Periodicity

- Classification of elements and periodic properties.

History ~

1) Proust Hypothesis -

- According to him, all the elements are made up of Hydrogen [H].
- Like, Nitrogen [N^{14}] are made up of 14 hydrogen.
- We know that this ~~is~~ hypothesis is wrong because all elements have [different] chemical and physical properties.

2) Dobereiner -

- He gave a theory of Trid
- According to him elements are arranged in terms of atomic mass.
- So, middle elements are avg. of the other 2.

Example :

Li	Na	K
7	$\frac{7+39}{2}$	39
	$= 23$	

3) Newsland -

- He gaves law of octaves.
- According to him, where elements are arranged in the terms of atomic weight just like Rhinse of music.
- Every 8th element resembles the property of 1st element.

सा (1st) रे गा म प ध नी सा (8th)

- At that time only 63 elements are known.
- Noble gas doesn't found at that time.
- Each group 1-7 have sub-groups and 8th group have 3 sub-groups.
- Each contain 3 elements.

Demirts / Merits of Mendleeve's Periodic Table ~

- Study of atoms, elements become very easy.
- Prediction of New elements.
- Isotopes are placed in same position.
- This periodic table is based on atomic weight.

Modern Periodic Table

Henry Mosely -

" All the physical & chemical properties of elements are periddic function of their atomic number "

Long Form of Periodic Table ~

Scientist : Werner, Rang, Bohr, Bury

7 Periods

- 1st Period - Shortest Period - 2 [H, He]
- 2nd Period - Short Period - 8 elements [$_{3}Li$ - $_{10}N$]
- 3rd Period - Short Period - 8 [$_{11}Na$ - $_{18}Ar$]
- 4th Period - long Period - 18 element [$_{19}K$ - $_{36}Kr$]
- 5th Period - long Period - 18
- 6th Period - longest Period - 32 elements [Cs - Rn]
- 7th Period - Incomplete Period - 26 element

Groups ~

⟹ Group 1 -

→ Alkali Metals

→ 1A group

H - ~~ह~~

Li - लीना

Na - ने

Rb - रब

Cs - से

Fr - फरीयाद

⟹ Group 2 -

→ Alkali Earth Metals

→ 2A group

Be - बेटा

Mg - मांगे

Ca - कार

Sr - स्कूटर

Ba - बाप

Ra - साज़ी

⟹ Group 13 -

→ Boron Family

→ B 3[III] A group

B - Baigan

Al - Aloo

Ga - Gaazar

In - In

Tl - Thella

⟹ Group 14 -

→ Carbon Family

→ 4A group

C - Chemistry

Si - Sir

Ge - Given

Sn - Some

Pb - Problem

⟹ 15th Group -

→ Nitogens
→ Nitrogen Family
→ VA [5th A]

N - Nana
P - Papa
As - Aasha
Sn - Sab
Bi - Bimar

⟹ Group 16

→ Chalcogens
→ Oxygen Family
→ VI A [6 A] group

O - old
S - style
Se - से
Te - ते
Po - पो

⟹ Group 17 -

→ Halogens
→ VII A [7 A] group

F - Fir
Cl - Kal
Br - Bahar
I - Aae
At - Aunty

G-3 Sc ↓ सुनो
G-4 Ti ↓ तुम
5 V ↓ विवाह
6 Cr ↓ करो
7 Mn ↓ मुझसे
8 Fe ↓ फिर
9 Co ↓ कोई
10 Ni ↓ नहीं
11 Cu ↓ कहेगा
12 Zn ↓ जानू

Demerits of Mendeleev's Periodic Table / Merits

1) Study of atoms, elements become very easier.
2) Prediction of new elements.
3) Isotopes are placed in same position.
4) This periodic table is based on atomic weight.

Periodic Table are divided into 4 parts -

1) S Block -
- It contain 14 elements
- It's common e^- configration are ns^1, ns^2.
- They are called alkaline metals and alkaly earth metals.
- He also placed in this groups.

1st Block - S Block

$ns^1 - ns^2$

14 elements

2 gas H, He

2 liq. Cs, Fr

Fr, Ra - Radioactive

Alkali metal

H except

Li	ns^1
Na	
K	
Rb	
Cs	
Fr	

Alkali earth metal

He	
Be	ns^2
Mg	
Ca	
Sr	
Ba	
Ra	

- Alkali metals are called Alkali metals due to, there aqueous (aq) soln are basic.
- Alkali earth metal are called as because its aq soln of oxides are basic and its oxide are formed in earth crust.

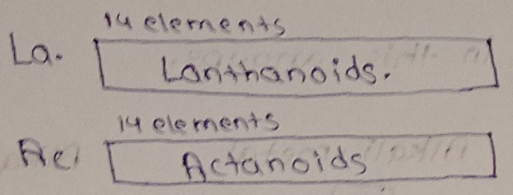
P Block -
- common e^- configration $ns^2 - np^{1-6}$
- There are 30 elements
- They contain all type of element (solid, liq, gas, metal, non-metal and metalloids).
- Ga and Br are liquid.
- It's 19 elements are solid.
- And 9 are gas

D-Block –

- D-Block element are also called transition elements except Zn, Hg and Cd, there common e⁻ configration are $(n-1)d^{1-10}\ ns^{1-2}$
- They are metals, all are solid except Hg.
- Most of the D-block elements are used as catalyst.

F-Block –

- They are also called inner-transition elements, with common e⁻ configration $(n-2)f^{1-14}\ (n-1)d^{1-10}\ ns^{1-2}$.
- They contain 2 periods of 14 elements. Lanthanoids and Actanoids.



- Lanthanium is a representative element of Lanthanoid Series but it is D-block element.
- Actanium are representative element of Actanoid Series but it is a D-block element.

Metal, Non-Metal and Metalloids

1) **Metal** –

- More than 78% of the element are metals and mostly they found in the left of the periodic table.
- Metal are solid at room tem. except Cs, Ga, Hg.
- They are good conductor of heat & electricity.

2) **Non-Metal** –

- Non-metal are usually solid or gas at room tem.
- They are bad conductor of heat & electricity.
- Br. one & only non-metal which is found in liq. form.

- 11 gases — H_2, N_2, O_2, Cl_2, He, F, Ne, Cl, Ar, Kr, Xe, Rn
- They are brittel.
- Some of the elements are also act as metalloids — B, Si, Ge, As, Sb, Te.
- They are also called semi-metals.

Above 100 atomic No. IUPAC Name

0 - Nil (n)
1 - Un (u)
2 - Bi (b)
3 - tri (t)
4 - quad (q)
5 - pent (p)
6 - hex (h)
7 - Sept (s)
8 - Oct~~er~~ (o)
9 - enn (e)

+ Suffix ium

Example :-
1) 105 - unnilpentium
2) 110 - ununnilium

Homework ~

1) 100 - unnilnilium (unn)
2) 102 - unnilbiium (unb)
3) 103 - unniltriium (unt)
4) 104 - unnilquadium (unq)
5) 105 - unnilpentium (unp)
6) 106 - unnilhexium (unh)
7) 107 - unnilseptium (uns)
8) 108 - unniloctium. (uno)
9) 109 - unnilennium (une)
10) 110 - ununnilium (uun)
11) 111 - unununium (uuu)
12) 112 - ununbiium (uub)
13) 113 - ununtriium (uut)
14) 114 - ununquadium (uuq)
15) 115 - ununpentium (uup)
16) 116 - ununhexium (uuh)
17) 117 - ununseptium (uus)
18) 118 - ununoctium (uuo)
19) 119 - ununennium (uue)
20) 120 - unbinilium (ubn)

Q) The IUPAC name of an element with atomic number 119 is [Neet 2022]

a) unnilennium
b) ununonnium
c) ununoctium
d) ununennium

Diagonal Relationship

Representative elements – Li Be B C N O I F

Na Mg Al Si P

Show same

Reason – Phy. che. property same – $\frac{\text{Charge}}{\text{Size}}$ ration is same

Magical Numbers

2
8
8
18
18
32
32

- This number are very helpful for founding periods & groups of elements.

Examples:

19
2
8
8
1 ← Group No.
↓
4th period

35
2
8
8
17 ← Group No.
↓
4th period

38
2
8
8
18
2 → gro
↓
5th period

Periodic Properties

- Radius (size)
- Ionization potential (I.P or I.E)
- Electron Affinity (E.A)
- Electronegativity (E.N)

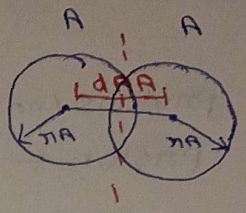
Radius ~

- It is not possible to calculate the Radius of atom because except noble gas all the elements are found in the form of molecules. So, It is not possible to calculate radius.

- There is a better option to calculate bond length of any molecule and half of its length called Radius.

Type of Bond Length ~

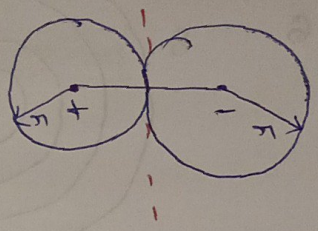
⇒ Covalent bond – covalent radius



Covalent radius = $d_{AA} = r_A + r_A$

$r_A = d_{AA}$

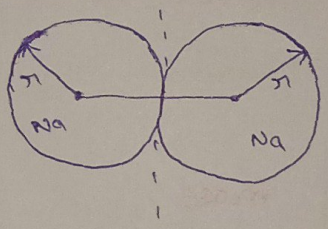
⇒ Ionic bond – Ionic radius



ionic radius = $\frac{d_{ionic}}{2}$

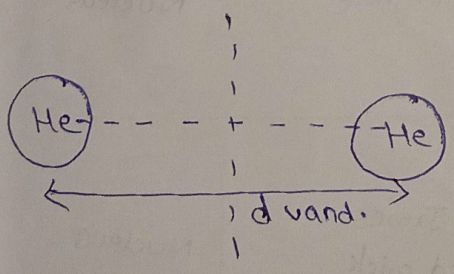
$d_{ionic} = r_+ + r_-$

⇒ Metallic bond –



$r_{metallic} = \frac{d_{metallic}}{2}$

⇒ Vanderwalls bond – ▪ Helium types of element are found in atomic / single state but we calculate other elements bond length then we also calculate bond length of Noble gases.



▪ The bond b/w noble gases are vanderwalls bond so, we also use this vanderwall bon for calculation the radius of Noble gases

$r_{vander} = \frac{d_{vander}}{2}$

∴ Radius – $r_{vanderwalls} > r_{metallic} = r_{ionic} > r_{co-valent}$

Zeffective ~

→ Net attraction force felt by any e^- that is called zeffective.

$$Z_{eff} = Z - \sigma$$

- Z = ~~Net~~ gross attraction force by nucleus ~~sigma~~
- σ = Sigma (σ) = net repulsion force by e^- and e^-.

- Z – no of protons / no. of e^-
- A – no. of Proton + no. of neutrons

$_{8}O^{16}$ $_{7}N^{15}$

Z = 8, A = 16 | Z = 7, A = 15

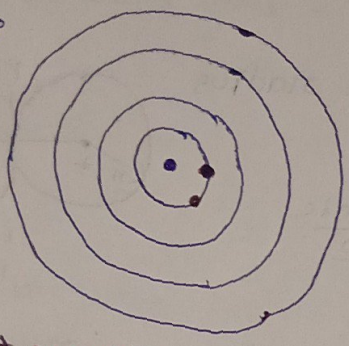
e p n
7 7 8
(15-7)

[A = Atomic mass]

[Z = Atomic no.]

$_{6}C^{14}$ – e^- p^+ n°
6 6 8

Z = 6



Zeff = Z – σ

Z → Net attraction force

σ → Net repulsion force

	Charge	mass	Discover By	Home
e^-	-1.6×10^{-19}.	9.1×10^{-31} kg	J.J. Thomson	Orbits
p^+	1.6×10^{-19}	1.667×10^{-27} kg	Goldstine	Nucleus
n°	0	1.668×10^{-28} kg	James Chadwick	Nucleus

$\Rightarrow$ Zeff increases while going left to right in a period

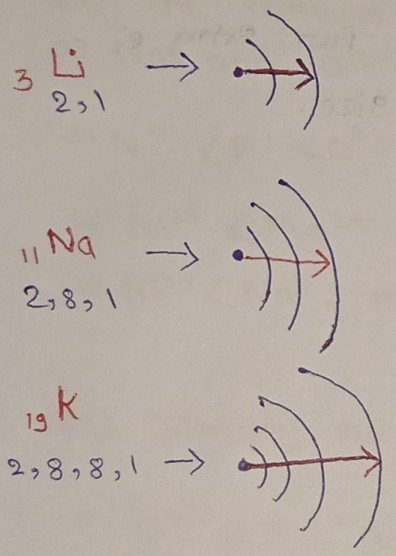
Let's talk about radius

- We know that from going Left - right zeff. increases & zeff are inversly proportion to size $\left[Z_{eff} = \frac{1}{size}\right]$.

$$Ne >> {}_3Li > {}_4Be > {}_5B > {}_6C > {}_7N > {}_8O > {}_9f$$

- In Noble gas only vanderwalls bond is present i.e. we know that largest bond are vanderwall so, in a period largest size are of Noble gas. & smallest size are of Halogens

- In a group we know that no. of orbitals are change from going top - bottom size increases.



$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f$
$5d^{10}$

Ionic Size ~

Ionic size $\longrightarrow$ ions $\nearrow$ the ion cation (form by removal of e^-)

$\searrow$ the ion Anion (form by addition of e^-)

${}_{20}Ca$	Ca^{+2}	;	${}_{15}P$	P^{-3}	;	${}_7N$	N^{-3}
$e^- = 20$	$e^- = 18$		$e = 15$	$e = 18$		$e^- = 7$	$e^- = 10$

Cation Size –

- When we remove e^- from mother atom, atom must be positive.
- No. of e^- decreases.
- Respective no. of e^- increase & zeff also incr. than size altimatly dec.
- When we remove e^- again & again there is also a possibility of vanising of shell which leads to decreasing the size of atom.

Reason

Zeff. incr. ↑
attraction inc. ↑
Size dec ↓

Example – $Al > Al^+ > Al^{+2} > Al^{+3}$

Anion Size –

Anion size increases due to repulsion of e^- Repulsion need more space for extra e^- so there must be increase in size.

Example – $O < O^- < O^{-2}$

Exception – 1) $Al > Ga$
2) $Zr > Hf$
3) $Fe \simeq Co \simeq Ni$

Reason of exception –

1) $Al > Ga$ – Suddenly d orbital $10e^-$ enter thats why z-eff. inc. & Size shrinks.

2) $Zr > Hf$ – Sudden f-block element $14e^-$ enter thats why zeff inc. & size shrinks.

3) $Fe \simeq Co \simeq Ni$ –

$_{26}Fe = [_{18}Ar]\ 3d^6\ 4s^2$

$_{27}Co = [_{18}Ar]\ 3d^7\ 4s^2$

$_{28}Ni = [_{18}Ar]\ 3d^8\ 4s^2$

d-block element e^- enter in penultimate shell (n-1 shell)

(no. of e^- is same)

Q1) The group having isoelectronic species is [JEE Main 2017]

a) O^-, F^-, Na^+, Mg^{2+} b) $O^{2-}, F^-, Na^+, Mg^{2+}$

c) O^-, F^-, Na, Mg^+ d) O^{2-}, F^-, Na, Mg^{2+}

Q2) The correct order of the atomic radii of C, Cs, Al and S is: [JEE main 2019]

a) $S < C < Al < Cs$ b) $S < C < Cs < Al$

c) $C < S < Cs < Al$ d) $C < S < Al < Cs$

Q3) Correct order of radius of element is: C, O, F, Cl, Br. [JEE main P-I 2020]

a) $Br > Cl > C > O > F$ b) $Br < Cl < C < O < F$

c) $Cl < C < O < F < Br$ d) $C < F < O < Br < Cl$

Q4) The correct order of the ionic radius of $O^{2-}, N^{3-}, F^-, Mg^{2+}$, Na^+ and Al^{3+} is: [JEE main P-II 2020]

a) $N^{3-} < F^- < O^{2-} < Mg^{2+} < Na^+ < Al^{3+}$

b) $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

c) $Al^{3+} < Na^+ < Mg^{2+} < O^{2-} < F^- < N^{3-}$

Q5) Identify the correct order of the size of the following. [AIPMT 2007]

a) $Ca^{2+} < K^+ < Ar < S^{2-} < Cl^-$

b) $Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$

c) $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$

d) $Ca^{2+} < Ar < K^+ < Cl^- < S^{2-}$

Q6) The correct order of the decreasing ionic radii among the foll. isoelectronic species is [AIPMT 2010]

a) $Ca^{2+} > K^+ > S^{2-} > Cl^-$

b) $Cl^- > S^{2-} > Ca^{2+} > K^+$

c) $S^{2-} > Cl^- > K^+ > Ca^{2+}$

d) $K^+ > Ca^{2+} > Cl^- > S^{2-}$

Q7) The species Ar, K^+ and Ca^{2+} contain the same no. of electrons. In which order do their radii increase [2015]

a) $Ar < K^+ < Ca^{2+}$

b) $Ca^{2+} < Ar < K^+$

c) ~~$Ca^{2+} < K^+ < Ar$~~

d) $K^+ < Ar < Ca^{2+}$

Q8) The correct order of atomic radii in group 13 elements is [NEET 2018]

a) $B < Ga < Al < Tl < In$

b) $B < Al < Ga < Tl$

c) $B < Al < In < Tl$

d) ~~$B < Ga < Al < In < Tl$~~

Ionization Potential ~

- Also called Ionization energy
- Defination - Energy required to remove an e^- from its outermost surface of isolated gaseous atom is called Ionization Potential / enthalpy

[Enthalpy] ΔH → -ve Exothermic

→ +ve Endothermic

Examples:

$Na(s) \longrightarrow Na(g) \xrightarrow{+IP} Na^+(g) + 1e^-$

$Ca(s) \longrightarrow Ca(g) \xrightarrow{+IP} Ca^+(g) + 1e^-$

$Fe(s) \longrightarrow Fe(g) \xrightarrow{+IP} Fe^+(g) + 1e^-$

$Cl_2 \longrightarrow Cl(g) \xrightarrow{+IP} Cl^+(g) + 1e^-$

$H_2 \longrightarrow H(g) \xrightarrow{+IP} H^+(g) + 1e^-$

$$E(g) \longrightarrow E(g) \xrightarrow[1^{st}\ IP]{-e^-} E^+(g) \xrightarrow[2^{nd}]{-e^-} E^{+2}(g) \xrightarrow[3^{rd}]{-e^-} E^{+3}$$

$$1^{st}\ IP < II^{nd}\ IP < III^{nd}\ IP$$

Factors Affecting IPs ~

- Size $\propto \frac{1}{IP}$
- Penitrating effect - $S > P > d > f$
- Stable half filled & full filled orbitals have higher IPs
  $S^2, P^6, P^3, d^5, d^{10}, f^7, f^{14}$
- Noble gas configration have higher IPs than others
  ns^2np^6

Note: If we calculate IPs it must follow up e^- configrations.

$_7N \longrightarrow 1s^2 2s^2 2p^3$ or $[He]\ 2s^2 2p^3$

$_{10}Ne \longrightarrow 1s^2 1s^2 2p^6$ or $[He]\ 2s^2 2p^6$

$_4Be \longrightarrow 1s^2 2s^2$ or $[He]\ 2s^2$

$_{17}Cl \longrightarrow 1s^2 2s^2 2p^6$ or $[Ne]\ 3s^2 3p^5$

$_{15}P \longrightarrow [Ne]\ 3s^2 3p^3$

Trends ~

	$_3Li$	$_4Be$	$_5B$	$_6C$	$_7N$	$_8O$	$_9F$	$_{10}Ne$
$[1s^2]$	$2s^1$	$2s^2$	$2s^2 2p^1$	$2s^2 2p^2$	$2s^2 2p^3$	$2s^2 2p^4$	$2s^2 2p^5$	$2s^2 2p^6$

1) Li < Be — 1) Size Li > Be ; Size $= \frac{1}{IP}$
   2) Stabe s^2 configration

2) Be > B — 1) Stable s^2 configration

3) B < C — 1) size B > C

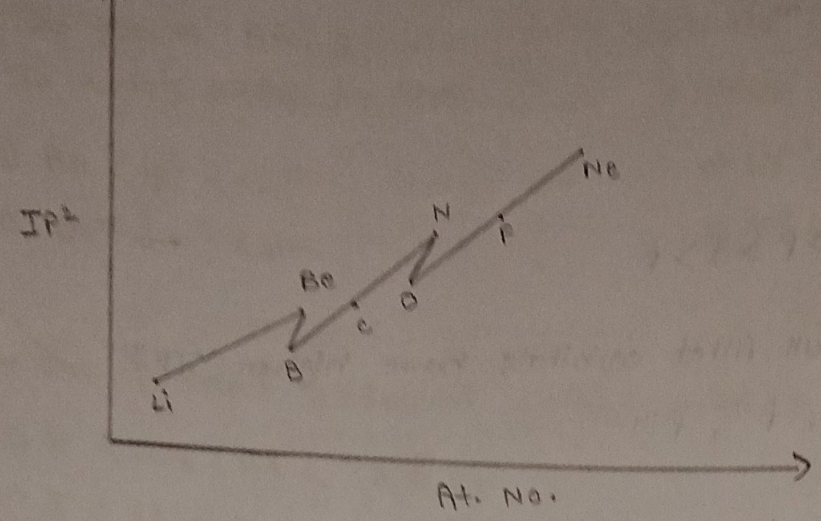
4) C < N — 1) Size C > N
   2) Stable p^3 configration

5) N > O — 1) Stable p^3 configration

6) O < F — 1) Size O > F

7) F << Ne — 1) Noble gas configration
   2) Stable p^6 configration

[Li < B < Be < C < O < N < F <<



1) The set representing the correct order of 1st ionization potential is [JEE 2017]

a) K > Na > Li

b) B > C > N

~~b)~~ Be > Mg > Ca

d) Ge > Si > C

2) Which of the following represent the correct order of increasing 1st ionization enthalpy for Ca, Ba, S, Se & Ar? [JEE 2017]

a) Ca < S < Ba < Se < Ar

~~b)~~ Ba < Ca < Se < S < Ar

b) S < Se < Ca < Ba < Ar

d) Ca < Ba < S < Se < Ar

3) Correct order of 1st ionization energy of the following metals (low) (3rd) (2nd) (high)
Na, Mg, Al, Si in kJ mol^{-1} respectively are— [JEE 2020]

~~a)~~ 497, 737, 577, 786

b) 786, 739, 577, 497

b) 497, 577, 737, 786

d) 739, 577, 786, 487

4) The correct order of 1st I.P. is : [JEE 2021]

a) Mg < S < Al < P

~~b)~~ Al < Mg < S < P

b) Mg < Al < S < P

d) Mg < Al < P < S

5) The 1st I.P. of Be, B, N & O follow— [JEE 2022]

a) O < N < B < Be

b) B < Be < N < O

b) Be < B < N < O

~~d)~~ B < Be < O < N

6) Which of the following e^- configration of an atom has the lowest I.P. ? [AIPNT 2022]

a) $1s^2, 2s^2, 2p^5$

b) $1s^2, 2s^2 2p^3$

c) $1s^2, 2s^2 2p^5, 3s^1$

d) $1s^2, 2s^2 2p^6$

7) Amongst the elements with following e^- confi which one may have the highest I.P ? [AIPMT 2009]

a) $[Ne]\ 3s^2 3p^3$

b) $[Ne]\ 3s^2 3p^2$

c) $[Ar]\ 3d^{10}, 4s^2 4p^3$

d) $[Ne]\ 3s^2 3p^1$

Application of IPs ~

1) ▪ Element which have high IPs are non-metals.
▪ Element which have low IPs are metals.
• Cs has the lowest IP thats why it is used in solar pannels.

2) ▪ Matallic property $\propto \frac{1}{IP_s}$
• Li < Na < K < Rs < Cs

3) ▪ Reducing Nature

Oxidation	Reduction
1) Addition of O	Removal of O
2) Removal of H	Addition of H
3) Removal of e^-	Addition of e^-

• $Fe^{+3} + 1e^- \longrightarrow Fe^{+2}$ (Reduction)

• $IP \propto \frac{1}{\text{Reducing Nature}}$

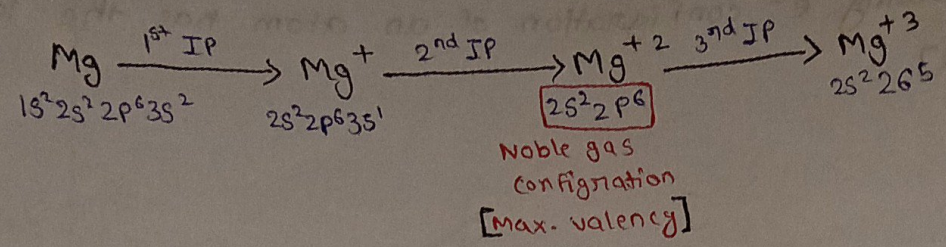
• Li > Be > B ∴ Good Reducing Agent

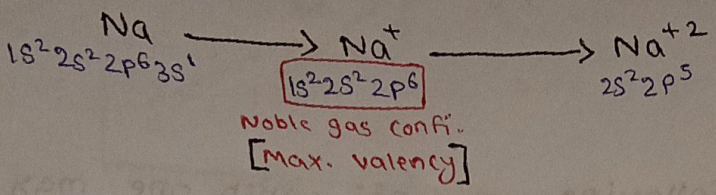
4) ▪ Valency ∝ higher IP (Maximum valency)

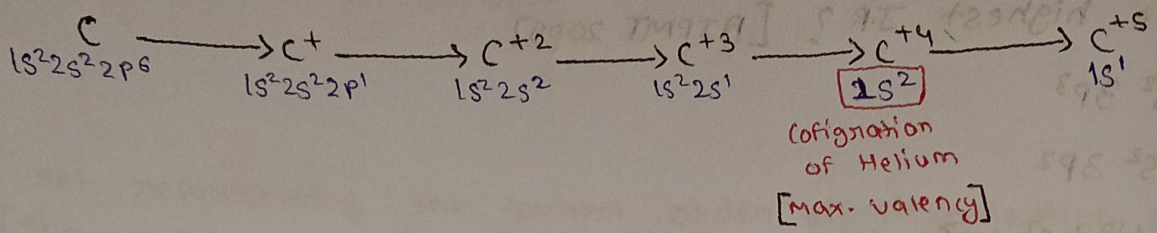
$Al \xrightarrow[200]{1^{st}\ IP} Al^+ \xrightarrow[300]{2^{nd}\ IP} Al^{+2} \xrightarrow[400]{3^{rd}\ IP} Al^{+3} \xrightarrow[1900]{} Al^{+4}$

$2s^2 2p^6 3s^2 3p^1$; $3s^2$; $3s^1$; $2s^2 2p^6$; $2s^2 2p^5$

$2s^2 2p^6$ Noble gas configration [Max. valency]







∴ Configration – $1s^2 2s^2 2p^6 3s^2 3p^6$

$_6C$ – $1s^2 2s^2 2p^2$ $_9F$ – $1s^2 2s^2 2p^5$

$_7N$ – $1s^2 2s^2 2p^3$

$_8O$ – $1s^2 2s^2 2p^4$

Question –

→ 2nd IP is highest ?

a) $_{12}Na$

b) $_{12}Mg$

c) $_{16}S$

d) $_{15}P$

→ Which of the following element have max. 3rd IP ?

a) Mg – $1s^2 2s^2 2p^6 3s^2$ after removing $2e^-$ → $2s^2 2p^6$

b) Na

c) S

d) P

→ Find the group of element?

a) 250 450 1700 2100

Sudden hike in 3rd IP

Ans 2nd group

b) 420 480 1400 3600

4th group

Ans 13th group

→ Which of the following IPs are of IIA elements?

a) 1400 1700 1900 2100
b) 140 380 440 1700
c) 250 380 1900 2100
d) 350 700 1400 1900

Electron Affinity

ΔH → +ve – heat absorb [Endothermic]
ΔH → -ve – heat alliminate [Exothermic]

$E + 1e^- \longrightarrow E^-$

E: ns^2np^5 [Unstable]
E^-: ns^2np^6 [Noble gas configration]
ΔH = -ve [electron gain enthalpy]

Energy released during gain of e^- to the isolated gaseous atom.

$Ne + e^- \longrightarrow Ne^-$ ΔH_{eg} / EA = +ve

Ne: $2s^2 2p^6$ [Noble gas confi.]

II nd EA

2nd EA is always +ve [Due to repulsion of e^-]

$N + e^- \longrightarrow N^-$ ΔH_{eg} / EA = +ve

[half filled Stable confi]

Trends :

E.A ↑ →
E.A ↓ ↓

Exception-

15th group
18th group
[Due to half & full filled e^- configration]

$E + 1e^- \longrightarrow E^-$ 1^{st} EA $[\Delta H_{eg} / -EA$

$E^- + 1e^- \longrightarrow E^{-2}$ 2^{nd} EA $[+\Delta H_{eg} / +EA]$

$O + 1e^- \longrightarrow O^-$ 1^{st} EA

$O^- + 1e^- \longrightarrow O^{-2}$ 2^{nd} EA

[Due to Repulsion of e^- & e^-]

Exception of e^- Affinity –

$F \not< Cl$

Reason - Size of F are very small. e^- & e^- repultion are very large.

$O < S$

Reason –

Note: When size are small repulsion of e^- & e^- are very high that why Florine and oxygen shows less e^- Affinity than Clorine and Sulfure

Electro Negativity –

- In any co-valent bond e^-'s can be attracted by highly electrone-gative sustanse that is called Electro Negativity.
- There is 3 rules / scale
  - → Pauling Scale
  - → Mullikan Scale
  - → Rowchow scale
- Most widly used are Mullikan scale.

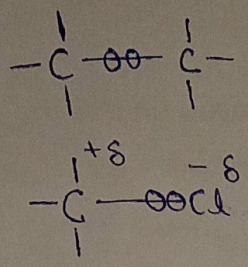
F = 4.0
Cl = 3.0
O = 3.5
N = 3.0

$A^{+\delta}$ — $B^{-\delta}$ → More electro negative

↳ ca ↳ covalent bond

δ – partial

Ex.



Metallic & Non Metallic behaviour :

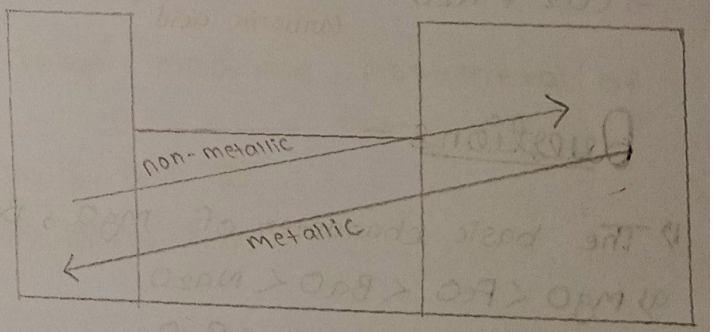
Metallic Property	Non-Metallic Property
• large size	• small size
• IP low	• High IP
• EA low	• High EA
• EN low	• High EN
• Easily gives e^-	• Solid (C), liq. (Br), gas (H_2, O_2)
• Ductile	• e^- can't flow electricity [except - graphite]
• Mellable	• Brittle
• Solid, hard	
• e^- flow easily	

Metallic behaviour –

Li < Na < K < Rb < Cs

Li > Be > B > C > N > O > F

least metallic



Oxides –

→ Acidic oxide –

Non metallic oxides

CO_2, SO_2, SO_3, NO_2 ..

→ Basic oxide –

Metallic oxide

Na_2O, MgO, CaO

→ Neutral oxides –

[O , NO , H_2O]

→ Amphoteric oxides –

[Al_2O_3, As_2O_3 , etc.]

$Na_2O < CS_2O$

more basic

- From going top - bottom metallic behavior increases. Oxide of metal are basic
- From going top - bottom basicity of oxides increases.

$SO_2 < Cl_2O_3$

- left – right non-metallic behavior increases
- left – right Acidic property increases

Metal oxides → Basic

→ $Na_2O_{(s)} + H_2O \rightarrow 2NaOH$

Non – Metal oxides → Acidic

→ $SO_3 + H_2O \rightarrow H_2SO_4$ Sulfonic acid

→ $CO_2 + H_2O \rightarrow H_2CO_3$ Carbonic acid

Questions –

1) The basic character of MgO , BaO , Na_2O and FeO follow the order.

a) $MgO < FeO < BaO < Na_2O$

b) $FeO < MgO < Na_2O < BaO$

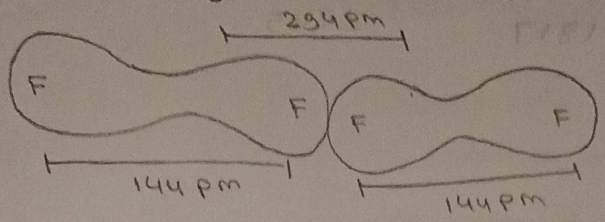
c) $FeO < MgO < BaO < Na_2O$

d) $Na_2O < MgO < FeO < BaO$

2) An element having electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ forms

a) Acidic oxide
b) Basic oxide
c) Amphoteric oxide
d) Neutral oxide

3) The vandercwaal and covalent raddi of florine atom respectively from the following figure are:



a) 219 pm , 72pm
b) 75pm , 72pm
c) 147pm , 72pm
d) 147pm , 144pm

4) The first ($\Delta_i H_1$) and second ($\Delta_i H_2$) ionization enthalpies (in $KJ\ mol^{-1}$) and the electron gain enthalpy ($\Delta_{eg} H$) (in $KJ\ mol^{-1}$) of the element I, II, III, IV and V are given below.

Element	$\Delta_i H_1$	$\Delta_i H_2$	$\Delta_{eg} H$
I	520	7300	−60
II	419	3051	−48
III	1681	3374	−328
IV	1008	1846	−295
V	2372	5251	+48

The most reactive metal and the least reactive, non-metal of these are respectively:

a) I and V
b) V and II
c) II and V
d) IV and V

5) Which of the following sequence correctly represents the decreasing acidic nature of oxides?

a) $Li_2O > BeO > B_2O_3 > CO_2 > N_2O_3$
b) $N_2O > CO_2 > B_2O_3 > BeO > Li_2O$
c) $CO_2 > N_2O_3 > B_2O_3 > BeO > Li_2O$
d) $B_2O_3 > CO_2 > N_2O_3 > Li_2O > BeO$

6) First three ionisation energies (in KJ/mol) of three representative elements are given below:

Element	IE_1	IE_2	IE_3
P	495.8	4562	6910
Q	737.7	1451	7733
R	577.5	1817	2745

Then incorrect option is:

a) Q : Alkaline earth metal
b) P : Alkali metals
c) R : S-block element
d) They belong to same Period.

7) In a given energy level, the order of penetration effect of different orbitals is

a) $f < d < p < s$
b) $s = p = d = f$
c) $s < p < d < f$
d) $p > s > d > f$

8) Consider the following changes:

(1) $M_{(s)} \longrightarrow M_{(g)}$
(2) $M_{(s)} \longrightarrow M^{2+}_{(g)} + 2e^-$
(3) $M_{(g)} \longrightarrow M^{+}_{(g)} + e^-$
(4) $M^{+}_{(g)} \longrightarrow M^{2+}_{(g)} + e^-$
(5) $M_{(g)} \longrightarrow M^{2+}_{(g)} + 2e^-$

The second ionization energy of M would be calculated from the energy values associated with:

a) 1 + 3 + 4
b) 2 - 1 + 3
c) 1 + 5
d) 5 - 3

9) Consider the following ionization enthalpies of two elements 'A' and 'B'

Element	Ionization Enthalpy (KJ/mol)		
	1st	2nd	3rd
A.	899	1757	14847
B.	737	1450	7731

Which of the following statements is correct?

a) Both 'A' & 'B' belong to group -1 where 'B' comes below 'A'.

b) Both 'A' & 'B' belong to group -1 where 'A' comes below 'B'.

c) Both 'A' & 'B' belong to group -2 where 'B' comes below 'A'.

d) Both 'A' & 'B' belong to group -2 where 'A' comes below 'B'.

10) Which pair of elements belongs to same group?

a) Elements with atomic no. 17 and 38

b) Elements with atomic no. 20 & 40

c) Elements with atomic no. 17 & 53

d) Elements with atomic no. 11 & 33