

**Paper Reference(s) 4CH1/2C**  
**Pearson Edexcel International GCSE (9–1)**

**Chemistry**  
**UNIT: 4CH1**  
**PAPER: 2C**

Total Marks
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**Tuesday 13 June 2023 – Morning**

**Time: 1 hour 15 minutes**

**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**

**YOU WILL BE GIVEN**

**Diagram Booklet, Periodic Table**

**INSTRUCTIONS**

**If pencil is used for diagrams / sketches / graphs it must be dark (HB or B).**

**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 70.**

**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 as a separate insert.**

**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 Use the Periodic Table to help you answer this question.**

**(a) (i) Name the element with atomic number 14.  
(1 mark)**

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**(ii) Name the element in Group 2 and Period 3.  
(1 mark)**

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**(continued on the next page)**

1(a) continued.

(iii) Name an element that is a liquid at room temperature.

(1 mark)

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(iv) Give the electronic configuration of an atom of phosphorus.

(1 mark)

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(v) Give the formula of sodium sulfide.

(1 mark)

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(continued on the next page)

1 continued.

(b) Explain, in terms of electron configuration, why neon is unreactive.

(2 marks)

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

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**2 This question is about gases in the atmosphere.**

**(a) Which of these gases has the lowest percentage by volume in the atmosphere?**

**(1 mark)**

- A argon**
- B carbon dioxide**
- C nitrogen**
- D oxygen**

**(b) When copper(II) carbonate is heated, copper(II) oxide and carbon dioxide form.**

**(i) What is the name of this type of reaction?**

**(1 mark)**

- A addition**
- B decomposition**
- C oxidation**
- D substitution**

**(continued on the next page)**

2(b) continued.

(ii) Which colour change occurs when copper(II) carbonate is heated?  
(1 mark)

A blue to black

B blue to orange

C green to black

D green to orange

(iii) Give the chemical equation for this reaction.  
(1 mark)

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(continued on the next page)

2 continued.

(c) Look at the diagram for Question 2(c) in the Diagram Booklet. A student uses this apparatus to find the percentage of oxygen in a sample of air.

The student leaves the apparatus until there is no further change in volume of gas in the syringe.

These are the student's results.

volume of gas in flask and connecting tube in $\text{cm}^3$	280
volume of gas in syringe at start in $\text{cm}^3$	100
volume of gas in syringe at end in $\text{cm}^3$	27

Calculate the percentage of oxygen in the sample of air.

Give your answer to two significant figures.  
(4 marks)

Answer space continues on the next page.

**2(c) continued.**

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

**(continued on the next page)**

**2 continued.**

- (d) Explain why an increasing amount of carbon dioxide in the atmosphere is likely to cause a problem for the environment.  
(2 marks)**

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**(Total for Question 2 = 10 marks)**

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**3 This question is about alcohols.**

**Ethanol can be manufactured using two different methods.**

- **hydration of ethene**
- **fermentation of glucose**

**This is the equation for hydration.**



**(a) Look at the equation for Question 3(a) in the Diagram Booklet. Complete the equation for fermentation.**

**(2 marks)**

**(b) Look at the table for Question 3(b) in the Diagram Booklet. It gives some information about the two methods.**

**(i) Complete the table by giving the missing information.**

**(3 marks)**

**(continued on the next page)**

**3(b) continued.**

- (ii) Explain one advantage and one disadvantage of using fermentation rather than hydration to produce ethanol.**

**You should use information from the table to help your answer.**

**(4 marks)**

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

**advantage**

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**3(b)(ii) continued.**

**disadvantage**

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**3 continued.**

**(c) Explain why fermentation needs to occur in the absence of air.**

**(2 marks)**

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**(continued on the next page)**

**3 continued.**

**(d) Propanol has this percentage composition by mass.**

**C = 60.0%      H = 13.3%      O = 26.7%**

**(i) Show by calculation that the empirical formula of propanol is  $C_3H_8O$ .  
(3 marks)**

**(continued on the next page)**

**3(d) continued.**

- (ii) Draw the displayed formula of propanol.  
(1 mark)**

**(Total for Question 3 = 15 marks)**

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**4 A student does a titration to find the concentration of potassium hydroxide solution.**

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

- **add 25.0 cm<sup>3</sup> of the potassium hydroxide solution to a conical flask**
- **add a few drops of methyl orange indicator to the conical flask**
- **fill a burette with dilute sulfuric acid and record the initial burette reading**
- **place the conical flask on a white tile**
- **add the acid from the burette to the mixture in the conical flask, swirling the flask continuously**
- **when the indicator changes colour at the end point, record the final burette reading**

**Repeat the titration to obtain concordant results.**

- (a) Give the name of the most suitable piece of apparatus to measure out 25.0 cm<sup>3</sup> of potassium hydroxide solution.  
(1 mark)**
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**(continued on the next page)**

**Turn over**

4 continued.

(b) Give the colour of methyl orange in potassium hydroxide solution and in dilute sulfuric acid.

(2 marks)

colour in potassium hydroxide solution

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colour in dilute sulfuric acid

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(continued on the next page)

4 continued.

**(c) State why the student places the conical flask on a white tile.**

**(1 mark)**

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**(d) State why the student swirls the flask continuously.**

**(1 mark)**

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4 continued.

(e) State what is meant by the term  
**CONCORDANT RESULTS.**

(1 mark)

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(f) The student finds that  $15.00 \text{ cm}^3$  of sulfuric acid of concentration  $0.180 \text{ mol/dm}^3$  neutralises  $25.0 \text{ cm}^3$  of potassium hydroxide solution.

This is the equation for the reaction.



Calculate the concentration of the potassium hydroxide solution.

(3 marks)

Answer space continues on the next page.

4(f) continued.

concentration = \_\_\_\_\_ mol/dm<sup>3</sup>

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4 continued.

(g) This is the ionic equation for the reaction between an acid and an alkali.



Explain why the  $\text{OH}^-$  ion is a proton acceptor in this reaction.

(2 marks)

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**(Total for Question 4 = 11 marks)**

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**5** When copper(II) sulfate solution is electrolysed, copper forms at the negative electrode.

Look at the diagram for Question 5 in the Diagram Booklet. A student uses this apparatus to investigate the electrolysis of copper(II) sulfate solution.

**(a)** Describe how the student could test a sample of copper(II) sulfate solution to show that it contains copper(II) ions.  
**(2 marks)**

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5 continued.

(c) State the appearance of the copper that forms on the negative electrode.

(1 mark)

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(d) Oxygen forms at the positive electrode.

(i) Give a test for oxygen.

(1 mark)

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**5(d) continued.**

**(ii) Look at the half-equation for Question 5(d)(ii) in the Diagram Booklet. Complete the half-equation for the formation of oxygen at the positive electrode.**

**(2 marks)**

**(iii) State why the formation of oxygen at the positive electrode is an oxidation reaction.**

**(1 mark)**

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**(Total for Question 5 = 10 marks)**

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**6 Ethanoic acid reacts with methanol to form an ester.**

**Look at the equation for Question 6 in the Diagram Booklet. It shows the displayed formulae for the reactants and products.**

**(a) (i) Give the name of a suitable catalyst to increase the rate of this reaction.  
(1 mark)**

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**(ii) State how you would know that an ester has formed.  
(1 mark)**

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**(iii) Give the name of this ester.  
(1 mark)**

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**6 continued.**

**(b) Look at the table for Question 6(b) in the Diagram Booklet. It shows the number of bonds in the reactants and the number of bonds in the products.**

**(i) State which two bonds need to be broken in the reactants.**

**(1 mark)**

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6(b) continued.

- (ii) Explain why the enthalpy change in this reaction is approximately 0 kJ/mol.  
(2 marks)

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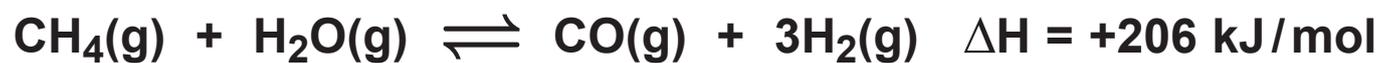
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**(Total for Question 6 = 6 marks)**

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- 7 Methane reacts with steam to form carbon monoxide and hydrogen.

This is the equation for the reaction.



- (a) State why carbon monoxide is poisonous to humans.  
(1 mark)

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**7 continued.**

- (b) Explain the effect, if any, on the yield of hydrogen at equilibrium when a nickel catalyst is used.  
(2 marks)**

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7 continued.

(c) The reaction conditions for this reaction are a temperature of  $700^{\circ}\text{C}$  and a pressure of 5 atmospheres.

(i) The temperature of the reaction mixture is reduced to  $600^{\circ}\text{C}$ , but the pressure is kept at 5 atmospheres.

Explain the effect on the yield of hydrogen at equilibrium.  
(2 marks)

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7(c) continued.

- (ii) The pressure of the reaction mixture is reduced to 4 atmospheres, but the temperature is kept at 700 °C.

Explain the effect on the yield of hydrogen at equilibrium.

(2 marks)

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7 continued.

(d) Calculate the volume, in  $\text{dm}^3$ , of methane gas at rtp needed to produce 6.6 tonnes of hydrogen gas.

[at rtp, molar volume =  $24 \text{ dm}^3$       1 tonne =  $10^6 \text{ g}$ ]

Give your answer in standard form.

(4 marks)

volume of methane = \_\_\_\_\_  $\text{dm}^3$

(Total for Question 7 = 11 marks)

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**TOTAL FOR PAPER = 70 MARKS**

**END OF PAPER**