Name .....Centre/Index No...../.....

Signature .....

P525/1
CHEMISTRY
Paper 1
August, 2022
$2\frac{3}{4}$hours.

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –AUGUST, 2022

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)

Attempt all questions in this section

1. (a) Complete the following nuclear transformation reactions. (3 marks)

(i) $^{239}_{94}Pu + {}^{1}_{o}n \rightarrow {}^{86}_{34}Se + {}^{150}_{60}Nd \pm$ ___

(ii) $^{242}_{96}Cm + {}^{4}_{2}He \rightarrow$ _____

(iii) $^{235}_{92}U + {}^{1}_{o}n \rightarrow {}^{148}_{57}La + 3{}^{1}_{0}n +$ _____

(b) Francium isotope ($^{223}_{87}Fr$) emits beta particles at a rate of 14.0 counts per second. The rate of emission decreased by 6.5 counts per second in 80 seconds. Calculate the half life of the isotope. (2 ½ marks)

2. The thermochemical data for some process are given in the table below.

Process	$\Delta H^{\sigma}(KJmol^{-1})$
$Rb_{(s)} \longrightarrow Rb_{(g)}$	+78
$Rb_{(g)} \longrightarrow Rb^{+}_{(g)} + e^{-}$	+402
$F_{2(g)} \longrightarrow 2F_{(g)}$	+160
$Rb^{+}_{(g)} + F_{(g)} \longrightarrow RbF_{(s)}$	-762
$F_{2(g)} + 2Rb_{(s)} \longrightarrow 2RbF_{(s)}$	-1104

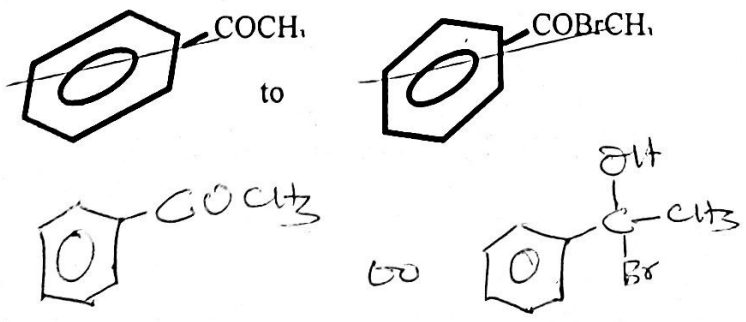
(i) Use the above data to calculate the first electron affinity of fluorine.

(3 marks)

(ii) The first electron affinity of oxygen is -142KJmol^{-1} whereas the second electron affinity is +791 KJmol^{-1}. Explain this observation. (2 marks)

3. Write equations to show how the following conversions can be effected.

(i) (2 marks)



(ii) CH_3CHO to $CH_3CH=CH_2$ (2 ½ marks)

4. (a) Write equation for the reaction between phosphorus and aqueous sodium hydroxide solution. (1 ½ marks)

(b) Compound G, contains 56.4% phosphorus the rest being oxygen.

(i) Calculate the molecular formula of G

(molar mass of G is 110) (3 ½ marks)

(ii) Write equation for the reaction between G and water. (1 ½ marks)

5. (a) Define the term solvent extraction. (1 mark)

(b) An aqueous solution contains 10g of hydroxybenzene per litre. When $100cm^3$ of this solution is shaken with $20cm^3$ of ether, the layer extracts 0.8g of hydroxybenzene. Calculate the mass of hydrobenzene extracted when $500cm^3$ of aqueous layer was shaken with $50cm^3$ of ether. (3 ½ marks)

(c) State one other application of the partition law. (½ mark)

6. (a) Nylon 6,6 is formed by reacting 1,6-diamino hexane and hexane-1,6-dioic acid.

(i) Write equation for formation of nylon-6,6. (1 mark)

(ii) State the type of polymerization involved in the formation of nylon-6,6. (1 mark)

(b) (i) The osmotic pressure of a solution containing $2gdm^{-3}$ of nylon 6,6 at 25°c was 20308 NM^{-2}.

Calculate the relative molecular mass of nylon 6,6. (2 ½ marks)

(ii) State one use of nylon 6,6. (½ mark)

7. (a) Write equation for solubility of silver phosphate in water. (1 ½ marks)

(b) The conductivity of a saturated solution of silver phosphate at 25°c is $2.661 \times 10^{-6} scm^{-1}$ and that of pure water is $1.519 \times 10^{-6} scm^{-1}$. Calculate the solubility of silver phosphate at 25°c. (The molar ionic conductivities of silver ions and phosphate ions at infinite dilution at 25°c are 61.9 and $240 Scm^2 mol^{-1}$ respectively) (3 ½ marks)

8. Although Boron is in group III of the periodic table, it resembles silicon which is in group IV in some of its properties.

(a) (i) State three properties in which boron resembles silicon. (3 marks)

(ii) Give one reason for anomalous behavior of boron. (1 mark)

(b) State conditions for the reaction between silicon and water. Write equation for the reaction.

Condition (1 mark)

Equation (1 ½ marks)

9. The molecular formula of compound R, is C_8H_8O. R burns with a luminous flame and forms a yellow precipitate with 2,4-dinitrophenylhydrazine solution.

(a) Write the structural formulae of all the possible isomers of R. (1 mark)

(b) R reacted with tollen's reagent on warming to form a silver mirror.

(i) Identify R. (½ mark)

(ii) Write equations to show how R can be synthesized from an alkene. (3 marks)

10. (a) Define the term azeotrope. (1 mark)

(b) (i) State three reasons why azeotrope is a mixture and not a compound. (1 ½ mark

(ii) Name two methods for separating azeotropic mixtures into pure components.

(1 mark)

(c) The total vapour pressures of a mixture of propanone and trichloromethane and the mole fraction of trichloromethane at constant temperature are given in the table below.

Mole fraction of $HCCl_3$	0.0	0.2	0.4	0.6	0.8	1.0
Total vapour pressure of mixture (mmHg)	347	305	267	244	256	293

(i) Plot a graph of total vapour pressure of the mixture against the mole fractions of trichloromethane. (3 marks)

(ii) Use the graph you have drawn to determine the composition of the azeotrope. (1 mark)

(d) State how the mixture in (c) deviates from raoults law.
Give a reason for your answer. (1 ½ marks)

11. Beryllium and magnesium are some of the elements in group II of the periodic table.

(a) Write the equation for reaction between water and the carbide of;

(i) Beryllium (1 ½ marks)

(ii) Magnesium (1 ½ marks)

(b) A sample of nitrogen gas completely reacted with heated magnesium to product E. E reacted with water and all the ammonia gas produced was absorbed in 50cm3 of 0.05M sulphuric acid. 12.5cm3 of 0.1M sodium

hydroxide solution was required to completely neutralize the remaining acid. Write equation for the reaction between;

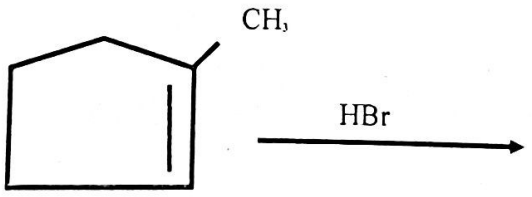
(i) Nitrogen gas and magnesium. (1 mark)

(ii) E and water. (1 ½ marks)

(c) Calculate the volume of nitrogen gas at s.t.p that reacted with magnesium. (4 ½ marks)

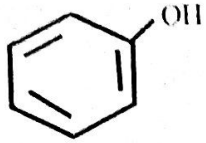
12. Complete the following equations and in each case, outline the mechanism for the reaction leading to formation of major product.

(a)



(3 marks)

(b) $(CH_3)_3CCl$ $\xrightarrow[\text{Heat}]{\text{EtO-/EtOH}}$ (3 marks)

(c)  + CH_3COBr $\xrightarrow{\bar{O}H_{(aq)}}$ (3 marks)

13. (a) A compound T contains 14.8% carbon, 1.8% hydrogen 19.7% oxygen and the rest being lead. (2 ½ marks)

(i) Calculate the empirical formula of T.

(ii) Determine the molecular formula of T.
(relative molecular mass of T is 325) (1 ½ marks)

(b) When T was heated, a colourless vapour with a ~~vinegar~~ sweet smell was given off. Identify T. (½ mark)

(c) T was dissolved in water and the resultant solution was divided into two portions.

(i) To the first portion, was added a few drops of neutral iron(III) chloride solution. State what was observed and write the equation for the reaction. (2 marks)

(ii) To the second portion was added dilute surphuric acid and mixture warmed. State what was observed and write the equation for the reaction. (2 ½ marks)

14.(a) (i) Write the electronic configuration of chromium. (½ mark)

(ii) State the common oxidation states exhibited by chromium in its compounds. (1 mark)

(b) An aqueous solution of a chrome alum ($K_2SO_4.Cr_2(SO_4)_3.24H_2O$)) was prepared and divided into two portions.
In each case state what is observed and write equation(s) for the reactions that take place when;

(i) The first portion was reacted with sodium carbonate solution. (2 ½ marks)

(ii) To the second portion 2-3 drops of sodium hydroxide solution was added followed by hydrogen peroxide. (2 ½ marks)

(c) To the resultant solution in b(ii) was added a few drops of dilute sulphuric acid. State what is observed and write equation for the reaction(s) that takes place. (2 ½ marks)

15.(a) State three factors that can affect solubility of salts. (1 ½ mrks0

(b) The solubilities of some of the group (II) metal sulphates are given in the table below.

Sulphate	Solubility at 10°c in g/100g of H_2O
$Mg\ SO_4$	30.9
$CaSO_4$	0.192
$SrSO_4$	0.104
$BaSO_4$	0.00265

(i) State how the solubility of Sulphates vary. (½ marks)

(ii) Explain your answer in (i) (3 marks)

(c) Lead (II) chloride is sparingly soluble in water and insoluble in ethanol whereas Lead (IV) chloride readily dissolves in ethanol and insoluble in water. Explain the observation. (4 marks)

16.(a) State three characteristics of a chemical equilibrium. (1 ½ marks)

(b) Nitrogen and hydrogen react to form ammonia according to the following equation.

$3H_{2(g)} + N_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad . \Delta H = -92KJmol^{-1}$

Write;

(i) Three industrial optimum conditions used to obtain maximum yield of ammonia. (1 ½ marks)

(ii) Equations for conversion of ammonia to nitric (V) acid. (3 marks)

(c) When a mixture of nitrogen and hydrogen in the ratio of 1:3 by volume was reacted at 250°c, the equilibrium mixture was found to contain 30.5% nitrogen.

Calculate the;

(i) Molar concentration of ammonia (1 ½ marks)

(ii) Equilibrium constant, Kc at 250°c for the reaction that takes place. (1 ½ marks)

17. State what would be observed and write equation for the reaction that would take place when;

(a) Dilute sulphuric acid is added to potassium maganate (VI) solution. (2 ½ marks)

(b) A mixture of ethanol and benedicts solution is heated. (2 marks)

(c) Hydrogen peroxide is added to acidified ferrous sulphate solution. (2 ½ marks)

(d) Aqueous solution of iodine and sodium hydroxide is warmed with propan-2-ol. (2 marks)

THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 TI 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

END.