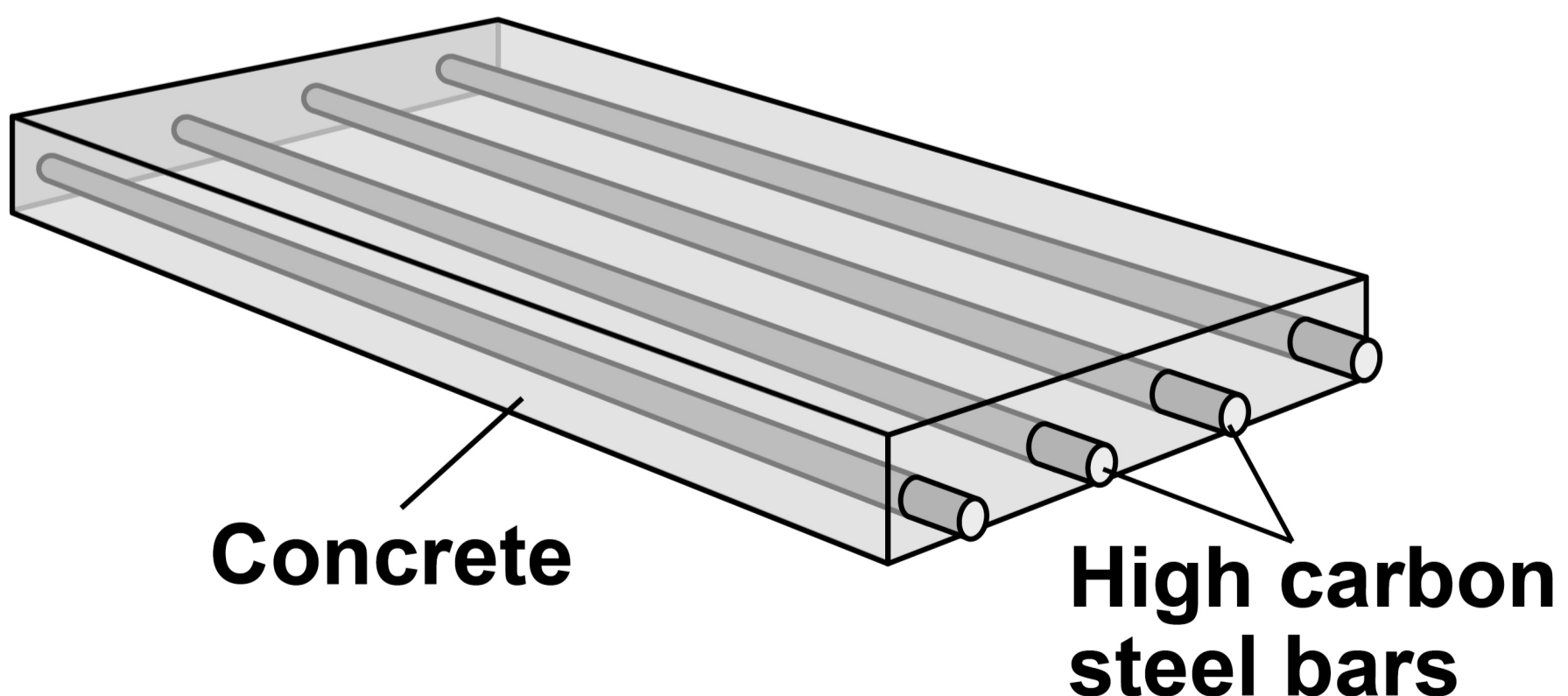
This question is about materials.

Pre-stressed concrete is a composite material.

The concrete is strengthened using high carbon steel bars.

FIGURE 8 shows the structure of a piece of pre-stressed concrete.

FIGURE 8



07.1

Which TWO words describe the high carbon steel bars? [2 marks]

Tick (✓) TWO boxes.

Alloy**Binder****Matrix****Ore****Reinforcement**

[Turn over]



Limestone is mainly calcium carbonate.

Limestone is a raw material used in the production of concrete.

07.2

In the first part of the production of concrete:

- **air is heated by burning methane**
- **the hot air is used to heat limestone**
- **the limestone decomposes.**

The equation for the decomposition of limestone is:

**calcium carbonate \longrightarrow
calcium oxide + carbon dioxide**



Give TWO ways in which a greenhouse gas is released in this process. [2 marks]

1 _____

2 _____

[Turn over]



07.3

How could a sample of limestone be tested to show the presence of carbonate ions?

Complete the sentences.

Choose answers from the list. [2 marks]

- **barium chloride**
- **hydrochloric acid**
- **limewater**
- **sodium hydroxide**
- **universal indicator**

The substance added to the limestone is

_____.

The gas produced is identified using

_____.



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[Turn over]



TABLE 4 gives some information about plain concrete and pre-stressed concrete.

TABLE 4

	PLAIN CONCRETE	PRE-STRESSED CONCRETE
Cost in £ per m³	75	225
Density in kg per m³	2300	2500
Strength in arbitrary units	600	3000



07.4

Explain why pre-stressed concrete rather than plain concrete is used to make bridges that carry heavy lorries.

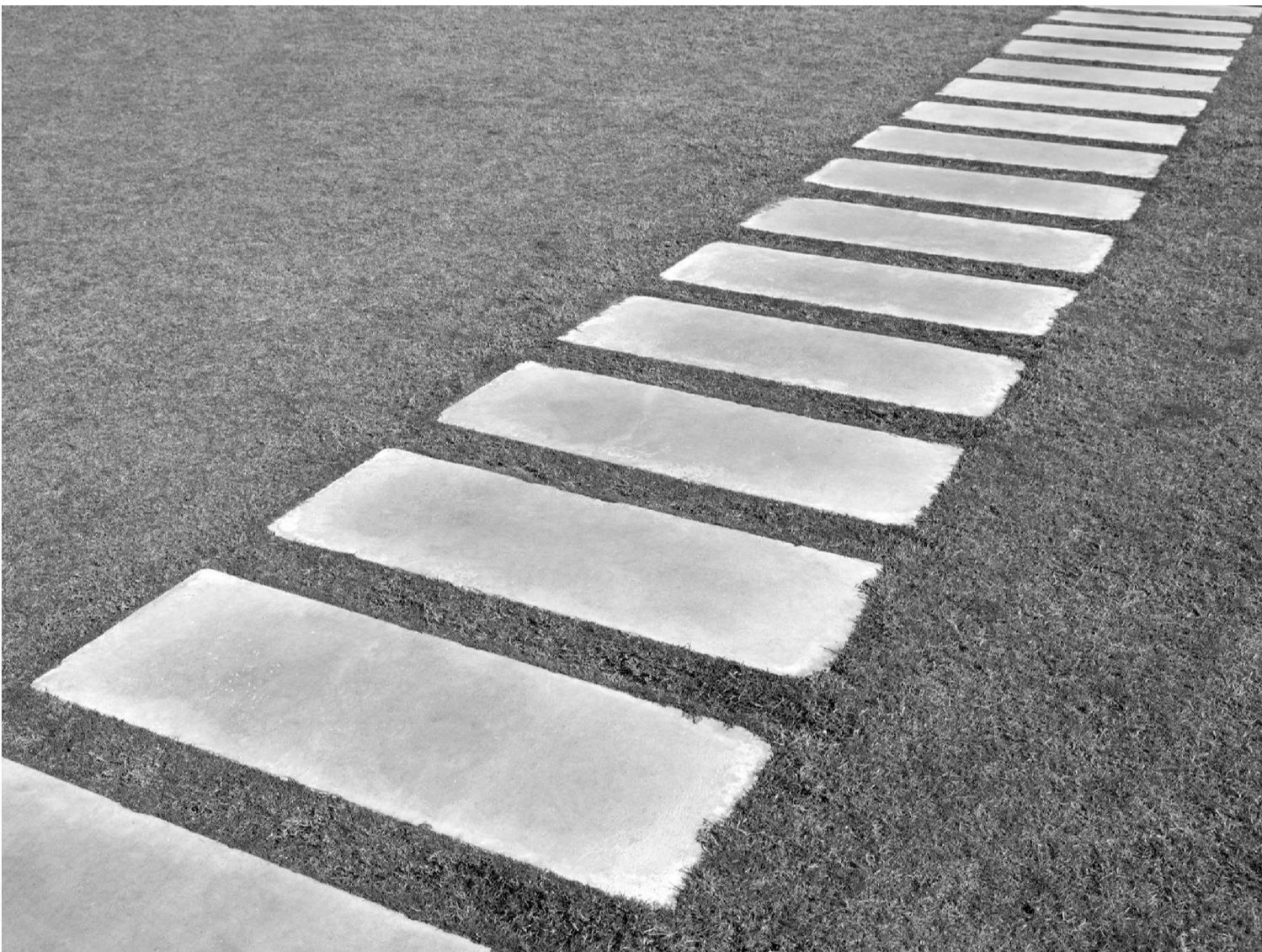
Use TABLE 4. [2 marks]

[Turn over]

07.5

FIGURE 9 shows a garden path made of plain concrete slabs.

FIGURE 9



Suggest TWO reasons why plain concrete rather than pre-stressed concrete is used to make slabs for garden paths.

Use TABLE 4, on page 80. [2 marks]

1 _____

2 _____

[Turn over]

10

0	8
---	---

A student investigated an aqueous solution of a salt.

The student identified that the salt solution contained only sodium ions and chloride ions.

0	8	.	1
---	---	---	---

Describe a test to identify sodium ions.

Give the result of the test. [2 marks]

Test for sodium ions _____

Result _____



08.2

Describe a test to identify chloride ions.

Give the result of the test. [2 marks]

Test for chloride ions _____

Result _____

[Turn over]



The student determined the concentration of sodium chloride in the salt solution.

This is the method used.

- 1. Weigh an empty evaporating dish.**
- 2. Add 25.0 cm³ of the salt solution into the evaporating dish.**
- 3. Heat the evaporating dish and contents.**
- 4. Weigh the evaporating dish and contents.**
- 5. Repeat steps 3 to 4 until there is no further change in mass.**
- 6. Repeat steps 1 to 5 three more times.**



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

Why did the student heat the evaporating dish and contents until the mass did not change? [1 mark]

[Turn over]



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

How did the student calculate the mass of solid sodium chloride remaining after steps 1 to 5? [1 mark]

Tick (✓) ONE box.

Mass of 25 cm³ of salt solution + mass of empty evaporating dish

Mass of 25 cm³ of salt solution – mass of empty evaporating dish

Mass of evaporating dish and dry contents + mass of empty evaporating dish

Mass of evaporating dish and dry contents – mass of empty evaporating dish



BLANK PAGE

[Turn over]



08.5

The student calculated the concentration of sodium chloride in the salt solution.

TABLE 5 shows the results.

TABLE 5

Concentration of sodium chloride in g/dm³			
TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
35.2	34.6	36.4	33.8

The percentage by mass of sodium ions in sodium chloride is 39.3%.



0	9
---	---

This question is about ammonia and nitric acid.

In the Haber process ammonia is produced from nitrogen and hydrogen.

FIGURE 10, on the opposite page, represents the Haber process.

0	9	.	1
---	---	---	---

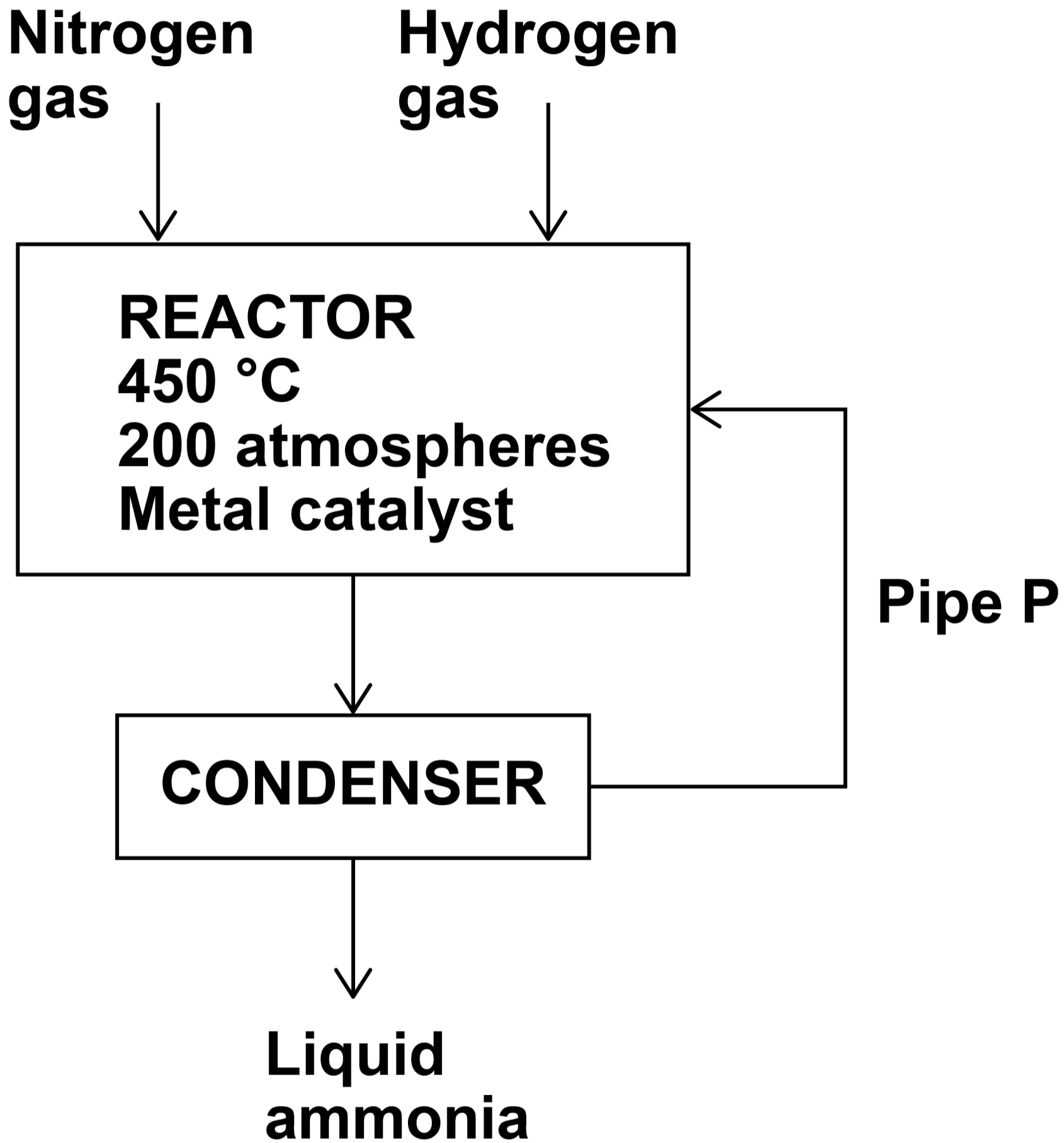
Pipe P links the condenser to the reactor.

Why is the condenser linked to the reactor?

Use FIGURE 10. [1 mark]



FIGURE 10



[Turn over]



0	9	.	2
---	---	---	---

Which metal is used as a catalyst in this reaction? [1 mark]

Nitric acid is produced by reacting ammonia with oxygen.

The word equation for the production of nitric acid is:

ammonia + oxygen \longrightarrow water + nitric acid

Platinum is a catalyst in this reaction.



09.3

Describe the test for oxygen gas.

**Give the result if oxygen gas is present.
[2 marks]**

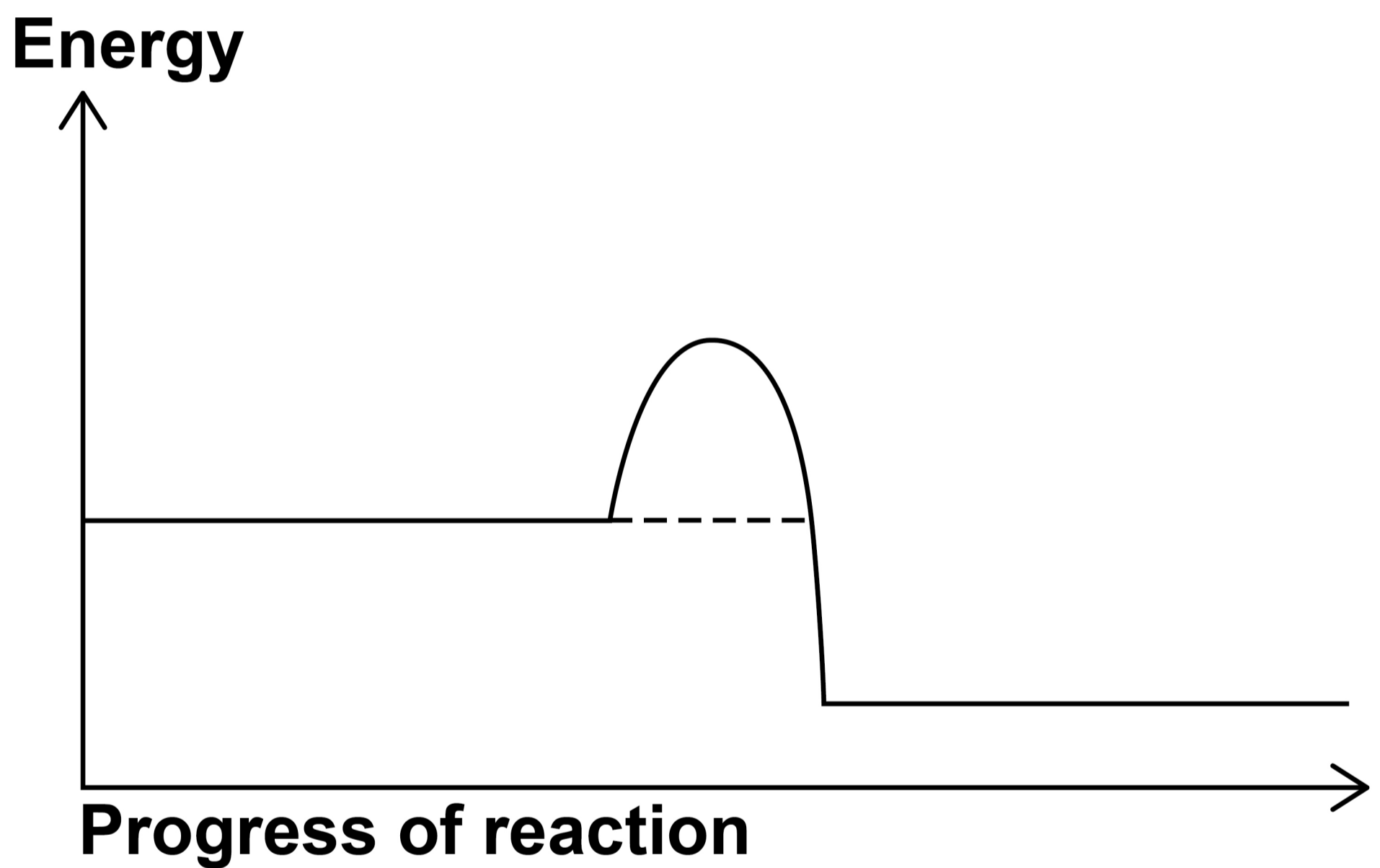
Test _____

Result _____

[Turn over]

FIGURE 11 represents the reaction profile of the catalysed reaction between ammonia and oxygen.

FIGURE 11



09.4

Complete the reaction profile for the catalysed reaction in FIGURE 11.

You should:

- **label the activation energy**
- **label the reactants and products, using the names of the reactants and products.**

[2 marks]

[Turn over]



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

**How would FIGURE 11, on page 96, be different if NO catalyst was used?
[1 mark]**

Tick (✓) ONE box.

The final energy level would be higher.

The final energy level would be lower.

The line would reach a higher peak.

The line would reach a lower peak.

0	9	.	6
---	---	---	---

Ammonia and nitric acid react to produce the salt, ammonium nitrate.

Ammonium ions and nitrate ions both contain nitrogen.

Suggest ONE use of ammonium nitrate.
[1 mark]

[Turn over]

—
8



1 0

This question is about water.

1 0 . 1

Hydrogen gas reacts with oxygen gas to produce water.

Water is decomposed into hydrogen gas and oxygen gas using electricity.

**Which TWO words, on the opposite page, describe the reaction between hydrogen gas and oxygen gas?
[2 marks]**



Tick (✓) TWO boxes.

Alloying

Combustion

Corrosion

Endothermic

Reversible

[Turn over]



10.2

Water molecules break down into hydrogen ions and hydroxide ions.

The equation for the reaction is:



Which sentence describes this reaction at equilibrium? [1 mark]

Tick (✓) ONE box.

Water molecules break down at a higher rate than they reform.

Water molecules break down and reform at the same rate.

Water molecules break down at a lower rate than they reform.



10.3

Water collected from rivers is used in the home for drinking and flushing toilets.

Water used in the home must be potable.

Potable water is safe to drink.

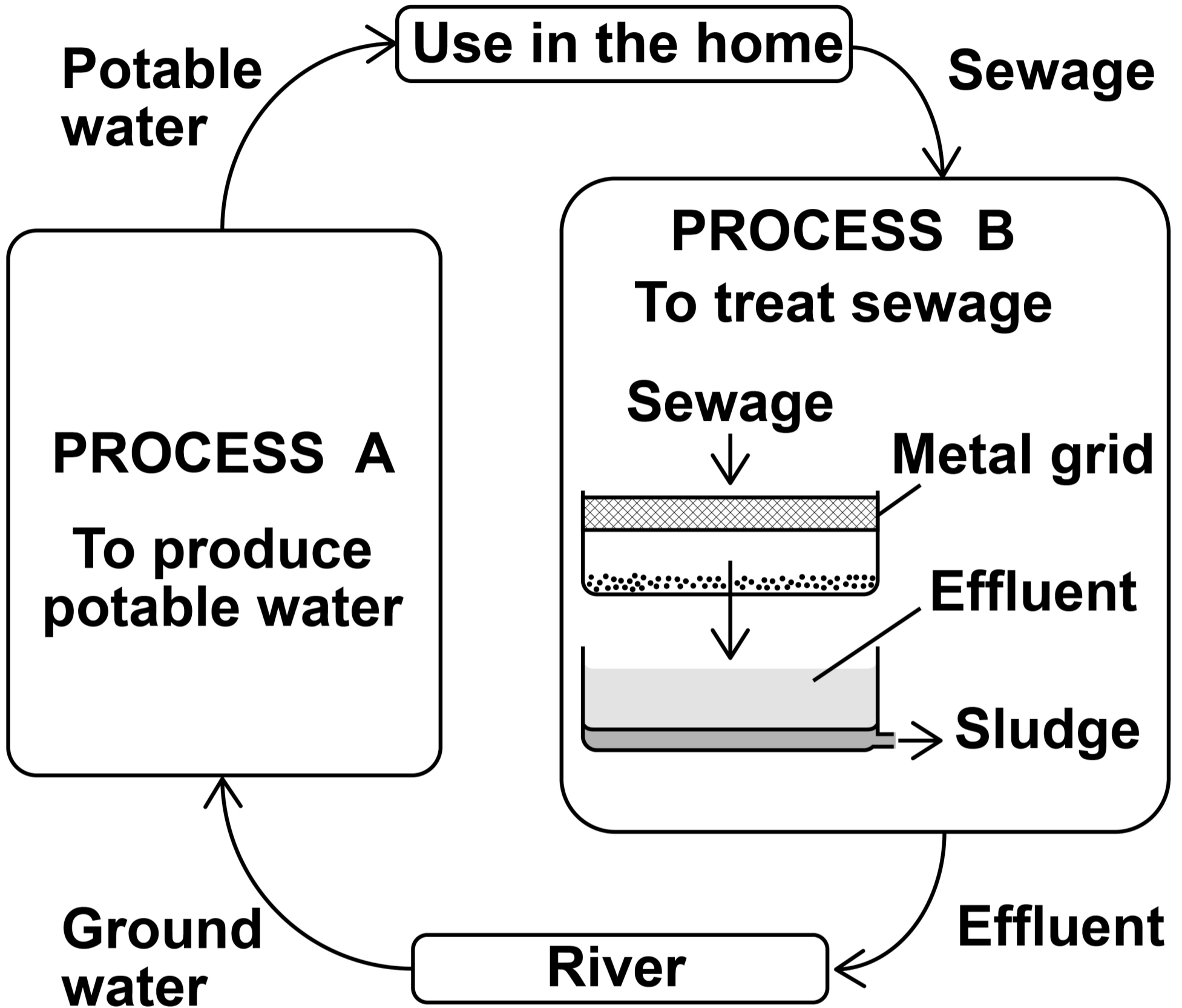
Waste water produced after use in the home is called sewage.

FIGURE 12, on page 104, shows how water is collected from rivers and returned to rivers after use.

[Turn over]



FIGURE 12



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For Examiner's Use	
Question	Mark
1	
2	
3	
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8	
9	
10	
TOTAL	

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