≈ Organic Chemistry ≈

This set of notes are presented by Me...

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Actual Credit: Sir Rizwan Khan → GOAT!

Enjoy ♡!

→ Study of Hydrocarbons

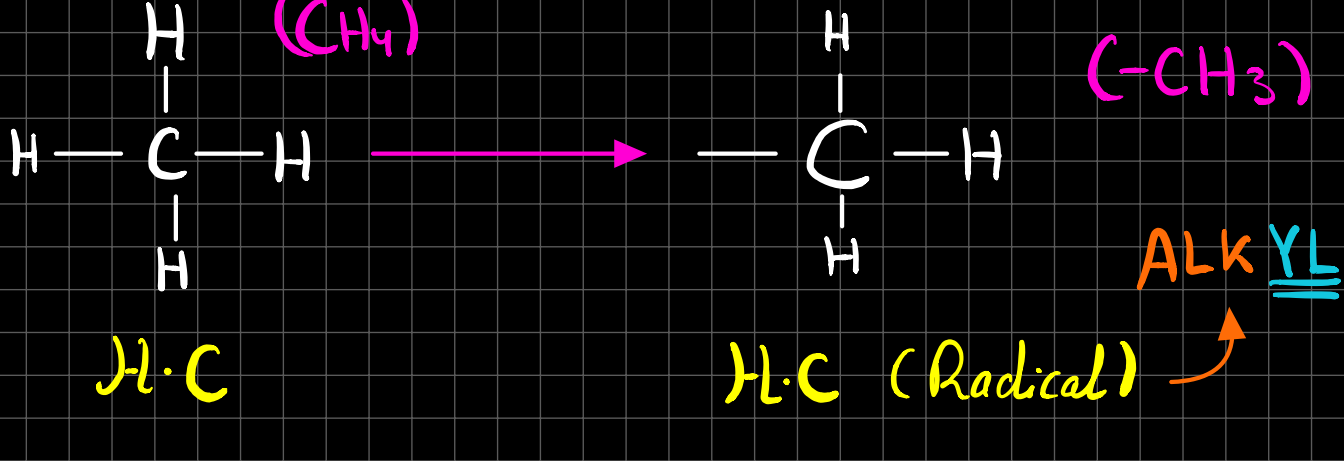
Organic Language :-

→ Carbon = Alk

→ Catenation : Chain formation ability of Carbon!

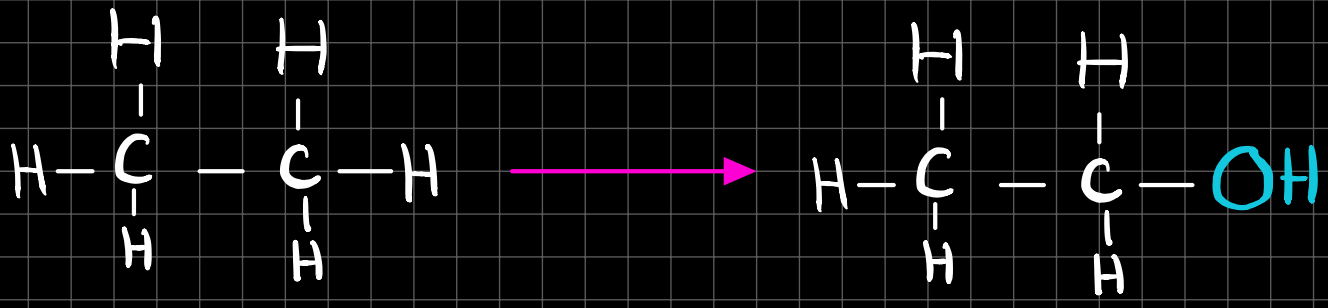
Radical (Alkyl) :-

a) Hydrocarbons in which one valency of Carbon is free



Functional Group :-

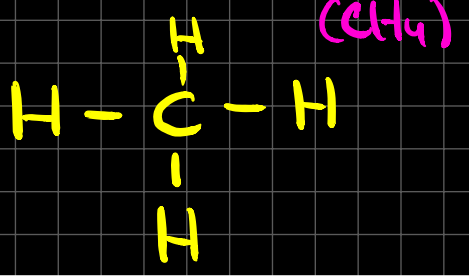
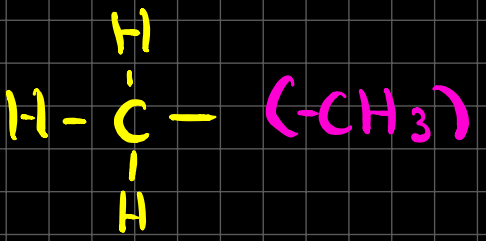
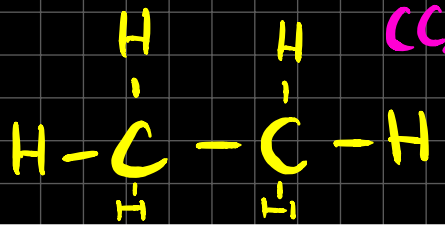
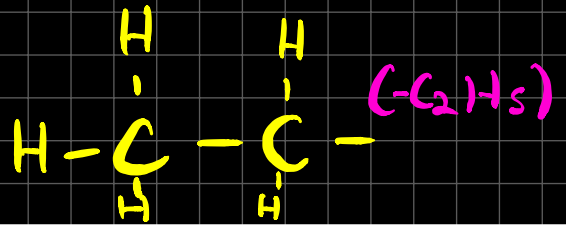
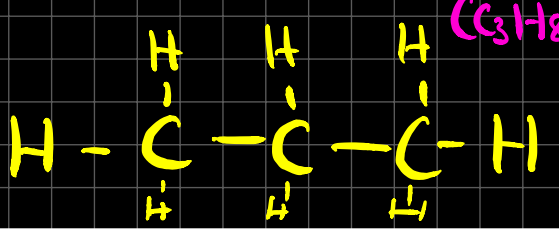
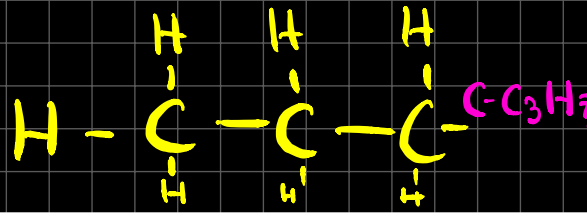
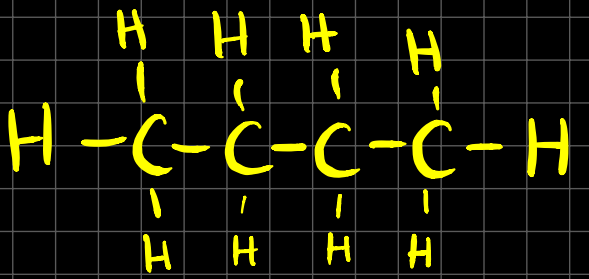
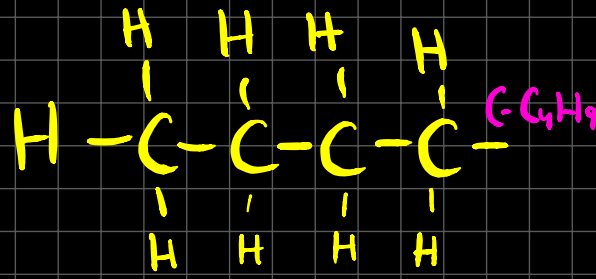
a) Atom or Group of Atoms which give a specific Property to a Compound !



Ethane :
✓ Gas ✓ Odorless

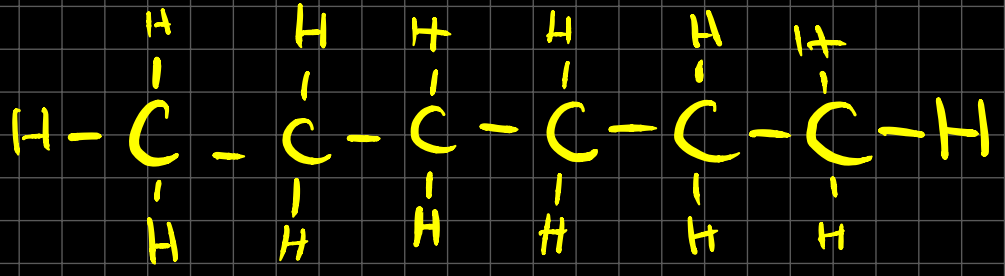
Ethanol :
✓ Liquid ✓ Smell

Functional Group	NAME	Examples !
R- Radical	Alkyl	$-CH_3$
$>C=C<$	Alkene	$CH_2=CH_2$
R-OH	Alcohol	CH_3-OH
$R-\overset{O}{\overset{\|}{C}}-O-R$	Esters	$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$
$R-\overset{O}{\overset{\|}{C}}-\overset{H}{N}-R$	Amide	$CH_3-\overset{O}{\overset{\|}{C}}-\overset{H}{N}-CH_3$

No of C atom	Name	Formula	Radical	Radical Name
C_1	MethANE	 (CH_4)	 ($-CH_3$)	MethYl
C_2	EthANE	 (C_2H_6)	 ($-C_2H_5$)	EthYl
C_3	PropANE	 (C_3H_8)	 ($-C_3H_7$)	PropYl
C_4	PentANE		 ($-C_4H_9$)	PentYl

Types of Formulas

C_6H_{14} :-

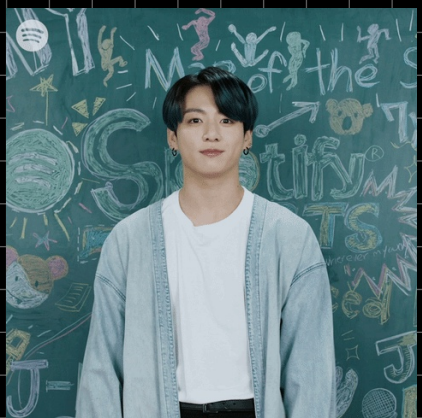


Displayed Formula

$-CH_3-CH_2-CH_2-CH_2-CH_2$ Structured Formula

$CH_3 \cdot (CH_2)_4 CH_3$ Condensed Formula

C_6H_{14} → Molecular Formula



≈ Homologous Series ≈

Series of Compounds in which adjacent member differs by CH_2!

*) Every Homologous series → Two properties!

1. Similar Chemical, but different Physical Properties
2. They have a General Formula!

Alkane:- C_nH_{2n+2}

CH_4
C_2H_6 — CH_2
C_3H_8 — CH_2
C_4H_{10} — CH_2
C_5H_{12} — CH_2

Alkyl:- C_nH_{2n+1}

$-CH_3$
$-C_2H_5$ — CH_2
$-C_3H_7$ — CH_2
$-C_4H_9$ — CH_2
$-C_5H_{11}$ — CH_2

Homologous Series!

≈ Alkanes ≈

Preparation :-

① Cracking : (Pyrolysis)

Bigger Hydro Carbons $\xrightarrow{\text{Broken into}}$ Smaller & Useful products!

$$C_6H_{14} \longrightarrow \underbrace{C_2H_4}_{\text{ethene (Alkene)}} + \underbrace{C_4H_{10}}_{\text{butane (Alkane)}}$$

$$C_2H_6 \longrightarrow \underbrace{C_2H_4}_{\text{Ethene (Alkene)}} + \underbrace{H_2}_{\text{Hydrogen}}$$

Conditions For Cracking :-

i) High temp = For Bond breaking!

iii) Absence of Oxygen = To avoid Combustion

Types of Cracking :-

i) Thermal Cracking = Heat

ii) Catalytic Cracking = Heat + Catalyst

Catalytic Cracking → Petroleum Industry!

Catalyst → Al_2O_3, SiO_2

≈ Reactions of Alkanes ≈

① Combustion :- C ∝ Energy !

Process in which substances are burned in Oxygen

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

Complete Combustion :-	Incomplete Combustion :-
a) Plentiful supply of Oxygen !	a) Limited supply of Oxygen
Products :- $CO_2 + H_2O$	Products :- $C, CO + H_2O$

$$C_2H_6 + 1.5O_2 \longrightarrow 2C + 3H_2O \quad \text{(Incomplete !)}$$

② Free Radical Substitution :- Halogenation !

Methane reacts with excess chlorine in presence of U.V Rays to produce Tetra Chloro Methane !

$$CH_4 + 4Cl_2 \xrightarrow{U.V} CCl_4 + 4HCl$$

$$C_2H_6 + 2Cl_2 \xrightarrow{U.V} C_2H_4Cl_2 + 2HCl$$

$$C_3H_8 + 3Cl_2 \xrightarrow{U.V} C_3H_5Cl_2 + 3HCl$$

≈ Isomerism in Alkanes ≈

Q) What is Isomerism :- Phenomenon !

Compounds → Different structures BUT

SAME Molecular Formula → Isomer !

C_4H_{10} :-

$CH_3-CH_2-CH_2-CH_3$ → Butane

$\overset{3}{C}H_3-\overset{2}{C}H(\overset{1}{C}H_3)-\overset{1}{C}H_3$

CH_3 → F.G

→ 2- Methyl Propane !

C_5H_{12}

$CH_3-CH_2-CH_2-CH_2-CH_3$ → Pentane !

$CH_3-CH(CH_3)-CH_2-CH_3$

CH_3 → F.G

→ 2- Methyl Butane

CH_3 → F.G

$CH_3-C(CH_3)_2-CH_3$

CH_3 → F.G

→ 2,2- Di Methyl Propane !

≈ Alkenes ≈ (Unsaturated)

① C_2H_4 = Ethene ⟶ $CH_2=CH_2$

② C_3H_6 = Propene ⟶ $CH_3-CH=CH_2$

③ C_4H_8 = Butene ⟶ $CH_3-CH_2-CH=CH_2$

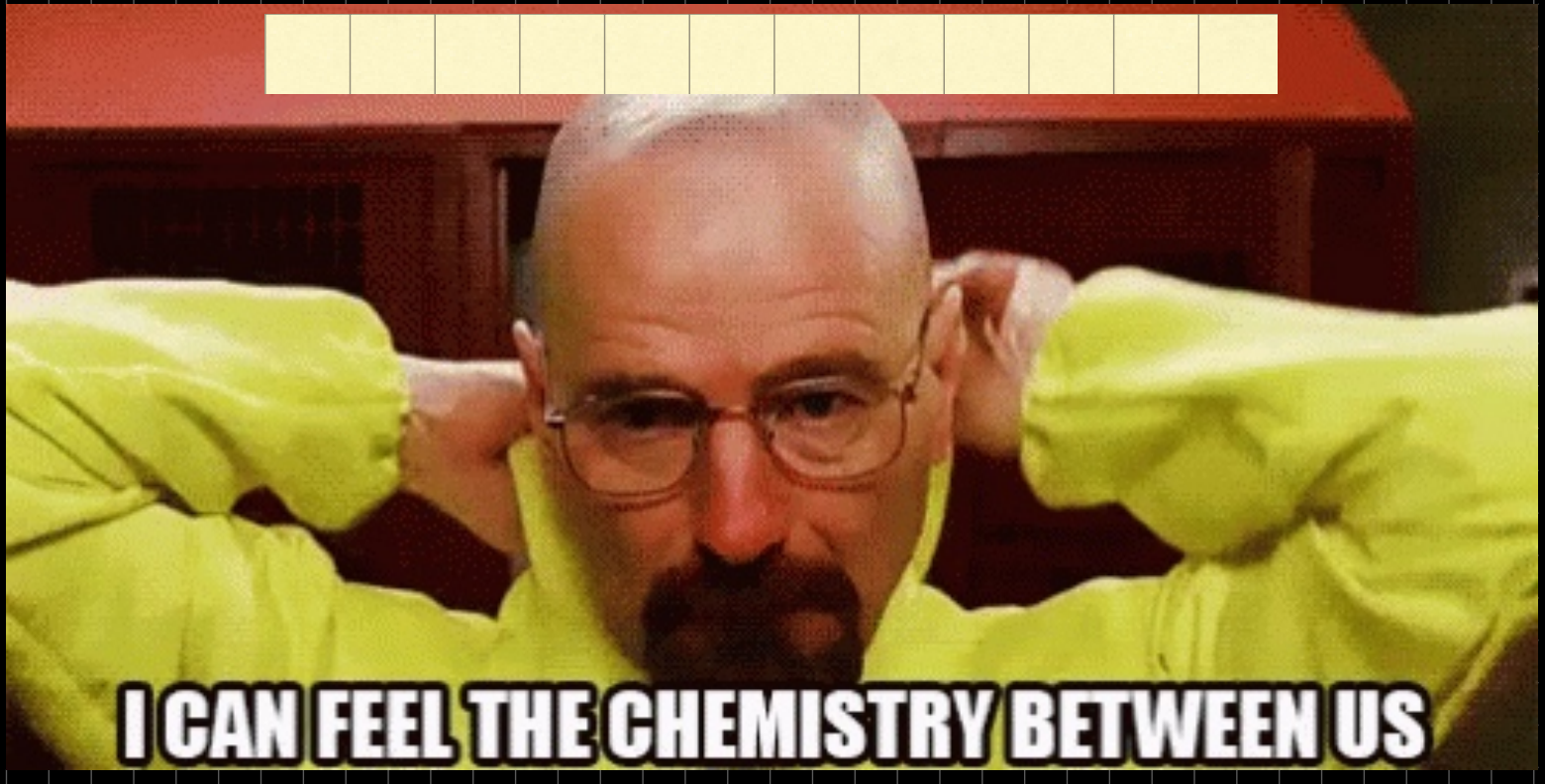
④ C_5H_{10} = Pentene ⟶ $CH_3-CH_2-CH_2-CH=CH_2$

⑤ C_6H_{12} = Hexene ⟶ $CH_3-CH_2-CH_2-CH_2-CH=CH_2$

CH_2 CH_2 CH_2 CH_2

Preparation of Alkenes :-

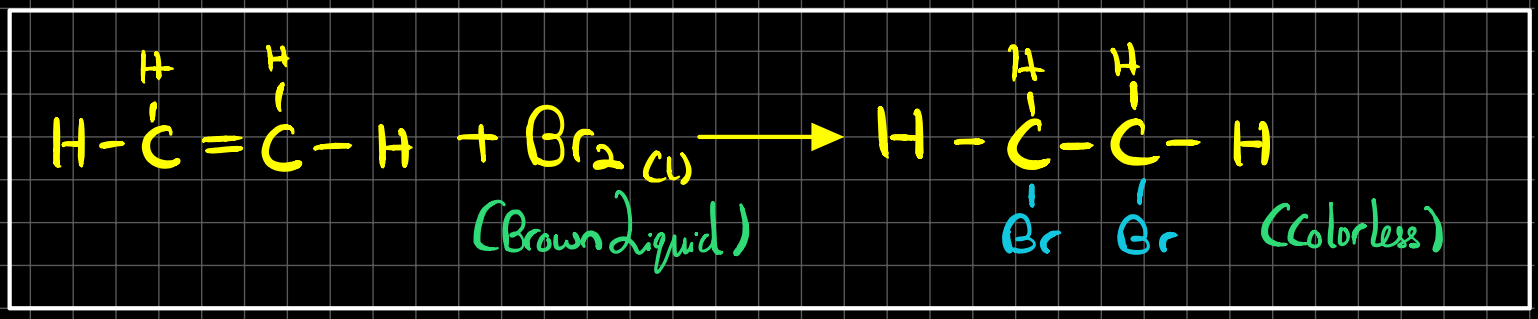
Cracking !



≈ Reactions of Alkene ≈

① Bromination :-

★ Hydrocarbon ⟶ Addition reaction ⟶ Unsaturated !



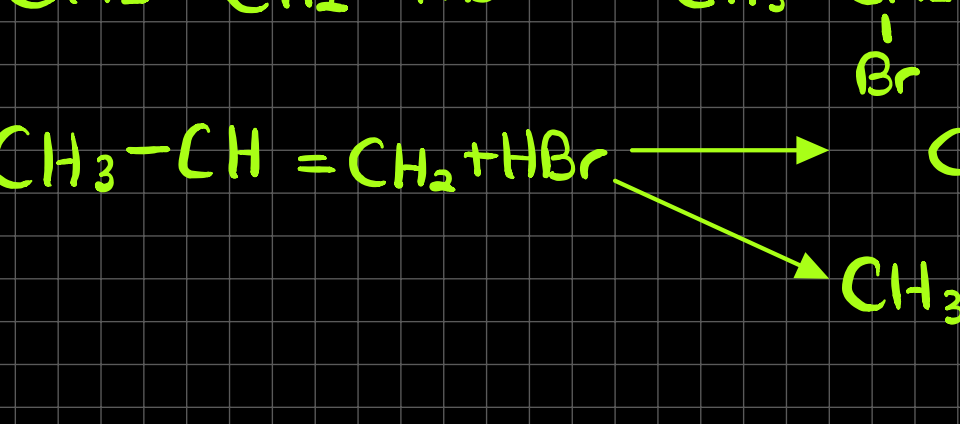
a) Bromine decolorizes ⟶ Reaction with Alkene !

② Hydro-Halogenation :-

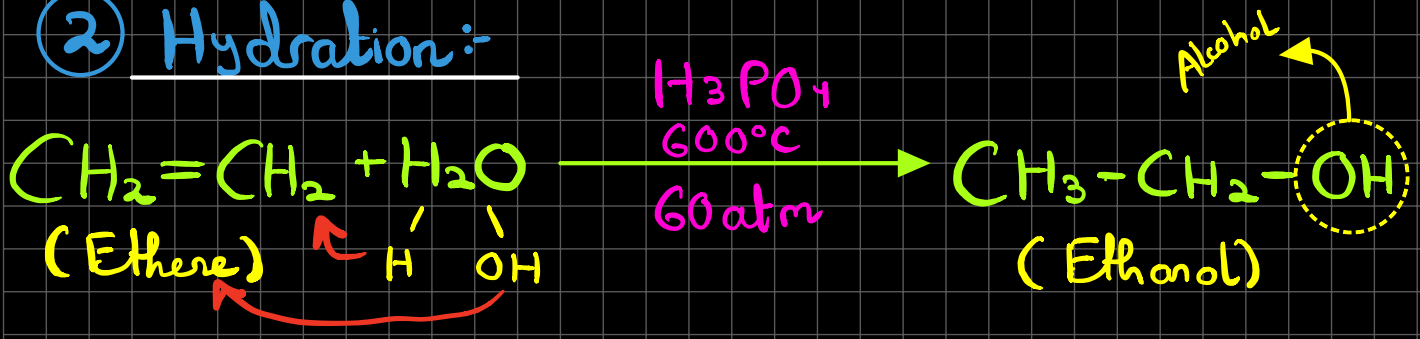
Alkenes → Symettrical C-C ≠ C-C

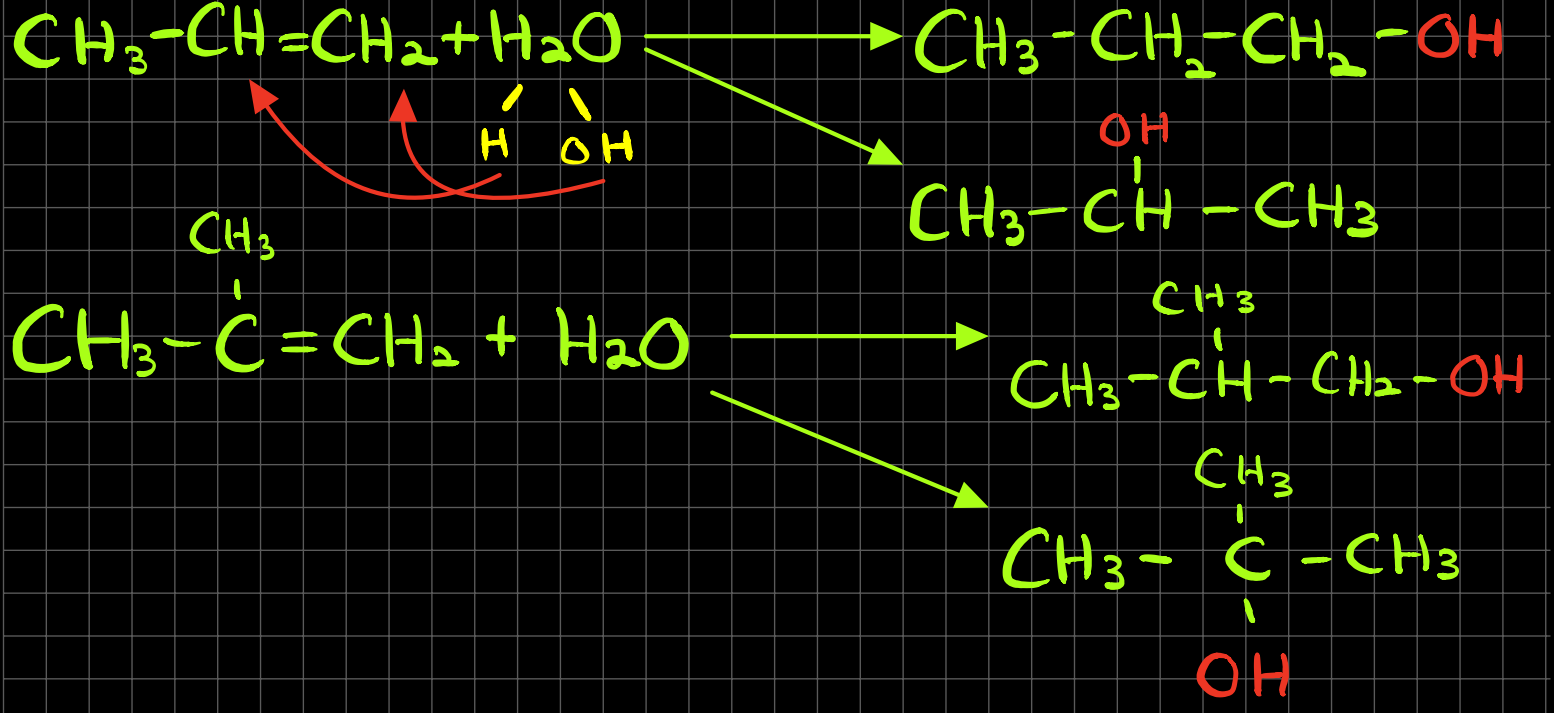
Alkenes → Un-Symettrical C-C ≠ C

Symettrical Alkenes will produce one Addition product while Unsymethrical Alkene will produce two addition products !



② Hydration :-





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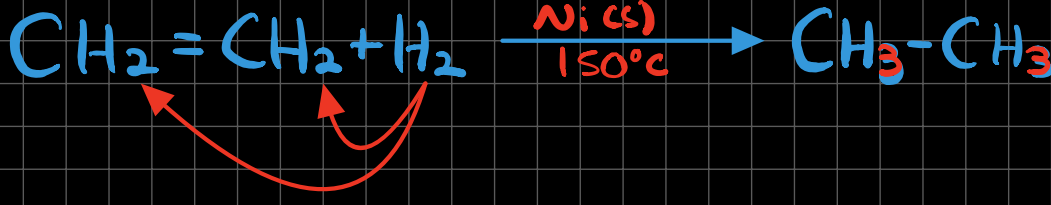
④ Hydrogenation :- Addition of Hydrogen



Unsaturated	Saturated
Vegetable oil	Margarine
liquid	Solid

Isomerism in Alkene

C_4H_8 :-

1. $CH_2=CH-CH_2-CH_3$ — But-1-ene
2. $CH_3-CH=CH-CH_3$ — But-2-ene
3. $CH_3=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}-CH_3$ — 2-methyl prop-1-ene
4. $\begin{matrix} CH_2-CH_2 \\ | \quad\quad | \\ CH_2-CH_2 \end{matrix}$ — Cyclo butane

C_5H_{10} :-

1. $CH_2=CH-CH_2-CH_2-CH_3$
2. $CH_3-CH=CH_2-CH_2-CH_3$
3. $CH_2=\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}H-CH_2-CH_3$
4. $CH_2=CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}H_2-CH_3$
5. $\begin{matrix} CH_2-CH_2 \\ | \quad\quad | \\ CH_2=CH_2 \\ \diagdown \quad / \\ \quad CH_2 \end{matrix}$ Cyclo Pentene !

Alcohols (OL)

Organic compounds which have Hydroxyl (OH) group

$CH_3-OH \longrightarrow$ Methanol $= CH_3-OH$

$C_2H_5-OH \longrightarrow$ Ethanol $= CH_3-CH_2-OH$

$C_3H_7-OH \longrightarrow$ Propanol $= CH_3-CH_2-CH_2-OH$

$C_4H_9-OH \longrightarrow$ Butanol $= CH_3-CH_2-CH_2-CH_2-OH$

$C_5H_{11}-OH \longrightarrow$ Pentanol $= CH_3-CH_2-CH_2-CH_2-CH_2-OH$

CH_2 CH_2 CH_2 CH_2

Homologous series :- $C_nH_{2n+1}OH$

Preparation of Alcohol :-

Hydration of Alkene :- (One in Alkene)

$$CH_2=CH_2 + H_2O \longrightarrow CH_3-\underset{\displaystyle OH}{\underset{|}{CH_2}}$$

Conditions :-

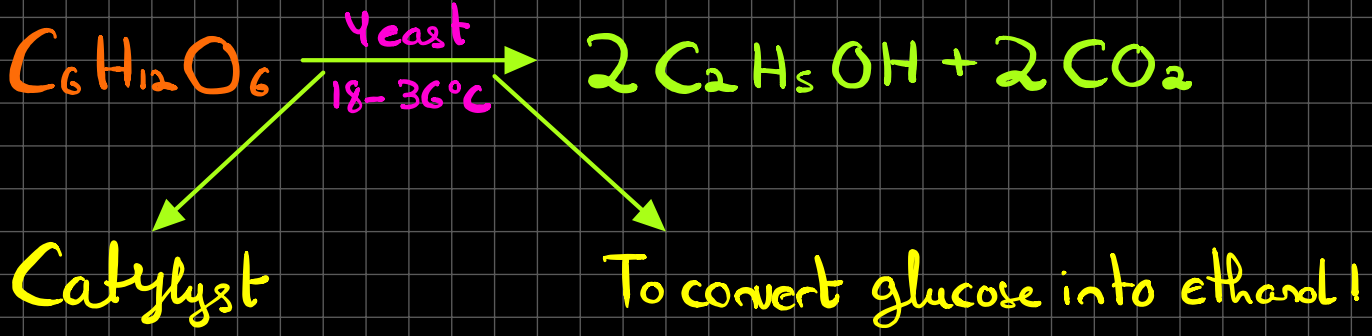
Conc H_3PO_4

300°C

70 atm

≈ Fermentation ≈

The process in which Glucose or Sugar is converted into Ethanol and Carbondioxide!



Conditions:-

1. Temperature = 18-36°C
2. Anaerobic condition
3. Yeast

→ After 15% of ethanol formation process will stop! As yeast will die!

→ Temperature not more than 40°C Otherwise yeast will denature!

Hydration :- Expensive, Any Alcohol, Non-Renewable

Fermentation:- Economical, Ethanol only!, Renewable!

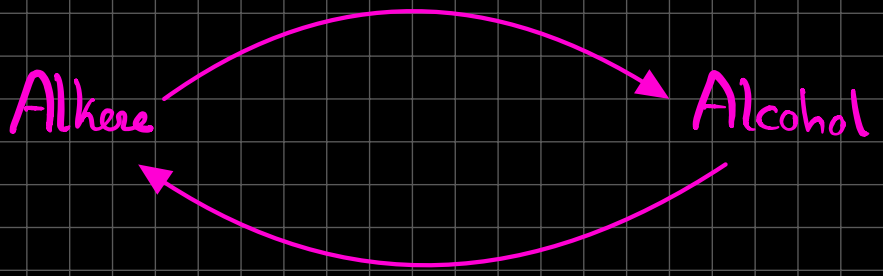
≈ Reactions of Alcohol ≈

$CH_3-OH + Na \longrightarrow CH_3-O^-Na^+ + 1/2\ H_2$

Combustion :-

$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O + Heat$

≈ Dehydration of Alcohols ≈



$CH_3-\underset{OH}{\underset{|}{CH}}-CH_2 \xrightarrow[Conc\ H_2SO_4]{180^\circ} CH_2=CH_2 + H_2O$

$CH_3-\underset{OH}{\underset{|}{CH}}-CH_3 \longrightarrow CH_3-CH=CH_2$ or $CH_3=CH-CH_3$

$CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-CH_3 \longrightarrow CH_2=CH-CH_2-CH_3$ or $CH_2-CH=CH-CH_3$

≈ Isomerism in Alcohol ≈

$C_3H_8O \longrightarrow$

① $CH_3-CH_2-CH_2-OH$

② $CH_3-CH(OH)-CH_3$

③ $CH_3-O-CH_2-CH_3$

$C_4H_{10}O$:-

① $CH_3-CH(OH)-CH_2-CH_3$

② $CH_3-CH_2-CH(OH)-CH_3$

③ $CH_3-CH(OH)-CH(CH_3)$

④ $CH_2(CH_3)-C(CH_3)(OH)$

Carboxylic Acid ($-\overset{O}{\overset{\|}{C}}-OH$)

Methanoic Acid = $HCOOH$ = $H-\overset{O}{\overset{\|}{C}}-OH$

Ethanoic Acid = CH_3COOH = $CH_3-\overset{O}{\overset{\|}{C}}-OH$

Propanoic Acid = C_2H_5COOH = $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH$

Butanoic Acid = C_3H_7COOH = $CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-OH$

Homologous series :- $C_nH_{2n+1}COOH$

Preparation of Carboxylic Acid

i) Oxidation of Alcohol :- CH_2-OH ONLY!

$$CH_3-CH_2-OH \xrightarrow[Heat]{H^+/K_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-OH$$

$$CH_3-\overset{CH_3}{\overset{|}{C}}H-CH_2-OH \longrightarrow CH_3-\overset{CH_3}{\overset{|}{C}}H-\overset{O}{\overset{\|}{C}}-OH$$

$$HO-CH_2-CH_2-OH \longrightarrow HO-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-OH$$

2e Alcohol :-

≈ Reactions of Carboxylic Acids ≈

① Acid Base Reaction

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

$2CH_3COOH + \overset{2+}{M}gO \longrightarrow Mg(CH_3COO)_2 + H_2O$

$2CH_3COOH + \overset{2+}{C}aCO_3 \longrightarrow Ca(CH_3COO)_2 + H_2O$

$2CH_3COOH + Mg \longrightarrow Mg(CH_3COO)_2 + H_2$

② Combustion :-

$CH_3COOH + O_2 \longrightarrow 2CO_2 + 2H_2O$

③ Esterification ★★★

→ Compounds containing $-\overset{O}{\overset{\|}{C}}-O-C$ are called Esters

o) Alcohol + Carboxylic Acid ⟶ Esters

o) Alcohol ⟶ Alkyl

Carboxylic acid ⟶ Alkanoate

★) Put OH of Alcohol with OH of Carboxylic acid

I) $CH_3-OH + CH_3-\overset{O}{\overset{\|}{C}}-OH \overset{H_2SO_4}{\rightleftharpoons}$ Methyl ethanoate!

Methanol Ethanoic acid .... So whats the Process?

$CH_3-OH \quad HO-\overset{O}{\overset{\|}{C}}-CH_3 \rightleftharpoons CH_3-O-\overset{O}{\overset{\|}{C}}-CH_3 + H_2O$

II) $CH_3-\overset{O}{\overset{\|}{C}}-OH + CH_3-CH_2-OH \overset{H^+}{\rightleftharpoons}$ Ethyl ethanoate!

ethanoic acid ethanol

$CH_3-\overset{O}{\overset{\|}{C}}-OH + HO-CH_2-CH_3 \overset{H^+}{\rightleftharpoons} CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3 + H_2O$

III) $CH_3-CH_2-OH + C_2H_5-\overset{O}{\overset{\|}{C}}-OH \rightleftharpoons$ Ethyl Propanoate

ethanol Propanoic acid

$CH_3-CH_2-OH \quad HO-\overset{O}{\overset{\|}{C}}-C_2H_5 \rightleftharpoons CH_3-CH_2-O-\overset{O}{\overset{\|}{C}}-C_2H_5 + H_2O$

IV) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH + CH_3-OH \rightleftharpoons$ Methyl Propanoate!

Propanoic acid Methanol

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH \quad HO-CH_3 \rightleftharpoons CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3 + H_2O$

V) $HO-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-OH + 2CH_3-OH \rightleftharpoons ? + 2H_2O$

$CH_3-OH \quad HO-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-OH \quad HO-CH_3 \rightleftharpoons$

$CH_3-O-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-O-CH_3 + 2H_2O$

Isomerism in Carboxylic Acids!

$C_4H_8O_2$

i) $CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-OH$

ii) $CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{O}{\|}}{C}-OH$

iii) $CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_3$

$C_5H_{10}O_2$

i) $CH_3-CH_2-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-OH$

ii) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{O}{\|}}{C}-OH$

iii) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-\overset{\overset{O}{\|}}{C}-OH$

iv) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\overset{\overset{O}{\|}}{C}-OH$

≈ Polymerization ≈

The process in which monomers combine to form a Polymer

Types of Polymerization :-

① Addition Polymerization :-

Polymerization in which monomers combine to form a Polymer as the one product

i) Polyethene ii) Poly Propene iii) Poly Butene !

iv) PVC → Poly - Vinyl Chloride

v) PTFE → Poly - Tetra Fluoro ethene !

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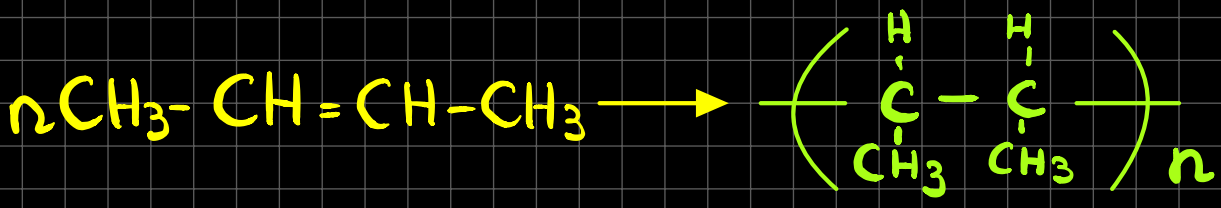
i) Poly ethene

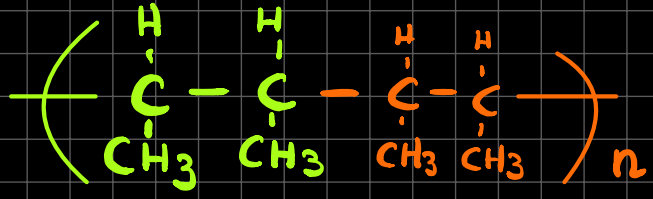
$$n\,CH_2=CH_2 \longrightarrow \left(-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{H}{C}}- \right)_n$$

ii) Poly propene

$$n\,CH_3-CH=CH_2 \longrightarrow \left(-\underset{CH_3}{\overset{H}{C}}-\underset{H}{\overset{H}{C}}- \right)_n$$

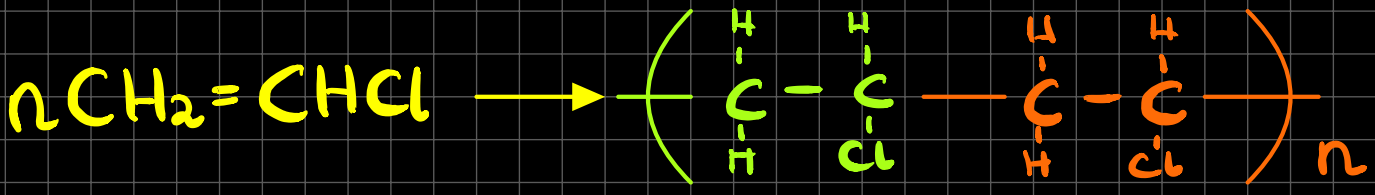
iii) Poly-Butene :-



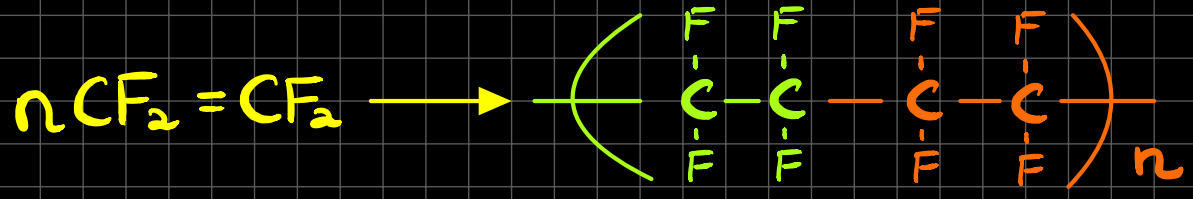


with two repeating units!

iv) PVC :- Poly Vinyl Chloride :-



v) PTFE (Poly Tetra Fluoro ethene) :-



Conditions :-

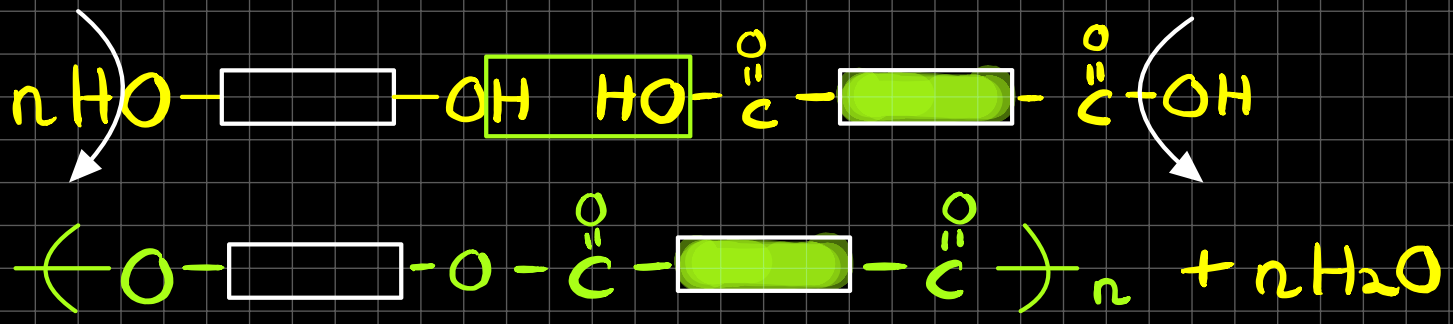
500°C → High Temp ✓

60atm → High Pressure ✓

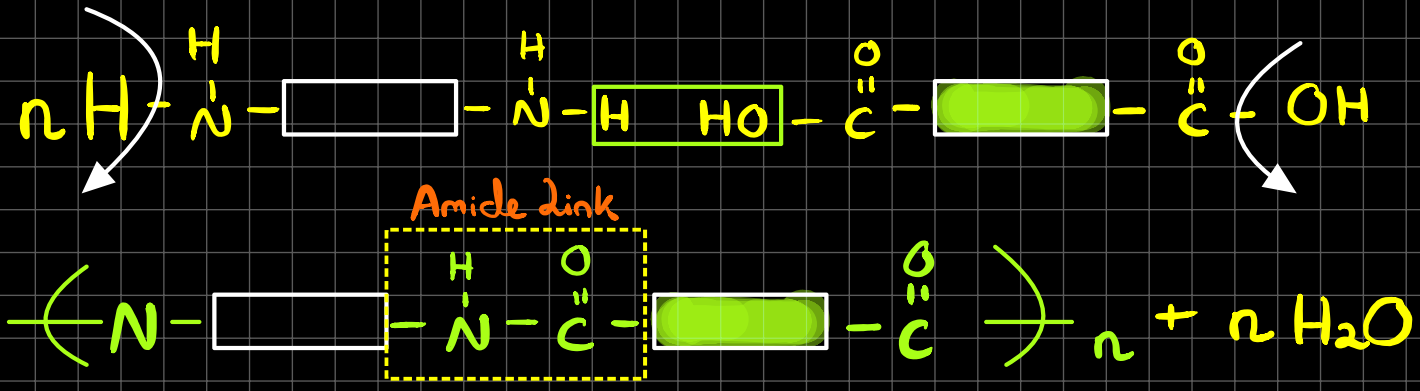
≈ Condensation Polymerization ≈

Polymerization in which monomers combine to form a polymer with elimination of small molecules like H_2O, HCl, etc !

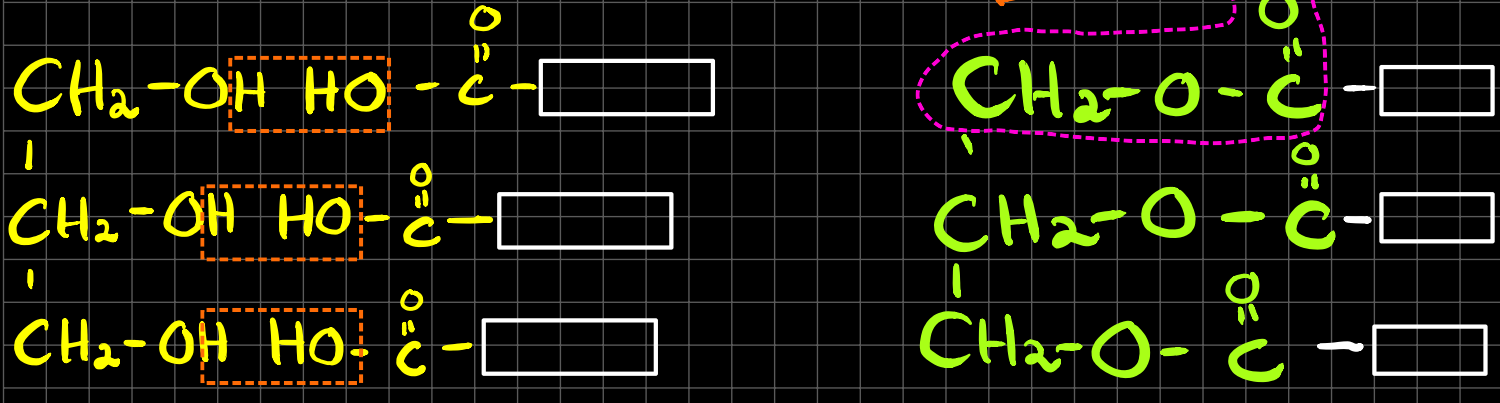
i) Terylene (Polyester) :-



ii) Nylon (Polyamide) :-



iii) Fat :-



Triol Carboxylic (Fat)

Similarities b/w Fat & Terylene :-

→ They both have Ester link

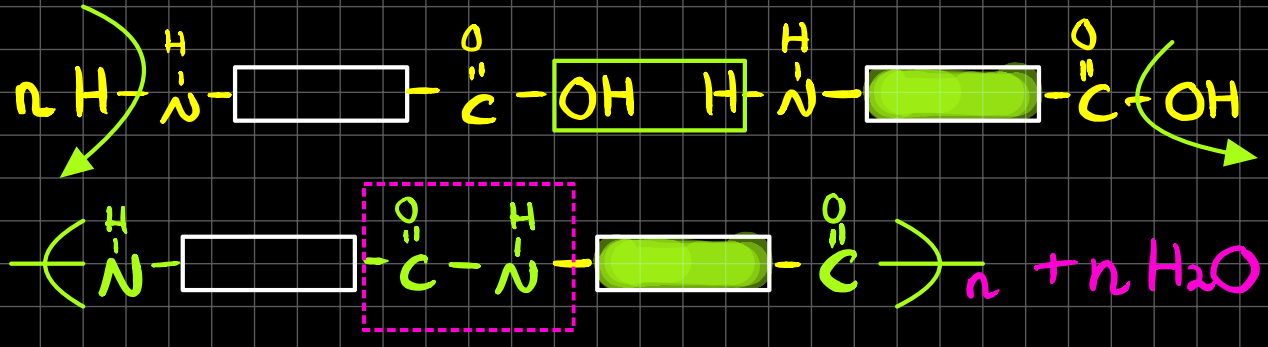
Difference b/w Fat & Terylene :-

→ They have different structures

→ Terylene is synthetic, Fat is Natural

→ Fat is Biodegradable. Terylene is non-Biodegradable

iv) Protein (Polyamide)



Similarity b/w Nylon & Protein :-

o) Amide link :- YO!

Differences b/w Nylon & Protein :-

o) Different structures

o) Protein → Natural , Nylon → Synthetic

o) Protein → Biodegradable, Nylon → Non-Biodegradable

V) Carbohydrate / Starch :-

$n C_6 H_{12} O_6 \longrightarrow$  $_n$

Uses of Organic Substances :-

i) Ethanol :- ✓ Solvent ✓ Orinks

ii) Ester :- ✓ Sweet Smelling liquids ✓ Perfumes ✓ Food Flavouring

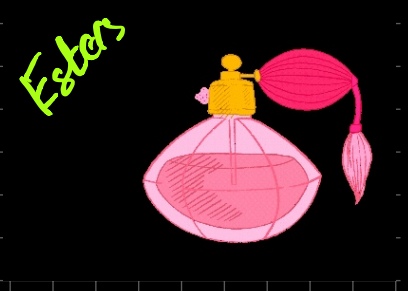
iii) Polyethene :- ✓ Chairs, Tables

iv) Terylene :- ✓ Parachutes ✓ Umbrella

v) Nylon :- ✓ Clothes ✓ Fishing Nets

vi) PVC :- ✓ Pipes !

vii) PTFE :- ★ Teflon :- ✓ Non Stick Fry Can



Ethanol !

Hydrolysis :- Reaction with water !

✱) Reverse Condensation Polymerization → Hydrolysis

i) Hydrolysis of Ester from $-\overset{O}{\overset{\|}{C}}-O-$

i) Acidic Hydrolysis :- Alcohol + Carboxylic Acid

$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3 \xrightarrow[HEAT]{aq\ H^+} CH_3-\overset{O}{\overset{\|}{C}}-OH \quad HO-CH_3$

Methyl ethanoate — Ethanoic — Methanol

$H-\overset{O}{\overset{\|}{C}}-O-CH_3 \xrightarrow[HEAT]{aq\ H^+} H-\overset{O}{\overset{\|}{C}}-OH \quad HO-CH_3$

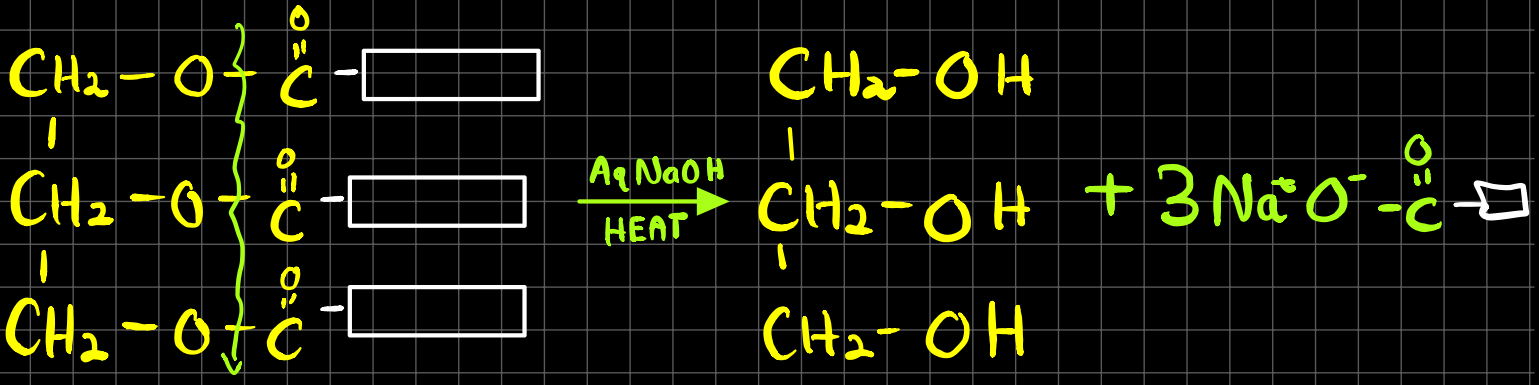
Methyl methanoate ! — Methanoic — Methanol

ii) Alkaline Hydrolysis :- Alcohol + Salt

$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3 \xrightarrow[HEAT]{aq\ NaOH} CH_3-CH_2-O^-Na^+ + HO-CH_3$

$H-\overset{O}{\overset{\|}{C}}-O-CH_3 \xrightarrow[HEAT]{aq\ NaOH} H-\overset{O}{\overset{\|}{C}}-OH-O^-Na^+ + HO-CH_3$

Saponification :-



Fat — Triol — Salt = Soap

Thats it, Hope you liked the notes, I tryed my best trying to make them as short as possible (Impossible)

These 26 pages of Organic Chem are 100%, you can attempt any pastpaper Now!

Organic Chem can be Spain (the "s" is silent), so if you need any help in Chemistry, I am available and will TRY MY BEST to Help! @dadcify ... contact if needed

Have a Great Day my Kings & Queens!

KING RIZWAN ♡ :- Huge Credit

Thank You