Date

CHAPTER #10
PREODIC TABLE

Introduction :-

=> In 1789, French scientist Antoine Lavoisier tried grouping elements as metals and non-metals.

=> In 1829, German Physict Johann Wolfang observed similarities in physical and chemical properties of certain elements

=> In 1864, John Newland aranged elements in Periodic table with increasing order of Atomic masses and introduced his law of octaves.

=> In 1869, Dmitri Mandaleeve, listed most known elements at that time by thier ascending atomic mass.

=> Henry mosely, in 1913, arranged elements on the basis of atomic no.

Periodic law:- (Systematic Arrangement of Elements)

'When elements are arranged in order of increasing atomic number, there is the periodic repetition of thier chemical and physical properties.

Overall Elements

-> 118 elements are discovered yet amongst which 92 are naturally occuring and 26 are artificially occuring.

PERIODS	GROUPS
Defination	
A period is a horizontal row of a periodic Table.	A group is a vertical coloumn of the elements in Periodic Table.

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Valance electrons

Accross the Period the outer most electron increase

Elements in each group have same no. of outermost e⁻

Properties

donot have similar Properties, for example 1 member group 1-A are active solids, however last member group 8-A are inactive gases.

all members have same Property for ex. group 1-A elements are soft, white & Shin either it is Na, K, or any other member of that group

Number

Overall 7 Periods

traditionally :→ I-A → VIII-A

IUPAC :→ 1 - 18 groups

Characterstics

1st Period is the shortest and 2nd & 3rd are also short

6th Period is longest

7th Period is incomplete

4th, 5th, 6th, 7th are long

-A → representative elements

-B → Transitive elements -

-I-A - Alkali II-A - Alkaline earth

III-A - Boron family IV-A - Carbon family

V-A - Nitrogen family

VI-A Oxygen family VII-A Halogens VIII-A - Noble gas

"BLOCK OF ELEMENTS IN "PERIODIC TABLE"

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* The block of an element refers to the position of the periodic table based on thier respective sub shells. with may be S, p, d, f. Accordingly there are 4 blocks in periodic table S-block, p-block, d-block and 7-block

OR

* The Block of the periodic table is a set of elements unified by the ~~Atomic~~ orbitals thier valance electrons or the vacconcies they lie in.
* The term was first used by charles Jannet.

S-Block

* 'S' stands for Sharp
* It's azimuthal Quantum number is equal to 0
* Valance electron in 'S' sub shell
* Contains element of group 1-A & 2-A + Helium
* Alkali and Alkaline earth metals are present
* for Example :- $Mg^{+12} \rightarrow 1s^2 2s^2 2p^6 3s^2$

P-Block

* 'P' stands for Principal
* It's azimuthal Quantum number is 1
* Valance electrons in 'P' sub shell.
* Contain elements of group III-A to VIII-A
* Its general electronic configuration is ns^2np^{1-6}
* Contain both metals and non-metals
* for example :- $O^8 \longrightarrow 1s^2 2s^2 2p^4$

D-Block

* 'D' stands for Diffuse
* Its azimuthal Quantum number is 2
* Valance electrons in 'd' sub shell.
* Contains all group 'B' elements (III-B to II-B)

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* Thier elements are known as transitional metals
* Its general e' configuration is $(n-1)d^{1-10}\ ns^{1-2}$
* For example :- $Zn^{30} \rightarrow 3d^{10}4s^2$

f - Block

* 'f' stands for fundamental
* Its azimuthal Quantum number is equal to 3
* Its valance e' is in 'f' sub shell
* Contain elements of 2 rows located at the bottom of Periodic table.
* General electronic Configuration is $(n-2)f^{1-14}$
* Contains lanthanides and Actinides.
* For example :- $Fm^{100} \rightarrow 7s^2 5f^{12}$

"POSITION OF ELEMENTS IN PERIODIC TABLE" (most imp. topic of this chap)

* We can configure the Position of Element in periodic Table through its electronic configuration
* By Examining the valance electron configuration, n-value and sub shell type you can identify an elements group, period and block.

Period s (Horizontal rows):

* The Period number corresponds to the no. of shells
* Elements in period 1 have 1 electronic shells
* Elements in period 2 have 2 electronic Shells
* for example :- $C^6 \rightarrow 2,4$; n-value = L = 2, So belongs to Second Period

Groups (vertical coloumns)

* Elements in same groups have same no. of valance e'.
* Elements in group 1A have 1 valance e'
* Elements in group 2-A have 2 valance e', & so on
* for example :- $Be^4 \rightarrow 2,\boxed{2}$, $Mg^{12} \rightarrow 2,8,\boxed{2}$; Valance Shell e' = 2, so belong to group II-A

Pg No.

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"Properties Of Elements In Group"

Properties of Elements in a group, can be predicted on the basis of thier position in Periodic table

* → Atomic Size ↑ increases from top to Bottom
* → Ionization energy ↓ decreases from top to Bottom
* → Electronegativity ↓ decreases from top to Bottom
* → Metallic Properties ↑ increases down the group

Metal · Non-Metals · Metalloid

(malleable → roll) (ductile → sheets)

Property	Metals	Non-Metals	Metalloids
Appearance	Shiny	Dull	Shiny
Conductivity	Good Conductor of heat & electricity.	Poor Conductor [INSULATOR]	Intermediate conductivity
State at room temperature	Solid [except Hg]	Mostly gas or solid	Solid
Malleability	Malleable and Ductile	Brittle	Brittle but Shinny
M.P & B.P	high	low	Intermediate
Ion formation	Cations	Anions	Both
Example	Fe, Cu	O, N	Si, B

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"Periodicity Of Properties"

Electron Affinity

* It is the ammount of energy released when an atom in the gaseous state gains an electron to form a negative ions.
* Symbol → E·A
* Unit → KJ/mol
* Explaination:

When an electron is added to a neutral atom, energy is released because the atom becomes more stable.

* for Example:-

$$X_{(g)} + e^{-} \longrightarrow X^{-}_{(g)} + Energy$$

factors Effecting Electron Affinity

1- Atomic Size $\propto \frac{1}{E \cdot A}$

Larger atoms have electrons farther from neucleus so there will be week attraction of e', resulting in lower electron affinity

2- Nuclear Charge $\propto$ E·A

No. of Protons in nucleus increases resulting in increase in force of attraction, making it easier to accept an electron.

3- Shielding Effect / Electron Repulsion $\propto \frac{1}{E \cdot A}$

If shielding effect increases, the added electrons bind less tightly to the nucleus, resulting in high E·A

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"TRENDS IN METALLIC AND NON-METALIC BEHAVIOR"

* The Valance electrons play a key role in determining the Chemical and physical behavior of elements.

Metallic Behavior - 10.6.1

→ Metalls are usually found on the left side of the Periodic table

→ They tend to easily lose valance electrons. They form cations to achieve stable electronic configuration

(Reason)

This is because metals usually 1-3 valance electrons Thier ionization energy is usually low. They have low electro-negativity and donot tend to attract electrons

→ Metallic character increases down the group

(Reason)

1- Atomic Size Increases

2- Ionization Energy decreases (easier to lose e')

Non-Metallic Behavior - 10.6.2

→ They are usually found on the right side of Periodic table.

→ Thier non-metallic behavior is due to thier tendency to gain or lose share valance electrons to achieve a stable structure

(Reason)

This is because non-metals usually have 5-7 valance electrons, they just need few more e' to complete thier octet. They have high Ionization energy, so they don't lose electrons readily, but, share or gain. Thier high Electronegativity also helps them with it.

→ Non-Metallic Character decreases down the group.

(Reason)

1- Atomic Size increase (nucleus pull on e' reduced)

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Trends in group (10.6.3)

→ Metallic Character :-

* It refers to tendency of an element to lose electrons and form positive ions (cations)

* Trend in group

→ 'Increases' down the group

→ Because atomic radii increases, and the outer most electrons experiance less nuclear pull, making them easier to loose

* Examples

→ In group I-A (Alkali metals) :- Li is less metalic than Ce

→ In group II-A (Alkaline Earth) :- Be is less metalic than Ba

→ Non-Metallic Characters :-

* It refers to the tendency of an element to gain e⁻ and form negative ions (anions)

* Trend in group

→ 'Decreases' down the group

→ Because atomic radii increases and nucleus ability to attract electron reduces.

* Examples :-

→ In group 17 (Halogens) :- F is most non-metalic while I is less.

Electronegativity and Types of bond

The E.N difference of bond b/w 2 atoms gives a rough indication of expected nature of bonds and hence bond type.

→ When the d/f is greater than 1.8 the bond is Ionic.

→ When the d/f is greater than 0.4 and less than 1.8, the bond is polar covalent bond

→ When the d/f is less than 0.4 the bond is covalent (non-polar)

So in this way, we can conclude that :

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This means that the ionic character in a bond increases with the increase in the difference of electronegativities of bonded atoms, And Δ E·N b/w group 1·2 metals and group 6-A, 7-A non metals is large, therefore they are ionic.

Trends in Chemical properties

Reaction with Oxygen

→ Sodium

Sodium vigrously react with oxygen especially when burnt in limited oxygen to form Na_2O and excess oxygen to form Na_2O_2

$$2Na + \frac{1}{2}O_2 \longrightarrow Na_2O$$

$$2Na + O_2 \longrightarrow Na_2O_2$$

→ Magnesium

Magnesium burns in O_2 with a brigh white flame, forming Magnesium oxide, (MgO)

$$2Mg + O_2 \longrightarrow 2MgO$$

Reaction with Chlorine

→ Sodium

Na reacts with Cl to form NaCl, with is exothermic and vigrous process

$$2Na + Cl_2 \longrightarrow 2NaCl$$

→ Magnesium

Mg reacts with Cl to form $MgCl_2$

$$Mg + Cl_2 \longrightarrow MgCl_2$$

Reaction with Water

→ Sodium

Na react vigrously with water at Room temp. forming NaOH

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

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Magnesium:-

Mg rcts slowly with cold $H_2O_{(l)}$, but rcts vigrously with Hot $H_2O_{(g)}$, forming $Mg(OH)_2$ or MgO respectively

cold water:-

$$Mg + 2H_2O_{(l)} \longrightarrow Mg(OH)_2 + H_2$$

Stean water:-

$$Mg + H_2O_{(g)} \longrightarrow MgO + H_2$$

"Conclusion":

Na reacts more vigrously as compared to Mg (Rxn) lower I.E of Na and higher reactivity

Note:-

Sodium is Silvery white Soft metal, is extremely rctv while Mg is relatively hard.

Oxidation number of oxides and Chlorides (10.6.6)

* Oxidation number of an element in oxides and Clorides corresponds to the number of electrons used for bonding
* Always positive, as Oxygen & Cl are more electronegative than other elements
* Sulpher and Phosphorus show variable oxidation states because they can expand thier octet
* Metal Oxides are generally basic in Character

$$Na_2O + H_2O \longrightarrow 2NaOH$$

* Non Metal Oxides are generally acidic in Character

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

Characterstics of Oxides along the period.

→ As Metallic Character decreases along the period, the basic Character of oxides also decreases, As a result, ΔE.N b/w these element and Oxygen also decreases

* Some Oxides are strongly basic and some are Amphoteric

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* Metal Chlorides are ionic in nature
* They form neutral solution when dissolve in water
* Some Chlorides Such as $AlCl_3$, $SiCl_4$, and PCl_5 are covalent in nature, they are soluable in water.
* They react vigrously with water forming acidic Solution

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl \quad pH = 3$$

Types of Bonding in Cl and oxides (10:6.8)

→ Ionic Compounds
- + higher melting and Boiling Points
- + Dissolve in water
- + Conduct electricity in molten State

→ Covalent Compounds
- + Lower M.P and B.P
- + Insoluable in water
- + Don't conduct electricity

* Specific property and reactivity help distingwish between Ionic and covalent Bonds
* Sometimes both types of bond are present

I.E and E.A trends in grp I-A and VII-A

Grp I-A

Ionization energy decreases (Rzn)
- → Shielding Effect (↑)
- → Atomic radii (↑)

These factors reduce the attraction b/w neucleus & valance e', Thus less energy req.

Grp VII-A

Electron Affinity decreases (Rzn)
- → Shielding effect (↑)
- → Atomic radii (↑)

These factors reduce attraction b/w nucleus & e'

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Identification of an unknown element

Consider an element having Atomic no. 19, and a highly reactive metal that reacts voilently with water to produce H_2 gas.

The atomic no. indicates that the elements electronic configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$.

So we can say that the element belongs to group 1-A, Period 4 and block S.

After confirming from PERIODIC TABLE we can say that it is potassium(K)

Thus, (K) elements position is confirmed by its E.C and its reaction with water, Because Alkali metal reacts vigrously with water.