

EDUZEDCO
233/2 CHEMISTRY
Paper 2
Form 4 End Term Examination

Time: 2 ½ Hours

Name:

Adm No:

School:

Class:

Signature:

Date:

INSTRUCTIONS TO CANDIDATES

- (a) Write your name and index number in the spaces provided at the top of this page.
- (b) Write your school name, sign and write the date of the examination in the spaces provided above.
- (c) This paper consists of **Two** sections: **Section I** and **Section II**.
- (d) Answer all questions as instructed in each section.
- (e) Marks may be given for correct working, relevant points, and clear presentation.
- (f) Non-programmable silent electronic calculators may be used where necessary.
- (h) This paper consists of **4 printed pages**.
- (i) Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.
- (j) Candidates should answer the questions in English.

For Examiner's Use Only

SECTION I

1	2	3	Total

SECTION II

4	5	6	7	8	9	10	11	Total	Grand Total

SECTION I (50 Marks)

Answer **all** questions in this section in the spaces provided.

1. This question is about alcohols and carboxylic acids. Answer all parts. (12 mks)
- (a) Draw the structural formula of ethanol and identify the functional group present. [2 marks]
- (b) Write balanced chemical equations for the complete combustion and for the oxidation of ethanol to ethanoic acid. [3 marks]
- (c) Describe a simple chemical test to distinguish between ethanol and ethanoic acid, stating the expected observations. [2 marks]
- (d) Explain the process of esterification between ethanol and ethanoic acid, including the role of concentrated sulfuric acid. [3 marks]
- (e) Draw the structural formula of the ester formed and state one commercial use of esters. [2 marks]
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2. In an experiment, excess marble chips (calcium carbonate) were reacted with dilute hydrochloric acid. The volume of carbon dioxide gas produced was measured at regular intervals. The results are shown in the table below. Time (s): 0,30,60,90,120,150,180,210,240 Volume of CO₂ (cm³): 0,22,38,48,55,59,61,62,62 (12 mks)
- (a) On the grid provided, plot a graph of volume of gas produced (y-axis) against time (x-axis). [3 marks]
- (b) Calculate the average rate of reaction in cm³/s over the first 120 seconds. [2 marks]
- (c) Determine the initial rate of reaction by drawing a tangent to the curve at t=0 and calculating its gradient. [2 marks]
- (d) Explain, using collision theory, why the rate of reaction decreases with time. [2 marks]
- (e) On the same axes, sketch a second curve to show the effect of increasing the temperature of the hydrochloric acid. Explain why the rate changes. [3 marks]
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3. The diagram below shows a blast furnace used for the extraction of iron. (11 mks)
- Study it and answer the questions that follow. [Insert diagram]
- (a) Name the raw materials used in the blast furnace and state their sources. [2 marks]
- (b) Write balanced chemical equations for the reduction of iron(III) oxide and the combustion of coke. [2 marks]
- (c) Explain the role of limestone (calcium carbonate) in the removal of impurities. [2 marks]
- (d) State two properties of slag and give two uses of slag. [3 marks]
- (e) Explain why the iron obtained

233/2 CHEMISTRY MARKING SCHEME

Form 4 Paper 2

SECTION I (50 marks)

1. This question is about alcohols and carboxylic acids. Answer all parts. (12 marks)

- (a) Structural formula of ethanol: $\text{CH}_3\text{CH}_2\text{OH}$ (or displayed: $\text{H H} \mid \mid \text{H-C-C-O-H} \mid \mid \text{H H}$) [1 mark]. Functional group: hydroxyl ($-\text{OH}$) [1 mark]. (2 marks) [2]
- (b) Complete combustion: $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ [1 mark for correct products, 1 mark for balancing]. (2 marks) Oxidation: $\text{CH}_3\text{CH}_2\text{OH} + [\text{O}] \rightarrow \text{CH}_3\text{COOH} + \text{H}_2\text{O}$ [1 mark for correct product; accept $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$ as oxidising agent]. (1 mark) (3 marks) [3]
- (c) Test: Add sodium hydrogencarbonate (or sodium carbonate) solution to each [1 mark]. Observation: With ethanoic acid, effervescence (bubbles of CO_2) [1 mark]; with ethanol, no effervescence. Alternative: Use blue litmus paper – ethanoic acid turns red, ethanol no change. (2 marks) [2]
- (d) Esterification: Ethanol + Ethanoic acid $\rightarrow$ Ethyl ethanoate + Water [1 mark for correct equation]. Role of conc. H_2SO_4 : Acts as a dehydrating agent (removes water) [1 mark] and as a catalyst [1 mark]. (3 marks) [3]
- (e) Structural formula of ester: $\text{CH}_3\text{COOCH}_2\text{CH}_3$ (ethyl ethanoate) [1 mark]. One commercial use: as a solvent in glues/nail polish remover; or as a flavouring agent/perfume. Accept any valid use. (2 marks) [2]

Alternative method/answer:

For (c), accept using smell: ethanoic acid has pungent vinegar smell, ethanol has alcoholic smell. Or adding magnesium ribbon: effervescence with ethanoic acid, no reaction with ethanol.

For (d), accept that conc. H_2SO_4 also absorbs water produced, shifting equilibrium to the right.

2. In an experiment, excess marble chips (calcium carbonate) were reacted with dilute hydrochloric acid. The volume of carbon dioxide gas produced was measured at regular intervals. The results are shown in the table below. Time (s):

0,30,60,90,120,150,180,210,240 Volume of CO_2 (cm^3): 0,22,38,48,55,59,61,62,62

- (a) Axes labelled with units (time/s, volume of CO_2/cm^3) [1 mark]; correct scale (suitable intervals) [1 mark]; points plotted correctly and joined with a smooth curve [1 mark]. (3 marks) [3]
- (b) Average rate = $(55 - 0) \text{ cm}^3 / (120 - 0) \text{ s} = 55/120 = 0.458 \text{ cm}^3/\text{s}$ [M1 for correct substitution, A1 for correct answer; accept 0.46 cm^3/s] (2 marks) [2]
- (c) Tangent drawn at $t=0$ [1 mark]. Gradient = $\Delta y/\Delta x$ (e.g., $(40 \text{ cm}^3)/(40 \text{ s}) = 1.0 \text{ cm}^3/\text{s}$) [M1 for method, A1 for answer within reasonable range]. (2 marks) [2]
- (d) Rate decreases because concentration of HCl decreases as reaction proceeds [1 mark]; fewer collisions per second between CaCO_3 and H^+ ions [1 mark]. (2 marks) [2]
- (e) Sketch: curve steeper initially but reaches same final volume [1 mark]; explanation: higher temperature increases kinetic energy of particles [1 mark], leading to more frequent and more energetic collisions (higher proportion of successful collisions) [1 mark]. (3 marks) [3]

Alternative method/answer:

For (c), if tangent drawn from $t=0$ to, say, $t=50\text{s}$ with volume 40cm^3 , gradient = $0.8 \text{ cm}^3/\text{s}$; any gradient between 0.7 and $1.2 \text{ cm}^3/\text{s}$ acceptable.

For (d), accept explanation in terms of surface area: marble chips are used up, surface area decreases.

3. The diagram below shows a blast furnace used for the extraction of iron. Study it and answer the questions that follow. [Insert diagram] (11 marks)

- (a) Raw materials: Iron ore (haematite) [1/2 mark], coke (carbon) [1/2 mark], limestone (calcium carbonate) [1/2 mark], air (oxygen) [1/2 mark]. (2 marks) [2]
- (b) Reduction of iron(III) oxide: $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ [1 mark for correct reactants and products, 1 mark for balancing]. Combustion of coke: $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ [1 mark]. (2 marks) [2]
- (c) Limestone decomposes to CaO and CO_2 [1/2 mark]; CaO reacts with silica (SiO_2) impurity to form slag (calcium silicate) [1 mark]; slag is molten and floats on iron, removed [1/2 mark]. (2 marks) [2]

(d) Properties of slag: low density/lighter than molten iron [1/2 mark]; high melting point/hard [1/2 mark].
Uses: road construction/building material [1 mark]; as fertiliser (provides calcium) [1 mark]. (3 marks) [3]
(e) Iron from blast furnace is not pure (contains carbon, silicon, etc.) [1 mark]. It can be purified by converting into steel in a basic oxygen furnace [1 mark] where oxygen is blown through to remove impurities [1 mark]. (2 marks) [Note: Accept alternative methods like re-melting with scrap iron.] [2]

Alternative method/answer:

For (a), accept specific names of iron ore (Fe_2O_3) and limestone (CaCO_3).

For (c), the equation: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$; then $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$.

For (e), accept that the iron contains about 4% carbon, making it brittle; purification by heating with oxygen to reduce carbon content.