2. Periodic Table

Modren periodic law:-

" The phyisical and chemical Properties are the periodic functions (an Element) of their Electronic configurations this is known to be Moseley Modren periodic law".

When the electronic configuration are appears to be similar. Then, the physical & chemical properties are also similar

* Long form of Peroidic table:-

Peroidic table consisting of 7 Periods and 18 groups (XIIV Groups). The verticle coloumns are known to be 'groups', and horizantal rows are known to be 'periods'. The first period of the perodic table consisting of only 'two' elements towards $1s^1, 1s^2$. Second Period consisting of 8 elements only ($2s^1, 2s^2$ - (2) and $2s^2 2p^{(1-6)}$ - (6). '8' elements) Third period consisting of 8 elements only - ($3s^{1-2}$) - (2), $3s^2 3p^{1-6}$ - 8 elements).

In reality '3' period should consisting of '18' elements (d^{1-10}) According to 'Afbau principle' after 4s orbital only the occupation of electrons in 3d takes place

$n+l$

$4s = 4+0 \Rightarrow 4$

$3d = 3+2 \Rightarrow 5$

$$\boxed{\therefore 4s\,(E_1) < 3d\,(E_2)}$$

forth period consisting of '18' elements only

$4s^1, 4s^2$ (2)

$3d^{1-10}$ - (10)

$4p^{(1-6)}$ - (6)

In reality 4 Period should have 32 elements But, on the basis of Afbau principle

$n+l$

5s ; $5+0=5$

4d, $4+2=6$

$\boxed{\therefore 5s < 4d}$

$n+l$

4f = $4+3 \Rightarrow 7$

6p = $6+1 = 7$

6s = $6+0 = 6$

5d = $5+2 = 7$

$\boxed{6s < 4f}$

Thatswhy '4f' orbital should takes places after the occupation of elections in n=6 ($6s^1, 6s^2$) Similarly, '4d' orbital takes place in n=5 ($5s^{1-2}$, $4d^{10}$) in '5'-th period there are 18 elements - ($5s^1, 5s^2, 4d^{1-10}, 5p^{1-6}$ = 18 elements).

6th period consisting of 32 elements Known to be "Long form of Peroidic table".

$6s^1, 6s^2$ - (2)

$4f^{1-14}$ - (14)

$5d^{1-10}$ - (10)

$6p^{1-6}$ - (6)

32

7th period is incomplete with the orbitals

$7s^1, 7s^2$ - (2)

$5f^{1-14}$ - (14)

$6d^{1-10}$ - (10)

$7p^{1-6}$ - (6)

⋮

* Peroidic properties:-

"The physical and chemical properties of elements are the periodic functions with the electronic configuration.

Types of Periodic Properties :-

1. ~~Ionoi~~ Ionization (Enthalpy / Energy).
2. Electron affinity (Electron Gain Enthalpy)
3. Electronegitivity :
4. Metallic property
5. Non-metallic property

Ionization Enthalpy:-

"The energy required to remove most loosely held electron in an atom in dissociated gases state"

* Trends :-

→ Groups :-

In the case of groups from top to bottom the atomic radius is gradually increases. In the case of 1st A group elements from lithum to Francium new joining electrons Enters into new main Energy level. thatswhy the atomic radius gradually increases, once the atomic radius increases the distance between neucley and valency electron is also increases thatswhy the attraction force of neuleus and on valancy gradually decreases and hence, in any group from top to bottom the Ionization Enth is gradually decreases

2S' Li (3)

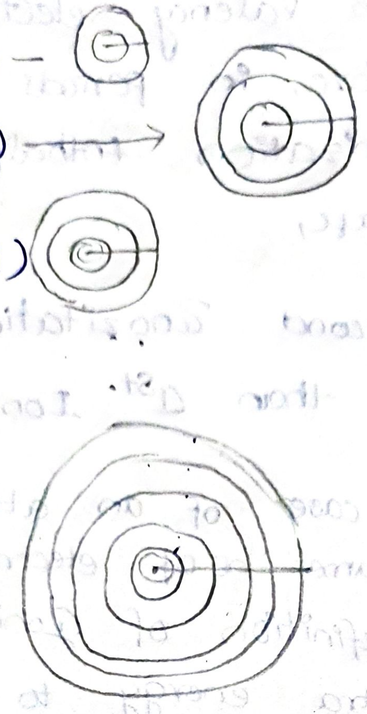
3S' Na (11)

4S' K (19)

5S' Rb

6S' Cs

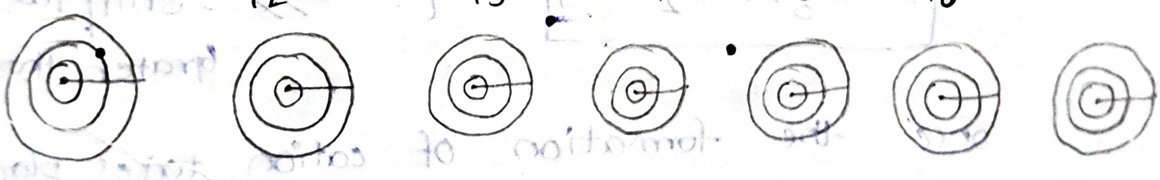
7S' Fr



* Periods :-

In periods from left to right the new joining electron enters into same main energy level thats why the atomic radius believed to be constant

Na	Mg	Al	Si	P	S	Cl
11	12	13	14	15	16	17



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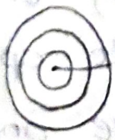


In the case of Periods from left to right one proton is gradully increases thats why the Nucleus is strong to attract the electrons towards it-self which it leads to decreasing atomic radius. So that in Periods from left to right the atomic radius graduals

Decreases and hence the attraction force of Nucleus on valency electrons gradually increases. Therefore, in periods from left to right the ionization enthalpy values are gradually increase,

"The second Inozitation potential is alway higher than 1st Ionization potential".

In the case of an atom same no. of protons and same no. of electrons are present As, per the definition of Ionization Enthalpy by supplying extra energy to atom then, 1st electron is removed (I_1)

$$M \xrightarrow{I_1} M^{\oplus} + e^{\ominus}$$

$$M^{\oplus} \xrightarrow{I_2} M^{+2} + e^{\ominus}$$

$$\boxed{\therefore \; I_2 > I_1}$$

As, $M^{+2} \xrightarrow{I_3} M^{+3} + e^{\ominus}$

$$\boxed{\because \; I_3 >> I_2 > I_1}$$

($\because$ '>>' - still/far grater than)

once the formation of cation takes place (M^+). The Neucleus is placed with one Proton exess thatswhy still we have to apply Extra energy $(I_2 , I_2 > I_1)$ To remove another electron thatway Second Ionization Enthalpy is always grater than 1st Ionization enthalpy

8m ✓* **Factors** :-

The following factors Effects the Ionization Enthalpy which are given by :-

1. Atomic radius
2. Nucluer charge
3. Screening effect
4. completely and half filled configurations

① **Atomic radius**:-

In given two atoms which atom has got high atomic radius is having low Ionization potential. The atom with less atomic radius is having high ionization potental.

$\therefore$ Ionization Enthalpy $\propto \frac{1}{\text{Atomic no.}(Z)}$

$\boxed{\Rightarrow I_E \propto \frac{1}{Z}}$

*② **Neuclear charge**:-

In given two atoms which atom has got high neuclear charge (nearly 50-70) then, the neucleus is capable to attract all the electron toward itself. That's why high energy is required to remove valency electron Nothing but Ionization enthalpy Increases

$\therefore$ Nuclear charge $\propto$ Ionization Enthalpy.

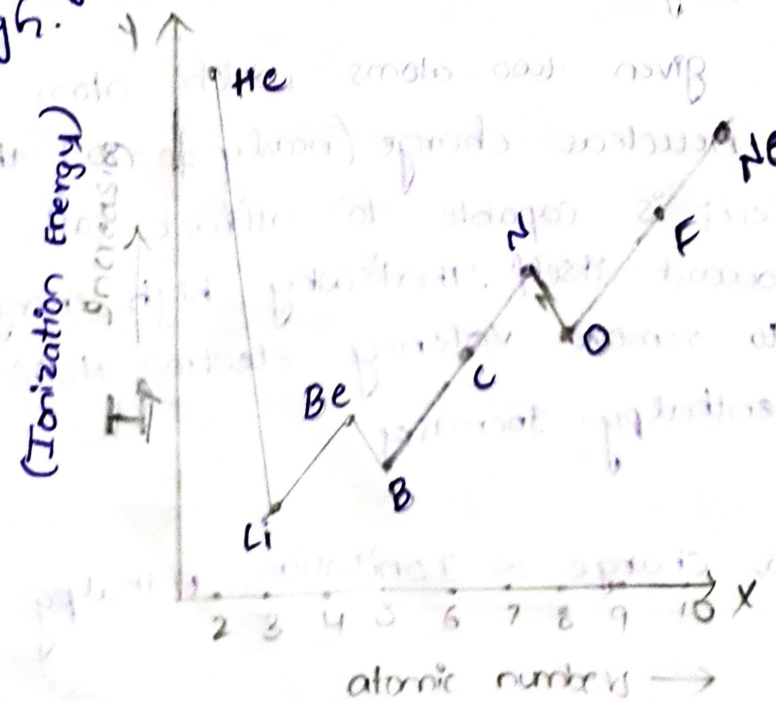
Screening effect:-

This effect is selective for high atomic numbered systems only (nearly 90). In this particular case the Inner shells of the atom completely filled with electron that'swhy those electrons are present in Inner shells can screens the Neucluer attraction out of "valency electrons". And hence, valency electrons Experience low Nuculer charge that'swhy it can be easily removed, results less Ionization Energy

$$\therefore \text{Ionozitation Enthalpy} \propto \frac{1}{\text{Screening effect}}$$

2m * completely filled and half filled (orbital)-configuration:-

In the case of atoms placed with completely filled or half filled orbitals are having (same stability that'swhy for these two configurations Ionization potential is reletively high.



∴ Helium having ~~heighst~~ heighest Ionization Potential in whole Periodic table.

2m In general, from Helium to Neon (In a period) from left to right Ionization enthalpy values should gradually Increase but, In the case of Berlirylium and Boron, 'Be' has got high I_E than boron because of its completely filled $2s^2$ configuration similarly in the case of Nitrogen and oxygen, Nitrogen atom has got high I_E than oxygen due to its half filled configuration ($2p^3$).

2m "In entire periodic table 'Inert gas' elements has got high I_E than the Remaining elements. Due to its octet configuration ($ns^2 np^6$) Helium $1s^2$"

2m Inert gas elements are also belongs to group elements from 'Helium' to 'Radon' atomic radius gradually increases that's why 'He' has got high I_E in entire Periodic table.

(2.) Electron affinity :- (Electron gain Enthalpy)

"Electron gain Enthalpy is the Liberated energy when one electron is added to an atom which is in gaseous state.

During electron affinity always energy is liberated to the environment, as the energy increases the added electron to atom stay for a long time if less energy is liberated the added electron Not at all stay for a long time

* **Trends :-**

In the case of groups from top to bottom the atomic radius gradually increases. So, the distance b/w neucleus and valency electron is also increases. Which results the attraction force of Nucleus on valency electrons decreases. Thatswhy the electron affinity values gradualy decreases by liberating less extent of energy.

Periods:-

In the case of periods from left to right the atomic radius gradually decreases. so that, the Attraction force of Nucles on valency electrons increases and Hence, Electron affinity values gradually increases.

In Entire peridic table 7^{th} A group elements has got high electron affinity. In which ~~clor~~ chlorine (Cl) has got high electron Affinity. This can be explained as follows:-

In the case of Flourine (F) it is having less Atomic radius thatswhy as per the Electron Affinity the Inter electron Repulsiony among Present electrons and with new electron. Due to Inter-electronic repulsion. Neucleus is said to be weak, results less extent of Electron Affinity. On the other hand, In the case of chlorine atom the atomic radius is relatively high than the flourine atom, thatswhy Interelectronic repulsions are less operative to increase electron affinity. Similarly, we can explain electron affinities of {Oxygen, sulphur} and {Nitrogen, Phosphorus}.

③ Electronegitivity :-

" the Tendency of an atom to attract bond pair of electrons towards itself partially is known to be Electro-Negitivity.

* Trends:-

In the case of groups from top to bottom the Atomic radius is Increases. once the atomic radius Increases the distance b/w neucles and valency electron is also Increases. So that the attraction force of neucleus on pair of electrons decreases. And Hence, electro-negitivity gradually decreases.

In the case of periods from left to right the atomic radius gradually decreases. That's why the attraction force of Neucleus on valency electrons Increases and hence, electro-negitivity values gradually Increases.

1m: In entire Periodic table "Florine" has got high 'Electro-negitivity' due to its less atomic radius. It's value is 4.0 units (experiment value)

oxygen has got 2^{nd} Position in periodic table with 3.5 units electronegitivity

chlorine and Nitrogen atoms are having Equal value of Electro-negitivity - 3.1 units. and further carbon is 2.6 and Hydrogen is 2.1

4) **Metallic Property :-**

"The Tendency of an atom to give electrons more readyly is known to be 'metal'. In periodic table IA, IIA group elements are believed to be best metals in periodic table.

Trends :-

In groups from top to bottom the atomic radius increases. That's why the attraction force of Neuclues on valency electrons gradually decreases. In entire periodic table :- "Cesium" (Cs) best metal. Because the last element of IA is a Radio-active element.

Periods :-

In periods from left to right the atomic radius decreases. that's why the attraction force of Neucleu on valency electrons gradually Increases. Nothing but Metallic Property decreases.

5) **Non-metallic Property :-**

"The Tendency of an atom to attract electrons more readily is known to be Non-metal

Trends :-

In the case of groups from top - bottom. The atomic radius Increases. So that the attraction force of Neucleus on valency electron gradually decreases. Nothing but non-metallic property decreases.

In the case of Periods from left to right The atomic radius decreases. That's why the attraction force of Neucley on valency electrons increases. Nothing by Non-metallic property increases.

In entire period table VII A group elements have got high Non. metallic property Because, they're adjecent to Intert gaselements. These VIIA group element can take up one electron to get nearest Inert gas configuration

Im

Classification of elements on the basis of Entering of the valency electron:-

on the basis of placement of valency electron in different orbitals (s, p, d, f) elements are calassified as:-

1. S-block elements
2. P- block elements
3. d- block elements
4. f- block elements

1. S-block elements:-

- In these elements the valency electrons enters into s-orbital
- IA, IIA this two groups are presented in s-block
- The general electronic configuration of s-block elements is given by ns^1, ns^2 $(ns^{1 \text{ to } 2})$
- All these elements are best metals in Periodic table. (Cesium is best metal)

* P-block elements:-

If valency electrons enters into P-orbital are known to be P-block elements.

- The general electronic configuration of P-block elements is given by ns^2np^1 to ns^2np^6.

- In P-block elements. 6 groups are present in which Inert gas element doesn't participate in chemical reaction, the remaing elements ready to attain Inert gas configuration.

- In the case of P-block elements more no. of elements towards non-metals and very few are metals and some are metalloids

* d-block elements:-

- The general electronic configuration of d-block elements is given by $ns^2(n-1)d^{1-10}$

- The general electronic config. of transision element is given by $ns^2(n-1)d^{1-9}$. That's why "all Transisation elements are d-block element, but all d-block elements needn't be Transision elements. So that $3d^{10}, 4d^{10}, 5d^{10}, 6d^{10}$ elements are known to be <u>Non-Transision elements</u>

- All d block elements are metals.

- Many d-block metals are used in Industry
  <u>ex</u>: (i) During the preparation of Ammonia, Iron (Fe) acts as catlyst
  (ii) Nikle (Ni) acts as catlyst in Dalda

- In d-block elements due to unpaired electrons these acts as magnetic materials and also exhibits special colours.

* f-block elements:-

- The general elec.configuration of f-block elements is given by $ns^2 (n-1)d^{1-0}(n-2)f^{1-14}$.
- In the case of f-block elements, the valency electron enters into "Anti-Penultimaite shell" (Means - Last but 2)
- If valency electron enters into 4f orbital these 14 elements are known to be "Lanthanides" [after the Lanthanum elements]
- If valency electron enters into 5f orbital are known to be Actinides [~~After~~ After the Actinum (Ac) the remaining 14 elements]
- These f-block elements are known to be "RARE EARTHS"
- In Actinides after 'Uranium' all elements are synthetic elements [Manmade] known to be "TRANS URANIC ELEMENTS"

* Classification of elements on the basis of their chemical properties:-

The elements are classified as 4 types on the basis of their reactivity:-

1. Representative elements
2. Inert gas elements
3. Transision elements
4. Inner-Transision elements

* Representativ elements:-

excluding Inert gas elements, The remaining s and p block elements are known to be Representative elements.

* S. block elements:-

* P-block elements from the above discussion.

Inert gas:-

In periodic table Inert gas elements are placed right-side of the periodic table of last row (group). These are

$He - 1s^2$

$Ne - 2s^2\ 2p^6$

$Ar - 3s^2\ 3p^6$

$Kr - 4s^2\ 4p^6$

$Xe - 5s^2\ 5p^6$

$Rn - 6s^2\ 6p^6$

Except Helium the remaining Inert gas elements have got $ns^2 np^6$ (octet configuration) That's why these elements are stable. So that during the course of chemical reaction these elements provides zero electron. and hence, these are known to be zero group elements. In atmosphere these gases are present in minute amount known to be RARE GASES.

* Transision elements:-

d- block elements are known to be Transision elements

d-block ...

* Inner-Transision elements :-

f-block elements are known to be Inner-transision elements. because, 24 elements are placed b/w 2 transision elements. That's why these are known to be Inner-tronission elements.

f-block element :-

Atomic radius :-

The distance b/w neucles and valency shell or valency orbital is known to be atomic radius. In reality it is impossible to calculate atomic radius. why because, atom is tiny so that the following methods are used

metallic radius :-

When two similar atoms are come closer to each other, two attraction forces, 2 repulsive forces are dominative. That's why the half of the distance between two centers of two Nuclie can be calculated which is grater than the original atomic radius is known to be metallic radius.

* In periodic table, In this way we can calculate atomic radius for all elements which are in solid state.

Eg:- when 2 Cu atoms are come closer to each other the calculated distance is 256 Pm. $\therefore$ 1 Picometer $= 10^{-9}$ m

$\therefore$ metallic radius of copper $= \frac{256}{2} = 128$ Pm.

Thats the atomic radius of $Cu = 128$ Pm.

* Covelent radius:-

In the case covelent bonded moleculey half of the distance b/w both the atoms in chemical bond is known to be covelent radius: In periodic table covelent radius is selective for covelent bonded molecules like H_2, N_2, O_2, F_2, Cl_2

*** Ex:- In the case of chlorine atom the ~~bed~~ bond distance b/w two atoms = 198 Pm.

Therefore, covelent radius of chlorine atom = $\frac{198}{2}$

= ~~98 Pm~~ 99pm = 99×10^{-9} m.

⟹ Types of oxides :-

* Acidic oxides:-

when non-metallic oxides dissolves in aqua to form acids thats why non-metallic oxides are known to be acidic oxides.

Ex:- $CO_2 + H_2O \longrightarrow H_2CO_3$ (Carbonic acid)

⟹ $SO_3 + H_2O \longrightarrow H_2SO_4$

* $Cl_2O_7 + H_2O \longrightarrow 2HClO_4$

(Chlorine Heptaoxide) (Perchloric acid)

* Strongest acid on Earth.

* Strongest acid on Earth - "Perchloric acid"

* Basic oxides :-

when given metallic-oxide dissolves an aqueous medium to produce bases are known to be basic oxides

Eg:- $Na_2O + H_2O \longrightarrow NaOH$ (Sodium hydroxide)

(iii) $CaO + H_2O \longrightarrow Ca(OH)_2$

calcium hydroxide.

CO, N_2O

Nitrous oxide

* Neutral oxides :

When given oxide dissolves in aqua then, Neither produce acid nor base are known to be Neutral oxides.

Eg:- CO, N_2O

(carbon monoxide) ↳ Nitrous oxide laughing gas)

* Amphoteric oxides:-

When given oxide reacts with both acid and base is known to be amphoteric oxide.

Eg:- (i) $ZnO + HCl \longrightarrow ZnCl_2 + H_2\uparrow$

(ii) $ZnO + NaOH \longrightarrow Na_2ZnO_2$

(Sodium Zincate)

* $ZnO + H_2O \longrightarrow Zn(OH)_2$

* EAMCET :-

Diagonal relationship:-

Li Be B C

Na Mg Al Si

(Li, Mg) (Be, Al), (B, Si)

$Al_4C_3 + 12H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$

Aluminium carbide

$Be_2C + 4H_2O \longrightarrow 2Be(OH)_2 + CH_4$ - Methane

(Beryllium carbide.)

Due to the similar atomic radius of the Different elements from different groups. Diagonal each other shows similar CP is known Diagonal r

After the 4th group the relation doesn't valid because of the atomic radius not at all equal to each other. like the previous pairs

2. C.P $\longrightarrow$ chemical properties.