NAME: ……SIGNATURE: ……

P525/1
Chemistry
Theory
2¾Hours

MIDLAND HIGH SCHOOL
SENIOR FIVE 2023

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

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)

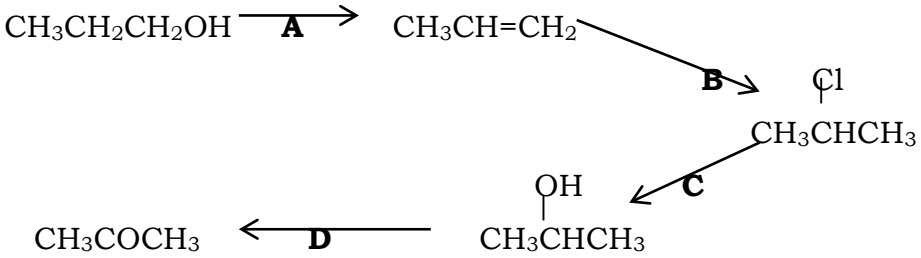
(Attempt all questions)

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

b) Explain why the value for heat of neutralization of a strong acid by a strong base is 57.0 $kjmol^{-1}$. (02mark)

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^1k^{-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 4200$jkg^{-1}k^{-1}$) 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)

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

   a) Ethene to 1,2-dichloroethanane (02½ marks)

   b) CH_3CH_2Cl to $H_4C_2O_2$ (02 ½ marks)

5. Complete the following **equations for nuclear reactions**.

   a. $^{239}_{94}Pu + {}^{4}_{2}He \longrightarrow$ ..... + $^{27}_{13}Al$ (01 mark)

   b. ..... $\longrightarrow$ $^{234}_{90}Th$ + α (01 mark)

   c. $^{214}_{83}Bi \longrightarrow {}^{206}_{82}Pb$ + ... + $3{}^{4}_{2}He$ (01 mark)

   d. $^{250}_{98}Cf$ + ... $\longrightarrow$ $^{257}_{103}Lw$ + $4{}^{1}_{0}n$ (01 mark)

6. 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

   $H_{2(g)} + ½O_{2(g)} \longrightarrow H_2O_{(l)}$ 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)

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

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b) State whether the reaction above is **feasible**, give a **reason** for your answer. (01 mark)

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7. The **first three** successive ionisation energies of element **T** are **549**, **1064** and **4226KJ/mol**.

a) Explain the **trend in the variation energy** of **T**. (03 marks)

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b) State the group in the periodic table to which T belongs to. (01 mark)

_____

_____

8. a) Concentrated nitric acid reacts with to form a yellow oily liquid. State the condition under which the reaction occurs and give the IUPAC name of the yellow oily liquid. (02marks)

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. **10.0cm³** of a hydrocarbon **P (C_xH_y)** was exploded in **90.0cm³** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm³**, when the residual gases were passed through potassium hydroxide solution, the volume reduced to **40.0cm³**.

a) i) Write the equation for the reaction between hydrocarbon P and oxygen gas. (01 mark)

ii) Determine the **molecular formula** of hydrocarbon P. (03marks)

b) Write equations to show how hydrocarbon P can be prepared from propan-2-ol. (02 marks)

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?

a) But-2-yne and But-1-yne

Reagent: _____

Observation: _____

_____

_____

b) CO_2^{3-} and HCO_3^- (03 marks)

Reagent: _____

Observation: _____

_____

_____

c) Pb^{2+} and Al^{3+} (03 marks)

Reagent: _____

Observation: _____

_____

_____

11. a) The vapour pressure of a solution containing **108.2g** of a substance **Y** in **1000g** of water at **20°C** was reduced by **0.186mmHg**.

(The vapour pressure of water at **20°C** is **17.54mmHg**)

a) Calculate the **molecular mass** of substance **Y**. (04 marks)

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b) State **three assumption made** in (a) above (03 marks)

c) Explain why the vapour pressure of a solution containing a non-volatile solute is less than the vapour pressure of the pure solvent. (03 marks)

12. Write equations to show how the following synthesis can be carried out. In each case indicates the necessary reagents and conditions.

a) Benzene from ethene. (03 marks)

b) 1-chloropropane to propanone (03 marks)

c) CH_3Cl to $CH_3CHBrCH_2Br$ (03 marks)

13.a) i) Define enthalpy of a reaction. (01 mark)

ii)State three factors affecting the quantity of an enthalpy change of a reaction. (03 marks

b) The standard heat of formation of ethanol, carbon dioxide and water are -227.0, -393.5, & -285.5KJ/mol respectively.
(02marks)

i) Draw a Born-Haber cycle to relate the energy changes stated above. (02 marks)

ii) Calculate the standard heat of combustion of ethanol using the drawn cycle. (01½ marks)

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iii) From your calculation in b (ii) above and energy changes in b (i), what can be ideal use of ethanol in chemistry. Give a reason for your answers. (01½ marks)

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13. a) Define the term **radioactivity**. (01mark)

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b) The table below shows how the mass of radioactive protactinium, $^{234}_{91}Pa$ varies with time.

mass of protactinium (g)	60.0	38.5	26.0	17.2	11.1
Time (s)	0	40	80	120	160

(i) Plot a graph of mass of protactinium against time. (03 marks)

(ii) Use your graph to determine the **half-life** of protactinium.

(01 mark)

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(iii) Calculate the radioactive decay of protactinium. (02 marks)

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15. a) State the essential conditions and give the IUPAC name for the product formed when chlorine; (0½ mark each)

i) Is added to benzene

Conditions;

_____

Name of the product

_____

ii) Substitutes a hydrogen atom of benzene

Conditions;

_____

Name of the product

_____

iii) Reacts with cyclohexene

Conditions;

_____

Name of the product

_____

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

(i) a) ii)

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_____

_____

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_____

(ii) a) iii)

16. The table shows the atomic radius and first ionization energy of some elements in period below 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)

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

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

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

17. 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)

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