Name:……..Signature: ……

P525/1
Chemistry
Paper 1
Nov./ Dec. 2024
2 ¾ hours

S.5

[redacted]

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY

Paper 1

(Theory)

END OF YEAR

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

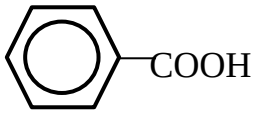
- Answer **all** questions in section **A** and any **six** questions in section **B**
- All questions **must** be answered in the spaces provided; no answer sheet must be attached.
- The Periodic Table, with relative atomic masses, is attached at the end of the paper.
- Mathematical tables(3-figure tables) are adequate or non-programmable scientific electronic calculators may be used
- Illustrate your answers with equation(s) where applicable.
- Where necessary, use the following:
  Molar gas constant R = 8.31 JK -1 mol -1
  Molar volume of a gas at s.t.p is 22400cm^3, Standard temperature = 273 K
  Standard pressure = 101325 N m^{-2}

For Examiner' Use Only																
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Total**

SECTION A. (46 MARKS)

Attempt ***all*** questions in this section.

1. (a) Complete the following equations and name the major product. **[04 marks]**

(i)  $\xrightarrow[AlCl_3]{CH_3Cl}$ _____

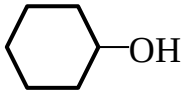
Name of major product_____

(ii) $CH_3C{\equiv}CH \xrightarrow[(ii)\ (CH_3)_2\text{-}CH\ Br]{(i)\ Na/NH_3\ (l)}$ _____

Name of major product_____

(iii) $CH_3CH_2Br \xrightarrow[Heat]{NaOH(aq)\ /Ethanol}$ _____

Name of major product_____

(iv)  $\xrightarrow[(ii)\ Br_2\ /\ CCl_4]{(i)\ Conc.\ H_3PO_4\ /\ Heat}$ _____

Name of major product_____

(b) Without an equation, show how product in (a) (iii) can be obtained from a given a named alcohol. **[$1\frac{1}{2}$ marks]**

_____

_____

_____

_____

2. (a) Define the term **isotopes** . **[01 mark]**

_____

_____

(b) An isotope of uranium with atomic number 92 and mass number 235 successively emitted 4 beta particles and 7 alpha particles to form a stable isotope of another element Y.

(i) Write an equation for the nuclear reaction that occurred to form Y. **[01 mark]**

_____

_____

(ii) Identify element Y**.** **[$0\frac{1}{2}$mark]**

_____

(c) Write an equation for the reaction of element Y with;

(i) Water **[$1\frac{1}{2}$ marks]**

_____

_____

(ii) Hot concentrated sodium hydroxide solution. **[$1\frac{1}{2}$ marks]**

_____

_____

3. (a) State the conditions and write an equation for the reaction that occurs when;

(i) Magnesium reacts with steam. **[02 marks]**

Condition (s)

_____

Equation

_____

_____

(ii) Aluminium oxide with sodium hydroxide solution. **[02 marks]**

Condition (s)

_____

Equation

_____

_____

(iii) Fluorine with hot sodium hydroxide solution. **[02 marks]**

Condition (s)

_____

Equation

_____

_____

4. (a) State Raoult's law. **[01 mark]**

_____

_____

_____

(b) State any two properties of ideal solutions. **[02 marks]**

_____

_____

_____

_____

(c) A mixture of aniline and water boils at 98.5^0C, the vapour pressure at this temperature is 42 mmHg and the vapour contains 76.8% by water. Determine the molecular mass of aniline. **[03 marks]**

_____

_____

_____

_____

_____

_____

5. An organic compound **Q** has a structural formula of; $\boldsymbol{HOCH_2CH_2OH}$

(a) Write the;

(i) IUPAC name of **Q**. **[$0\frac{1}{2}$mark]**

_____

(ii) Name of functional group of Q. **[$0\frac{1}{2}$mark]**

_____

(b) ***Without equation(s);*** show how compound W can be synthesized from the following;

(i) **Named alkyl halide.** **[$1\frac{1}{2}$marks]**

_____

_____

_____

(ii) **Named alcohol.** **[02 marks]**

_____

_____

_____

_____

_____

6. State what is observed and write an equation for the reaction that occurs when;

(a) Sodium sulphite was added to acidified potassium manganate (VII) solution. **.**

[$2\frac{1}{2}$marks]

Observation

_____

Equation

_____

_____

(b) Hydrogen sulphide was bubbled through acidified solution of potassium dichromate (VI). **[$2\frac{1}{2}$marks]**

Observation

_____

Equation

_____

_____

7. (a) Explain what is meant by the term ***radioactivity*?** **[*01 mark*]**

_____

_____

(b) The graph in Figure 1 below shows the variation of $log_{10}mass$ of radioactive substance against time.

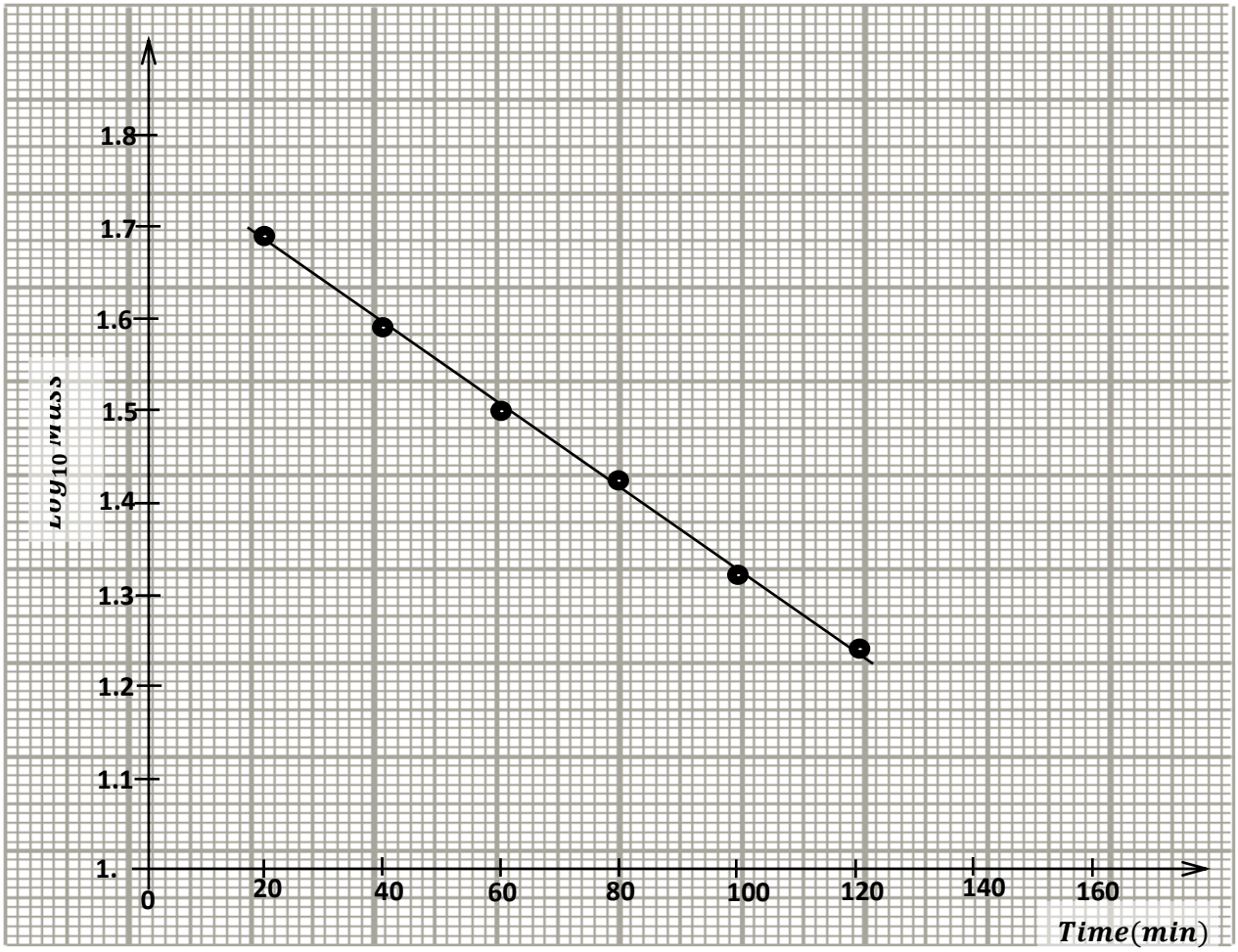


Figure.1

Using the graph determine the,

(i) Original mass of the radioisotope. **[01 mark]**

_____

_____

(ii) Half-life of the radioisotope. **[03 mark]**

_____

_____

_____

8. Sulphuric acid can be manufactured industrially by contact process from sulphur dioxide.

(a) Write an equation to show how sulphur dioxide can be obtained on a large scale from zinc blende. **[$1\frac{1}{2}$ marks]**

_____

_____

(b) Using equations only; show how **concentrated** sulphuric acid can be obtained from sulphur dioxide. **[$3\frac{1}{2}$ marks]**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

9. (a) Define the term **Bond energy**. **[01 mark]**

_____

_____

_____

(b) Methane reacts with chlorine as shown in the reaction.

$$CH_4\,(g) + Cl_2\,(g) \longrightarrow CH_3Cl\,(g) + HCl\,(g)$$

Given the data below;

Bond	Bond energy ($kJmol^{-1}$)
C-H	414
C-Cl	322
Cl-Cl	242
C-C	346
H-Cl	430

Calculate the heat of reaction. **[03 marks]**

SECTION B. (54 Marks)

Answer **six** questions from this section.

10. (a) Define the following terms.

(i) Allotropy **[01 mark]**

_____

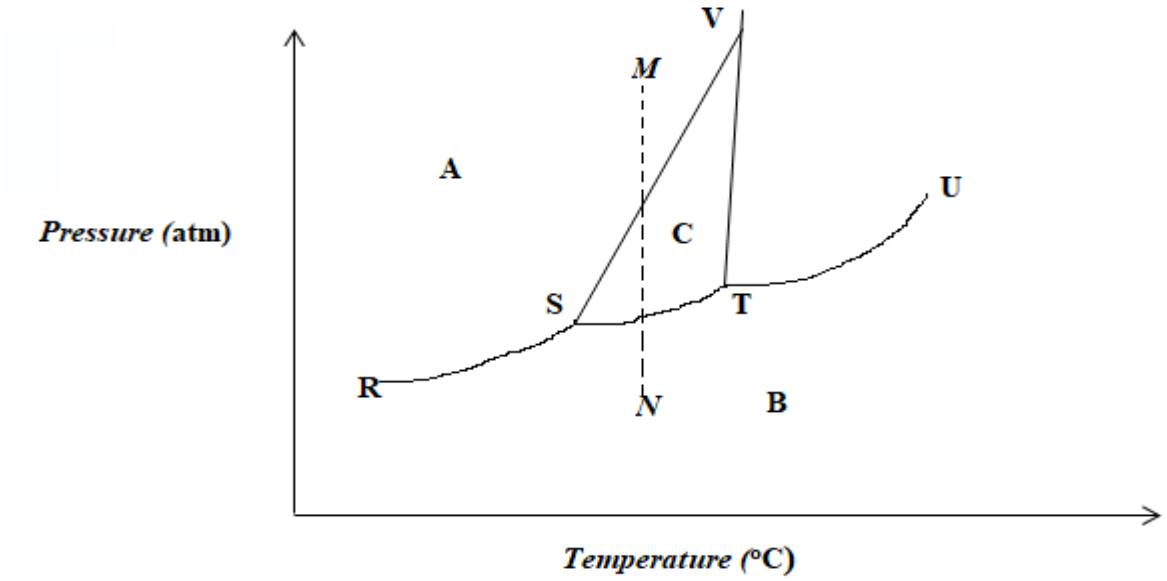
_____

(ii) Phase. **[01 mark]**

_____

_____

(b) Figure 2 below shows the phase diagram of sulphur.



(i) Identify phases **[01 mark]**

A

_____

B

_____

(ii) Name curve SV and TU. **[02 marks]**

SV

_____

_____

TU.

_____

_____

(iii) State **one** similarity between point S and T. **[01 mark]**

_____

_____

(c) Explain the changes that occur when pressure of the system is lowered at constant temperature from point M to N. **[03 marks]**

_____

_____

_____

_____

_____

_____

_____

_____

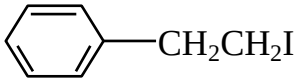
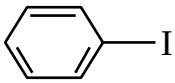
(d) Give one reason why eutectic mixtures are not compounds. **[01 mark]**

_____

_____

_____

11. Name one reagent that can be used to distinguish between each of the following pairs of compounds. In each case, state what is observed if the reagent is separately treated with each member of the pair and write an equation where possible.

(a)  and  **[03 marks]**

Reagent(s)

_____

_____

observation

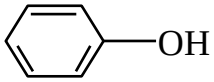
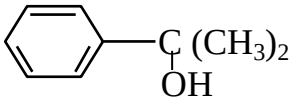
_____

_____

Equation

_____

_____

(b)  and  **[03 marks]**

Reagent(s)

_____

_____

Observation

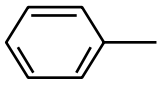
_____

_____

Equation

_____

_____

(c) CH_3CH_2OH and  **[03 marks]**

Reagent(s)

_____

_____

Observation

_____

_____

Equation

_____

_____

12. Beryllium, barium and magnesium are some of the elements in group (II) of the periodic table.

(a) (i) Write the electronic configuration of beryllium ion and barium ion. **[01 mark]**

Beryllium ion

_____

Barium ion

_____

(ii) Explain why beryllium chloride is more covalent than ionic. **[02 marks]**

_____

_____

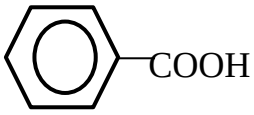
_____

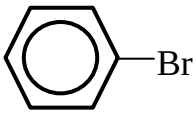
_____

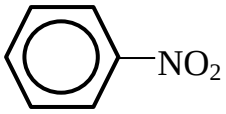
_____

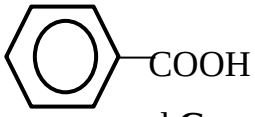
(b) Describe the reactions of magnesium and beryllium with nitric acid. **[05 marks]**

(c) Write an equation for any reaction in which beryllium behaves differently from other group (II) elements. **[01 mark]**

13. (a) Write equations to show how  can be obtained from;

(i)  **[03 marks]**

(ii)  **[03 marks]**

(b)  Reacts with bromo Ethane under suitable conditions to form compound **G**.

(i) State the suitable conditions for the reaction above and give the IUPAC name of G. **[01 mark]**

Condition (s)

UPAC name of G.

(ii) Give a reason for the formation of compound G. **[02 marks]**

14. Silicon and lead are elements in group (IV) of the periodic table.

(a) (i) State condition(s) under which sodium hydroxide solution and Silicon (IV) oxide; **[01 mark]**

React

_____

Do not react

_____

(ii) Write an equation for the reaction that occurs between sodium hydroxide solution and Silicon (IV) oxide under the stated conditions in (a) (i) above. **[$1\frac{1}{2}$ marks]**

_____

_____

(b) State what is observed and write an equation for the reaction that occurs when lead (IV) oxide is;

(i) Strongly heated with concentrated hydrochloric acid. **[$2\frac{1}{2}$ marks]**

Observation

_____

Equation

_____

_____

(i) Strongly heated in presence of sulphur dioxide gas. **[$2\frac{1}{2}$ marks]**

Observation

_____

Equation

(c) Name the reagent that can be used to distinguish between $\mathbf{Pb^{2+}}$ and $\mathbf{Sn^{2+}}$ ions and state what is observed when the named reagent is treated with the ions separately.

[$1\frac{1}{2}$ marks]

15. When $25cm^3$ of a gaseous hydrocarbon Q ($\mathbf{C_xH_y}$) were exploded with $200cm^3$ of oxygen, the residual gases occupied $150cm^3$ after cooling. When residual gas was passed through a combustion chamber with copper turnings, there was a decrease in volume to $100cm^3$.

(a) Give a reason for the decrease in volume when residual gas was passed through a combustion chamber and write an equation if applicable. **[$1\frac{1}{2}$ marks]**

(b) (i) Determine the molecular formula of Q. **[$2\frac{1}{2}$ marks]**

(ii) Write the structure formulae of all possible isomer of Q. [$1\frac{1}{2}$ **marks]**

_____

_____

_____

_____

(c) When Q was reacted with hydrogen chloride gas followed by hot concentrated sodium hydroxide solution; compound K was formed, that forms cloudy solution within 1 to 2 minutes on treatment with concentrated hydrochloric acid in presence of anhydrous zinc chloride.

(i) Write the IUPAC name of compound K. **[01 mark]**

_____

(ii) Write an equation for the reaction that led to formation of compound K.**[01 mark]**

_____

_____

(d) Write an equation and a mechanism for the reaction that leads to formation of compound Q from compound K. **[03 marks]**

_____

_____

_____

_____

_____

_____

_____

_____

16. Explain the following observations. Write an equation where possible.

(a) When aluminium chloride was dissolved in water and resultant solution added to sodium hydrogen carbonate solution, effervescence occurs. **[04 marks]**

(b) The first electron affinity of sulphur is ***-200KJ mol^{-1}*** whereas for phosphorus is ***-73KJ mol^{-1}*** yet the two are period 3 elements. **[03 marks]**

(c) Boron and silicon are diagonally related. **[02 marks]**

17. (a) What is meant by the following terms?

(i) Solvent extraction. **[01mark]**

_____

_____

_____

(ii) Steam distillation. **[01mark]**

_____

_____

_____

(b) (i) state two conditions under which partition law is valid. **[01mark]**

_____

_____

_____

_____

(ii) A solute D is three times as soluble in ethoxyethane as in water. An aqueous solution containing 4.5g of D per litre of solution was shaken by ethoxyethane in a separating funnel. Calculate the mass of D that is extracted by two successive $50.0cm^3$ portions of ethoxyethane. **[03marks]**

_____

_____

_____

_____

_____

_____

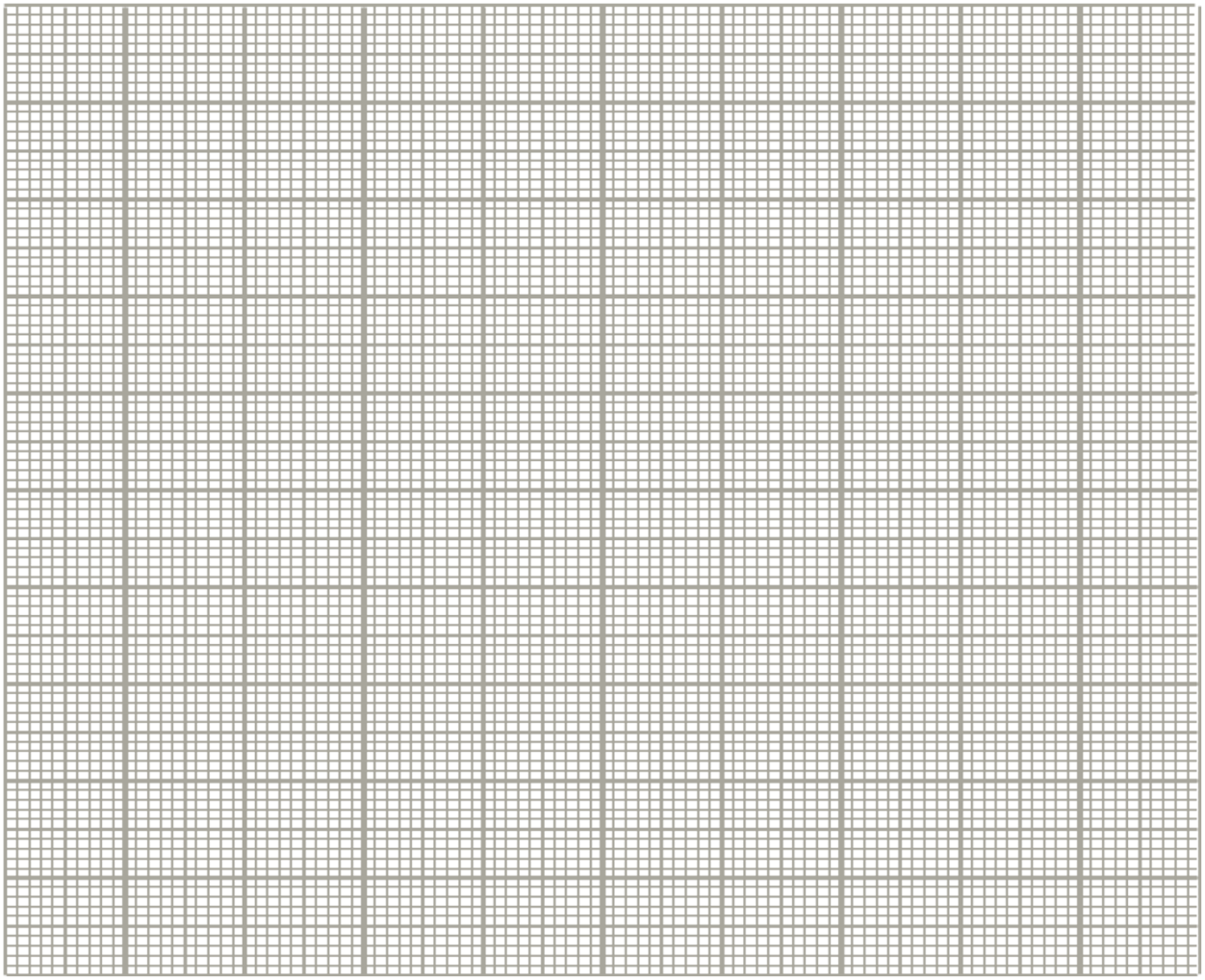
_____

_____

(c) Table 1 shows the results of portioning of aminomethane between trichloromethane and 0.1M copper (II) sulphate solution.

$[CH_3NH_2]$ in 0.1M $CUSO_4$	3.0	4.0	5.0	6.0	7.0	10.0
$[CH_3NH_2]$ in $CHCl_3$	69.0	45.0	35.0	31.0	24.0	18.5

(i) Plot a graph of $[CH_3NH_2]$ in copper (II) sulphate versus $[CH_3NH_2]$ in trichloromethane. **[02marks]**



(ii) Determine the formula of the complex formed. **[01mark]**

_____

_____

_____

_____

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

WE WISH YOU A BLESSED HOLIDAY

STAY SAFE, TAKE CARE AND THE STRUGGLE CONTINUES!!!