HYDROCARBON

Compounds which contain Carbon & Hydrogen in the form of Eg C_xH_y are Hydrocarbon.

→ Saturated
→ Unsaturated
→ Aromatic

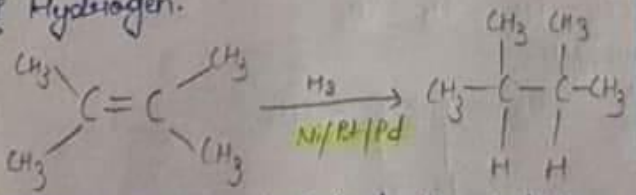
ALKANES→

→ General formula for alkanes are C_nH_{2n+2} Eg→ CH_4, C_2H_6, C_3H_8
→ Alkanes are also called paraffin.
→ Alkanes contain sigma bond which is strong, Breaking of sigma bond requires high energy so alkanes are less reactive.
→ Alkanes do not react with chemical reagents such as

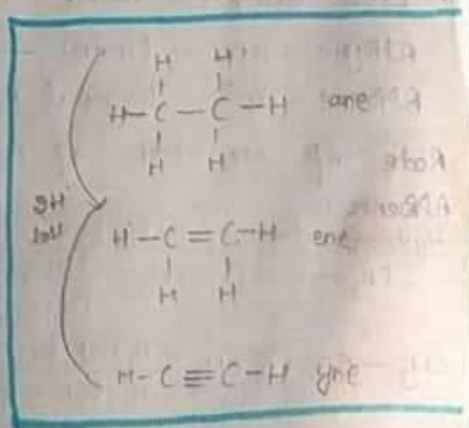
- dil/conc. HCl
- dil / conc. H_2SO_4
- dil / conc. HNO_3
- caustic soda
- acidic & basic $K_2Cr_2O_7$, $KMnO_4$

PREPARATION→

Hydrogenation ⇒ Conversion of multiple bond into single bond, by addition of Hydrogen.



→ Raney Nickel is obtained by boiling Ni/Al with NaOH.
→ Aluminium gets dissolved & Nickel is obtained in finely divided state.



Catalyst →
Catalyst is taken in powdered form bcoz, more surface area increases rate of rxn.
→ Methane can't prepared by using this method.

Imp Point:- Both the Hydrogen are added on the same side, this is called syn addition.
→ Cis ka syn addition karne se Meso product banta hai.
→ optically inactive. [CSI]
→ Trans ka syn addition karne se optically active Compound banega. [TSA]

$$CH_3-CH=CH-CH_3 \xrightarrow[Ni/Pt/Pd]{H_2} CH_3-CH_2-CH_2-CH_3$$

$$CH_3-C\equiv C-CH_3 \xrightarrow[Ni/Pt/Pd]{2H_2} CH_3-CH_2-CH_2-CH_3$$

$$CH_3-\underset{H}{C}=\underset{H}{C}-CH_3$$

Less surface area, More rate of reaction
Alkyne - sp - linear - less surface area
Alkene - sp^2 - Trigonal planar - more surface area
Rate of reaction of Alkynes is more as compared to Alkenes.

Hydrogenation of Alkyne →

$$CH_3-C\equiv C-CH_3 \xrightarrow[Pd]{H_2} CH_3-CH_2-CH_2-CH_3$$

Poisoned

$$CH_3-C\equiv C-CH_3 \xrightarrow[H_2/Pd-CaCO_3]{H_2/Pd-BaSO_4} CH_3-\underset{H}{C}=\underset{H}{C}-CH_3$$

Lindlar

Hydrogenation of Alkyne →

$H_2/Pd-BaSO_4$ = Rosenmund catalyst

$H_2/Pd-CaCO_3$ = Lindlar's catalyst

Hydrogenation mein syn addition hota hai so cis Alkene will be formed.

$CH_3-C\equiv C-CH_3 \xrightarrow{Na/NH_3}$ Trans alkene

ene $\xrightarrow[\text{catalyst}]{H_2}$ ane

yne $\xrightarrow[\text{catalyst}]{H_2}$ ane

yne $\xrightarrow[\text{Lindlar}]{\text{Rosenmund}}$ ene

yne $\xrightarrow{Na/NH_3}$ trans ene

Alkane from Alkyl Halide :-

$R-X + H_2 \longrightarrow R-H + H-X$

Metal & Acid

$Zn + HCl$

$Zn + CH_3COOH$

Mechanism :- $R-X + H_2 \longrightarrow R-H + H-X$

$Zn^{2+} \rightarrow Zn^{2+} + 2e^-$

$R^{\delta+}-X^{\delta-} + 2e^- \longrightarrow R^{\ominus} + X^{\ominus}$ (carbanion)

$R^{\ominus} + H^+ \longrightarrow R-H$ alkane (acid)

1. This is a reduction reaction (addition of Hydrogen)
2. Reduction is due to electron transfer from metal to R-X
3. Methane can be prepared with this reaction.

WURTZ REACTION

$R-X + Na + X-R \longrightarrow R-R + 2NaX$

3 mol R–X / Na / dry ether

Wurtz reaction se no. of Carbon increased in the product.

$CH_3-Cl + 2Na + Cl-CH_3 \longrightarrow CH_3-CH_3 + 2NaCl$

$C_2H_5-Br + 2Na + Br-C_2H_5 \longrightarrow C_4H_{10} + 2NaBr$

There are two mechanisms proposed for this reaction

1. Ionic Mechanism
2. Free Radical Mechanism

Free Radical Mechanism :-

$$R-X + Na + X-R \longrightarrow R-R + 2NaX$$

$2Na \longrightarrow 2Na^{+} + 2e^{-}$

$R^{\delta+}-X^{\delta-} \longrightarrow R^{\cdot}$

$\Rightarrow R-R + NaX$

$R_{\delta+}-X_{\delta-} \longrightarrow R^{\cdot}$

- Free radical also undergo disproportionation reaction, one radical loosses $e^{\ominus}$ & one radical gains $e^{\ominus}$.

C_2H_5
- C_2H_6 (alkane)
- C_2H_4 (alkene)

Ionic Mechanism :-

$$R-X + Na + X-R \longrightarrow R-R + 2NaX$$

$R-X$ ($\delta+$ $\delta-$) $\quad R_{\delta+}-P_{\delta-} \longrightarrow R-R + NaX$

$2Na \longrightarrow Na^{+} + 2e^{-}$, R^{-}

Imp Point → Methane can't be prepared by this method.

Selective Hydrogenation →

$$CH_3-\underset{\uparrow}{CH}=CH-\underset{\uparrow}{CH_2}-CH=CH_2 \xrightarrow[Ni]{1\ mol\ H_2} CH_3-CH=CH-CH_2-CH-CH_3$$

5° Hydrogen — 2° Hydrogen, less stable

Ques → What is the function of Dry ether in Wurtz rxn?

→ inert atmosphere.

Product → $C_2H_6Br \xrightarrow[\text{Dry ether}]{Na} C_4H_{10} + 2NaBr$

✓ Butane is major product

✓ ethane & ethene are minor product

$C_2H_5^{\cdot} + C_2H_5^{\cdot} \longrightarrow C_2H_4$ (ethene), C_2H_6 (ethane)

Ques → Which product is not possible in the following rxn:

$C_2H_5Br \xrightarrow[\text{Dry ether}]{Na} C_2H_5 \cdot \cdot C_2H_5$

(A.) $CH_3 - CH_2 - CH_2 - CH_3$

(B.) $CH_3 - CH_2 - CH_3$ (✓)

(C.) $CH_3 - CH_3$

(D.) $CH_2 = CH_2$

Ques → Find the product in the following Wurtz Reaction

$CH_3 - Cl + 2Na + Cl - C_2H_5 \xrightarrow{\text{dry ether}} CH_3 - CH_2 - CH_3$

Propane (not good yield)

Wurtz reaction is good for molecules having even number of carbon.

Ques → Which of the following compounds will give good yield in Wurtz reaction.

(a.) CH_4

(b.) $CH_3 - CH_3$ (✓)

(c.) $CH_3 - CH_2 - CH_3$

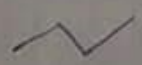
(d.) $CH_3 - CH_2 - CH_2 - CH_3$ (✓)

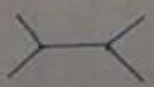
(e.) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

even no. of C + symmetrical

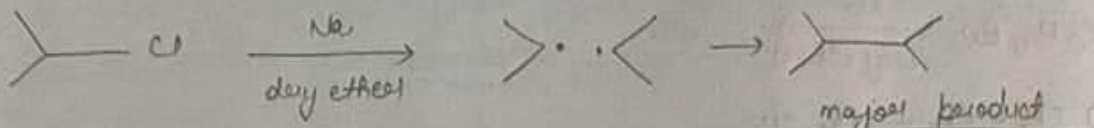
(a)  (even + unsymmetrical) not good yield

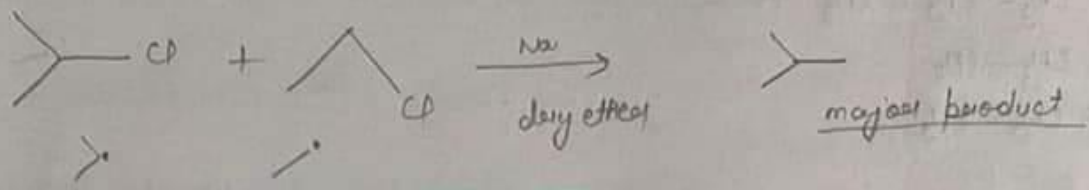
(b)  (even + unsymmetrical) not good yield

(c)  (even + symmetry) good yield

(d)  (even + symmetry) good yield

Ques → Find the product in following Wurtz reaction?





① Alkene ① catalytic hydrogenation Ni/Pt/Pd/Raney Ni
Alkyne → Alkane

② Rosenmund H_2-Pd/$BaSO_4$
Lindlar Catalyst H_2-Pd/$CaCO_3$

③ Cis + syn = Gnactive CSI
Trans + syn = active TSA

④ $\xrightarrow[NH_3]{Na}$ Trans alkene

⑤ R–X → R–H
metal + acid
Zn + HCl
or
Zn + CH_3COOH

⑥ R–X + Na + dry ether → Wurtz Rxn

Frankland Reagent →

If Zn is used in place of Na, the reaction is named as Frankland Reaction.

$$R-X + 2Zn + X-R \longrightarrow \underbrace{R_2Zn + ZnX_2}_{\text{Frankland reagent}}$$

$$R_2Zn + R-X \longrightarrow R-R + RZnX$$

(Alkane)