ONE PAGE NOTES OF CHEMISTRY



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HYDROCARBONS

Compound which have both the elements ie 'C' and 'H' is called as hydro-carbon.
Eg - CH_4, C_2H_5 etc
Alkanes, Alkenes, Alkynes, Aromatic

ALKANES :-

→ general formula = C_nH_{2n+2}
→ Alkanes show structural isomers.
* Physical property = it shows structural isomers thus have branching ie results to lower the boiling points.

* Preparation :-

1. Hydrogenation :- addition of H

$CH_2=CH_2 + H_2 \xrightarrow{Ni/Pd/Pt} CH_2(H)-CH_2(H)$

→ Syn addition (same side)
→ Exothermic $\Delta H = -ve$
→ $\Delta S < 0$, $\Delta G < 0$ spontaneous

Rate of Rxn :- Alkynes > Alkenes

$ROR \propto \frac{1}{\text{stability}}$ | → stability of Alkenes ∝ No of ∝ Hydrogen

2. From Alkyl halide :-

(a) Reduction ;

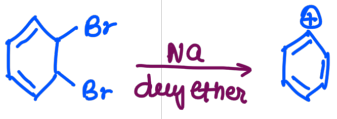
$R-X \xrightarrow{Zn/H^{\oplus}} R-H + ZnX_2$

(b) Wurtz Reaction ;

$R-X \xrightarrow[\text{dry ether}]{Na} R-R + NaX$

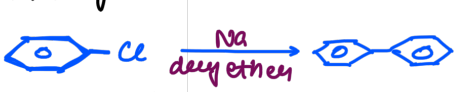
→ Free Radicle mechanism
→ Coupling Rxn
→ can not form CH_4
→ Unsymmetrical alkane - have low yield.

(c) Intermolecular wurtz :-

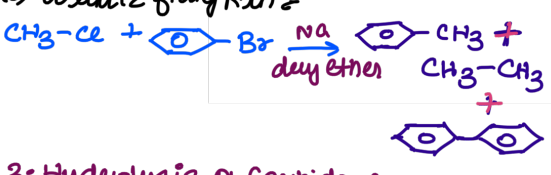


NOTE ; If alkyl halide is 3°, then no wurtz reaction
→ No coupling, No disproportionation Rxn

(d) Fittig Rxn :-



(e) Wurtz fittig Rxn :-



3. Hydrolysis of Carbides :-

$Be_2C + H_2O \longrightarrow Be(OH)_2 + CH_4$
$Al_4C_3 + H_2O \longrightarrow Al(OH)_3 + CH_4$
$CaC_2 + H_2O \longrightarrow Ca(OH)_2 + CH \equiv CH$
$Mg_2C_3 + H_2O \longrightarrow Mg(OH)_2 +$
$CH_3-C \equiv CH$

4. Kolbe's Reactions :- same as wurtz

$R-\underset{\underset{O}{\|}}{C}-OH \xrightarrow[\text{electrolysis}]{NaOH} \underset{\text{Anode}}{R-R} + 2CO_2 + \underset{\text{cathode}}{H_2}$

→ It is used to prepare symmetrical Alkane
→ CH_4 can't be formed
→ Unsymmetrical will have poor yield.

$CH_2(-COOH)-CH_2(-COOH) \xrightarrow[\text{electrolysis}]{NaOH} CH_2=CH_2$

5. Soda lime decarboxylation :-

$R-\underset{\underset{O}{\|}}{C}-OH \xrightarrow[CaO]{NaOH} R-H + CO_2\uparrow$

* Chemical properties :-

1. Halogenation ; Rxn with halogens in presence of hν (light).

$R-H + X_2 \xrightarrow{h\nu} R-X + HX$

→ Free Radicle mechanism
steps involved in mechanism ;
chain initiation → chain propagation → chain Termination

NOTE ; $F_2 > Cl_2 > Br_2 > I_2$ Halogens
Reactivity - 3° > 2° > 1°

2. Fluorination :- highly reactive, uncontrolable.

3. Iodination :-

$R-H + I_2 \rightleftharpoons R-I + HI$ (HI → strong reducing agent.)

4. Chlorination ; exothermic, controlable non-selective.

$CH_3-CH_3 + Cl_2 \xrightarrow{h\nu} CH_2(Cl)-CH_3$

How to find Major Product ;
Chlorination → 1° : 2° : 3°
1 : 3.8 : 5 R

Hp = No of 1°H — 1° = Hp × Rp
Hs = No° of 2°H — 2° = Hs × Rs
H_T = No° of 3°H — 3° = H_t × Rt

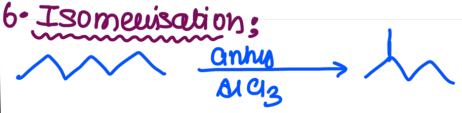
5. Bromination :- as more stable free radicle is preferred.

1°	2°	3°
1 (Rp)	: 82 (Rs) :	1600 (Rt)

Hp = No of 1H — 1° = Hp × Rp
Hs = No° of 2°H — 2° = Hs × Rs
H_T = No° of 3°H — 3° = H_t × Rt

$\overset{1^\circ}{CH_3}-\overset{2^\circ}{CH_2}-\overset{1^\circ}{CH_3} + Br_2 \xrightarrow{h\nu} CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

6. Isomerisation ;



7. Aromatisation :-

$C-C-C-C-C-C \longrightarrow$ 

Reagent = V_2O_5, MoO_3, Al_2O_3, Cr_2O_3

8. Combustion Rxn :-

$R + O_2 \xrightarrow{\Delta} H_2O + CO_2$

9. Controlled Rxn :-

$CH_4 + O_2 \xrightarrow{Cu/523K} CH_3-OH$
$CH_4 + O_2 \xrightarrow{MoO_3/\Delta} HCHO$


10. Pyrolysis :-
higher compound → lower compound

$C-C-C-C-C-C-C-C \xrightarrow{\Delta} C_6H_2 + H_2$
random product

11. with steam :-

$CH_4 + H_2O \longrightarrow CO_2 + H_2$
syn gas

12. Nitration :-

$R-H + \text{Conc. } HNO_3 \longrightarrow R-NO_2$

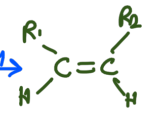
13. Sulphonation ;

$RH + \underset{H_2SO_4}{\text{Conc.}} \longrightarrow R-SO_3H$

ALKENES :-

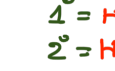
Preparations :-

1. From Alkynes :-

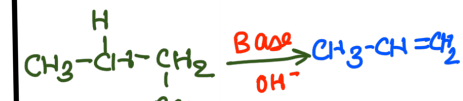
$R_1-C \equiv C-R_2 + H_2 \xrightarrow{Pd/BaSO_4}$ 

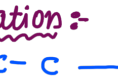
$R_1-C \equiv C-R_2 + H_2 \xrightarrow[NH_3]{Na/Liq}$ 

2. Dehydrohalogenation :-

Reagent = alc KOH, $NaNH_2$ and soda lime, $RO^-Na^+/R-OH$,


(sodium teertiary butaoxide)



No intermediate is formed.
Rate of Rxn → RI > R-Br > R-Cl
Rate of Rxn - 3°RX > 2°RX > 1°RX
Anti elimination Rxn.
Rate of Rxn = [R-X][OH⁻]
order = 1
most stable is major product
E^2 mechanism, β elimination.
major product = Saytzeff
minor product = Hoffmann
except the bulky group ;


, major = Hoffmann
minor = Saytzeff

NOTE ;
AlC° KOH = only 1 Dehydrohalogenation
$NaNH_2$ = strong Base = 2 time Dehydrohalogenation

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3- Dehalogenation :-

$CH_3-CH(Cl)-CH_2 \xrightarrow[\text{Alcohol}]{Zn} CH_3-CH=CH_2 + Cl_2$

Rearrange carbo-cation :-

No reagent required.
Purpose - to increase stability.

$CH_3-\overset{2}{C}H(H)-\overset{3}{C}H_2 \xrightarrow{1,3\ \text{Hydride shift}} CH_3-CH^{\oplus}-CH_2(H)$

Trick :-
1 Par laga H shift to 3.
2 Par lagao ⊕ve charge.

Ring expansion :- 6 > 5 > 4 > 3



4- Dehydration of Alcohol :-

Reagent :- Conc° H_2SO_4 or Conc° H_3PO_4

Eg- $CH_3-CH_2-CH_2-OH \xrightarrow[H_2SO_4\ \Delta]{\text{conc}^\circ} CH_3-CH_2-CH_2^{\oplus}$

$CH_3-CH_2-CH_2^{\oplus}$ → 1° carbo-cation → 1,2 H shift → $CH_3-CH^{\oplus}-CH_3$ 2° carbo-cation

- 1° carbo-cation → E1 mechanism
- Re-arrangement
- Most stable alkene (Satzaff)
- Rate of Rxn ∝ stability of carbo-cation

1,2 dH	1,6 dH
$CH_3-CH=CH-CH_3$ (Satzaff) Major	$CH_3-CH_2-CH=CH_2$ Hoffman (minor)

*Chemical property :-

1- Hydrogenation :- Addition of H_2

$R-CH=CH_2 + H_2 \longrightarrow R-CH_2-CH_2$ (H, H)

(Syn addition)

2- Halogenation :- addition of halogen

Reactivity = $F_2 > Cl_2 > Br_2 > I_2$

→ Anti-addition, No intermediate, Electrophilic addition Rxn.

Case I :- Non-polar solvent, $\mu = 0$

$CH_3-CH=CH_2 \xrightarrow[CCl_4]{Br_2} CH_3-CH(Br)-CH_2(Br)$ Anti

Brown gas = test for unsaturation.

Case II :- Polar solvent - H_2O

$CH_3-CH=CH_2 \xrightarrow[H_2O]{Cl_2} CH_3-CH(OH)-CH_2(Cl)$

$Cl_2 + H_2O \rightarrow OH^- + Cl^+$

3- Addition of HX :-

$CH_3-CH=CH_2 \xrightarrow{HCl} CH_3-CH^{\oplus}-CH_3 \xrightarrow{Cl^-} CH_3-CH(Cl)-CH_3$

2° carbo-cation

MAKOVNIKOFF RULE :- -ve part adding to that carbon which has less no° of H-atom.

* Add of HBr in prence of ROOR :-

$CH_3-CH=CH_2 \xrightarrow[ROOR]{HBr} CH_3-CH_2-CH_2(Br)$

- Peroxide effect
- Kharash effects, No rearrangement
- Free Radical

Anti markovnikoff Rule :- -ve part is added to 'C' with more H atoms.

4) Rxn with H_2SO_4 :-

Case I :- Conc° H_2SO_4

$CH_3-CH=CH_2 \xrightarrow[H_2SO_4]{\text{conc}^\circ} CH_3-CH(SO_3H)-CH_3$

Case II :- dil° H_2SO_4 - add of water.

$CH_3-CH(CH_3)-CH=CH_2 \xrightarrow[H_2SO_4]{\text{dil}^\circ} CH_3-C(OH)(CH_3)-CH_2-CH_3$

5) Ozonolysis :-

$CH_3-CH=CH_2 \xrightarrow{(i)\ O_3} CH_3-CH(O-O-CH_2)$

$CH_3-CH(O-O-CH_2) \xrightarrow[Zn/H_2O]{(ii)} CH_3-CHO + H-CHO$

6) Oxidative ozonolysis :-

(i) O_3 (ii) H_2O

Ketone = Leave it Aldehyde = $C(=O)-OH$

$CH_3-C(CH_3)=CH \xrightarrow[(ii)\ H_2O]{(i)\ O_3} CH_3-C(CH_3)=O + CH_3-CH(=O)-OH$

1 (Ketone) 2 (Aldehyde)

7) Ozonolysis of alkynes :-

$CH_3-C\equiv C-CH_3 \xrightarrow[Zn/H_2O]{O_3} CH_3-C(=O)-C(=O)-CH_3$

(i) O_3 (ii) H_2O

$CH_3-C(=O)-C(=O)-CH_3 \rightarrow CH_3-C(=O)-CH_3 + HO-C(=O)-CH_3$

8- Oxidation of Alkenes :-

Case I - strong oxidising agents.

answer is same as oxidative ozonolysis

$CH_3-C(CH_3)=CH-CH_3 \xrightarrow{KMnO_4/H^+} CH_3-C(CH_3)=O + HO-C(=O)-CH_3$

Case II - mild oxidising agents.

$CH_3-CH=CH_2 \xrightarrow[\text{Baeyer's Reagent}]{\text{mild } KMnO_4} CH_3-CH(OH)-CH_2(OH)$

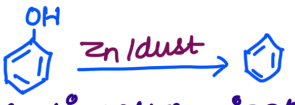
- $AgNO_3$ → $CH_3-CH(OH)-CH_2(OH)$
- $R-C(=O)-O-O-H$ → $CH_3-CH(OH)-CH_2(OH)$
- OsO_4 → $CH_3-CH(OH)-CH_2(OH)$

AROMATIC :

Benzene Toluene ($C_6H_5-CH_3$)

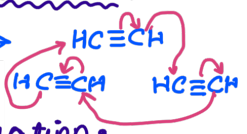
* Preparation :-

1) Reduction of Phenol :

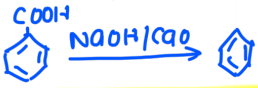


2) Cyclic polymerisation :-

$3HC\equiv CH \xrightarrow[\text{iron tube}]{\text{Red Hot}}$ Benzene



3) By Decarboxylation :-



* Chemical property :-

→ electrophilic addition



Aromatic Non aromatic

1- Electromeric aromatic subs :-

$Ar-H + E^{\oplus} \longrightarrow Ar-E + H^{\oplus}$ (E = electrophile)

2) Nitration :- Electrophile = $NO_2^{\oplus}$

Reagent = Conc° HNO_3 (Base) + Conc° H_2SO_4 (Acid)

$Ar-H + NO_2^{\oplus} \longrightarrow Ar-NO_2 + H^{\oplus}$

3) Friedal Craft Rxn :-

Alkylation ; $CH-Cl_3 + AlCl_3 \rightarrow [AlCl_4]^- + CH_3^{\oplus}$

$Ar-H + CH_3^{\oplus} \longrightarrow Ar-CH_3$ (Toluene)

Acylation :-

Reagent = $CH_3-C(=O)-Cl + AlCl_3$

$Ar-H + CH_3-C^{+}(=O) \longrightarrow Ar-C(=O)-CH_3 + H^{\oplus}$

4) Halogenation ;

Reagent = $Cl_2 + AlCl_3 \rightarrow [AlCl_4]^- + Cl^{\oplus}$

$Ar-H + Cl^+ \longrightarrow Ar-Cl + H^{\oplus}$

5- Sulphonation ;

Reagent = Conc° H_2SO_4 or oleum ($H_2S_2O_7$)

Electrophile = SO_3 ↘ Neutral.

$Ar-H + SO_3 \longrightarrow Ar-SO_3H$

Benzene sulphonic acid

* Activating group ; which increase the e⁻ density on benzene, EDG {+R, +H, +I}

* Deactivating grp ; which decrease the e⁻ density on benzene, EWG {-R, -H, -I}

NOTE ; Halogens, e⁻ ortho-para directing
↳ Deactivity
Reason → +R < -I

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ALKYNES:-

→ general formula = C_nH_{2n-2}

* Preperation:-

(i) $CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

(ii) $CH_2Br-CH_2Br \xrightarrow[KOH]{alc.} CH_2=CH-Br \xrightarrow{NaNH_2} CH\equiv CH$

* Chemical property:

(i) Acidic character;

→ $CH_3-C\equiv CH + Na \longrightarrow CH_3-C\equiv C^-Na^+ + \frac{1}{2}H_2$

Acidity order of some hydrocarbon;

$CH\equiv CH > CH_2=CH_2 > CH_3-CH_3$

$HC\equiv CH > CH_3-C\equiv CH \gg CH_3-C\equiv C-CH_3$

(ii) Addition Reaction;

(a) Addition of Dihydrogen;

$R-C\equiv CH + 2H_2 \xrightarrow{Pd} RCH_2CH_3$

(b) Addition of halogen:-

$CH_3-C\equiv CH \xrightarrow{Br_2} CH_3-\underset{Br}{\overset{Br}{C}}-\underset{Br}{\overset{Br}{CH}}$

Reddish orange colour of the solution of bromine in CCl_4 is decolourised

(c) addition of hydrogen halides;

$CH\equiv CH \xrightarrow{HBr} [CH_2=CH-Br] \xrightarrow{HBr} CH_3-CHBr_2$

(d) addition of water:-

$CH_3-C\equiv CH \xrightarrow[Hg^{+2}/H^+]{H_2O} CH_3-\underset{O-H}{C}=CH_2$ ⇌ $CH_3-\underset{O}{\overset{\|}{C}}-CH_3$ (Tautomers)

(e) Polymerisation:-

$3CH\equiv CH \xrightarrow[Fe\ tube\ 873K]{Red\ hot}$ 

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