NAME: ……SIGNATURE: ……

P525/1
Chemistry
Theory
2¾Hours

MIDLAND HIGH SCHOOL

UGANDA ADVANCED CERTIFICATE OF EDUCATION

MID TERM EXAMINATION

CHEMISTRY

(PRINCIPAL SUBJECT)

PAPER 1

2 HOURS 45 MINUTES

INSTRUCTIONS TO CANDIDATES:

- Answer all questions in section **A** and **six** questions in section **B**.
- The questions must be answered in the space provided.
- The periodic table is provided at the back of the paper.
- Mathematical calculators (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.
- Where necessary, use:

Gas constant R=8.314J/mol/k, standard pressure=101325Nm^{-2} =760mmHg, 1 mole of a gas occupies a volume of 22.4dm^3

For examiner's use only																
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.

SECTION A (46 MARKS)

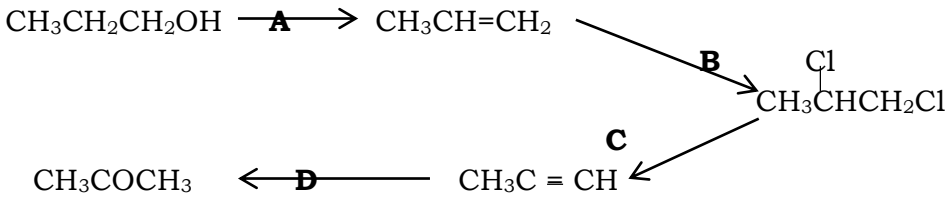
(Attempt all questions)

1. a) What is meant by the term standard enthalpy of neutralization (01mark)

b) Explain why the value for heat of neutralization of a cyanic acid base is not a constant value of around -57kjmol^{-1}. (02marks)

c) 250cm^3 0f 0.40M sodium hydroxide solutions were added to 250cm^3 of 0.40M hydrochloric acid in a calorimeter of 500g and specific heat capacity of 400jkg^{-1}k^{-1}. All the three were initially at 17.05^{o}c and the temperature rose to 19.55^{o}c. (Assuming that the specific heat capacity of the two solutions is 4.2jg^{-1}k^{-1}) calculate the standard enthalpy of neutralization (04marks)

2. Propanone can be prepared from propan-1-ol according the scheme below.



Identify the reagent A, B, C and D and state the condition(s) for the reaction in each case. (06marks)

	Reagent	**Condition(s)**
A		
B		
C		
D		

3. An iron chloride contains 34.5% iron and 65.5% chlorine. When 0.6 of the chloride of iron were strongly heated in a sealed tube of volume 200cm^3 to a temperature of 600k, the pressure exerted was found to be 4.6x10^{4}pa.

a) Calculate the molecular formula of the iron chloride. (03marks)

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b) Draw the structure of the chloride in a gaseous phase. (01mark)

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

   a) Ethene to propyne (02½ marks)

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   b) CaO to Benzene (02½ marks)

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5. a) State the oxidation state of the central atom in each of the following complex ions and in each case, give the name of the complex ion. (03marks)

Complex ion	Oxidation state of the central atom	Name of the complex ion
$[CuBr_4(H_2O)_2]^{2-}$		
$[Al(OH)_4(H_2O)_2]^{1-}$		
$[Co(NH_3)_4Cl]^{+}$		

b) State 2 reasons why zinc is a d-block element but not a transition element (01marks)

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6. a) State the two colligative properties. (01marks)

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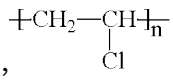
b) A solution of 0.4% polyvinyl chloride,  in dioxin has an osmotic pressure of 65pa at 20^0c

i) Calculate the relative formula mass of the polyvinyl chloride (02marks)

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ii) Determine the number of monomer units in the polyvinyl chloride. (02marks)

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7. Beryllium exhibits unique properties from the rest of the group (ii) elements.

   a) Explain what is meant by the term anomalous behavior (01mark)

   _____

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   b) What 2 anomalies does beryllium show among group ii elements (01marks)

   _____

   _____

   _____

   _____

   c) Give one properties to show that beryllium is anomalous from the group ii elements. (01mark)

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8. a) Concentrated nitric acid reacts with benzene to form a yellow oily liquid. State the condition under which the reaction occurs and give the IUPAC name of the yellow oily liquid. (01mark)

   Condition: _____

   IUPAC name: _____

   b) Outline the mechanism for the reaction between nitric acid and benzene in presence of the conditions given. (02marks)

c) Show how that yellow oily liquid can be converted to phenol (02marks)

9. a) Explain what is meant by the term **isotopes**. (01mark)

b) Bromine has relative atomic mass of 79.9 and consists of two isotopes $^{79}_{35}Br$ and $^{81}_{35}Br$. Determine which of the two isotopes is the most abundant. ($2^1/_2$ marks)

c) Sketch the mass spectrum for bromine. ($1^1/_2$ marks)

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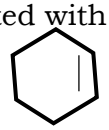
SECTION B (54 MARKS)

(Attempt any 6 questions in this section)

10. Name **one reagent** that can be used to distinguish between each of the following pairs of compounds. In each case, state what is observer if each member of the pair is treated with the reagent? (03 marks each)

(a)  and 

Reagent: _____

Observation:

_____

_____

(b) But-1-yne and But-2-yne

Reagent: _____

Observation:

_____

_____

(c) Propyne and propene

Reagent: _____

Observation:

11. a) Write an equation for the reaction between acidified potassium dichromate(vi) and potassium iodide solution. (01½marks)

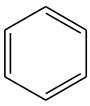
b) 1.015g of potassium dichromate (vi) were dissolved in 100cm^3 and the solution made up to the mark in a 250cm^3 volumetric flask with distilled water. A 25cm^3 portion of the solution was added to excess 10% potassium iodide solution followed by 1.5M sulphuric acid and the iodine liberated required 19.2cm^3 of sodium thiosulphate solution in presence starch indicator. Calculate;

(i) The number of moles of iodine liberated in 25 cm^3 (03marks)

(ii) The concentration in moldm^{-3} of sodium thiosulphate. (04½marks)

12. Complete the following equations and in each case outline a suitable **mechanism** for the reaction.

a. $CH_3CH_2C{\equiv}CH \xrightarrow{2HBr}$ ..... (03 marks)

b.  + $Conc.H_2SO_4 \xrightarrow{Conc.HNO_3}$ ..... (02 ½ marks)

c. $C(CH_3)_3Br \xrightarrow[\text{Heat}]{NaOH_{(aq)}/CH_3CH_2OH}$ ..... (03½ marks)

13. A compound **R** on complete combustion yielded 8.8g of carbon dioxide and 1.8g of water. 0.1g of **R** when vaporized at 273^{o}c and 734 mmHg occupied a volume of 4.46×10^{-2} dm^3

a) Calculate

i) the empirical formula of **R**. (02marks)

ii) Determine the molecular formula of **R**. (02marks)

b) When **R** was ozonolysed followed hydrolysis. Compound **S**, a ketone was formed. Write the structure and IUPAC name of **R** (01mark)

c) Write the equation and mechanism between **R** and hydrogen bromine (03 marks)

14. Methane reacts with steam according to the following equation:

$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)}$ $H_r = ?$

The enthalpy of formation of methane, water & carbon dioxide gas are -76, -242 & -394KJ/mol.

$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$ ΔH_f -76KJ/mol

$H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$ ΔH_f -242KJ/mol

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ ΔH_f -394KJ/mol

a) Calculate the enthalpy of reaction (03 marks)

$CH_{4(g)} + 2H_2O_{(l)} \longrightarrow CO_{2(g)} + 4H_{2(g)}$

c) (i) Define the **order of reaction**. (01 mark)

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e) The experimental results in the table were obtained for the reaction between nitrogen monoxide gas and oxygen gas.

$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$

Initial concentrations (mol/dm^3)		Rate of reaction ($mol/dm^3/s$)
NO	O_2	
0.03	0.03	2.7×10^{-5}
0.03	0.06	5.5×10^{-5}
0.06	0.03	10.8×10^{-5}

(i) Determine the **order of reaction** with respect to:
Nitrogen monoxide. (01 mark)

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(ii) Oxygen. (01 mark)

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(iii) Write the **rate equation** for the reaction. (01 mark)

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d) Calculate the:

i) Overall order of reaction. (01mark)

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ii) **Rate constant** for the reaction and **state it's S.I unit** (01mark)

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15. a) State the essential conditions and give the IUPAC name for the product formed when chlorine; (0 ½ marks each)

i) Is added to benzene

Conditions;

_____

Name of the product

_____

ii) Substitutes a hydrogen atom of benzene

Conditions;

_____

Name of the product

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iii) Reacts with cyclohexene

Conditions;

_____

Name of the product

_____

b) Outline the mechanism for the reaction in (03marks)

(i) a) ii)

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(ii) a) iii)

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16. The boiling point of pure water in 100^{o}c at 760mmHg pressure. At the same pressure, a solution containing 1.576g of potassium chloride in 100g of water boils at 100.11^{0}c.

a) Calculate the boiling point constant, Kb for water

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b) Explain why;

(i) The boiling point of potassium chloride solution is higher than that of pure water. (03 marks)

(ii) A 0.1M potassium chloride solution boils at the same temperature as a 0.2M glucose solution. (2 ½ marks)

17. The table shows the atomic radius and first ionization energy of some elements in period 3 of the periodic table.

Elements	Na	Mg	Al	Si	P	S	Cl
Atomic radius	0.186	0.160	0.143	0.117	0.110	0.104	0.099
1^{st} I.E(KJ/mol)	496	738	577	787	1060	1000	1251

a) (i) State how **atomic radius** of the elements **varies across** the period. (01 mark)

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(ii)Explain your answer in a (i). (03 marks)

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b. i) Explain how atomic radius affects the ionization energy. (02 marks)

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ii) Why the first ionization energy of aluminium is lower than that of magnesium. (03 marks)

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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