KIIRA COLLEGE BUTIKI

Uganda Advanced Certificate of Education

CHEMISTRY

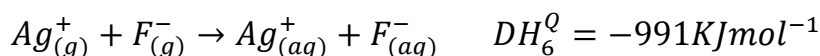**(Principal Subject)**

Paper 2

Use equations where necessary to illustrate your answers

Al = 27, Br = 80, C = 12, H = 1, O = 16

SECTION A

(Answer three questions from this section)

1. (a) State Hess's law of heat summation. (1 mark)\

   (b) Some thermo chemical data for silver, silver Fluoride and Fluorine are given below

   $$F2_{(g)} \rightarrow 2F_{(g)} \qquad DH_1^Q = +158 KJmol^{-1}$$

   $$Ag^+_{(g)} + F^-_{(g)} \rightarrow AgF_{(s)} \qquad DH_2^Q = +278 KJmol^{-1}$$

   $$Ag_{(s)} \rightarrow Ag_{(g)} \qquad DH_3^Q = +278 KJmol^{-1}$$

   $$Ag_{(s)} + \frac{1}{2}F_{2(g)} \rightarrow AgF_{(s)} \qquad DH_4^Q = -203 KJmol^{-1}$$

   $$Ag^{(g)} \rightarrow Ag^+_{(g)} + e^- \qquad DH_5^Q = +731 KJmol^{-1}$$

   $$Ag^+_{(g)} + F^-_{(g)} \rightarrow Ag^+_{(aq)} + F^-_{(aq)} \qquad DH_6^Q = -991 KJmol^{-1}$$

   (i) Draw an energy level diagram for the formation of solid silver Fluoride

   (3 marks)

   (ii) Calculate the first electron ajfinity of Fluoride (2 marks)

   (c) (i) Define the term enthaiph of solution (1 mark)

   (ii) Describe an experiment that can be used to determine the enthalpy of solution of silver Fluoride. (9 marks)

   (iii) Explain energy terms that determine the Magnitude of enthalph of solution of any Ionic salt.

   (iv) Sketch a labeled energy diagram for the dissolution of silver Fluoride.

   (2 marks)

2. An organic compound K, on combustion yielded 8.8g of Carbon dioxide and 1.8g of water 0.1g of K when vapourised at 273°c and 734mm Hg occupied a volume of

$4.46 = 10^{-2}dm^3$.

(a) Calculate

    (i) The empirical formula of K   (2 marks)

    (ii) Molecular formula of K   (3 marks)

(b) Write the structure and IUPAC name of K   (1 mark)

(c) When K was reacted with hot acidified potassium permanganate, compound Q was obtained.

    (i) Identify Q   (1 mark)

    (ii) Discuss the reaction of Q with phenol   (4 marks)

(d) Describe the chemical reactions of the following compounds.

    (i) But-1-ene and acidified water   (4 marks)

    (ii) Nitro benzene with liltium aluminium tetrahydride.   (2 marks)

    (iii) 1-Bromopropane with amixture of possaium hydroxide and propa-1-01

                                                              (3 marks)

3. Describe the reaction of

(a) Sulphuric acid with

    (i) Carbon   (3 marks)

    (ii) Tin   (3 marks)

(b) water with

    (i) Silcon(IV) chloride   (3 marks)

    (ii) Carbon dioxide   (2 marks)

    (iii) Silicon(IV) hydride   (3 marks)

(c) Compare the chemistry of tin with that of lead in relation to the stability and properties of their chlorides   (3 marks)

(d) State what would be observed and write the equation for reaction that would take place if;

    (i) aqueous potassium Iodide is added to a solution of lead acetate.   (1 ½ marks)

    (ii) acidified potassium dichromate is added to an aqueous solution of tin(II) ions.

                                                             (1 ½ marks)
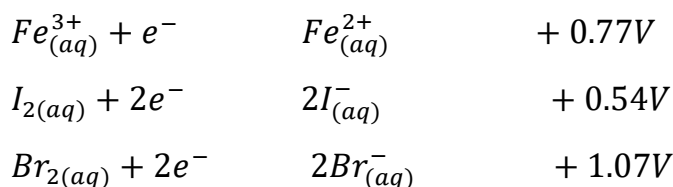
4. (a) (i) State the distribution law   (2 marks)

        (ii) State two limitations of the distribution law   (1 mark)

(b) Describe how partition coefficient for benzoic acid between water and kerosene can be determined. (6 marks)

(c) Industrially, silver is extracted from molten Zinc which is insoluble in lead. The solubility of silver is 300times greater in Zinc than it is in an equal volume of lead. Calculate the percentage of silver extracted from $0.2dm^3$ of solution containing 5.0g of silver by extracting with $0.01dm^3$ of molten Zinc. (5 marks)

(d) 4 grams of an Ore of Zinc was dissolved in excess ammonia and the resultant solution shaken with 200cm3 of trichloromethane. The mixture was allowed to stand to attain equilibrium. 20cm3 of the organic layer required 10cm3 of 0.02M hydrochloric acid for complete neutralization. 20cm3 of the aqueous layer required 9cm3 of 1M hydrochloric acid for complete neutralization. Calculate the percentage of Zinc in the ore.

Given that Zinc(II) ions form a complex of co-ordination number four with ammonia liqands in aqueous layer.

(partition coefficient of ammonia between water and trichloromethane is 25 at room temperature,Zn=65) (6 marks)

SECTION B (40 MARKS)

Answer two questions from this section

5. (a) Explain what is meant by the tem standard electrode potential. (2 marks)

(b) Describe an experiment to determine standard electrode potential of Iron electrode. (7 marks)

(c) Equations for some half cell reactions are shown below:

$Fe^{3+}_{(aq)} + e^-$ $Fe^{2+}_{(aq)}$ $+ 0.77V$

$I_{2(aq)} + 2e^-$ $2I^-_{(aq)}$ $+ 0.54V$

$Br_{2(aq)} + 2e^-$ $2Br^-_{(aq)}$ $+ 1.07V$

State the feasibility of the reactions below using electrode potential values.

(i) Iron(II) and Iodide ions (2 ½ marks)

(ii) Iron(III) and Bromide ions (2 ½ marks)

(d) Distinguish between rate constant and order of reaction. (2 marks)

(e) The following results were obtained in a study of the reaction between Iodide ions and hypochloride ion

EXPT No	$[\bar{O}Cl]$ moldm^{-3}	$[I^-]$ moldm^{-3}	Intial rate moldm^{-3}s^{-1}
1	1.7 x 10^{-3}	1.7 x 10^{-3}	1.75 x 10^4
2	3.4 x 10^{-3}	1.7 x 10^{-3}	3.50 x 10^4
3	1.7 x 10^{-3}	3.4 x 10^{-3}	3.50 x 10^4

      (i) Write the rate equation   (2 marks)

      (ii) Calculate the rate constant for the reaction and state its units.   (2 marks)

6.   (a)   Define the following terms

       (i) solubility   (1 mark)

       (ii) solubility product   (1 mark)

   (b)   (i) Describe an experiment to determine the solubility product of aluminium sulphide.   (5 ½ marks)

       (ii) Derive an expression for the solubility product of aluminium sulphide and give the units.   (1 ½ marks)

   (c)   50cm3 0.13M silvernitrate solution was mixed with 150cm3 of 0.0M sodium sulphate at 20ºc.

       (i) Calculate the Ionic product of silver sulphate at 20ºC   (3 ½ marks)

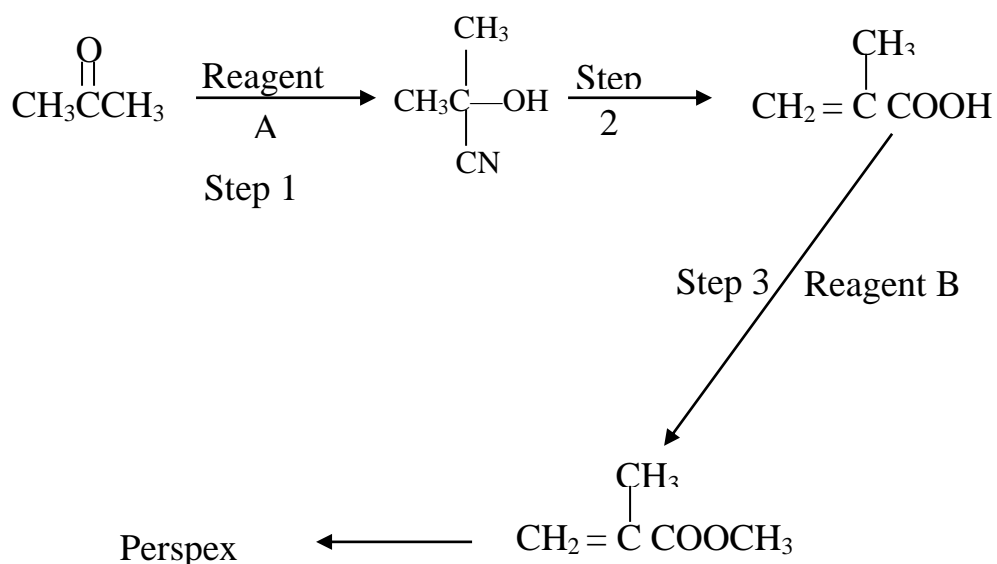   (ii) State whether silver sulphate will be precipitated or not in solution, give areas on for your answer.

       (Solubility product of silver sulphate at 20ºc is 1.7 x 10^{-s}mol^{3}l^3)   (2 marks)

   (d)   Explain the following observations:

       (i) Zinc Sulphide is insoluble in water soluble hydrochloric acid.   (3 marks)

       (ii) A white precipitate is formed when ammonia is added to magnesium sulphate when aqueous ammonia is added to a mixture of magnesium sulphate and ammonium chloride solution.   (4 marks)

7. (a) Write equations to show how the following compound can be synthesized.

     (i) Bromoethane to benzene   (4 marks)

     (ii) Ethanol to 2-methy butan-2-ol.   (4 marks)

     (iii) Ethyne to cyclohex-iene   (5 marks)

(b) The polymer (methyl 2-methyl propenoate) (Perspex) can be made by a process which involves the following reactions.

$$CH_3CCH_3 \ (O) \xrightarrow[A]{Reagent} \ CH_3C(CH_3)(CN)OH \xrightarrow{Step\ 2} \ CH_2=C(CH_3)COOH$$

Step 1

Step 3 / Reagent B

$$CH_2=C(CH_3)COOCH_3$$

Perspex ⟵

     (i) Identify reagent A   (1 mark)

     (ii) Name and outline the mechanism for the reaction in step 1   (2 ½ marks)

     (iii) Name reagent B   (½ mark)

     (iv) Name the type of reaction occurring and give a substance which would act as a catalyst for the reaction in step 3.   (2 marks)

     (v) Draw the structure of Perspex: (1 mark)

8. One property of chromium and Iron as transition metals is their ability to form coloured compounds.

(a) State three other properties of transition metals.   (1 ½ marks)

(b) Outline the reactions that take place in the blast furnace during the extraction of Iron from one of the ores named above.   (7 marks)

(c) Outline the reactions that take place in the blast furnace during the extraction of Iron from one of the ores named above.   (7 marks)

(d) State what would be observed and write equations for the reaction that would take place if sodium hydroxide solution was added drop wise until in excess to the following ions and the mixture allowed to stand for some time.

(i) $Fe^{2+}_{(aq)}$ (4 marks)

(ii) $Cr^{3+}_{(aq)}$ (4 marks)

(e) Explain why aqueous chromium (II) salts are acidic   (2 ½ marks)