12-11-24
Tuesday

9. Carbon Compounds.

Carbon:

① Atomic No. = No. of protons or electrons.
= 6

② Atomic Mass No. = No. of protons + No. of neutrons
= 6+6 = 12

③ Electronic configuration = 6 = (2,4)

④ Valency = 6 = (2,4)

+4(4) −4(4)

(2,8) (2)

Valency = ±4

12-11-24
Tuesday

Bonds in Carbon Compounds.

C = 6 = (2,4)

Carbon donates 4 electrons.

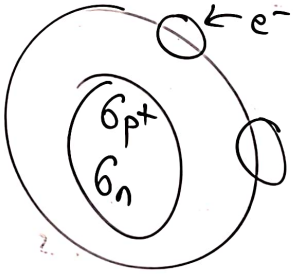
(+) P = 6

(-) e = 2

Net charge = 6 − 2

= +4

$C \rightarrow C^{4+}$ (cation)



C = 6 = (2,4)

Carbon accepts 4 electrons.

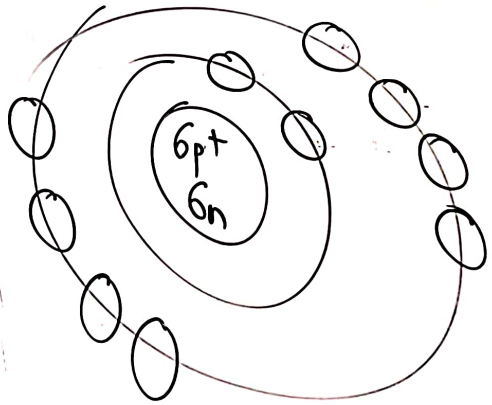
(+) P = 6

(-) e = 10

Net charge = 6 − 10

= −4

$C \rightarrow C^{4-}$ (anion)

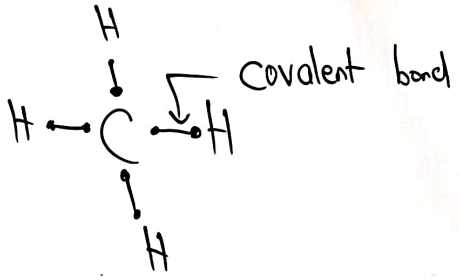


2-11-24
Tuesday

Bonds in Carbon Compounds.

Carbon prefers sharing of electrons and it forms covalent bond

C = 6 = (2, 4) H = 1 = (1)



CH_4

(methane)

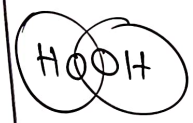
12-11-24
Tuesday

Electron dot structure and line structure.

2 - Duplet
8 - Octet.

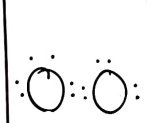
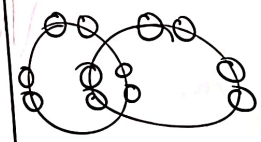
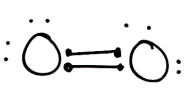
1] H_2 molecule.

H = 1 = (1)

Electron dot structure (without circle)	Electron dot structure (with circle)	Line structure
H : H		H — H

2] O_2 molecule.

O = 8 = (2, 6)

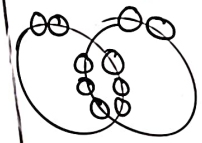
Electron dot structure (without circle)	Electron dot structure (with circle)	Line structure.
		

12-11-24
Tuesday

Electron dot structure and line structure.

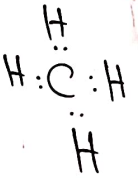
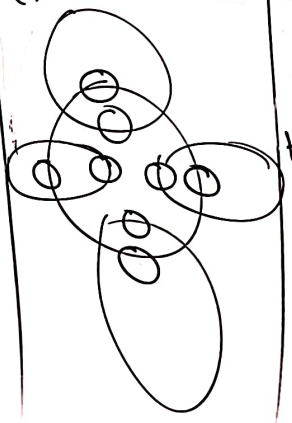
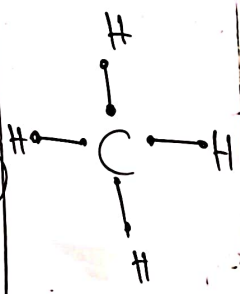
3] N_2 molecule.

N = → = (2, 5)

Electron dot structure (without circle)	Electron dot structure (with circle)	Line structure
		

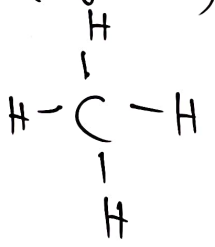
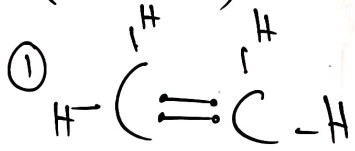
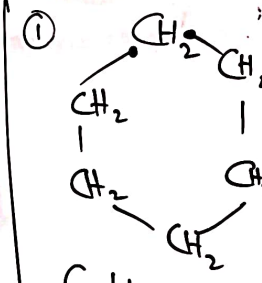
4] CH_4 molecule.

C = 6 – (2, 4) H = 1 = (1)

Electron dot structure (without circle)	Electron dot structure (with circle)	Line structure.
		

12-11-24
Tuesday

Types of Hydrocarbons.

- Open chain hydrocarbons.
  - Saturated
    - Alkane (Single bond)
      - ① 
      - CH_4 (methane)
  - Unsaturated
    - Alkene (Double bond)
      - ① 
      - C_2H_4
      - ethene
    - Alkyne (Triple bond)
      - ① 
      - C_2H_2
      - ethyne
- Closed chain / Cyclic hydrocarbons
  - ① 
  - C_6H_{12}
  - Cyclohexane

12-11-24
Tuesday

4-11

Types of Hydrocarbons.

- Open chain hydrocarbons.
  - Saturated
    - Alkane (Single bond)
      - C_2H_6
      - ethane
  - Unsaturated
    - Alkene (Double bond)
      - C_3H_6
      - propene
    - Alkyne (Triple bond)
      - C_3H_4
      - propyne
- Closed chain / Cyclic hydrocarbons
  - C_6H_6
  - benzene

12-11-24
Tuesday

alkane

Types of Saturated Hydrocarbons.

Straight chain

① $CH_3-CH_2-CH_3$

C_3H_8

propane

② $CH_3-CH_2-CH_2-CH_3$

C_4H_{10}

butane

Branched Chain

① $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

C_4H_{10}

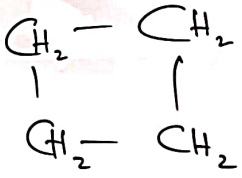
iso butane

② $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

C_5H_{12}

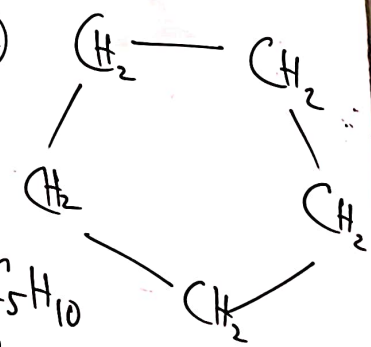
iso pentane

Closed Chain / Cyclic

① 

C_4H_8

Cyclobutane

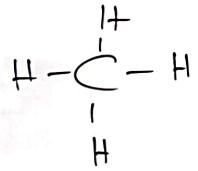
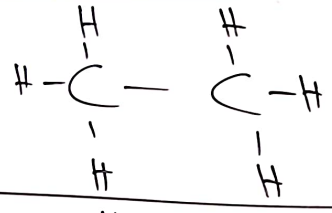
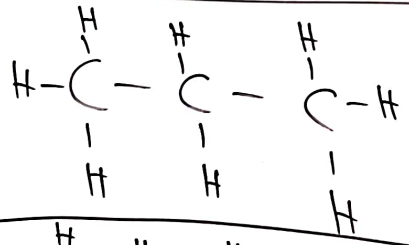
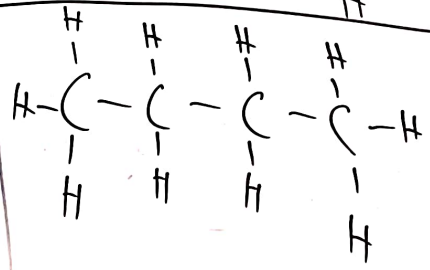
② 

C_5H_{10}

Cyclopentane

12-11-24
Tuesday

alkane

No. of carbon atoms	Structural Formula.	Molecular Formula	Name.
1		CH_4	methane
2		C_2H_6	ethane
3		C_3H_8	propane
4		C_4H_{10}	butane

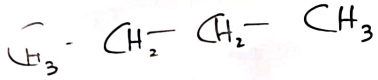
12-11-24
Tuesday

alkane

No. of carbon atoms	Structural Formula.	Molecular Formula	Name.
5	$CH_3-CH_2-CH_2-CH_2-CH_3$	C_5H_{12}	pentane
6	$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$	C_6H_{14}	hexane
7	$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$	C_7H_{16}	heptane

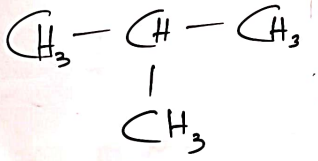
12-11-24
Tuesday

Structural Isomerism.



C_4H_{10}

butane



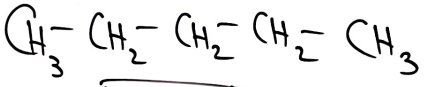
C_4H_{10}

iso butane

Molecular formula is same

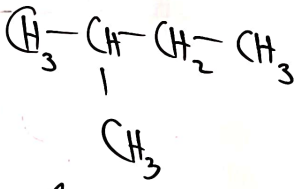
but

Structural formula is different.



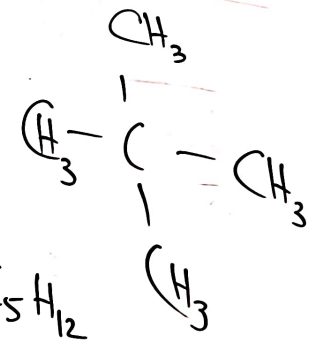
C_5H_{12}

pentane



C_5H_{12}

isopentane

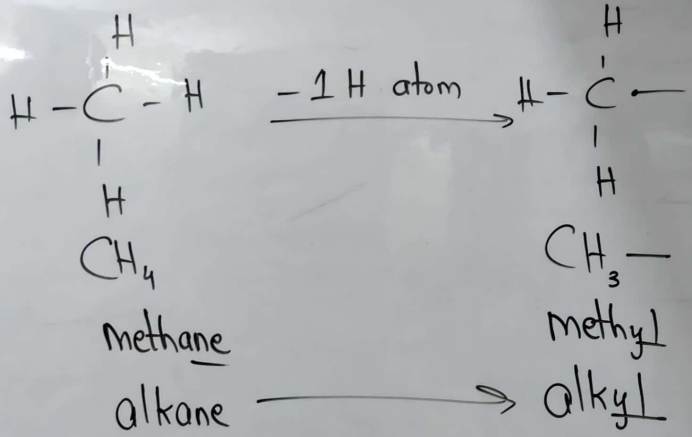


C_5H_{12}

neo-pentane

12-11-24
Tuesday

Functional Groups.



hetero atoms

12-11-24
Tuesday

Functional Groups.

i) Halogens (X) (F, Cl, Br, I)

prefix : halo

Chloro
bromo
iodo.

alkyl = R

General Formula : R—X

① $CH_3—Cl$

Common Name : methyl chloride

IUPAC : Chloro methane

② CH_3-CH_2-Br

CN : ethyl bromide

IUPAC : bromoethane

③ $CH_3-CH_2-CH_2-F$

CN : propyl fluoride

IUPAC : fluoro propane

12-11-24
Tuesday

2] Alcohol [Suffix : ol]

$R-\overset{}{C}-H$

$(R-OH)$

① CH_3-OH

CN: methyl alcohol.

IUPAC: methanol

② CH_3-CH_2-OH

CN: ethyl alcohol.

IUPAC: ethanol

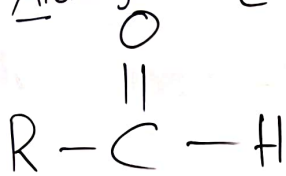
③ $CH_3-CH_2-CH_2-OH$

CN: propyl alcohol

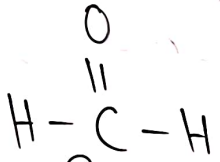
IUPAC: propanol.

12-11-24
Tuesday

3] Aldehyde. [Suffix = al]

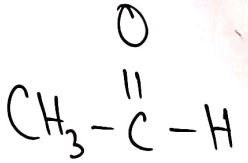


(R-CHO)

① 

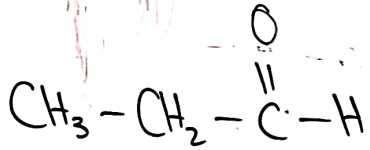
CN: formaldehyde

IUPAC: methanal

② 

CN: acetaldehyde

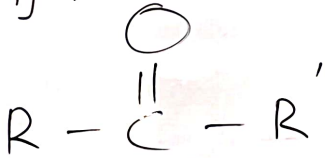
IUPAC: ethanal

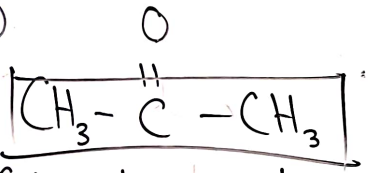
③ 

CN: propionaldehyde

IUPAC: propanal

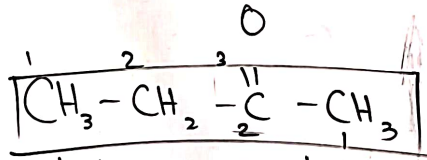
12-11-24
Tuesday
4] Ketone [Suffix = one]



① 

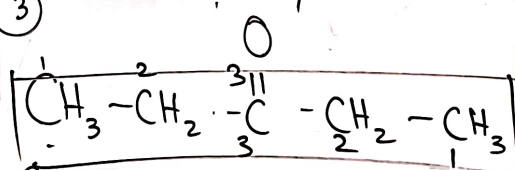
CN: dimethyl ketone

IUPAC: propanone

② 

CN: ethyl methyl ketone

IUPAC: butan-2-one

③ 

CN: diethyl ketone

IUPAC: pentan-3-one

5] Carboxylic Acid.

G.F: $R-\overset{\overset{O}{\|}}{C}-OH$

$R-COOH$

Suffix:
CN: ic acid
IUPAC: oic acid

① $H-\overset{\overset{O}{\|}}{C}-OH$

CN: formic acid
IUPAC: methanoic acid.

② $CH_3-\overset{\overset{O}{\|}}{C}-OH$

CN: acetic acid.
IUPAC: ethanoic acid.

③ $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-OH$

CN: propionic acid.
IUPAC: propanoic acid.

6] Ether:

G.F: $R-O-R$

Suffix: oxy

① CH_3-O-CH_3

CN: dimethyl ether

IUPAC: methoxy methane

② $CH_3-CH_2-O-CH_3$

CN: ethyl methyl ether

7] Ester

G.F: $R-\overset{O}{\overset{\|}{C}}-O-R'$

$R-COO-R'$

Suffix: oate

① $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$

IUPAC: methyl ethanoate

② $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

IUPAC: ethyl ethanoate

8] Amine

G.F: $R-\overset{\overset{H}{|}}{N}-H$

$(R-NH_2)$

Suffix : amine

① CH_3-NH_2

CN: methyl amine

IUPAC: methanamine

② $CH_3-CH_2-NH_2$

CN: ethyl amine

IUPAC: ethanamine

③ $CH_3-CH_2-CH_2-NH_2$

CN: propyl amine

IUPAC: propanamine

Homologous Series.

→ $CH_3 - OH$

→ $CH_3 \boxed{CH_2} - OH$

$CH_3 - CH_2 \boxed{CH_2} OH$

① 1 carbon atom gets added

② One $-CH_2-$ unit gets added.

③ Molecular Mass of $-CH_2-$ unit
$= (1 \times 12) + (2 \times 1)$
$= 12 + 2$
$= 14u.$

④ Physical properties shows "Gradation".

⑤ Chemical properties shows similarity.

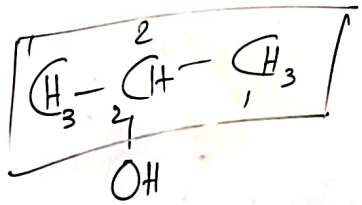
Alkane	Alkene	Alkyne
G.F : $C_n H_{2n+2}$	G:F : $C_n H_{2n}$	$C_n H_{2n-2}$
n=3 : $C_3 H_{2(3)+2}$ $C_3 H_8$	n=3 : $C_3 H_{2(3)}$ $= C_3 H_6$	n=3 : $C_3 H_{2(3)-2}$ $C_3 H_4$
n=5 : $C_5 H_{2(5)+2}$ $C_5 H_{12}$	n=5 : $C_5 H_{2(5)}$ $C_5 H_{10}$	n=5 : $C_5 H_{2(5)-2}$ $C_5 H_8$

IUPAC Nomenclature.

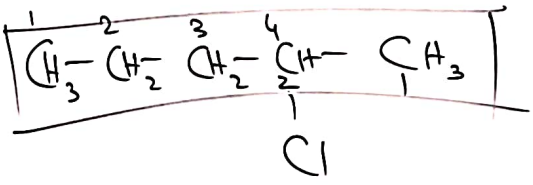
Step 1 : Identify the parent hydrocarbon

Step 2 : Identify the functional group and assign appropriate prefix or suffix.

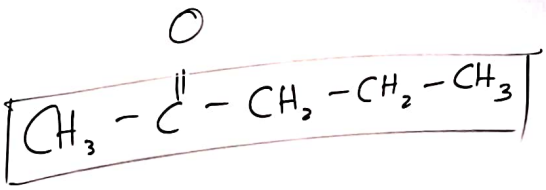
Step 3 : Assign suitable numbering to the functional groups

① 

propan-2-ol

② 

2-chloro pentane

③ 

pentan-2-one

1] Combustion.

① $C + O_2 \longrightarrow CO_2 + \text{heat} + \text{light}$.

② $CH_3 - CH_2 - OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O + \text{heat} + \text{light}$

R	P
H 6	2
	↓
	2x③ = 6

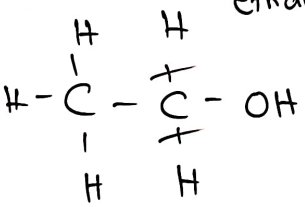
R	P
C 2	1
	↓
	1x② = 2

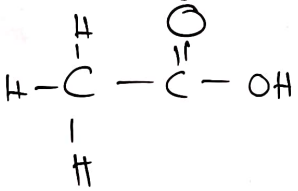
R	P
O 3	7
	↓
1+2	4+3
↓	
2x③ = 6	

R	P
O 7	7
↓	↓
1+6	4+3

2] Oxidation.
[Addition of Oxygen]

CH_3-CH_2-OH ethanol $\xrightarrow{(O)}$ alkaline $KMnO_4$ $\rightarrow$ CH_3-COOH ethanoic acid. $+ H_2O$



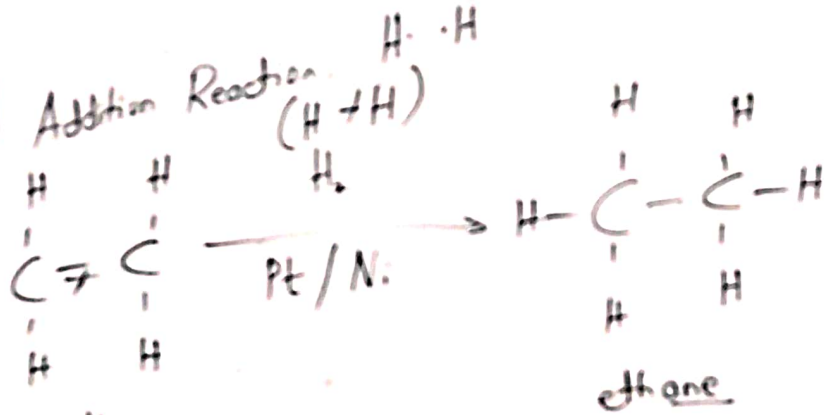


Oxidizing agent = alkaline $KMnO_4$

alkaline potassium permanganate.

[O] = Nascent Oxygen.

3] Addition Reaction



ethene

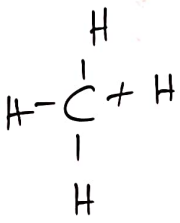
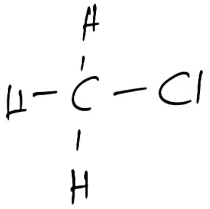
alkene

ethane

alkane

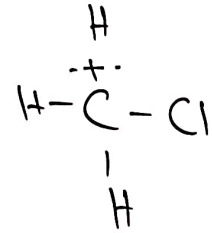
4] Substitution Reaction. $Cl \cdot \cdot Cl$

$[Cl \neq Cl]$

①  $+ Cl_2 \xrightarrow{\text{Sunlight}}$  $+ HCl$

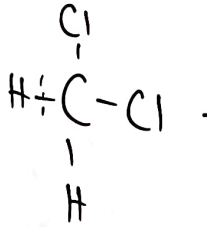
CH_3Cl

Chloro methane

②  $+ Cl_2 \xrightarrow{\text{Sunlight}} CH_2Cl_2 + HCl$

$(Cl \neq Cl)$

dichloromethane

③  $+ Cl_2 \xrightarrow{\text{Sunlight}} CHCl_3 + HCl$

$(Cl - Cl)$

trichloromethane

chloroform.

4] Substitution Reaction. $Cl \cdot \cdot Cl$

Ethanol:

1] Reaction with Sodium.

$$2CH_3-CH_2-OH + 2Na \longrightarrow 2CH_3-CH_2-ONa + H_2\uparrow$$

ethanol — Sodium ethoxide

$$CH_3-CH_2-O\overset{1}{\underset{1}{-}}H + Na \longrightarrow CH_3-CH_2-O-Na$$

	R	P
H	6	7
		↓
		5+2
		↓
		5×②=10

	R	P
H	6	12
	↓	↓
	6×②=12	10+2

	R	P
Na	1	2
	↓	
	1×②=2	

	R	P
C	4	4

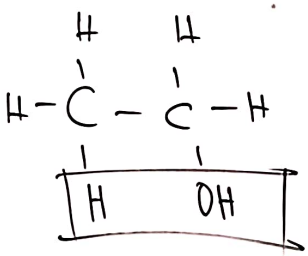
	R	P
O	2	2

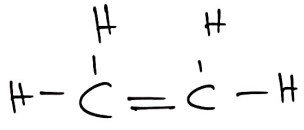
Ethanol:

2] Dehydration Reaction.
[Removal of H_2O]

$$CH_3-CH_2-OH \xrightarrow[\text{conc. } H_2SO_4]{170^\circ C} CH_2=CH_2 + H_2O$$

ethene





Ethanoic acid:

1] Reaction with base.

Neutralization Reaction

Acid + Base ⟶ Salt + Water

$CH_3-COOH + NaOH \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-ONa + H_2O$

IUPAC: Sodium ethanoate

$CH_3-\overset{O}{\overset{\|}{C}}-\underline{OH} + Na \div \underline{OH} \longrightarrow CH_3-\boxed{\overset{O}{\overset{\|}{C}}-O} + Na$

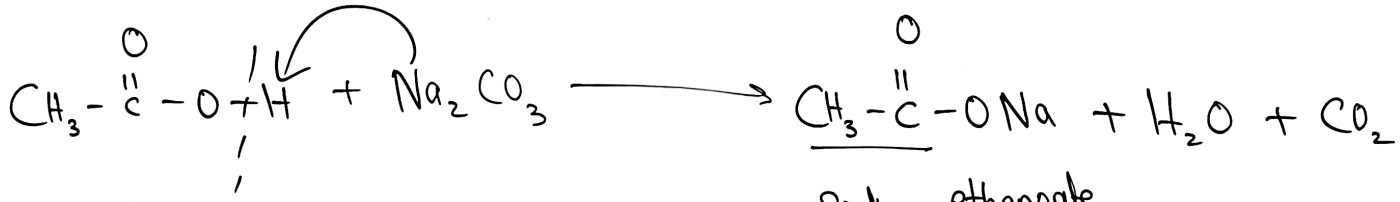
(Weak acid) (strong base) (basic salt)

CN: Sodium acetate

Ethanoic Acid:

2] Reaction with carbonates and bicarbonates.

① $2CH_3-COOH + Na_2CO_3 \longrightarrow 2CH_3-COONa + H_2O + CO_2$



Sodium ethanoate

	R	P
H	4	5

5 ↓

3+2 ↓

3×② = 6

	R	P
H	4	8

4 ↓

4×② = 8

	R	P
Na	2	2

	R	P
C	5	5

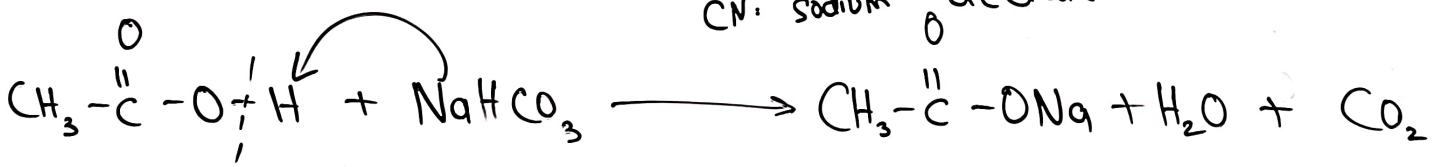
	R	P
O	7	7

Ethanoic Acid:

2] Reaction with carbonates and bicarbonates.

② $CH_3-COOH + NaHCO_3 \longrightarrow CH_3-COONa + H_2O + CO_2$

IUPAC: Sodium ethanoate
CN: Sodium acetate



	R	P
H	5	5

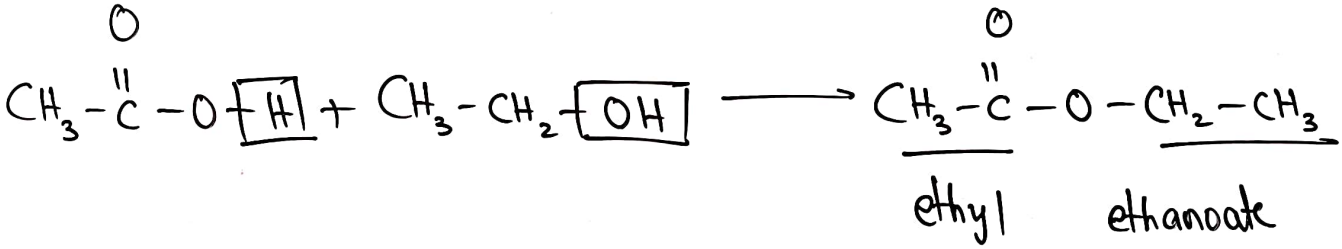
	R	P
Na	1	1

	R	P
C	3	3

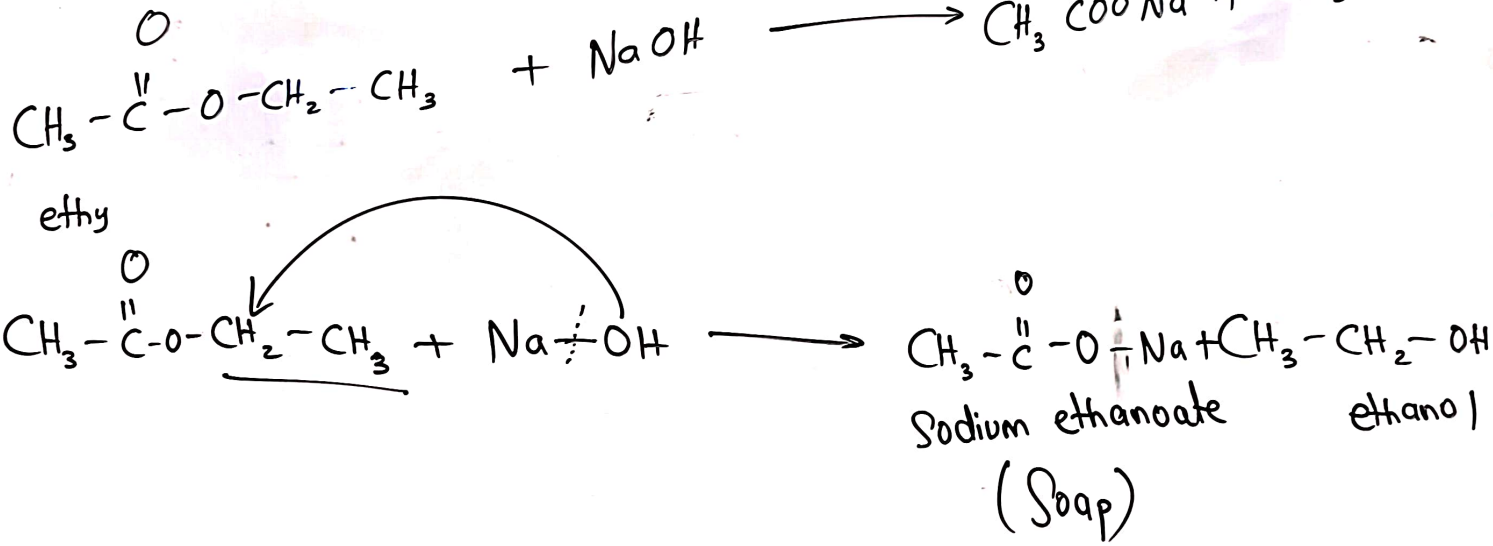
	R	P
O	5	5

Esterification Reaction

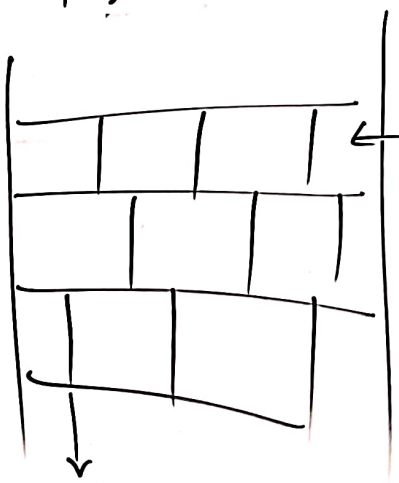
$$CH_3-COOH + CH_3-CH_2-OH \xrightarrow{\text{Acid catalyst}} CH_3-COO-CH_2-CH_3 \quad H_2O$$



Saponification Reaction.



Polymers.

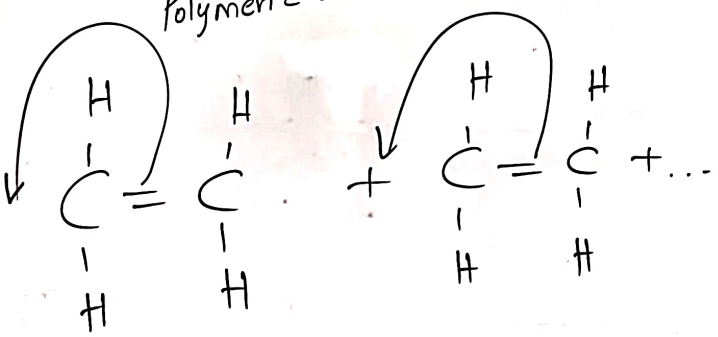


brick (single unit)
(monomer)

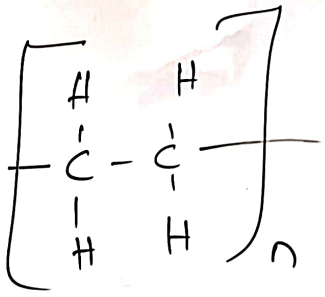
Wall → polymer
(multiple units)

Monomer —Polymerization→ Polymer

Polymerization : Ethene



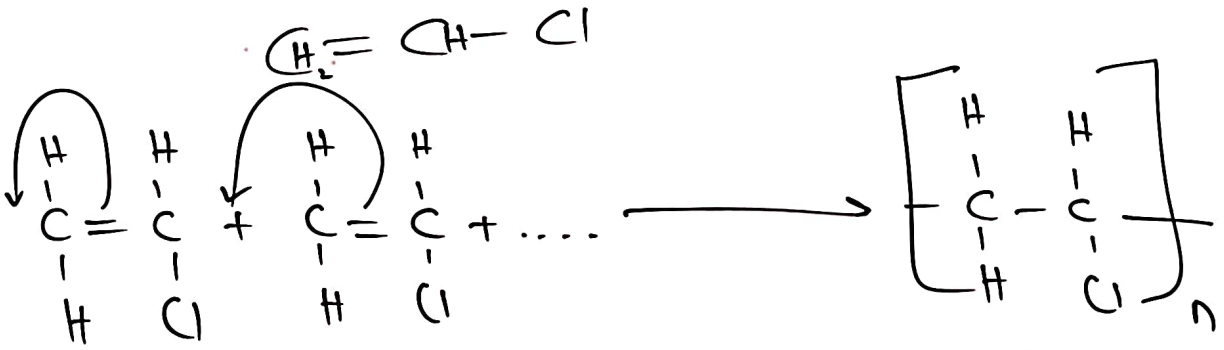
ethene



polyethene

Polyvinyl Chloride (PVC)

Monomer: Vinyl Chloride

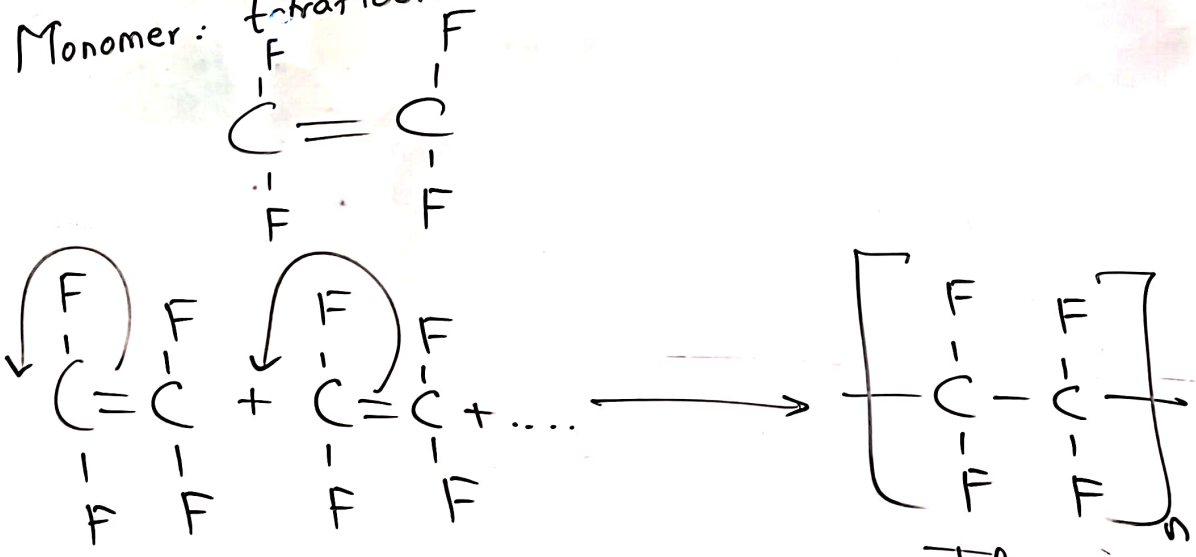


Vinyl chloride

PVC

Teflon

Monomer: tetrafluoro ethene



Teflon.