



Rewarding Learning

General Certificate of Secondary Education

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C2



Higher Tier

[GDW52]

GDW52

Assessment

TIME

1 hour 15 minutes.

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions	
Other	

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 80.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question **6(c)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.



- 1 (a) (i) Describe two observations, apart from heat being given off, when magnesium ribbon is added to copper(II) sulfate solution. You can assume that the magnesium is in excess.

1. _____

2. _____ [2]

- (ii) Write a balanced symbol equation for the reaction between magnesium and copper(II) sulfate.

_____ [2]

- (b) A student wanted to find out the order of reactivity of four metals, A, B, C and D. She carried out a series of displacement reactions and found that:

Metal B displaced metal C

Metal C displaced metal D but not metal A

Metal A displaced two of the other three metals.

Which of the other three metals, B, C or D, could A **not** displace?

_____ [1]





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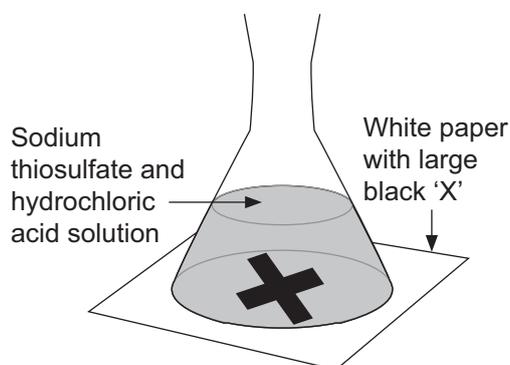
[Turn over



20GDW5203

- 2 (a) When sodium thiosulfate solution reacts with hydrochloric acid, a precipitate is formed (the mixture in the flask goes cloudy).

The diagram below shows how the rate can be investigated by drawing an X on a piece of paper placed under a flask containing the reaction mixture and timing how long it takes for the X to disappear from sight.

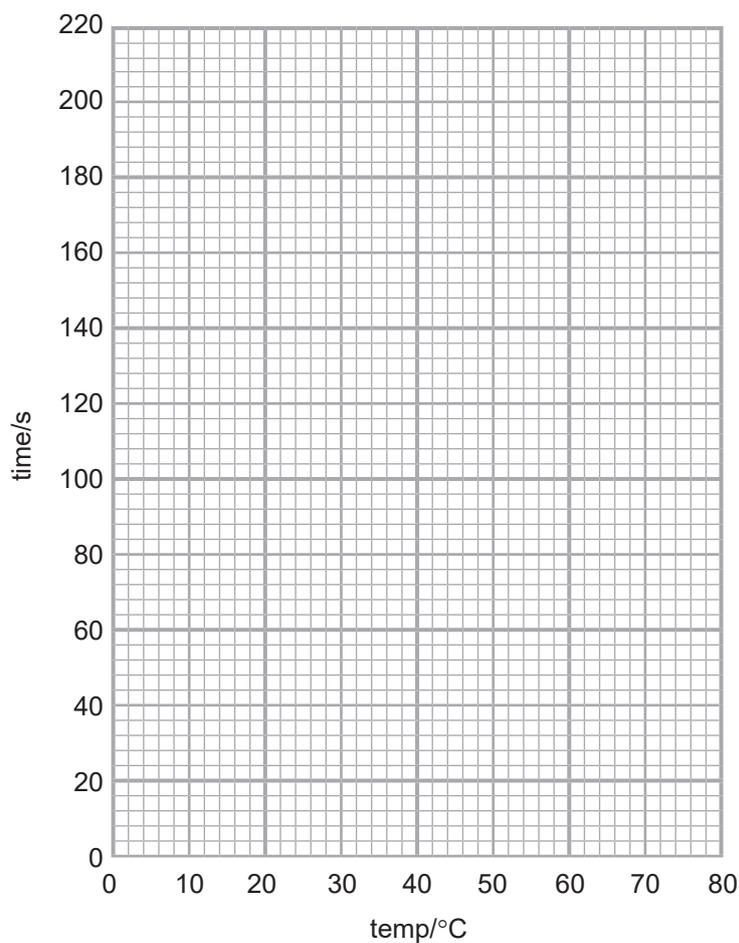


The reaction was carried out several times using exactly the same reactants but changing the temperature each time and the results below were obtained.

temp/ $^{\circ}\text{C}$	10	20	30	40	50	60
time/s	188	108	60	36	18	8



On the grid below, plot a graph to show how the time taken for the X to disappear changes with temperature.



[3]

(b) (i) From your graph, estimate the reaction time at 26 °C.

[1]

(ii) If the reaction had been carried out at 70 °C, how long might the reaction have taken? Circle the most likely answer from the list below.

8 seconds 6 seconds 4 seconds 0 seconds

[1]

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12763



20GDW5205

(c) Calcium carbonate reacts with dilute hydrochloric acid as shown in the equation below:



You are given 0.5 g of calcium carbonate and 100 cm³ of dilute hydrochloric acid. Suggest an appropriate practical method to obtain a set of results which can be used to investigate the rate of this reaction at room temperature. Set out your steps clearly.

There is space below for up to three steps after Step 1 but you may use fewer or add more steps if you wish.

Step 1: Add the calcium carbonate to the acid in a conical flask

Step 2: _____

Step 3: _____

Step 4: _____

[4]



(d) Explain, in terms of collisions between particles, why the reaction rate in part (a) increased as the temperature increased.

[3]

[Turn over

12763



20GDW5207

- 3 (a) There are many organic compounds, some of which are hydrocarbons. Explain what is meant by the term hydrocarbon.

[2]

- (b) Propan-2-ol and methanoic acid are two examples of organic compounds.

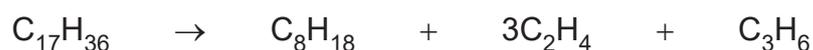
Complete the table below to show the molecular formula, structural formula and physical state at room temperature of propan-2-ol and methanoic acid.

Name	Molecular formula	Structural formula	Physical state at room temperature
Propan-2-ol		$\begin{array}{c} \text{H} \quad \text{OH} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	
Methanoic acid	HCOOH		Liquid

[3]

- (c) The alkane heptadecane ($\text{C}_{17}\text{H}_{36}$) undergoes cracking to form a mixture containing octane (used in petrol), ethene and propene.

The equation for the reaction is:



Explain why **this** reaction is described as cracking.

[4]



- 4 (a) Give the name and formula of the compound formed when carbon dioxide reacts with water.

Name _____ Formula _____ [2]

- (b) Complete the sentence below to describe the laboratory preparation of oxygen.

Oxygen is prepared in the laboratory by the catalytic _____

of _____ using _____

as a catalyst. [3]

- 5 Molten lead(II) chloride is an example of an electrolyte that can be decomposed as it conducts electricity. This process is known as electrolysis.

- (a) Explain, in terms of the particles present, why an electrolyte is able to conduct electricity.

_____ [2]

- (b) Write **balanced half equations** for the reactions occurring at the anode and cathode during the electrolysis of lead(II) chloride.

At the anode:

At the cathode:

_____ [4]

[Turn over



6 (a) Two equations are given below:



Which substance is being oxidised in equation 1 and which substance is being reduced in equation 2?

In equation 1 _____ is being oxidised.

In equation 2 _____ is being reduced. [2]

(b) The electrolysis of aluminium oxide can be described by the following half equations:



(i) Which species is being oxidised during this electrolysis? Explain your answer.

Species being oxidised: _____

Explanation: _____

_____ [2]

(ii) Why can the extraction of aluminium be described as a redox reaction?

_____ [1]



(c) Describe the extraction of iron from haematite in the blast furnace.

In your answer you should:

- Describe, in words, the production of the reducing agent
- Write a balanced symbol equation for the reaction which produces the iron
- Describe, in words, how the acidic impurity, silicon dioxide, is removed from the blast furnace

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Description, in words, of the production of the reducing agent in the blast furnace:

A balanced symbol equation for the reaction which produces the iron:

Description, in words, of how the acidic impurity, silicon dioxide, is removed from the blast furnace:

[6]

[Turn over



- 7 (a) (i) The thermal decomposition of hydrated copper(II) sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) is an example of a reversible reaction. Write a balanced symbol equation for this reversible reaction.

_____ [2]

- (ii) The thermal decomposition of hydrated copper(II) sulfate can reach a dynamic equilibrium if there is a closed system.

In a dynamic equilibrium, which **two** of the statements A,B,C,D, E,F,G,H are true?

- A The forward reaction is faster than the reverse reaction
- B The forward reaction is slower than the reverse reaction
- C The rates of the forward and reverse reactions are equal
- D Both the forward and reverse reactions have stopped

- E The amounts of reactant and product remain constant
- F The amounts of reactant and product both increase
- G The amounts of reactant and product both decrease
- H It will always end up with 50% reactant and 50% product

The true statements are _____ and _____

[2]

- (b) (i) Calculate the relative formula mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
(Relative atomic masses: H = 1, O = 16, S = 32, Cu = 64)

_____ [1]



(ii) If 0.5 mole of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is heated to constant mass, how much of the mass, in grams, will be lost?

_____ g [1]

(c) A hydrocarbon contains 80% carbon and 20% hydrogen by mass. Work out the empirical formula for the hydrocarbon and suggest a possible molecular formula.

Empirical formula: _____

Possible molecular formula: _____ [3]

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12763



20GDW5213

- (d) (i) A 200 cm^3 solution contains 10 g of sodium hydroxide. Calculate the concentration of the solution in mol/dm^3 . (relative formula mass: $\text{NaOH} = 40$)

_____ mol/dm^3 [1]

- (ii) How many moles of sodium hydroxide are present in 400 cm^3 of a 1.5 mol/dm^3 solution?

_____ mol [1]





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20GDW5215

8 (a) Name two products other than water that could be formed during the incomplete combustion of methane.

1. _____ 2. _____ [2]

(b) Write a balanced symbol equation for the addition reaction of propene with hydrogen.

_____ [2]

(c) Describe how bromine water can be used to distinguish ethane gas from ethene gas.

_____ [4]

(d) Polyvinyl bromide is an addition polymer. Complete the table below to show the structure of the monomer used to make this polymer.

Monomer structure	Polymer structure
	$\left[\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{Br} \end{array} \right]_n$

[1]



(e) Draw the functional group found in all alcohols.

_____ [1]

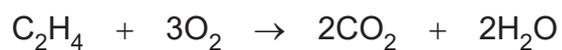
(f) Describe, giving the conditions required, how ethanol is prepared by the fermentation of a sugar solution.

_____ [3]

[Turn over



9 Ethene undergoes complete combustion in oxygen to form carbon dioxide and water.

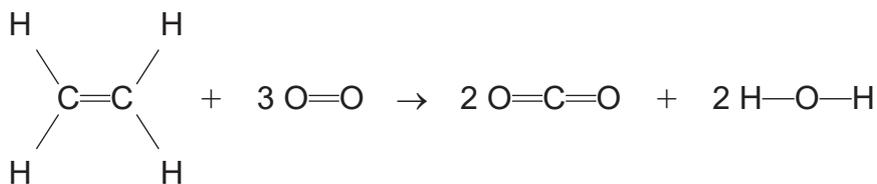


(a) Explain, in terms of bond breaking and bond making, why **this** reaction is exothermic.

[5]



(b) Use the bond energy data in the table below to calculate the energy change for the complete combustion of ethene. **Include the correct units in your answer.**



Bond	C—H	C=C	O=O	C=O	O—H
Bond energy/kJ	412	612	496	743	463

You are advised to show your working.

_____ [3]

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12763



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For Examiner's use only	
Question Number	Marks
1	
2	
3	
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Total Marks	
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Examiner Number

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