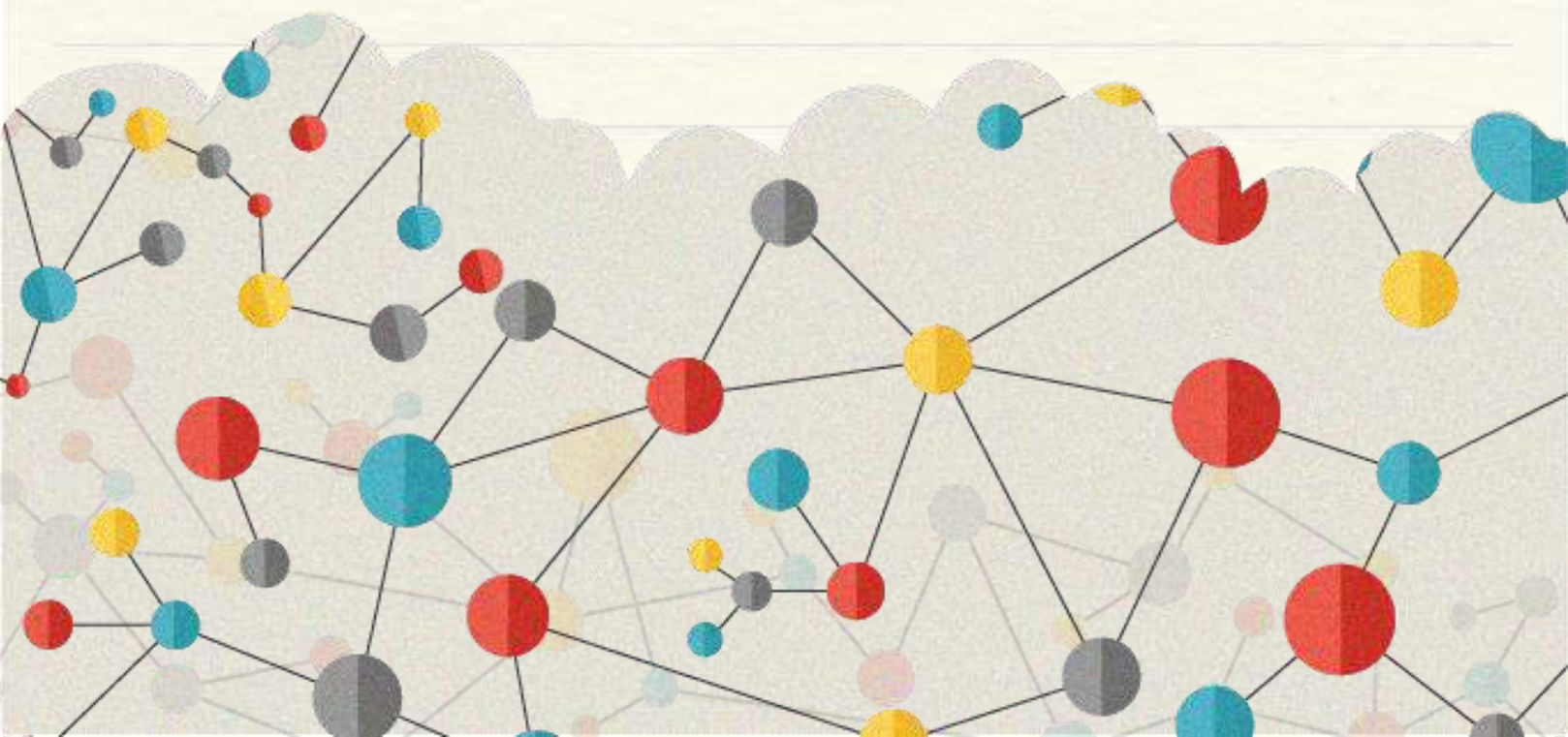
CHEMISTRY

BYJU'S
POST CLASS NOTES

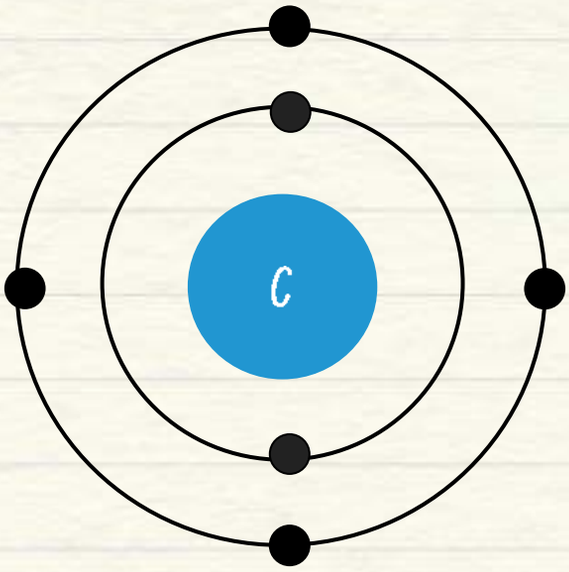
Carbon and Its Compounds

Topics

1. Carbon
2. Allotropes of carbon
3. Hydrocarbons
4. Chemical properties of carbon
5. Ethanol
6. Ethanoic acid
7. Saponification



1. Carbon



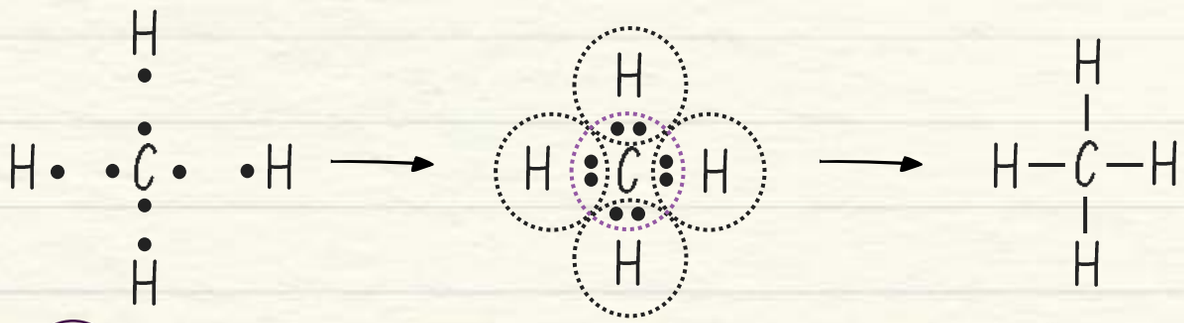
6
Atomic number

12
Mass number

2, 4
Electronic configuration

Carbon is **tetravalent**

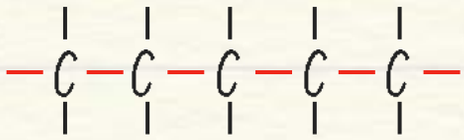
1.1 Covalent Bonding in Carbon



Note: Usually, carbon **does not** form ionic bonds as losing or gaining **four** electrons requires a large amount of **energy**

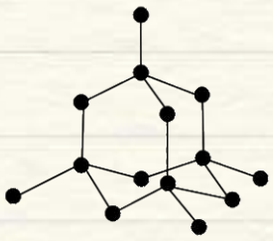
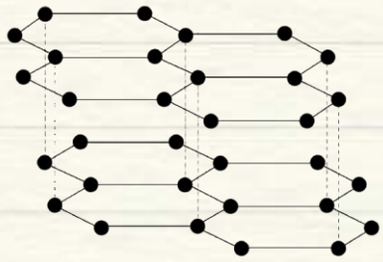
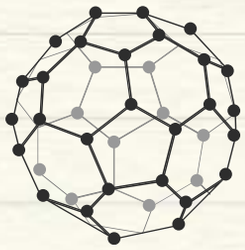
1.2 Catenation

Carbon bonding with other atoms of carbon



2. Allotropes of Carbon

Allotropes are different forms of a chemical element

Diamond	Graphite	Fullerene
		
Regular tetrahedral arrangement of atoms (3D)	Hexagonal arrangement of atoms in a single plane (2D)	Hollow molecules forming a closed cage or cylinder
Each carbon atom bonded to four other carbon atoms	Each carbon atom bonded to three other carbon atoms	Buckminsterfullerene (C_{60}) was the first fullerene to be discovered
Extremely hard	Soft and slippery	
Bad conductor of electricity	Good conductor of electricity	

3. Hydrocarbons

Saturated → **Alkanes**: Only single covalent bonds between carbon atoms

Unsaturated

- **Alkenes**: At least one carbon-carbon double bond
- **Alkynes**: At least one carbon-carbon triple bond

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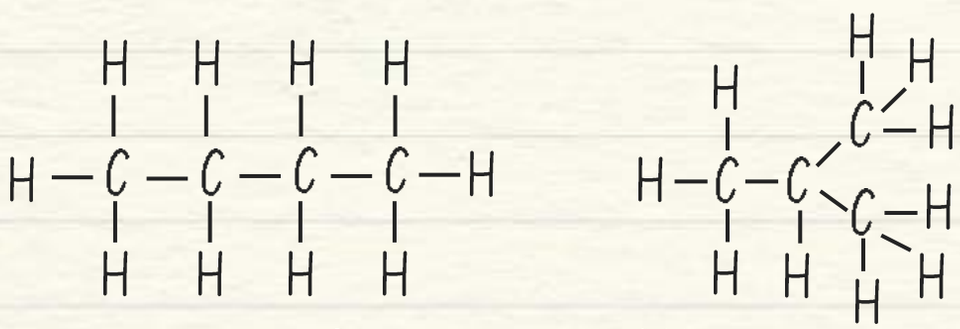
3.1 Heteroatoms and Functional Groups

Heteroatom	Oxygen			
Functional group	Alcohol	Aldehyde	Ketone	Carboxylic acid
Formula of functional group	$-OH$	$-C(=O)-H$	$-C(=O)-$	$-C(=O)-OH$

3.2 Structural Isomers

Identical molecular formula but different arrangement of atoms



Structural isomers of C_4H_{10}

3.3 Homologous Series

- Same functional group
- Successive members differ by a $-CH_2$ unit
- Different physical properties but similar chemical properties

General formula for homologous series of:

- Alkane = C_nH_{2n+2}
- Alkene = C_nH_{2n}
- Alkyne = C_nH_{2n-2}

3.4 Heteroatoms and Functional Groups

Prefix + Word root + Primary suffix + Secondary suffix

Prefix

Functional group	Chlorine	Bromine
Prefix	Chloro	Bromo

Word root

# Carbon atoms	1	2	3	4	5	6	7	8
Word root	Meth	Eth	Prop	But	Pent	Hex	Hept	Oct

Primary suffix

Hydrocarbon	Alkane	Alkene	Alkyne
Primary suffix	ane	ene	yne

Secondary suffix

Functional group	Alcohol	Aldehyde	Ketone	Carboxylic acid
Secondary suffix	ol	al	one	oic acid

* If the secondary suffix starts with a vowel, delete 'e' from primary suffix

4. Chemical Properties of Carbon

4.1 Combustion Reaction

Carbon and most of carbon compounds burn in oxygen to give carbon dioxide along with the release of heat and light

- $C + O_2 \longrightarrow CO_2 + \text{Heat} + \text{Light}$
- $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Heat} + \text{Light}$

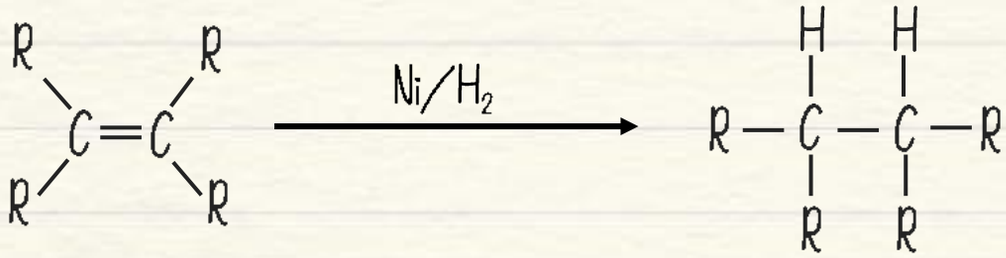
4.2 Oxidation Reaction

In the presence of oxidising agents, alcohols oxidise to carboxylic acid

$$CH_3CH_2OH \xrightarrow[\text{OR acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$$

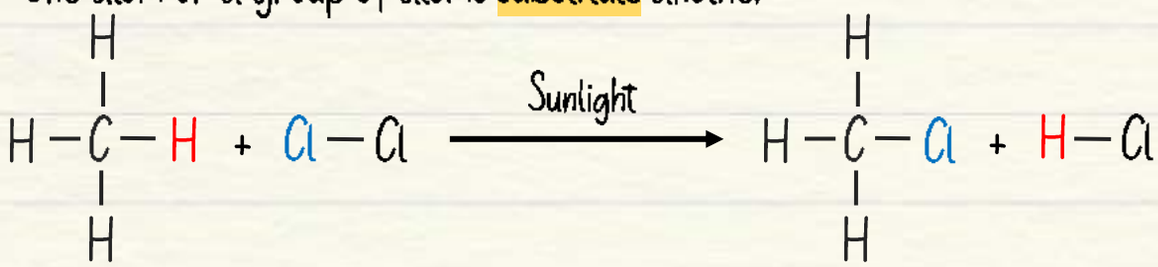
4.3 Addition Reaction

Hydrogen can be added to unsaturated hydrocarbons in the presence of catalysts to give saturated hydrocarbons



4.4 Substitution Reaction

One atom or a group of atoms substitute another



5. Important Reactions of Ethanol

$$2Na + 2CH_3CH_2OH \longrightarrow \underset{\text{Sodium ethoxide}}{2CH_3CH_2O^-Na^+} + H_2$$

$$CH_3CH_2OH \xrightarrow{\text{Hot conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

6. Important Reactions of Ethanoic Acid

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{CH_3CH_2OH} \overset{\text{Acid}}{\rightleftharpoons} \underset{\text{Ester}}{CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_3} + H_2O$$

Esterification reaction:- Carboxylic acid reacts with an alcohol in the presence of an acid catalyst to form ester and water

$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$

7. Saponification

- Preparation of soap
- When an ester is treated with an alkali like sodium hydroxide, it is converted to an alcohol and a sodium salt of the carboxylic acid

$$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$$

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7.1 Soaps and Detergents

Soap

- Sodium or potassium salts of long-chain carboxylic acids
- Produces scum in hard water
- Hard water affects its cleansing action

Detergent

- Sodium salts of sulphonic acids or ammonium salts with chlorides or bromides ions
- Does not produce scum in hard water
- Hard water does not affect its cleansing action

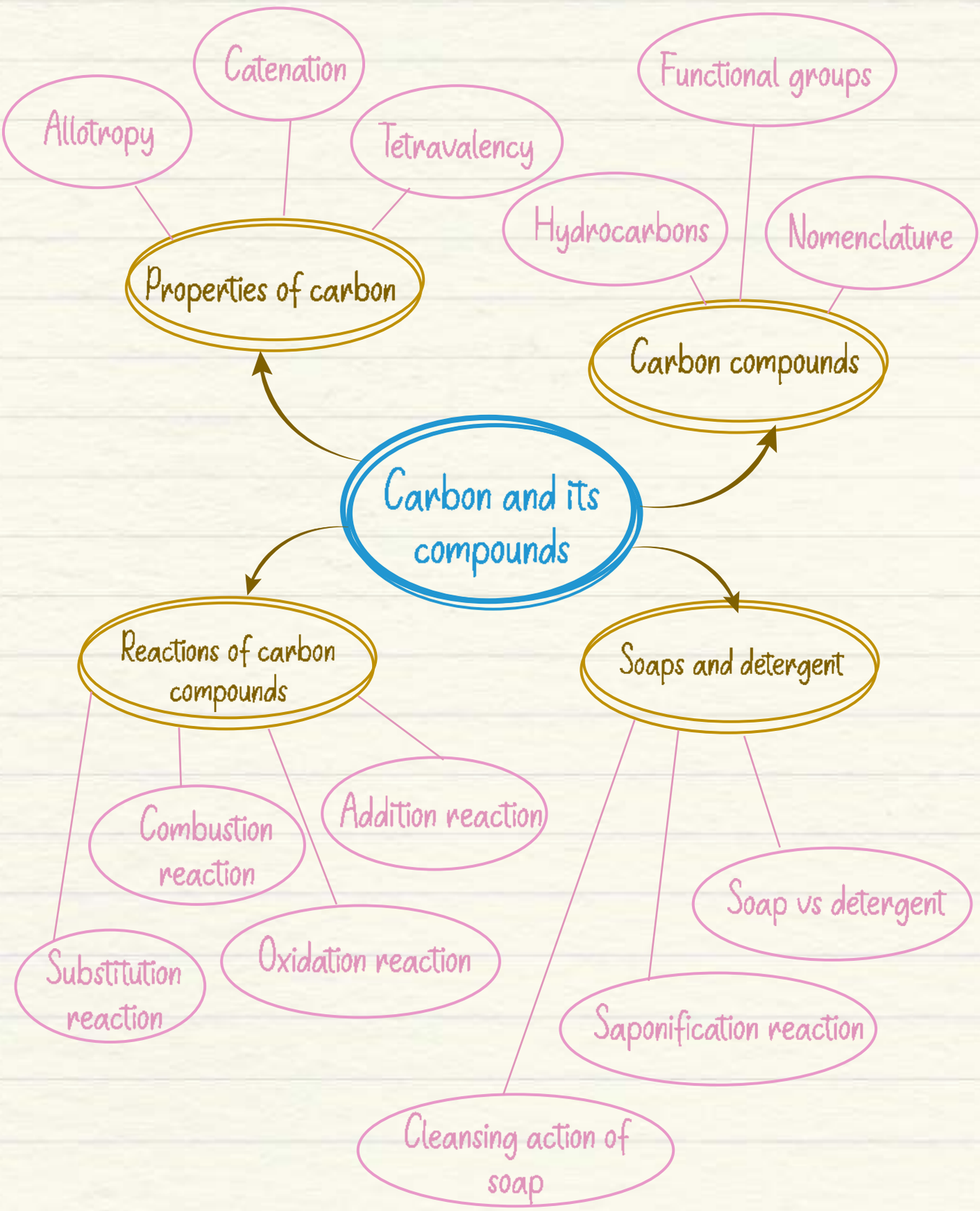
7.2 Cleansing Action of Soap

Hydrophobic tail of soap molecule interacts with oil, the hydrophilic head interacts with water

Soap molecule

When dissolved in water, soap molecules form micelles which remove the oily dirt from the clothes

Mind Map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Properties of carbon
Allotropy
Catenation
Tetravalency
Carbon compounds
Functional groups
Hydrocarbons
Nomenclature
Reactions of carbon compounds
Combustion reaction
Addition reaction
Substitution reaction
Oxidation reaction
Soaps and detergent
Soap vs detergent
Saponification reaction
Cleansing action of soap