OrganiC=Chemistry

Fuel: A substance that burns to give out energy.

Fossil Fuel: Substances formed in Earth's crust due to the decomposition of dead organisms

- Fossil fuels are formed due to high temperature & pressure on buried organisms

Coal: Cheap black solid fossil fuel composed of carbon and traces of non-metals like sulfur

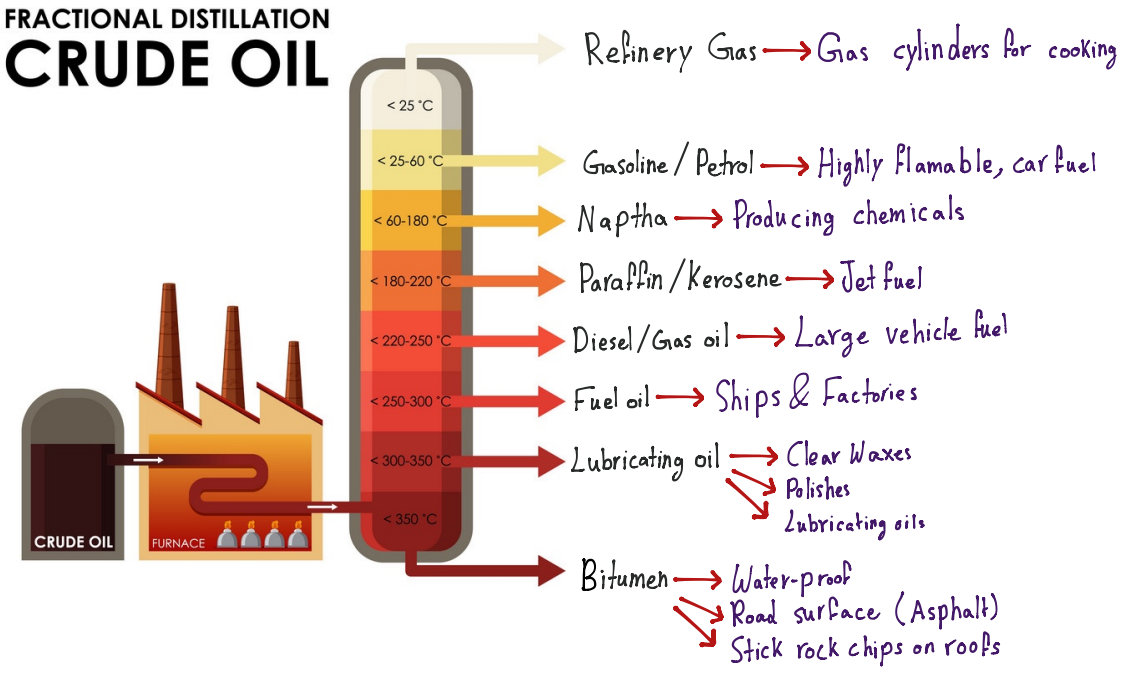
Natural Gas: Gaseous layers above petroleum, 94% methane

Petroleum: A mixture of hydrocarbons

Fractional Distillation: A method of separating miscible liquids due to the difference in boiling points

- Petroleum Fractional distillation:

* Heated slowly to 500°C
* Smaller chains vapourise first and are at the top of fractionating tower



Hydrocarbons

Hydrocarbons: Compounds made up of carbon and hydrogen only

Homologous Series: A family of organic compounds with same general chemical properties due to having the same functional group.

□ Properties of homologous series:

* Same functional group
* Same general chemical properties
* Same way of preparation
* Same general formula
* Trend in physical properties

Isomers: Organic compounds with same molecular formula but different structural formulae

Carbon No.	1	2	3	4	5	6	7	8	9	10
Prefix	meth-	eth-	prop-	but-	pent-	hex-	hept-	oct-	non-	dec-

Alkane ⟶ -ane

Alkene ⟶ -ene

Alcohol ⟶ -anol

Carboxylic Acid ⟶ -anoic Acid

Chlorine ⟶ Chloro-

Bromine ⟶ Bromo-

Alkyl ⟶ -yl-

Alkanes

* Saturated hydrocarbons (C–C)
* General Formula: $C_n H_{2n+2}$
* C5–C9 liquids

Combustion: (burning in presence of oxygen)

Complete	Incomplete
* Excess Oxygen	* Insufficient Oxygen
Alkane + $O_2 \longrightarrow CO_2 + H_2O$ (g)	Alkane + $O_2 \longrightarrow CO + H_2O$(g)

Substitution: (reaction with halogens)

* Ultra-Violet Light required
* Photochemical Reaction
* Mixture of products obtained (different isomers)

Alkane + $Cl_2 \xrightarrow{\text{UV Light}}$ ChloroAlkane + HCl

Cracking: (breakdown of large molecules into smaller, more valuable molecules)

* Heat (600°C) + Al_2O_3 Catalyst

Alkane $\longrightarrow$ Alkene + Alkane OR Alkane $\longrightarrow$ Alkene + H_2 OR Alkane $\longrightarrow$ Alkene + Alkene + H_2

Alkenes

* Unsaturated hydrocarbons (C=C)
* Easy to break C=C bond making it more reactive than alkanes
* General Formula: $C_n H_{2n}$
* C5 – C19 liquids
* Starts from ethene

Combustion: (burning in presence of oxygen)

Complete	Incomplete
* Excess Oxygen	* Insufficient Oxygen
Alkene + O_2 ⟶ CO_2 + H_2O (g)	Alkene + O_2 ⟶ CO + H_2O(g)

Addition: (adding hydrogen / water / bromine across C=C)

Hydrogenation	Hydration	Bromination
* 200°C	* 300°C	Alkene + Br_2 ⟶ Dibromo Alkane
* Nickel Catalyst	* 60 a.t.m. pressure	* Reddish Brown → Colourless
Alkene + H_2 ⟶ Alkane	* Phosphoric Acid (H_3PO_4)	
	* Alkene + H_2O ⟶ Alcohol	Addition of HBr
		Alkene + HBr ⟶ Bromo Alkane

Alcohols

* Hydroxyl group (-OH)
* General Formula: $C_nH_{2n+1}OH$
* Colourless, Neutral, Bad Electric Conductors, Flammable, Volatile

Oxidation:

* $KMnO_4$ (potassium manganate VII) | $K_2Cr_2O_7$ (potassium dichromate)

Alcohol + O_2 ⟶ Carboxylic acid

Reaction with metals:

2 Alcohol + 2 Metal ⟶ 2 Salt + H_2

Ethanol Uses

- Fuel
- Solvent
- Alcoholic Drinks

Dehydration:

* Heat with excess concentrated H_2SO_4
* Pass vapour over hot Al_2O_3

Alcohol ⟶ Alkene + H_2O

Hydration

* 300°C, 60 atm, H_3PO_4

Ethene + H_2O ⟶ Ethanol

Pure Ethanol	Non-renewable
Fast & continous	High Energy

Fermentation

* Yeast (Zymase), < 37°C

Glucose ($C_6H_{12}O_6$) ⟶ 2 Ethanol + CO_2

* Stops at 15%, sugar runs out

Renewable	Slow, Requires large vessels
	Ethanol in mixture

Carboxylic Acids

* -COOH functional group
* General Formula: $C_{n-1}H_{2n-1}COOH$

Acid Reactions:

Carboxylic Acid + Base → Salt + Water

Carboxylic Acid + Metal → Salt + hydrogen

Carboxylic Acid + Metal Carbonate → Salt + CO_2 + H_2O

Esters

Alcohol + Carboxylic Acid → Ester + Water

* Strong & pleasant tastes and smells
* Water molecule removed. Concentrated H_2SO_4 to remove water formed.
* Conc H_2SO_4 Catalyst

Uses:

* Food flavouring * Perfumes * Solvent

Ester Hydrolysis: Breaking down of ester linkage by addition of water

Ester + Water → Carboxylic Acid + Alcohol

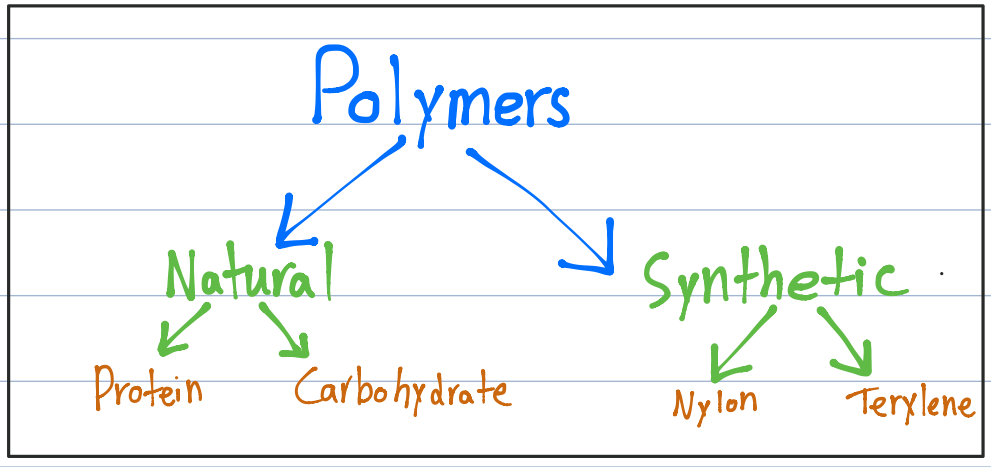
Polymerisation

Polymerisation: Chemical reaction in which monomers join to form a long chain polymer

Addition	Condensation
* Breaking C=C * One product (polymer) * Non-biodegradable * Alkene monomer	* Elimination of water * Two products (polymer & H_2O) * Biodegradable * Two monomers, each having a functional group on each end * Conc. Sulphuric Acid Catalyst

Non-Biodegradable Disadv.:

* Visual Pollution
* Shortage of landfill sites
* Toxic gases when burnt (HCl, CO)

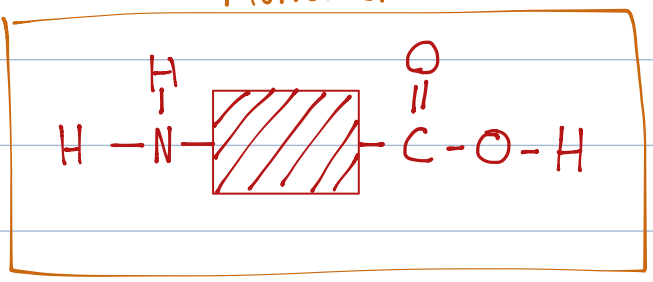


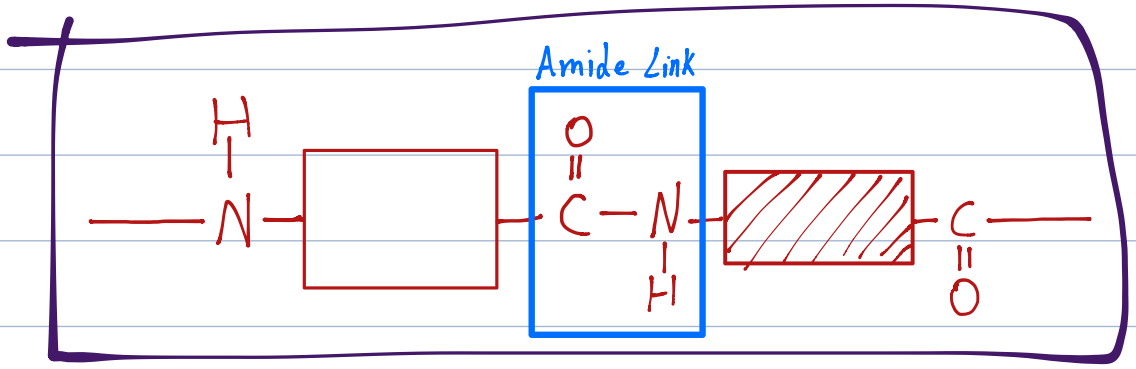
Condensation Polymerisation

Proteins:

* Natural
* Monomers called Amino Acids
* Amide linkage

Monomer



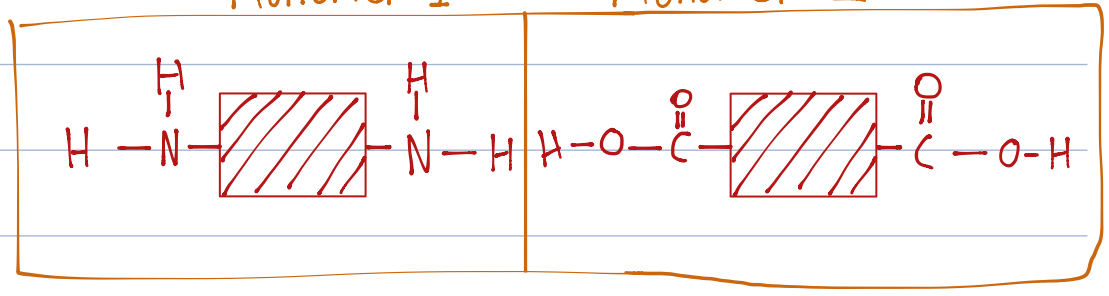


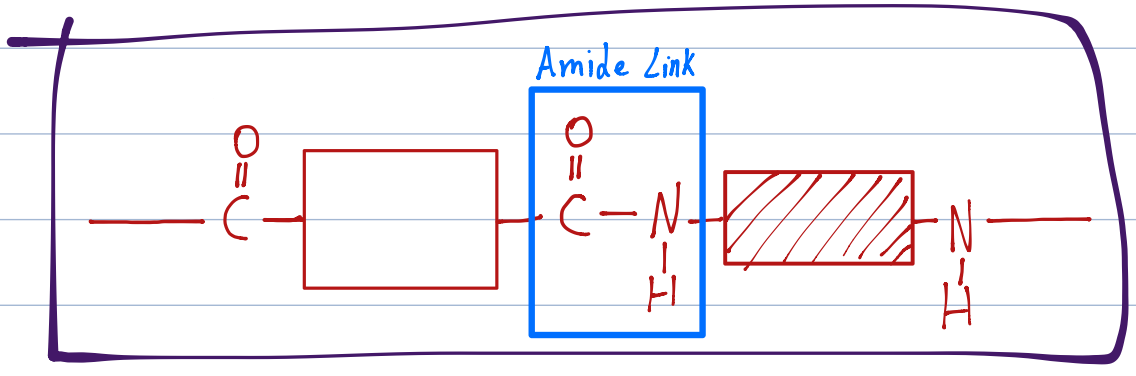
Polymer

Nylon:

* Synthetic
* Amide linkage
* Can be turned into fibres

Monomer 1 Monomer 2

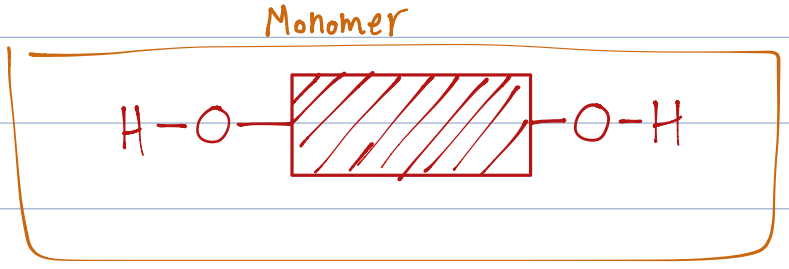


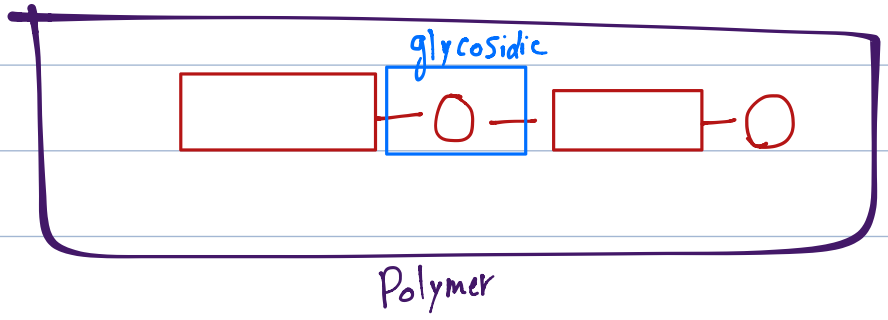


⚠ Both polymers can be hydrolysed by refluxing with conc. HCl

Carbohydrates: group of naturally occuring organic compounds containing: carbon, hydrogen, and oxygen.

* Ratio of H:O is always 2:1
* Glucose: Monosaccharide, Sucrose: Disaccharide, Starch: Polysacchride

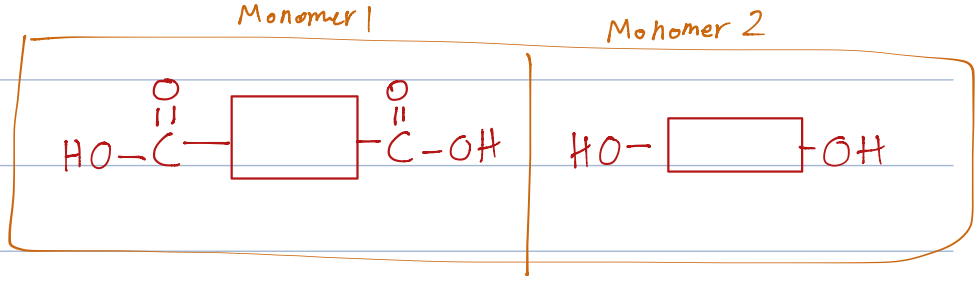




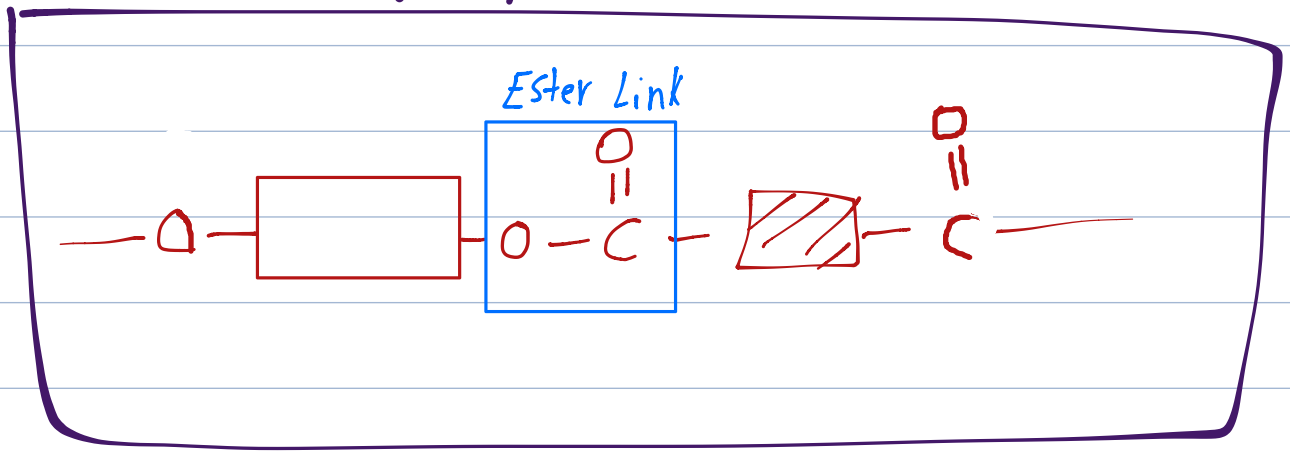
* Hydrolysed by refluxing with HCl
* Locating Agent (ninhydrin) needed in chromatography

Terylene:

* Ester Linkage
* Can be turned into fibres



Polymer

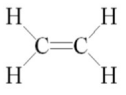
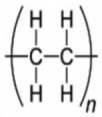
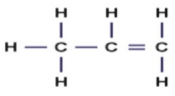
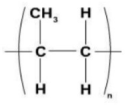
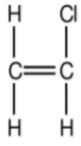
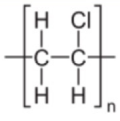
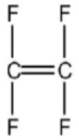
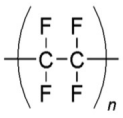


Plastics

Adv.	Dis adv.
Cheap	Non-biodegradable
Lighter than metal	Toxic gases when burnt
Resists Corrosion	Visual pollution
Insulator	Shortage of landfill sites

Biodegradable: decomposes by bacteria

Non-Biodegradable: doesn't get decomposed by bacteria

Monomer	Polymer	Uses
 Ethene	 Poly(ethene)	1. Plastic bags 2. Bowls, bottles, packaging
 Propene	 Poly(propene)	1. Crates and boxes 2. Plastic rope
 Chloroethene	 Poly(chloroethene) (also called Polyvinyl chloride, PVC)	Insulation, pipes and gutters
 Tetra fluoroethene	 Poly(tetra-fluoroethene) (Teflon)	Non-stick frying pans
Styrene	Poly(styrene)	Insulation, packaging (foam)

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