

Science (Single Award)  
Chemistry  
PAPER: 1C

Total Marks
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Tuesday 11 June 2024 – Morning

Time: 1 hour 10 minutes

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

Surname					
Other names					
Centre Number					
Candidate Number					

**YOU MUST HAVE**

**Calculator, ruler**

**YOU WILL BE GIVEN**

**Periodic Table**

**Diagram Booklet**

**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.**

**Calculators may be used.**

**INFORMATION**

**The total mark for this paper is 60.**

**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.**

**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.**

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**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 This question is about organic compounds.**

**(a) What is the name of the compound with the formula  $\text{C}_4\text{H}_{10}$ ?  
(1 mark)**

- ☐ **A butane**
- ☐ **B ethane**
- ☐ **C pentane**
- ☐ **D propane**

**(continued on the next page)**

1 continued.

(b) What is the general formula for alkanes?  
(1 mark)

☐ A  $C_nH_{2n}$

☐ B  $C_nH_{2n+1}$

☐ C  $C_nH_{2n-2}$

☐ D  $C_nH_{2n+2}$

(c) Calculate the relative formula mass ( $M_r$ ) of  $C_3H_8$   
(1 mark)

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

(continued on the next page)

**1 continued.**

**(d) Give the displayed formula of methane.  
(1 mark)**

**(e) Name the compound formed when many  
molecules of  $\text{C}_2\text{H}_4$  join together.  
(1 mark)**

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**(Total for Question 1 = 5 marks)**

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**2 (a) The melting point of solid Y is measured.**

**State how the result of this measurement would show whether Y is a pure substance or a mixture.  
(2 marks)**

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**(continued on the next page)**

**2 continued.**

- (b) A student is given three liquids. One liquid is a sample of a food colouring **X**, and the other liquids are a yellow dye and a red dye.**

**Describe a chromatography experiment that the student could do to show that **X** contains the yellow dye and the red dye.  
(5 marks)**

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

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**2(b) continued.**

[illegible]

**(Total for Question 2 = 7 marks)**

**Turn over**

**3 Argon and oxygen are two gases found in the atmosphere.**

**(a) (i) What is the approximate percentage by volume of argon in dry air?  
(1 mark)**

☐ **A 0·01 %**

☐ **B 0·1 %**

☐ **C 1 %**

☐ **D 10 %**

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

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**(continued on the next page)**

**3 continued.**

- (b) Oxygen reacts with hot phosphorus to form white fumes of phosphorus oxide.**

**A scientist uses this reaction to find the approximate percentage by volume of oxygen in a sample of air.**

**Look at the diagram for Question 3(b) in the Diagram Booklet. It shows the apparatus the scientist uses.**

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

- remove the bung and record the initial water level in the glass tube**
- use a hot metal rod to ignite the phosphorus and quickly replace the bung**
- wait until all the white fumes have disappeared and the water level in the glass tube stops rising**
- record the final water level in the glass tube**

**(continued on the next page)**

**3(b) continued.**

- (i) Give a reason why the scientist quickly replaces the bung.  
(1 mark)**

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**(continued on the next page)**

**3(b) continued.**

- (ii) Look at the table for Question 3(b)(ii) in the Diagram Booklet. It shows the scientist's results.**

**Use the diagram and the results to calculate the percentage by volume of oxygen in the sample of air.**

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

**percentage of oxygen = \_\_\_\_\_ %**

**(continued on the next page)**

**3 continued.**

**(c) The fumes of phosphorus oxide dissolve in the water and react to form a solution of phosphoric acid.**

**(i) Look at the equation for Question 3(c)(i) in the Diagram Booklet. Complete the chemical equation for this reaction.  
(1 mark)**

**(ii) Describe how to show whether the solution is strongly acidic or weakly acidic.  
(3 marks)**

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

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**3(c)(ii) continued.**

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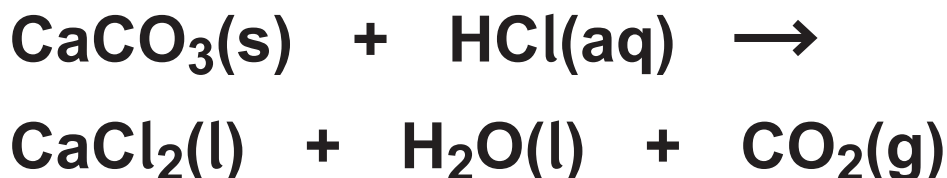
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**(Total for Question 3 = 11 marks)**

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- 4 Marble chips react with hydrochloric acid to form calcium chloride solution, water and carbon dioxide.

(a) A student gives this incorrect equation for the reaction.



Identify two changes that should be made to the student's equation.

(2 marks)

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(continued on the next page)



**4 continued.**

- (b) Look at the diagram for Question 4(b) in the Diagram Booklet. The student uses this apparatus to investigate the effect of the concentration of hydrochloric acid on the rate of the reaction with marble chips.**

**In the first experiment the student records the total volume of carbon dioxide gas in the gas syringe every 30 seconds.**

- (i) When the reaction has finished, some marble chips remain in the flask.**

**Give a conclusion the student could make about the reaction.**

**(1 mark)**

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**(continued on the next page)**

**4(b) continued.**

- (ii) State how the student would know that the reaction has finished.  
(1 mark)**

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**(continued on the next page)**

**4(b) continued.**

**(iii) Look at the graph for Question 4(b)(iii) in the Diagram Booklet. It shows the student's results.**

**Explain how the shape of the curve shows how the rate of reaction changes as the time increases.**

**(3 marks)**

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**(continued on the next page)**

**4(b) continued.**

- (iv) The student repeats the experiment using the same mass of marble chips and the same volume of hydrochloric acid. However, the acid is only half as concentrated as the acid used in the first experiment.**

**Look again at the graph for Question 4(b)(iii) in the Diagram Booklet. On the grid, draw the curve you would expect the student to obtain in the second experiment.**

**(2 marks)**

**(Total for Question 4 = 9 marks)**

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- 5 Hydrogen sulfide ( $\text{H}_2\text{S}$ ) contains covalent bonds between the sulfur atom and the hydrogen atoms. Hydrogen sulfide has a low melting point and a low boiling point and is a gas at room temperature.**

**(a) Describe how covalent bonds are formed.  
(2 marks)**

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**5 continued.**

**(b) Explain why hydrogen sulfide has a low boiling point.**

**Refer to structure and forces of attraction in your answer.**

**(3 marks)**

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**5 continued.**

- (c) Diamond is also a covalent substance, but it has a very high melting point.**

**Give the type of structure in diamond.  
(1 mark)**

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**(Total for Question 5 = 6 marks)**

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- 6 Caesium (**Cs**) is an element in Group **1** of the Periodic Table.

An atom of one of the isotopes of caesium has atomic number 55 and mass number 133

- (a) Determine the numbers of protons, neutrons and electrons in this atom.  
(2 marks)

protons

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neutrons

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electrons

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(continued on the next page)



**6 continued.**

- (b) A small piece of sodium metal is added to a trough of water. A rapid reaction takes place.**

**A small piece of caesium metal is added to another trough of water.**

- (i) Predict one observation that could be made in both reactions.  
(1 mark)**

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**(continued on the next page)**

**6(b) continued.**

- (ii) Predict how the reaction of caesium with water compares with the reaction of sodium with water.**

**Refer to the trend in reactivity of Group 1 metals in your answer.  
(3 marks)**

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**6 continued.**

**(c) Caesium reacts with chlorine gas ( $\text{Cl}_2$ ) to form caesium chloride.**

**(i) State the name given to the group of the Periodic Table that contains chlorine.  
(1 mark)**

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**(ii) Give a chemical equation for the reaction between caesium and chlorine.  
(1 mark)**

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**6 continued.**

**(d) The bonding in caesium chloride is ionic.**

**(i) Describe how caesium atoms and chlorine atoms form ions, giving the charges on the ions.**

**(3 marks)**

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**6(d) continued.**

- (ii) Explain what is meant by the term  
IONIC BONDING.  
(2 marks)**

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**6(d) continued.**

**(iii) Solid caesium chloride has a giant ionic lattice.**

**Give a physical property of caesium chloride.  
(1 mark)**

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**(Total for Question 6 = 14 marks)**

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- 7** When a salt dissolves in water, a heat energy change may occur.

Look at the diagram for Question 7 in the Diagram Booklet. A student uses this apparatus to find the heat energy change that occurs when magnesium sulfate dissolves in water.

This is the student's method.

**Step 1** add **50.0 cm<sup>3</sup>** of water to the beaker

**Step 2** record the initial temperature of the water

**Step 3** add **3.0 g** of magnesium sulfate and stir carefully using the thermometer

**Step 4** record the highest temperature of the solution

- (a) Explain how **Step 4** shows what type of heat energy change occurs when the magnesium sulfate dissolves.

(2 marks)

Answer space continues on the next page.

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**7(a) continued.**

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**(b) Explain one change that could be made to the student's apparatus that would improve the accuracy of the results.  
(2 marks)**

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**(continued on the next page)**



**7 continued.**

- (c) Look at the table for Question 7(c) in the Diagram Booklet. It shows the student's results.**

**Calculate the heat energy change ( $Q$ ), in kJ, that occurs when magnesium sulfate dissolves in water.**

**(4 marks)**

**[for the solution, mass of  $1.00 \text{ cm}^3 = 1.00 \text{ g}$   
 $c = 4.2 \text{ J/g/}^\circ\text{C}$ ]**

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

7(c) continued.

[for the solution, mass of  $1.00 \text{ cm}^3 = 1.00 \text{ g}$   
 $c = 4.2 \text{ J/g/}^\circ\text{C}$ ]

$Q =$  \_\_\_\_\_ kJ

(Total for Question 7 = 8 marks)

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**TOTAL FOR PAPER = 60 MARKS**

**END OF PAPER**