

P525/2

CHEMISTRY

PAPER 2

July – 2024

2½ hours



MUKONO EXAMINATION COUNCIL 2024

S.6 RESOURCEFUL EXAMINATION

CHEMISTRY

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO THE CANDIDATES.

Answer **five** questions including **three** from section A and any **two** from section B

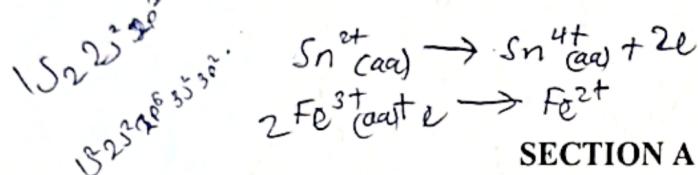
Begin equation on a fresh page.

Extra question will not be marked.

Mathematical tables and squared paper are provided.

Illustrate your answers with equations where applicable.

Where necessary use C = 12 , H = 1 , O = 16 , Cl = 35.5



SECTION A

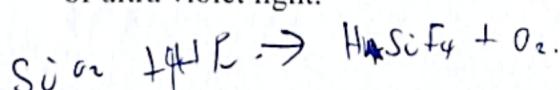
Answer three questions from this section.

1. Carbon, silicon, germanium, tin and lead are elements of Group(IV) of the Periodic Table.
 - (a) (i) Write the outer most electronic configuration of Group(IV) elements. (01mark)
 - (ii) State the oxidation states of Group(IV) elements. (01mark)
 - (iii) State how the stability of the oxidation states vary down the group. (02marks)
 - (b) Describe the reactions of the elements with (i) water (06marks)
 - (ii) concentrated sulphuric acid. (06marks)
 - (c) Write equations for the reactions between;
 - (i) silicon (IV)oxide and hot concentrated hydrofluoric acid. (1½marks)
 - (ii) trileadtetraoxide and warm dilute nitric acid. (1½marks)
 - (iii) tin(II) chloride solution and iron(III) sulphate solution. (1½marks)

2. (a) Benzene reacts with concentrated nitric acid in the presence of a concentrated acid X to form a pale yellow liquid when the resultant mixture warmed.
 - (i) Name acid X (01mark)
 - (ii) Write equation and suggest a mechanism for the reaction. (05marks)

- (b) write equations to show how the main organic product in (a) above can be converted into phenol. (05mrks)

- (d) State what was observed and write equation for the reaction when:
 - (i) Chlorine gas was bubbled through benzene in the presence of ultra violet light. (02marks)



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- (ii) A mixture of methyl benzene and acidified potassium dichromate (VI) was refluxed. (2 marks)
- (iii) Hot iron metal was added to a mixture of benzene and bromine (2 marks)
- (e) Using equations only show how chlorobenzene can be converted to benzoic acid. (03marks)

3. (a) Define the following terms

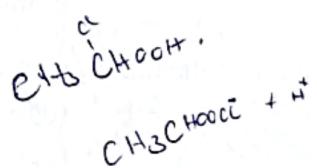
- (i) Lattice energy (01mark)
- (ii) Hydration energy (01mark)

(b) Given the following thermodynamic data.

Standard enthalpy of formation of magnesium fluoride	= -1129kJmol ⁻¹
Standard enthalpy of atomisation of magnesium	= +150kJmol ⁻¹
Standard enthalpy of bond dissociation of fluorine gas	= +158kJmol ⁻¹
First ionisation energy of magnesium	= +725kJmol ⁻¹
Second ionisation energy of magnesium	= +1451kJmol ⁻¹
First electron affinity of fluorine	= -348kJmol ⁻¹

- (i) Draw an energy level diagram for the standard enthalpy of formation of magnesium fluoride and use it to determine the lattice energy of magnesium fluoride. (06marks)
- (ii) Given that the hydration energies of magnesium ions and fluoride ions are -1921 and -364 kJmol⁻¹ respectively. Calculate the enthalpy of solution of magnesium fluoride and comment on its solubility in water. (04marks)
- (c) State and explain two factors that affect the lattice energy. (05marks)

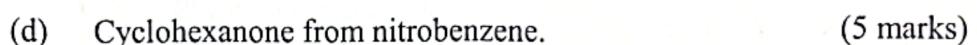
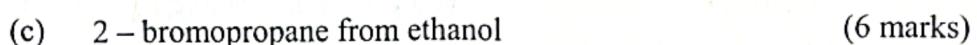
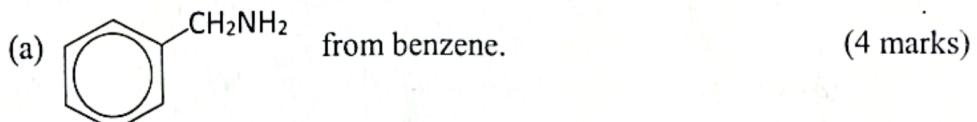
- (d) Would you expect the lattice energy of magnesium bromide to less than , greater than or equal to that of magnesium fluoride. Give a reason for your answer. (03marks)
4. Ethanol and ethanoic acid react reversibly and exothermically according to the following equation
- $$\text{CH}_3\text{COOH(l)} + \text{CH}_3\text{CH}_2\text{OH(l)} \rightleftharpoons \text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3(\text{l}) + \text{H}_2\text{O(l)}$$
- $$\Delta H = -45 \text{ kJ mol}^{-1}$$
- (a) Write the expression for the equilibrium constant, K_C for the reaction. (01mark)
- (b) Describe an experiment that can be used to determine the equilibrium constant for the esterification reaction between ethanol and ethanoic acid. (06marks)
- (c) State and explain how the equilibrium position and equilibrium constant would be affected if
- (i) temperature of the equilibrium mixture was increased. (03marks)
 - (ii) some little calcium carbonate powder was added to the equilibrium mixture. (02marks)
 - (iii) some little anhydrous copper(II) sulphate powder was added to equilibrium mixture. (02marks)
- (d) 62.1g of ethanol were mixed with 150g of ethanoic acid and the mixture allowed to reach equilibrium at 70°C. Calculate the mass of the ethyl ethanoate formed at equilibrium .
 $(K_C \text{ for the esterification reaction} = 4.00)$ (06marks)



SECTION B

Attempt any two questions from this section

- 5 Write equations to show how the following compound can be synthesized. Indicate reagents and conditions for the reactions involved.



6.

- (a) What is meant by the term **weak acid?** (01mark)

- (b) The K_a values of ethanoic acid and chloroethanoic acid are 1.74×10^{-5} mol dm $^{-3}$ and 1.38×10^{-3} mol dm $^{-3}$ respectively.

Calculate the pH of

- (i) 0.1M ethanoic acid
(ii) 0.1M chloroethanoic acid (05marks)

[State any assumptions in your calculation]

- (c) Explain difference in pH values in (b) (04marks)

- (d) 75cm 3 0.1M chloroethanoic acid were mixed with 25cm 3 of 0.1M sodium hydroxide solution. Calculate the pH of the resultant solution. (05marks)

- (e) State and explain the effect of adding few drops of dilute hydrochloric acid on the pH of the resultant mixture in (d) above. (03marks)

- (f) Sketch a graph of pH against volume sodium hydroxide when 25cm 3 of 0.1M ethanoic was titrated with 0.1M sodium hydroxide solution. (02marks)

7. Explain the following observations

- (a) When cold concentrated hydrochloric acid was added to lead (IV) oxide, brown solid dissolves to form a pale yellow liquid. However on slight warming, there was effervescence of a gas. (04marks)
- (b) When sodium hydroxide solution was added to zinc sulphate solution drop-wise until in excess, white precipitate was formed that dissolved to form a colourless solution. (05marks)
- (c) When few drops of ammonium oxalate solution were added to barium ions in solution followed concentrated ethanoic acid, white precipitate was formed which dissolved in ethanoic acid to form a colourless solution. (04marks)
- (d) When few drops of concentrated sodium carbonate solution were added to iron(III) chloride solution there was effervescence of a colourless gas and brown precipitate formed. (04marks)
- (e) Iodine is insoluble in water but very soluble in potassium iodide solution. (03marks)

8. Fluorine, chlorine, bromine and iodine are elements in group (VII) of the periodic table.

- (a) Explain the general method of preparing chlorine, and bromine in the laboratory. (2 marks)
- (b) Fluorine differs in some of its properties from chlorine, bromine and iodine:
- Explain why fluorine differs from other group (vii) members. (2 marks)
 - State four properties in which fluorine differs from other group members. (4 marks)
- (c) Describe the reactions of group (VII) elements with
- water (4 marks)
 - sodium hydroxide (6 marks)
- (d) Explain why Hydrofluoric acid is weaker than hydroiodic acid. (2 marks)

END