

**Paper Reference(s) 4CH1/1C 4SD0/1C  
Pearson Edexcel International GCSE (9–1)**

**Chemistry**

**UNIT: 4CH1**

**Science (Double Award) 4SD0**

**PAPER: 1C**

Total Marks

**Monday 22 May 2023 – Morning**

**Time: 2 hours**

**In the boxes below, write your name, centre number and candidate number.**

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					



**YOU MUST HAVE**

**Calculator, ruler**

**YOU WILL BE GIVEN**

**Diagram Booklet, Periodic Table**

**INSTRUCTIONS**

**Answer ALL questions.**

**Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.**

**Show all the steps in any calculations and state the units.**

## **INFORMATION**

**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.**

**There may be spare copies of some diagrams.**

**A periodic table is provided as a separate insert.**

## **ADVICE**

**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.**

**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 .**

**1 Look at the list for Question 1 in the Diagram Booklet. It gives some methods that are involved in the separation of mixtures.**

**(a) Use words from the list to identify the method involved in each of these separations.**

**(i) Give the best method for obtaining gasoline from crude oil. (1 mark)**

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**(ii) Give the best method for separating the dyes in black ink. (1 mark)**

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**(continued on the next page)**

**1(a) continued.**

**(iii) Give the best method for obtaining pure water from seawater.  
(1 mark)**

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**(continued on the next page)**

**1 continued.**

**(b) A sample of solid hydrated copper(II) sulfate can be obtained from a mixture of copper(II) oxide and copper(II) sulfate.**

**Look again at the list for Question 1 in the Diagram Booklet. Complete the passage by using words from the list. (4 marks)**

**The mixture of copper(II) oxide and copper(II) sulfate can be separated by first**

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**the copper(II) sulfate in distilled water.**

**The copper(II) oxide is then removed by**

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**(continued on the next page)**

**Turn over**

**1(b) continued.**

**Some of the water from the copper(II) sulfate solution is then removed by**

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**A pure sample of hydrated copper(II) sulfate is then obtained by**

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**(Total for Question 1 = 7 marks)**

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**2 This question is about the reactions of iron.**

**(a) Iron rusts when exposed to water and oxygen.**

**(i) Give the chemical name of the compound that forms when iron rusts.**

**(1 mark)**

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**(ii) What type of reaction occurs when iron rusts?**

**(1 mark)**

**A combustion**

**B decomposition**

**C neutralisation**

**D oxidation**

**2(a) continued.**

**(iii) Galvanising is a method used to prevent iron from rusting.**

**Give the name of the metal used to galvanise iron.**

**(1 mark)**

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**(continued on the next page)**

**2 continued.**

**(b) When iron reacts with dilute sulfuric acid, the products are iron(II) sulfate and hydrogen.**

**(i) Give a chemical equation for the reaction between iron and sulfuric acid.  
(1 mark)**

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**(ii) Give a test for hydrogen.  
(1 mark)**

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**(continued on the next page)**

**2 continued.**

**(c) An excess of iron is added to copper(II) sulfate solution.**

**(i) Name the type of reaction that occurs.  
(1 mark)**

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**(ii) State the appearance of the solid that forms in the reaction.  
(1 mark)**

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**(continued on the next page)**

**2 continued.**

**(d) Give the reason why no reaction occurs when iron is added to magnesium sulfate solution.  
(1 mark)**

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**(Total for Question 2 = 8 marks)**

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**3 Look at the table for Question 3 in the Diagram Booklet. It gives some information about three substances, X, Y and Z.**

**(a) Write your answers to A, B, C and D by giving the missing information below.  
(4 marks)**

**A** \_\_\_\_\_

\_\_\_\_\_

**B** \_\_\_\_\_

\_\_\_\_\_

**C** \_\_\_\_\_

\_\_\_\_\_

**D** \_\_\_\_\_

\_\_\_\_\_



**4 This question is about unsaturated hydrocarbons.**

**(a) Ethene (C<sub>2</sub>H<sub>4</sub>) is a member of the homologous series of alkenes.**

**(i) Give two characteristics of a homologous series.  
(2 marks)**

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

\_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**4(a) continued.**

**(ii) Draw a dot-and-cross diagram to show the bonding in a molecule of ethene.**

**Show outer electrons only.**

**(2 marks)**

**4 continued.**

**(b) Propene (C<sub>3</sub>H<sub>6</sub>) is another member of the homologous series of alkenes.**

**(i) State why the empirical formula of all alkenes in this homologous series is CH<sub>2</sub>  
(1 mark)**

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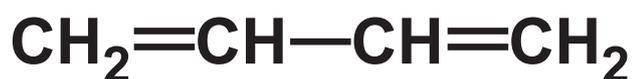
**(ii) Propene can be polymerised to form poly(propene).**

**Look at the diagram for Question 4(b)(ii) in the Diagram Booklet. Draw the displayed formula of propene and the repeat unit of poly(propene).  
(2 marks)**

**(continued on the next page)**

**4 continued.**

**(c) This is the structural formula of another hydrocarbon compound.**



**(i) Give the molecular formula and the empirical formula of this compound.  
(2 marks)**

**molecular formula**

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**empirical formula**

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**(continued on the next page)**

**Turn over**



**4(c) continued.**

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

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**(Total for Question 4 = 14 marks)**

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**5 This question is about lithium and some of its compounds.**

**(a) A small piece of lithium is added to a trough containing water.**

**The lithium floats on the surface of the water and a vigorous reaction occurs.**

**(i) Give two other observations when lithium reacts with water. (2 marks)**

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

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

**(continued on the next page)**

**5(a) continued.**

**(ii) A few drops of methyl orange are added to the solution in the trough.**

**Explain the final colour of the solution.**

**(2 marks)**

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**(continued on the next page)**

**5 continued.**

**(b) An unlabelled bottle containing a white powder is found in a laboratory.**

**Describe tests to show that the white powder in the bottle is lithium carbonate.  
(5 marks)**

**Answer space continues on the next 2 pages.**

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**5(b) continued.**

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**(continued on the next page)**

**5 continued.**

**(c) Lithium carbonate has ionic bonding.**

**State what is meant by the term  
IONIC BONDING.  
(2 marks)**

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**(Total for Question 5 = 11 marks)**

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**6** When solutions of lead(II) nitrate and potassium chloride are mixed, a precipitate of lead(II) chloride forms.

**(a) (i)** Complete the equation for the reaction by adding the state symbols.  
**(1 mark)**



**(continued on the next page)**

**6(a) continued.**

**(ii) Give the formula of each ion in lead(II) nitrate.  
(1 mark)**

**lead ion**

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**nitrate ion**

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**(continued on the next page)**

**6(a) continued.**

**(iii) Calculate the relative formula mass ( $M_r$ ) of lead(II) nitrate,  $\text{Pb}(\text{NO}_3)_2$  (2 marks)**

$M_r =$  \_\_\_\_\_

**(continued on the next page)**

**Turn over**

**6 continued.**

**(b) A student investigates the height of the precipitate formed when lead(II) nitrate solution is added to potassium chloride solution.**

**This is the student's method.**

**STEP 1 pour  $15.0\text{ cm}^3$  of potassium chloride solution into a boiling tube**

**STEP 2 add  $2.0\text{ cm}^3$  of lead(II) nitrate solution and allow the precipitate to settle**

**STEP 3 measure the height of the precipitate**

**Repeat steps 2 and 3 until a total of  $14.0\text{ cm}^3$  of lead(II) nitrate solution has been added.**

**(continued on the next page)**

**Turn over**

**6(b) continued.**

**The table shows the student's results.**

<b>Volume of lead(II) nitrate in cm<sup>3</sup></b>	<b>2·0</b>	<b>4·0</b>	<b>6·0</b>	<b>8·0</b>	<b>10·0</b>	<b>12·0</b>	<b>14·0</b>
<b>Height of precipitate in cm</b>	<b>0·8</b>	<b>1·6</b>	<b>2·9</b>	<b>3·2</b>	<b>3·6</b>	<b>3·6</b>	<b>3·6</b>

**Look at the grid for Question 6(b) in the Diagram Booklet.**

- (i) Plot the results on the grid.  
(1 mark)**
  
- (ii) Draw a circle around the anomalous result.  
(1 mark)**

**(continued on the next page)**

**6(b) continued.**

**(iii) Draw a line of best fit through the first four points and another line of best fit through the last three points. Make sure that the lines cross.**

**(2 marks)**

**(iv) Give two possible mistakes the student could have made to cause the anomalous result.**

**(2 marks)**

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

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

**(continued on the next page)**

**Turn over**

**6(b) continued.**

- (v) State why the first line of best fit should pass through the origin.  
(1 mark)**

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- (vi) Use your graph to determine the volume of lead(II) nitrate solution needed to react completely with  $15.0 \text{ cm}^3$  of potassium chloride solution.  
(1 mark)**

**volume = \_\_\_\_\_  $\text{cm}^3$**

**(Total for Question 6 = 12 marks)**

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**Turn over**

**7 This question is about the three halogens, bromine, chlorine and iodine.**

**(a) Give the number of protons and the number of neutrons in an atom of iodine-127  
(2 marks)**

**number of protons**

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**number of neutrons**

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**(continued on the next page)**

**7 continued.**

**(b) A sample of bromine contains two isotopes.**

- Br–79 with relative abundance 52·8%**
- Br–81 with relative abundance 47·2%**

**Calculate the relative atomic mass ( $A_r$ ) of this sample of bromine.**

**Give your answer to three significant figures.  
(3 marks)**

**$A_r =$  \_\_\_\_\_**

**(continued on the next page)**

**Turn over**

7 continued.

(c) Aluminium reacts with chlorine to form aluminium chloride.

This is the equation for the reaction.



Calculate the minimum mass of chlorine needed to form 26.7 g of aluminium chloride.

(3 marks)

[for  $\text{Cl}_2$ ,  $M_r = 71$  for  $\text{AlCl}_3$ ,  $M_r = 133.5$ ]

minimum mass of chlorine = \_\_\_\_\_ g

(continued on the next page)

Turn over

**7 continued.**

**(d) A student mixes the following pairs of solutions.**

**Pair 1 bromine solution and potassium chloride solution**

**Pair 2 bromine solution and potassium iodide solution**

**Explain how the student can use the results of these experiments to show the order of reactivity of the three halogens, bromine, chlorine and iodine.**

**Include observations in your answer.  
(6 marks)**

**Answer space continues on the next 2 pages.**

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**Turn over**





- 8 Look at the diagram for Question 8(a) in the Diagram Booklet. A student uses this apparatus to find the molar enthalpy change ( $\Delta H$ ) of combustion for the liquid fuel, pentanol.**

**This is the student's method.**

- **find the initial mass of the spirit burner and pentanol**
- **add  $100\text{ cm}^3$  of water to the copper can**
- **record the initial temperature of the water**
- **light the wick of the spirit burner to heat the water**
- **stir the water until the temperature rises by  $35.0\text{ }^\circ\text{C}$**
- **extinguish the flame and immediately find the final mass of the spirit burner and pentanol**

**(continued on the next page)**

**8 continued.**

**(a) (i) State why the student stirs the water.  
(1 mark)**

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**(ii) Suggest why it is important that the student immediately finds the final mass of the spirit burner and pentanol.  
(1 mark)**

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**8 continued.**

**(b) Look at the diagram for Question 8(b) in the Diagram Booklet. It shows the initial temperature of the water.**

**Complete the table to show the temperature readings.**

**Give both values to the nearest 0.1 °C.  
(2 marks)**

<b>Initial temperature of water in °C</b>	
<b>Final temperature of water in °C</b>	
<b>Temperature change in °C</b>	<b>35.0</b>

**(continued on the next page)**

**Turn over**

**8 continued.**

**(c) (i) Show by calculation that the heat energy (Q) supplied by the pentanol is approximately 15 000 J. (2 marks)**

**[for water,  $c = 4.2 \text{ J/g/}^\circ\text{C}$ ]**

**[for  $1.0 \text{ cm}^3$  of water, mass = 1.0 g]**

**8(c) continued.**

**(ii) Look at the table for Question 8(c)(ii) in the Diagram Booklet. It gives the initial and final mass readings.**

**Use your answer to part (c)(i) and the information in the table to calculate the molar enthalpy change ( $\Delta H$ ) of combustion, in kJ/mol, for pentanol.**

**[for pentanol,  $M_r = 88$ ]**

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

**Answer space continues on the next page.**

**8(c)(ii) continued.**

**[for pentanol,  $M_r = 88$ ]**

**$\Delta H$  for pentanol = \_\_\_\_\_ kJ/mol**

**(continued on the next page)**

**Turn over**

**8 continued.**

**(d) The formula of pentanol is  $C_5H_{11}OH$**

**Write a chemical equation for the complete combustion of pentanol.  
(2 marks)**

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**(Total for Question 8 = 13 marks)**

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9 This question is about different hydrated forms of sodium sulfate.

(a) A compound has the formula  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$

(i) How many different elements are there in the formula  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ?  
(1 mark)

A 3

B 4

C 5

D 10

(continued on the next page)

**9(a) continued.**

**(ii) What is the total number of atoms in the formula  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ? (1 mark)**

**A 10**

**B 22**

**C 27**

**D 28**

**(continued on the next page)**

**9 continued.**

**(b) Another hydrated form of sodium sulfate has the formula  $\text{Na}_2\text{SO}_4 \cdot x\text{H}_2\text{O}$**

**Look at the diagram for Question 9(b) in the Diagram Booklet. A student uses this apparatus to find the value of  $x$ .**

**This is the student's method.**

- **find the mass of an empty tube**
- **add solid hydrated sodium sulfate to the tube**
- **find the mass of the tube and hydrated sodium sulfate**
- **heat the tube for several minutes**
- **allow the tube to cool and find the mass of the tube and contents**

**(continued on the next page)**

**9(b) continued.**

- (i) Describe what the student should do next to make sure that all the water is removed from the hydrated sodium sulfate.  
(2 marks)**

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**(continued on the next page)**

**9(b) continued.**

**(ii) Explain the role of the ice in the beaker.  
(2 marks)**

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**(continued on the next page)**

**9(b) continued.**

**(iii) Describe how the student could prove that the liquid collected is pure water.  
(2 marks)**

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**(continued on the next page)**

**9 continued.**

**(c) Look at the table for Question 9(c) in the Diagram Booklet. It gives the student's results.**

**Use the student's results to calculate the value of  $x$ .  
(5 marks)**

**[for  $\text{Na}_2\text{SO}_4$ ,  $M_r = 142$       for  $\text{H}_2\text{O}$ ,  $M_r = 18$ ]**

**Answer space continues on the next page.**

9(c) continued.

[for  $\text{Na}_2\text{SO}_4$ ,  $M_r = 142$       for  $\text{H}_2\text{O}$ ,  $M_r = 18$ ]

$x =$  \_\_\_\_\_

**(Total for Question 9 = 13 marks)**

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Turn over

**10 Zinc reacts with dilute hydrochloric acid to form zinc chloride and hydrogen gas.**

**This is the equation for the reaction.**



**(a) In an experiment, 20 cm<sup>3</sup> of hydrochloric acid containing 0.0036 mol are reacted with 1.3 g of zinc granules at a temperature of 30 °C.**

**(i) Show by calculation that the zinc is in excess.  
(2 marks)**

**10(a) continued.**

**(ii) The volume of hydrogen collected is measured at regular time intervals.**

**Look at the diagram for Question 10(a)(ii) in the Diagram Booklet. Curve A shows the results of this experiment.**

**The experiment is repeated using 1.3 g of zinc powder instead of zinc granules.**

**All other conditions are kept the same.**

**On the grid, draw the curve you would expect to obtain.  
(2 marks)**

**(continued on the next page)**

**10 continued.**

**(b) In the original experiment,  $20\text{ cm}^3$  of hydrochloric acid containing  $0.0036\text{ mol}$  were reacted with  $1.3\text{ g}$  of zinc granules at a temperature of  $30^\circ\text{C}$  and curve A was obtained.**

**Look at the diagram for Question 10(b) in the Diagram Booklet. The student does two more experiments and obtains curves B and C.**

**(i) In one of these experiments the student repeats the original method but at a temperature of  $20^\circ\text{C}$ .**

**Explain in terms of particle collision theory why the curve obtained could be curve B.  
(4 marks)**

**Answer space continues on the next page.**

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**Turn over**



**10(b) continued.**

**(ii) In the other experiment the student repeats the original method but uses  $20\text{ cm}^3$  of hydrochloric acid containing  $0.0018\text{ mol}$ .**

**Explain why curve C shows the results the student obtained.  
(2 marks)**

**Answer space continues on the next page.**

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**10(b)(ii) continued.**

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**(continued on the next page)**

**10 continued.**

**(c) Catalysts can be used to speed up reactions.**

**Describe how a catalyst works.  
(2 marks)**

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**(Total for Question 10 = 12 marks)**

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**TOTAL FOR PAPER = 110 MARKS  
END OF PAPER**