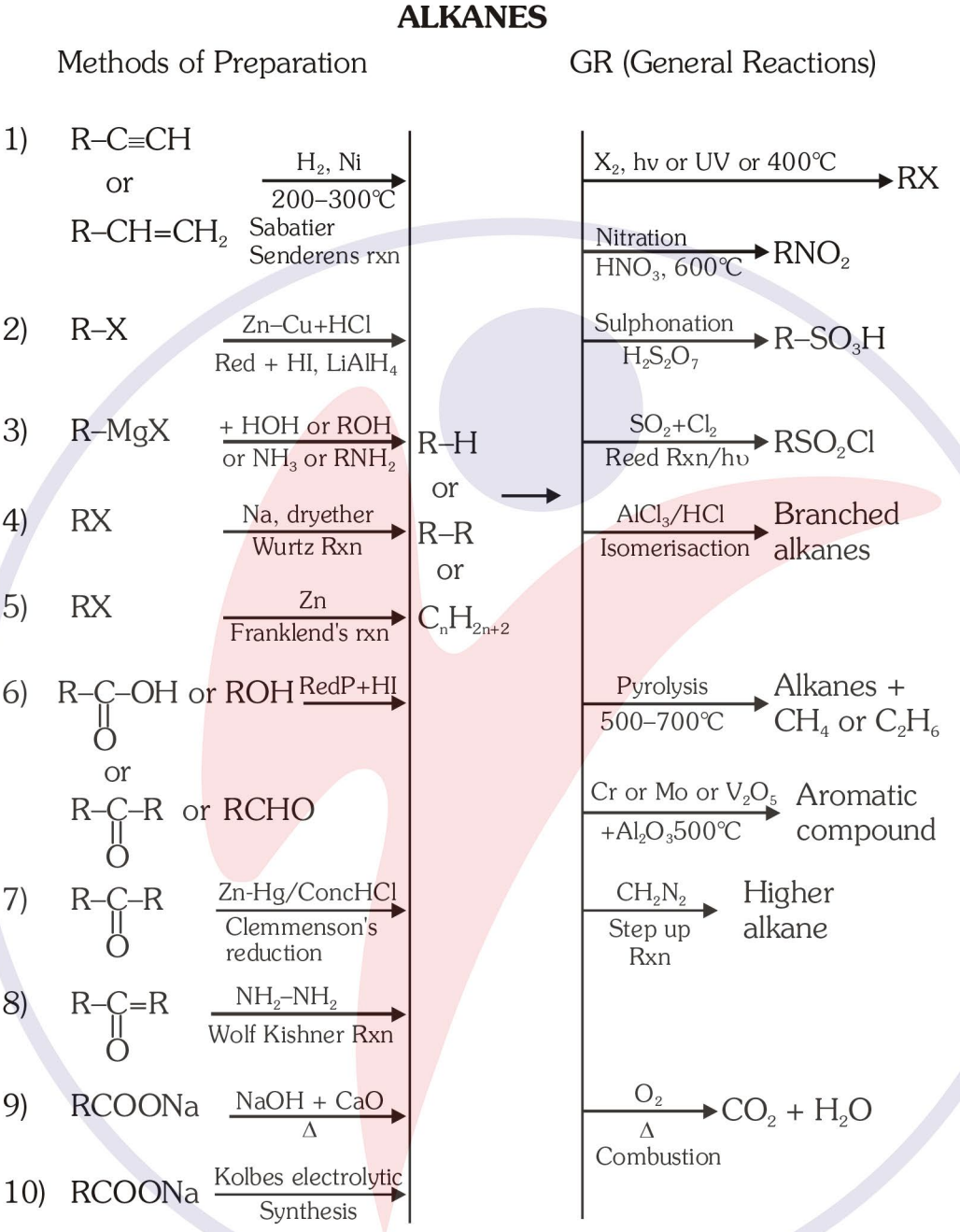
ALKANES


Methods of Preparation
GR (General Reactions)
1) R–C≡CH or R–CH=CH2
H2, Ni
200–300°C
Sabatier Senderens rxn
2) R–X
Zn–Cu+HCl
Red + HI, LiAlH4
3) R–MgX
+ HOH or ROH or NH3 or RNH2
4) RX
Na, dryether
Wurtz Rxn
5) RX
Zn
Franklend's rxn
6) R–C(=O)–OH or ROH
RedP+HI
or R–C(=O)–R or RCHO
7) R–C(=O)–R
Zn-Hg/ConcHCl
Clemmenson's reduction
8) R–C(=O)–R
NH2–NH2
Wolf Kishner Rxn
9) RCOONa
NaOH + CaO
Δ
10) RCOONa
Kolbes electrolytic Synthesis
R–H or R–R or CnH2n+2
X2, hv or UV or 400°C → RX
Nitration HNO3, 600°C → RNO2
Sulphonation H2S2O7 → R–SO3H
SO2+Cl2 Reed Rxn/hυ → RSO2Cl
AlCl3/HCl Isomerisaction → Branched alkanes
Pyrolysis 500–700°C → Alkanes + CH4 or C2H6
Cr or Mo or V2O5 +Al2O3 500°C → Aromatic compound
CH2N2 Step up Rxn → Higher alkane
O2 Δ Combustion → CO2 + H2O

ALKENE

Methods of Preparation

1) $R-CH_2-CH_2-OH$ —(Conc H_2SO_4, $-H_2O$)→ $R-CH=CH_2$ or C_nH_{2n}

2) $R-CH_2-CH_2-X$ —(alc KOH, $-HX$)→ $R-CH=CH_2$ or C_nH_{2n}

3) $R-CH_2-CHX_2$ —(Zn dust for higher alkene, $-XZ$)→ $R-CH=CH_2$ or C_nH_{2n}

4) $R-CHX-CH_2X$ —(Zn dust, Δ)→ $R-CH=CH_2$ or C_nH_{2n}

5) $R-CH=CH_2$ —(Ni, H_2, 200–300°C)→ $R-CH=CH_2$ or C_nH_{2n}

6) $R-CH(COOK)-CH(COOK)-R$ —(Kolbes electrolytic Synthesis)→ $R-CH=CH_2$ or C_nH_{2n}

7) $(C_2H_5)_4\overset{\oplus}{N}OH^{\ominus}$ —($\overset{\ominus}{OH}$, Δ)→ $R-CH=CH_2$ or C_nH_{2n}

8) $R-C(=O)-O-CH_2-CH_2-R$ —(Pyrolysis)→ $R-CH=CH_2$ or C_nH_{2n}

9) $R-H$ —(Pyrolysis)→ $R-CH=CH_2$ or C_nH_{2n}

GR (General Reactions)

$R-CH=CH_2$ or C_nH_{2n}

- (H_2, Ni, 200–300°C) → $R-CH_2-CH_3$
- (X_2) → $R-CHX-CH_2X$
- (HX) → $R-CHX-CH_3$
- (HBr, Peroxide) → $R-CH_2-CH_2-Br$
- (HOCl) → $R-CH(OH)-CH_2-Cl$
- (dil H_2SO_4, $+H_2O$) → $R-CH_2(OH)-CH_3$
- ($1/2O_2$, Aq 300°C) → $R-CH(O)-CH_2$
- ($+CH_2N_2$) → $R-CH(CH_2)-CH_2$
- (BH_3) → $(RCH_2CH_2)_3B$
  - ($H_2O_2/\overset{\ominus}{OH}$) → $R-CH_2-CH_2-OH$
  - ($H^{\oplus}/H_2O$) → $R-CH_2-CH_3$
- (O_2, Δ) → CO_2+H_2O
- (OsO_4) → $R-CH(OH)-CH_2(OH)$
- (Strong Oxidant) → $R-C(=O)-OH+CO_2+H_2O$
- (Peracid) → $R-CH(O)-CH_2$
- (Cl_2 or Br_2, 500°C) → Substitution product
- ($Al_2(SO_4)_3$, 200–300°C) → Isomerisation rxn
- (O_3+H_2O/Zn, Ozonolysis) → $R-C(=O)-H + H-C(=O)-H$

ALKYNE

Methods of Preparation

1) $CH_2(Br)-CH_2(Br)$ —alcKOH or $NaNH_2$→ C_2H_2

2) CH_3-CHBr_2 —alcKOH, $NaNH_2$→ C_2H_2

3) $CHCl_3$ —Ag powder, Δ→ C_2H_2

4) $CHBr_2-CHBr_2$ —Zn dust, Δ→ C_2H_2

5) $CHBr=CH-Br$ —Zn dust, Δ→ C_2H_2

6) $CH_2=CH-Cl$ —$NaNH_2$→ C_2H_2

7) $HC(=H)-COONa$ / $H-C(=COONa)-COONa$ —Kolbe's electrolytic Synthesis method→ C_2H_2

8) CaC_2 —H_2O→ C_2H_2

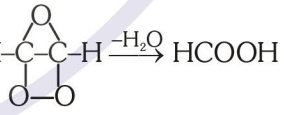
9) $2C+H_2$ —electrical, 1200°C, Berthelot's Process→ C_2H_2

10) $CH_3-C\equiv CH$ —i) Na ii) R–X→ $CH_3-C\equiv C-R$

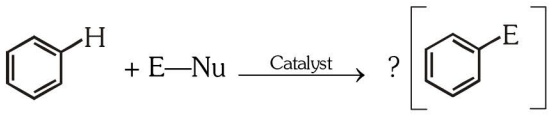
11) $CH_3-C\equiv CH$ —(i) CH_3MgI (ii) R–X→ $CH_3-C\equiv C-R$

GR (General Reactions)

C_2H_2 →

- —H_2, Ni→ C_2H_6
- —X_2→ $C_2H_2X_4$
- —HBr, Peroxide→ CH_3-CHBr_2
- —HBr, No Peroxide→ CH_3-CHBr_2
- —HOCl→ Cl_3CHCHO
- —HCN, $Ba(CN)_2$→ $CH_2=CH-CN$
- —CH_3COOH, Hg^{+2}→ $CH_3CH(OCOCH_3)_2$
- —Hg^{+2}, 80°C, dilH_2SO_4→ CH_3CHO
- —ConcH_2SO_4→ $CH_3-CH(HSO_4)_2$
- —$AsCl_3$→ $CHCl=CHAsH_2$
- —$NaNH_2$→ $NaC\equiv CNa$
- —$AgNO_3+NH_4OH$ (Tollen's reagent)→ $Ag-C\equiv C-Ag$ (White ppt)
- —$Cu_2Cl_2+NH_4OH$→ $Cu-C\equiv C-Cu$ (Red ppt)
- —Combustion, O_2→ $CO_2 + H_2O$
- —Baeyer's Reagent→ CHO / CHO
- —O_3, Ozonolysis→  $-H_2O$→ HCOOH
- —Trimerisation (Red hot iron tube)→ Benzene
- —Tetramerisation, $[Ni(CN)_2]$→ C_8H_8 or 
- —CH_3OH, BF_3–HgO→ $CH(OCH_3)_2$ methylal / CH_3

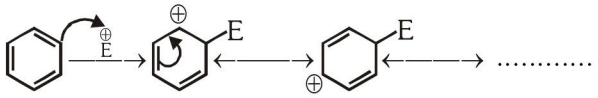
Electrophilic substitution reaction [ESR] : Characteristic reaction of arenes is ESR



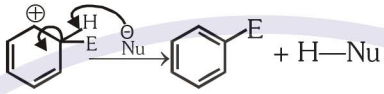
Mechanism :

Formation of $\overset{\oplus}{E}$ $E-Nu \xrightarrow{Catalyst} \overset{\oplus}{E} + \overset{\ominus}{Nu}$

Attack of $\overset{\oplus}{E}$



Abstraction of $\overset{\oplus}{H}$



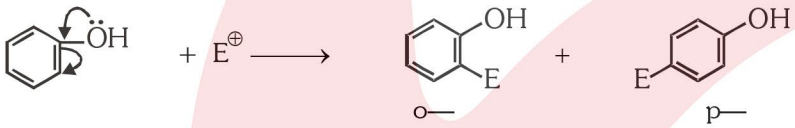
Note:

(1) ortho/para directing group or activating group : Group which direct electrophile on ortho and para position is called as o/p directing group.

These group increases electron density or increases reactivity of benzene ring so are called activating group.

These groups are :

$-\ddot{N}H_2$, $-\ddot{N}HR$, $-\ddot{N}R_2$, $-\ddot{O}H$, $-\ddot{O}R$, $-\ddot{N}HCOCH_3$, $-\ddot{S}H$, $-\ddot{O}COR$, $-CH_3$, $-CH_2CH_3$, $-CH(CH_3)_2$



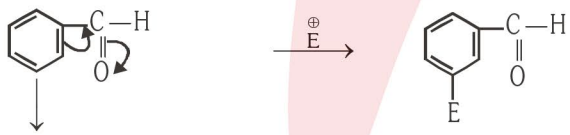
due to +M/+H of these groups electron density at ortho and para position is increased so electrophile easily attack on ortho/para position.

(2) ***Meta directing or deactivating group :*** Due to –M/–H of groups electron density at ortho and para position is less but more at meta position so electrophile attack on meta position. So, groups which direct electrophile on meta position are called as meta directing groups.

These groups decrease electron density in benzene ring and decrease reactivity of benzene ring so are called as deactivating group.

These groups are :

—CHO, COOH, —COOR, —COR, —CN, $—NO_2$, $—SO_3H$, $—CX_3$

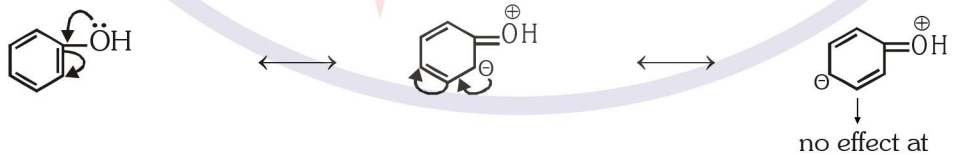


More e^- density at meta position

(3) Halogens are o/p directing group due to +M effect but are deactivating group due to –I > +M.

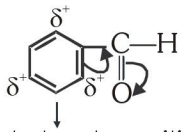
(4) M and H effect does not depend on distance while I–effect depends on distance In given example

(5) M-effect at meta position is considered zero.



no effect at meta position

Similarly :



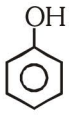
no effect at meta position

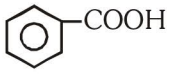
Aromatic Hydrocarbon

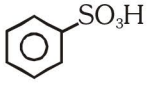
Preparation

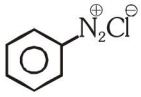
1) n-Hexane $\xrightarrow[600°C]{Cr_2O_3/Al_2O_3}$

2) $CH{\equiv}CH \xrightarrow[Tube]{Red\ hot\ iron}$

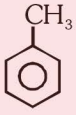
3)  $\xrightarrow[\Delta]{Zn}$

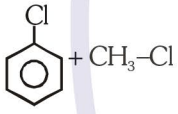
4)  $\xrightarrow{Sodalime/\Delta}$

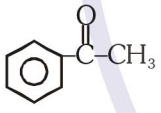
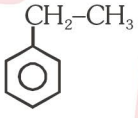
5)  $\xrightarrow[\Delta]{H_3O^+}$

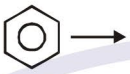
6)  $\xrightarrow[or\ C_2H_5OH]{H_3PO_2\ or\ HCOOH}$

7)  $\xrightarrow{H-OH}$

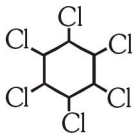
8)  $\xrightarrow{NH_2-NH_2/OH^{\ominus}}$ 

9)  $\xrightarrow[\Delta]{Na/ether}$ 

10)  $\xrightarrow[HCl]{Zn\text{-}Hg}$ 



Properties

$\xrightarrow{3Cl_2/h\nu}$  (BHC) or gammaxene or lindane or 666

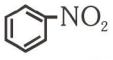
$\xrightarrow[Ni,\ \Delta]{H_2}$ 
Complete hydrogenation

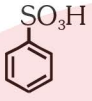
$\xrightarrow[Partial\ hydrogenation\ (Birch\ reduction)]{Na/liq\ NH_3}$ 

$\xrightarrow[Zn]{O_3/H_2O}$ 3 

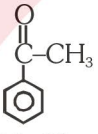
$\xrightarrow{O_3/H_2O}$ 

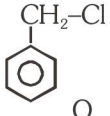
$\xrightarrow[FeCl_3]{Cl_2}$ 

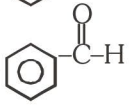
$\xrightarrow{Con\ HNO_3 + H_2SO_4}$ 

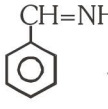
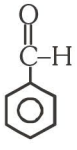
$\xrightarrow{Con\ H_2SO_4}$ 

$\xrightarrow[AlCl_3(Anh)]{R-X}$ 

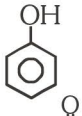
$\xrightarrow[AlCl_3]{CH_3-C(=O)-Cl}$ 

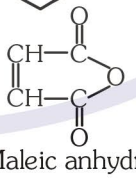
$\xrightarrow[ZnCl_2]{HCHO+HCl}$ 

$\xrightarrow[AlCl_3]{CO+HCl}$ 

$\xrightarrow[AlCl_3]{HCN+HCl}$  $\xrightarrow{H_3O^{\oplus}}$ 

$\xrightarrow{O_2}$ $6CO_2+3H_2O$

$\xrightarrow[300°C]{V_2O_5}$ 

$\xrightarrow[450°C]{V_2O_5}$ 
Maleic anhydride