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

School..... Signature.....

P525/1
CHEMISTRY
Paper 1
August 2016
2 ¾ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- *Attempt **all** questions in section A and any **six** questions from section B.*
- *All questions are to be answered in the spaces provided.*
- *A Periodic Table with relevant atomic masses is supplied at the end of the paper.*
- *Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.*
- *Illustrate your answers with equations where applicable.*

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

SECTION A (46 Marks)

Answer **all** questions in this section.

1. (a) One of the practical applications of radioactive delay is the determination of the mechanism of esterification.

(i) Name the isotope used to determine the mechanism. (0½marks)

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(ii) State **one** other practical application of radioactivity. (0½marks)

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(b) Given the nuclear process below:

$$^{223}_{87}Fr \xrightarrow{(1)} {}^{219}_{87}W \xrightarrow{(2)} {}^{219}_{88}X \xrightarrow{\gamma\text{rays}} Z$$

Identify

(i) The emitted particles (1) and (2). (1½marks)

(1) .....

(2) .....

(ii) Z.....

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(½marks)

(c) The half – life of radioactive substance T is 27 years.
Calculate the time taken by 0.02moles of T to decay by 62%. (2½marks)

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2. Anhydrous sodium carbonate is obtained from the solvay process by the thermal decomposition of sodium hydrogen carbonate.

20.0g of solid mixture of sodium carbonate and sodium hydrogen carbonate were heated to a constant mass of 13.8g.

a) Calculate the percentage composition by mass of the mixture. (3½marks)

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b) In an alternative experiment, the mixture was dissolved in water to form an aqueous solution.

(i) State how the aqueous solution can be used to determine the composition of the mixture. (1mark)

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(ii) State **one** application of anhydrous sodium carbonate in volumetric analysis. ($^1/_2$marks)

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3. a) Complete each of the following organic reactions and name the major organic product.

(i) $CH_3\overset{\overset{O}{\|}}{C}CH_3 \xrightarrow[10\text{-}20^0C]{KCN/\text{dilute } H_2SO_4}$ (1mark)

Name of the product.....

(ii)  $\xrightarrow[2.\ PCl_5]{1.\ H_2O/\text{conc.}H_2SO_4}$ (1mark)

Name of product.....

b) Suggest a suitable mechanism for the reaction in a(i) above. (2marks)

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4. a) Carbon, Silicon, Germanium and Tin belong to group IV of the periodic Table and their respective bond energies are given below.

Bond	C - C	Si - Si	Ge - Ge	Sn –Sn
B.E($KJmol^{-1}$)	346	175	168	156

(i) State the trend in bond energy. Give a reason for your answer. ($1\frac{1}{2}$marks)

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(ii) How does bond energy affect the tendency of the above elements to catenate? (1 marks)

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b) Describe the reactions of the elements in (a) above with concentrated hydrochloric acid. (2 marks)

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c) Silicon forms a series of hydrides of general formular Si_nH_{2n+2}. The first member of the series can be prepared by reacting dilute hydrochloric acid with a stoichiometric binary compound formed between magnesium and silicon.

(i) Name the hydride. ($\frac{1}{2}$marks)

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(ii) Write an equation for the reaction leading to the formation of the hydride in c (i) above. (1mark)

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5. (a) 5.9852×10^{-4}g of solid silver (I) chromate dissolve in 1dm^3 of 0.1M potassium chromate to form a saturated solution at 25^0C.

(i) Define the term "saturated solution". (1mark)

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(ii) Calculate the solubility of silver (I) chromate in pure water at 25^0C. ($3\frac{1}{2}$marks)

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b) Ammonia solution is added to a saturated solution of silver (I) chromate in water at 25^0C.

(i) State the effects of adding ammonia on the solubility of silver (i) chromate. ($^1/_2$marks)

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(ii) Explain your answer in b (i) above. ($1^1/_2$ marks)

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c) State one practical application of solubility product. ($^1/_2$ marks)

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6. a) The molar conductivity of a carboxylic acid RCOOH at infinite dilution at 25^0C is $390.7\Omega^{-1}cm^2mol^{-1}$ and the acid dissociation constant, Ka = 1.80×10^{-5}M.

(i) Define the term molar conductivity. (1mark)

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(ii) Calculate the molar conductivity of 0.01M solution of RCOOH. ($2^1/_2$marks)

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b) The zinc/silver oxide cell used in hearing aids and electric watches has the following electrode potentials.

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^{-}$ $E^{\theta} = +0.76V$

$Ag_2O_{(S)} + H_2O_{(l)} + 2e^{-} \rightarrow Ag_{(s)} + 2\bar{O}H_{(aq)}$, $E^{\theta} = +0.344V$.

(i) Calculate the e.m.f of Zinc / silver oxide cell. (1mark)

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(ii) Write the overall redox reaction that generates the e.m.f calculated in b(i) above. (1mark)

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(iii) Draw a well labelled diagram to show how the cell (zinc/ silver oxide) can be set-up and the e.m.f measured. (1mark)

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7. (a) When heated below 800^0C in the presence of excess oxygen, Barium forms a peroxide unlike Beryllium and magnesium which form normal oxide.
Explain why Barium forms a peroxide while other group II elements form normal oxides. (2marks)

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(b) Write equation(s) for the reaction(s) that take place,

(i) between any oxides of Beryllium and Magnesium and hot concentrated sodium hydroxide solution. (1mark)

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(ii) between Barium peroxide and dilute hydrochloric acid. (1mark)

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(iii) If Barium peroxide is heated above 800^0C. (1mark)

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8. For each of the following experiments, state what would be observed and write an equation for the organic reaction that takes place.

a) Bromine water is added to aqueous solution of phenol.

(i) Observation.....

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(ii) Equation of reaction

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(1 mark)

b) To $1cm^3$ of Silver nitate solution, 3drops of sodium hydroxide solution are added followed by excess ammonia solution. 2-Methyl propanal is added to the resultant solution and the mixture heated.

(i) Observation.....

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($^1/_2$ mark)

(ii) Equation of reaction. (1mark)

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9. a) Teflon which is used to make non-stick utensils is an addition polymer whose synthesis is represented by the equation below.

$$n\,F_2C=CF_2 \xrightarrow[(NH_4)_2S_2O_8\ \text{catalyst}]{H_2O\ \text{underpressure}} \left(\begin{array}{cc} F & F \\ | & | \\ C & - C \\ | & | \\ F & F \end{array}\right)_n$$

(i) What is meant by an addition polymer? (1mark)

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(ii) State the IUPAC name of Teflon. (½mark)

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b) 3.0g of Teflon were dissolved in 2 litres of solvent x at 25^0C.
The osmotic pressure of the resultant solution was $247.89972Nm^{-2}$.
Calculate the value of n in the formular of Teflon. (2marks)

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SECTION B (54 Marks)

Answer only **six** questions from this section.

10. W is an organic compound of the $C_nH_{2n}O$ series. $40cm^3$ of gaseous W were mixed with $180cm^3$ of oxygen, the mixture was exploded and the residual gaseous product at room temperature bubbled through concentrated potassium hydroxide solution. The final volume of gas was found to be $20cm^3$.

a) Calculate the molecular formular of W. (03marks)

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b) W has **two** structural isomers. Write the structural formulae and IUPAC names of the isomers of W. (02marks)

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c) (i) Name **one** reagent that can be used to distinguish the isomers in (b) above. (01mark)

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(ii) State what would be observed when the reagent named in c (i) above is treated with each isomer. (01mark)

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(iii) Write equation(s) for the reaction(s) that occurs in c (ii) above. (01marks)

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d) (i) Name **one** inorganic reagent that reacts with both isomers in (b) above to give the same observation. ($^1/_2$ mark)

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(ii) State the observation in d (i) above. ($^1/_2$ mark)

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11. Hydrogen gas reacts with nitrogen (II) oxide according to the equation below at 500k.

$2H_{2(g)} + 2NO_{(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$

The rate law is given by; Rate = $K[NO]^2[H_2]$ and the mechanism;

(i) $2NO \rightleftarrows N_2O_2$

(ii) $N_2O_2 + H_2 \xrightarrow{slow} N_2O + H_2O$

(iii) $N_2O + H_2 \rightarrow N_2 + H_2O$

a) Define the term;

(i) Order of reaction. (01marks)

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(ii) Molecularity. (01marks)

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b) State the order and molecularity of the reaction. Give a reason for your answer. (02marks)

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c) State the effect on the rate of reaction and in each case explain your answer.

(i) doubling the molar concentration of nitrogen (ii) oxide while the partial pressure of hydrogen is reduced to a quarter its original value. ($1^1/_2$ mark)

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(ii) Increasing temperature above 500K while the concentration of both reactants remain constant. ($1^1/_2$ mark)

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d) Sketch a graph to show the variation in reciprocal of time ($^1/_t$) with concentration of hydrogen gas in an experiment where excess nitrogen (II) oxide is used.

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12. a) Cobalt (III) ions form a wide range of complexes with co-ordination number 6.

(i) Define the term co-ordination number. (01mark)

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(ii) Write the formula of the complex formed between cobalt (III) ions and ethane – 1, 2 – diamine ($H_2NCH_2CH_2NH_2$). (01mark)

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State **two** reasons why cobalt forms complexes. (01marks)

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b) 2.033g of an isomer of $CoBr_3.6H_2O$ were dissolved in water and the resultant solution treated with excess silver nitrate solution. The mixture was filtered and the mass of the dry pale yellow residue was 2.8185g.

(i) Explain how the pale yellow residue is formed. (1½ mark)

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(ii) Calculate the structural formula of the isomer of $C_oBr_3.6H_2O$. Deduce its IUPAC name. (04 marks)

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c) State **one** other method by which the isomers of $C_oBr_3.6H_2O$ can be distinguish from each other. (½mark)

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13. Use equations to show how the following conversions can be effected.

a) Ethanoic acid to 4-hydroxy-4-methylpentan-2-one. (03marks)

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b) Iodomethane to Iodoethane. (03marks)

c) 2, 2-dichloropropane from propan-1-0*l*. (03marks)

14. Explain each of the following observations. Illustrate your answer with equations where necessary.

a) Aminopropane and trimethylamine have the same molar mass, however trimethylamine has a lower boiling point than aminopropane. ($2^1/_2$mark)

b) In the conductrimetric titration of Aluminum nitrate solution against sodium hydroxide solution, the electrolytic conductivity of the mixture decreases to a minimum value, then increases gradually and finally increases rapidly with excess base. (04marks)

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c) Iron (III) chloride and Tin (II) chloride cannot exist together in aqueous solution. ($2^1/_2$marks)

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15. a) Dimethylamine partially ionizes in water to form an alkaline solution. Write an equation for the ionization of dimethylamine in water. (01mark)

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b) The pH of 0.02M dimethylamine solution at 20^0C was found to be 11.51.

(i) Calculate the molar concentration of hydroxide ions in the solution. The ionic product of water at 20^0C is $6.81 \times 10^{-15} mol^2 dm^{-6}$. (02marks)

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(ii) Deduce the basic ionization constant. Kb of dimethylamine from your answer in b (i) above. ($1^1/_2$marks)

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c) Explain why the Kb for ammonia at 20^0C is lower than the value calculated in b (ii) above. (02marks)

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Turn Over

d) The pH range for different indicators are shown in the table below.

Phenolphthalein	Bromothymol blue	Methylorange
8.30 - 10.0	6.00 - 7.60	3.10 - 4.40

(i) Identify the most suitable indicator for the titration of dimethylamine with hydrochloric acid. (01mark)

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(ii) Briefly explain your answer in d (i) above. ($1^1/_2$marks)

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16. (a) The oxidizing strength of group VII elements decreases in the order;
$F_2 >> Cl_2 > Br_2 > I_2$.

(i) State **three** reasons to account for the high oxidizing strength of fluorine relative to other halogens. ($1^1/_2$marks)

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(ii) State **two** other anomalous properties of fluorine. (02marks)

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(b) Describe the reactions of chlorine and iodine with;

(i) Sodium thiosulphate solution. ($3^1/_2$marks)

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(ii) Iron (II) sulphate solution. (02marks)

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17. A mixture of benzene and methyl benzene at 330K is an ideal solution. The partial vapour pressure of benzene above the solution varies according to Raoult's law as shown in the table below.

Partial vapour pressure of benzene in solution (Kpa)	10.0	15.0	25.0	30.0	40.0
Mole fraction of benzene in solution	0.20	0.30	0.50	0.60	0.80

a) State;

(i) Raoult's law.

(01mark)

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(ii) The effect of adding methyl benzene to the temperature and volume of a fixed mass of benzene.

(01mark)

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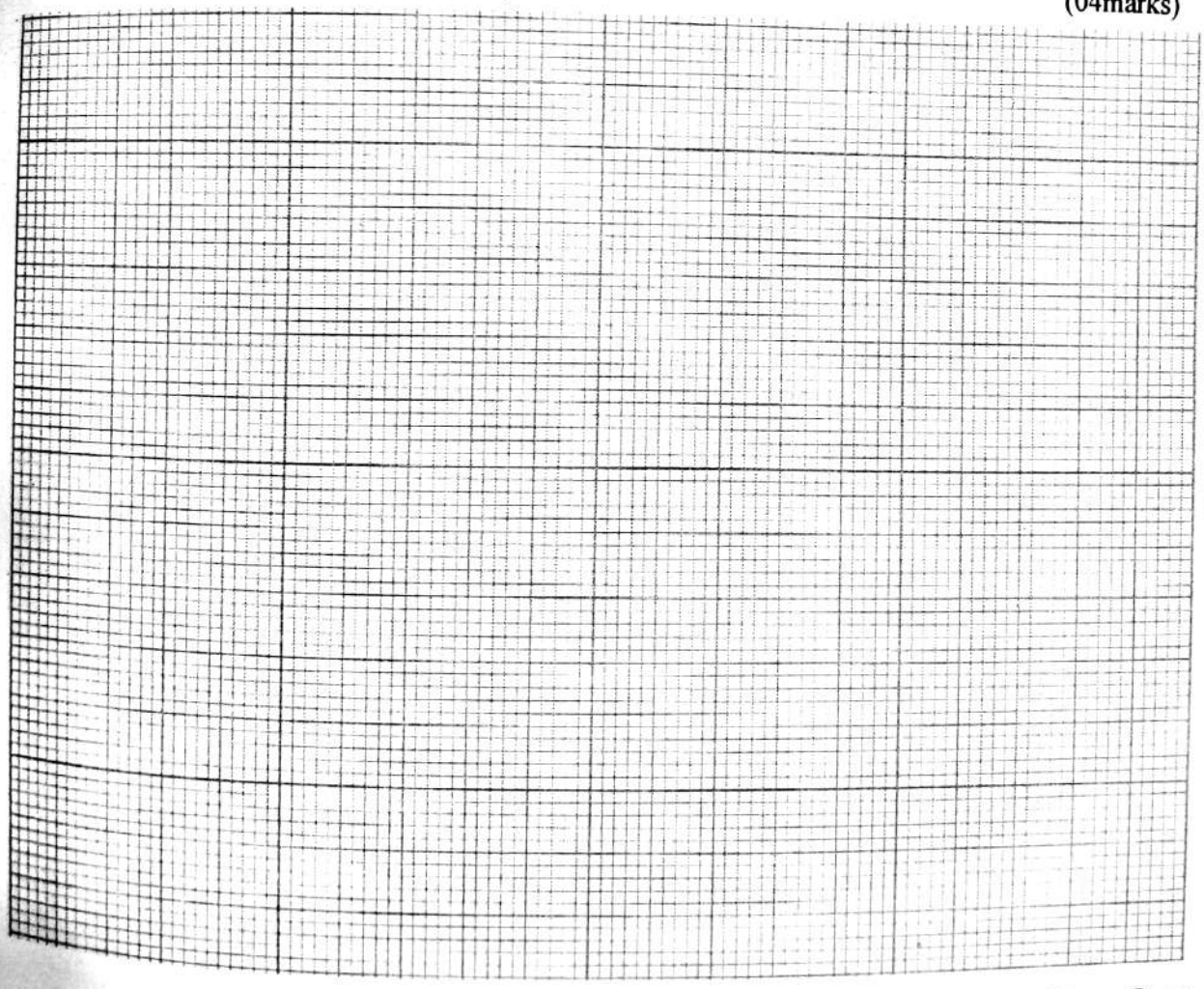
b) On the same axes, plot a graph of ;

(i) Vapour pressure of benzene.

(ii) Total vapour pressure above the solution against mole fraction of benzene. (The composition of benzene in the vapour is 50% when its mole fraction in solution is 0.27).

(04marks)



c) Use the graphs in (b) above to determine the;

(i) Saturated vapour pressure of benzene at 330K. (01mark)

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(ii) Saturated vapour pressure of methyl benzene at 330K (01mark)

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d) Compare the boiling points of pure benzene and pure methyl benzene. Give a reason for your answer. (01mark)

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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 Tl 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