

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

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

<b>Total Marks</b>
--------------------

**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, 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 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.**

**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 diagram for Question 1 in the Diagram Booklet. It shows the sub-atomic particles in an atom of an element.**

- (a) (i) Give the name of each of the sub-atomic particles labelled P, Q and R.  
(3 marks)**

**P** \_\_\_\_\_

\_\_\_\_\_

**Q** \_\_\_\_\_

\_\_\_\_\_

**R** \_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**1 continued.**

**(ii) Give the name of the part of the atom  
labelled S.  
(1 mark)**

---

---

**(b) Give the name of this element.  
(1 mark)**

---

---

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

---

**2 Look at the diagram for Question 2 in the Diagram Booklet.**

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

**After several days a coloured solution forms.**

**(a) Give the names of the two processes that cause the coloured solution to form.  
(2 marks)**

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

\_\_\_\_\_

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

\_\_\_\_\_

**(continued on the next page)**

**2 continued.**

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

**(i) How many different types of atom are  
in  $\text{KMnO}_4$ ?  
(1 mark)**

**A 3**

**B 4**

**C 6**

**D 7**

**(continued on the next page)**

2 continued.

- (ii) Calculate the relative formula mass ( $M_r$ ) of  $\text{KMnO}_4$   
(1 mark)

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

- (c) Potassium permanganate can be used as an oxidising agent.

State what is meant by the term

**OXIDISING AGENT.**

(1 mark)

---

---

---

**(Total for Question 2 = 5 marks)**

**Turn over**

**3 This question is about alkanes.**

**(a) (i) Which of these is the MOLECULAR formula of an alkane?**

**(1 mark)**

- A**  $\text{C}_2\text{H}_5$
- B**  $\text{C}_4\text{H}_{10}$
- C**  $\text{CH}_2\text{CH}_2$
- D**  $\text{CH}_3\text{CH}_2\text{CH}_3$

**(ii) Which of these has the same empirical formula and molecular formula?**

**(1 mark)**

- A**  $\text{CH}_2$
- B**  $\text{C}_2\text{H}_6$
- C**  $\text{C}_3\text{H}_8$
- D**  $\text{C}_4\text{H}_{10}$

**(continued on the next page)**

**3 continued.**

**(b) In the presence of ultraviolet radiation, methane reacts with bromine to form bromomethane and hydrogen bromide.**

**(i) State the name of this type of reaction.  
(1 mark)**

---

---

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

---

---

**(continued on the next page)**

**3 continued.**

**(c) One mole of an alkane burns completely in oxygen.**

**The equation represents the reaction.**



**The numbers x, y and z are used to balance the equation.**

**(continued on the next page)**

3 continued.

- (i) The complete combustion of one mole of the alkane produces 220 g of carbon dioxide and 108 g of water.

Calculate the values of  $y$  and  $z$ .

[ $M_r$  of  $\text{CO}_2 = 44$      $M_r$  of  $\text{H}_2\text{O} = 18$ ]  
(2 marks)

$y =$  \_\_\_\_\_

$z =$  \_\_\_\_\_

(continued on the next page)

Turn over

**3 continued.**

- (ii) Determine the molecular formula of the alkane and the value of x.  
(2 marks)**

**molecular formula = \_\_\_\_\_**

**x = \_\_\_\_\_**

**(continued on the next page)**

**Turn over**

**3 continued.**

**(d) When an alkane burns in a limited supply of air, incomplete combustion occurs.**

**Explain why incomplete combustion of an alkane could be harmful to humans.**

**(2 marks)**

---

---

---

---

---

---

---

---

**(Total for Question 3 = 10 marks)**

---



**4 continued.**

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**4 continued.**

**(b) Look at the diagram for Question 4(b) in the Diagram Booklet. It shows the electrolysis of copper(II) sulfate solution, using graphite electrodes.**

**Copper forms at the negative electrode and oxygen forms at the positive electrode.**

**(i) Give the formula of the copper ion and the formula of the sulfate ion in copper(II) sulfate. (1 mark)**

**copper ion**

---

---

**sulfate ion**

---

---

**(continued on the next page)**

4 continued.

(ii) State what would be seen at the positive electrode.  
(1 mark)

---

---

---

(iii) Give a test for oxygen.  
(1 mark)

---

---

---

(iv) Give an ionic half-equation for the formation of oxygen at the positive electrode.  
(2 marks)

---

---

(continued on the next page)

**4 continued.**

**(v) Suggest why the copper(II) sulfate solution contains some  $\text{OH}^-$  ions.**

**(1 mark)**

---

---

---

---

---

---

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

---

**5 This question is about alcohols, carboxylic acids and esters.**

**(a) Ethanol can be manufactured by the fermentation of a solution of glucose.**

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

---

---

**(ii) State the substance that needs to be added for the reaction to occur.  
(1 mark)**

---

---

**(continued on the next page)**

5 continued.

(iii) State two conditions needed for this reaction.  
(2 marks)

1 \_\_\_\_\_

2 \_\_\_\_\_

(b) In the presence of an acid catalyst, ethanoic acid is heated with butanol to form an ester.

(i) Which of these is the formula of the ester?  
(1 mark)

A  $\text{CH}_3\text{COOC}_3\text{H}_7$

B  $\text{CH}_3\text{COOC}_4\text{H}_9$

C  $\text{C}_2\text{H}_5\text{COOC}_4\text{H}_9$

D  $\text{C}_3\text{H}_7\text{COOC}_2\text{H}_5$

(continued on the next page)

Turn over

**5 continued.**

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

**(1 mark)**

---

---

---

**(iii) Give one use of an ester.**

**(1 mark)**

---

---

---

**(continued on the next page)**

**5 continued.**

**(c) Aspirin is a compound used to reduce pain.**

**Aspirin contains a carboxylic acid functional group and an ester functional group.**

**(i) State what is meant by the term  
FUNCTIONAL GROUP.  
(1 mark)**

---

---

---

**(ii) Look at the diagram for Question 5(c)(ii) in the Diagram Booklet. It is the structural formula of aspirin.**

**Draw a circle around the carboxylic acid functional group.  
(1 mark)**

**(continued on the next page)**

**5 continued.**

**(iii) Aspirin has this percentage composition by mass.**

**C = 60.00%    H = 4.44%    O = 35.56%**

**Show by calculation that the empirical formula of aspirin is  $C_9H_8O_4$   
(3 marks)**

**(Total for Question 5 = 12 marks)**

---

**Turn over**

**6 A student uses this method to do a titration.**

- **use a measuring cylinder to obtain  $25\text{ cm}^3$  of sodium hydroxide solution**
- **transfer the solution to a conical flask**
- **add a few drops of universal indicator to the flask**
- **fill a burette with dilute sulfuric acid and record the initial burette reading**
- **add the acid to the flask, swirling the flask continuously**
- **add the acid slowly near the end-point**
- **record the final burette reading at the end-point**

**The student repeats the titration until at least two concordant results are obtained.**

**(continued on the next page)**

**6 continued.**

**(a) State what is meant by concordant results.  
(1 mark)**

---

---

---

**(b) Explain two improvements to the student's method  
so that more accurate results are obtained.  
(4 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**



6 continued.

(c) The student makes the improvements and repeats the titration.

The sulfuric acid has a concentration of  $0.600 \text{ mol/dm}^3$ .

The sodium hydroxide solution has a concentration of  $1.50 \text{ mol/dm}^3$ .

This is the equation for the reaction.



Calculate the volume, in  $\text{cm}^3$ , of sulfuric acid that the student needs to completely react with  $25.0 \text{ cm}^3$  of the sodium hydroxide solution.

(3 marks)

volume of sulfuric acid = \_\_\_\_\_  $\text{cm}^3$

(continued on the next page)

Turn over

**6 continued.**

- (d) The student plans to obtain pure dry crystals of hydrated sodium sulfate.**

**They add the calculated volume of sulfuric acid to 25.0 cm<sup>3</sup> of the sodium hydroxide solution to form sodium sulfate solution.**

**Describe what the student should do to obtain pure dry crystals of hydrated sodium sulfate from the solution.**

**(4 marks)**

---

---

---

---

---

---

---

---

---

---

**(continued on the next page)**

**Turn over**



- 7 In the presence of an iron catalyst, nitrogen reacts with hydrogen to form ammonia.

The reaction conditions used are a temperature of 450 °C and a pressure of 200 atmospheres.

This is the equation for the reaction.



- (a) (i) State what the symbol  $\rightleftharpoons$  represents.  
(1 mark)

---

---

---

- (ii) Give the reason for using a catalyst.  
(1 mark)

---

---

---

(continued on the next page)

7 continued.

(b) (i) The reaction mixture is kept at a pressure of 200 atmospheres, but the temperature is increased to 550 °C.

Explain the effect of this change on the yield of ammonia at equilibrium.

(2 marks)

---

---

---

---

---

---

---

---

(continued on the next page)

**7 continued.**

- (ii) The reaction mixture is kept at a temperature of 450 °C, but the pressure is increased to 300 atmospheres.**

**Explain the effect of this change on the yield of ammonia at equilibrium.**

**(2 marks)**

---

---

---

---

---

---

---

---

**(continued on the next page)**

**7 continued.**

**(c) Look at the diagram for Question 7(c) in the Diagram Booklet.**

**Draw an energy level diagram for the reaction between nitrogen and hydrogen.**

**Include the reactants, products and  $\Delta H$  in your diagram.**

**(3 marks)**

**(continued on the next page)**

7 continued.

(d) At the start of the reaction,  $48 \text{ dm}^3$  of nitrogen is added to  $120 \text{ dm}^3$  of hydrogen at rtp.



[molar volume of any gas at rtp =  $24 \text{ dm}^3$ ]

(i) Show by calculation that the nitrogen is in excess.  
(3 marks)

(continued on the next page)

Turn over

7 continued.

(ii) The yield of ammonia at equilibrium is 20%.

Calculate the volume, in  $\text{dm}^3$ , of ammonia formed from  $120 \text{ dm}^3$  of hydrogen.

(3 marks)

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

(Total for Question 7 = 15 marks)

---

---

**TOTAL FOR PAPER = 70 MARKS**

**END OF PAPER**