Chapter : 12 HYDROCARBONS

SLOs

Soch Badlo By MAK

- **Why Alkanes are chemically unreactive?**

Alkanes:

Alkanes are saturated hydrocarbons having general formula C_nH_{2n+2}.

Alkanes are chemically inert.

Reason:

Alkanes are chemically inert because they contain carbon-carbon single bond. They only consist of one sigma bond & no pie bonds. These bonds are very strong & non-polar, meaning they dont readily react with other substances.

- **Comparison b/w Sigma & Pie bond.**

Sigma	Pi
Overlapping	
i- It is formed by head-on overlap of atomic orbitals.	i- Pi bond is formed by side to side overlap.
Electrons.	
ii- Sigma bond allow sharing of electrons along bond axis.	ii- Pi bond creates a region of electron density above & below bond axis.
Strength.	
iii- Sigma bond is the strongest type of covalent bond.	iii- It is a weaker type of bond.
Stability	
v- They are more stable.	iv- Pi bond add more flexibility to molecule.
Representation.	
v- σ	v- π

• Why lighter alkanes are used as fuels?

Lighter alkanes are widely used as fuels:-

Reasons:-

i- Their combustion can be controlled.
ii- They produce large amount of heat per gram.
iii- They are cheap & readily available.

Compare the end products of ~~eh~~ complete & incomplete combustion.

Combustion:- A reaction of substance with O_2 or air that causes the rapid release of heat & the appearance of a flame is called combustion.

Complete Combustion:

The following reaction occurs in complete combustion:

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)} + heat.$$

Products: The products of complete combustion are carbon dioxide (CO_2), water (H_2O) & heat.

Incomplete Combustion:-

The following combustion reaction occurs:

$$3CH_{4(g)} + 4O_{2(g)} \rightarrow 2CO_{2(g)} + C_{(s)} + 6H_2O_{(g)}$$

Products:- The end products are CO_2 (carbon dioxide), C (Carbon) & H_2O (water)

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- Comparison b/w complete & incomplete combustion.

Complete	Incomplete.
i- produces CO_2 & O_2 as end product	end products. result in formation of CO, C as well as H_2O & CO_2.
ii- requires Sufficient O_2 Supply during combustion process.	O_2 supply- Happens when there is limited supply of O_2.
iii- Releases a large amount of energy	Energy release. Produce less energy compared to complete combustion.
iv- Typically occurs in well-ventilated environment.	Production- Can contribute to air pollution due to release of CO.
v- Is desired type of combustion.	Efficiency It is less efficient.

- **Why Alkene is more reactive than alkane?**

Alkene is more reactive than alkane.

Reason:-

An alkene is more reactive than an alkane because it contains a double bond b/w Carbon atoms, which provides more opportunities for chemical reaction to occur compared to the single bonds present in alkanes.

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- **Write detection test for Alkene / What happens when we add Br in Alkene?** (Test for unsaturation)

Bromine is used for the detection test of Alkene.

Br Test / Detection test for Alkene:

Bromine is a reddish brown liquid & product is colorless. When Bromine water is added to Alkene, the red-brown color disappears. This decolourization of Br solution is frequently used as a simple test for presense of unsaturation.

- **How we will detect double bond in Alkene?**

Baeyer's test is used for the detection of double bond in Alkene.

Baeyer's Test / Reaction with $KMnO_4$:-

When alkene is treated with dilute alkaline aq. solution of $KMnO_4$ (1%) addition of two hydroxyl groups occurs across the double bond. The pink color of $KMnO_4$ is discharged during this reaction. This reaction is used as a test for the presence of an alkene & it is also known as Baeyer's test.

Reaction:

$$3CH_2=CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3\,\underset{\text{Ethylene Glycol}}{CH_2(OH)-CH_2(OH)} + 2MnO_2 + 2KOH$$

Ethene

*also used to diff b/w alkane & alkene".

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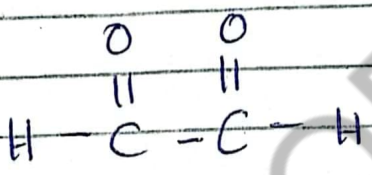
- Oxalyic Acid has which type of functional group?

Oxalyic Acid:- end product of reaction of alkyne with $KMnO_4$.

Functional Group:- Oxalic acid has functional group "Carboxylic Acid".

- Glyoxal has which type of functional group?

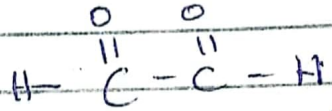
Glyoxal:-



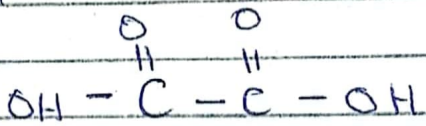
Functional Group:- Aldehyde.

- Compare end product of reaction of $KMnO_4$ with alkene & alkyne?

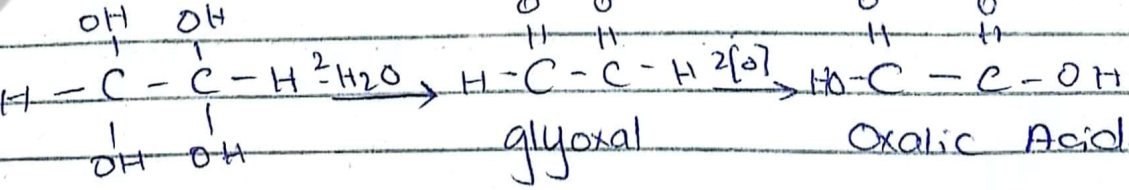
Reaction with alkene:- The end product of alkenes is glyoxal



Reaction with alkyne:- The end product of alkyne is Oxalic Acid.



Overall Reaction:-



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• Write the composition of natural gas.

Composition of Natural Gas:

Natural gas is a mixture of low molecular weight hydrocarbons. It's composition can vary depending upon the source, but it primarily consists of :-

i- Methane (CH_4)
ii- Ethane (C_2H_6)
iii- Propane & Butane (C_3H_8 & C_4H_{10})
iv- Other hydrocarbons (small amount of pentane and higher alkanes).
v- Inert gases.

• Write the reaction for preparation of chloroform / How can you prepare CCl_4 ?

Preparation of Chloroform:

Carbon Tetra chloride(CCl_4) is prepared by the proce of halogenation.

Halogenation:

The reaction of alkane and a halogen is called substitution reaction. Halogenation is a type of substitution reaction.

$$CH_{4(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CH_3Cl_{(g)} + HCl_{(g}$$

Chloromethane

$$CH_3Cl_{(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CH_2Cl_{2(g)} + HCl_{(g}$$

Dichloromethane

$$CH_2Cl_{2(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CHCl_{3(g)} + HCl_{(g)}$$

Tri Tetra chloromethane

$$CHCl_{3(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CCl_{4(g)} + HCl_{(g)}$$

Tetra chloromethane.

• Compare reaction of methane in presence of Direct & Indirect Sunlight.

Reaction of Methane:

(i) Direct Sunlight:

In direct sunlight the reaction of methane is explosive with Chlorine and forms carbon and HCl.

$$CH_4(g) + Cl_2(g) \xrightarrow[\text{sunlight}]{\text{direct}} C(s) + 4HCl(g)$$

(ii) Indirect Sunlight:

The reaction of methane in indirect sunlights is as follow:-

$$CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g)$$

$$CH_3Cl(g) + Cl_2(g) \longrightarrow CH_2Cl_2(g) + HCl(g)$$

$$CH_2Cl_2(g) + Cl_2(g) \longrightarrow CHCl_3(g) + HCl(g)$$

$$CHCl_3(g) + Cl_2(g) \longrightarrow CCl_4(g) + HCl(s)$$

Conclusion:-

methane forms carbon (solid) and HCl as biproduct in direct sunlight whereas $CCl_4(g)$ in Indirect Sunlight.

• Write the reactivity / ionization power of Halogens:

$$F_2 > Cl_2 > Br_2 > I_2$$

Florine reacts explosively, chlorine reacts slowly in dark at room temperature but rapidly in strong sunlight. Bromine is less reactive than chlorine and requires high temperature or strong sunlight. Iodine is essentially unreactive.

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- If Halogenation of alkane is done in diffused sunlight but with florine. What will happen?

Halogenation of alkane in diffused sunlight with flourine is extremely violent and highly exothermic, often leading to an uncontrollable reaction that can result in explosive mixture.

- Write the reactions for the halogenation of Ethane.

$C_2H_{6(g)} + Cl_{2(g)} \xrightarrow{\text{diffused sunlight}} C_2H_5Cl_{(g)} + HCl_{(g)}$

Chloroethane

$C_2H_5Cl_{(g)} + Cl_{2(g)} \xrightarrow{\text{diffused sunlight}} C_2H_4Cl_{2(g)} + HCl_{(g)}$

Dichloroethane

$C_2H_4Cl_{2(g)} + Cl_{2(g)} \xrightarrow{\text{diffused sunlight}} C_2H_3Cl_{3(g)} + HCl_{(g)}$

Trichloroethane

$C_2H_3Cl_{3(g)} + Cl_{2(g)} \xrightarrow{\text{diffused sunlight}} C_2H_2Cl_{4(g)} + HCl_{(g)}$

Tetrachloroethane

$C_2H_2Cl_{4(g)} + Cl_{2(g)} \xrightarrow{\text{diffused sunlight}} C_2HCl_{5(g)} + HCl_{(g)}$

Pentachloroethane

$C_2HCl_{5(g)} + Cl_{(g)} \xrightarrow{\text{diffused sunlight}} C_2Cl_{6(g)} + HCl_{(g)}$

Hexachloroethane