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Chapter 3
Classification of Elements

1) State Modern Periodic Law.
Ans) The physical and chemical properties of elements are periodic of their atomic numbers.

2) Modern Periodic Table (Long Form Periodic table)
Ans) · Elements are arranged in the increasing order of atomic numbers.
· The horizontal columns are periods and vertical column are called groups.
· There are 7 periods and 18 groups in Modern Periodic Table.
· There are 4 blocks, 's' block, 'p' block, 'd' block and 'f' block depending on filling of electrons in valence shell.
· Two Rows of elements known as landtinodes and antinodes are placed in separate panel at the bottom which is called 'F' block or inner transition.
· Groups one and two known as S-block
· Groups 3-12 are known as d-block and also known as transition elements.
· Groups 13-18 are known as p-block elements

3) IUPAC naming: This is used to remember the elements with atomic number more than 100.

Digit	
0	nil
1	un

2	bi
3	tri
4	quad
5	pent
6	Hex
7	Sept
8	Oct
9	enn

For example,

Atomic no.	IUPAC name	Symbol
Z = 115	Ununpentium	Uup
Z = 102	unnilbium	Unb
Z = 118	Ununoctium	Uuo

4) Periodic trends in properties of elements

a) Atomic radius : It refers to both covalent or metallic radius depending on wheather the element is metal or non-metal.

covalent radius - It is one-half of distance between two atoms that covalently bonded.

Internuclear distance in Cl_2 molecule is 198pm and atomic radius is $198/2 = 99$pm.

For metals : we define metallic radius.

b) metallic radius : It is taken as half of intermolecular distance separting the metal core in the metallic crystal.

example, the distance between two adjacent copper is 256 pm.

The metallic radius of copper is $256/2 = 128$pm

5) Variation of Atomic Size along a period

Atomic size decreases along a period because effecting nuclear charge increases along a period.

6) Variation of Atomic size down a group

Atomic size decreases down a group because of increasing number of energy levels.

7) Give reasons

i. A cation is smaller than its parent atom. Why?

Ans) In a cation, less number of electrons are present compared to parent atom. per electon is more, hence due to increased attraction size is less.

ii. Atomic radius of Na is 186pm and Na^+ ion is 95pm.

Ans) Same as above

iii. Anions are larger than parent atom.

Ans) Added electrons causes ~~repl~~ repulsion.
Due to increased number of electrons

iv. Ionic radius of F^- is 136pm and atomic radius of F is 64pm. Why?

Ans) Same as above.

8) Which of the following species will have largest and smallest size: Mg, Mg^{2+}, Al, Al^{2+}

Ans) Smallest = Al^3
Largest = Mg

9) Isoelectronic Species: Atoms and ions with same number of electrons are called Isoelectronic Species.

For example, $_{11}Na^+$ number of $\bar{e} = 11-1=10$

$_8O^{2-}$ number of $\bar{e} = 8+2=10$

$_{13}Al^{3+}$ number of $\bar{e} = 13-3=10$

For isoelectronic species, greater the +ve charge lesser the size.

For example, $Al^{3+} < Mg^{2+} < F^{-} < O^{2-} < N^{3-}$

Increasing size : Isoelectric species

Ionisation Enthalpy : The energy required to remove an electron from an isolated gaseous atom X in its ground state represented as $\Delta_i H$.

$\Delta_i H_1$ is the energy to remove the first most loosely bound electron.

$\Delta_i H_2$ is the energy to remove the first most loosely bound electron.

$$X_{(g)} \xrightarrow{\Delta_i H_1} X^+_{(g)} + \text{electrons}$$
$$X_{(g)} \xrightarrow{\Delta_i H_2} X^{2+}_{(g)} + \bar{e}$$

9) $\Delta_i H_2$ is higher than $\Delta_i H_1$. Why?

Ans) It is difficult to remove an electron from a positive charged ion than a nuetral atom, because positive ions has more nuclear attraction on $\bar{e}$.

10) Variation of IE along a period, down a group : Along a period $\Delta_i H$ increases, down a group $\Delta_i H$ decreases.

Some ~~exce~~ exceptions are seen from this general trend.

II period : Li, Be, B, C, N, O, F, Ne

$_4Be$: $1s^2 2s^2$ [full filled]
$_7N$: $1s^2 2s^2 2p^3$ [half filled]

11) Give reasons:
i. ΔH of noble gases are very high.
Ans) Because they have octet stable configuration in valence orbital.
For example, Neon : $1s^2 2s^2 2p^6$ [2^{nd} energy level, 8 $\bar{e}$s]
ii. ΔiH of Be is higher than B.
Ans) Be : $1s^2 2s^2$
B : $1s^2 2s^2 2p^1$
Be has full filled s orbital configuration.
It is easy to remove 2p electrons from O than N because N is stable.
iii) ΔiH of N is higher than O
Ans) N - $1s^2 2s^2 2p^3$
O - $1s^2 2s^2 2p^4$
N has half filled p orbital configuration.
It is easy to remove $2pe^-$ from O than N because N is stable.
. cause repulsion which makes moving easy.

2) Electron Gain Enthalpy (ΔegH) : When the electron is added to a neutral gaseous atom X to convert it into a positive ~~atom~~ ion, the enthalphy change accompinying the process is defined as electron gain enthalphy.

$$X(g) + \bar{e} \longrightarrow X^-(g)$$

Enthalphy change ΔegH

→ $\Delta_{eg}H$ negative, when energy is released which indicates strong tendancy of atom to recieve the electron.
→ $\Delta_{eg}H$ positive, when energy is absorbed which indicates less tendancy of atom to recieve electron a electron.

13) In every period group 17 elements show high -ve $\Delta_{eg}H$.
Ans) Negative $\Delta_{eg}H$ indicates strong tendancy to recieve electron. Group 17 elements have $7e^-$ in valence orbital hence they readily accept $1e^-$ to complete the octet and become stable.

14) Give reason
i. Noble gases show positive ΔE_{gh} values.
Ans) They have stable octet configuration in the valence orbital. So they have low tendency to recieve electron.
ii. $\Delta_{eg}H$ of Cl is higher in magnitude than F.
Ans) F is a smaller atom, the added electron causes more repulsion in the 2p orbital.
Note: O and S, $\Delta_{eg}H$ value ~~mag~~ magnitude is higher for S.

15) Define electronegativity.
Ans) Tendency of an atom to attract an electron towards it is termed as electronegativity. Electronegativity increases along a period and decrease down a group.

16) Using Periodic table, predict the formula of the compounds formed by the following pairs of elements.
i. Si and Br

Ans) $Si^{4} \times Br^{1}$
$SiBr_4$.

17) Using periodic table, predit the formula of the compounds formed by the following pairs of elements.

i. Al^{3+} S^{2-}
Al_2S_3

ii. Ca and Cl
Ca^{2+} Cl^{-1}
$CaCl_2$

iii. Mg and N
Mg^{2} N^{3-}
Mg_3N_2

18) Blocks in Periodic Table

a. S Block
→ Group I and II
→ General E.C. is ns^{1-2}
For example, Na_{11} is $1s^2 2s^2 2p^6 3s^1$
Outer config : $3s^1$
Period : 3
Group : 1

b. P Block
→ Group 13 to 18
→ General Outer config – $ns^2 np^{1 \text{ to } 6}$
For example, P_{15} : $1s^2 2s^2 2p^6 3s^2 3p^3$
Period : 3
Group = 15

c) D Block

- Groups 3 to 12
- General outer configuration $(n-1)d^{1 \text{ to } 10} ns^{12}$

For example, Sc : $1s^2 1s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

Period = 4

Group = 3 Valence = 3

d) F Block

- Lanthanoids and Actinoids
- General outer configration : $(n-2)f^{1 \text{ to } 14} (n-1)d$

19) Metallic and Non-metallic properties along ~~an~~ a period and down a group: Along a period metallic properties decrease and down a group meti properties increase.