

## Hydrocarbons

Compounds of carbon and hydrogen

**Saturated hydrocarbons** - have carbon-carbon single bonds

**Unsaturated hydrocarbons** - have carbon-carbon multiple bonds

## Wurtz Reaction

Used for the preparation of higher alkanes

Alkyl halides on treatment with sodium metal in dry ethereal solution give higher alkanes containing even number of carbon atoms

## Halogenation of Alkanes

Free radical chain mechanism

Rate of reaction of alkanes with halogens is  $F_2 > Cl_2 > Br_2 > I_2$

Rate of replacement of hydrogens of alkanes is  $3^\circ > 2^\circ > 1^\circ$

## Controlled Oxidation of Alkanes

Alkanes give a variety of oxidation products with suitable catalysts, e.g.

- i)  $\text{CH}_4 \longrightarrow \text{CH}_3\text{OH}$  with Cu/  
523K/100atm
- ii)  $\text{CH}_4 \longrightarrow \text{HCHO}$  with  $\text{Mo}_2\text{O}_3 + \Delta$
- iii)  $\text{C}_2\text{H}_6 \longrightarrow \text{CH}_3\text{COOH}$  with  
 $(\text{CH}_3\text{COO})_2\text{Mn}$

## Markovnikov Rule

Addition of hydrogen halides to unsymmetrical alkenes

The negative part of the addendum (here, hydrogen halide) gets attached to the carbon atom having lesser number of hydrogen atoms

## Peroxide or Kharash Effect

Anti Markovnikov addition of HBr to unsymmetrical alkenes. It proceeds via free radical chain mechanism

## Alkane

Containing carbon - carbon single bonds

General formula -  $C_nH_{2n+2}$

Carbon is  $sp^3$  hybridised

C-C bond length is 154 pm and bond enthalpy  $348 \text{ kJ mol}^{-1}$

H-C-H bond angles are of  $109.5^\circ$

## Alkene

Containing carbon - carbon double bonds

General formula -  $C_nH_{2n}$

Carbon is  $sp^2$  hybridised

C=C bond length is 134 pm and bond enthalpy  $681 \text{ kJ mol}^{-1}$

## Alkyne

Containing carbon - carbon triple bonds

General formula -  $C_nH_{2n-2}$

Carbon is  $sp$  hybridised

$C\equiv C$  bond length is 120 pm and bond enthalpy  $823 \text{ kJ mol}^{-1}$

H-C-C bond angle -  $180^\circ$

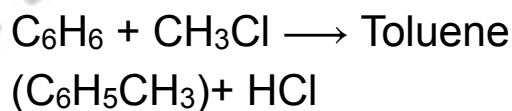
## Aromaticity

Ring system satisfying these criteria:

- planar structure
- complete delocalisation of the  $\pi$  electrons
- $(4n + 2) \pi$  electrons, where  $n$  is an integer ( $n = 0, 1, 2, \dots$ ) (Hückel Rule)

## Friedel-Crafts Alkylation Reaction

Benzene is treated with an alkyl halide in the presence of anhydrous aluminium chloride to form alkyl benzene



## Substitution in Mono-substituted Benzene

### Ortho and para directing groups:

$-\text{OH}$ ,  $-\text{NHR}$ ,  $-\text{OCH}_3$ ,  $-\text{CH}_3$ ,  $-\text{C}_2\text{H}_5$ ,  $-\text{NH}_2$ ,  $-\text{NHCOCH}_3$ , etc.

Meta directing groups:  $-\text{NO}_2$ ,  $-\text{CN}$ ,  $-\text{CHO}$ ,  $-\text{COR}$ ,  $-\text{COOH}$ ,  $-\text{COOR}$ ,  $-\text{SO}_3\text{H}$ , etc.