Name:……**COMBN**……

Signature: …….

P525/1
Chemistry
Paper 1
MARCH 2023
2 ¾ hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION
S.5 CHEMISTRY
Paper 1
2 ¾ hours

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*
- *The Periodic Table, with relative atomic masses, is supplied.*
- *Mathematical tables(3 – figure tables) are adequate or non-programmable scientific electronic calculators may be used*
- *Illustrate your answers with equations 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 22.4 litres.*
- *Standard temperature = 273 K*
- *Standard pressure = 101325 N m $^{-2}$*

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

1. (a) State Graham's law of diffusion. (01 mark)

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(b) A certain volume of oxygen diffused through a porous membrane in 120s. Under the same conditions, the same volume of a gas **X** diffused in 112s. Calculate the formula mass of **X** (03 marks)

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(c) State one application of diffusion of gases (01mark)

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2. **10.0cm^3** of a hydrocarbon **P (C_xH_y)** was exploded in **90.0cm^3** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm^3**, when the residual gases were passed through potassium hydroxide solution, the volume reduced to **40.0cm^3**.

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

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

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b) Write the structural formula and name of P (01 mark)

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3. (a) What is meant by **first electron affinity**? (01 mark)

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(b) Write an equation for first electron affinity of oxygen. (01 mark)

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(C). The first electron affinity of oxygen is negative while the second electron affinity is positive. Explain (03 marks)

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4. The combustion of a hydrocarbon **P** gave 8.8g of carbon dioxide and 4.5g of water, if the molecular mass of **P** is 58. Determine the
(a) Empirical formula of **P**

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(b) Molecular formula of **P**

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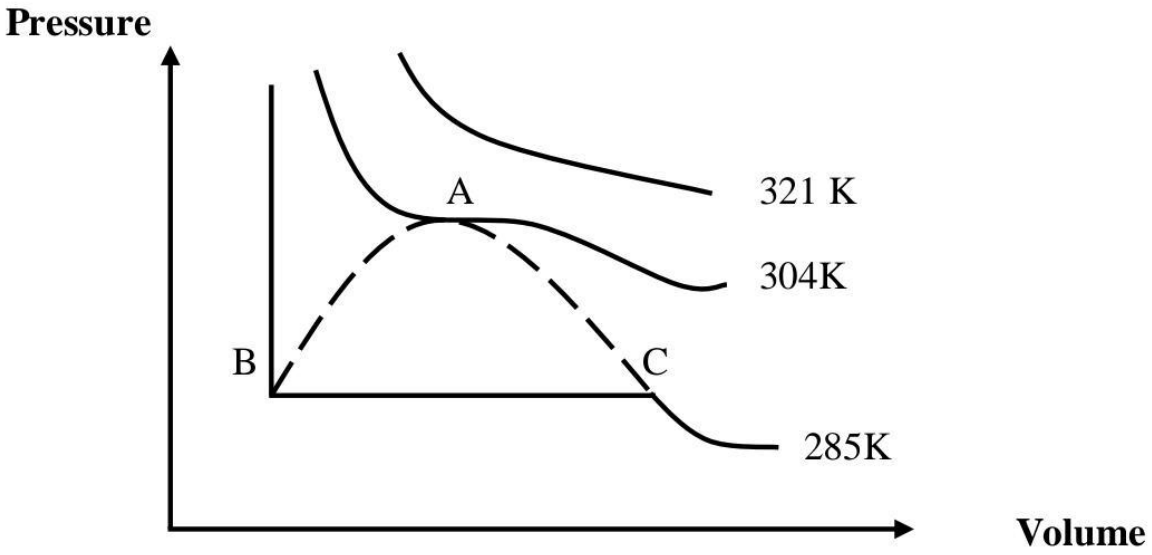
5. (a) The diagram below shows the isothermals of a gas.



(i) What is the critical temperature of the gas. (01 mark)

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(ii) Which isothermal almost represents an ideal gas. (01 mark)

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(iii) What does the region ABC represent. (01 mark)

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(b) State two conditions for liquefying a gas. (01 mark)

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6. Gas **X** has a vapour density of 2.615gdm^3 at 25^{0}c at a pressure of 101Pa. Determine the molecular mass of gas **X**

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b) In another experiment gas **X** occupies a 225cm^3 vessel at 7^{0}c and pressure of 4.8 x 10^5 Pa. Determine then number of moles of gas **X** present under those conditions

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7. Complete the following equations for nuclear reactions.

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

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

(b). In an experiment, the rate of radioactive decay of protactinium decreased to 25% in 54 minutes. Calculate the half-life of protactinium.(03mks)

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8. (a) What is meant by the following terms

(i) A **d-block element** (01 mark)

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(ii)An **orbital** (01 mark)

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b) Write the electronic configuration of the following

(i) Boron (01 mark)

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(ii) Aluminium (01 mark)

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(i) Cobalt (01 mark)

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(iv)Manganese (01 mark)

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(v) Iron (01 mark)

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9. The table below shows the first four successive ionisation energies of elements **A, B, C** and **D**

Element	**1st I.E (KJmol^{-1})**	**2nd I.E (KJmol^{-1})**	**3rd I.E**	**4th I.E**
A	800	2400	3700	25000
B	900	1800	14800	21000
C	500	4600	6900	9500
D	1090	2400	4600	6200

With reasons, state the group of the periodic table to which the elements A, B and C belong

(i) A

Group (01 mark)

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Reason (02 marks)

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(ii) B (01mark)

Group

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Reason (02 marks)

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(iii) ***C***

Group (01 mark)

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Reason (02 marks)

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SECTION B

Attempt any *six* questions from this section.

10. (a) (i) Distinguish between an **ideal gas** and **a real gas** (02 marks)

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(ii) State two properties of an ideal gas (01mark)

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(b) Explain how liquefication of a gas can be affected by

(i) Pressure. ($1\frac{1}{2}$ marks)

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(ii)Temperature (02 marks)

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(c). The curves below show deviations of some gases from the ideal behaviour

(i) State why helium shows a small deviation from the ideal behaviour compared to other gases. (01 mark)

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(ii) Compare the deviations of methane and nitrogen from the ideal behaviour and give a reason for your answer. (1½ marks)

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11. (a) State two factors affecting stability of a nucleus of an atom. (02mks)

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b) Below is a graph of number of neutrons against number of neutrons against number of protons for different nuclei

Identify (i) region **S**…… (01 mk)

(ii) line **A**……(01 mk)

c). State how the following nuclide can gain stability

(i) **Q** (01 mark)

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(ii) **R** (01 mark)

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(iii) **P** (01 mark)

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State two properties of a stable nuclide (02 marks)

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12. Explain the following

(i) the first ionisation energy of magnesium is higher than that of aluminium. (03 marks)

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(ii) the atomic radius of sodium atom is **0.156nm** while the ionic radius of sodium ion is **0.095nm**. (03 marks)

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(iii) Potassium atom has a larger atomic radius than lithium (03marks)

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13 (a) Define the following terms

(i) Relative Atomic Mass. (01 mark)

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(ii) Relative abundance (01 mark)

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(b) A mass spectrum of chlorine shows molecular peaks at 70, 72 and 74. Explain this observation. (02 marks)

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(ii) Chlorine has two isotopes **Cl-35** and **Cl-37**. State the formula of each ion of the respective molecular peak formed. (1 ½ marks)

Molecular peak	**Formula of the ion**
70	
72	
74	

(c) . (i)Determine the relative abundance of each isotope of chlorine stated above. (1½ marks)

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(iii) Draw the mass spectrum of the above two isotopes. (1 ½ marks)

(d) State one advantage and one disadvantage of determining the relative atomic mass of an element using the mass spectrum

Advantage (0½ mark)

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Disadvantage (0½ mark)

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14. (a)State Dalton's law of partial pressure of gases. (01 mark)

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(b) What is meant by the following terms?

(i) Partial pressure of a gas (01 mark)

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(ii) Mole fraction of a gas (01 mark)

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(c) **12.0g** of nitrogen, **0.4g** of hydrogen and **9.0g** of oxygen were put in a **1litre** vessel at a pressure of **22.4atm**.calculate the partial pressure of the respective gases present in the vessel. (06 marks)

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15. (a) What is meant by the term atomic radius. (01mark)

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(b)Describe how atomic radius varies

(i) Down a group. (04 marks)

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(i)Across a given period. (04 marks)

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16. (a). Define the term

(i) Radioactivity. (01 mark)

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(ii). **Half life** (01mark)

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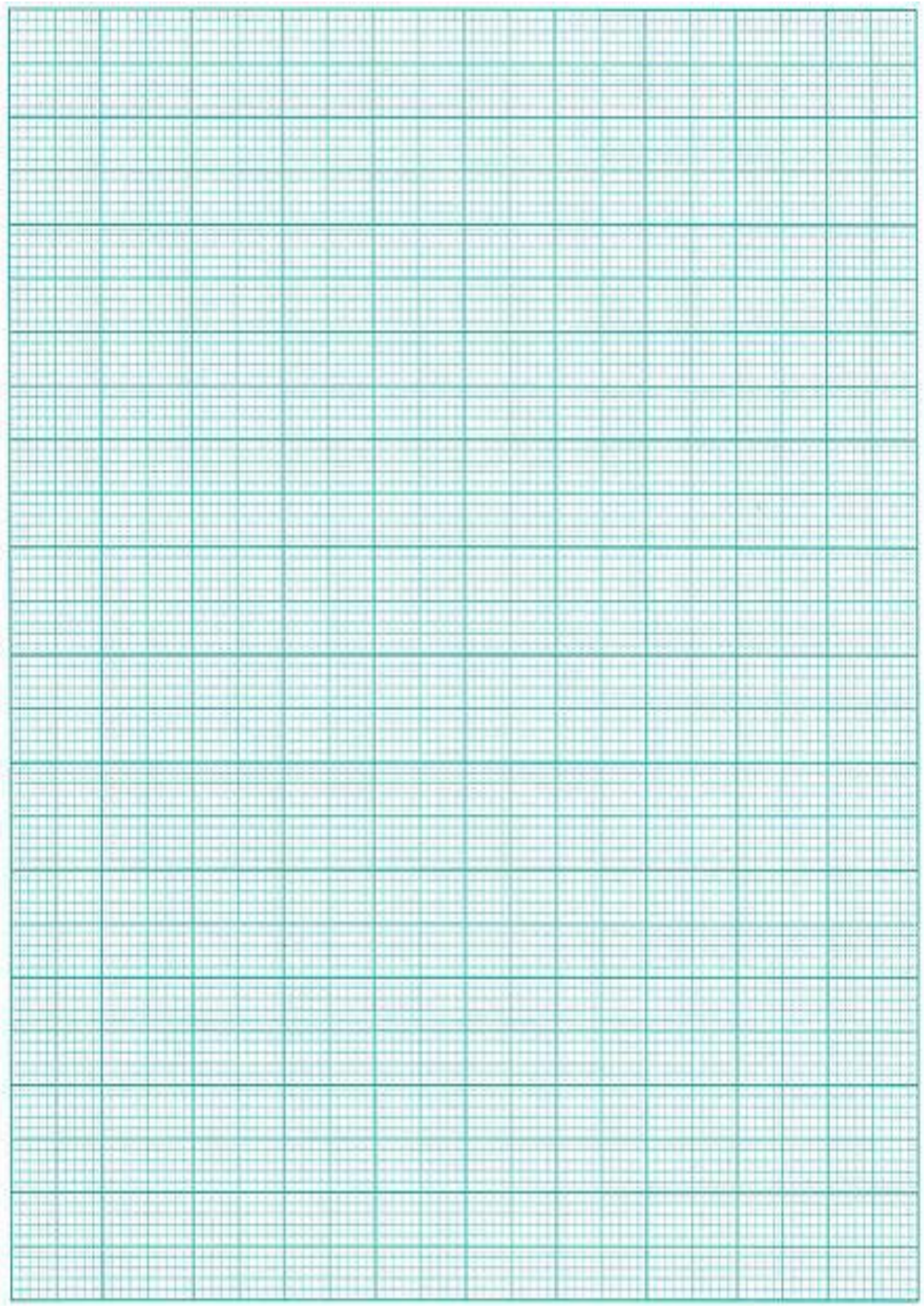
b) The table below shows how the mass of radioactive substance **R** varies with time.

Mass of R (g)	60.0	38.5	26.0	17.2	11.1
Time (minutes)	0	40	80	120	160

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



(ii).Use your graph to determine the **half-life** of **R**. (01 mark)

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(iii).Calculate the **radioactive decay constant** of **R**. (01 mark)

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(c) Differentiate between nuclear fission from nuclear fusion. (02 marks)

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17. (a) What is meant by isomerism (01 mark)

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(b) Write short notes on the following types of structural isomerism.

(i) Position isomerism (02marks)

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(ii) Functional group isomerism (03 marks)

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(iii) Chain isomerism (03 marks)

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(a) Define the term third ionisation energy. (01 mark)

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(b) Write an equation for the third ionisation energy of magnesium.(01mk)

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(c) State how the following factors affect the value of ionisation energy of an atom or ion.

(i) Electronic configuration of the atom or ion. (01 mark)

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(ii) Nuclear charge (01 mark)

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d) The table below shows the variation in first ionisation energies of elements in group (VII) of the periodic table

Element	**F**	**Cl**	**Br**	**I**
First ionisation energy(KJmol^{-1})	1681	1255	1142	1007

(i) State the trend in first ionisation energy of the elements. (01 mk)

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(ii) Explain your trend in (c) (i) above. (04 marks)

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END.

WELCOME TO S5 CHEMISTRY CLASS 2023.

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