

Second Term Evaluation - 2025

Grade

12

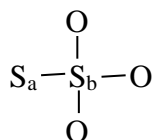
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Subject

Chemistry II

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Time

3 Hrs

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Name



	S_a	S_b
oxidation number		
valency		

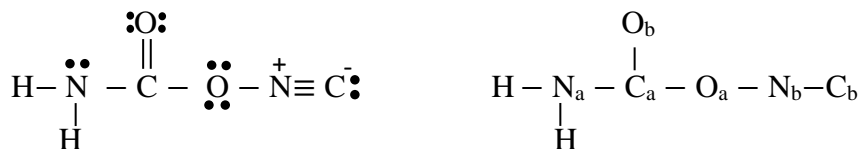
iv) State a balanced half ionic equation for $\text{S}_2\text{O}_3^{2-}$ acting as a reducing agent.

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v) State a balanced half ionic equation for $\text{S}_2\text{O}_3^{2-}$ acting as a oxidizing agent.

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c) Use the structure of $[\text{CNOH}]_2$ molecule to answer the questions given below.



i) Complete the following table by using above structure of the molecule.

	N_a	C_a	O_a	N_b
Hybridization				
electron pair geomatry				
shape				

ii) Write the atomic orbitals which form below σ bonds

- $\text{H} - \text{N}_a$ H N_a
- $\text{N}_a - \text{C}_a$ N_a C_a
- $\text{C}_a - \text{O}_a$ C_a O_a
- $\text{N}_b - \text{C}_b$ N_b C_b

iii) Name the orbitals which are used to form below π bonds.

- $\text{C}_a - \text{O}_b$ C_c O_b
- $\text{N}_b - \text{C}_b$ N_b C_b

iv) What are the approximate bond angles around below atoms.

N_a C_a O_a N_b

v) Arrange N_a , C_a , O_b , N_b , C_b atom in to the acending order of electronegativity.

.....

d) $\text{NH}_3(\text{g})$ reacts with liquid HCl to produce white fume. It can be dissolved in water to form $\text{NH}_4\text{Cl}(\text{aq})$ and then resulting solution can be evapoarted to from NH_4Cl crystals. Mension primary/secondary interactions occur in the following species.

	primary interaction	Íecondary interaction
$\text{NH}_3(\text{g})$
$\text{HCl}(\text{l})$
$\text{NH}_4\text{Cl}(\text{s})$
$\text{NH}_4\text{Cl}(\text{g})$

(02) a) X is an metal which belongs to the s -block and it has the highest electronegativity of the group.

- X gives an aqueous solution A and evolve a gas B after reacting with cold water.
- By the combustion of X in air, products C and D are obtained. When C and D are added to water, D gives solution A, while C gives E gas together with solution A.
- A solid compound F, is formed by the reaction of X with gas B,
- When solid F reacts with water, solution A and B_(g) are produced.

i) Identify X and write the electronic configuration at ground state.

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.....

ii) Write the chemical formulae for the compounds/ molecules A to F.

A - D -

B - E -

C - F -

iii) Give balanced chemical equation for the reaction of X with,

1. air -

2. water -

3. With gas E -

iv) Y is the element adjacent to X in the same period, where Z is a metallic element adjacent to X in the same group. Arrange X , Y and Z or their compounds in ascending order of the properties given below.

1. Reducing power -

2. melting point-.....

3. Basicity of the oxides -

4. decomposition temperature of carbonates.....

b) To identify CO_{2(g)} in the laboratory, it is continuously bubbled in to lime water.

i) Give the chemical formula corresponding to the chemical species in lime water.

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ii) Mention two observations that could be obtained from the above process.

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iii) Identify the chemical compounds for the each observations mentioned above.

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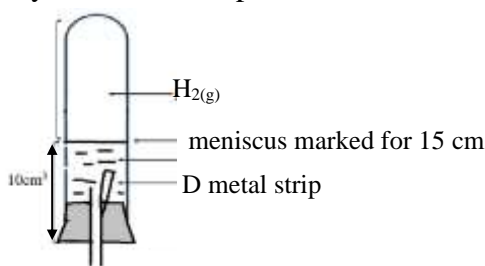
iv) Write balanced chemical equations for the above observations mentioned in (ii)

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v) Give an observation when the final mixture obtained in the above process is heated.

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(03) a) i. Below steps were followed to calculate the relative atomic mass of Al. A glass tube closed at one end was taken and filled with 150 cm^3 of water and the meniscus was marked B. Then the water is removed and the tube was completely filled with an aq solution of NaOH. Thereafter a 100 mg strip of D was inserted to it and the delivery tube was set up as shown in the below diagram.



In the above experiment, $\text{H}_2(\text{g})$ and $\text{NaAlO}_2(\text{aq})$ are given as the products. At the end of the experiment, the weight of the remaining dried metal strip was 10 mg .

room temperature - 27°C

atmospheric pressure - $0.83 \times 10^5\text{ Pa}$

pressure of water $0.01 \times 10^5\text{ Pa}$

molar volume of a gas - 22400 cm^3 at STP

i) Write the balanced chemical equation for the above process.

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ii) Calculate the volume of gas accumulated at standard temperature 0°C and standard pressure $1 \times 10^5\text{ Pa}$

.....

iii) What will be the moles of gas accumulated in the above experiment?

.....

iv) Calculate the number moles of Al, which reacted with aq NaOH solution.

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v) Calculate the relative atomic mass of the metal.

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vi) If dil HCl solution is used instead of dil NaOH calculate the mass of metal consumed during the above experiment.

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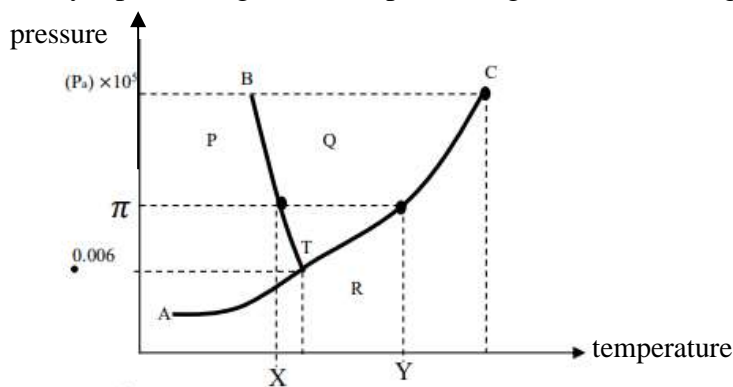
vii) a) Mention any assumption that you made for the above calculations.

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b) Define the term "boiling point" of a substance.

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(Variation of melting point/ boiling point/ sublimation point of a substance with room temperature and pressure is illustrated by a phase diagram.) The phase diagram of water is given below.



i) Identify the region illustrated by P, Q and R.

A -

B -

C -

ii) π is the atmospheric pressure at sea level. Identify X and Y and give the corresponding values for them.

X..... Y.....

iii) Label following curves

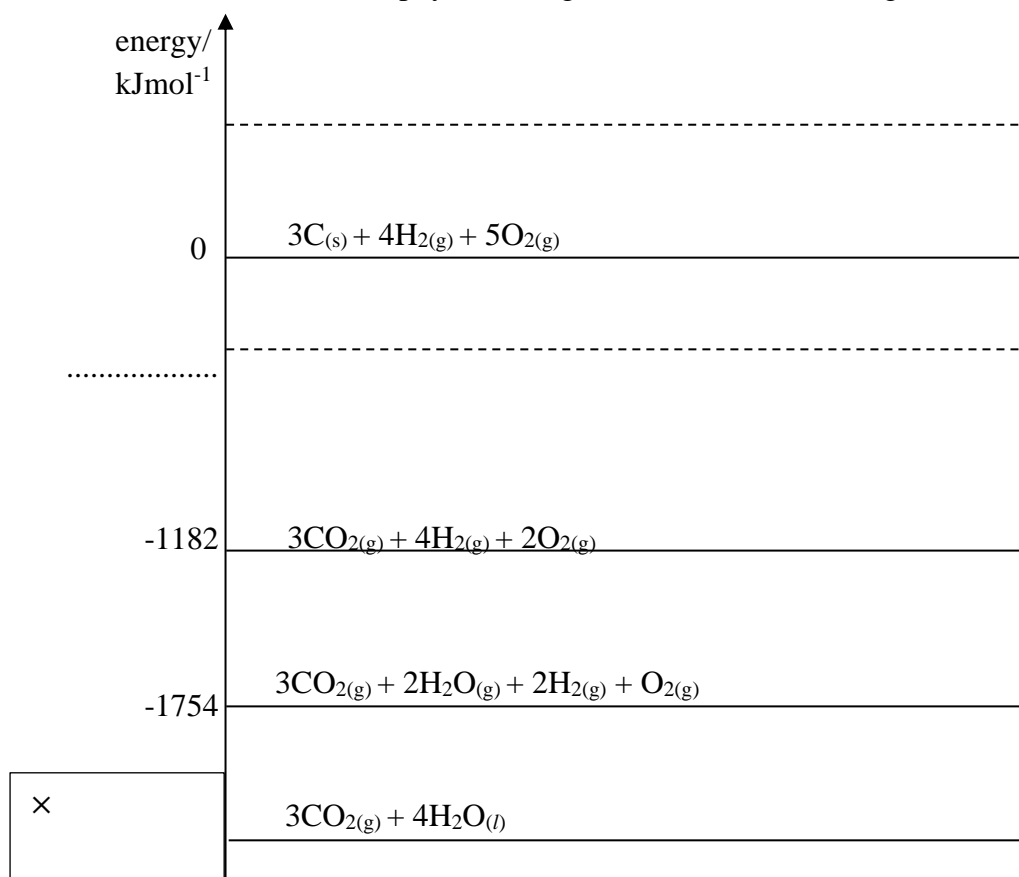
A -T curve -

B -T curve -

C -T curve -

iv) The highest temperature at which steam can be liquefied by increasing pressure is 374°C . Name that temperature. Label that temperature in graph.

- (04) a) Propane (C_3H_8) and Propyne (C_3H_4) are two gaseous hydrocarbons. An incomplete energy diagram constructed to determine an enthalpy value is given below. Use this diagram to calculate below data.



- Write the balanced equation for the standard enthalpy of formation of $\text{CO}_{2(\text{g})}$ and calculate that value.
.....
.....
.....
- Write the balanced equation for standard formation enthalpy of $\text{H}_2\text{O}_{(\text{l})}$ and calculate it..
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.....
.....
- Calculate value of X and mention in the above energy diagram.
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.....
- The standard formation enthalpy of propyne ($\text{C}_3\text{H}_{4(\text{g})}$) is $+180 \text{ kJ mol}^{-1}$. Identify the final and initial energy levels relevant reactants and products with an arrow which demonstrate relevant energy difference in the above diagram.
- The standard combustion enthalpy of propyne is $-2220 \text{ kJ mol}^{-1}$. Insert that value in to the above enthalpy diagram.

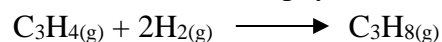
- vi) Write a balanced chemical equation for standard combustion enthalpy of $\text{C}_3\text{H}_{4(g)}$. Calculate that value using above diagram.

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- vii) State balanced equation for standard formation enthalpy of $\text{C}_3\text{H}_{8(g)}$. Calculate above value by using given enthalpy diagram.

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- viii) Calculate the enthalpy of below reaction.



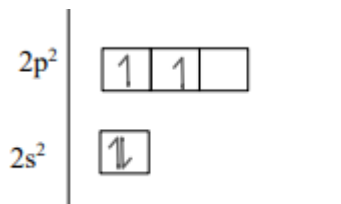
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Part B - Essay

- Answer only four questions.

(05) a) HCO_3^- ions react in an aqueous medium as an acid donating H^+ to water, and as a base by accepting H^+ from water.

- Draw all the resonance structures for HCO_3^- .
- An energy diagram is given below to determine the energy in the ground state of orbitals of the valence energy level of C atom of HCO_3^- ion.



Draw the energy diagrams in your answer script which are relevant to the excited state and hybrid state.

- Draw an orbital diagram for HCO_3^- to illustrate the shape around central atoms. (Draw only bonded orbitals of terminal atoms)
- Write the balanced chemical equations to illustrate acidic and basic properties of HCO_3^- (aq)
- The mass ratio of $\text{KHCO}_3 : \text{H}_2\text{O}$ in KHCO_3 solution is 1 : 99. If the density of the solution is 1.0 g cm^{-3} , calculate the concentration of KHCO_3 solution.

b) The relative molecular mass of compound X, which contains only C, H, O is 90. When pure sample of this compound is combusted 3.52 g and 0.72 g of CO_2 and H_2O formed respectively.

(C = 12, O = 16)

- Calculate the C : H molar ratio of compound X.
- If C : O molar ratio of compound X is 1 : 2, obtain the molecular formula of X using appropriate calculations.
- The weakly acidic compound X reacts with KOH in 1 : 2 molar ratio.
 - Draw the most acceptable Lewis structure for X.
 - Write the balanced chemical equation for the reaction between X and KOH.

c) A volume of 25 cm^3 of 0.2 mol dm^{-3} KCl solution was acidified with H_2SO_4 and oxidized to KClO_x . 10 cm^3 of 0.5 mol dm^{-3} $\text{K}_2\text{Cr}_2\text{O}_7$ was required for oxidation.

- Write the balanced half ionic equation for reduction (Using X).
- Write the balanced half ionic equation for oxidation.
- Calculate value x.
- Write balanced chemical reaction for the above reaction.

(06) a) Gas laws are used to describe the macroscopic properties of gases that affect their behavior. Molecular kinetic theory has been proposed to study quantitatively/ qualitatively the molecular properties/ microscopic properties that contribute the macroscopic properties of a gas.

- State four assumptions of molecular kinetic theory.
- Write molecular kinetic equation and define the terms of it. Give the SI units
- Derive an expression for the root mean square speed of an ideal gas including its pressure and density.
Discuss how pressure and density affect the mean speed of the gas.

iv. The density of atmospheric air at 27°C and $1 \times 10^5 \text{ Pa}$ is 1.2 kg m^{-3} . Calculate the mean speed of a gas molecule in the atmosphere.

v. Write two reasons for the deviation of real gases from ideal behavior.

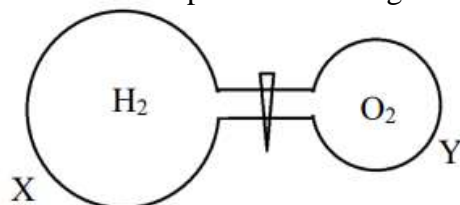
b) The changes in a gaseous system are given below.

A. The two containers (X and Y), with H_2 and O_2 , with volumes of 8.314 dm^3 and 4.157 dm^3 and the pressures $6 \times 10^5 \text{ Pa}$ and $3 \times 10^5 \text{ Pa}$ respectively are at 27°C .

B. Later they were connected by a narrow tube to allow the gases mix.

C. Then only container X was heated up to 127°C .

D. The total system was heated up to 227°C and gases were allowed to react completely with each other



i. Calculate initial moles of each gas in the containers.

ii. State the gas law that can be applied to each gas in step B. Calculate partial pressures of H_2 and O_2

iii. At step C, will the air pressures in the containers be equal or unequal. Discuss giving reasons. Calculate pressure/ pressures in the containers.

iv. After step D, the system was cooled until 27°C . Calculate the partial pressures of gases in gaseous phase.

(07) a) The system reached a maximum temperature of 50°C , when 3.45 g of ethanol [$\text{C}_2\text{H}_5\text{OH}$] stored along with excess oxygen were burnt completely using electrical sparks in a rigid, closed container at 27°C .

The heat capacity of this system (heat required to increase its temperature by 1 K) is 2100 J K^{-1} . ($\text{C} = 12$, $\text{O} = 16$, $\text{H} = 1$)

i. Write the balanced chemical equation for the above combustion reaction.

ii. What is the amount of ethanol combusted here.

iii. Sketch a graph from the beginning to the end of the reaction, to show the variation of temperature of the system with time. Include the correct values related to data.

iv. What is the amount of heat change in the above combustion?

v. Calculate the heat change at constant volume in the combustion of ethanol.

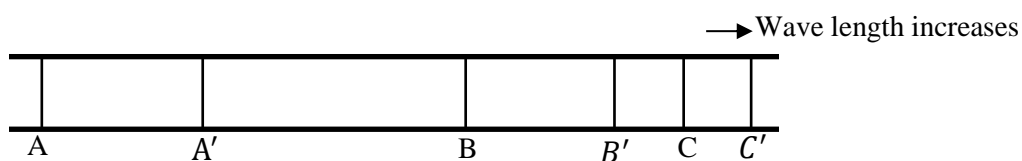
b) Some standard enthalpy values related to combustion of ethanol are given below.

Compound	Standard enthalpy kJ mol^{-1}
$\text{CO}_2 (\text{g})$	-394
$\text{H}_2\text{O} (\text{l})$	-286
$\text{C}_2\text{H}_5\text{OH} (\text{l})$	-278

I. Calculate the standard enthalpy of combustion using the above given data.

II. State two reasons, why I and the above a(v) are different from each other.

- c) The initial and final spectral lines of the three consecutive spectral series in the maximum frequency zones of the emission spectrum of Hydrogen are shown coupled as A - A', B - B' and C - C'. They are shown in the spectrum below when arranged in the increasing order of wavelength.



- Draw the electronic transitions related to the above spectral lines using arrows in an energy level diagram drawn, showing the correct distances between energy levels. Label those arrows as A - A', B - B', C - C'.
 - Derive an expression for the energy of one mole of photons. Using the derived expression, calculate the energy of one mole of photons with a wave length of 91.2 nm.
 - Define "energy of the first energy level". Mention its value accurately.
 - Show the ionization of Hydrogen using a suitable balanced chemical equation. Obtain its value using the answer in the above(iii).
- (08) a) The following steps were followed to determine the composition of H_2SO_4 in a bottle of concentrated acid stored in the chemical laboratory, as its label was damaged.
- A - 10.00 cm^3 of the concentrated H_2SO_4 acid was accurately measured using a pipette and it was diluted with distilled water up to 500 cm^3 to prepare the solution A.
- B - 10.2 g of NaOH having weight percentage (w/W) as 98% were weighted and the solution B was prepared by dissolving it using distilled water until the final volume became 500 cm^3 .
- C - The endpoint was obtained as 20 cm^3 , when 25.0 cm^3 of the acid solution A, kept in the titration flask were titrated with the solution B, kept in the burette, in the presence of a suitable indicator.
- Name a suitable indicator for the above titration and mention its colour change at the endpoint..
 - Calculate the concentration of the solution B prepared in the above steps.
 - Calculate the concentration of the acid solution A and the concentration of the concentrated H_2SO_4 solution.
 - The density of the above concentrated H_2SO_4 solution is 1.4 g dm^{-3} . Determine the percentage of H_2SO_4 acid in it.
- b) It is identified that tomato juice contains oxalic acid which is an organic acid. To determine its composition, the following steps were followed.
- A- 20 cm^3 of Tomato juice extracted by pressing one fruit was diluted with distilled water up to 250 cm^3
- B - 25 cm^3 of the above diluted solution was added to the titration flask and it was heated until 60°C after adding 10 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$ into it.
- C - The heated solution was titrated with $0.01 \text{ mol dm}^{-3} \text{ KMnO}_4$ solution and the endpoint obtained was 8.00 cm^3
- Write atleast one reason for following the steps given below in the titration mentioned above.
 - diluting with distilled water
 - Adding H_2SO_4 acid
 - heating the content in the titration flask.
 - Write the balanced ionic equation for the chemical reaction in the above titration.
 - Identify the indicators related to this titration. Write the colour change of it.
 - Calculate the composition in Tomato juice in mol dm^{-3}
 - Show using an appropriate calculation, whether the amount of H_2SO_4 acid added to this titration is sufficient?



- (09) a) To Calculate the composition of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$), 10.0 g of crystals were heated until a constant mass is obtained. The mass obtained after heating was 4.24 g.
- Give a suitable expression to illustrate the chemical change occurs during heating. (using X)
 - Calculate the value of X and write the chemical formula of the hydrated salt
 - Calculate the mass of above hydrated sodium carbonate having percentage purity 80% (W/W) that should be used to prepare a solution of 250 cm^3 with 0.4 mol dm^{-3} concentration.
- b) Na gives a mixture of, Na_2O_2 and Na_2O . when combusted in air. To identify the major product of the mixture, the following procedure was carried out.
- A. 3.22 g of pure Na metal was combusted in air and the resultant mixture of products was dissolved in water and diluted up to 250 cm^3 .
- B - 25 cm^3 of the above solution was pipetted out and treated with excess KI solution. The solution was kept for a sufficient time to complete the reaction.
- C - Then the solution was titrated with 0.5 mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3$ Solution and the end point was detected as 20 cm^3 .
- Write the balanced chemical equations occur in the above process.
 - Calculate the mass of Na which converted in to Na_2O_2 .
 - Based on the moles of Na_2O_2 and Na_2O formed during combustion, identify the major product obtained during combustion of Na in air.
- Give the total process in a balanced chemical equation, using the above calculation.

Periodic Table

1 H 1.008																	2 He 4.00															
3 Li 6.94	4 Be 9.01																	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18									
11 Na 22.99	12 Mg 24.31																	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95									
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80															
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30															
55 Cs 132.91	56 Ba 137.33																	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)																	104 Rf (261)	105 Db (268)	106 Sg (271)	107 Bh (272)	108 Hs (270)										
																		57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
																		89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (268)	102 No (269)	103 Lr (262)