P525/2

CHEMISTRY

Paper 2

July / Aug. 2023

2 ½ hours

UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

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** *questions from Section* **B**.

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

[C = 12, H = 1, *1 mol of a gas occupies 22.4 dm^3 at s.t.p.*]

SECTION A:

Answer **THREE** *questions from this section*

1. (a) Define the term **osmotic pressure.** (01 mark)

(b) Describe an experiment that can be carried out to determine the molecular mass of a substance by osmotic pressure method. (05 marks)

(c) The osmotic pressure of various concentrations of a polysaccharide R dissolved in water at 25°C is shown below:

Concentration (g/dm^3)	1.0	2.0	3.0	4.0	5.0	6.0
Osmotic pressure (Nm^{-2})	23	37	53	75	92	109

(i) Plot a graph of osmotic pressure against concentration. (03 marks)

(ii) Determine the molecular mass of the polysaccharide **R**. (04 marks)
($R = 8.314 JK^{-1}mol^{-1}$)

(d) The osmotic pressure of a solution containing 5.5g per litre of polyphenylethene in benzene is $106.39 Nm^{-2}$ at 20°C.

(i) Calculate the relative molecular mass of polyphenylethene. (02 marks)

(ii) Determine the number of monomers that formed polyphenylethene. (01 mark)

(e) Explain why elevation is boiling point method is not suitable for determination of relative molecular mass of polyphenylethene. (04 marks)

2. Without using equations ***or by using words only***, show how flux following organic compounds can be synthesized.

(a) Propanoic acid from $CH_3CH_2CH_2Cl$ (2 ½ marks)

(b) Pent – 1 – yne from $CH_2 = CH_2$. (5 ½ marks)

(c) Benzaldehyde from benzene. (02 marks)

(d) Phenol from benzene and sulphuric acid. (03 marks)

(e) Butanone from But – 2 – ene. (2 ½ marks)

(f) Aniline from benzoic acid. (4 ½ marks)

3. (a) Describe how aluminium is extracted from a named ore. (05 marks)

(b) Beryllium and aluminium exhibit diagonal relationship:-

(i) Define the term diagonal relationship. (½ mark)

(ii) Describe five properties in which beryllium and aluminium shows diagonal relationship. (2 ½ marks)

(iii) Explain your answer in (b) (ii). (1 ½ marks)

(c) The atomic numbers and melting points of some period 3 elements are shown in the table below.

Element	Na	Mg	Al	Si	P
Atomic number	11	12	13	14	15
Melting point (°C)	98	650	660	1410	44

(i) Plot a graph of melting points against atomic number. (02 marks)

(ii) Explain the shape of the graph. (05 marks)

(d) Explain how the chlorides of the above elements react with water. (3 ½ marks)

4. (a) Define the term eutectic mixture. (01 mark)

(b) The table below shows melting points of mixtures of various concentrations of tin and lead.

Mole fraction of tin	0.2	0.4	0.7	0.8
Melting point (°C)	280	234	193	206

(i) Draw a fully labeled diagram of the tin – lead system (melting point of pure tin and pure lead are 232°C and 327°C respectively. (05 marks)

(ii) Use the graph to determine eutectic point and composition of eutectic mixture. (02 marks)

(c) Describe what would take place if a mixture containing 0.6 mole fraction of lead is cooled from 400°C to 100°C. (05 marks)

(d) State one application of this eutectic mixture above. (01 mark)

(e) Explain why a eutectic mixture is not considered to be a pure substance or compound. (03 marks)

(f) Sketch a well labeled cooling curve for the liquid mixture cooled in (c) above. (03 marks)

SECTION B

Attempt **TWO** questions only

5. (a) Name a reagent which when treated with each of the following pairs of organic compounds gives similar observations, in each case state what is observed and write equation(s) for the reactions that take place.

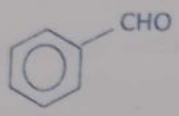
(i) Phenol and phenylamine. (03 marks)

(ii) Propanol and propanone. (03marks)

(iii) Ethanol and ethanoic acid. (03 marks)

(b) Complete each of the following equations and suggest a mechanism for the reaction;

(i) $CH_3C \equiv CH \xrightarrow[N_a/Liq\ NH_3]{CH_3Br}$ (02 marks)

(ii)  $\xrightarrow[r.t]{NaOH(aq)}$ (02 marks)

(c) 1.86g of compound **Z** containing carbon, hydrogen and nitrogen when burnt in oxygen liberates 5.28g of carbon dioxide gas and 224cm^3 of nitrogen gas at s.t.p.

(i) Determine the empirical formular of **Z.** (03 marks)

(ii) When vapourised 0.2g of **Z** occupied 81cm^3 at 184.1°C. Determine the molecular formula of **Z.** (02 marks)

(iii) Z reacts with nitrous acid at 0°C to form a product which reacts with an alkaline solution of 2 – naphthol to form a red precipitate. Write equation(s) for the reaction(s) that take(s) place. (02 marks)

6. (a) Define the term **acidic buffer.** (01 mark)

(b) Describe how an acidic buffer works. (03 marks)

(c) The table below shows variation in pH during titration of 25cm^3 of 0.1M ethanoic acid with sodium hydroxide solution.

Volume of NaOH added (cm^3)	0	4	8	12	16	20	22	22.5	23	24	28
pH of resultant solution	2.8	3.5	4.0	4.5	5.1	5.8	7.0	9.0	10.5	11.4	12.3

(i) Plot a graph of pH against volume of sodium hydroxide added. (03 marks)

(ii) Explain the shape of the graph. (03 marks)

(iii) Determine the pH at end point and rise it to calculate the acid dissociation constant Ka for the ethanoic acid used. (03 marks)

(d) Copper (II) sulphate solution was added to an aqueous solution of sodium benzoate.

(i) State what was observed. (½ mark)

(ii) Explain your observation. (03 mark)

(e) 25cm^3 of 0.1M sodium hydroxide was added to 30cm^3 of 0.1M benzoic acid. Calculate pH of resultant solution (Ka for benzoic acid is 1.8×10^{-5} moldm^{-3}).

(3 ½ marks)

7. Explain each of the following observations.

(a) When magnesium ribbon is dropped into aqueous solution of iron (III) chloride a brown precipitate is formed and bubbles of colourless gas given off. (03 marks)

(b) A mixture of water and benzene (boiling point 80°C) boils at 70°C at 760mmHg. (03 marks)

(c) Fehlings solution can be used to distinguish between methanoic acid and ethanoic acid. (03 marks)

(d) When concentrated hydrochloric acid is added to lead (ii) nitrate solution, a white precipitate is formed soluble in excess to form a colourless solution. (03 marks)

(e) 4 – nitrophenol can be seperated from 2 – nitrophenol by steam distillation. (03 marks)

(f) The ionic conductivities of cesium and lithium ions at $79\Omega^{-1}cm^2\ mol^{-1}$ and $50\Omega^{-1}cm^2\ mol^{-1}$ respectively. (02 marks)

(g) When a saturated solution of sodium bisulphite is added to propanone, a white precipitate is formed. (03 marks)

8. (a) Define the term **Standard Electrode potential.** (01 mark)

(b) Describe three factors which determine magnitude of standard electrode potential. (4 ½ marks)

(c) With aid of a labeled diagram, describe an experiment to determine standard electrode potential of a redox electrode of iron. (05 marks)

(d) The equations for some redox reactions are shown below;

$$2H^+(aq) + 2Fe^{2+} \longrightarrow H_2(aq) + 2Fe^{3+}(aq)$$

$$3Zn_{(s)} + 6\,\bar{O}H(aq) + BrO_3^-(aq) + 3H_2O(l) \rightarrow 3Zn(OH)_4^{2-}(aq) + Br^-(aq)$$

For each of the reactions, write half equation taking place at;

(i) Negative electrode. (01 mark)

(ii) Positive electrode. (01mark)

(iii) For each of the reactions, write the convention or notation made by combining the electrodes. (02 marks)

(e) The standard electrode potentials of lead and magnesium are shown below;

$$Pb^{2+}(aq) + 2\bar{e} \longrightarrow Pb(s)\varepsilon^{\theta} = -0.13V$$

$$Mg^{2+}(aq) + 2\bar{e} \longrightarrow Mg(s)\varepsilon^{\theta} = -2.40V$$

(i) Write cell convention or notation at cathode and anode. (01 mark)

(ii) Calculate e.m.f of the cell and comment on your answer. (2 ½ marks)

(f) An element X has relative atomic mass 162 when 0.579 amperes of current was passed through a salt solution of X for 2 hours, 3.5g of X was deposited at the cathode. Calculate the quantity of charge required to liberate one mole of X. (2 ½ marks)

END