



UNNASE MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 2

2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

- Answer **five** questions, including **three** questions from section **A** and any **two** from section **B**.
- Write the answers in the answer booklets provided.
- **Begin each question on a fresh page.**
- Graph papers are provided.
- **Illustrate your answers with equations where applicable.**
- **Indicate the questions attempted on answer booklets provided.**
- **Where necessary use $H = 1$, $C = 12$, $O = 16$, $Cl = 35.5$, $Ca = 40$**

Question						Total
Marks						

SECTION A

Answer any **three** questions from this section.

1. (a) The table below shows the first ionization energies of the elements in third short period of the Periodic Table.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
1 st I.E(kJmol ⁻¹)	494	736	577	786	1060	1000	1260	1520
Atomic number	11	12	13	14	15	16	17	18

- (i) What is meant by the term **first ionization energy**? (01mark)
- (ii) Write an equation for the first ionization energy of phosphorus. (01mark)
- (iii) Plot a graph of $\log_{10}(\text{first ionisation energy})$ against atomic number. (05marks)
- (iv) Explain the shape of the graph. (07marks)
- (b) (i) State how the first ionization energies of group(I) elements vary down the group. (01mark)
- (ii) Show how the first ionization energies of group(I) elements are related to the reactivity of the elements. (Illustrate your answer using the reaction of group(I) elements with water). (05marks)
2. (a) (i) Explain what is meant by the term lattice energy. (03marks)
- (ii) State **two** factors that affect the magnitude of lattice energy. (02marks)
- (iii) Describe how the factors you have stated in(ii) affect the magnitude of the lattice energy. (05marks)
- (b) (i) Draw a Born – haber cycle for the first formation of solid rubidium chloride from its elements. (03marks)
- (ii) Calculate the electron affinity of chlorine from the following data.
- Lattice energy of rubidium chloride = -675kJmol⁻¹
- Bond dissociation energy of chlorine = +242kJmol⁻¹
- Atomisation energy of rubidium = +84kJmol⁻¹
- Ionisation energy of rubidium = +397kJmol⁻¹
- Standard enthalpy of formation of rubidium chloride = -431kJmol⁻¹ (03marks)
- (iii) Given that the hydration energies of rubidium ions and chloride ions are -301 and -364kJmol⁻¹ respectively, determine the enthalpy of solution of rubidium chloride and comment on the solubility of rubidium chloride in water. (04marks)
3. An organic compound **T**, **C₄H₁₁N** when treated with a mixture of concentrated hydrochloric acid and sodium nitrite solution, there was effervescence of a colourless neutral gas **Y** and another organic compound **Z** were formed.
- (a) (i) Identify **Y** (0½mark)
- (ii) Write the structural formulae and IUPAC names of the possible isomers of **T**. (04marks)

- (b) When **Z** was treated with iodine solution and sodium hydroxide solution, a pale yellow precipitate **R** was formed. Identify
- T**
 - Z**
 - Pale yellow precipitate **R** (1½marks)
- (c) Write equation and suggest a mechanism for the reaction between
- T** and ethanoyl chloride (04marks)
 - Z** and hot concentrated phosphoric acid (04marks)
- (d) Using equations only show how **T** can be synthesized from propyne. (06marks)
4. (a) Write equation to show how concentration sodium hydroxide solution reacts with:
- Aluminium oxide.
 - Silicon (IV) hydride.
 - Chlorine heptoxide
 - Disulphur dichloride (06 marks)
- (b) Compare the properties of Carbon, silicon, and lead by considering the reactions of:
- Their tetrachlorides with water.
 - Their dioxides with sodium hydroxide
 - Elements with concentrated nitric acid. (14 marks)

SECTION B

Answer **two** questions from this section.

5. (a) A solution containing 20g of a polymer **Q** in a litre of solvent exerts an Osmotic pressure of 1.40 mm Hg at 25°C.
- Explain what is meant by the terms **osmosis** and **osmotic pressure**. (02marks)
 - Calculate the relative molecular mass of **Q**. (03 marks)
 - If the monomer of **Q**, is $\text{CH}_2=\overset{\text{Cl}}{\underset{|}{\text{C}}}\text{CH}=\text{CH}_2$, determine the number of monomer units and hence write the structural formula of **Q** (2½marks)
- (b) (i) Describe how the molecular mass of **Q** can be determined in the laboratory using osmotic pressure method. (06 marks)
- (ii) State why such a method in b(i) above is preferred. (01 marks)
- (c) (i) The vapour pressure of a solution containing 108.5g of substance **M** in 100g of water at 20°C was reduced by 0.182 mmHg. Calculate the relative molecular mass of substance **M**. Given that the vapour pressure of water at 20°C is 17.54 mmHg. (2½marks)
- (ii) Explain why the vapour pressure containing a non-volatile solute is less than the vapour pressure of a pure solvent. (02marks)
- (iii) State what change would be noted in the relative molecular mass if **M** associated in water. (01mark)

6. Using equations only show how the following conversions can be effected.
- (a) phenol from benzene sulphonic acid (05marks)
 - (b) cyclohexanol from aminobenzene. (05marks)
 - (c) propanoic acid from 2-bromopropane (05marks)
 - (d) Polystyrene from benzene (05marks)
7. (a) Write:
- (i) The electronic configuration of manganese atom (Atomic number 25). (01mark)
 - (ii) The possible oxidation states of manganese (2½ marks)
- (b) (i) Write the half equation for the reduction of potassium permanganate in acidic medium (2½ marks)
- (ii) State the change in the oxidation state of the manganese in the reaction in (b)(i) above (01mark)
- (c) Briefly explain why hydrochloric acid and nitric acid are **not** used for acidifying potassium permanganate solution during volumetric analysis. (03marks)
- (d) State **three** advantages of using potassium permanganate in volumetric analysis. (03marks)
- (e) Explain what would be observed if dilute sulphuric acid was added to an aqueous solution of potassium manganate(VI). (04 marks)
- (f) Name a reagent apart from aqueous ammonia and sodium hydroxide that can be used to distinguish between manganese (II) ions and nickel (II) ions. State what would be observed if each of them is separately treated with the reagent you have named. (03 marks)
8. (a) (i) What is meant by the term polymer? (01mark)
- (b) Natural rubber is a natural polymer while nylon 6,10 is an artificial polymer.
- (i) Distinguish between natural polymer and artificial polymer. (02marks)
- (ii) Write the structural formulae of the polymers named above. (02marks)
- (iii) Give the names of the monomers of the polymers in (ii) above. (1½marks)
- (c) (i) Describe briefly how natural rubber can be made stronger and more elastic. (3½marks)
- (ii) State **two** uses of the product in c(i) above. (02marks)
- (d) (i) Distinguish between soap and soapless detergents (02marks)
- (ii) Describe how soaps and soapless detergents work. (05marks)
- (i) State **one** advantage and **one** disadvantage of soapless detergents. (01marks)

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