

Lecture 8

12.5 Reactions of Organic Compounds

Learning Outcomes:

At the end of the lesson the students should be able to:

- State the relative stabilities of primary, secondary and tertiary free radicals, carbocations and carbanions.
- Explain the inductive effect of alkyl group towards the stability of carbocations and carbanions.
- Define electrophile and nucleophile.

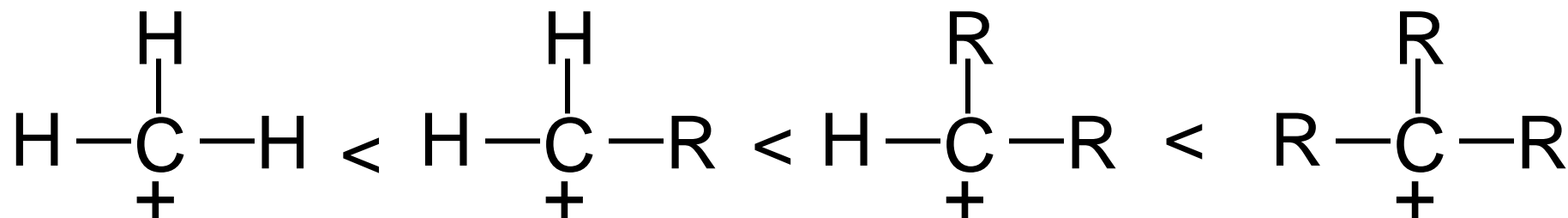
Relative Stabilities of Carbocations, Carbanions and Free Radicals

- Carbocation, carbanion and free radical can be classified into:
 - Primary
 - Secondary
 - Tertiary

Carbocation Stability

- The alkyl groups (electron-releasing group) stabilise the positive charge on the carbocation.
- The stability of carbocation increases with the number of alkyl groups present.

Carbocation Stability:



Methyl
cation

Primary
 1°

Secondary
 2°

Tertiary
 3°

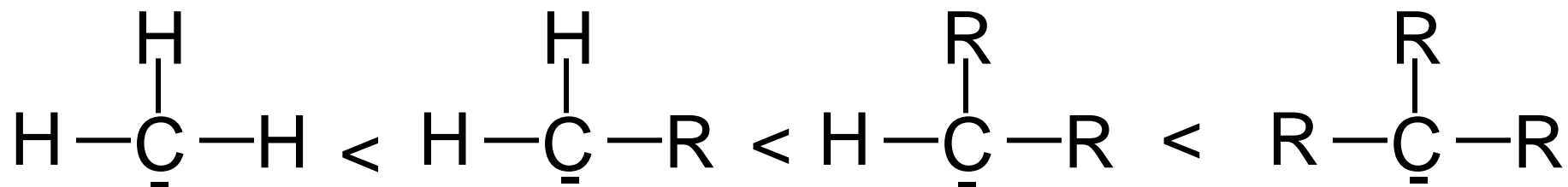


Increasing stability

Carbanion Stability

- o Alkyl group and other electron-donating groups destabilise carbanions.
- o Electron withdrawing group (e.g: halogen) stabilise carbanions through the inductive withdrawal of electron density

Carbanion Stability:



Methyl
anion

Primary
 1°

Secondary
 2°

Tertiary
 3°

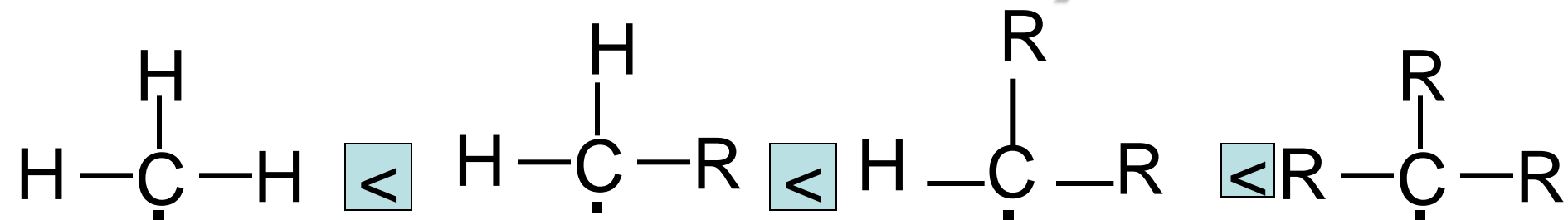


Increasing stability

Free-radical stability

- The stability of free radical increases as more alkyl groups are attached to the carbon atom with unpaired electron.

Free Radical Stability :



methyl
radical

Primary
 1°

Secondary
 2°

Tertiary
 3°



Increasing stability

Reagents and sites of organic reactions

A) Electrophile

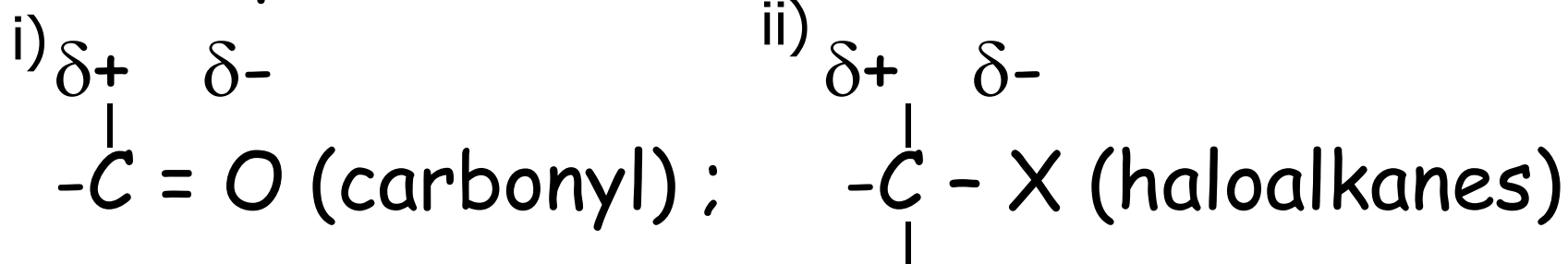
- Means 'electron loving'.
- An electron-deficient species and accepting electron from an attacking nucleophile.
- Can be either neutral or positively charged

Examples of electrophiles :

- cations such as H^+ , H_3O^+ , NO_2^+ etc.
- carbocations.
- Lewis acids such as $AlCl_3$, $FeCl_3$, BF_3 etc.
- oxidizing agents such as Cl_2 , Br_2 and etc.

electrophilic sites are molecules with low electron density around a polar bond

Examples:



- ***b) Nucleophile***
- means 'nucleus loving'
- An electron-rich species and electron-pair donor.
- A nucleophile can be either neutral or negatively charged.

Examples of nucleophiles :

- anions such as OH^- , RO^- , Cl^- , CN^- etc.
- carbanions (species with a negative charge on carbon atoms).