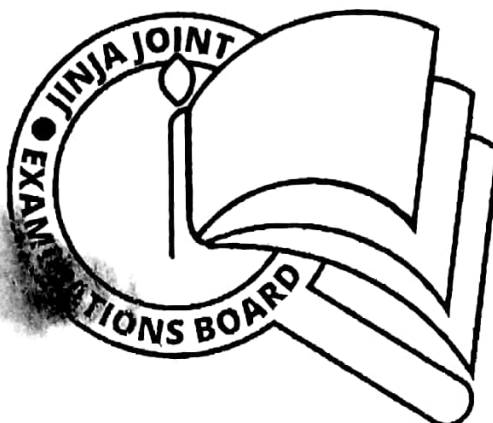P525/1
CHEMISTRY
Paper 1
DECEMBER, 2020
$2\frac{3}{4}$ hours.

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –DECEMBER, 2020

CHEMISTRY

(Principal Subject)

Paper 1

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

Answer **ALL** questions in part **A** and Six questions from part **B**.

All questions are to be answered in the spaces provided.

The Periodic Table with relative atomic masses is provided at the back.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

PART A (46 MARKS)

1. (a) (i) Write the general electronic configuration of group (IV) elements.

($\frac{1}{2}$ mark)

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(ii) State the common oxidation states of group (IV) elements in their Compounds.

(01 mark)

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(b) What is meant by the term inert pair effect?

(01 mark)

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(c) State and explain the trend in inert pair effect down group (IV) elements.

(03 marks)

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2. (a) An aqueous solution containing 5.48 gdm^{-3} of Y has osmotic pressure of 7.093 x 10^4 NM^{-2} at 25^{0}C. calculate the;

(i) Molecular mass of Y

(02 marks)

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End

(ii) Freezing point of solution (freezing point depression constant for water is $1.86^{0}C$ $mol^{-1}kg^{-1}$)
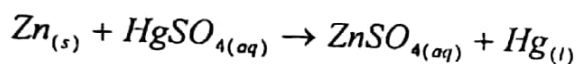
($2\frac{1}{2}$ marks)

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(b) State two assumptions made in the calculation in (a)   (01 mark)

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3. The equation for the redox reaction that occurs in an electrochemical cell is shown below.

$$Zn_{(s)} + HgSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + Hg_{(l)}$$

(a) Write the cell notation   ($1\frac{1}{2}$ marks)

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(b) Write equation for the reaction that takes place at the;
   (i)   Cathode   ($1\frac{1}{2}$ marks)

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   (ii) Anode   ($1\frac{1}{2}$ marks)

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(c) The standard reduction potentials for the half cell reactions at the cathode and anode are +0.6IV and – 0.76V respectively.

Calculate the EMF of the cell   (1½ marks)

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4. (a) Methylbutanoate can be reduced to two alkanols.

Write;

   (i)   The equation for the reduction of methylbutanoate   (01 mark)

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   (ii)   Equation(s) to show how methylbutanoate can be synthesized from one of the alkanols in (i)   (02 marks)

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(b) Name the reagent (s) that can be used to distinguish between butanoic acid and methylbutanoate and state what would be observed if each compound is separately treated with the reagent.   (03 marks)

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5. An aqueous solution contains $80cm^3$ of 0.02M ammonia solution and $60cm^3$ of 0.02M ammonium nitrate.

Calculate the PH of the solution.

(Kb for ammonia = 1.8×10^{-5} moldm^{-3} at 25^0C.)   (4½ marks)

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6. Phosphorous, Silicon and sulphur are some of the elements in the third period of the periodic table.

   (a) Write down the formula of the oxide of each element in its highest oxidation state. $(1\frac{1}{2}$ marks)

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   (b) Write equations for the reactions, if any between the oxides in (a) and water (04 marks)

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7. Write equations to show how the following conversions can be affected.

   (a) Benzoic acid to phenylamine (03 marks)

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   (b) Phenol to methylbenzene (04 marks)

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8. Cobalt forms a complex of formula $Co(NH_3)_5SO_4Br$.
   (a) State the oxidation state and the coordination number for cobalt in the complex. (01 mark)

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   (b) Write the formulae for the ionization isomers of the complex. (02 marks)

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   (c) Name the reagent that can be used to distinguish between the isomers in (b) (01 mark)

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   (d) In each case state what is observed when the isomers are separately treated with the reagent you have named in (c). (02 marks)

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9. (a) Define the term eutectic mixture. (01 mark)

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(b) A cooling curve for a mixture of 25% Sn and 75% Pb that forms a cutectic mixture is given below.
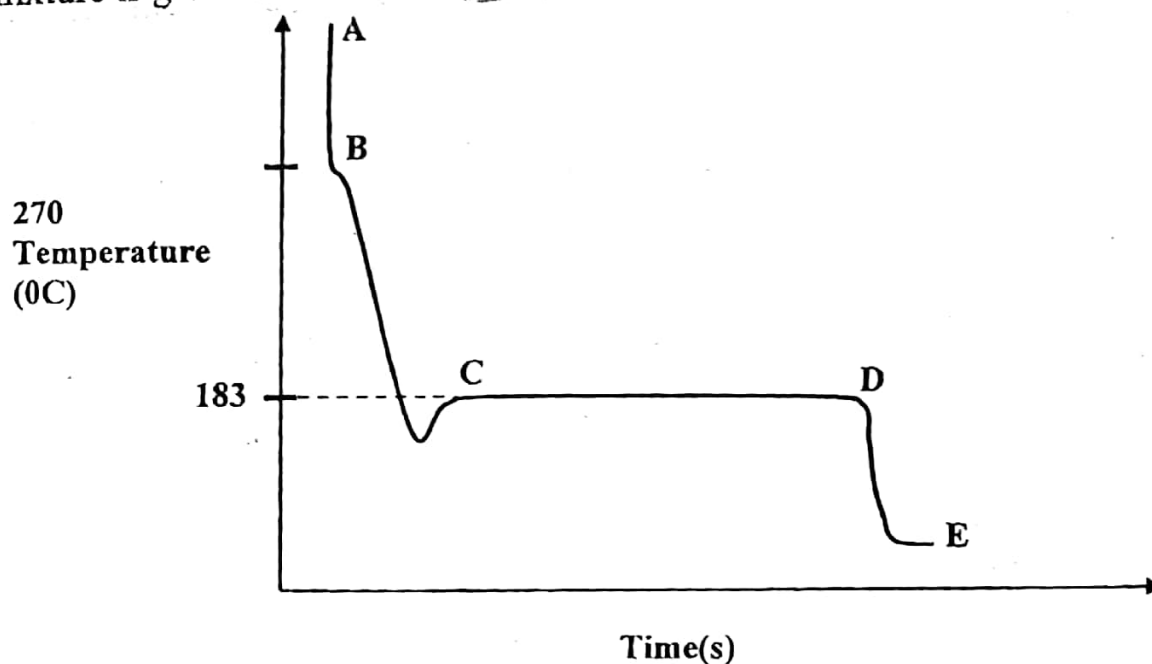
State what happens to the mixture along regions.   (02 marks)

AB;

BC;

CD;

DE;

SECTION B (54 Marks)

10. An amine Z contains 77.42% carbon, 7.52% hydrogen and the rest nitrogen.

    (a) Calculate the empirical formula of Z.   ($2\frac{1}{2}$ marks)

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(b) Determine the molecular formula of Z (the vapor density of Z = 46.5)

(2½ marks)

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(c) Z burns with a sooty flame and reacts with bromine water forming a white precipitate. Identify Z.

(03 marks)

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(d) Write a reaction scheme to show how Z can be synthesized from benzoic acid.

(03 marks)

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11. Explain the following observations.

(a) Carbon dioxide is a gas at room temperature where as silicon (IV) oxide is a solid.

(03 marks)

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(b) When an aqueous solution of silver nitrate is added to a solution containing potassium chloride and potassium chromate (VI) a white precipitate is formed instead of a red precipitate yet K_{sp} of silver chloride is 1×10^{-10} mol^2dm^{-6} and K_{sp} of silver chromate is 1.3×10^{-12} mol^3dm^{-9}. (03 marks)

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(c) Lead (IV) chloride exists where as lead (IV) bromide does not. (03 marks)

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12. The elements beryllium, magnesium and calcium belong to the group II of the periodic table, but beryllium differs in some of its properties from the group members.

(a) State three properties in which beryllium differs from the rest of the group members. (03 marks)

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(b) Give three reasons why beryllium shows different properties from the rest of the group members.
(1 ½ marks)

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(c) Write equations for the reactions between water and the following carbides.

(i) Beryllium carbide
(1 ½ marks)

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(ii) Magnesium carbide
(1 ½ marks)

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(iii) Calcium carbide
(1 ½ marks)

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13. (a) What is meant by the term salt hydrolysis?
(01 mark)

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(b) Sodium sulphide undergoes hydrolysis. Write the;
(i) equation for the hydrolysis of sodium sulphide.
(1 ½ marks)

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(ii) expression for the hydrolysis constant K_h, for sodium sulphide.
(01 mark)

End

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(c) Calculate the PH of a solution containing 3.9 gdm^{-3} of sodium sulphide.
(the hydrolysis constant for sodium sulphide = 1.25 x 10^{-10} $moldm^{-3}$)

$(3\frac{1}{2}$ marks)

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(d) State whether an aqueous solution of sodium chloride is acidic, basic or neutral. (give a reason for your answer)   (02 marks)

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14. (a) Sketch a graph to show how conductivity of an aqueous solution of ammonia varies with concentration.   (02 marks)

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(b) Explain the shape of the graph in (a)   (03 marks)

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(c) Molar conductivities of some electrolytes at infinite dilution at 298K are given in the table below.

Electrolyte	Molar conductivity ($\Omega^{-1}cm^2mol^{-1}$)
Sodium chloride	126.5
Hydrochloric acid	426.2
Sodium hydroxide	248.4

(i)   Use the above data to calculate the molar conductivity of water at infinite dilution at 298K. $(1\frac{1}{2}$ marks)

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(ii)   Calculate the degree of ionization of water at 298K. $(2\frac{1}{2}$ marks)

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(conductivity of water $= 5.5 \times 10^{-3}\Omega^{-1}cm^{-1}$ and 1 mole of water occupies a volume of 18 cm^3)

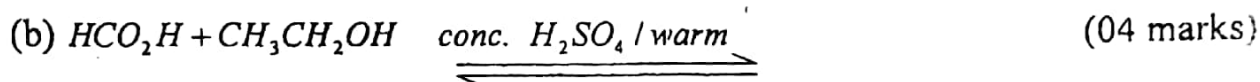15. Complete the following equations and outline the accepted mechanism(s) for the reactions.

(a) $CH_3CH{=\!=\!=}CH_2$ $\xrightarrow{\text{Br}_2/H_2O}$ (03 marks)

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(b) $HCO_2H + CH_3CH_2OH$ $\underset{\longleftarrow}{\overset{\text{conc. } H_2SO_4 / warm}{\longrightarrow}}$ (04 marks)

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(c) CH_3COCH_3 $\xrightarrow{\text{NaCN}/H_2SO_4}$ (02 marks)

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16. (a) State three properties exhibited by copper as a transitional element. $(1\frac{1}{2}$ marks)

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(b) Describe reactions of copper with nitric acid. $(2\frac{1}{2}$ marks)

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(c) An aqueous solution of ethane – 1, 2 – diammine was added to a solution of copper (II) sulphate. $(1\frac{1}{2}$ marks)

(i) State what is observed $(1\frac{1}{2}$ marks)

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(ii) Write equation (s) for the reactions that take place. (01 mark)

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17. (a) Explain what is meant by the following terms.

(i) Rate constant (01 mark)

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(ii) Order if reaction. (01 mark)

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(b) The iodination of propanone in the presence of an acid occurs according to the following equation; $CH_3COCH_3 + I_2 \xrightarrow{H^+} CH_3COCH_2I + HI$

The following Kinetic data was obtained for the above reaction.

Time (s)	0	3600	7200	10800	14400
Concentration of propanone (moldm⁻³)	0.241	0.157	0.105	0.069	0.046

Plot a graph of concentration of propanone against time. (03 marks)

(c) Use the graph to;

(i) Deduce the order of reaction with respect to propanone. (Order of reaction w .r.t iodine is zero). ($1\frac{1}{2}$ marks)

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(ii) Determine the rate constant, K. (2½ marks)

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