P525 /2
CHEMISTRY
PAPER 2
$2^1/_2$ HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

DEPARTMENT OF CHEMISTRY

SENIOR SIX MOCK EXAMINATIONS 2019

TIME; $2^1/_2$ HOURS

INSTRUCTIONS TO CANDIDATES:

This paper is made up of two sections **A** and **B**

Answer five questions including only ***three*** questions in section A and ***two*** questions in section B

Begin each question on a new page

Where required use the following data;

K=39 Cr =52 O=16 C=12 H=1

SECTION A

(Answer any **three** questions)

(1) (a) Define the following terms;

(i) Lattice energy (1 mark)

(ii) Hydration energy (1 mark)

(iii) Enthalpy of solution (1 mark)

(b) In an experiment to determine the enthalpy of solution, 3.20g of ammonium nitrate crystals were added to $50cm^3$ of water and the temperature of the mixture noted and recorded at different time intervals as shown below;

Time (seconds)	0	30	60	90	120	150	180	210
Temperature (^0C)	25.0	23.25	22.05	21.30	20.80	20.80	21.05	21.60

Plot a graph of temperature against time . (3 marks)

(c) Using your graph in (b) above;

(i) determine the minimum temperature and deduce the maximum temperature change. ($1^1/_2$ marks)

(ii) calculate the molar enthalpy of solution of ammonium nitrate.

(specific heat capacity of solution is 4.2 J $g^{-1}k^{-1}$, density of water =1.0gcm^{-3}) (5 marks)

(d) (i) Compare the magnitude of lattice energy and hydration energy of ammonium nitrate. Give a reason for your answer ($1^1/_2$ marks)

(e) The enthalpy of combustion of ethane, carbon and hydrogen are -1560Kj mol^{-1}, -394.6Kj mol^{-1} and -286Kj mol^{-1} respectively.

(i) Calculate the enthalpy of formation of ethane. ($2^1/_2$ marks)

(ii) State whether ethane is stable or not. Give a reason for your answer. (1 mark)

(f) Using your answer in (d) above and the atomization energies of carbon and hydrogen being +715 and +218 Kj mol^{-1} respectively ,and the bond energy of C–C = 346 Kj mol^{-1} , **calculate** the average bond energy of the C–H bond . ($2^1/_2$ marks)

(2) Explain briefly each of the following observations;

(a) Carbon tetrachloride is immiscible with water however carbon tetrachloride dissolves easily in dimethyl ether. ($3^1/_2$marks)

(b) When ammonium hydroxide solution is added to aqueous solution of manganese (II)sulphate a white precipitate is formed which turns to brown on standing in air. (4 marks)

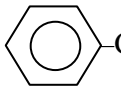
(c) The melting points of the following compounds are in the order

$BaCl_2 > SrCl_2 > CaCl_2 > MgCl_2$ (4 marks)

(d) Pure water boils at 100^0C and benzene at 80^0C at one atmosphere however a liquid mixture of benzene and water boils at a temperature below 80^0C at the same pressure. (4 marks)

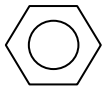
(e) Methanoic acid forms silver mirror when warmed with silver nitrate solution and ammonium hydroxide solution.

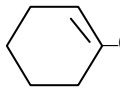
(3) Complete the following organic reactions and outline the possible reaction mechanism.

(a)  $+ \; Cl_2 \xrightarrow{Fe}$ (4marks)

(b) $CH_3CHO + NaHSO_3 \longrightarrow$ (4marks)

(c) $(CH_3)_2C(OH)\,CH_2CH_3 \xrightarrow{ZnCl_2/Conc\ HCl}$ (4marks)

(d)  $+ \; CH_3COBr \xrightarrow{AlCl_3}$ (4 marks)

(e)  $\xrightarrow[warm]{\text{Dilute sulphuric acid}}$ (4 marks)

(4) (a) State Roaults law

(b) A mixture of ethanoic acid and pyridine show negative deviation from Roaults law. (The boiling points of ethanoic acid and pyridine are 118^0C and 123^0C respectively)

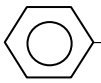
(i) Draw the vapour pressure-composition curve for the mixture of pyridine and indicate the line for ideal behaviour.
(ii) Explain the shape of the curve in relation to Roaults law.
(iii) Mention one other example of liquid mixture that can exhibit this type of deviation.
(c) (i) Draw a corresponding boiling point-composition diagram for the mixture in (b)i above.
(ii) Explain what will happen to the mixture in(c) above containing 70% of ethanoic acid if it is fractionally distilled.
(d) Calculate the composition of the vapour pressure of a solution containing 50.0g of heptane and 35.0g of octane at 20^0C.The vapour pressures of heptane and octane are 47.3 and 140 Pascal respectively.

SECTION B

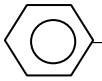
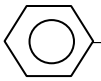
(Answer any **two** questions)

(5)(a) (i)Explain what is meant by the term transition metal element. (1mark)
(ii) Scandium and zinc are d-block elements but are not considered as true transition metal elements. Explain. Zn(30) Sc(21) (3 marks)
(b) To an aqueous solution of chromium (III) chloride was added sodium hydroxide solution drop wise until in excess followed by hydrogen peroxide solution .The mixture was warmed and allowed to cool.
State what was observed and write equation for the reaction that took place. ($2^1/_2$marks)
(c) To the solution formed in (b) was added a few drops of dilute sulphuric acid followed by butan-2-ol and heated. State what was observed and write equations for the reactions that took place. ($4^1/_2$ marks)
(d) To the solution in (c) was added a few drops of concentrated sulphuric acid then followed by 2, 4-dinitro phenyl hydrazine. State what was observed and write equation for the reaction that occurred. (2marks)
(e) **2.0g** of an **impure** sample of potassium dichromate (VI) was dissolved in water and the solution made up to 250cm^3 with water. To 25$cm^3$of the solution was added excess potassium iodide solution then followed by dilute sulphuric acid, and titrated with 0.15M sodium thiosulphate solution. 26.0$cm^3$of the thiosulphate solution was required to reach the end point.
(i) Name the indicator used. (1mark)
(ii)Write half ionic equations for the reactions that occurred . (2marks)
(iii) Determine the percentage purity of the potassium dichromate (VI) sample. (4marks)

(6) (a) The following pair of organic compounds are given;

P  –NH_2 and $CH_3CH_2NH_2$

Q $CH_3COCH_2CH_3$ and CH_3CH_2CHO

R  –OH and  –CH_2OH

For each of the pair of compounds given above ;

(i) Name the reagent which when reacted with each pair will give **similar** observable change. State the observation made. (6 marks)

(ii) Name the reagent that can be used to **distinguish** between the members in the pair. State the observation made. (9 marks)

(c) Write equations to show how the following synthesis can be carried out. Indicate the reagents and conditions necessary.

Methyl benzoate to phenylamine. (5 marks)

(7) (a) Explain what is meant by each of the following terms;

(i) Electrolytic conductivity (1mark)

(ii) Molar conductivity (1 mark)

(b) (i) On same graph sketch curves showing variation in conductivity with concentration for both hydrochloric acid and methanoic acid. (3 marks)

(ii) Explain the shapes of the graphs in (i) above (5 marks)

(c) Molar ionic conductivity of aqueous solutions containing the following compounds are in the order; RbCl > KCl > NaCl (3 marks)

(d) A solution of weak monobasic acid HA of concentration 0.02 mol dm^{-3} has conductivity $0.184\Omega^{-1}m^{-1}$ at 25^0C. The molar conductivity at infinite dilution is $4.0 \times 10^{-2}\Omega^{-1}m^2mol^{-1}$.Calculate

(i) degree of dissociation, (3 marks)

(ii) the dissociation constant K_a for the acid. (3 marks)

(e) State any two applications of conductivity. (1 mark)

(8) Zinc blende is a major ore in extraction of zinc metal and acts as one of the source of material in manufacture of sulphuric acid.

(a)Write equations to show how sulphuric acid can be obtained starting with zinc blende. ($4^1/_2$ marks)

(b) Describe briefly how zinc is obtained from zinc blende. (12 marks)

(c) Compare the reactions of zinc and lead with sodium hydroxide solution. ($3^1/_2$ marks)

END