FOR OFFICIAL USE

Section B **Total Marks**

X012/201

NATIONAL QUALIFICATIONS 2007

TUESDAY, 29 MAY
9.00 AM – 11.00 AM

CHEMISTRY
INTERMEDIATE 2

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

Necessary data will be found in the Chemistry Data Booklet for Standard Grade and Intermediate 2.

Section A – Questions 1–30 (30 marks)

Instructions for completion of **Section A** are given on page two.

For this section of the examination you must use an **HB pencil**.

Section B (50 marks)

All questions should be attempted.

The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, **and must be written clearly and legibly in ink**.

Rough work, if any should be necessary, should be written in this book, and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the invigilator.

Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this booklet.

Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

Read carefully

1 Check that the answer sheet provided is for **Chemistry Intermediate 2 (Section A)**.

2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.

3 Check that the answer sheet you have been given has **your name**, **date of birth**, **SCN** (Scottish Candidate Number) and **Centre Name** printed on it.

Do not change any of these details.

4 If any of this information is wrong, tell the Invigilator immediately.

5 If this information is correct, **print** your name and seat number in the boxes provided.

6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).

7 There is **only one correct** answer to each question.

8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.

9 At the end of the exam, put the **answer sheet for Section A inside the front cover of this answer book**.

Sample Question

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be

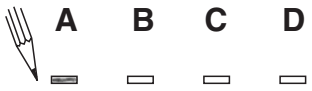
A chromatography

B fractional distillation

C fractional crystallisation

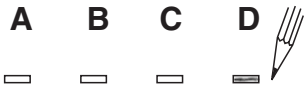
D filtration.

The correct answer is **A—**chromatography. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.



SECTION A

1. Which of the following elements has similar chemical properties to argon?

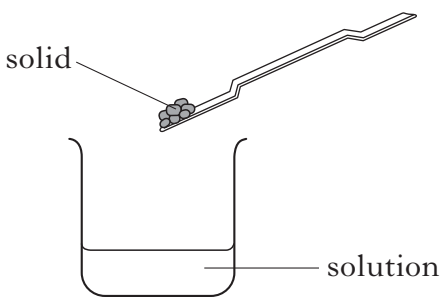
A Fluorine

B Krypton

C Potassium

D Zinc

2.



Which of the following would **not** be evidence of a chemical reaction when the solid is added to the solution?

A A colour change

B A gas being given off

C The temperature rising

D The solid disappearing

3. Which line in the table shows the approximate percentage composition of air?

	Nitrogen	**Oxygen**	**Carbon dioxide**	**Noble gases**
A	78	21	0·03	1
B	21	78	1	0·03
C	1	21	78	0·03
D	0·03	78	1	21

4. Isotopes of the same element have identical

A nuclei

B mass numbers

C numbers of neutrons

D numbers of protons.

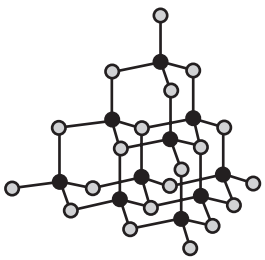
5. Vinegar is prepared by dissolving ethanoic acid in water.

Which line in the table identifies the solute, solvent and solution?

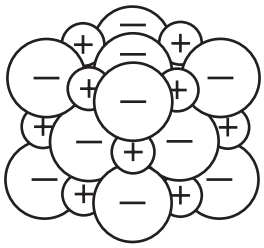
	Solute	**Solvent**	**Solution**
A	water	ethanoic acid	vinegar
B	water	vinegar	ethanoic acid
C	ethanoic acid	water	vinegar
D	vinegar	water	ethanoic acid

6. Which of the following diagrams could be used to represent the structure of a covalent network compound?

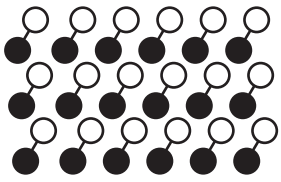
A



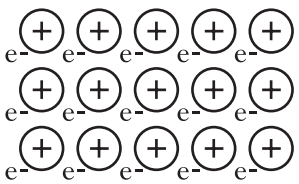
B



C



D



[Turn over

7. The table shows the colours of some ionic compounds in solution.

Compound	Colour
potassium chloride	colourless
potassium chromate	yellow
copper chromate	green
copper sulphate	blue

The colour of the chromate ion is

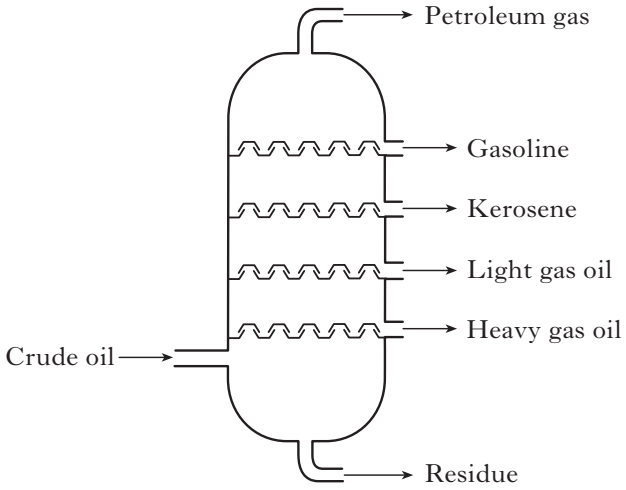
A colourless

B yellow

C green

D blue.

8. Gasoline produced by the fractional distillation of crude oil has a low viscosity.



Which of the following properties also applies to gasoline?

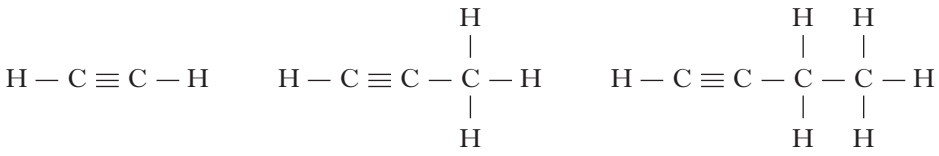
A High boiling point and high flammability

B Low boiling point and high flammability

C High boiling point and low flammability

D Low boiling point and low flammability

9. The first three members of the alkyne homologous series are:



What is the general formula for this homologous series?

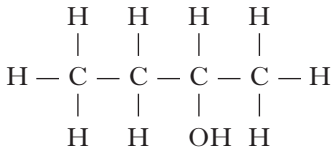
A C_nH_n

B C_nH_{n+1}

C C_nH_{n+2}

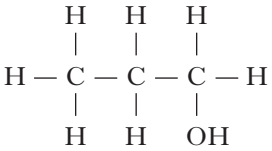
D C_nH_{2n-2}

10.



Which of the following compounds is an isomer of the one above?

A



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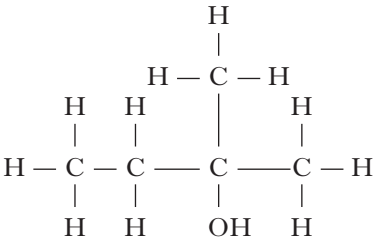

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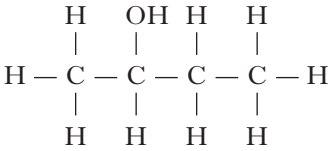

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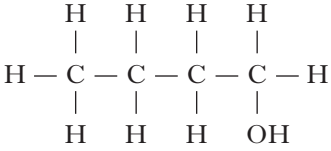
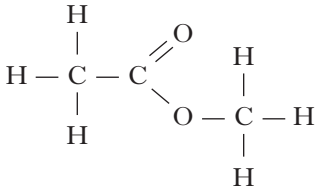
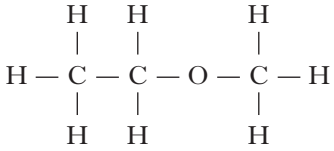


11. Which of the following represents an ester?

A



B



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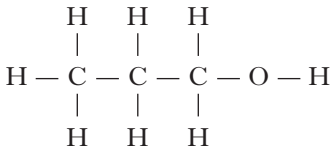

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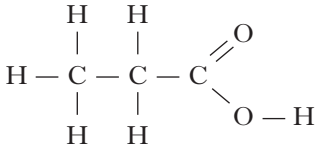
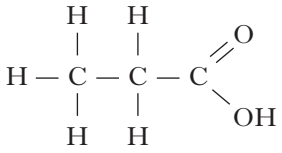
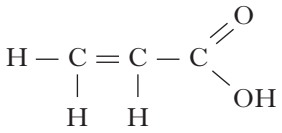
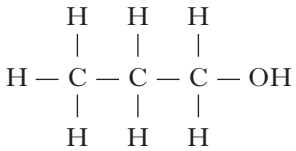
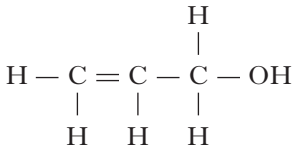
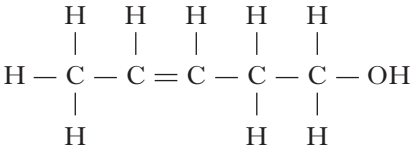


[Turn over

12. A student tested some compounds. The results are given in the table.

Compound	pH of aqueous solution	Effect on bromine solution
	4	no effect
	4	decolourised
	7	no effect
	7	decolourised

Which line in the table below shows the correct results for the following compound?



	pH of aqueous solution	Effect on bromine solution
A	4	decolourised
B	7	decolourised
C	4	no effect
D	7	no effect

13. Poly(ethenol) is

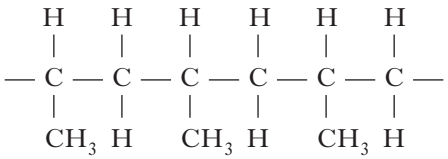
A a natural polymer, which is insoluble in water

B a natural polymer, which is soluble in water

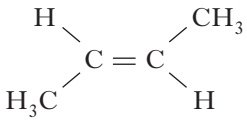
C a synthetic polymer, which is soluble in water

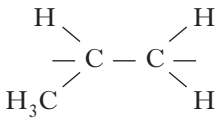
D a synthetic polymer, which is insoluble in water.

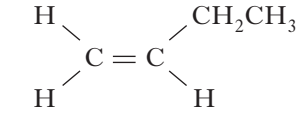
14. Part of the structure of a polymer is drawn below.

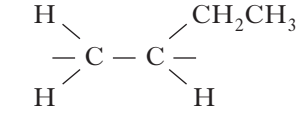


The repeating unit of this polymer is

A 

B 

C 

D 

15. Which sugar will **not** be detected by the Benedict's test?

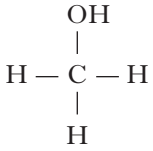
A Fructose

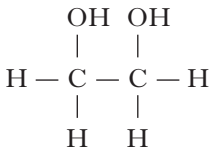
B Glucose

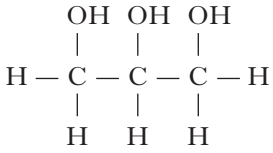
C Maltose

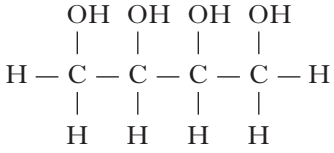
D Sucrose

16. The structure of glycerol is

A 

B 

C 

D 

17. The conversion of an oil into a hardened fat involves the

A removal of hydrogen

B addition of hydrogen

C removal of water

D addition of water.

18. Which of the following oxides, when shaken with water, would leave the pH unchanged?

(You may wish to use page 5 of the data booklet to help you.)

A Carbon dioxide

B Copper oxide

C Sodium oxide

D Sulphur dioxide

19. Which of the following **increases** when hydrochloric acid is diluted with water?

A Rate of reaction with magnesium

B Concentration of H^+ ions

C Electrical conductivity

D pH

20. Which of the following statements describes the concentrations of $H^+(aq)$ and $OH^-(aq)$ ions in pure water?

A The concentrations of $H^+(aq)$ and $OH^-(aq)$ ions are equal.

B The concentrations of $H^+(aq)$ and $OH^-(aq)$ ions are zero.

C The concentration of $H^+(aq)$ ions is greater than the concentration of $OH^-(aq)$ ions.

D The concentration of $OH^-(aq)$ ions is greater than the concentration of $H^+(aq)$ ions.

21. When 100 cm^3 of a 1 $mol\,l^{-1}$ solution of sodium sulphate was evaporated to dryness, 14·2 g of solid was obtained.

To obtain 14·2 g of solid from a 2 $mol\,l^{-1}$ solution of sodium sulphate the volume of solution needed would be

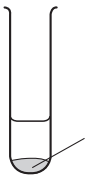
A 25 cm^3

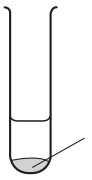
B 50 cm^3

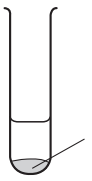
C 100 cm^3

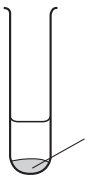
D 200 cm^3.

22. In which of the following test tubes will a gas be produced?

A 

B 

C 

D 

23. Which of the following compounds would **not** be used as a fertiliser?

A NH_4NO_3

B KNO_3

C NaCl

D K_3PO_4

24. Which of the following solutions would produce a precipitate when mixed together?

(You may wish to use page 5 of the data booklet to help you.)

A Ammonium chloride and potassium nitrate

B Zinc nitrate and magnesium sulphate

C Calcium nitrate and nickel chloride

D Sodium iodide and silver nitrate

25. Sodium sulphate solution reacts with barium chloride solution.

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

The spectator ions present in this reaction are

A Na^+ and Cl^-

B Na^+ and SO_4^{2-}

C Ba^{2+} and Cl^-

D Ba^{2+} and SO_4^{2-}.

26. Which of the following solutions will react with magnesium metal?

A Magnesium chloride

B Zinc chloride

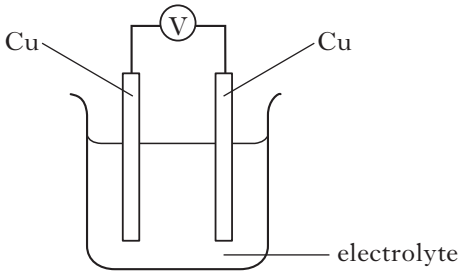
C Potassium chloride

D Sodium chloride

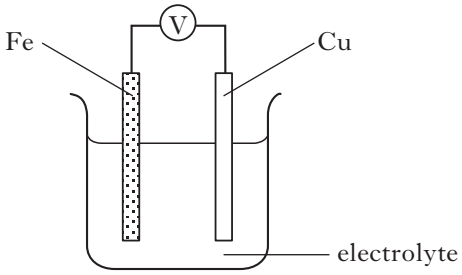
27. Which of the following cells would produce the highest voltage?

(You may wish to use page 7 of the data booklet to help you.)

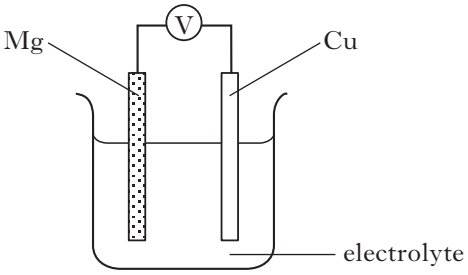
A



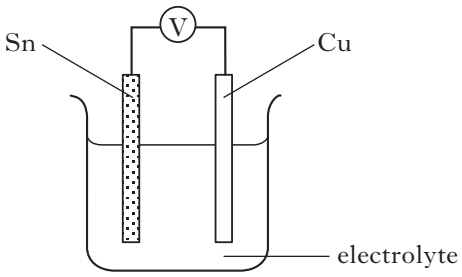
B



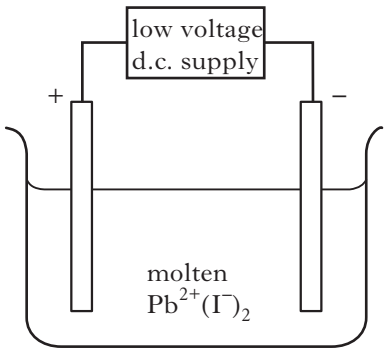
C



D



28.



Which of the following describes the reaction at the positive electrode?

A I^- reduced

B I^- oxidised

C Pb^{2+} oxidised

D Pb^{2+} reduced

29. The table contains information about calcium and calcium chloride.

	Melting point (°C)	**Density ($g\,cm^{-3}$)**
Calcium	842	1·54
Calcium chloride	772	2·15

When molten calcium chloride is electrolysed at 800 °C the calcium appears as a

A solid on the surface of the molten calcium chloride

B liquid on the surface of the molten calcium chloride

C solid at the bottom of the molten calcium chloride

D liquid at the bottom of the molten calcium chloride.

30. Which ion will turn ferroxyl indicator pink?

A $Fe^{2+}(aq)$

B $Fe^{3+}(aq)$

C $H^+(aq)$

D $OH^-(aq)$

Candidates are reminded that the answer sheet for Section A MUST be placed INSIDE the front cover of this answer book.

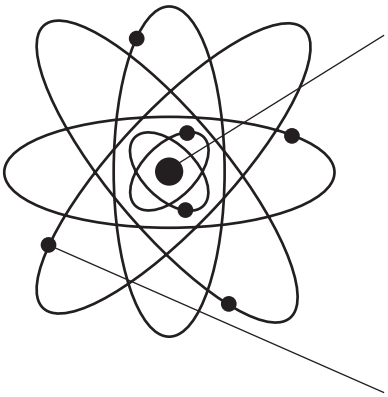
Marks

SECTION B

50 marks are available in this section of the paper.

All answers must be written clearly and legibly in ink.

1. The diagram represents the structure of an atom.



In the Nucleus		
Name of particle	**Relative mass**	**Charge**
Proton		+1
Neutron	1	

Outside the Nucleus		
Name of particle	**Relative mass**	**Charge**
	almost zero	

(*a*) Complete the tables. **2**

(*b*) Ernest Rutherford used alpha particles to confirm the structure of the atom. The table shows the number of protons, electrons and neutrons in an alpha particle.

	Number
Proton	2
Electron	0
Neutron	2

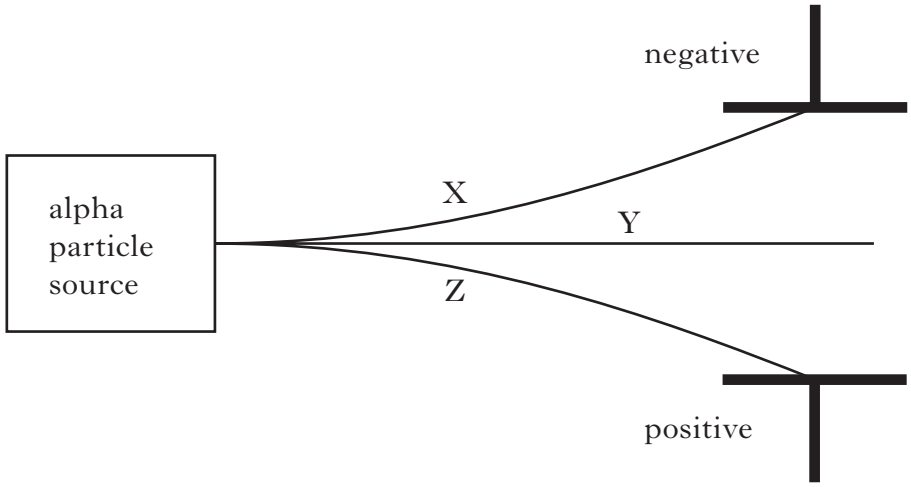
(i) What is the atomic number of an alpha particle?

_____ **1**

Marks

1. (*b*) (continued)

(ii) When alpha particles are passed through an electric field, which letter in the diagram shows the path taken by them?



Letter _____ **1**

(4)

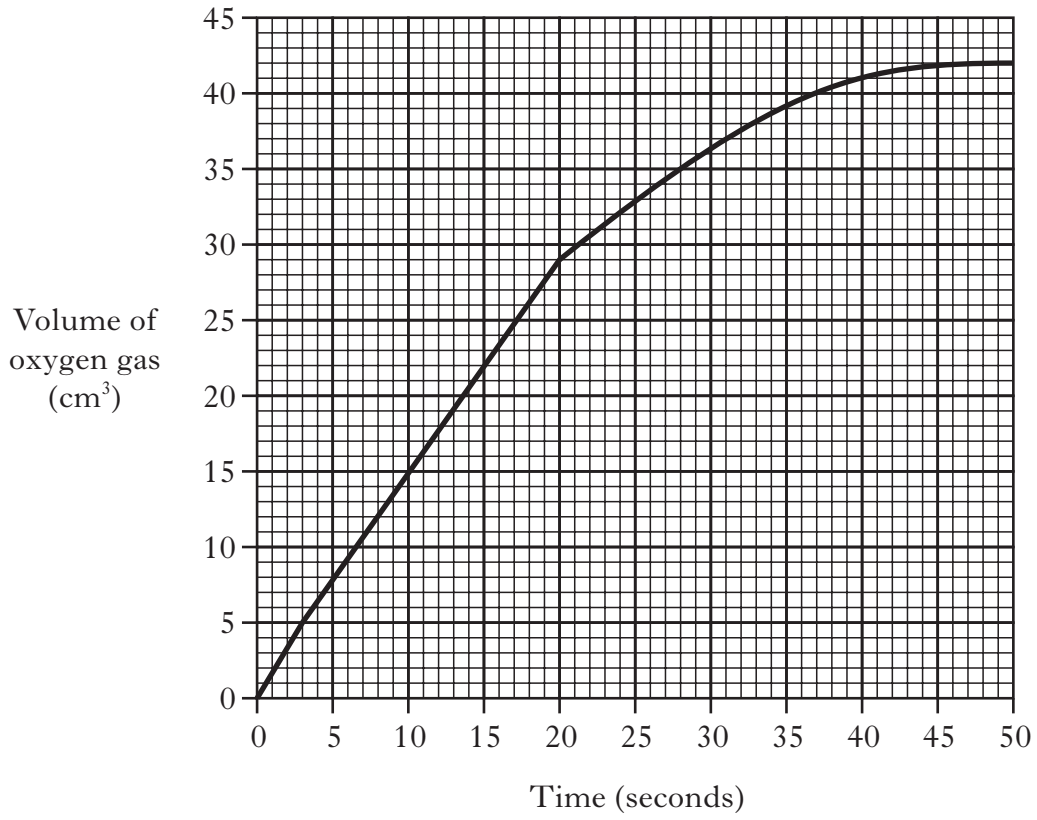
[Turn over

Marks

2. Hydrogen peroxide solution decomposes to give water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(\ell) + O_2(g)$$

(*a*) The graph shows the results of an experiment carried out to measure the volume of oxygen gas released.



Calculate the average rate of reaction between 0 and 20 seconds.

_____ $cm^3 s^{-1}$ **1**

(*b*) The reaction was catalysed by a **solution** of Fe^{3+} ions which is amber in colour.

(i) Why is the term homogeneous used to describe this catalyst?

_____

_____ **1**

(ii) What colour would the solution be at the end of the reaction?

_____ **1**

(3)

Marks

3. Tin and its compounds have many uses.

(*a*) Why do metals such as tin conduct electricity?

_____

_____ **1**

(*b*) Tin(IV) chloride, $SnCl_4$, is used in the processing of glass and can be prepared as shown.

$$SnO_2 + 4HCl \rightarrow SnCl_4 + 2H_2O$$

(i) Name the type of reaction taking place.

_____ **1**

(ii) Tin(IV) chloride is a liquid at room temperature and is made up of discrete molecules.

What type of bonding does this suggest is present in tin(IV) chloride?

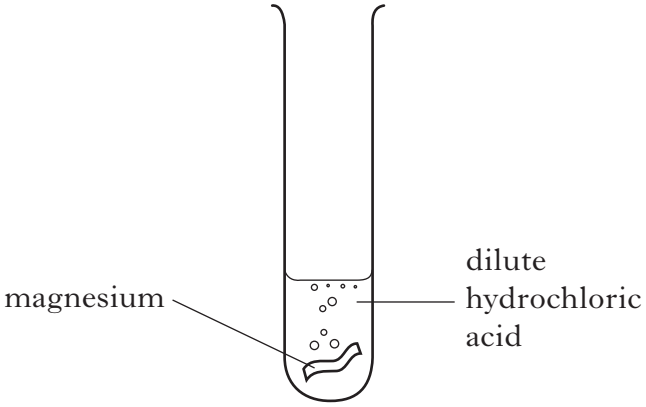
_____ **1**

(3)

[Turn over

Marks

4. Magnesium reacts with dilute hydrochloric acid.



The equation for the reaction is shown.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(\ ) + H_2(g)$$

(*a*) (i) Complete the equation by adding the state symbol for magnesium chloride.
(You may wish to use page 5 of the data booklet to help you.) **1**

(ii) State the test for hydrogen gas.

_____ **1**

(*b*) In an experiment 4·9 g of magnesium reacted with excess dilute hydrochloric acid. Calculate the mass of hydrogen produced in this reaction.

_____ g **2**

(4)

Marks

5. Thiols are organic compounds containing sulphur. Some thiols are listed in the table.

Formula	Name of thiol
CH_3SH	methanethiol
CH_3CH_2SH	ethanethiol
$CH_3CH(CH_3)CH_2SH$	**X**
$CH_3CH(CH_3)CH_2CH_2SH$	3-methylbutane-1-thiol

(*a*) Ethanethiol is added to natural gas to give it a smell.
Draw the **full** structural formula for ethanethiol.

1

(*b*) Suggest the name for thiol **X**.

_____ **1**

(*c*) Thiols undergo complete combustion.

thiols + oxygen → carbon dioxide + water + _____

Complete the word equation for this reaction. **1**

(3)

[Turn over

Marks

6. A student completed the **PPA "Testing for Unsaturation"**. Results from the experiment are shown in the table.

Hydrocarbon	Molecular formula	Observation with bromine solution	Saturated or unsaturated
A	C_6H_{14}	no change	
B	C_6H_{12}		unsaturated
C	C_6H_{12}		saturated
D	C_6H_{10}	bromine decolourises	

(*a*) Complete the table. **2**

(*b*) Care had to be taken when using bromine solution. Give a safety precaution, **other** than eye protection, which should be taken when completing this PPA.

_____ **1**

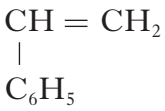
(*c*) Suggest a possible name for hydrocarbon **B**.

_____ **1**

(4)

Marks

7. Polystyrene is made from the monomer, styrene. The systematic name for styrene is phenylethene.

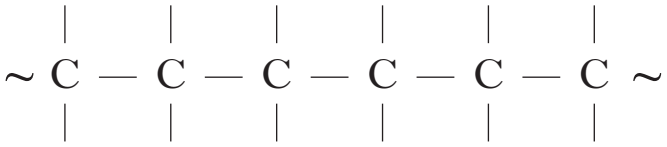


Styrene (phenylethene)

(*a*) The monomer used to form polystyrene is shown.
Which part of the structure of styrene allows the polymer to form?

_____ **1**

(*b*) Complete the diagram to show how three styrene molecules join to form part of the polymer chain.



1

(*c*) Give another name for polystyrene.

_____ **1**

(3)

[Turn over

Marks

8. The fermentation of glucose is catalysed by the enzyme zymase.

$$C_6H_{12}O_6(aq) \rightarrow C_2H_5OH(aq) + CO_2(g)$$

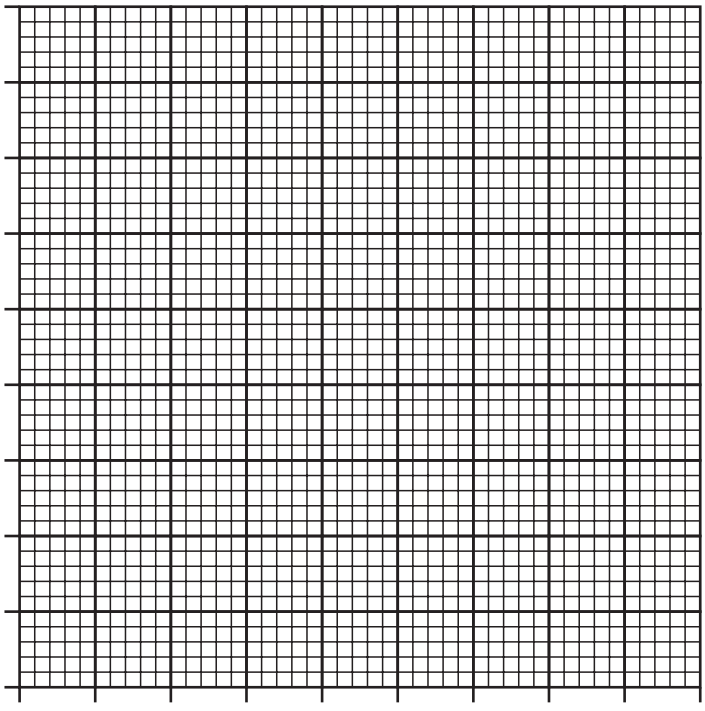
(*a*) Balance the equation. **1**

(*b*) A series of fermentation experiments was carried out at different temperatures and the volume of carbon dioxide was measured.

Experiment	Temperature (°C)	Volume of CO_2 (cm^3)
1	15	8
2	20	25
3	25	35
4	30	42
5	35	27
6	40	14

(i) Plot a line graph of these results, showing the temperature of the reaction against the volume of CO_2 collected.

(Additional graph paper, if required, will be found on page 28.)



2

(ii) When the experiment was carried out at 70 °C, no carbon dioxide was produced.

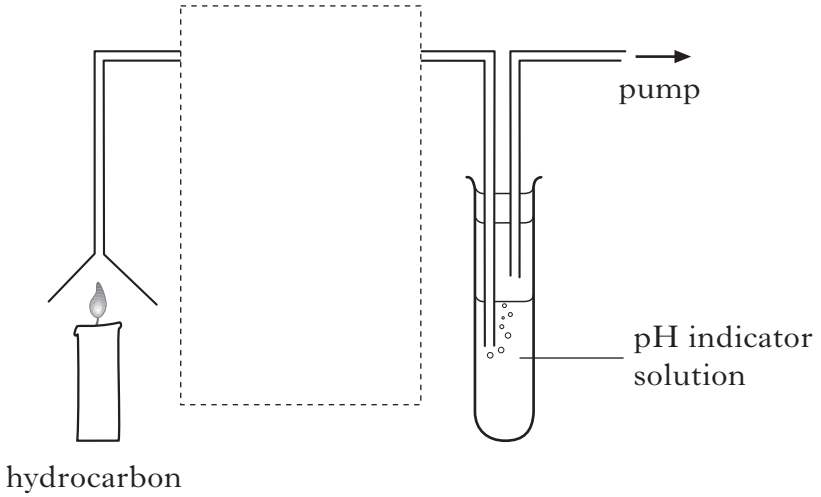
Suggest a reason for this.

_____ **1**

(4)

Marks

9. When a hydrocarbon is burnt, carbon dioxide and water are produced. The following experiment can be used to investigate the products of combustion.



(*a*) Complete the diagram to show the apparatus which would be used to collect the water. **1**

(*b*) When the carbon dioxide produced in the reaction is passed through the pH indicator solution, the solution turns from green to red.
What does this colour change suggest about carbon dioxide?

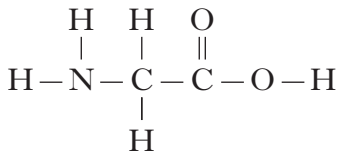
_____ **1**

(2)

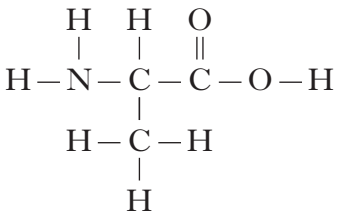
[Turn over

Marks

10. The silk that spiders spin into a web is made from a protein called fibroin. Two of the amino acids spiders use to make this protein are glycine and alanine.

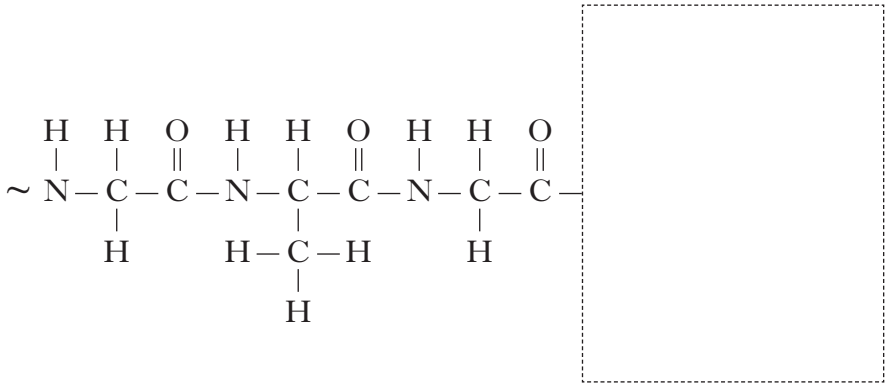


glycine



alanine

When fibroin is formed, the glycine and alanine are joined by a peptide link. Part of the structure of the protein is shown below.



(*a*) Circle a peptide link in the protein structure. **1**

(*b*) Complete the structure by adding another molecule of **glycine**. **1**

(*c*) Name the type of polymerisation that produces fibroin.

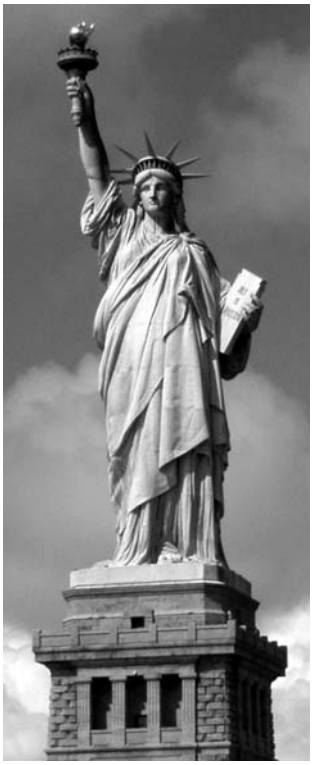
_____ **1**

(3)

Marks

11. The Statue of Liberty is made from copper attached to an iron frame.

Statue of Liberty



(*a*) Why does the iron frame rust more quickly when attached to the copper?

_____

_____

_____ **1**

(*b*) The statue sits on an island surrounded by seawater.
Why does the seawater increase the rate of rusting?

_____

_____

_____ **1**

(*c*) Rust contains iron(III) oxide.
Write the formula for iron(III) oxide.

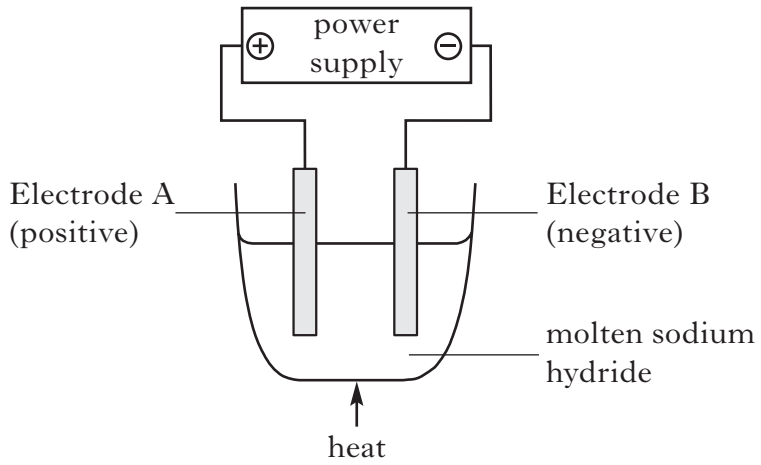
_____ **1**

(3)

[Turn over

Marks

12. Electrolysis of molten sodium hydride produces hydrogen gas.



The ion-electron equations taking place at the electrodes are:

$$Na^+ + e^- \rightarrow Na$$

$$2H^- \rightarrow H_2 + 2e^-$$

(*a*) Use the equations to identify the electrode at which hydrogen gas is produced.

_____ **1**

(*b*) Combine the two ion-electron equations to give the **balanced** redox equation.

_____ **1**

(*c*) Sodium hydride reacts with water to form a solution of sodium hydroxide.

Sodium hydroxide is an example of a strong base.

Complete the table by circling the correct words to show how the properties of sodium hydroxide solution compare with ammonia solution, which is a weak base.

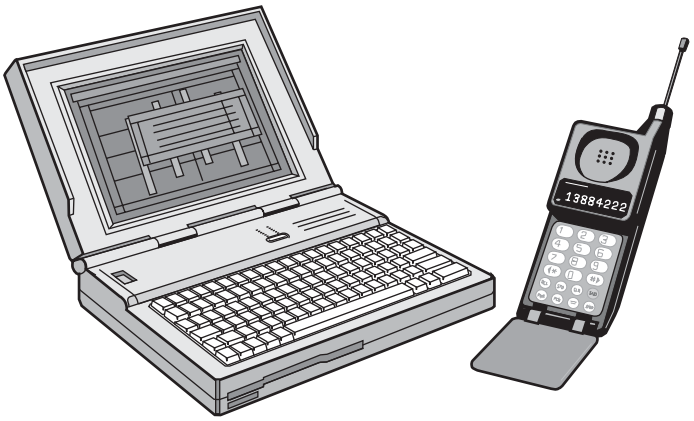
	0·1 mol l^{-1} ammonia solution	**0·1 mol l^{-1} sodium hydroxide solution**	
pH	10	lower	higher
Current in a conductivity cell (microamps)	22	lower	higher

1

(3)

Marks

13.



Lithium cells are used as batteries in laptops and mobile phones. In these cells lithium is present as ions.

(*a*) (i) Write the electron arrangement for the lithium **ion**.

1

(ii) Suggest an advantage of using lithium **ions** rather than lithium atoms in the cell.

_____ **1**

(*b*) The voltages of cells can be measured. Some voltages of cells in which different metals are connected to copper are shown in the table.

Metal connected to copper	Voltage (V)
Iron	0·44
Lead	0·13
Lithium	3·02

State the relationship between the position of the metal in the electrochemical series and voltage.

_____ **1**

(3)

[Turn over

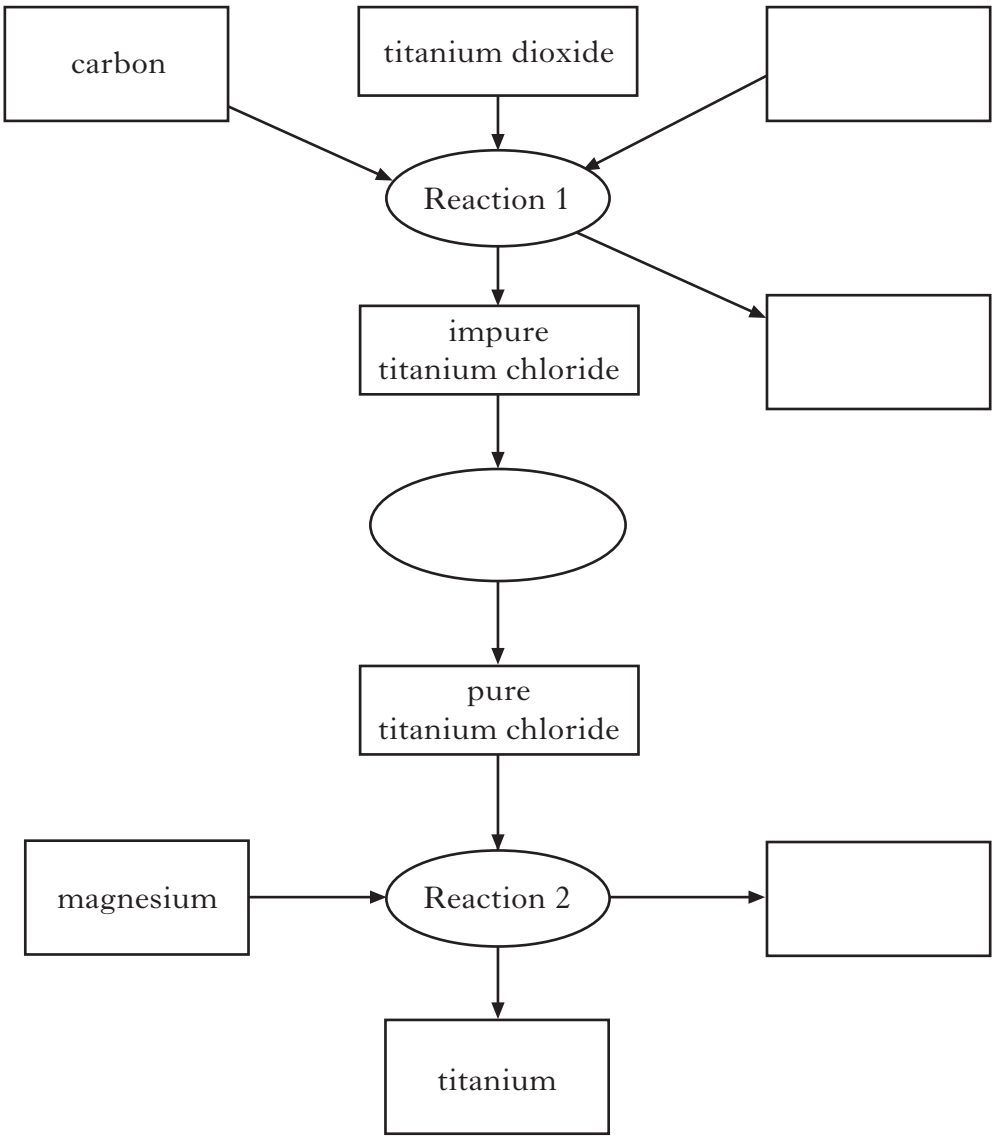
Marks

14. Titanium is an important metal.

(*a*) Titanium can be extracted from titanium dioxide.

The titanium dioxide is reacted with carbon and chlorine to produce impure titanium chloride and carbon dioxide. The impure titanium chloride is purified by distillation. Magnesium metal is added to the pure titanium chloride producing titanium and magnesium chloride.

Complete the flow chart to show the extraction process.



2

Marks

14. (continued)

(*b*) A mixture of titanium and nickel is used to make the alloy, Nitinol. This alloy is used to make dental braces.

The composition of Nitinol is shown in the table.

Metal	titanium	nickel
percentage by mass	45	55

A set of braces has a mass of 8 g.

(i) Calculate the mass of titanium in the braces.

_____ g **1**

(ii) Calculate the number of moles of titanium in the braces.
(Relative atomic mass of titanium = 48)

_____ **1**

(4)

Marks

15. A student carried out a **PPA** to prepare the salt, magnesium sulphate.

(*a*) Name the acid used to make this salt.

_____ **1**

(*b*) Part of the student's PPA assessment sheet is shown.

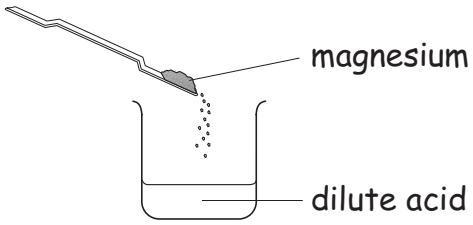
Intermediate 2 Chemistry	**Preparation of a Salt**	**Unit 3 PPA1**

Assessment Sheet

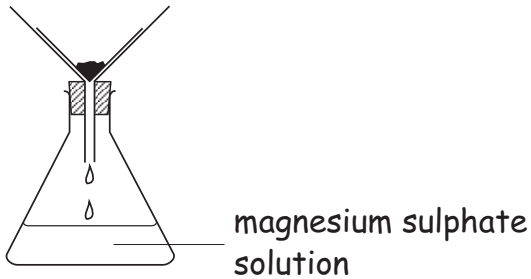
Aim To prepare magnesium sulphate crystals by reacting excess magnesium with dilute acid.

Procedure

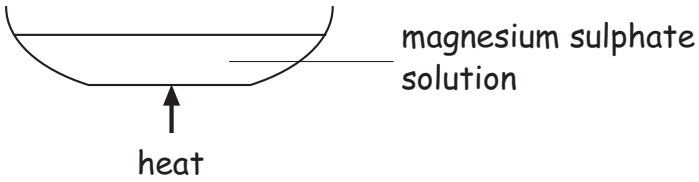
Step 1
reaction



Step 2
filtration



Step 3



Marks

15. (*b*) (continued)

(i) Why was the reaction mixture filtered in step 2?

_____ **1**

(ii) There are three steps in the preparation of magnesium sulphate.

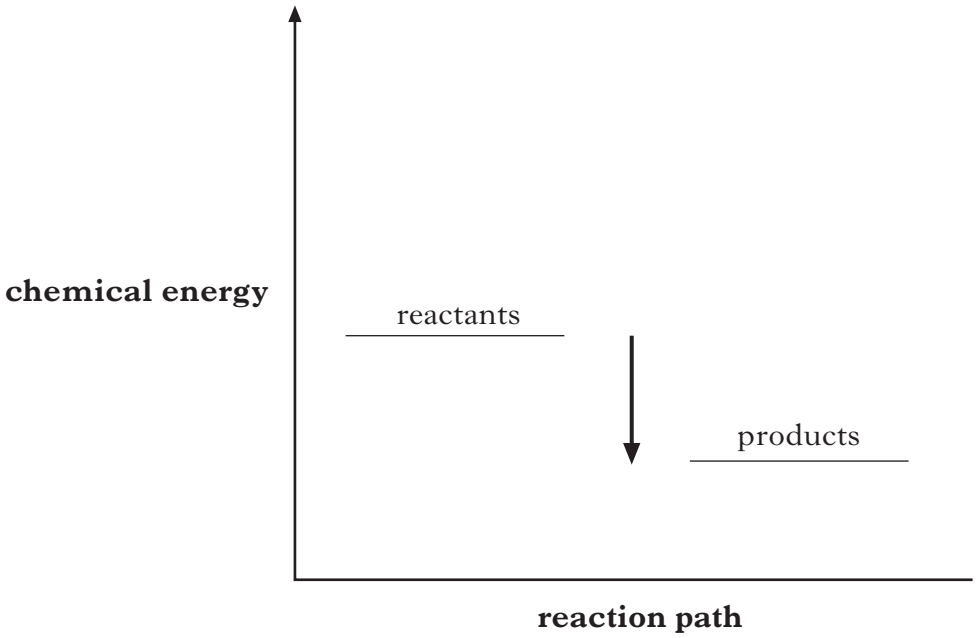
Step 1 reaction

Step 2 filtration

Step 3 _____

Name step 3. **1**

(*c*) The diagram shows the chemical energies of the reactants and products when magnesium reacts with dilute acid.



In what way does the energy diagram show that the reaction is exothermic?

_____

_____

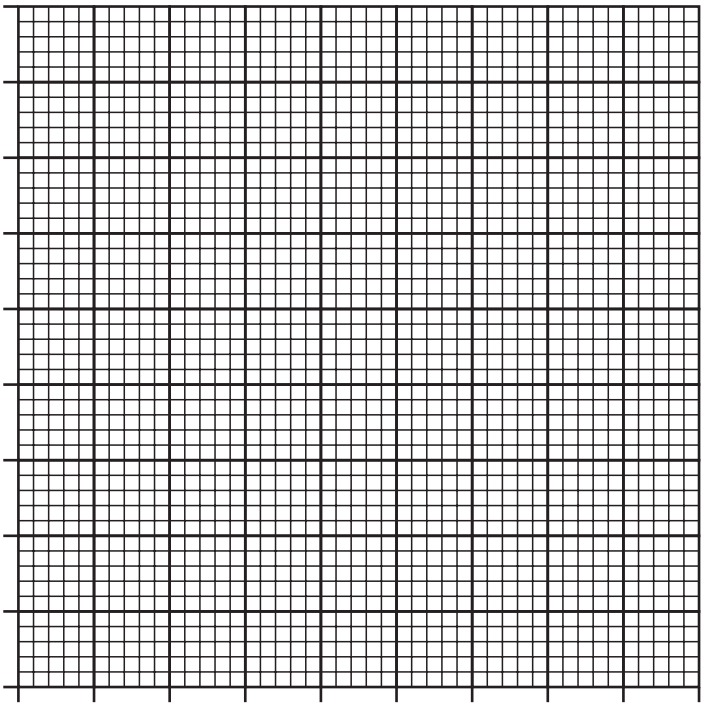
_____ **1**

(4)

[*END OF QUESTION PAPER*]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 8(*b*)(i)



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