A

Surname ____________________

Other Names ____________________

Centre Number ____________________

Candidate Number ____________________

Candidate Signature ____________________

I declare this is my own work.

GCSE
CHEMISTRY

F

Foundation Tier **Paper 2**

8462/2F

Wednesday 10 June 2020 **Morning**

Time allowed: 1 hour 45 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 0 8 4 6 2 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. 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.**
- **In all calculations, show clearly how you work out your answer.**

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.**
- **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 ammonia and fertilisers.

Ammonia is produced from nitrogen and hydrogen.

A catalyst is used to speed up the reaction.

The word equation for the reaction is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

0 1 . 1 What does the symbol $\rightleftharpoons$ show about the reaction? [1 mark]

____

____

____

0 1 . 2 **Which catalyst is used when ammonia is produced from nitrogen and hydrogen?**
[1 mark]

Tick (✓) ONE box.

☐ **Chlorine**

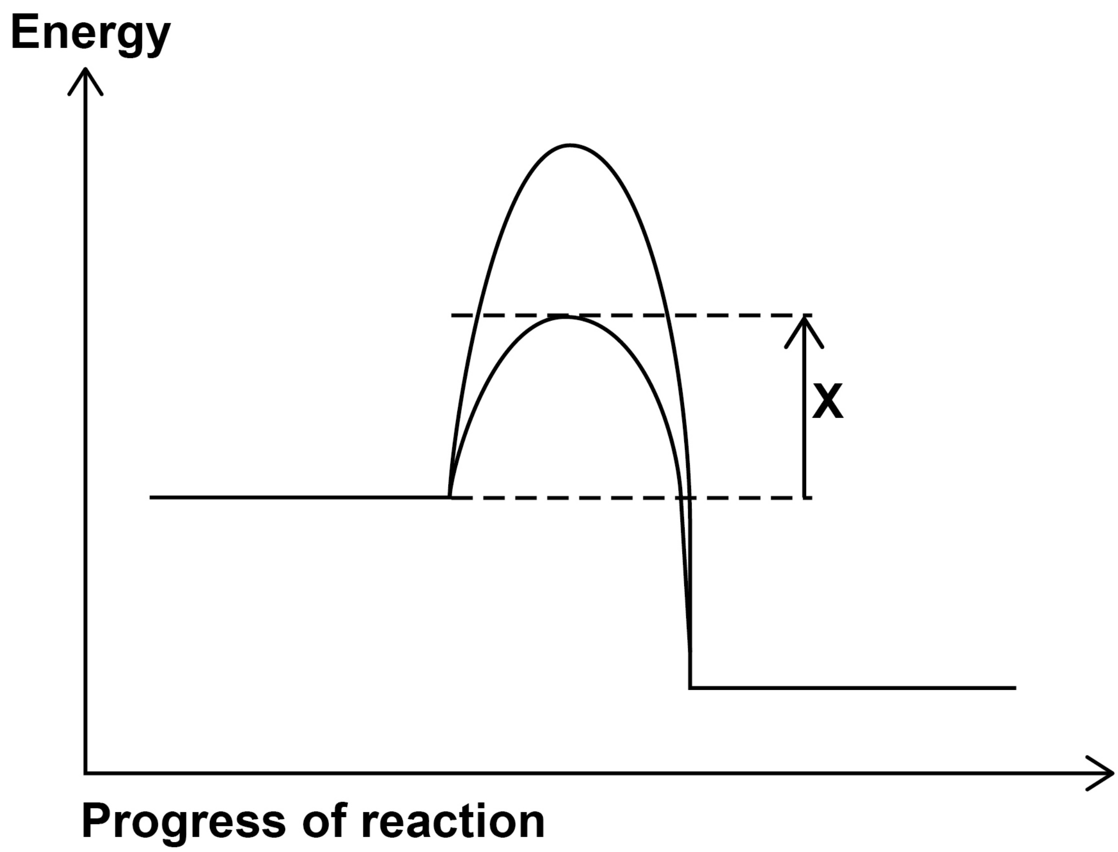
☐ **Iron**

☐ **Oxygen**

[Turn over]

0 1 . 3 **FIGURE 1 shows the reaction profile for the production of ammonia both with a catalyst and without a catalyst.**

FIGURE 1



What is represented by label X? [1 mark]

Tick (✓) ONE box.

- [ ] **Activation energy with a catalyst**
- [ ] **Activation energy without a catalyst**
- [ ] **Overall energy change with a catalyst**
- [ ] **Overall energy change without a catalyst**

[Turn over]

Ammonia is used to produce fertilisers.

NPK fertilisers contain the elements nitrogen, phosphorus and potassium.

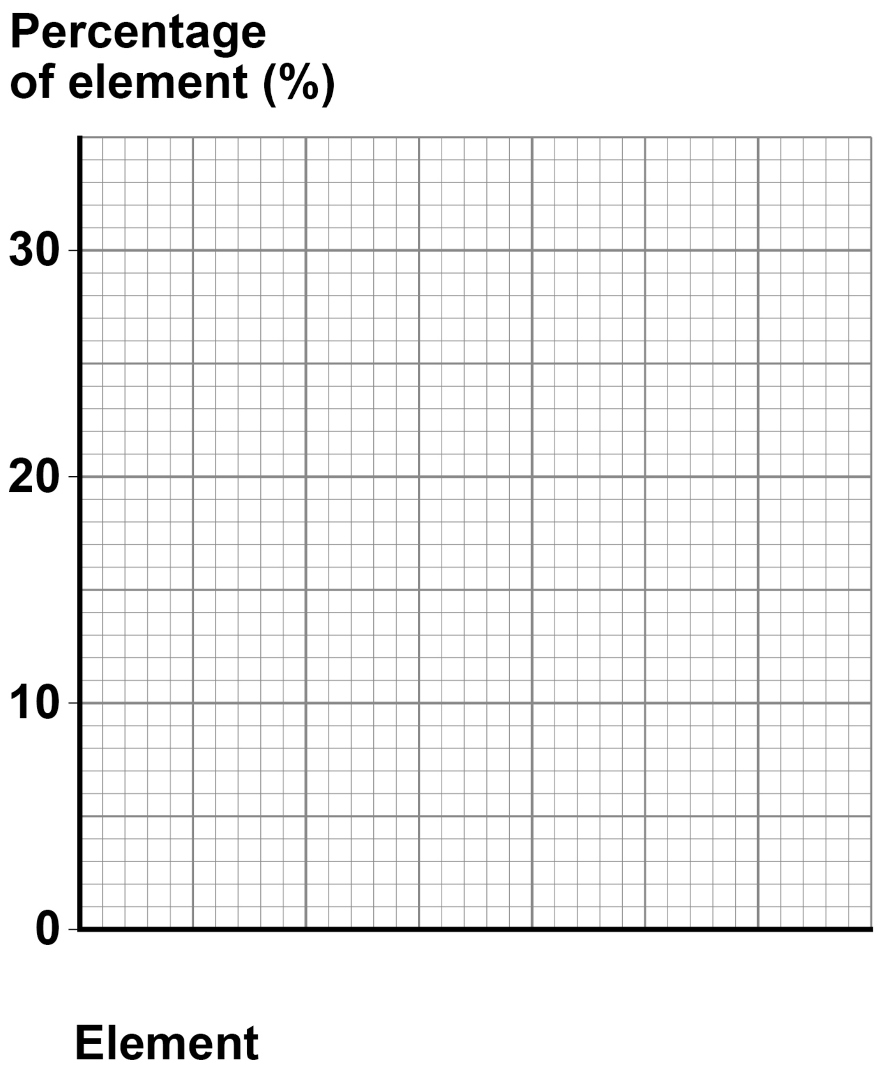
A fertiliser contains:

- **22% phosphorus**
- **25% potassium.**

0 1 . 4 **Draw a bar chart on FIGURE 2, on the opposite page, to show the percentages of phosphorus and of potassium in this fertiliser. [2 marks]**

0 1 . 5 **Why do the percentages of phosphorus and of potassium in this fertiliser NOT add up to 100%? [1 mark]**

FIGURE 2



[Turn over]

Fertilisers help plants grow by adding essential elements to soil.

TABLE 1 shows the percentages of nitrogen, phosphorus and potassium in four fertilisers, A, B, C and D.

TABLE 1

Fertiliser	Percentage (%) of essential element		
	Nitrogen (N)	Phosphorus (P)	Potassium (K)
A	14	0	39
B	25	16	23
C	21	23	0
D	21	0	0

0 1 . 6 **Plants lacking essential elements do not grow well because:**

- **too little phosphorus can cause slow plant growth**
- **too little potassium can cause leaves to have brown edges.**

Which fertiliser helps prevent slow plant growth AND brown leaf edges?

Use TABLE 1. [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

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0 1 . 7 **Which fertiliser has the greatest total percentage of essential elements?**

Use TABLE 1 on page 10. [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

8

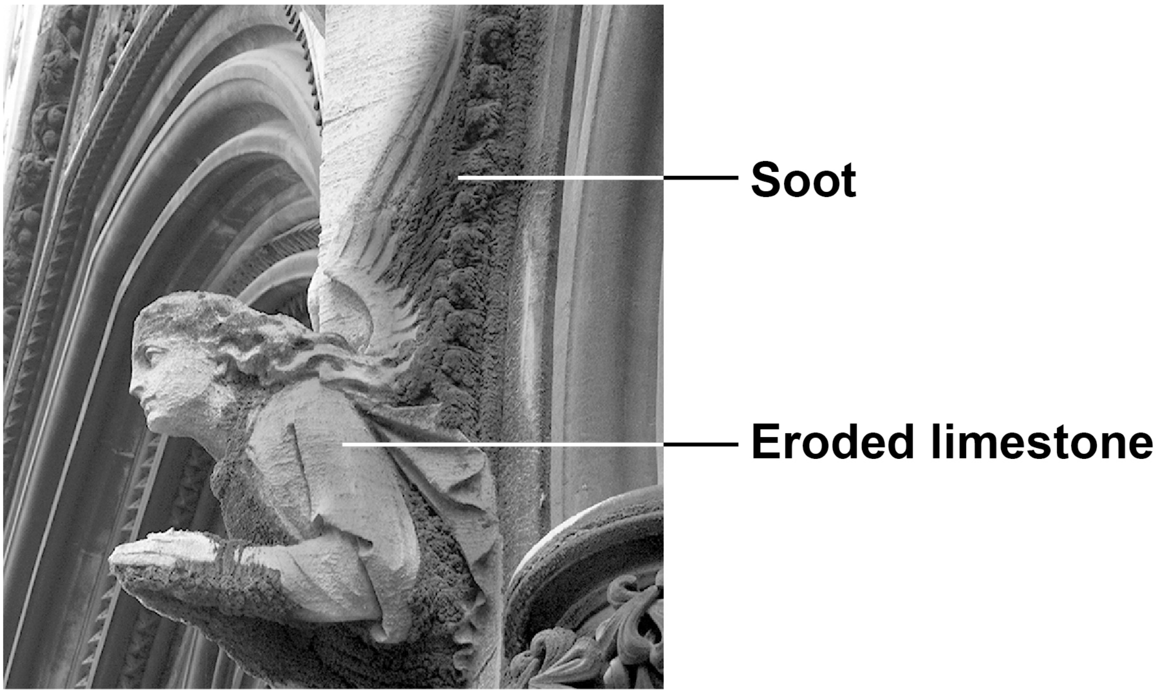
0 2 This question is about atmospheric pollution.

FIGURE 3 shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.

FIGURE 3



0 2 . 1 **What reacted with the limestone to cause the erosion? [1 mark]**

Tick (✓) ONE box.

☐ **Acid rain**

☐ **Ammonia**

☐ **Carbon monoxide**

☐ **Oxygen**

[Turn over]

0 2 . 2 Soot is produced by the incomplete combustion of diesel oil.

Complete the sentences.

Choose answers from the list. [2 marks]

- ammonia
- carbon
- methane
- nitrogen
- oxygen

Incomplete combustion happens when there

is not enough ____________________ .

Incomplete combustion produces particles of

____________________ .

0 2 . 3 Complete the sentence. [1 mark]

Particles of soot in the atmosphere cause

global_________________________ .

0 2 . 4 **Carbon monoxide is produced by the incomplete combustion of methane.**

Balance the equation for the reaction. [1 mark]

$$2CH_4 + 3O_2 \longrightarrow \_\_\_\_\_\_\_\_\_\_ CO + 4H_2O$$

[Turn over]

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0 2 . 5 Car engines work at high temperatures.

Complete the sentences.

Choose answers from the list. [3 marks]

- air
- methane
- oxides of nitrogen
- oxygen
- petrol
- sulfur dioxide

In car engines, nitrogen is present.

The nitrogen in car engines comes from

______________________ .

At high temperatures, the nitrogen reacts with

______________________ .

This reaction produces ___________________ .

8

0 3 This question is about the rate of the reaction between hydrochloric acid and calcium carbonate.

A student investigated the effect of changing the size of calcium carbonate lumps on the rate of this reaction.

This is the method used.

1. Pour hydrochloric acid into a conical flask up to the 50 cm^3 line.
2. Add 10.0 g of small calcium carbonate lumps to the conical flask.
3. Attach a gas syringe to the conical flask.
4. Measure the volume of gas produced every 20 seconds for 100 seconds.
5. Repeat steps 1 to 4 using 10.0 g of large calcium carbonate lumps.

0 3 . 1 The student used the 50 cm^3 line on the conical flask to measure the volume of hydrochloric acid.

Suggest a piece of equipment the student could use to make the measurement of volume more accurate. [1 mark]

____

0 3 . 2 Carbon dioxide gas is produced in the reaction between hydrochloric acid and calcium carbonate.

Which test is used to identify carbon dioxide gas? [1 mark]

Tick (✓) ONE box.

- ☐ A burning splint pops
- ☐ A glowing splint relights
- ☐ Damp litmus paper is bleached
- ☐ Limewater turns milky

[Turn over]

TABLE 2 shows the student's results for large calcium carbonate lumps.

TABLE 2

Time in seconds	Volume of gas in cm^3
0	0
20	16
40	30
60	40
80	46
100	48

FIGURE 4 on the opposite page shows the student's results for small calcium carbonate lumps.

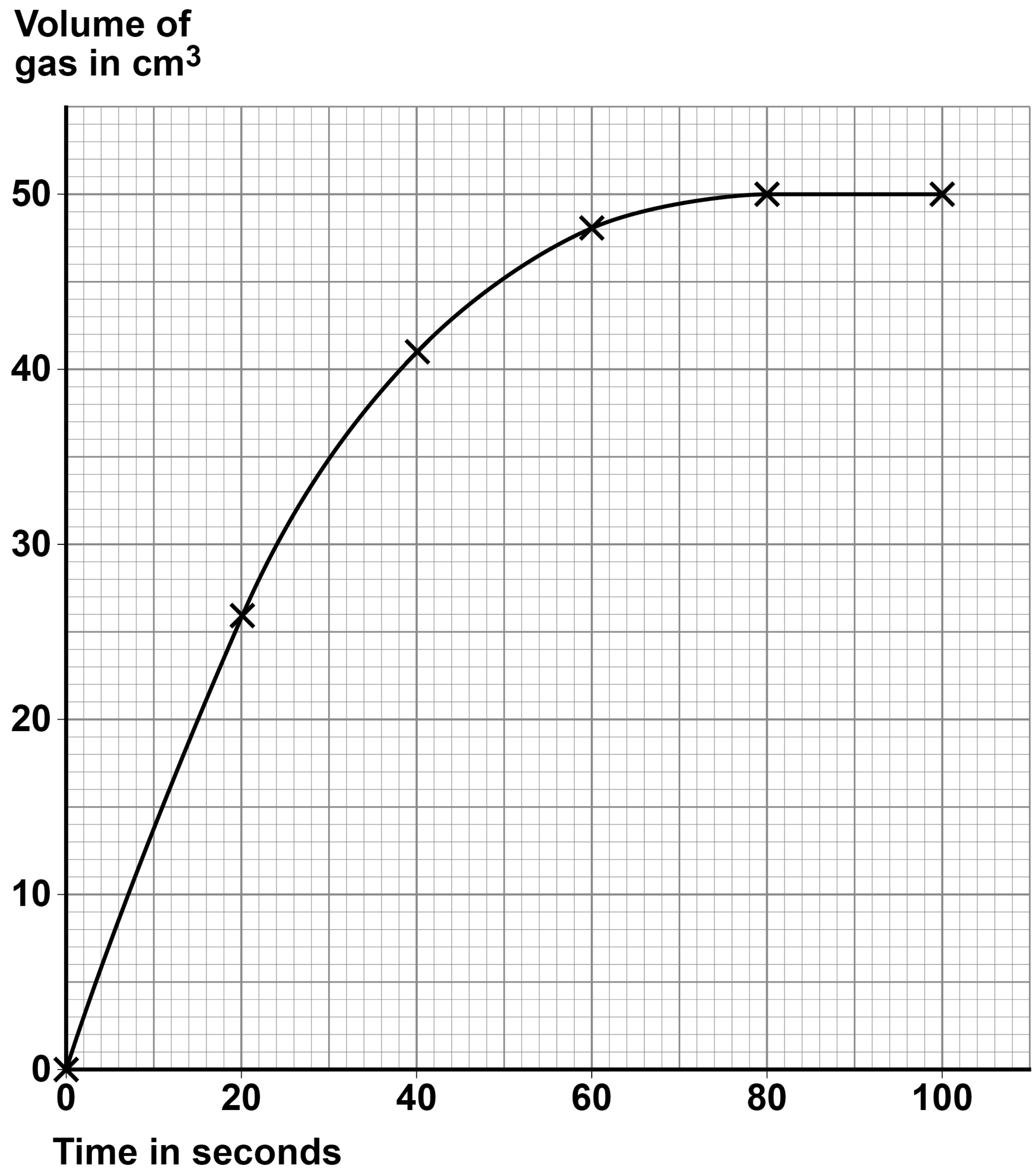
0 3 . 3 **Complete FIGURE 4, on the opposite page.**

You should:

- **plot the data for large calcium carbonate lumps from TABLE 2 on FIGURE 4**
- **draw a line of best fit for large calcium carbonate lumps.**

[3 marks]

FIGURE 4



[Turn over]

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0 3 . 4 **Determine the mean rate of reaction using SMALL calcium carbonate lumps between 0 seconds and 60 seconds.**

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced}}{\text{time taken}}$$

Use FIGURE 4, on page 23. [3 marks]

____

____

____

____

____

____

Mean rate of reaction = ________________ cm^3/s

[Turn over]

0 3 . 5 **Describe what happens to the volume of gas collected using SMALL calcium carbonate lumps:**

- **between 0 and 20 seconds**
- **between 80 and 100 seconds.**

Use FIGURE 4, on page 23. [2 marks]

Between 0 and 20 seconds ____________________

____

____

Between 80 and 100 seconds ____________________

____

____

0 3 . 6 **The balance used to weigh 10.0 g of calcium carbonate lumps caused an error.**

The balance always read 0.2 g before being used.

What type of error was caused by the balance?
[1 mark]

Tick (✓) ONE box.

☐ **Human error**

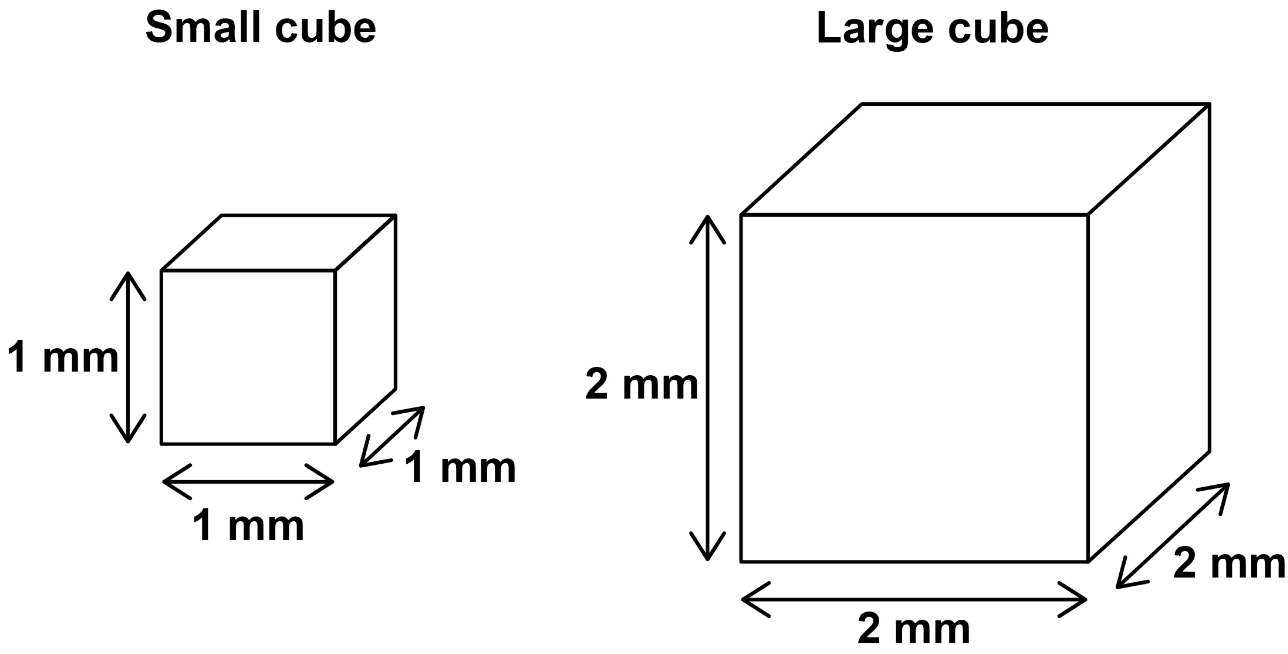
☐ **Random error**

☐ **Systematic error**

[Turn over]

FIGURE 5 shows the dimensions of two cubes of calcium carbonate.

FIGURE 5



0 3 . 7 A cube of calcium carbonate has six faces.

Calculate the total surface area of the LARGE cube of calcium carbonate.

Use FIGURE 5. [3 marks]

Total surface area = ____________________ mm^2

[Turn over]

BLANK PAGE

0 3 . 8 **The large cube of calcium carbonate was divided into eight smaller cubes.**

The eight smaller cubes have a greater total surface area than the one large cube.

Compare the rate of reaction when using the eight smaller cubes with the rate of reaction when using the large cube.

Complete the sentence.

Choose the answer from the list. [1 mark]

- **faster**
- **slower**
- **the same**

The rate of reaction of the eight smaller cubes

is ____________________ .

[Turn over]

15

0 4 This question is about ink.

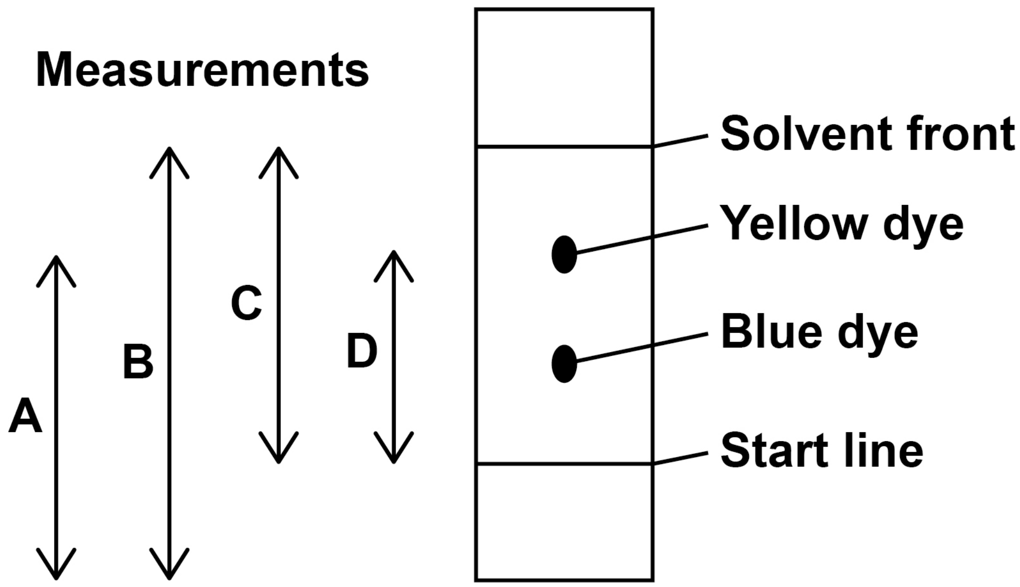
A student investigated green ink using paper chromatography in a beaker.

FIGURE 6 shows:

- the results the student obtained
- measurements A, B, C and D the student could make.

FIGURE 6 is not drawn to scale.

FIGURE 6



0 4 . 1 **The student calculated the R_f value of the blue dye.**

The student measured:

- **the distance moved by the blue dye = 2.7 cm**
- **the distance moved by the solvent = 9.0 cm**

Calculate the R_f value of the blue dye.

Use the equation:

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

[2 marks]

____

____

____

____

R_f = ____

[Turn over]

0 4 . 2 **Which measurements on FIGURE 6, on page 32, are needed to calculate the R_f value of the yellow dye? [1 mark]**

Tick (✓) ONE box.

☐ **A and B**

☐ **A and C**

☐ **B and D**

☐ **C and D**

0 4 . 3 **Paper chromatography has a stationary phase and a mobile phase.**

Draw ONE line from each phase to the identity of that phase in the student's investigation.
[2 marks]

PHASE	IDENTITY
	Beaker
Mobile phase	Ink
	Paper
Stationary phase	Solvent
	Start line

[Turn over]

The green ink contains 85% yellow dye and 15% blue dye.

0 4 . 4 **Determine the simplest whole number ratio of yellow dye : blue dye in the green ink. [1 mark]**

____

____

____

Yellow dye : Blue dye = _________ : _________

0 4 . 5 **Which word correctly describes the green ink? [1 mark]**

Tick (✓) ONE box.

☐ **Compound**

☐ **Element**

☐ **Formulation**

☐ **Solvent**

0 4 . 6 **The student repeated the investigation using green ink containing 75% yellow dye and 25% blue dye.**

What would happen to the R_f value of the yellow dye? [1 mark]

Tick (✓) ONE box.

☐ **The R_f value would decrease.**

☐ **The R_f value would increase.**

☐ **The R_f value would stay the same.**

[Turn over]

8

0 5 **This question is about alloys.**

Bronze and brass are both alloys which contain copper.

0 5 . 1 **Bronze is an alloy of copper and one other metal.**

What is the other metal in bronze? [1 mark]

Tick (✓) ONE box.

- [ ] **Aluminium**
- [ ] **Tin**
- [ ] **Zinc**

0 5 . 2 Give ONE use of brass. [1 mark]

[Turn over]

Alloys of gold are used to make jewellery.

0 5 . 3 **The proportion of gold in an alloy is measured in carats:**

- **pure gold is 24 carat**
- **50% gold is 12 carat.**

TABLE 3 shows information about two gold rings, A and B.

A and B contain only gold and silver.

Complete TABLE 3. [2 marks]

TABLE 3

Gold ring	Carat	Mass of metal in grams	
		gold	silver
A		7	7
B	18	9	

0 5 . 4 **Suggest TWO reasons why alloys of gold are used instead of pure gold to make jewellery.**
[2 marks]

1 ____

____

____

2 ____

____

____

Steels are alloys of iron.

0 5 . 5 **Spoons are made of stainless steel.**

Spoons:

- **are washed after use**
- **must not wear away quickly.**

Suggest ONE reason why stainless steel is suitable for making spoons. [1 mark]

0 5 . 6 Steel horseshoes are shaped to fit the feet of horses.

Which type of steel is most easily shaped into horseshoes? [1 mark]

Tick (✓) ONE box.

☐ High carbon steel

☐ Low carbon steel

☐ Stainless steel

[Turn over]

8

0 6 This question is about materials used to make plates.

Plates are made from ceramics, paper or poly(propene).

0 6 . 1 Paper plates are biodegradable and recyclable.

Which stage of a life cycle assessment (LCA) would contain this information? [1 mark]

Tick (✓) ONE box.

- [ ] Disposal at the end of useful life
- [ ] Extracting and processing raw materials
- [ ] Manufacturing and packaging
- [ ] Use and operation during lifetime

0 6 . 2 Which TWO processes are used to make ceramic plates? [2 marks]

Tick (✓) TWO boxes.

- [ ] Forming a composite
- [ ] Galvanising with zinc
- [ ] Heating in a furnace
- [ ] Melting sand and boron trioxide
- [ ] Shaping wet clay

[Turn over]

Poly(propene) is produced from an alkene.

0 6 . 3 Complete the sentences. [2 marks]

The name for very large molecules such as poly(propene) is ________________________ .

The name of the alkene used to produce poly(propene) is ________________________ .

0 6 . 4 **The alkene needed to make poly(propene) is produced from crude oil.**

Which TWO processes are used to produce this alkene from crude oil? [2 marks]

Tick (✓) TWO boxes.

- [ ] **Chromatography**
- [ ] **Cracking**
- [ ] **Fermentation**
- [ ] **Fractional distillation**
- [ ] **Quarrying**

[Turn over]

0 6 . 5 **What type of bond joins the atoms in a molecule of poly(propene)? [1 mark]**

Tick (✓) ONE box.

☐ **Covalent**

☐ **Ionic**

☐ **Metallic**

TABLE 4 shows information about two polymers used to make plates.

TABLE 4

Polymer	Effect of heating the polymer
A	does not melt
B	melts at 50 °C

0 6 . 6 **What type of polymer is polymer A?**

Use TABLE 4. [1 mark]

0 6 . 7 **Why does polymer A behave differently to polymer B when heated?**

You should refer to crosslinks in your answer. [1 mark]

[Turn over]

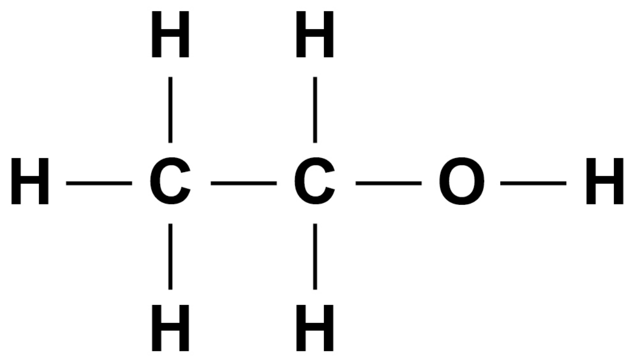
10

0 7 This question is about ethanol and ethanoic acid.

Ethanol is an alcohol.

0 7 . 1 FIGURE 7 shows the displayed structural formula of ethanol.

FIGURE 7



Draw a circle on FIGURE 7 around the alcohol functional group. [1 mark]

0 7 . 2 **An ethanol molecule contains atoms of three different elements.**

Complete TABLE 5 to show:

- **the name of each element**
- **the symbol for each element**
- **the number of atoms of each element in one molecule of ethanol.**

Use FIGURE 7. [3 marks]

TABLE 5

Name of element	Symbol for element	Number of atoms in one molecule of ethanol
Carbon	C	
Hydrogen		6
	O	1

[Turn over]

0 7 . 3 **Ethanol removes grass stains from clothes.**

What type of substance is ethanol when used to remove grass stains? [1 mark]

Tick (✓) ONE box.

☐ **A solute**

☐ **A solution**

☐ **A solvent**

Wine contains ethanol.

Wine is produced from grape juice by fermentation.

0 7 . 4 Complete the sentence. [1 mark]

Grape juice can be fermented to produce wine

because grape juice contains

______________________________ .

0 7 . 5 What is added to grape juice to cause fermentation? [1 mark]

____

____

[Turn over]

0 7 . 6 **Ethanol reacts with ethanoic acid to produce an ester.**

What is the name of the ester produced when ethanol reacts with ethanoic acid? [1 mark]

Tick (✓) ONE box.

☐ **Ethane**

☐ **Ethene**

☐ **Ethyl ethanoate**

0 7 . 7 **Ethanoic acid reacts with sodium carbonate.**

The equation for the reaction is:

$$2\ CH_3COOH(aq) + Na_2CO_3(s) \longrightarrow$$

$$2\ CH_3COONa(aq) + H_2O(l) + CO_2(g)$$

What is the name of the liquid produced by this reaction? [1 mark]

____

07.8 **Vinegar is a solution that contains ethanoic acid.**

400 cm^3 of vinegar contains 20 g of ethanoic acid.

Calculate the mass of ethanoic acid in 1.0 dm^3 of vinegar. [3 marks]

Mass = ________________ g

0 8 This question is about chemical analysis.

A student tested copper sulfate solution and calcium iodide solution using flame tests.

This is the method used.

1. Dip a metal wire in copper sulfate solution.
2. Put the metal wire in a blue Bunsen burner flame.
3. Record the flame colour produced.
4. Repeat steps 1 to 3 using the same metal wire but using calcium iodide solution.

0 8 . 1 What flame colour is produced by copper sulfate solution? [1 mark]

____

____

0 8 . 2 **Calcium compounds produce an orange-red flame colour.**

The student left out an important step before reusing the metal wire.

The student's method did NOT produce a distinct orange-red flame colour using calcium iodide solution.

Explain why. [2 marks]

[Turn over]

0 8 . 3 **The student added sodium hydroxide solution to:**

- **copper sulfate solution**
- **calcium iodide solution.**

Give the results of the tests. [2 marks]

Copper sulfate solution ____________________

____

____

Calcium iodide solution ____________________

____

____

08.4 **To test for sulfate ions the student added dilute hydrochloric acid to copper sulfate solution.**

Name the solution that would show the presence of sulfate ions when added to this mixture. [1 mark]

____

08.5 **To test for iodide ions the student added dilute nitric acid to calcium iodide solution.**

Name the solution that would show the presence of iodide ions when added to this mixture.

Give the result of the test. [2 marks]

Solution ______________________________

____

Result ______________________________

____

8

0 9 **This question is about water.**

0 9 . 1 **In the UK, potable (drinking) water is produced from different sources of fresh water.**

Explain how potable water is produced from fresh water. [4 marks]

0 9 . 2 **A different country has:**

- **very little rainfall**
- **a long coastline**
- **plentiful energy supplies.**

Suggest ONE process this country could use to obtain most of its potable water. [1 mark]

[Turn over]

0 9 . 3 **Waste water is not fit to drink.**

Treatment of waste water produces two substances:

- **liquid effluent**
- **solid sewage sludge.**

Draw ONE line from each substance to the way the substance is processed. [2 marks]

SUBSTANCE	PROCESS
	Aerobic biological treatment
Liquid effluent	Anaerobic digestion
	Grit removal
Solid sewage sludge	Screening
	Sedimentation

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[Turn over]

TABLE 6 shows information about the disposal of processed solid sewage sludge in the UK in 1992 and in 2010.

TABLE 6

Year	Mass of processed solid sewage sludge in millions of kilograms				
	Used as fertiliser	Sent to landfill	Burned	Other methods	Total
1992	440	130	90	338	998
2010	1118	9	260	26	1413

0 9 . 4 **Calculate the percentage of processed solid sewage sludge that was burned in 2010.**

Give your answer to 3 significant figures.

Use TABLE 6. [3 marks]

Percentage (3 significant figures) = ____________________ %

0 9 . 5 Suggest ONE reason why the total mass of processed solid sewage sludge increased between 1992 and 2010. [1 mark]

0 9 . 6 Between 1992 and 2010 the proportion of processed solid sewage sludge used as fertiliser increased.

Suggest TWO reasons why. [2 marks]

1

2

13

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[Turn over]

10 This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

10.1 **Draw ONE line from each hydrocarbon to the formula of that hydrocarbon. [2 marks]**

HYDROCARBON	FORMULA
	C_6H_8
Hexane	C_6H_{10}
	C_6H_{12}
Hexene	C_6H_{14}
	C_6H_{16}

10.2 **Bromine water is added to hexane and to hexene.**

What would be observed when bromine water is added to hexane and to hexene? [2 marks]

Hexane ____________________

____

____

Hexene ____________________

____

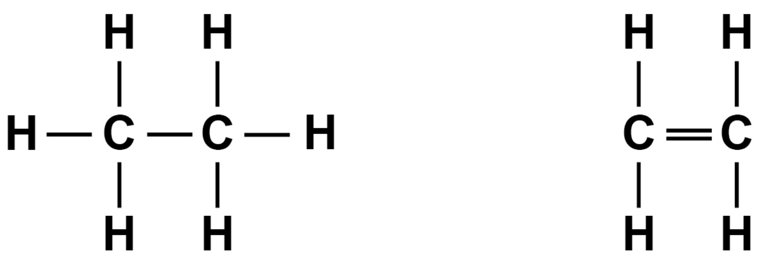
____

[Turn over]

10.3 Ethane is an alkane and ethene is an alkene.

FIGURE 8 shows the displayed structural formulae of ethane and of ethene.

FIGURE 8



Ethane Ethene

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

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.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
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