NAME……..……**Combination:** ……

P525/1

CHEMISTRY

PAPER 1 **S.5**

2Hours

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2Hrs

INSTRUCTIONS:

This paper has **two** sections; *section A* and *section B*.

Attempt **ALL** items in section **A**.

Section **B** has two parts; *part one* and *part two*. You are required to respond to only **ONE** item from each of the parts.

Responses of each item **must be** written on the **fresh page** of the answer booklet provided.

Mathematical tables (3-figure tables are adequate) or non-programmable scientific electronic calculators may be used.

Illustrations of your answers with relevant equations where necessary are added marks.

Were possible use (C = 12, H = 1, O = 16, 1 mole of a gas occupies 22.4dm^3 at s.t.p)

For Scorers' Use Only				
Item				Total
Score				

Section A

Attempt *all* items in this section

1. Carbon dating is one of the radioactivity applications used to determine the age of ancient art crafts and sites of over million thousands of years by measuring radioactive isotopes. A group of chemists analyzed a mineral; Uranium discovered in Eastern Congo to know its life span and they were able to obtain the following data.

Time(s)	20	40	60	80	100	120
Mass of uranium(g)	48.2	38.5	31.5	26.0	21.0	17.2

However with this information, they could still not be able to determine the life span of Uranium. The have approached for help

Task;

As a student of chemistry with vast knowledge of radioactivity,

(a) Plot a suitable graph of $\log_{10}{}^{\text{mass}}$ against time using the information they obtained

(b) use your graph to determine;

(i) initial mass of Uranium

(ii) the radioactivity decay constant of hence deduce the half-life of Uranium

(c) Help them calculate the life span (age) of the mineral- Uranium if 85% of the it had decayed

(d) Explain one danger associated with the long use of radioactivity in everyday life and possible mitigation measure.

(e) Complete the following nuclear reaction equations.

(i) $^{27}_{13}Al + {}^{1}_{0}n \rightarrow ------- + \alpha$

(ii) $^{236}_{92}U \rightarrow {}^{92}_{36}Kr + ------ + {}^{141}_{56}Ba$

(iii) $^{214}_{83}Bi \rightarrow {}^{206}_{82}Pb + ------ + 2{}^{4}_{2}He$

(iv) $^{226}_{88}Ra \rightarrow ------ + {}^{111}_{43}Te + \gamma$

Section B

Attempt <u>one</u> item from each part

Part one;

2. A chemical engineer working with National Water and Sewage Corporation analyzed some water sample from L.Victoria before supplied for domestic use. He found out that water contained the following elements and noted them using atomic numbers in brackets. He unfortunately left before finishing his report and in his absentia, the area manager could not tell the elements, their uses, and impact of the elements in the water.

   X (12), **Y** (17), **Z** (20), **K** (29), and **M** (26)

   Further preliminary reports indicated that **Y** dissolves in water resulting into reduction in the pH of water which is disastrous for human consumption. The manager was advised to neutralize the acidity by using sodium hydroxide. However, everything shared to him was not understood.

   The manager came to you seeking for guidance on how to analyse this report by;

   (a) Identifying the categories of the elements present
   (b) writing the electronic configurations of the elements
   (c) using the configurations to identify the group, period, and block of Z, **Y**, and **M** given in (a) above.
   (d) Writing balanced chemical equations for the reaction between;
      (i) Y and water
      (ii) Hydrochloric acid formed and sodium hydroxide
   (e) giving two properties of any **<u>one</u>** of the elements above
   (f) assessing the danger with mitigation of any **<u>one</u>** of the elements when in water.

Part two;

3. After an attempt to kill Gen. Katumba in 2021, a forensic study was carried out at the crime scene and the sample collected was taken for analysis using spectrometer. The following structural formulae were obtained;

A; CH_4 **B; $CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}HCH_3$** **C; $CH_3CH_2CH_3$** **D; $CH_3CH{=}CHCH_3$**

E; $CH_3\overset{\displaystyle O}{\overset{\|}{C}}\underset{\displaystyle OH}{\underset{|}{C}}HCH_2\underset{\displaystyle Br}{\underset{|}{C}}HC{\equiv}CCOOH$

When the report was handed over to the police department, the junior officer could not understand what data obtained meant and functional groups in the structures.

Other findings from the forensic studies show that Butyric acid commonly known as butanoic acid is a fatty acid found in small amounts in animal fats and some plant oils. To the surprise of many, the officer said that this acid is used in the production of flavoring agents used to improve the quality of food in food industry if used appropriately. The acid is made up carbon, hydrogen and oxygen forming the general formula $C_nH_{2n+1}COOH$. When 4.24g of the butyric acid was completely burnt in oxygen, it gave out 8.45g carbon dioxide, and 3.46g of water.
The following data was obtained by the factory analyst. The officer needs to know the amount of heat involved in the formation of sample **C**

Enthalpy of combustion of carbon ($kjmol^{-1}$)	-393
Enthalpy of combustion of hydrogen ($kjmol^{-1}$)	-286
Enthalpy of combustion of C_3H_8 ($kjmol^{-1}$)	-1393

The officer could not use the data to draw his conclusion and sought for help from you as an informed person.

Task;

As a student of chemistry, help the junior officer with;

(a) meaning of the term functional group

(b) the names of the functional groups in **E** and **D**

(c) the names of **A**, **B**, **C** and **D** according to I.U.P.A.C system

(d) Use the data the collected to calculate the enthalpy of formation of C_3H_8 and comment on the value obtained.

(e) any one use of **C**, dangers associated with long use of **C** in day to day life and how the effect can be mitigated.

(f) Empirical formula of the acid used in production of flavoring agents

(g) Molecular formula of the acid if its molecular mass is 88.

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	35.5 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