Lecture 9
12.5 Reactions of Organic Compounds

Learning Outcomes:

At the end of the lesson the students should be able to explain the main types of organic reactions:

- addition: electrophilic and nucleophilic
- substitution: electrophilic, nucleophilic and free radical
- elimination
- rearrangement

4 Types of Organic Reactions

- Addition
- Substitution
- Elimination
- Rearrangement

I) Addition Reaction

- A reaction in which atoms or groups ***add*** to adjacent atoms of a multiple bond.
- Two types of addition :-

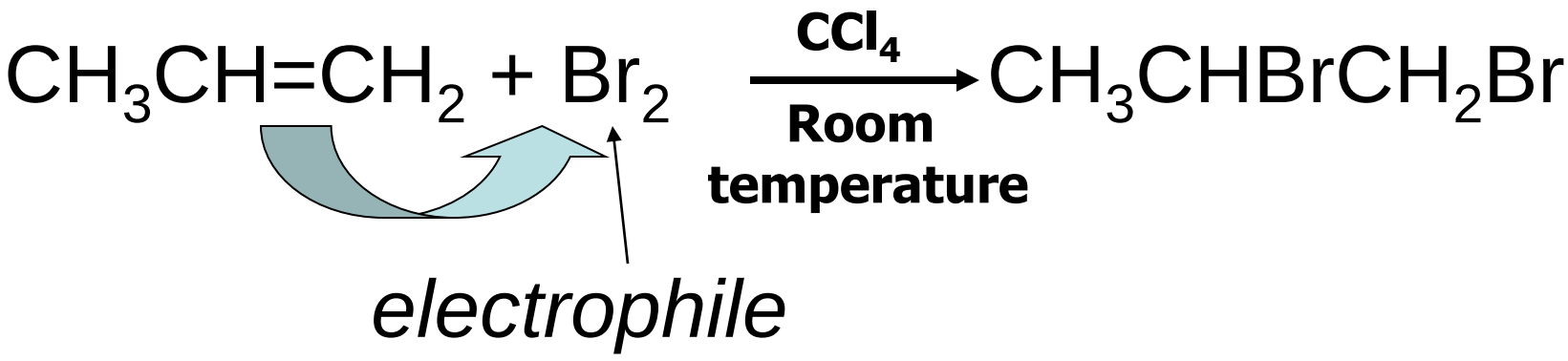
a) Electrophilic Addition

b) Nucleophilic Addition

a)Electrophilic Addition

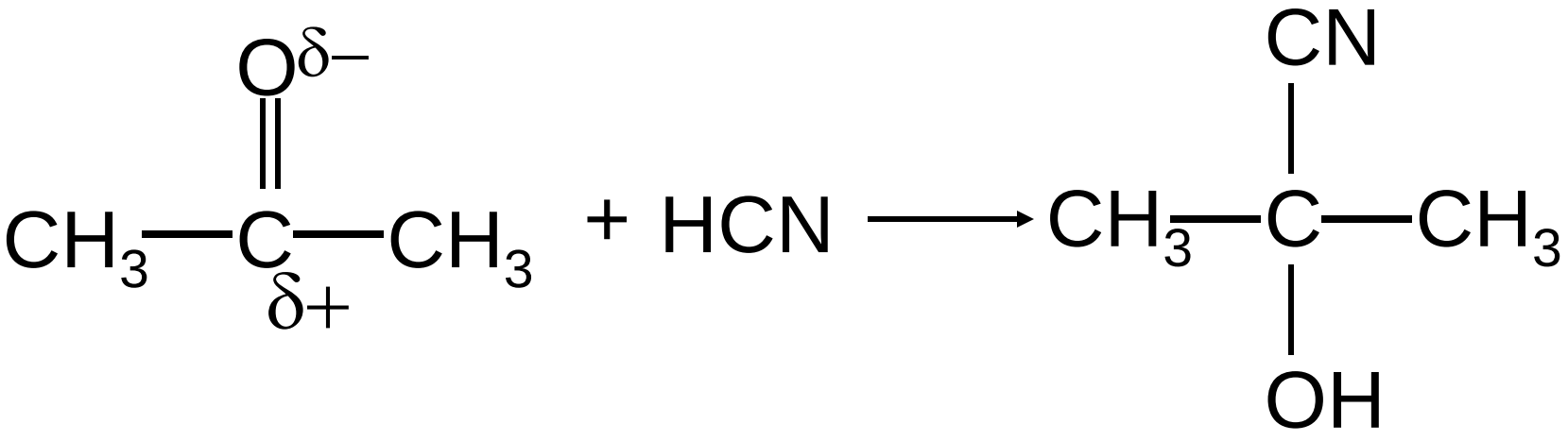
- Initiated by an electrophile accepting electron from an attacking nucleophile.
- Typical reaction of unsaturated compounds such as alkenes and alkynes.

Example :



b) Nucleophilic Addition

- Initiated by a nucleophile, which attacks an electrophilic site of a molecule.
  - Typical reaction of carbonyl compounds.



II) Substitution Reaction

- A reaction in which an atom or group in a molecule is replaced by another atom or group.

- Three types of substitution :-
  a) free radical substitution.
  b) electrophilic substitution.
  c) nuclephilic substitution.

a) Free-radical Substitution

- Substitution which involves free radicals as intermediate species.
- Example :

b) Electrophilic Substitution

- Typical reaction of aromatic compounds.
  - The aromatic nucleus has high electron density, thus it is nucleophilic and is prone to electrophilic attack.

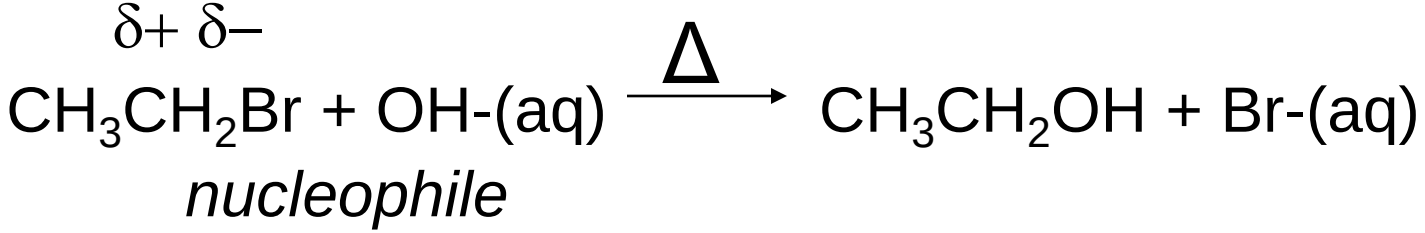
Example:

electrophile

c) Nucleophilic Substitution

Typical reaction of saturated organic compounds bearing polar bond as functional group, such as haloalkane with alcohol.

Example :



III) Elimination Reaction

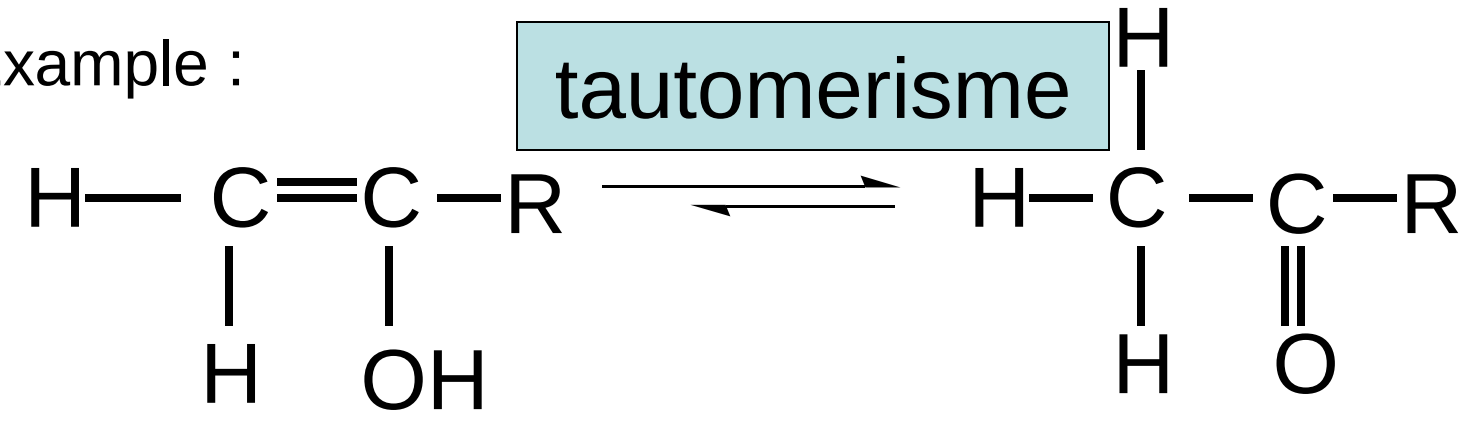
- An atoms or groups are removed from adjacent carbon atoms of a molecule to form a multiple bond (double or triple bond).
- Results in the formation of unsaturated molecules.
- Example :

- $CH_3CH_2OH \xrightarrow[\Delta]{\text{conc. } H_2SO_4} CH_2= CH_2 + H_2O$

IV) Rearrangement Reaction

- A reaction in which atoms or groups in a molecule *change position*.
- Occurs when a single reactant reorganizes the bonds and atoms.

Example :



Exercises

1. Explain how the free radicals are formed in homolytic cleavage.

2. Write an equation for the bromine-bromine bond cleavage in the bromination of methane. State the type of bond cleavage.

3. Which would you expect to be the most stable free radical ?

•CH_2CH_3 , $(CH_3)_2$ CH• , •CH3 ,