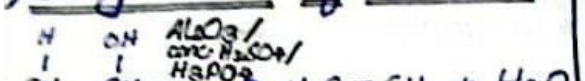
Alkenes

Methods of Preparation:

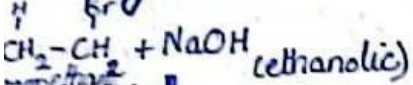
1) Dehydration of Alcohols:



ethanol → ethene

elimination reaction:

2) Dehydrohalogenation of Halogenoalkanes:



bromoethane → ethene

elimination reaction:

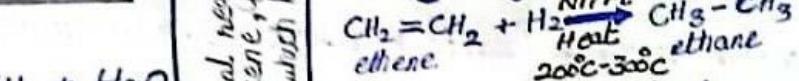
Note:

- In the presence of alcoholic base, elimination rxn is favoured.
- In the presence of aqueous base, substitution rxn is favoured.

Markonikov's Rule: When an unsymmetrical reagent attacks an unsymmetrical alkene, the H-atom bonds itself to that C which bears more H-atoms.

Chemical Reactions:

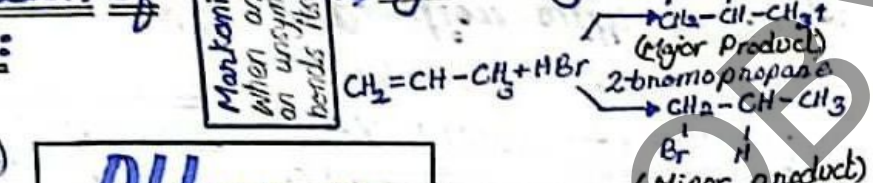
1) Hydrogenation:



ethene → ethane

→ This rxn is used for industrial preparation of margarines.

2) Hydrohalogenation:

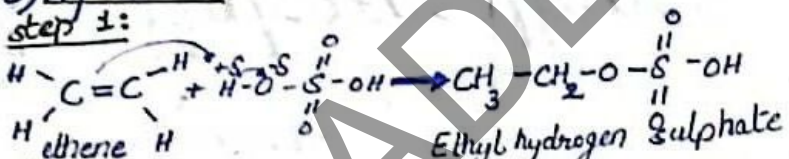


(Major product) 2-bromopropane

(Minor product) 1-bromopropane

3) Hydration:

step 1:

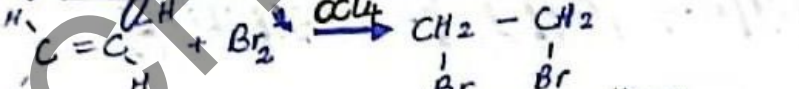


ethene → Ethyl hydrogen sulphate

step 2:

ethanol

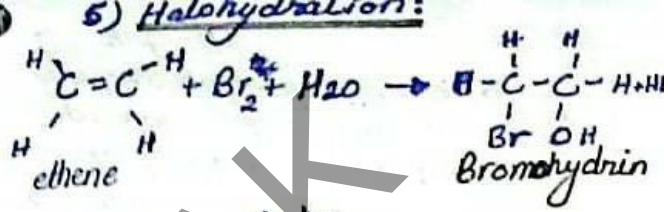
4) Halogenation:



ethene → 1,2-dibromoethane

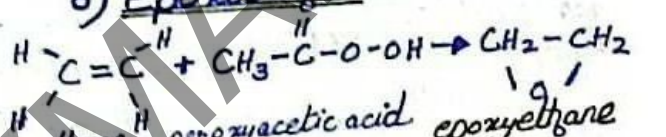
→ The brown colour of Br water is discharged very fast in this rxn so, Br water can be used as a check test to check unsaturation in compounds.

5) Halohydration:



ethene → Bromohydrin

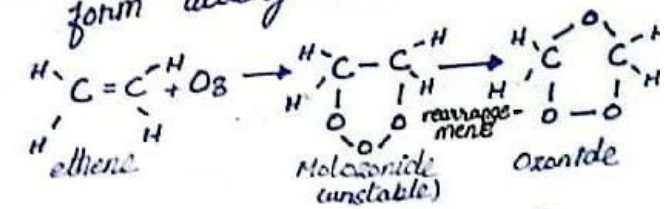
6) Epoxidation:



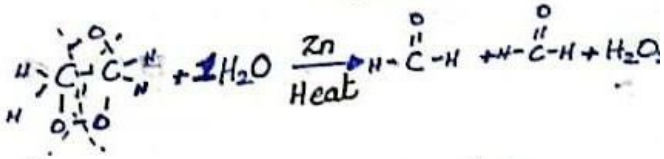
ethene → peroxyacetic acid → epoxyethane + acetic acid

7) Ozonolysis:

→ Ozone is bubbled through into very cold (-78°C) solution of alkene in dichloromethane (CH_2Cl_2) which cleaves the double bond and form aldehydes and ketones.



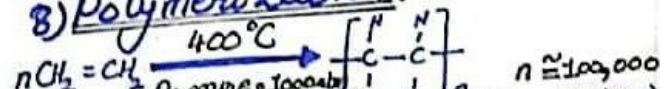
ethene → Molozonide (unstable) → Ozonide



$H_2O_2 + Zn \longrightarrow ZnO + H_2O$

→ This rxn is used to determine the position of double bond in alkenes by reasoning back from structures of products.

8) Polymerization:



ethene → Poly (ethene) (Polyethylene) $n \simeq 100,000$

→ Ethene gives harder & high melting polymer in presence of mixture of triethylaluminium, $Al(C_2H_5)_3$ and titanium tetrachloride, $TiCl_4$ that acts as catalyst

Compiled by : Lubena Kazim
Teacher : Ma'am Ayesha

Shape of Ethene Molecule:

No. of C-atoms : Two C-atoms

Type and no. of Covalent Bonds:

- Each C-atom forms single covalent bonds (two) and one double covalent bond.

Hybridization: C-atom is sp^2 hybridized.

σ and π Bonds:

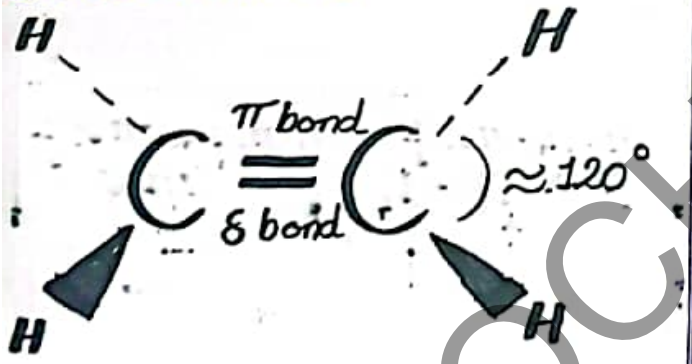
- 1 σ bond → $sp^2 - sp^2$
- 2 σ bonds → $sp^2 - s$
- 1 π bond → $p_z - p_z$

Bond Angle: ≈120°

Shape:

Trigonal planar shape.

Structure :



Shape of Cyclopropane:

No. of C-atoms: Three C-atoms

Type and no. of Covalent Bonds:

- Each C-atom forms four single covalent bonds.

Hybridization: C-atom is sp^3 hybridized.

σ and π Bonds:

- 2 σ bonds → $sp^3 - sp^3$
- 2σ bonds → $sp^3 - s$

Bond Angle:

C-C-C → 60°
H-C-H → 109.5°
C-C-H → 109.5°

Shape :

Tetrahedral arrangement

Structure :

Structure of Ethane :

No. of C-atoms: Two C-atoms.

Type and no. of Covalent Bond

- Each C-atom forms four single covalent bonds.

Hybridization: C-atom is sp^3 hybrid

σ and π Bonds :

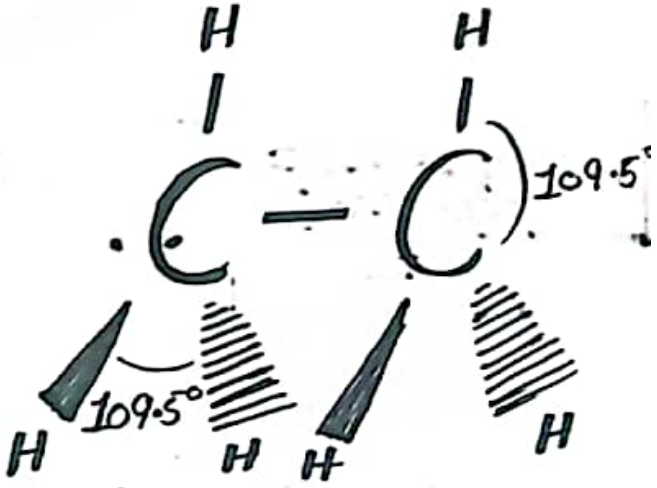
- 1 σ bond → $sp^3 - sp^3$
- 3 σ bonds → $sp^3 - s$

Bond Angle: 109.5°

Shape:

Tetrahedral shape

Structure :



Isomerism:

The molecules having same molecular formulae, but different structural formulae are called isomers. This phenomenon is called isomerism.

Structural Isomerism:

Structural isomers have same molecular formulae but different arrangement of atoms in molecules.

Chain Isomerism:

- found in molecules having same molecular formulae, but different structural formula w.r.t length of C-chain.

Example:

$CH_3-CH_2-CH_2-CH_3$

butane

and

$CH_3-CH(CH_3)-CH_3$

2-methyl propane.

Positional Isomerism

- found in molecules having similar molecular formulae but different position of functional groups on the principal C-chain.

Example:

$CH_3-CH_2-CH_2-OH$

propan-1-ol

and

$CH_3-CH(OH)-CH_3$

propan-2-ol

Functional Group Isomerism

- arises in those molecules having same molecular formulae, but different functional groups.

Example:

$CH_3-CH_2-CH_2-OH$

propan-1-ol

and

$CH_3-O-CH_2-CH_3$

methoxy methane

Metamerism:

- Metamers have same molecular formulae but different structural formulae w.r.t chain length on both sides of a functional group.

Example:

$CH_3-O-CH_2-CH_2-CH_3$

methoxy propane

and

$CH_3-CH_2-O-CH_2-CH_3$

ethoxy ethane

Tautomerism:

- shown by isomers which differ in w.r.t different position of H-atom (mobile H).
- exist in dynamic equilibrium as a result of intermolecular migration of proton.
- Ethyl acetoacetate shows this

Example:

$CH_3-C(=O)-CH_2-C(=O)-O-CH_2-CH_3$ (Keto)

$\rightleftharpoons$

$CH_3-C(OH)=CH-C(=O)-O-CH_2-CH_3$ (enol)

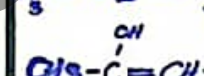
Stereo Isomerism:

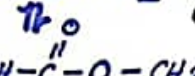
Molecules having same molecular formulae but different structural formula w.r.t arrangement of atoms in space are called stereoisomers.

Optical Isomerism:

- Optical isomers have same molecular formulae but different structural formula w.r.t arrangement of atoms in space.
- shown by molecules having chiral C (C-atom bonded to 4 different atoms or groups of atoms).
- a pair of optical isomers rotates the plane of polarised light either clockwise or anticlockwise by equal amounts.
- also called enantiomers.
- can not be superimposed
- mirror images of each other
- Diastereoisomers are not mirror images of one another.
- The optical activity of a substance is measured by polarimeter. mirror (Lactic acid)

Example:





Geometric Isomerism:

- shown by unsaturated or substituted cyclic compounds having same molecular formula but different arrangement of atoms in space.
- also known as cis-trans isomerism.
- arises due to restricted rotation of atoms or groups of atoms around double bonded C-atoms of the chain or ring.
- A molecule can show this if ① it has different atoms or groups of atoms bonded to C-C double bonds in unsaturated compounds.
② C-C single bond in substituted cyclic compound.
- If same groups are on the same side of double bonds or ring Cs, it is called cis-isomer.
- The isomer which has same groups on opposite sides of double bond or ring Cs is called trans isomer.

Example: