P525/1

CHEMISTRY

Paper 1

$2\frac{3}{4}$ Hours

S.5 MID TERM III

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CONDIDATES:

Answer **all** questions in section **A** and **six** Questions in section **B**

All answers must be answered in the spaces provided

The periodic Table, with relative atomic masses is provided.

Illustrate your answers with equations where applicable

Where necessary, use the following:

Molar gas constant R = $8.31JK^{-1}mol^{-1}$

Standard pressure = $101325Nm^{-2}$

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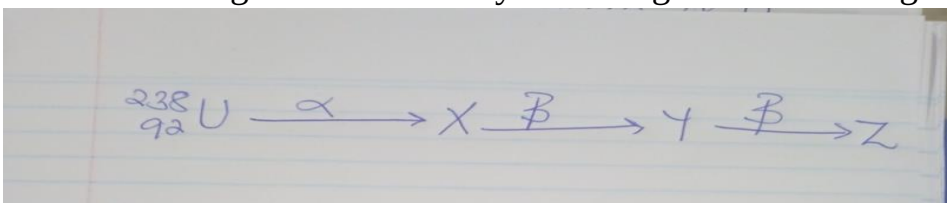
SECTION A (46)

Answer all questions from this section

1) Uranium undergoes nuclear decay according to the following equation



a) Identify the species X, Y, and z (03 marks)

X

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Y

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Z

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b) 10g of Uranium was left to decay. Calculate the mass of Uranium that remained after 2.9×10^9 years. (The half-life of Uranium-238 is 4.5×10^9)
(03 marks)

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2) Complete the following equations and write the acceptable mechanism in each case.

a) $CH_3CH_2CH(OH)CH_3 \xrightarrow[\text{heat}]{\text{conc } H_2SO_4}$ $(2\frac{1}{2} marks)$

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b)  $\xrightarrow[\text{Heat}]{\text{Conc } H_2SO_4}$

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3) Draw the structure and name the shape of the following species.
(04 marks)

Species	Structure	Shape
$NO2^-$		
SF4		
$(CH_3)_3N$		
PCl5		

4) Write equation for the reaction between aqueous sodium hydroxide and

a) Beryllium oxide $(1\frac{1}{2} marks)$

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b) Aluminum oxide $(1\frac{1}{2} marks)$

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C) Sulphur(iv) oxide $(1\frac{1}{2} marks)$

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5. a) State

i) Raoult's law (01 mark)

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ii) two conditions under which the law is valid (01mark)

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b. The vapour pressure of heptane and octane are 473.2Pa and 139.8Pa respectively at 20^{o}c. Calculate:

i) the vapour pressure of the mixture containing 0.5 moles of heptane and 0.25 moles of octane at 20^{o}c (assume that the two liquids form an ideal solution) (2 marks)

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ii) the composition of the vapour (01 mark)

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6. Substance A and B react according to the equation

A + B $\longrightarrow$ C + D

The data below shows initial concentrations of A and B and their initial rates of reaction in three different experiments.

Exp	[A](moldm-3)	[B](moldm-3)	Initial rate(moldm-3)
1	2.0×10-1	2.0×10-1	0.00035
2	4.0×10-1	4.0×10-1	0.0014
3	8.0×10-1	4.0×10-1	0.0056

a) Determine the order of reaction with respect to:

i) A ($1\frac{1}{2}$marks)

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

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b) Write experimental rate equation for the reaction (01mark)

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c) Determine overall order of reaction. (01mark)

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d) Calculate the value for the rate constant of the reaction and state its units ($1\frac{1}{2}$ marks)

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7) a) Explain the term disproportionation reaction (3 marks)

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b) Calculate the oxidation state of Manganese in;

i) MnO42- ($\frac{1}{2}$marks)

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ii) MnO4- ($\frac{1}{2} marks$)

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iii) MnO2 $(\frac{1}{2} marks)$

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c) Chlorine gas was bubbled through an aqueous solution of potassium manganate (VI)

i) state what was observed? $(1\ marks)$

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ii) write equation for the reaction that takes place. $(1\frac{1}{2} marks)$

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8) By means of equations only, show how the following conversions can be effected.

a) CH3CH(OH)CH3 to 1-bromoproprane $(2\frac{1}{2} marks)$

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b) CH3COCH3 from propene $(2\frac{1}{2}marks)$

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9) 25cm^3 of a gaseous hydrocarbon K was exploded with 200cm^3 of oxygen. On cooling to room temperature, the residual gases occupied 150cm^3. After shaking with concentrated potassium hydroxide solution, the final volume was 50cm^3.

a) Determine the molecular formula of K $(3marks)$

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b) Write the structural formulae of all possible isomers of K and give their IUPAC names $(2marks)$

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SECTION B (54 MARKS)

Answer only six questions from this section.

Any additional question(s) answered will not be marked.

10) a) An organic compound M contains carbon 80%, hydrogen 6.7% and the rest being oxygen. Determine the formula of M $(2\frac{1}{2} marks)$

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b) 0.5g of M when vaporized at 150ºC and 760mmHg occupied 144.6cm^3.

i) Determine the molecular mass of M and hence its molecular formula.

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

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ii) Write the structures of all possible isomers of P. $(1 marks)$

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c) M burns with a yellow sooty flame, forms a yellow orange precipitate with Brady's reagent and also reacts with iodine in sodium hydroxide to forma yellow precipitate. Write the structure of M. $(01 mark)$

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d) Write equation for the reaction between M and Brady's reagen

$(01 mark)$

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11) a i) Name the ore used in the extraction of Aluminium $(\frac{1}{2} marks)$

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ii) Write the formula of the ore named in a(i) above $(\frac{1}{2} marks)$

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b) During the extraction process of Aluminium, the ore is treated with hot concentrated sodium hydroxide solution.

i) Briefly state what happens to the ore when treated with sodium hydroxide solution $(02 marks)$

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ii) Write equations for the reactions that take place in b(i) $(2\frac{1}{2} marks)$

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C) The soluble complex of aluminium obtained in (b) is taken by through several reactions to form pure aluminium oxide.

i) State how the purified aluminium oxide is treated to form pure aluminium. $(1\frac{1}{2} marks)$

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ii) Write equation for the reaction that takes place. $(02 marks)$

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12 a) Define the following terms:

i) Standard heat of formation of a substance $(01 marks)$

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ii) lattice energy $(01 marks)$

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c) The standard heat of formation of phosphorus trichloride is -306kjmol^{-1}. The bond dissociation energy of phosphorus and chlorine are 314 and 242kjmol^{-1} respectively.

i) Draw a Born-Haber cycle for the formation of phosphorus trichloride. $(02marks)$

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ii) Use your cycle to calculate the P-Cl bond energy $(02marks)$

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d) Calculate the standard heat of formation of ethane if the standard heats of combustion of graphite, hydrogen and ethane are 402, 285 and 1395kjmol-1 respectively. $(03marks)$

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13) Write equations to show how the following synthesises can be carried out in each case indicate the reagents and conditions necessary.

a) Propanone from 1-bromopropane $(04marks)$

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b) Propan-1-ol to propane $(3\frac{1}{2}marks)$

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c) Cyclohexanone from bromo cyclohexane
$(1\frac{1}{2} marks)$

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14 a) State;

i) What is meant by the term diagonal relationship $(01 marks)$

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ii) four properties in which beryllium and aluminium show diagonal relationship. $(04 marks)$

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b) Give a reason why the elements exhibit diagonal relationship $(01 marks)$

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c) Write equation(s) for the reaction(s) between water and

i) beryllium carbide $(1\frac{1}{2} marks)$

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ii) Calcium carbide $(1\frac{1}{2} marks)$

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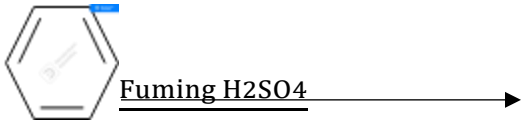
15). Complete the following reactions and in each case write a mechanism.
(03 Marks each)

a) 

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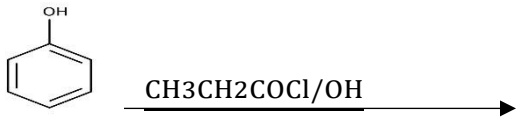
b 

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C) (CH3)2CHCOCH3 $\xrightarrow{NaHSO3}$

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16 a) Define the terms;

i) Eutectic point $(01marks)$

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ii) Eutectic mixture $(01marks)$

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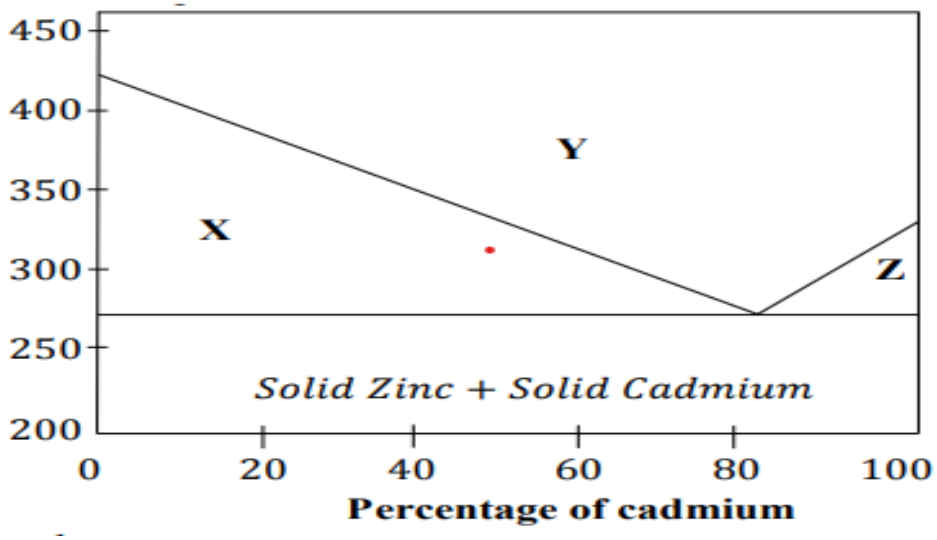
b) The diagram below is a temperature – composition diagram for Zinc – Cadmium mixture



Use the graph to;

i) determine the eutectic point of the system (01 marks)

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ii) Name the phases in the regions X, Y and Z $(1\frac{1}{2} marks)$

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iii) estimate the melting points of zinc and cadmium $(01 mark)$

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IV) Describe the changes that take place when a mixture containing 80% Zinc is cooled from 450ºC to 250ºC $(3\frac{1}{2}marks)$

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17) Name a reagent that can be used to distinguish between the following pairs of ions. In each case, state what would be observed if each ion is separately treated with the reagent you have named.

a) Ba^{2+} and Ca^{2+} $(03marks)$

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b) Br^{-} and Cl^{-} $(03marks)$

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C) $CH_3CO_2^-$ and $C_2O_4^{2-}$ $(03marks)$

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END