

**Paper Reference(s)    4CH1/1C    4SD0/1C**

**Pearson Edexcel International GCSE (9–1)**

**Chemistry**

**Unit: 4CH1**

**Science (Double Award) 4SD0**

**Paper: 1C**

**Thursday 16 May 2019 – Morning**

**Time: 2 hours plus your additional time allowance**

**INSTRUCTIONS TO CANDIDATES**

**Write your centre number, candidate number, surname, other names, your signature and complete the paper reference for which you have been entered in the boxes below. Check that you have the correct question paper.**

<b>Centre No.</b>					
<b>Candidate No.</b>					
<b>Surname</b>					
<b>Other names</b>					
<b>Signature</b>					
<b>Paper Reference</b>					/ 1 C



- Use **BLACK** ink or ball-point pen.
- Answer **ALL** questions.
- Answer the questions in the spaces provided – there may be more space than you need.
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

## **MATERIALS REQUIRED FOR EXAMINATION**

Calculator, ruler

## **ITEMS INCLUDED WITH QUESTION PAPERS**

Periodic Table

## **INFORMATION FOR CANDIDATES**

- The total mark for this paper is 110.
- The marks for **EACH** question are shown in brackets – use this as a guide as to how much time to spend on each question.
- A Periodic Table is provided.

## **ADVICE TO CANDIDATES**

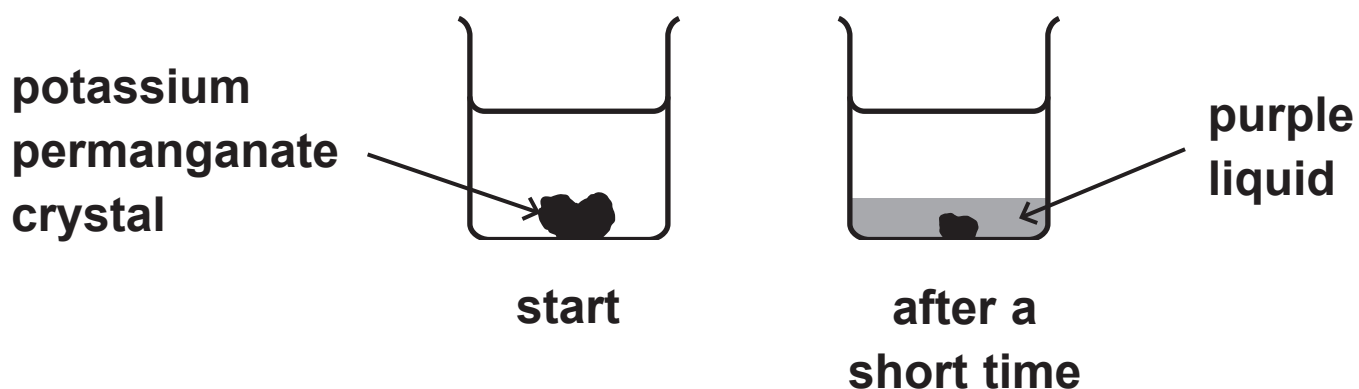
- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

(Turn over)

**Answer ALL questions.**

- 1 Potassium permanganate is a purple solid that is soluble in water.**

**A crystal of potassium permanganate is placed in a beaker containing water.**



- (a) After a short time, the crystal becomes smaller and the liquid at the bottom of the beaker becomes purple.**

**Which statement explains this observation?**

**(1 mark)**

- ☐ **A** the crystal condenses in the water
- ☐ **B** the crystal dissolves in the water
- ☐ **C** the crystal evaporates in the water
- ☐ **D** the crystal melts in the water

**(b) The beaker is left until there is no further change in the appearance of the liquid.**

**(i) Which statement describes the final appearance of the liquid? (1 mark)**

- ☐ **A all of the liquid is purple**
- ☐ **B none of the liquid is purple**
- ☐ **C only the bottom half of the liquid is purple**
- ☐ **D only the top half of the liquid is purple**

**(ii) Which process causes this change in appearance? (1 mark)**

- ☐ **A condensation**
- ☐ **B crystallisation**
- ☐ **C diffusion**
- ☐ **D evaporation**

**(Question continues on next page)**

**(Turn over)**

(c) The formula of potassium permanganate is  $\text{KMnO}_4$

How many different elements are there in potassium permanganate? (1 mark)

☐ A 3

☐ B 4

☐ C 6

☐ D 7

(TOTAL FOR QUESTION 1 = 4 MARKS)

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(Questions continue on next page)

(Turn over)

- 2 The diagram shows part of the Periodic Table, with elements represented by the letters L, M, Q, R and T.

The letters in the diagram represent elements but are NOT their chemical symbols.

1	2												3	4	5	6	7	0
																		T
L																		
M													Q		R			

- (a) Give the letter from the diagram that represents a noble gas. (1 mark)

- (b) Elements L and M are in the same group.

State why they have similar chemical reactions.  
(1 mark)

(c) An atom of element Q has 31 protons.

Use this information to explain how you can determine the number of protons in an atom of element R. (2 marks)

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**(TOTAL FOR QUESTION 2 = 4 MARKS)**

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(Questions continue on next page)

**(Turn over)**

**3 A student does these two tests on a solution made from a white solid.**

- **flame test**
- **add acidified silver nitrate solution**

**The table shows his results.**

<b>Test</b>	<b>Result</b>
<b>flame test</b>	<b>red flame</b>
<b>add acidified silver nitrate solution</b>	<b>cream precipitate</b>

**(a) Give the formula of the ion that produces the red flame. (1 mark)**

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**(b) Name the cream precipitate. (1 mark)**

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**(c) Identify the white solid. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

(d) The student uses a clean metal wire in the flame test.

(i) State why the wire should be clean when used in the flame test. (1 mark)

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(ii) The table lists properties of some metals.

Add ticks (✓) to the table to show the two properties needed in a metal wire used in a flame test. (2 marks)

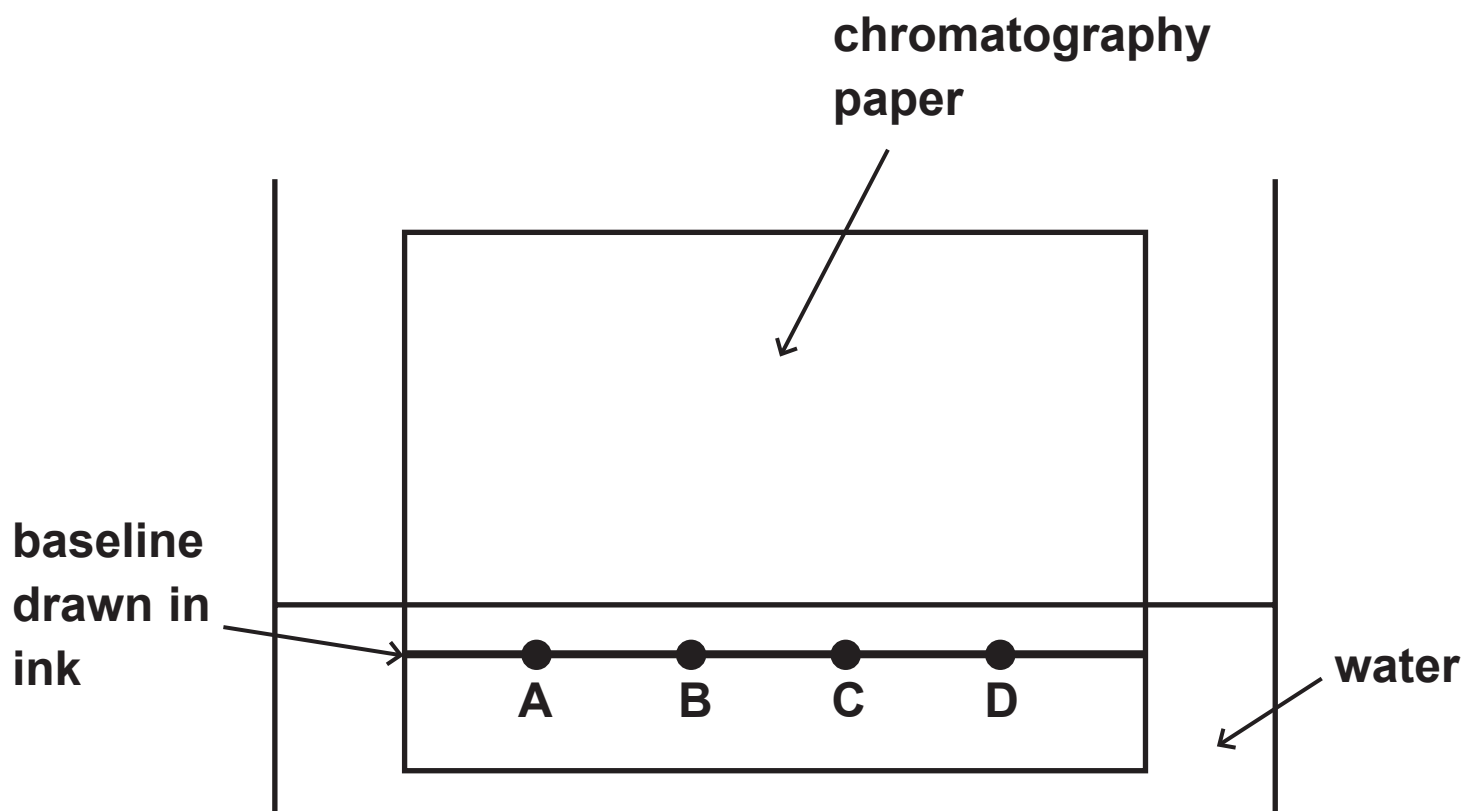
Property	
good conductor of electricity	
high density	
high melting point	
unreactive	

(TOTAL FOR QUESTION 3 = 6 MARKS)

(Questions continue on next page)

(Turn over)

- 4 A student uses this apparatus to investigate the colours in four different inks, A, B, C and D.



(Question continues on next page)

(Turn over)

**(a) Explain two mistakes the student made when setting up his experiment. (4 marks)**

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

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

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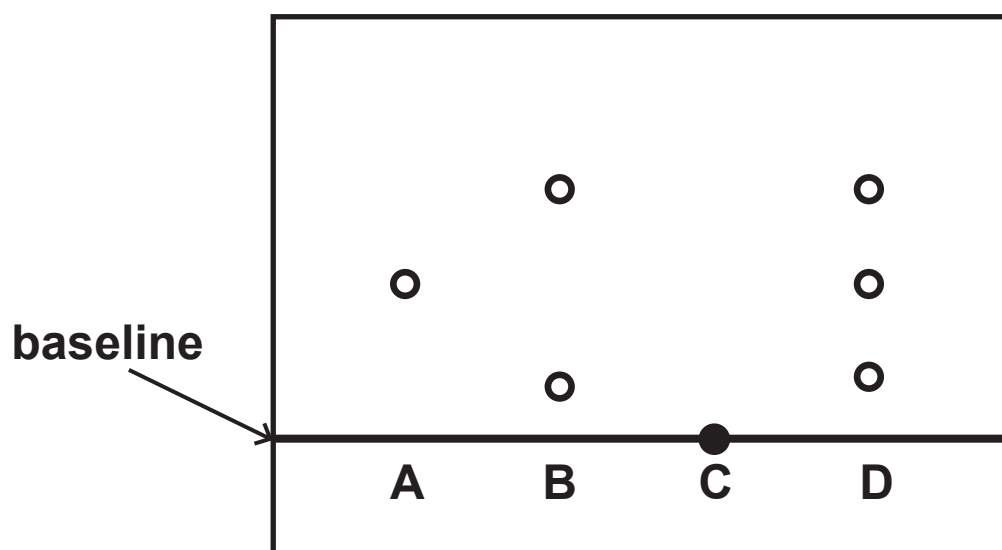
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**(Question continues on next page)**

**(Turn over)**

- (b) Another student does the experiment but does not make any mistakes.

The diagram shows her results.



- (i) State how many colours ink D contains.  
(1 mark)

- 
- (ii) State which of the inks tested could be mixed together to make ink D. (1 mark)
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(Question continues on next page)

(Turn over)

**(iii) Explain which of the inks tested is insoluble in water. (2 marks)**

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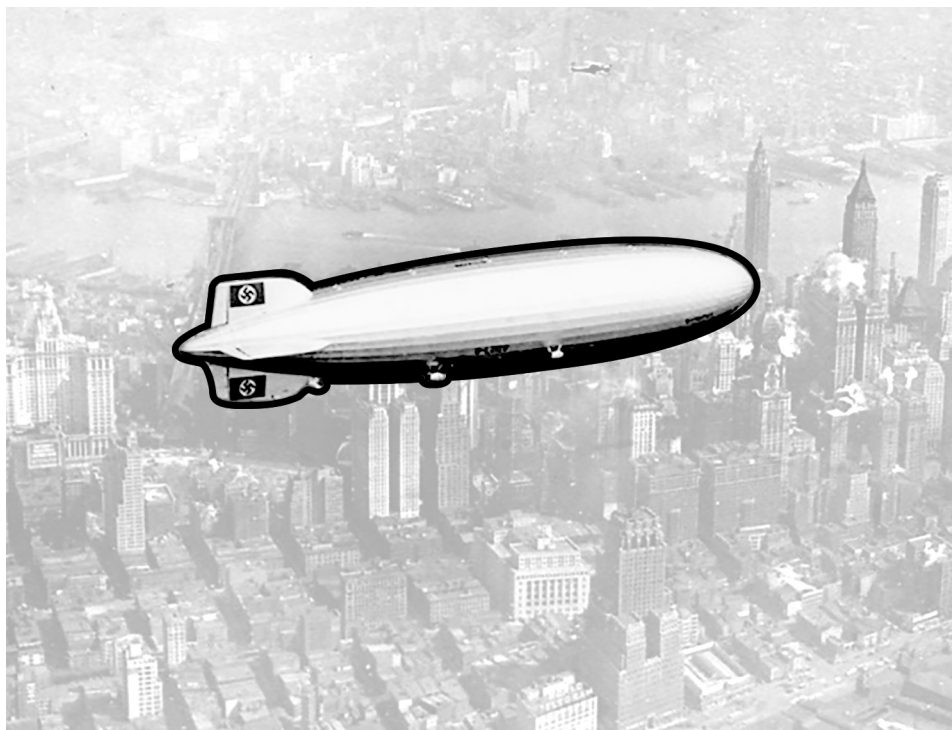
**(TOTAL FOR QUESTION 4 = 8 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

- 5 In 1937 an airship full of hydrogen gas flew from Germany to America.**



- (a) Which property of hydrogen makes it a suitable gas to use in an airship? (1 mark)**

- ☐ **A colourless**
- ☐ **B insoluble in water**
- ☐ **C low density**
- ☐ **D no smell**

**(Question continues on next page)**

**(Turn over)**

**(b) Explain why helium is now used in airships instead of hydrogen. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(c) Hydrogen is used to manufacture ammonia,  $\text{NH}_3$**

**Hydrogen is reacted with nitrogen using an iron catalyst.**

**(i) Give a chemical equation for this reaction.  
(1 mark)**

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**(ii) State why a catalyst is used in this reaction.  
(1 mark)**

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**(TOTAL FOR QUESTION 5 = 5 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

- 6 The reactions of metals with water and with dilute sulfuric acid can be used to determine the order of reactivity of the metals.

The table shows the reactions of four metals, W, X, Y and Z, with water and with dilute sulfuric acid.

Metal	Reaction with water	Reaction with dilute sulfuric acid
W	no reaction	no reaction
X	very slow reaction	reacts quickly
Y	no reaction	reacts slowly
Z	reacts quickly	reacts violently

- (a) What is the order of reactivity of these metals?  
(1 mark)

		most reactive	—————→		least reactive
<input type="checkbox"/>	A	W	X	Y	Z
<input type="checkbox"/>	B	Z	X	Y	W
<input type="checkbox"/>	C	W	Y	X	Z
<input type="checkbox"/>	D	Z	Y	X	W

(Question continues on next page)

(Turn over)

- (b) (i) State which metal, W, X, Y or Z, could be copper. (1 mark)

- 
- (ii) State which metal, W, X, Y or Z, could be magnesium. (1 mark)
- 

- (c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate. (2 marks)

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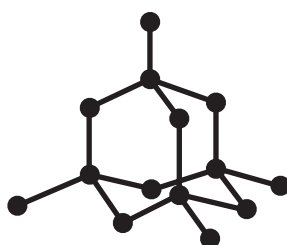
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(TOTAL FOR QUESTION 6 = 5 MARKS)

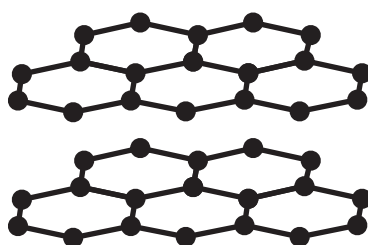
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- 7 Diamond, graphite and silicon dioxide all have giant covalent structures.

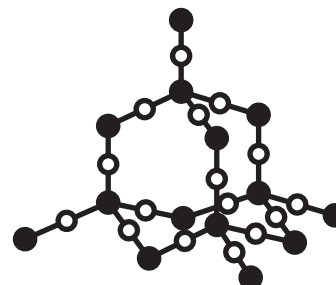
The diagram shows the structures of these three substances.



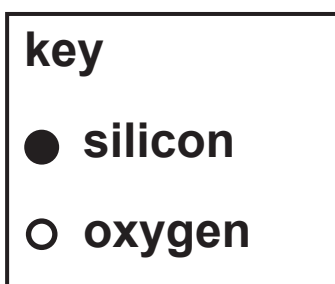
diamond



graphite



silicon dioxide



(Question continues on next page)

(Turn over)

**(a) Explain why silicon dioxide has a high melting point. (2 marks)**

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**(b) Explain why graphite conducts electricity. (2 marks)**

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- (c) State why diamond is hard but graphite is soft.  
(2 marks)

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**(TOTAL FOR QUESTION 7 = 6 MARKS)**

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**(Questions continue on next page)**

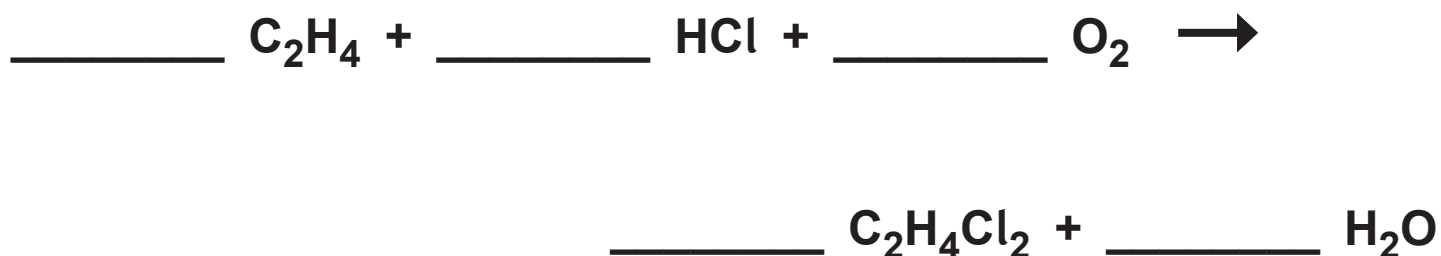
**(Turn over)**

8 Ethene ( $\text{C}_2\text{H}_4$ ) can be converted into chloroethene ( $\text{C}_2\text{H}_3\text{Cl}$ ) in a two-stage process.

(a) The first stage is to convert ethene into 1,2-dichloroethane,  $\text{C}_2\text{H}_4\text{Cl}_2$

Ethene is reacted with hydrogen chloride and oxygen.

Complete the chemical equation for this reaction.  
(1 mark)



(b) In the second stage, 1,2-dichloroethane is converted into chloroethene.



This is a thermal decomposition reaction.

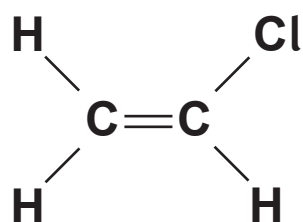
State what is meant by the term THERMAL DECOMPOSITION. (1 mark)

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- (c) The diagram shows the displayed formula of chloroethene.



- (i) State why chloroethene is described as an unsaturated compound. (1 mark)

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(Question continues on next page)

(Turn over)

**(ii) Describe a test to show that chloroethene is unsaturated. (2 marks)**

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**(d) Name the polymer formed from chloroethene.  
(1 mark)**

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**(TOTAL FOR QUESTION 8 = 6 MARKS)**

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**(Turn over)**

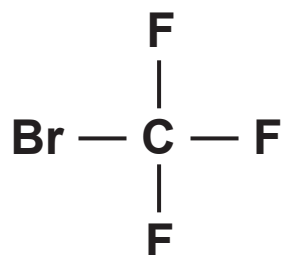
- 9 Halon 1301 is a compound used in some fire extinguishers.

Halon 1301 has the percentage composition by mass of

C 8.05%      Br 53.69%      F 38.26%

- (a) Show, by calculation, that the empirical formula of this compound is  $\text{CBrF}_3$  (2 marks)

- (b) The diagram shows the displayed formula of a molecule of Halon 1301.



Draw a dot-and-cross diagram to show all the outer electrons in this molecule. (2 marks)

(Question continues on next page)

(Turn over)

- (c) The boiling point of Halon 1301 is  $-58^{\circ}\text{C}$ .  
Explain why Halon 1301 has a low boiling point.

(2 marks)

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(TOTAL FOR QUESTION 9 = 6 MARKS)

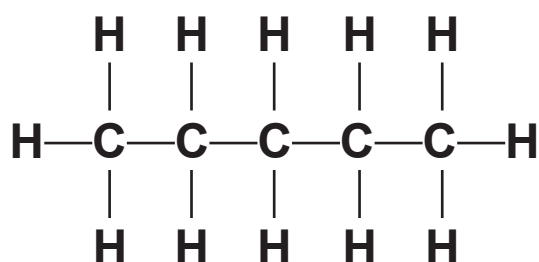
(Questions continue on next page)

(Turn over)

- 10 (a) There are three isomers with the molecular formula  $C_5H_{12}$

One of these isomers is pentane.

The displayed formula for pentane is



- (i) State what is meant by the term ISOMERS.  
(2 marks)

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(Question continues on next page)

(Turn over)

- (ii) Draw the displayed formula for another isomer of  $C_5H_{12}$  (2 marks)

- (b) Pentane reacts with bromine in the presence of ultraviolet radiation.

- (i) Complete the equation for this reaction.  
(2 marks)



- (ii) Give the name of this type of reaction.  
(1 mark)

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(TOTAL FOR QUESTION 10 = 7 MARKS)

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(Questions continue on next page)

(Turn over)

- 11 The gas burned in a Bunsen burner is methane.

The equation for the complete combustion of methane is



- (a) Calculate the mass of oxygen required to react with 32 g of methane. (2 marks)

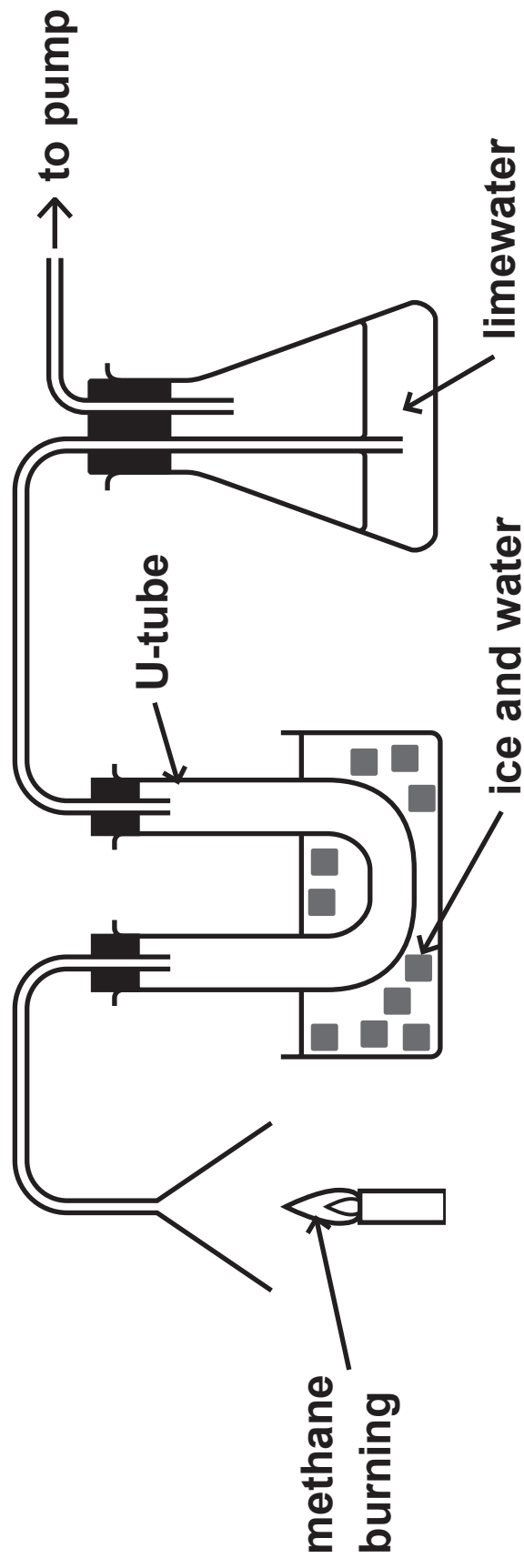
[ $M_r$  of methane = 16]

mass of oxygen = \_\_\_\_\_ g

(Question continues on next page)

(Turn over)

- (b) The diagram shows methane burning in air. It also shows how the two gases formed are collected and tested.



(Question continues on next page)

(Turn over)

- (i) Explain why water collects in the U-tube.  
(2 marks)

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- (ii) Describe how anhydrous copper(II) sulfate is used to test for water. (2 marks)

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**(iii) Explain the change in appearance of the limewater. (3 marks)**

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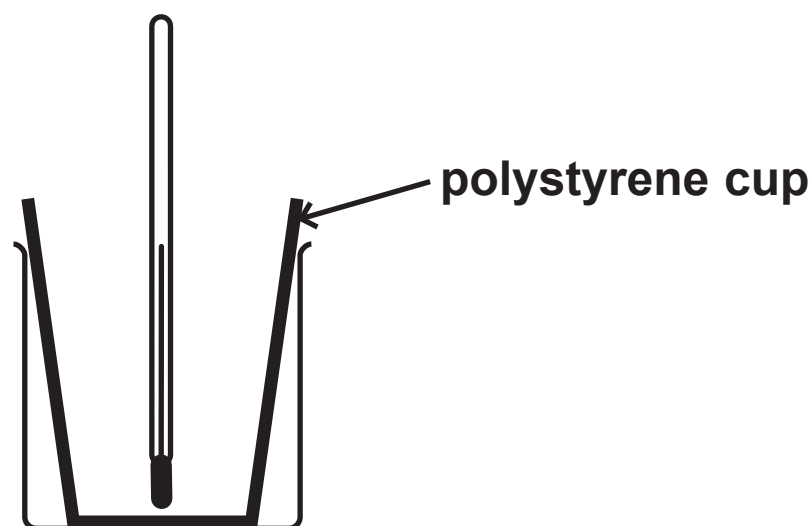
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**(TOTAL FOR QUESTION 11 = 9 MARKS)**

**(Questions continue on next page)**

**(Turn over)**

- 12 A student uses this apparatus to investigate the temperature change that occurs when ammonium nitrate is dissolved in water.**



**She uses this method.**

- **put  $100\text{ cm}^3$  of water into the polystyrene cup and measure the initial temperature of the water**
- **add  $8.00\text{ g}$  of ammonium nitrate and stir**
- **record the lowest temperature reached by the solution**

**(Question continues on next page)**

**(Turn over)**

The table shows her results.

Initial temperature of water in °C	20.0
Lowest temperature of solution in °C	14.2

- (a) Use the results of the experiment to explain what type of reaction is taking place when ammonium nitrate is added to water. (2 marks)

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(Question continues on next page)

(Turn over)

- (b) Show that the heat energy change,  $Q$ , is about 2400 J.

[mass of  $1.00 \text{ cm}^3$  of solution =  $1.00 \text{ g}$ ]

[for the solution,  $c = 4.18 \text{ J/g/}^\circ\text{C}$ ]

(3 marks)

$Q =$  \_\_\_\_\_ J

(Question continues on next page)

(Turn over)

- (c) Use your answer to part (b) to calculate the enthalpy change,  $\Delta H$ , in kilojoules per mole of ammonium nitrate.

[ $M_r$  of ammonium nitrate = 80.0]

Include a sign in your answer. (4 marks)

$\Delta H =$  \_\_\_\_\_ kJ/mol

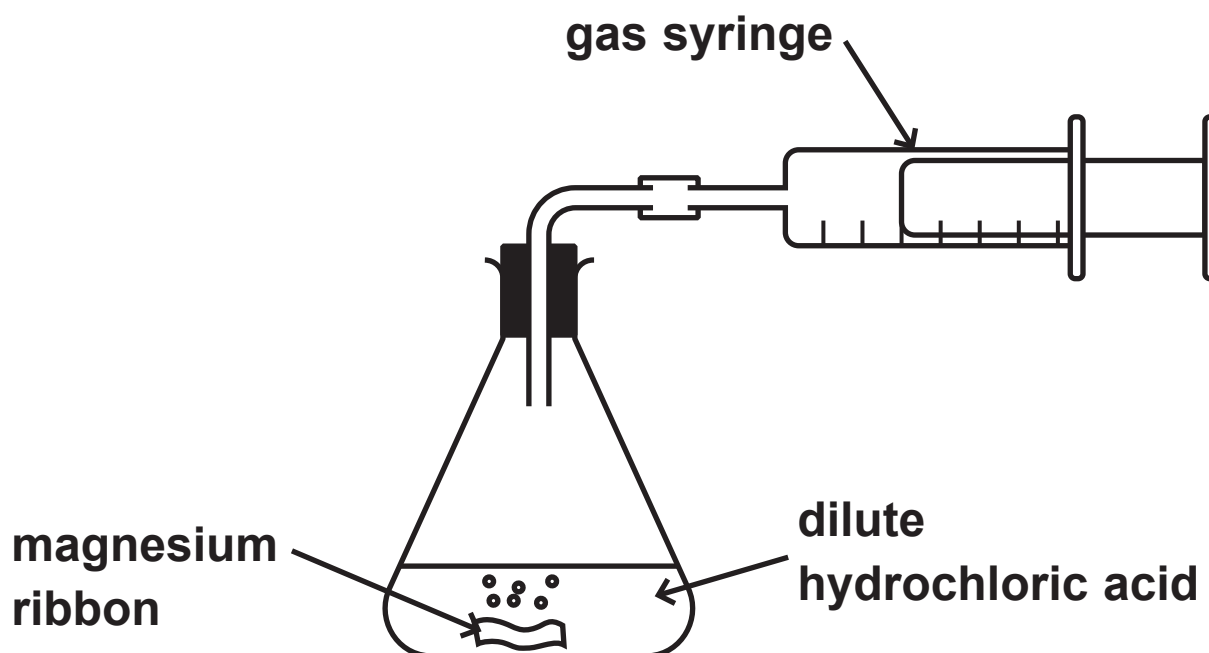
(TOTAL FOR QUESTION 12 = 9 MARKS)

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(Questions continue on next page)

(Turn over)

- 13 A student uses this apparatus to investigate the rate of reaction between magnesium and an EXCESS of dilute hydrochloric acid.



She uses this method.

- use a graduated beaker to pour  $50\text{ cm}^3$  of dilute hydrochloric acid of concentration  $2.00\text{ mol/dm}^3$  into the conical flask
- add a piece of magnesium ribbon of mass  $0.086\text{ g}$  to the acid and put the bung into the neck of the flask
- measure the total volume of gas collected every ten seconds until the reaction stops

(Question continues on next page)

(Turn over)

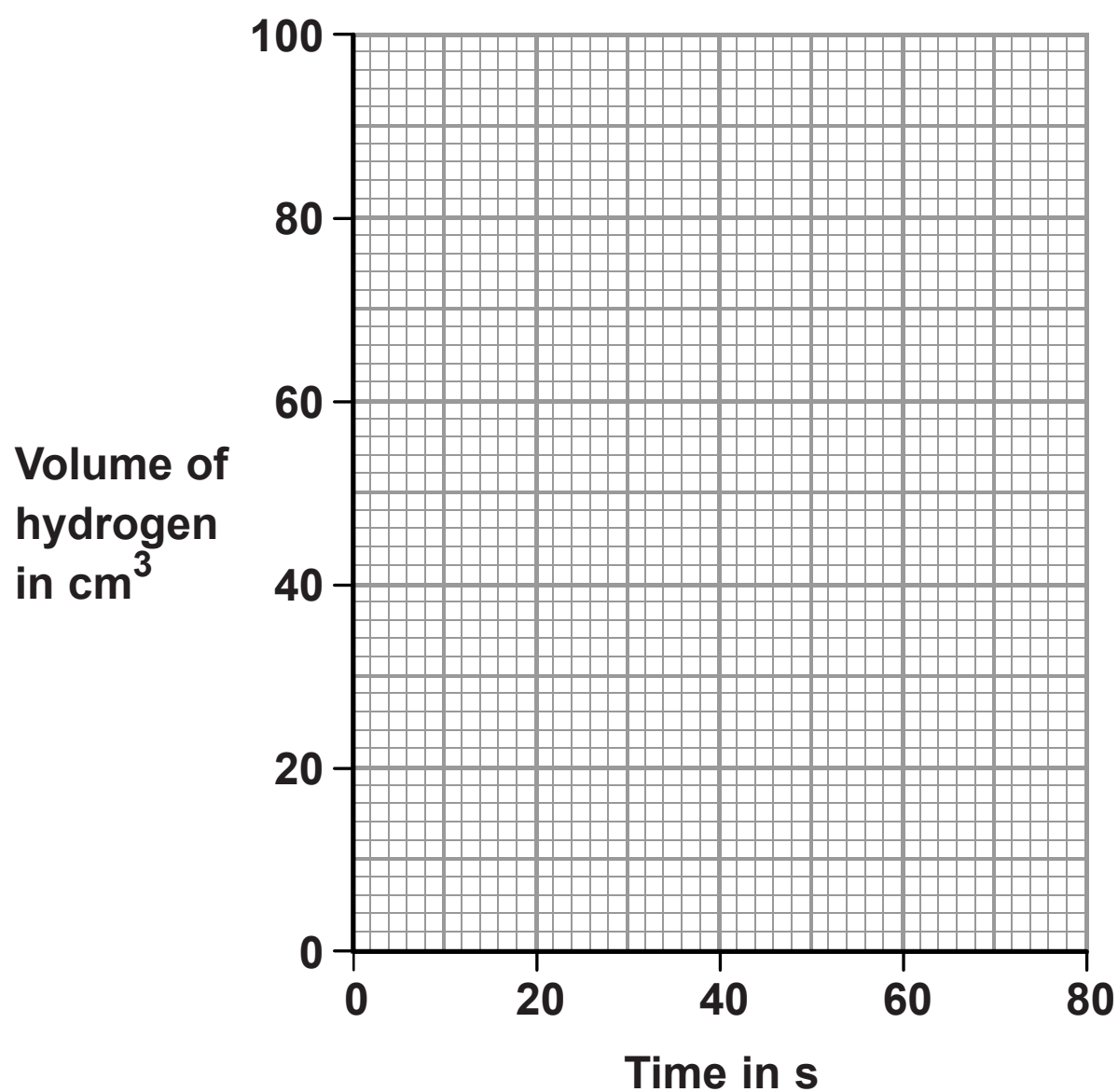
The table shows the student's results.

Time in s	Volume of hydrogen in cm <sup>3</sup>
0	0
10	29
20	52
30	67
40	76
50	81
60	84
70	84
80	84

(Question continues on next page)

(Turn over)

- (a) (i) Plot the student's results on the grid. (1 mark)
- (ii) Draw a curve of best fit. (1 mark)



(Question continues on next page)

(Turn over)

**(b) (i) The student repeats the experiment using**

- **0.043 g of magnesium ribbon**
- **50 cm<sup>3</sup> of 2.00 mol/dm<sup>3</sup> hydrochloric acid**

**Draw, on the grid in part (a), the curve you would expect in this experiment.**

**Label this curve Y. (2 marks)**

**(ii) The student repeats the experiment again, using**

- **0.086 g of magnesium ribbon**
- **50 cm<sup>3</sup> of 2.00 mol/dm<sup>3</sup> hydrochloric acid**
- **a slightly higher temperature than the first experiment**

**Draw, on the grid in part (a), the curve you would expect in this experiment.**

**Label this curve Z. (2 marks)**

**(Question continues on next page)**

**(Turn over)**

- (c) The expected volume of gas produced in the first experiment is  $86\text{ cm}^3$ .

Suggest why the volume collected is less than the expected volume. (1 mark)

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- (d) The student uses a graduated beaker to measure the volume of dilute hydrochloric acid.

Explain why it is NOT necessary to use a measuring cylinder in this experiment. (2 marks)

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- (e) The ionic equation for the reaction between magnesium and hydrochloric acid is



Use the information in this equation, and the particle collision theory, to explain why the rate of reaction decreases during each of the experiments. (3 marks)

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(TOTAL FOR QUESTION 13 = 12 MARKS)

- 14 A salt can be made by reacting an acid with an insoluble base.**

**A student has a sample of copper(II) oxide.**

**The student uses this method.**

**Stage 1 pour  $50\text{cm}^3$  of dilute sulfuric acid into a beaker**

**Stage 2 warm the acid using a Bunsen burner**

**Stage 3 add a small amount of copper(II) oxide to the warm acid and stir the mixture**

**Stage 4 add further amounts of copper(II) oxide until copper(II) oxide is in excess**

**Stage 5 filter the mixture**

**Stage 6 obtain crystals from the filtrate**

- (a) State why the acid is warmed in stage 2. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(b) State how the student would know that the copper(II) oxide is in excess in stage 4. (1 mark)**

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**(c) State why the mixture is filtered in stage 5. (1 mark)**

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**(d) State the colour of the filtrate obtained in stage 5. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**



**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

- (f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is



- (i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  crystals that can be obtained is about 30 g.

[ $M_r$  of  $\text{CuO} = 79.5$        $M_r$  of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} = 249.5$ ]

Give your answer to an appropriate number of significant figures. (3 marks)

mass = \_\_\_\_\_ g

- (ii) In this experiment, the actual yield of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  crystals is 23.92 g.

Calculate the percentage yield of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$   
(2 marks)

percentage yield = \_\_\_\_\_ %

(TOTAL FOR QUESTION 14 = 14 MARKS)

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(Questions continue on next page)

(Turn over)

- 15** Hydrated ammonium iron(III) sulfate is a violet solid that has the formula  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$

The table shows some tests done on three separate samples of the solid.

Test	Observation
Dissolve the solid in water and add acidified barium chloride solution.	
Dissolve the solid in water and add sodium hydroxide solution.	
Add sodium hydroxide solution to the solid and warm the mixture. Test the gas given off with moist universal indicator paper.	

- (a) Complete the table to show the observation made in each test. (3 marks)

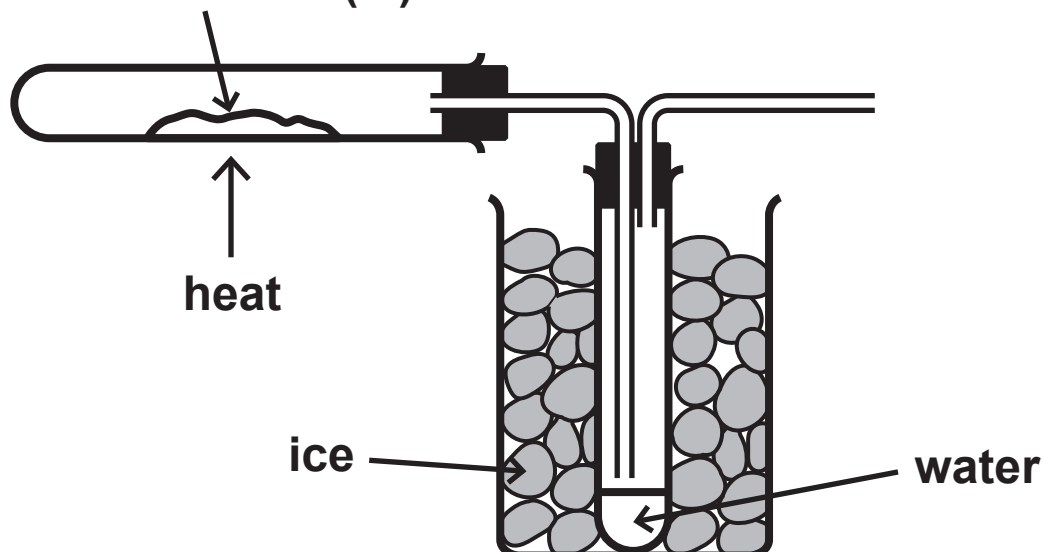
(Question continues on next page)

(Turn over)

- (b) A student needs to find the value of  $x$  in the formula  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$

He uses this apparatus.

hydrated ammonium iron(III) sulfate



The hydrated solid decomposes when heated gently.

The equation for the reaction is



(Question continues on next page)

(Turn over)

The table shows the student's results.

mass of empty test tube in g	22.04
mass of test tube and $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$ in g	34.09
mass of test tube and $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3$ in g	28.69

- (i) Calculate the mass of  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3$  produced by heating. (1 mark)

mass of  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 =$  \_\_\_\_\_ g

- (ii) Calculate the mass of water produced. (1 mark)

mass of water = \_\_\_\_\_ g

(Question continues on next page)

(Turn over)

(iii) Calculate the value of x.

[ $M_r$  of  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 = 532$  and  $M_r$  of  $\text{H}_2\text{O} = 18$ ]

Give your answer to the nearest whole number. (4 marks)

value of x = \_\_\_\_\_

(TOTAL FOR QUESTION 15 = 9 MARKS)

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TOTAL FOR PAPER = 110 MARKS

END