

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

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

**Chemistry**

**Unit: 4CH1**

**Science (Double Award) 4SD0**

**Paper: 1CR**

**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 R



- 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.

**(Instructions continue on next page)**

**(Turn over)**

## **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.**

**Answer ALL questions.**

**1 This question is about the three states of matter, solid, liquid and gas.**

**(a) Solids, liquids and gases can be changed from one state to another.**

**The box gives the names of some changes of state.**

<b>condensing</b>	<b>evaporation</b>
<b>melting</b>	<b>sublimation</b>

**Use words from the box to complete the sentences on page 5.**

**Each word may be used once, more than once or not at all.**

**(Question continues on next page)**

**(Turn over)**

- (i) The change from solid to liquid is called**

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**(1 mark)**

- (ii) The change from liquid to gas is called**

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**(1 mark)**

- (iii) The change from solid to gas is called**

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**(1 mark)**

**(Question continues on next page)**

**(Turn over)**

**(b) Describe the arrangement and the movement of particles in a solid.  
(3 marks)**

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**(TOTAL FOR QUESTION 1 = 6 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**2 This question is about some elements in Group 1 of the Periodic Table.**

**(a) The table gives some statements about the reaction of potassium with water.**

**Place ticks (✓) in three boxes to show which three statements are correct. (3 marks)**

<b>Statement</b>	
<b>potassium reacts more vigorously than sodium when added to water</b>	
<b>potassium sinks to the bottom of the water</b>	
<b>bubbles of oxygen gas are produced</b>	
<b>a lilac flame is seen</b>	
<b>potassium moves around</b>	
<b>a solution of potassium oxide is formed</b>	

**(Question continues on next page)**

**(Turn over)**

**(b) After the reaction of potassium with water is complete, a few drops of universal indicator are added to the solution formed. The universal indicator turns purple.**

**(i) Suggest a value for the pH of the solution. (1 mark)**

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**(ii) Give the formula of the ion responsible for this pH value. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**



(c) Sodium burns in oxygen to produce sodium oxide.

Complete the equation for this reaction. (1 mark)



**(TOTAL FOR QUESTION 2 = 6 MARKS)**

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(Questions continue on next page)

- 3 A student uses paper chromatography to investigate the dyes in five different inks, V, W, X, Y and Z.**

**This is what she uses.**

- **a beaker**
- **a piece of chromatography paper with a pencil line drawn near the bottom of the paper**
- **a solvent**
- **inks V, W, X, Y and Z**

**(Question continues on next page)**

**(Turn over)**

- (a) Describe how the student should set up and carry out her experiment.**

**You may draw a diagram to help with your answer. (4 marks)**

**(Continue your answer on next page)**

**(Turn over)**

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**(Continue your answer on next page)**  
**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

**(b) Explain why the line on the paper is drawn in pencil rather than in ink.  
(2 marks)**

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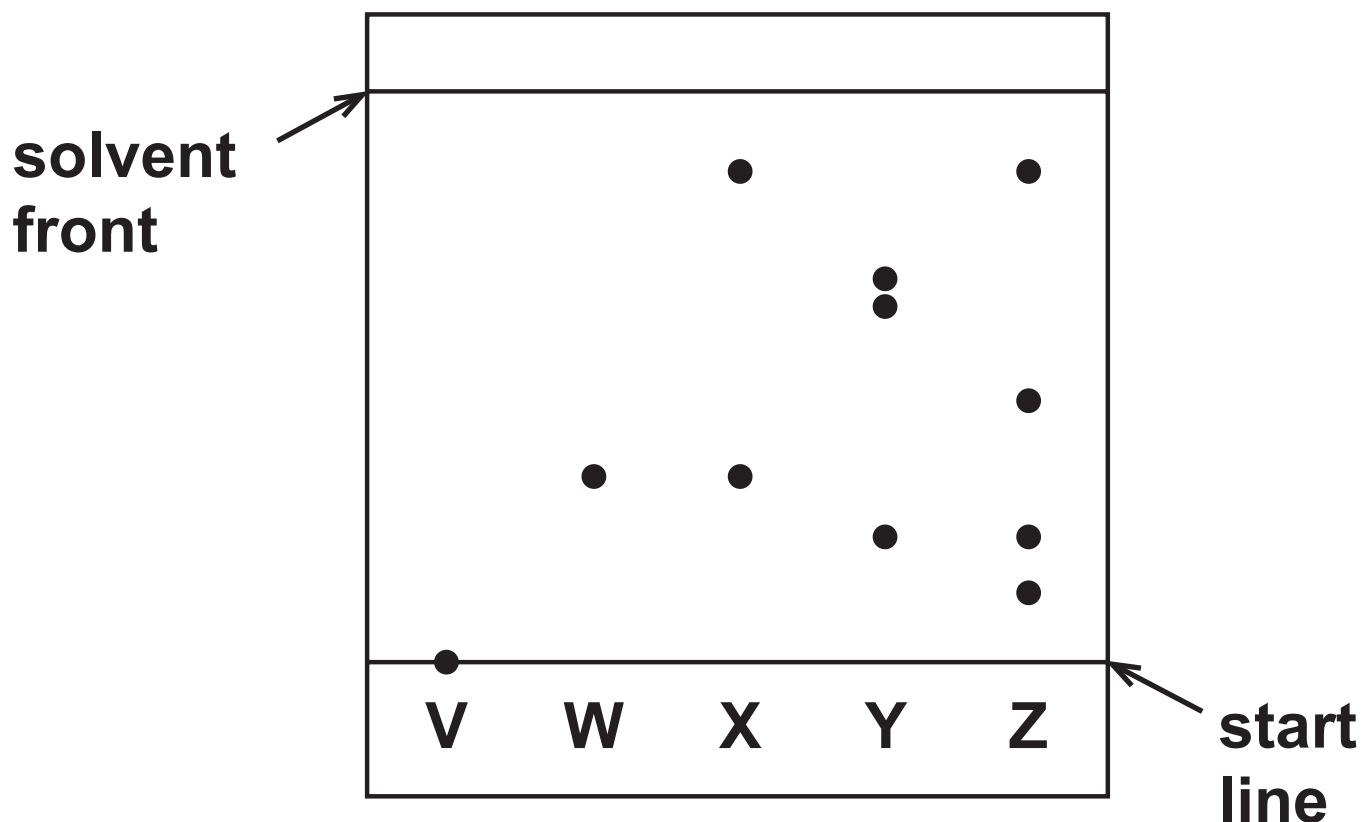
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**(Question continues on next page)**

**(Turn over)**

(c) The chromatogram shows the results for inks V, W, X, Y and Z.



- (i) Explain which ink contains a dye that is insoluble in the solvent.  
(2 marks)

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(Question continues on next page)

(Turn over)

- (ii) Explain which two inks contain the dye that is likely to be the most soluble in the solvent. (2 marks)**

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- (iii) Explain which two inks may contain only one dye. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**



- (d) One dye in ink Y moves 4.3 cm when the solvent front moves 6.5 cm.

Calculate the  $R_f$  value for this dye.

Give your answer to 2 significant figures. (3 marks)

$R_f$  value = \_\_\_\_\_

**(TOTAL FOR QUESTION 3 = 15 MARKS)**

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(Questions continue on next page)

(Turn over)

**4 This question is about hydrocarbons.**

**(a) State the meaning of the term  
HYDROCARBON. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(b) One homologous series of hydrocarbons is the alkanes.**

**Pentane ( $\text{C}_5\text{H}_{12}$ ) is an alkane.**

**(i) When pentane burns completely in oxygen, carbon dioxide and water are produced.**

**Give a chemical equation for this combustion reaction. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) Incomplete combustion can occur when the oxygen supply is limited.

Give the names of two products of the incomplete combustion of pentane. (2 marks)

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

(Question continues on next page)

(Turn over)

**(iii) One of the products of incomplete combustion is a poisonous gas.**

**State why this gas is poisonous to humans. (1 mark)**

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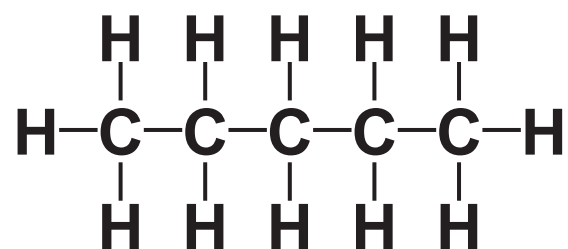
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**(Question continues on next page)**

(iv)  $\text{C}_5\text{H}_{12}$  has three isomers.

The displayed formula for one of these isomers is



Draw the displayed formulae of the other two isomers. (2 marks)

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(Question continues on next page)

(Turn over)

**(c) Another homologous series of hydrocarbons is the alkenes.**

**Alkenes are unsaturated hydrocarbons.**

**(i) Give the general formula for the alkenes. (1 mark)**

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**(ii) State the meaning of the term UNSATURATED. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(iii) Describe a test to show that a hydrocarbon is unsaturated.  
(2 marks)**

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**(TOTAL FOR QUESTION 4 = 13 MARKS)**

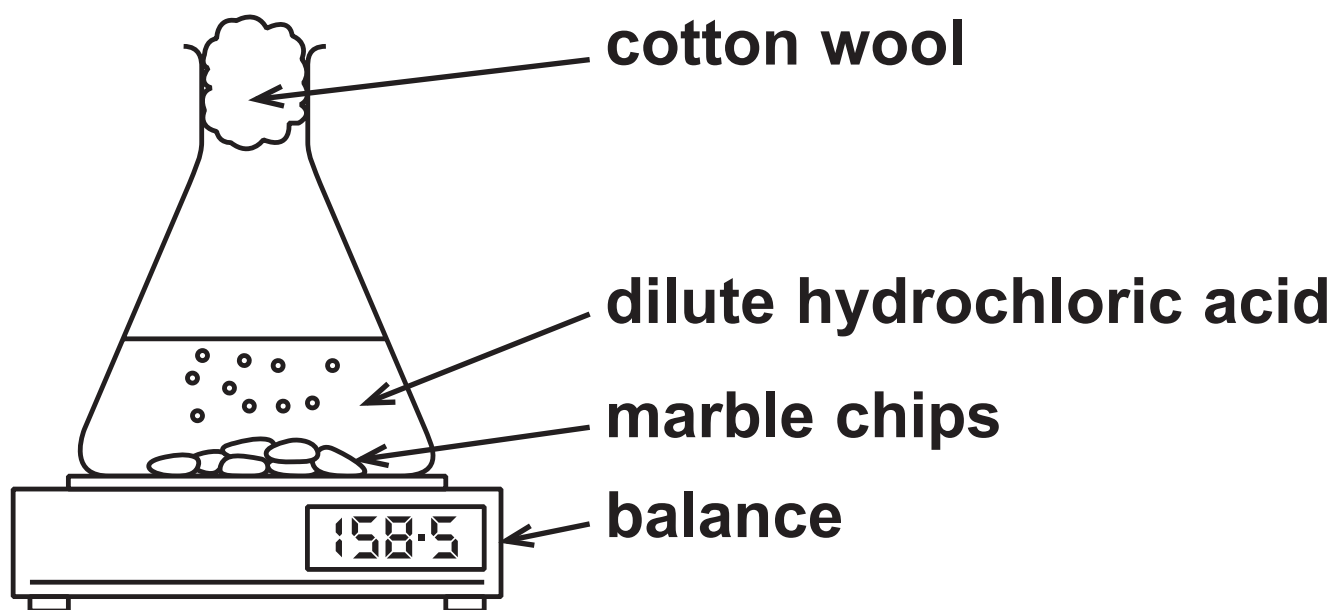
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**(Questions continue on next page)**

**(Turn over)**



- 5 A student uses this apparatus to investigate the rate of reaction between marble chips and dilute hydrochloric acid.**



**(Question continues on next page)**

**(Turn over)**

**(a) During the reaction, the reading on the balance decreases because mass is lost from the flask.**

**(i) Explain how using the cotton wool increases the accuracy of this investigation. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(ii) Why is mass lost from the flask?  
(1 mark)**

- ☐ **A acid particles are moving**
- ☐ **B gas is given off**
- ☐ **C heat energy is produced**
- ☐ **D marble chips are dissolving**

**(Question continues on next page)**

**(b) This is the equation for the reaction between marble chips and dilute hydrochloric acid.**

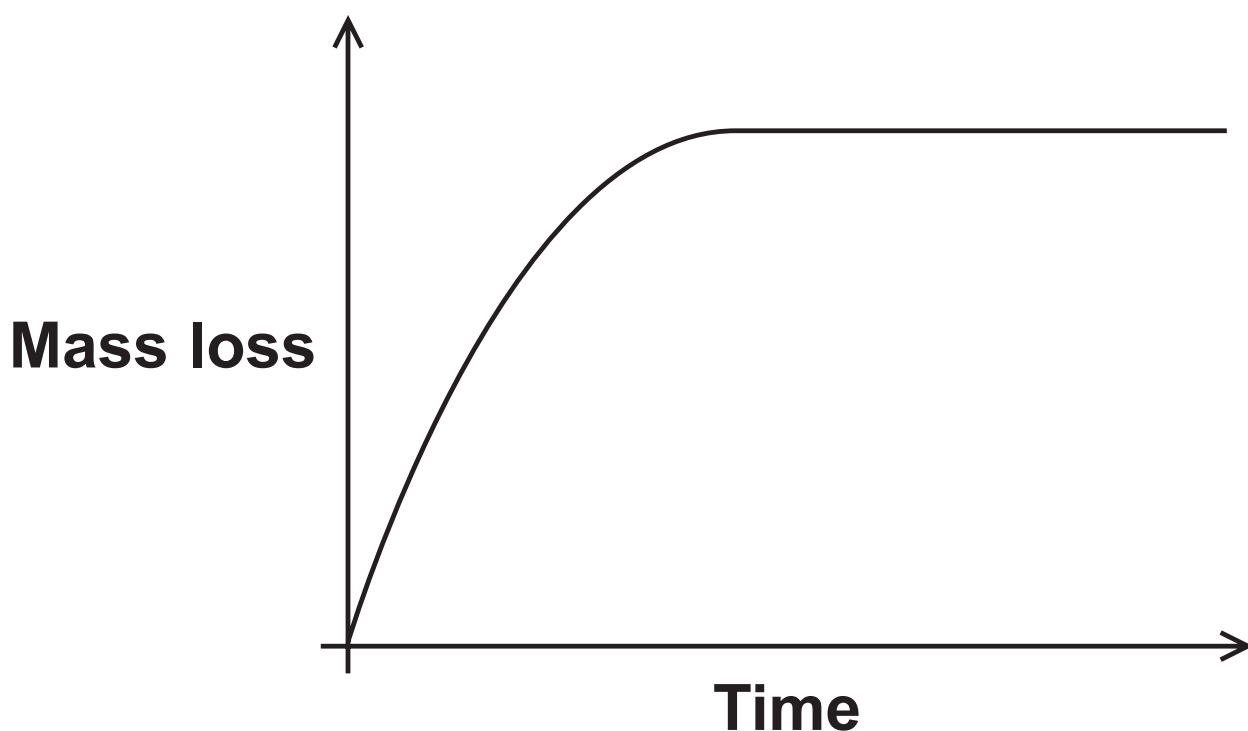
**Complete the equation by adding the state symbols.  
(2 marks)**



**(Question continues on next page)**

**(c) The student uses large marble chips in the investigation.**

**This is a graph of his results.**



**The student repeats the experiment using the same total mass of smaller marble chips.**

**On the graph, draw the curve that would be obtained.**

**[assume the marble chips are in excess] (2 marks)**

**(Question continues on next page)**

**(Turn over)**

**(d) The rate of this reaction can be altered by increasing the temperature or by increasing the concentration of the hydrochloric acid.**

**(i) Explain, using the particle collision theory, how increasing the concentration of the hydrochloric acid would affect the rate of this reaction. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) Explain, using the particle collision theory, how increasing the temperature would affect the rate of this reaction. (3 marks)

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**(TOTAL FOR QUESTION 5 = 13 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**



**6 Poly(chloroethene) is a polymer.**

**It is made from its monomer,  
chloroethene.**

**(a) Chloroethene has the percentage  
composition by mass**

**C = 38·4%      H = 4·8%      Cl = 56·8%**

**Show, by calculation, that the  
empirical formula of chloroethene is  
 $\text{C}_2\text{H}_3\text{Cl}$  (3 marks)**

**(Question continues on next page)**

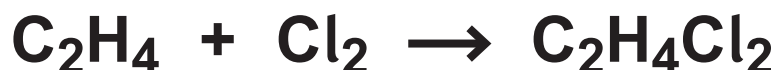
**(Turn over)**

**(b) The molecular formula of chloroethene is also  $C_2H_3Cl$**

**Chloroethene can be prepared by a two-stage process.**

**In stage 1, ethene reacts with chlorine in the presence of an iron(III) chloride catalyst to form dichloroethane.**

**The reaction is exothermic.**



**(i) Give the formula of iron(III) chloride. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(ii) State the purpose of using a catalyst. (1 mark)**

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**(iii) State the meaning of the term EXOTHERMIC. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

**(iv) What type of reaction occurs in stage 1 between ethene and chlorine? (1 mark)**

- ☐ **A     addition**
- ☐ **B     displacement**
- ☐ **C     neutralisation**
- ☐ **D     substitution**

**(v) In stage 2, dichloroethane decomposes into chloroethene and hydrogen chloride.**

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

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**(Question continues on next page)**

**(Turn over)**

**(c) (i) Draw the displayed formula of**

- **chloroethene**
- **the repeat unit of poly(chloroethene) (3 marks)**

<b>chloroethene</b>	<b>repeat unit of poly(chloroethene)</b>

**(Question continues on next page)**

**(Turn over)**

- (ii) Draw a dot-and-cross diagram to represent a molecule of chloroethene.**

**Show only the outer electrons of each atom. (2 marks)**

**(TOTAL FOR QUESTION 6 = 13 MARKS)**

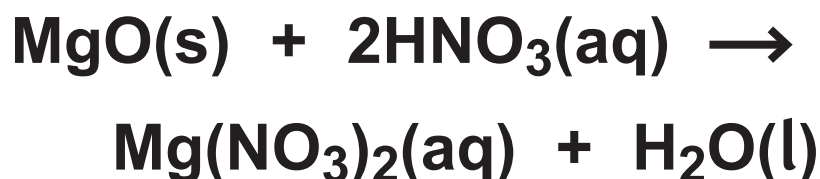
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**(Questions continue on next page)**

**(Turn over)**

- 7 A student makes some magnesium nitrate crystals from magnesium oxide and dilute nitric acid.**

**The equation for the reaction is**



- (a) (i) Give the formula of each ion in magnesium nitrate. (2 marks)**

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**and**

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**(Question continues on next page)**

**(Turn over)**

- (ii) A student has a beaker containing dilute nitric acid.

**Describe a method that she could use to prepare a pure, dry sample of magnesium nitrate crystals from magnesium oxide. (6 marks)**

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**(Continue your answer on next page)**

**(Turn over)**



**(Continue your answer on next page)**  
**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

**(b) Magnesium nitrate crystals contain water of crystallisation with the formula  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$**

**(i) Show by calculation that the relative formula mass of  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  is 256. (1 mark)**

**(Question continues on next page)**

**(Turn over)**

- (ii) Show that the maximum mass of  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  that could be made from 0.050 mol of nitric acid is about 6 g. (3 marks)

**(Question continues on next page)**

**(Turn over)**

- (iii) The actual mass of crystals that the student obtains is 4.8 g.

Calculate the percentage yield of  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  in this experiment.  
(2 marks)

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

**(TOTAL FOR QUESTION 7 = 14 MARKS)**

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(Questions continue on next page)

(Turn over)

- 8 A student investigates the neutralisation reaction between sodium hydroxide and nitric acid.**

**This is her method.**

- **pour  $20\text{ cm}^3$  of sodium hydroxide solution into a polystyrene cup**
- **record the temperature of the sodium hydroxide solution**
- **add  $5\text{ cm}^3$  of dilute nitric acid to the cup**
- **stir the mixture and record the highest temperature reached**
- **add further  $5\text{ cm}^3$  portions of dilute nitric acid, recording the highest temperature reached each time, until a total of  $40\text{ cm}^3$  of acid has been added**

**(Question continues on next page)**

**(Turn over)**

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

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**(ii) Explain why a polystyrene cup is used rather than a beaker. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (iii) Give a safety precaution that the student should take when using sodium hydroxide solution. (1 mark)**

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**(Question continues on next page)**



**(b) The table shows the student's results.**

<b>Total volume of acid in cm<sup>3</sup></b>	<b>0</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>25</b>	<b>30</b>	<b>35</b>	<b>40</b>
<b>Temperature of reaction mixture in °C</b>	<b>20·5</b>	<b>22·5</b>	<b>24·4</b>	<b>26·4</b>	<b>28·5</b>	<b>28·3</b>	<b>27·5</b>	<b>26·7</b>	<b>26·0</b>

**(i) Plot the results on the grid on page 50.**

**49**

**Draw a straight line of best fit through the first five points and another straight line of best fit through the last four points.**

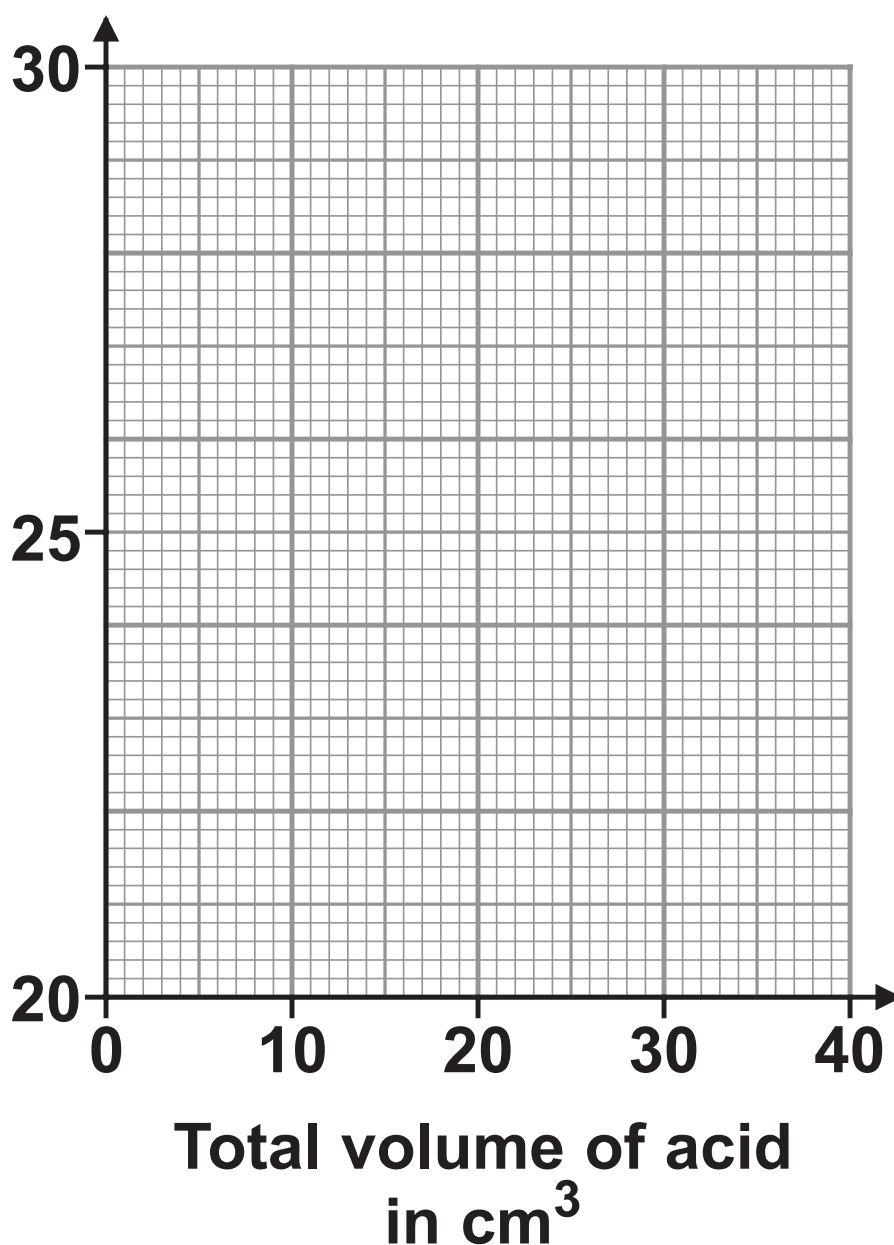
**Make sure that the two lines cross. (3 marks)**

**(Question continues on next page)**

**(Turn over)**

50

Temperature  
of reaction  
mixture  
in °C



(Question continues on next page)

(Turn over)

**(ii) The point where the lines cross shows**

- **the volume of acid needed to exactly neutralise the alkali**
- **the maximum temperature reached**

**Use your graph to determine these values. (2 marks)**

**volume of acid = \_\_\_\_\_ cm<sup>3</sup>**

**maximum temperature = \_\_\_\_\_ °C**

**(TOTAL FOR QUESTION 8 = 9 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

- 9 (a) Diamond is a naturally-occurring form of carbon.

It has a giant molecular structure.

Explain, with reference to its structure and bonding, why diamond has a high melting point. (3 marks)

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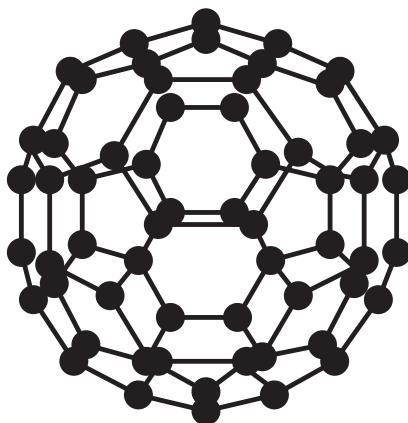
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(Question continues on next page)

(Turn over)

**(b)  $C_{60}$  fullerene is another form of carbon.**

**The diagram shows a molecule of  $C_{60}$  fullerene.**



**(Question continues on next page)**

**(Turn over)**

- (i) Explain why  $C_{60}$  fullerene has a much lower melting point than diamond. (2 marks)

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(Question continues on next page)

(Turn over)

- (ii)  $C_{60}$  fullerene is used by doctors when injecting medicines into their patients.

$C_{60}$  fullerene allows medicines, which might damage some parts of the body, to reach the part of the body where they are needed.

Suggest why  $C_{60}$  fullerene is suitable for this purpose.  
(1 mark)

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(Question continues on next page)

(Turn over)

- (c) Graphite is another naturally-occurring form of carbon. Graphite can be used in pencils because it is soft and can leave marks on paper. Graphite can also be used as a conductor of electricity.**

**Explain why graphite is soft and conducts electricity.**

**Refer to structure and bonding in your answer. (5 marks)**

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**(Continue your answer on next page)**

**(Turn over)**



**(Continue your answer on next page)**  
**(Turn over)**

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

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**(Questions continue on next page)**

**(Turn over)**

**10 A student investigates the reaction between zinc and copper(II) sulfate solution.**

**The equation for the reaction is**



**This is his method.**

- **add exactly 25.0 cm<sup>3</sup> of copper(II) sulfate solution to a polystyrene cup**
- **record the temperature of the solution**
- **add about 5g of zinc powder (an excess) and stir the mixture**
- **record the highest temperature reached**

**(Question continues on next page)**

**(Turn over)**

- (a) (i) Suggest why it is not important to add an exact mass of zinc powder. (1 mark)**

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- (ii) State the colour change of the solution. (2 marks)**

**from** \_\_\_\_\_

**to** \_\_\_\_\_

**(Question continues on next page)**

**(Turn over)**

**(b) The table shows the student's results**

<b>volume of copper(II) sulfate solution in cm<sup>3</sup></b>	<b>25·0</b>
<b>initial temperature of copper(II) sulfate solution in °C</b>	<b>19·0</b>
<b>final temperature of solution in °C</b>	<b>31·5</b>

**(Question continues on next page)**

**(Turn over)**

- (i) Show that the heat energy change (Q) is about 1300 J.

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

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

(Question continues on next page)

(Turn over)

- (ii) The mass of anhydrous copper(II) sulfate ( $\text{CuSO}_4$ ) used to make  $25.0 \text{ cm}^3$  of solution is  $2.00 \text{ g}$ .

Calculate the amount, in moles, of  $\text{CuSO}_4$  in  $2.00 \text{ g}$ .

$[\text{M}_r \text{ of } \text{CuSO}_4 = 159.5]$  (1 mark)

amount of  $\text{CuSO}_4 =$  \_\_\_\_\_ mol

(Question continues on next page)

(Turn over)

**(iii) Calculate the value of the enthalpy change ( $\Delta H$ ), in kilojoules per mole, for the reaction between zinc and copper(II) sulfate.**

**Include a sign in your answer.  
(3 marks)**

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

**(TOTAL FOR QUESTION 10 = 10 MARKS)**

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**TOTAL FOR PAPER = 110 MARKS**

**END**