P525/2
Chemistry
Paper 2
July - August 2023
2 ½ hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS 2023

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

Paper 2

2 hours 30minutes

INSTRUCTIONS TO THE CANDIDATES

*This paper consists of two sections **A** and **B**.*

*Attempt any three questions from section **A** and any two from section **B** on the answer sheets provided.*

Illustrate your answers with equations where possible.

Molar volume $R=8.314J\ mol^{-1}K^{-1}$.

Molar volume at s.t.p = $22.4dm^3$.

Begin each question on a fresh page.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Indicate the questions in the grid below.

Where necessary use, Pb=207; Br = 80; Ag = 108; Na = 23; C = 12; O = 16; H =1; P=31; Cl = 35.5

Question						Total
Marks						

SECTION A (60 MARKS)

Answer three questions from this section

1. (a) (i) Define the term colligative property. (01 mark)

(ii) State any two colligative properties other than boiling point elevation. (01 mark)

(b) Describe an experiment to determine the relative formula mass of glucose by boiling point elevation. No diagram is required (09 marks)

(c) An aqueous solution containing 9.0g of glucose ($C_6H_{12}O_6$) in 250 cm^3 of water boils at same temperature as an aqueous solution containing 1.46g of sodium chloride in 250 cm^3 of water. (K_b for water is 0.52°C per mole per 1000kgs).

(1) Calculate the relative molecular mass sodium chloride in water (04 marks)

(ii) State any two assumptions made in (c)(ii) above (01 mark)

(d) Compare your results in (c)(i) above with the theoretical R.F.M of sodium chloride. Explain the differences between the two values (04 marks)

2. Chromium (Atomic number 24) is not only a transition but also a d-block element.

(a) Write the electronic configuration of chromium ($\frac{1}{2}$ mark)

(b) State the reason why chromium is a:

(i) transition element (01 mark)

(ii) d-block element (01 mark)

(c) Both chromium and calcium belong to period 4 of the periodic table but chromium has a higher melting point than calcium. Explain this observation. (02 marks)

(d) (i) State the most common oxidation states of chromium exhibited in its compounds (01 mark)

(ii) Write the formulae of the oxides of chromium formed in each of the oxidation states in d(i) above (02 marks)

(e) Ammonium dichromate is an orange solid. When heated strongly, it decomposes to form a green solid **Q**. **Q**, when fused with potassium hydroxide in presence of oxygen form a yellow solid **W**. **W** dissolves in water to form a yellow solution when dilute sulphuric acid is added to the yellow solution, it turns orange.

(i) Name solid **Q** ($\frac{1}{2}$ mark)

(ii) Write equation(s) leading to the formation of solid **Q** from ammonium dichromate, solid **W** and the orange solution (4 $\frac{1}{2}$ marks)

(f) When potassium nitrite is added to the acidified orange solution in (e), a green solution was formed. Explain. (3 $\frac{1}{2}$ mark)

(g) State what would be the observed and write equation between an aqueous solution of **W** and

(i) acidified hydrogen peroxide in presence of the ether. (02 marks)

(ii) Silver nitrate (02 marks)

3. Write equation and outline a mechanism for the reaction when:

(a) 2-iodo-2-methylbutane is added to aqueous sodium hydroxide and the mixture heated (03 marks)

(b) benzene is reacted with propene in presence of concentrated arthophosphoric acid (3 $\frac{1}{2}$ mark)

(c) hydrogen chloride gas is bubbled through a boiling mixture of ethanol and benzoic acid (05 marks)

(d) cyclohexanone is converted to cyclohexanone hydrazone (05 marks)

(e) Methyl ethanoate is reacted with alcoholic ammonia solution (3 $\frac{1}{2}$ marks)

4. Phosphorus(V) chloride decomposes at high temperature according to the following equation

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

(a) Write an expression for the equilibrium constant , $\mathbf{K_c}$ for the reaction.

(b) Calculate the enthalpy change for the forward reaction above. (The bond energies for CL -CL and P -CL bonds are -242 and -276.6 $kJmol^{-1}$ respectively) (03 marks)

(c) State and explain the effect on the equilibrium position and values of the equilibrium constant for the reaction when

(i) pressure was increased (03 marks)

(ii) temperature was increased (03 marks)

(iii) inert gas was added at constant volume (02 marks)

(d) 82.5g of phosphorus(V) chloride was sealed in a 8,950 cm^3 glass tube and healed up to 450^0C until equilibrium was attained. The tube as quickly broken into an ice-cold excess potassium iodide solution 25.0cm^3 of solution required 38.50cm^3 of 0.025M sodium thiosulphate for complete reaction using starch indicator.

(i) State why the tube was quickly broken into an ice-cold potassium iodide solution. (01 mark)

(ii) Write equation(s) for the reaction(s) that took place (02 marks)

(iii) Calculate the equilibrium constant, K_c for the reaction at 450^0C (04 marks)

SECTION B: (40 MARKS)

Answer any two questions from the section

5. The Elements beryllium, magnesium, calcium, strontium and barium belong to group II of the periodic Table.

(a) Write the general outermost electronic configuration of the elements above ($\frac{1}{2}$ mark)

(b) State and explain the trend in variation of the first ionization energy amongst the elements ($3\frac{1}{2}$ mark)

(c) (i) Describe the reactions of the elements with hydrochloric acid. (04 marks)

(ii) Write equation(s) for the reaction(s) of beryllium and magnesium with nitric acid under different conditions (03 marks)

(d) The table below shows solubility in water of 20^0C and decomposition temperatures at 1 atmosphere of the hydroxides and carbonates of same of the elements respectively

Hydroxide	**$Mg(0H)_2$**	**$Ca(0H)_2$**	**$Sr(0H)_2$**	**$Ba(0H)_2$**
Solubility (g/100g at 20^0C)	**0.002**	**0.15**	**0.9**	**4.0**
Carbonate	**$MgC0_3$**	**$CaC0_3$**	**$SrC0_3$**	**$BaC0_3$**
Decomposition temperature(^{0}C)	**540**	**900**	**1290**	**1360**

Explain the trend in variation of :

(i) solubility of the hydroxides in water. (03 marks)

(ii) thermal stability of the carbonates. (03 marks)

(e) Write equation(s) for the reaction(s) , if possible for the:

(i) hydroxides of the elements with potassium hydroxides ($1\frac{1}{2}$ marks)

(ii) carbonates in (d) above with dilute sulphuric acid ($1\frac{1}{2}$ marks)

6. With the help of the equations and giving necessary conditions, show how each of the following conversions could be effected.

(a) Chlorobenzene to benzamide ($5\frac{1}{2}$ marks)

(b) But-2-ene to nitrobenzene ($5\frac{1}{2}$ marks)

(c) 2-methylpropan-2-ol from ethene ($5\frac{1}{2}$ marks)

(d) Propanoylchloride to propylamine ($5\frac{1}{2}$ marks)

(e) Methylbenzoate to benzene (02 marks)

7. Explain each of the following observations.

(a) An aqueous solution of potassium nitrate has pH 7 whereas an aqueous solution of potassium nitrite has pH above 7 (04 marks)

(b) A mixture of water and carbon tetrachloride boils at a temperature considerably below the boiling point of either liquids (3 $\frac{1}{2}$ marks)

(c) The basic strength of the following compounds id in the order

$$C_5H_5NH_2 < NH_3 < (CH_3)_2NH$$ (05 Marks)

(d) When an aqueous solution of sodium chlorate(I) and lead (II) nitrate was heated, a brown precipitate was formed (3 $\frac{1}{2}$ marks)

(e) Calcium phosphate is less soluble in calcium nitrate solution but more soluble in dilute hydrochloric acid. (04 marks)

8. (a) What is meant by the terms:
   (i) order of reaction (01 mark)
   (ii) half-life of a reaction (01 mark)

(b) The equation for the acid catalyzed reaction between propanone and iodine is:

$$CH_3C0CH_3(aq) + I_2(aq) \longrightarrow CH_3C0CH_2I(aq) + HI(aq)$$

The rate equation for the reaction is Rate = $k[CH_3C0CH_3][H^+]$

Describe an experiment to determine the order of reaction with respect to iodine in the laboratory.

(c) The table below shows the results for the hydrolysis of a bromoalkene, C_4H_9Br. The enthalpy for the reaction is $-160 kJmol^{-1}$

Experiment	$[C_4H_9Br]$ ($moldm^{-3}$)	$[H_2O]$ ($moldm^{-3}$)	Initial rate ($moldm^{-3}s^{-1}$)
1	0.05	0.10	1.0×10^{-5}
2	0.20	0.10	4.0×10^{-5}
3	0.20	0.05	4.0×10^{-5}

(i) Determine the order of the reaction with reasons to explain your answer (04 marks)

(ii) Write the structural formula and name of the alkylhalide. (1 $\frac{1}{2}$ marks)

(iii) Draw a well labelled energy diagram for the reaction. (2 $\frac{1}{2}$ marks)

END