Name: …….....……Signature: …….

P525/2

Chemistry

Time: 2 ½ Hours

KAMSSA JOINT MOCK EXAMINATIONS
Uganda Advanced Certificate Of Education

CHEMISTRY
PAPER 2
2HOURS 30MINUTES

INSTRUCTIONS TO THE CANDIDATES

- *Answer **five** questions including **three** questions in section **A** and any **two** questions in section **B**.*
- *Write the answers in the answer booklet provided.*
- *Mathematical tables and graph papers are provided.*
- ***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 C = 12 , O = 16 , H =1, Molar gas volume is **22.4dm³ at s.t.p,** 1 atmosphere = 101325Nm⁻²*

Question						**Total**
Marks						

SECTION A

(Attempt any **three** questions in this section)

1. a) **0.0627g** of an organic compound **Y** on complete combustion yielded **0.036g** of water. In another experiment **0.0209g** of the same compound yielded **29.88cm^3** of carbon dioxide gas measured at standard conditions of temperature and pressure. Calculate the empirical formula of **Y**. **(06 marks)**

b) Compound **Y** in a) above was steam distilled at 98^{0}C and 760mmHg**,** the distillate was found to contain **72.1%** of water. The vapour pressure of water at **98**^{0}C is **707mmHg.**

i. Deduce the molecular formula of **Y**. **(3$^1/_2$ marks)**
ii. **Y** burns with a sooty flame. Write the possible structure of **Y**. **(01 mark)**
iii. Write equation and suggest a mechanism for the reaction when bromomethane is added to an alkaline solution of compound **Y**. **(2$^1/_2$ marks)**

c) **3.0g** of Zinc ore was dissolved in excess hydrochloric acid. To the products was added excess concentrated ammonia and the solution was then made up to **500cm^3** of water. The resultant mixture was shaken with tetrachloromethane and left to stand. **25cm^3** of the organic layer required **12.5cm^3** of **0.025M** of hydrochloric acid for complete neutralization. **12.5cm^3** of the aqueous layer was neutralized by **20.0cm^3** of **0.25M** hydrochloric acid. Calculate the percentage purity of the Zinc ore.(*Partition coefficient of ammonia between tetrachloromethane and water is **0.04***) **(07 marks)**

2. a) Describe briefly how chlorine is manufactured from brine. **(05 marks)**

b) Write equations to show how chlorine reacts with; **(4$^1/_2$ marks)**

i. Water exposed highly to sunlight.
ii. Dilute sodium hydroxide.
iii. Sodium sulphite solution.

c) The table below shows the hydrides of group (VII) elements and their boiling points.

Period number	2	3	4	5
Hydride	HF	HCl	HBr	HI
Boiling point (^{0}C)	+20	-85	-67	-35

i. Plot a graph of boiling point against period number. **(4$^1/_2$ marks)**
ii. Explain the shape of the graph. **(05 marks)**
iii. Explain the trend in the acidic strength of the hydrides. **(02 marks)**

3. A sweet smelling organic compound **W** has a molecular formula, $C_8H_8O_2$ and it burns with a **sooty** flame.
   a) Write structure formulae and IUPAC names of **W**. **(02 marks)**
   b) When **W** was warmed with dilute sulphuric acid, compounds **X**, C_6H_6O and Y, $C_2H_4O_2$ were formed. A calcium salt of **Y** on strong heating yielded compound **Z** which formed a white crystalline solid on treatment with an acidified solution of sodium sulphite. Identify **W** and write equations leading to the formation of **X** and **Z**.
   (03 marks)
   c) Write the equation and suggest a mechanism for the reaction between
      i. **X** with hot fuming sulphuric acid. **(05 marks)**
      ii. **Z** with acidified hydrazine. **(05 marks)**
   d) Comparing **X** and **2,4,6-trinitrophenol**, name a reagent that can be used to:
      i. identify the major functional group and
      ii. distinguish between the two compounds.
      (*In each case state what is observed if the named reagent is treated separately with the organic compounds*) **(05 marks)**

4. a) The vapour pressures of pure ethanol at **70^0C** are **400mmHg** and **1400mmHg** respectively. The vapour pressure of the mixture at 70^0C is **760mmHg**. Calculate the composition of the liquid mixture at the same temperature. **($3^1/_2$ marks)**

   b) A mixture of benzene and toluene behaves as an ideal solution. The saturated vapour pressure of benzene and toluene at 20^0C are **1000** and **2920Nm^{-2}** respectively. Calculate the composition of the vapour obtained:

      i. From a liquid mixture containing **0.6 mole fraction** of benzene. **($2^1/_2$ marks)**
      ii. When the vapour in (b) i above is condensed and revaporized. **($2^1/_2$ marks)**

   c) The boiling point of water is 100^0C and an alcohol **Y** is 80^0C. A mixture of the two liquids when boiled gives a constant boiling mixture at 78^0C containing **95%** of water.

      i. Define the term constant boiling point mixture. **(01 mark)**
      ii. Using a well labeled diagram, describe what would happen if a mixture containing less than 95% water was fractionally distilled. **($5^1/_2$ marks)**

   d) i. Define the term eutectic mixture. **(01 mark)**

      ii. Bismuth and cadmium form a liquid mixure at 300. Describe what happens when the concentration of bismuth in the mixture is increased. **($1^1/_2$ marks)**

      iii. Determine the mass of bismuth that crystallizes when 200g of the mixture containing 25% cadmium was cooled from 300 to 168 at 38% cadmium. **($2^1/_2$ marks)**

SECTION B

(Attempt any **two** questions from this section)

5. The elements; Carbon, Silicon, Tin and Lead are in group (IV) of the periodic table.

a) Explain the trend in

i. Metallic character. **(02 marks)**

ii. Stability of the +2 oxidation state. **(02 marks)**

b) Describe the reactions of the group (IV) elements with:

i. Bromine

ii. Concentrated sulphuric acid. **($6^{1}/_{2}$ marks)**

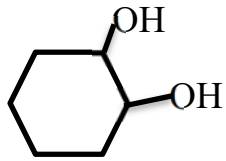
c) Excess chlorine water was warmed with lead (II) nitrate solution.

i. State what was observed and write the equation for the reaction. **(02 marks)**

ii. The mixture from c) i was filtered and the residue warmed with concentrated hydrochloric acid. State what was observed and explain your answer. **(05 marks)**

iii. To a portion of the filtrate from c) i was added drops of aqueous potassium iodide followed by carbon tetrachloride. State what was observed and write the equation for the reaction. **($2^{1}/_{2}$ marks)**

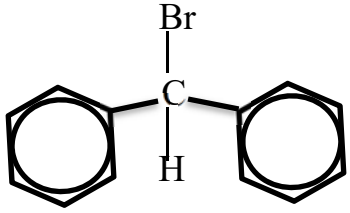
6. Write down equations to show how each of the following compounds can be synthesized. In each case indicate the reagents and conditions for the reactions.

a) 

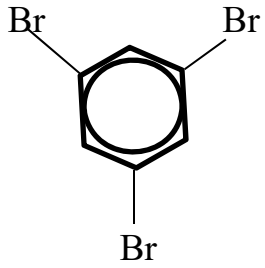
from **Phenol** **(3 ½ marks)**

b) $(CH_3)_2C{=}NNHOH$ from **Methanol** **(3½ marks)**

c) $CH_2{=}C(CH_3)\text{-}COOH$ from **Propene** **(4½ marks)**

d) 

from **Water** **(4½ marks)**

e) 

from **Benzene** **(4½ marks)**

7. a) i. Define the term enthalpy of solution. **(01 mark)**

ii. Describe two energy factors that affect the enthalpy of solution. **(03 marks)**

b) **5.35g** of ammonium chloride were added to **100cm^3** of water in a plastic beaker and the mixture stirred gently with a thermometer. The temperature of the mixture was recorded at different intervals of time as shown below.

Time (s)	0	10	20	30	40	50	60	70
Temperature(^{o}c)	21.0	19.2	18.0	17.4	17.5	17.5	18.4	19.0

i. Plot a graph of temperature against time. **(04 marks)**

ii. Use your graph to determine the molar enthalpy of solution of ammonium chloride. (Density of Water=**1.0g/cm^3**, Specific Heat Capacity of Solution= **4.2jg^{-1}c^{-1}**). State any assumption made. **(06 marks)**

iii. State the effect of increasing temperature on the solubility of ammonium chloride. Give a reason for your answer. **(02 marks)**

c) i. Define the term cryoscopic constant. **(01 mark)**

ii. In how much water should **10.7g** of ammonium chloride be dissolved to obtain a solution with a freezing point at a temperature of **-0.465^{o}c**?

(K_f of water = **1.86^{o}Ckg^{-1}mol^{-1}**) **(03 marks)**

8. Explain the following observations

a) Lead(iv) oxide dissolves in concentrated hydrochloric acid to give a yellow solution from which a yellow solid can be separated on addition of a saturated solution of ammonium chloride. **(4½ marks)**

b) Boron trichloride and phosphorous trichloride have different shapes. **(03 marks)**

c) Alkenes undergo electrophilic addition reactions whereas carbonyl compounds undergo nucleophilic addition reactions. **(04 marks)**

d) The freezing point of a solution of 0.02M ethanoic acid in benzene is higher than that of 0.02M glucose in the same solvent. **(04 marks)**

e) Butan-1-ol when dehydrated by concentrated sulphuric acid at 170^{o}C forms but-2-ene as the major product but not but-1-ene **(4 ½ marks)**

END