ORGANIC REAGENTS

→ 3 types of reagents
i) electrophiles ($E^{\oplus}$) → electron loving species, L-acid
ii) Nucleophiles ($Nu^{\ominus}$) → e^- having species
iii) Free radical (•)

(I) Electrophiles :
→ (1) Charged electrophiles – +vely charged in which central atom have incomplete octet.
→ (2) Neutral electrophiles – No charge on central atom.

(1) Charged electrophiles : $H^{\oplus}$, $R^{\oplus}$ [$CH_3^{\oplus}$, $CH_3CH_2^{\oplus}$, ...], $X^{\oplus}$ [Cl^+, Br^+, I^+], $\overset{\oplus}{NO_2}$, $NO^{\oplus}$, $\overset{\oplus}{SO_3H}$, etc.

(2) Neutral electrophiles

(i) central atom has incomplete octet is a neutral electrophile.
Ex: $BeCl_2$, BF_3, BH_3, $AlCl_3$, $ZnCl_2$, $FeBr_3$, $\dot{C}H_3$, $\ddot{C}H_2$, $\ddot{C}X_2$, etc.

(ii) central atom has complete & expanded octet & has vacant d-orbitals.
Ex: $SnCl_4$, $SiCl_4$, PCl_5, SF_6, IF_7, etc

(iii) Covalent compound in which central atom is bonded with more e^- atom.
Ex: $BeCl_2$, BX_3, AlX_3, FeX_3, PCl_3, NF_3, $\ddot{C}X_2$, etc.

Carbon with multiple bonds with heteroatoms is a neutral electrophile. (N, O, S, P)
Ex: CO_2, CS_2, CN

(II) Nucleophiles :→ e^- rich species, these attack at the point of min. e^- density

(1) Neutral nucleophiles : neutral covalent compound with octet on central atom & with 1 or more l.p of e^-s.
Ex: $\ddot{N}H_3$, $R\text{-}\ddot{N}H_2$, R_2NH, $NH_2\text{-}NH_2$, $H\text{-}\ddot{O}\text{-}H$, $R\text{-}\ddot{O}H$, R-O-R

With C–C multiple bonds.
Ex: Alkenes, alkynes, benzene

(ii) Ambident nucleophiles :- species with 2 nucleophilic centres, 1 is neutral & other is charged (-ve).

Ex: ~~R-C≡N~~ (alkyl cyanide) ($C^{\ominus}\equiv \ddot{N}$)

$R-N\equiv C$, $R-O-N=O$, $R-NO_2$, $R-SCN$, $R-NCS$

⇒ Nucleophilicity : Ability of molecule to donate $\bar{e}$ pair to $\bar{e}$ deficient atom (or) molecule. [New bond form b/w C & $Nu^{\ominus}$] (for $C^{\oplus}$ only)

Ex: $CH_3-CH_2-\overset{\oplus}{C}H-CH_3 \xrightarrow{Nu^{\ominus}} CH_3-CH_2-\underset{Nu}{CH}-CH_3$

Basicity : Ability of molecule to abstracts H^+ ion (or) donation of $\bar{e}$ pair to H^+ is called basicity.

$Nu-C \rightarrow$ nucleophilicity

$Nu-H \rightarrow$ basicity

⇒ In periods nucleophilicity ∝ basicity ∝ $\frac{1}{\text{acidity}}$

Acidic order – $CH_3 < NH_3 < H_2O < HF$

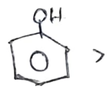
→ In groups nucleophilicity ∝ $\frac{1}{\text{basicity}}$

→ If the no. of donar atoms ↑ $nu^{\ominus}$ ↑

$H_2O < H_2O_2$

If donating atom is same then nucleophilicity is directly proportional to basicity. (without crowding)

Acidity

Ex: $R-SO_3H > R-COOH >$  $> CH_3OH > H_2O > C_2H_5OH$

Basicity ∝ Nucleophilicity

$R-SO_3^{\ominus} < R-COO^{\ominus} <$  $< CH_3O^{\ominus} < OH^{\ominus} < C_2H_5O^{\ominus}$

→ If bulk groups are attached then

$CH_3O^{\ominus} > CH_3-CH_2-O^{\ominus} > CH_3-\underset{CH_3}{CH}-O^{\ominus} > CH_3-\underset{CH_3}{\overset{CH_3}{C}}-O^{\ominus}$

Here basicity ∝ $\frac{1}{Nu^{\ominus}}$

Nucleophilicity – $I^- > Br^- > Cl^- > F^-$