CANDIDATE'S NAME.....

SIGNATURE:.....

UGANDA ADVANCED CERTIFICATE OF EDUCATION
END OF TERM II EXAM, 2024
S5 CHEMISTRY
PAPER TWO
2 HOURS 30 MINS

INSTRUCTIONS:

- *Attempt any **three** questions in section **A** and any t**wo** questions in section **B**.*

SECTION A

1. (a)(i) Describe how the molecular mass of a substance can be determined using the freezing point depression method. ***(6 marks)***

(ii) Explain why the method you have described above is not suitable for determining the molecular mass of a polymer. ***(4 marks)***

(b) Calculate the freezing point of a given soluting containing 4.2g of ethane -1, 2-dio1(molecular mass 62) in 30g of water. (Kf of water is 18.6°C mol^{-1} per 100g).
(4 marks)

(c) The osmotic pressure of various concentrations of solute X in methyl benzene at 25°C are given in the table below.

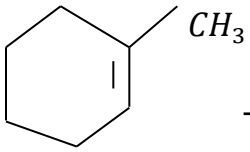
Concentration (gdm^{-3})	1.0	2.0	3.0	4.0	5.0
Osmotic pressure (Nm^{-3})	23	37	53	75	92

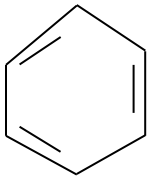
i) Plot a graph of osmotic pressure against concentration. ***(4 marks***)
ii) Use your graph to determine the molecular mass of X. ***(2 marks)***

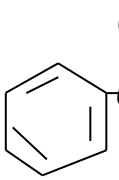
2. Complete the following equations and each case outline a mechanism for the reaction.

a) $CH_3CH = CH_2 \xrightarrow[\text{Warm}]{H^+/H_2O}$ ***(4 marks)***

b) $CH_3\overset{OH}{\overset{|}{C}}HCH_3 \xrightarrow[\text{Heat}]{\text{Con.}H_3PO_+}$ ***(4 marks)***

c)  $\xrightarrow{HBr}$ ***(4 marks)***

d)  $\xrightarrow[ConH_2SO_4/Heat]{+Con.HNO_3}$ ***(5 marks)***

e)  $\xrightarrow{HI}$ ***(3 marks)***

3. Beryllium and its compounds behave differently from the other elements.

a) State the reasons for the anomalous behavior. ***(4 marks)***

b) Explain the reactions of Be, Mg, Ca and Sr with;

i) Air (***6 marks***)

ii) Water ***(6 marks)***

iii) Dilute hydrochloric acid (***4 marks)***

4. (a) Define the following terms;

i) Eutectic temperature ***(2 marks)***

ii) Eutectic mixture ***(2 marks)***

(b) The table below shows the melting points and compositions of various mixtures of cadmium and bismuth.

Percentage of cadmium	20	35	50	65	80	95
Melting point (°C)	226	190	156	184	242	300

Draw a labeled phase diagram for the cadmium-bismuth system. Use your graph to

i) Determine the melting points of pure cadmium and pure bismuth. ***(2 marks)***

ii) Determine the composition and melting point of the eutectic mixture. ***(1 mark)***

iii) Describe what happens when a liquid mixture containing 90% bismuth at 350°C is gradually cooled. **(4 marks)**

iv) Determine the mass of bismuth that crystalized when 20g of the mixture containing 25% cadmium was cooled from 300°C to 168°C. **(4 marks)**

SECTION B

5. (a) Describe the reaction of halogens with

i) Water ***(5 marks)***

ii) Hot concentrated sodium hydroxide solution ***(7 marks)***

(b) (i) Explain why hydrogen fluoride has a higher boiling point than hydrogen iodide. ***(3 marks)***

(ii) Describe how aluminium can be purified from its ore. ***(5 marks)***

6. (a) The solubility of lead (II) sulphate is 1.5 X 10-4mol-1 at 25°C.

i) Write the equation for the solubility of lead (II) sulphate in water ***(2 marks)***

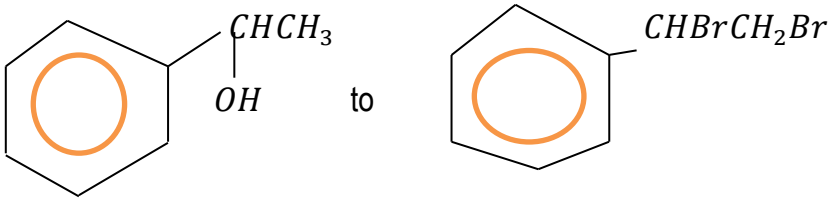
ii) Write an expression for the solubility product constant, Ksp, of lead (II) sulphate. ***(1 mark)***

(b) Calculate the solubility product constant, Kspfor lead (II) sulphate at 25°C. ***(4 marks)***

(c)i) Sketch a graph that would be obtained if hydrochloric acid is titrated with ammonia solution. ***(3 marks)***

(ii) Explain the shape of the graph in (c) above. ***(10 marks)***

7. (a) Write equations to show how the following syntheses can be carried out..

i) 

(4 marks)

ii) CH_3CH_2OH to CH_2BrCH_2Br ***(4 marks)***

(b) Complete the following equations and write the mechanism.

i) $CH_3CH = CH_2 \xrightarrow[CH_3OOCH_3]{HBr}$ ***(4 marks)***

ii) $(CH_3)_2CBrCH_3 \xrightarrow[\text{Heat}]{CH_3CH_2OK/CH_3CH_2OH}$ ***(4 marks)***

iii) $CH_4 \xrightarrow[U.v\ light]{Cl_2}$ **(4 marks)**

8. (a) 15dm^3 of gaseous hydrocarbon X was exploded with 105dm^3 of excess oxygen. The residue gas occupied 75dm^3. On addition of concentrated potassium hydroxide, the volume reduced by 45dm^3. Determine the molecular formula of X. ***(5 marks)***

(b) Describe the phase diagram of sulphur, and explain the position of the line in relation to melting point of sulphur. ***(8 marks)***

(c) 1.86g of compound X contains carbon, hydrogen and nitrogen only. On combustion, X liberated 5.28g of carbon dioxide gas and 224cm^3 of nitrogen at s.t.p.

i) Determine the empirical formula of X. ***(3 marks)***

ii) When vaporized, 0.2g of X occupied 81cm3 at 184.1°C 101325Pa, determine the molecular formula of X. ***(6 marks)***

END