

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

Chemistry
UNIT: 4CH1
PAPER: 2CR

Total Marks

Tuesday 11 June 2024 – Morning

Time: 1 hour 15 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.

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

Turn over

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.

ADVICE

Read each question carefully before you start to answer it.

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 This question is about sulfur.

(a) Look at the diagram for Question 1(a) in the Diagram Booklet. It represents the electronic configuration of an atom of sulfur.

**(i) Which period of the Periodic Table contains sulfur?
(1 mark)**

☐ **A 2**

☐ **B 3**

☐ **C 4**

☐ **D 6**

(continued on the next page)

1(a) continued.

**(ii) What is the charge on a sulfide ion?
(1 mark)**

☐ **A 1+**

☐ **B 2+**

☐ **C 1–**

☐ **D 2–**

(continued on the next page)

Turn over

1 continued.

(b) When a mixture of sulfur and zinc is heated to a high temperature a reaction occurs, forming the compound zinc sulfide, ZnS

**(i) Give a reason why the mixture of sulfur and zinc needs heating before a reaction occurs.
(1 mark)**

(continued on the next page)

1(b) continued.

**(ii) Calculate the relative formula mass (M_r) of zinc sulfide.
(1 mark)**

[for Zn, $A_r = 65$ for S, $A_r = 32$]

$M_r =$ _____

(Total for Question 1 = 4 marks)

2 (a) Look at the diagram for Question 2(a) in the Diagram Booklet. It represents an atom of an element.

**(i) What is the name of the particle labelled *W*?
(1 mark)**

☐ **A electron**

☐ **B ion**

☐ **C neutron**

☐ **D proton**

(continued on the next page)

2(a) continued.

**(ii) What is the mass number of this atom?
(1 mark)**

☐ **A 4**

☐ **B 5**

☐ **C 9**

☐ **D 13**

(continued on the next page)

2 continued.

(b) These are the symbols for the two isotopes of lithium.



**(i) In terms of sub-atomic particles, give one similarity and one difference between the two isotopes.
(2 marks)**

similarity

difference

(continued on the next page)

Turn over

2(b) continued.

**(ii) A sample of lithium contains
7.5% of ${}^6_3\text{Li}$ and 92.5% of ${}^7_3\text{Li}$**

**Calculate the relative atomic
mass (A_r) of this sample
of lithium.
(2 marks)**

$A_r =$ _____

(Total for Question 2 = 6 marks)

3 This question is about magnesium metal and its compounds.

(a) (i) Look at the diagram for Question 3(a)(i) in the Diagram Booklet. It represents the structure of magnesium.

**Add the labels for A and B below.
(2 marks)**

A _____

B _____

(continued on the next page)

3(a) continued.

**(ii) Explain why magnesium
is malleable.
(2 marks)**

(continued on the next page)

3 continued.

(b) Magnesium burns in oxygen gas to form solid magnesium oxide.

**(i) Look at the diagram for Question 3(b)(i) in the Diagram Booklet. Complete the chemical equation for the reaction by balancing the equation and adding the state symbols.
(2 marks)**

**(ii) Give a reason why magnesium is oxidised in this reaction.
(1 mark)**

(continued on the next page)

Turn over

3 continued.

(c) A student uses this method to make a solution of magnesium chloride.

Step 1 **measure 25 cm^3 of dilute hydrochloric acid into a beaker**

Step 2 **add magnesium powder a little at a time**

Step 3 **keep adding magnesium powder until it is in excess**

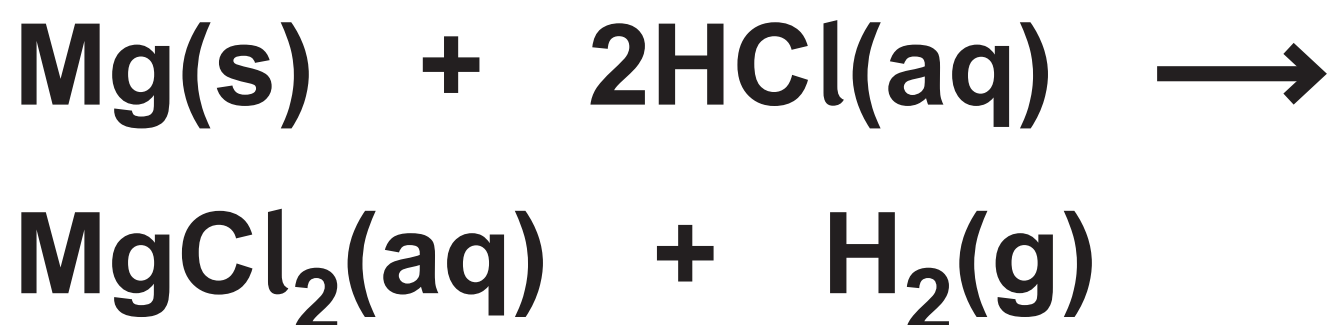
Step 4 **remove the excess magnesium powder by filtration**

(continued on the next page)

Turn over

3(c) continued.

This is the equation for the reaction.



- (i) Give a reason why the student uses magnesium powder rather than magnesium ribbon.
(1 mark)**

(continued on the next page)

3(c) continued.

**(ii) Give a reason why the student
adds an excess of magnesium
in step 3
(1 mark)**

(continued on the next page)

3(c) continued.

- (iii) Calculate the minimum mass of magnesium needed to react with 25.0 cm^3 of 2.00 mol/dm^3 hydrochloric acid.
(3 marks)**

[for Mg, $A_r = 24$]

mass = _____ g

(Total for Question 3 = 12 marks)

Turn over

4 This question is about the manufacture of ethanol by the fermentation of glucose.

(a) Fermentation needs to be done in the absence of air.

**Give TWO other conditions needed for fermentation.
(2 marks)**

1 _____

2 _____

(continued on the next page)

4 continued.

**(b) Explain why fermentation needs to be done in the absence of air.
(2 marks)**

(continued on the next page)

Turn over

4 continued.

**(c) (i) Look at the diagram for Question 4(c)(i) in the Diagram Booklet. Complete the equation for fermentation.
(1 mark)**

(ii) A mixture containing 500 mol of glucose is fermented.

A mass of 5750 g of ethanol is obtained.

**Calculate the percentage yield.
(3 marks)**

[for ethanol, $M_r = 46$]

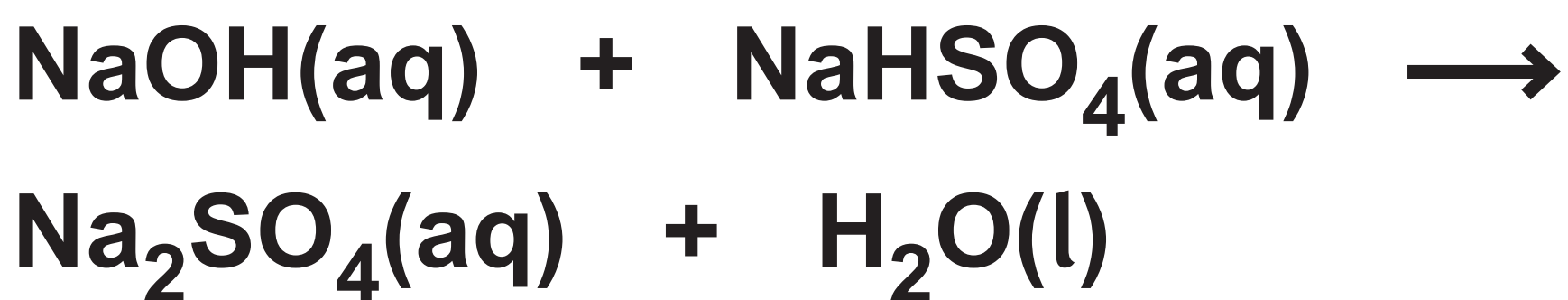
percentage yield = _____ %

(Total for Question 4 = 8 marks)

Turn over

- 5 Sodium sulfate can be prepared by the reaction between sodium hydroxide solution and sodium hydrogensulfate (NaHSO_4) solution.**

This is the equation for the reaction.



Sodium hydrogensulfate solution is acidic.

A student adds 25.0 cm^3 of sodium hydroxide solution to a conical flask and adds two drops of indicator.

The student does a titration.

(continued on the next page)

5 continued.

- (a) (i) Name a piece of apparatus that should be used to add 25.0 cm^3 of sodium hydroxide solution to the conical flask. (1 mark)**
-
-

- (ii) Describe the method the student should use to find the accurate volume of sodium hydrogensulfate solution needed to neutralise the 25.0 cm^3 of sodium hydroxide solution. (5 marks)**

Answer space continues on the next 2 pages.

Turn over

5(a)(ii) continued.

5(a)(ii) continued.

(continued on the next page)

5 continued.

(b) The student repeats the titration without the indicator and forms a solution of sodium sulfate.

**Describe how the student can obtain pure, dry crystals of hydrated sodium sulfate from the solution.
(4 marks)**

Answer space continues on the next page.

Turn over

5(b) continued.

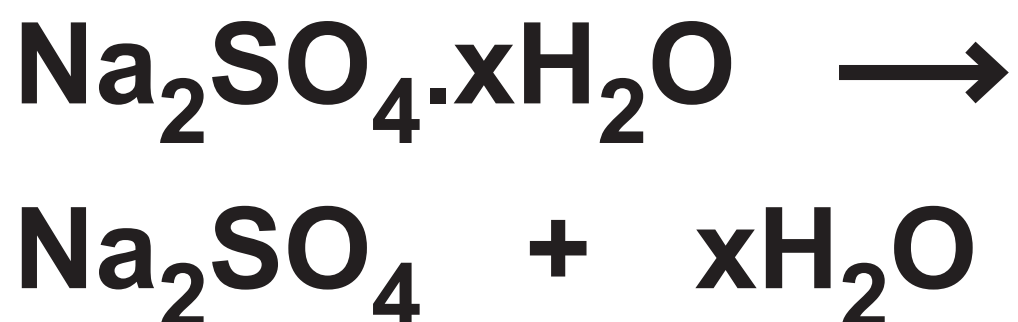
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Turn over

5 continued.

(c) Crystals of hydrated sodium sulfate decompose when heated.

This is the equation for the decomposition.



Look at the diagram for Question 5(c) in the Diagram Booklet. A student uses the apparatus to find the value of X.

The student heats the crystals until the decomposition is complete.

Look at the table for Question 5(c) in the Diagram Booklet. It shows the student's results.

(continued on the next page)

Turn over

5(c) continued.

**Use the results to calculate the value
of X.
(4 marks)**

**[for Na_2SO_4 , $M_r = 142$
for H_2O , $M_r = 18$]**

value of X = _____

(Total for Question 5 = 14 marks)

Turn over

6 This question is about electrolysis.

(a) Look at the diagram for Question 6(a) in the Diagram Booklet. The apparatus is used to collect the gases produced when an electric current passes through dilute sulfuric acid.

**(i) Name a suitable material for the inert electrodes.
(1 mark)**

**(ii) Give a test to show that the gas produced at the positive electrode is oxygen.
(1 mark)**

(continued on the next page)

Turn over

6(a) continued.

- (iii) Give a test to show that the gas produced at the negative electrode is hydrogen.
(1 mark)**

- (iv) Give an ionic half-equation for the formation of hydrogen at the negative electrode.
(1 mark)**

(continued on the next page)

Turn over

6(a) continued.

(v) The oxygen gas in the tube has a volume of 17.8 cm^3 at rtp.

Calculate the mass, in grams, of oxygen gas in the tube.

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

[for O_2 at rtp,
molar volume = $24\,000 \text{ cm}^3$]

mass of oxygen = _____ g

(continued on the next page)

Turn over

6 continued.

(b) Look at the diagram for Question 6(b) in the Diagram Booklet. The apparatus is used to electrolyse a concentrated solution of sodium chloride.

**(i) Give a reason why sodium chloride solution conducts electricity.
(1 mark)**

(continued on the next page)

Turn over

6(b) continued.

(ii) The positive ions in the solution are H^+ and Na^+

**Give a reason why hydrogen forms at the negative electrode rather than sodium.
(1 mark)**

(continued on the next page)

6(b) continued.

- (iii) A sample of the solution is taken from near the negative electrode. The sample is tested with universal indicator.**

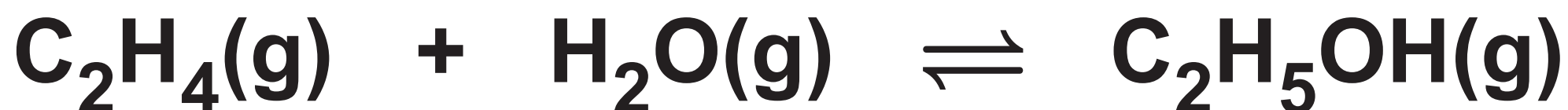
**Explain the final colour of the universal indicator.
(2 marks)**

(Total for Question 6 = 11 marks)

Turn over

- 7 Gaseous ethanol is manufactured by reacting ethene gas with steam.**

This is the equation for the reaction.



- (a) (i) The pressure on an equilibrium mixture of the three gases is decreased. All the other conditions are kept the same.**

**Predict the effect of this change on the yield of ethanol at equilibrium, giving a reason for your answer.
(2 marks)**

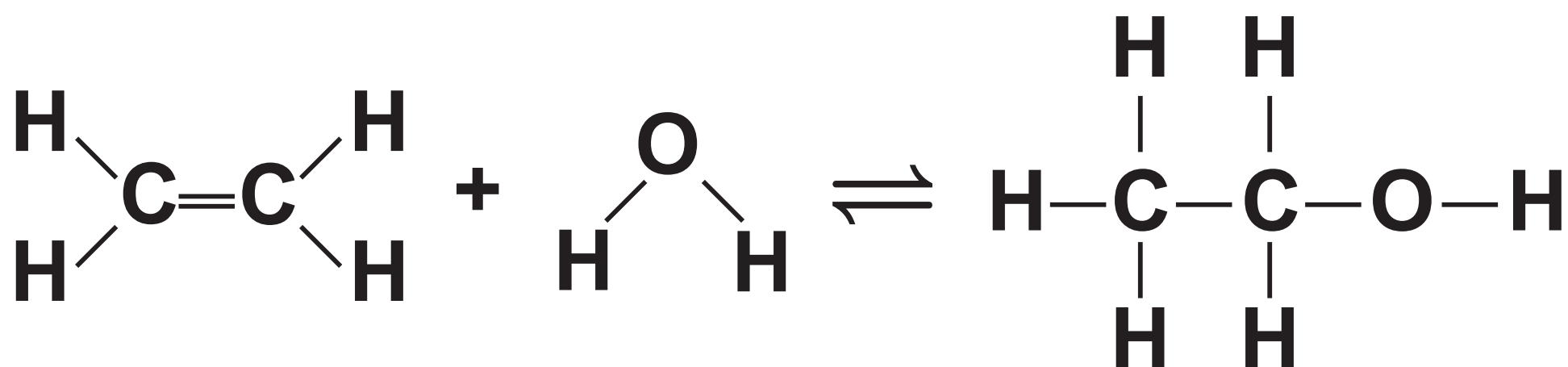
7(a) continued.

**(ii) Predict the effect of adding a catalyst on the yield of ethanol at equilibrium, giving a reason for your answer.
(2 marks)**

(continued on the next page)

7 continued.

(b) The equation shows the displayed formulae for the reactants and products.



Look at the table for Question 7(b) in the Diagram Booklet. It gives the bond energies.

- (i) Using the data in the table and the equation, show that the enthalpy change, ΔH , is approximately -40 kJ/mol (3 marks)**

Answer space continues on the next page.

Turn over

7(b)(i) continued.

(continued on the next page)

Turn over

7(b) continued.

**(ii) Explain, in terms of bonds broken and bonds made, why this reaction is exothermic.
(2 marks)**

(continued on the next page)

Turn over

7(b) continued.

(iii) Look at the diagram for Question 7(b)(iii) in the Diagram Booklet. Draw an energy level diagram for the reaction between ethene and steam.

**Label the enthalpy change, ΔH
(3 marks)**

(continued on the next page)

7 continued.

(c) Ethanoic acid reacts with ethanol to form ester **A and water.**

(i) Look at the diagram for Question 7(c)(i) in the Diagram Booklet. Complete the equation by adding the displayed formula of ester **A.
(2 marks)**

(ii) Give the name of ester **A.
(1 mark)**

(Total for Question 7 = 15 marks)

TOTAL FOR PAPER = 70 MARKS
END OF PAPER