REACTION INTERMEDIATE CARBANION

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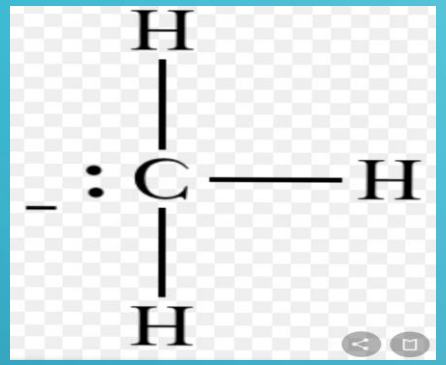
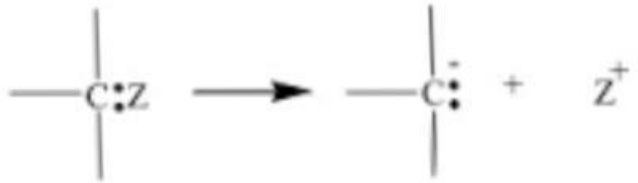
INTRODUCTION

- ANY ORGANIC ION HAVING NEGATIVELY CHARGED CARBON ATOM, CALLED CARBANION. (IN GENERAL, ANIONS WITH UNSHARED PAIR OF ELECTRONS ON A CARBON)
- THEY ARE FORMED BY HETEROLYTIC BOND CLEVAGE OF COVALENT BOND IN WHICH CARBON GAINS BONDING ELECTRON PAIR.

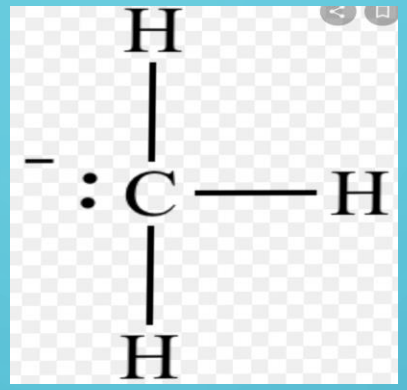
INTRODUCTION





where, Z is less elctronegative than carbon.

INTRODUCTION



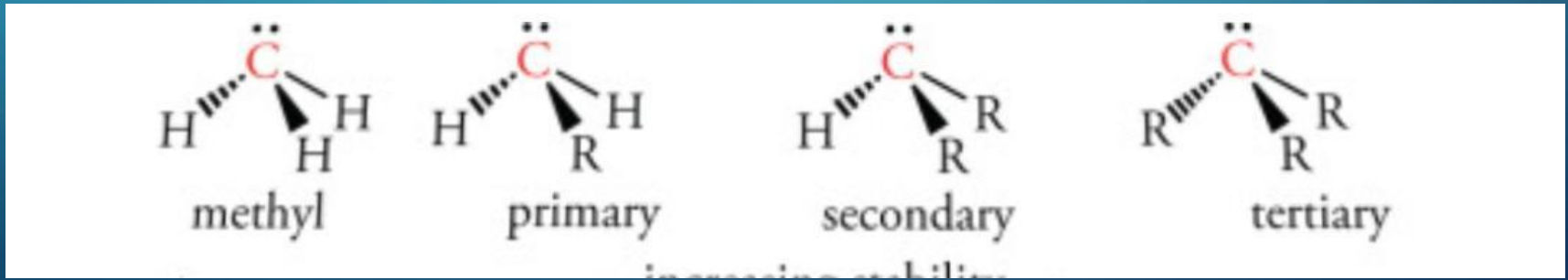
- **Therefore carbanion is an organic anion in which carbon is trivalent and bears a negative charge.**
- CARBANION has total of 8 valence shell electrons so it behaves like nucleophile.

CLASSIFICATION

- CARBANIONS MAY BE CLASSIFIED INTO PRIMARY, SECONDARY AND TERTIARY DEPENDING UPON THE NATURE OF CARBON ATOM BEARING NEGATIVE CHARGE.
- IF ONE CARBON ATOM IS DIRECTLY ATTACHED TO ANIONIC CARBON THEN IT IS CALLED PRIMARY CARBANION.
- IF TWO CARBON ATOMS ARE ATTACHED TO ANIONIC CARBON THEN IT IS CALLED SECONDARY CARBANION.

CLASSIFICATION

- IF THREE CARBON ATOMS ARE DIRECTLY ATTACHED TO ANIONIC CARBON THEN IT IS CALLED TERTIARY CARBANION.
- IF NO CARBON ATOM IS ATTACHED TO ANIONIC CARBON THEN IT IS SIMPLY CALLED METHYL CARBANION.

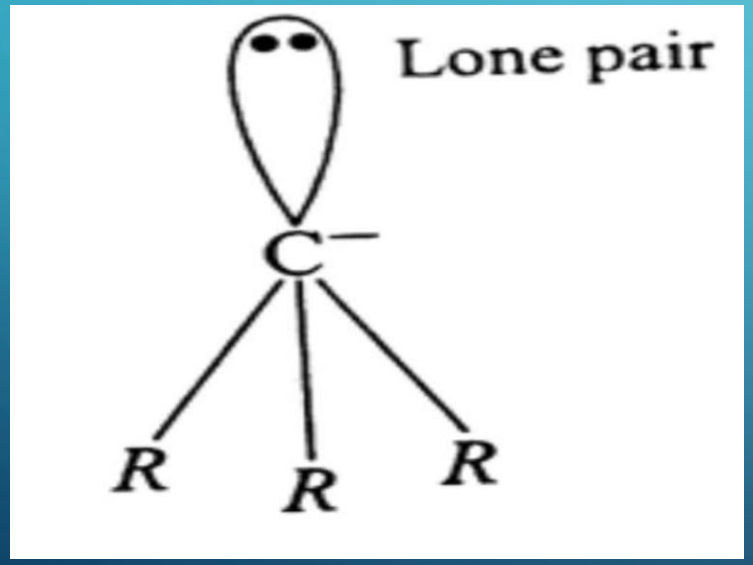


STRUCTURE OF CARBANION

- THE CARBON ATOM OF CARBANION IS **sp3 HYBRIDIZED.**
- **OUT OF FOUR HYBRID ORBITALS THE THREE HYBRID ORBITALS ARE INVOLVED IN FORMATION OF SIGMA BOND, WHEREAS FOURTH HYBRID ORBITAL CONTAINS UNSHARED ELECTRON PAIR, WHICH GIVE NEGATIVE CHARGE TO CARBON ATOM.**

STRUCTURE OF CARBANION

- THEREFORE THE GEOMETRY OF CARBANION WILL BE PYRAMIDAL SIMILAR TO AMMONIA.

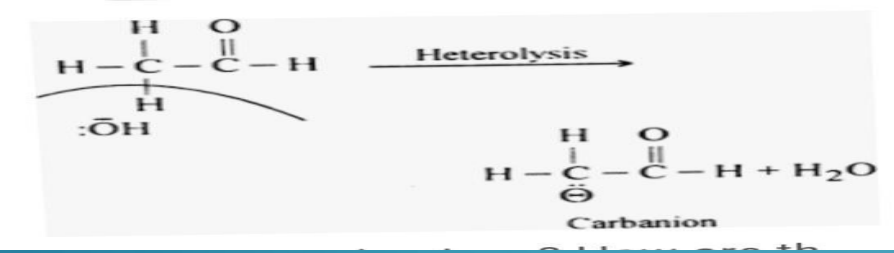


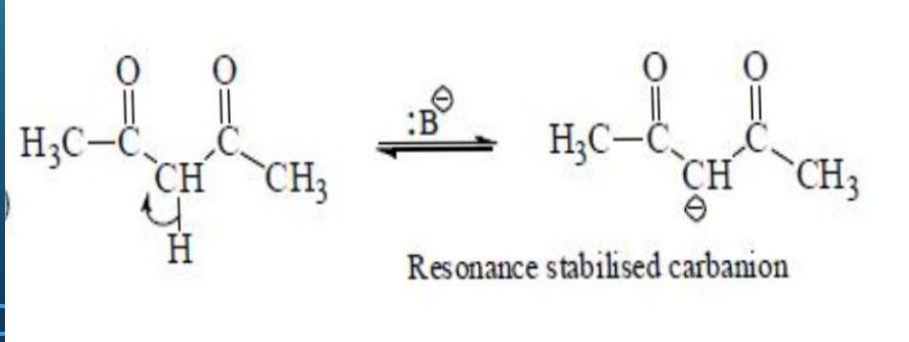
GENERATION OF CARBANION

- IN DIFFERENT REACTIONS THE CARBANIONS ARE GENERATED AS AN REACTION INTERMEDIATE, SOME IMPORTANT REACTIONS ARE :
- 1. BY ABSTRACTION OF PROTON
- 2. BY DECARBOXYLATION
- BY ORGANOMETALLIC COMPOUNDS

BY PROTON ABSTRACTION

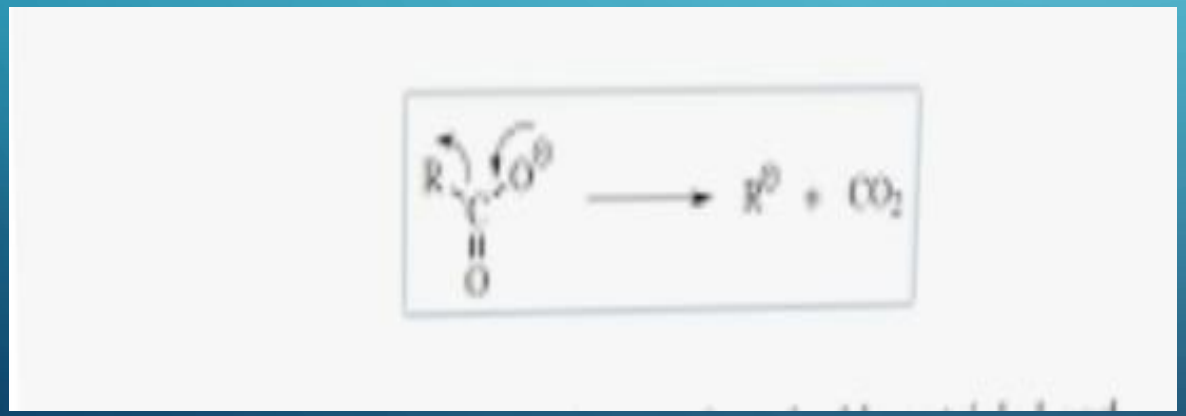
- THE BASE CAN ABSTRACT A PROTON FROM THE SUBSTRATE TO PRODUCE STABLE CARBANION. FOR EXAMPLE :





BY DECARBOXYLATION

- CARBANIONS MAY BE GENERATED BY DECARBOXYLATION OF CARBOXYLATE ION. FOR EXAMPLE :



BY ORGANOMETALLIC COMPOUNDS

- Organometallic compounds are those compounds in which carbon atom is directly bonded to Metal atom.
- The partial negative charge on Carbon bonded to a highly active metal results in greater reactivity that is referred to as nucleophilic or carbanion character.

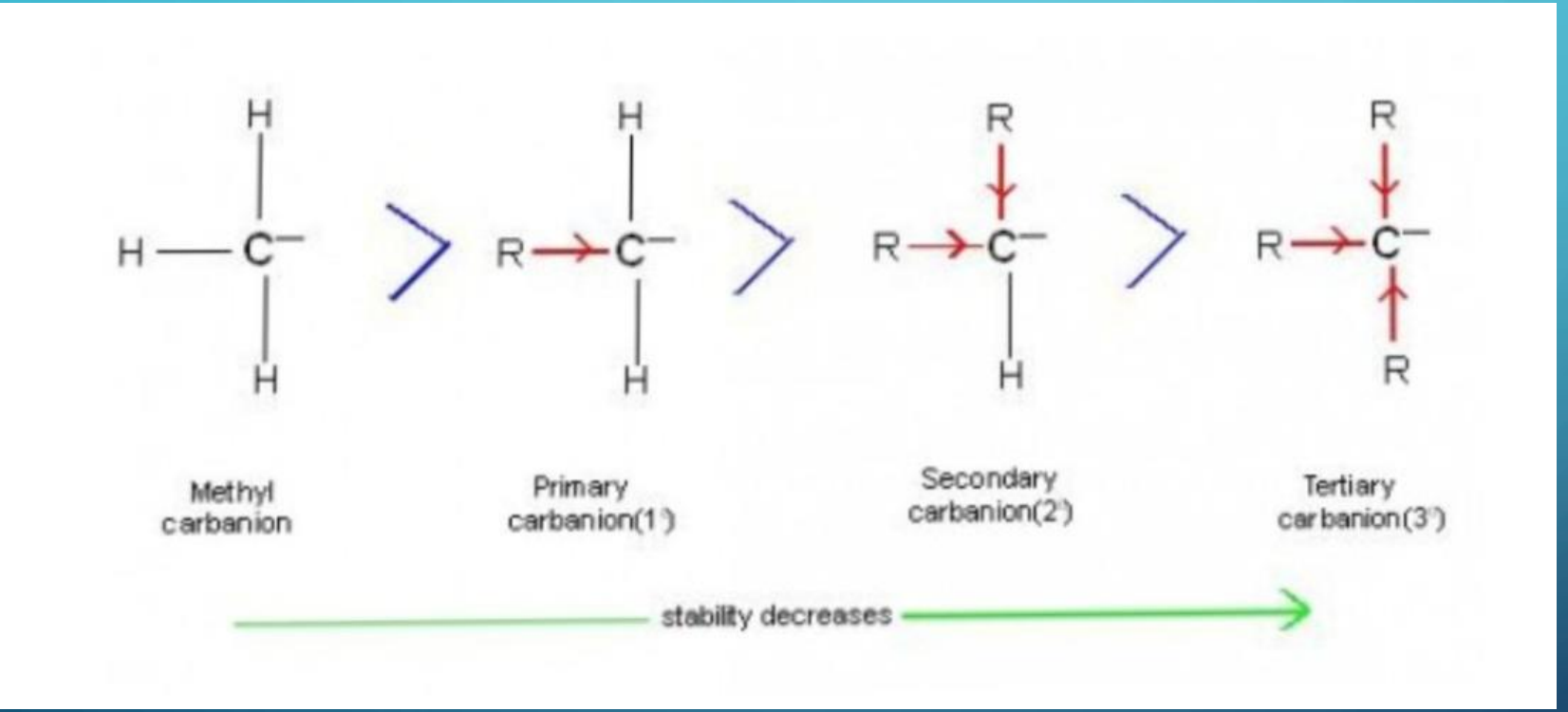
STABILITY OF CARBANIONS

- ANY STRUCTURAL FEATURES WHICH DISPERSE THE NEGATIVE CHARGE OF THE CARBANION WILL INCREASE ITS STABILITY. SOME IMPORTANT FACTORS ARE GIVEN BELOW :
- 1. BY INDUCTIVE EFFECT
- 2. BY RESONANCE
- 3. BY AROMATISATION
- 4. BY % s-Character

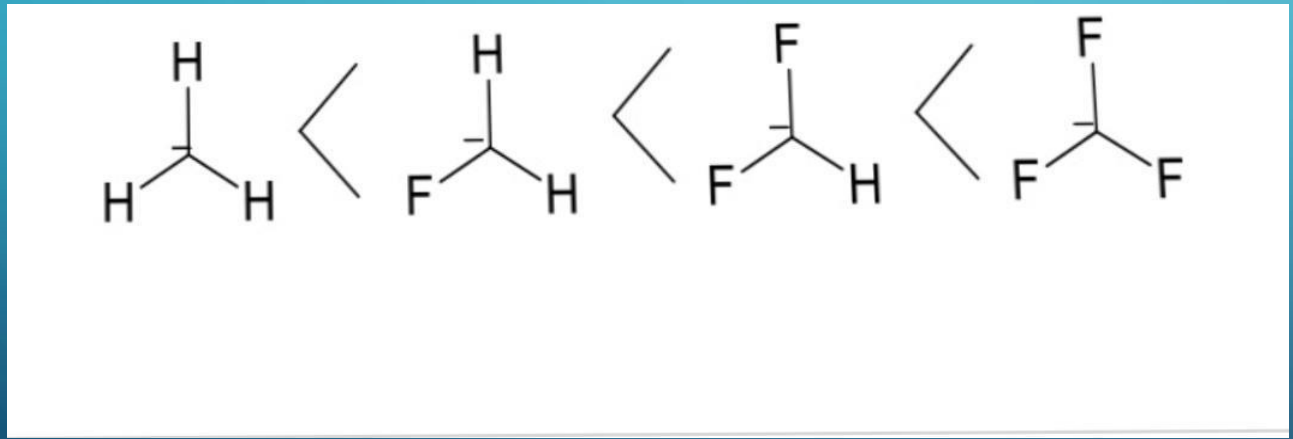
BY INDUCTIVE EFFECT

- IF +I EFFECT GROUP ATTACHED TO THE ANIONIC CARBON THEN IT DECREASES ITS STABILITY BECAUSE IT INCREASES THE ELECTRON DENSITY ON ANIONIC CARBON.
- IF – I EFFECT GROUP ATTACHED TO THE ANIONIC CARBON THEN IT INCREASES ITS STABILITY BECAUSE IT DECREASES ELECTRON DENSITY ON ANIONIC CARBON.

BY INDUCTIVE EFFECT (+I)



BY INDUCTIVE EFFECT(-I)

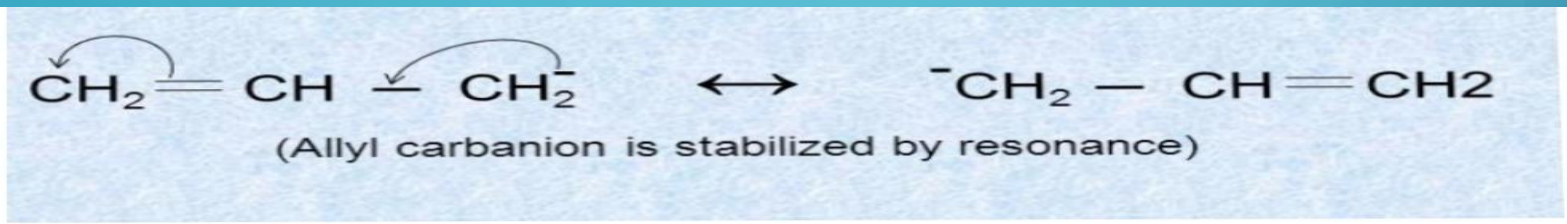


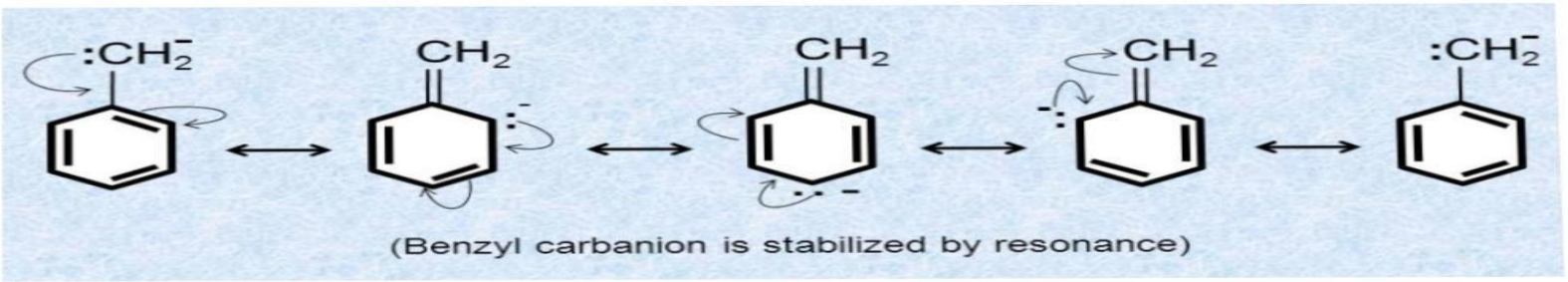
BY RESONANCE EFFECT

- THE UNSATURATED CONJUGATED CARBANIONS ARE STABILISED BY RESONANCE.
- SUCH CARBANIONS ARE MORE STABLE THAN THE SATURATED CARBANIONS.

BY RESONANCE EFFECT

- MORE THE NUMBER OF RESONATING STRUCTURES MORE WILL BE THE STABILITY OF CARBANION.

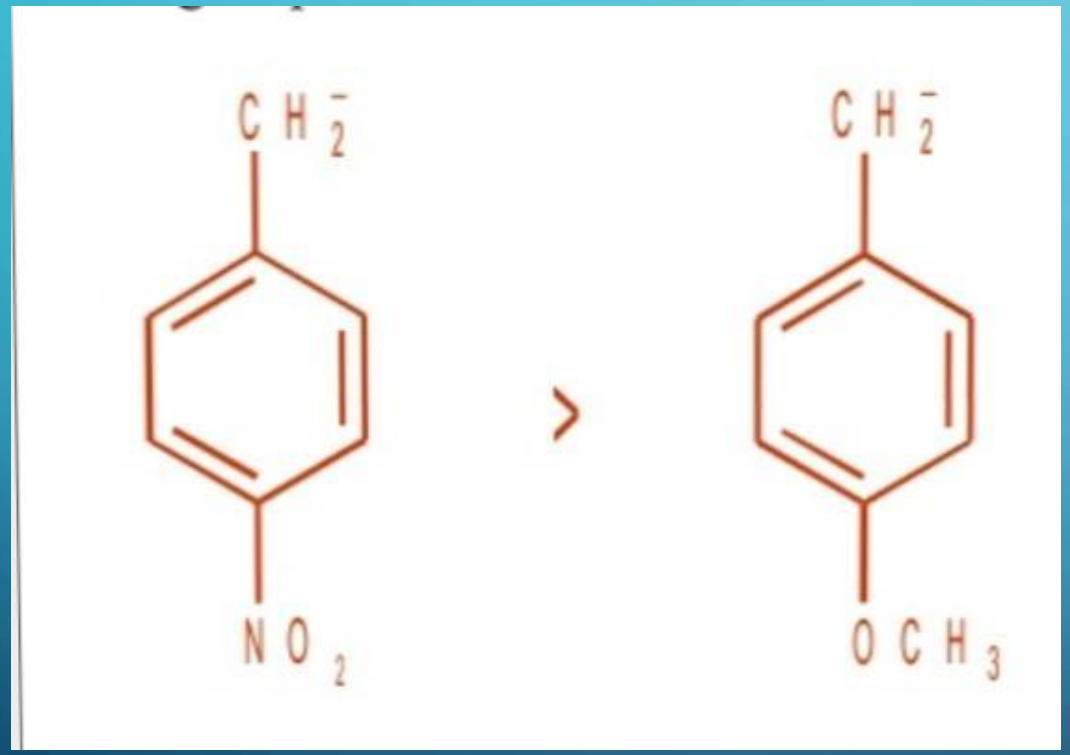




EFFECT OF SUBSTITUENT ON THE AROMATIC RING

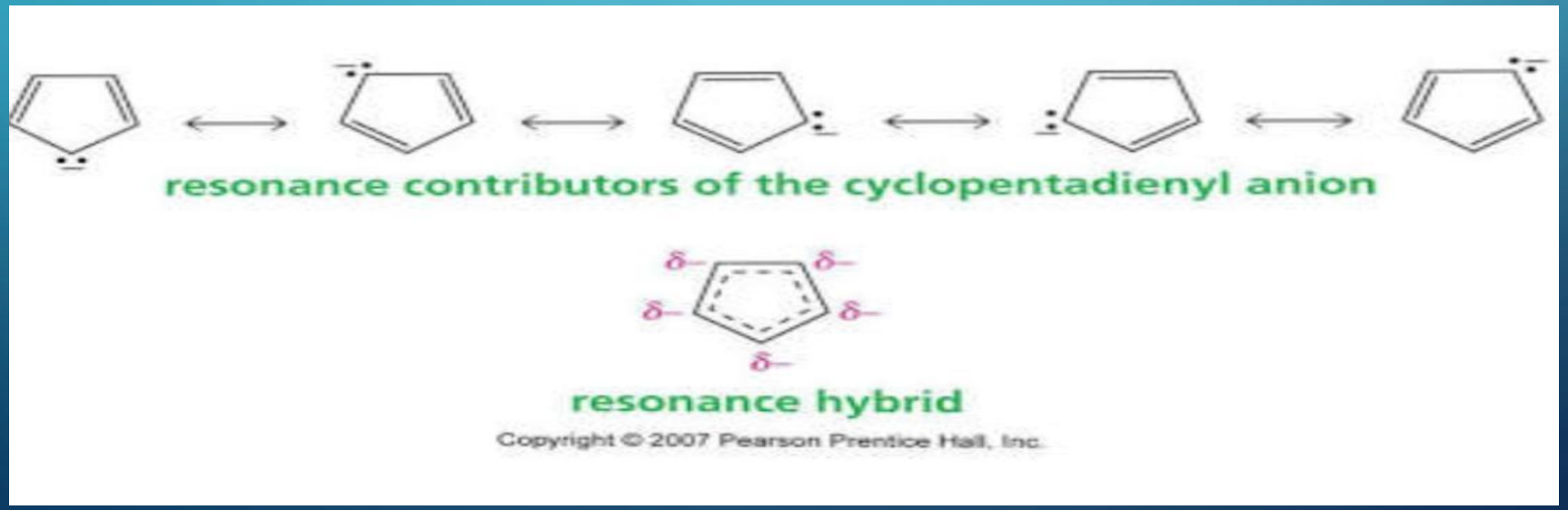
- IF THE ELECTRON RELEASING GROUP ATTACHED TO AROMATIC RING OF BENZYL CARBANION THEN THE STABILITY DECREASES. EXAMPLE : METHYL GROUP, METHOXY GROUP ETC.
- IF THE ELECTRON WITHDRAWING GROUP ATTACHED TO AROMATIC RING OF BENZYL CARBANION THEN THE STABILITY INCREASES. EXAMPLE : NITRO GROUP

EXAMPLE



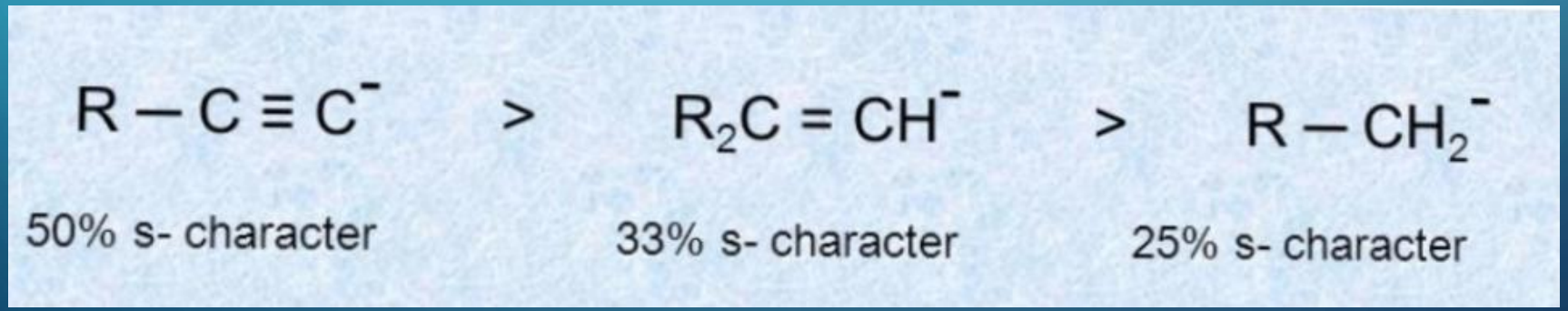
BY AROMATISATION

- THE CYCLIC CONJUGATED CARBANIONS WHICH OBEY HUCKEL'S RULE OF AROMATICITY WILL BE MORE STABLE BECAUSE THEY ATTAIN AROMATIC CHARACTER DUE TO NEGATIVE CHARGE ON CYCLIC CARBON. FOR EXAMPLE : CPD ANION



BY % S- CHARACTER

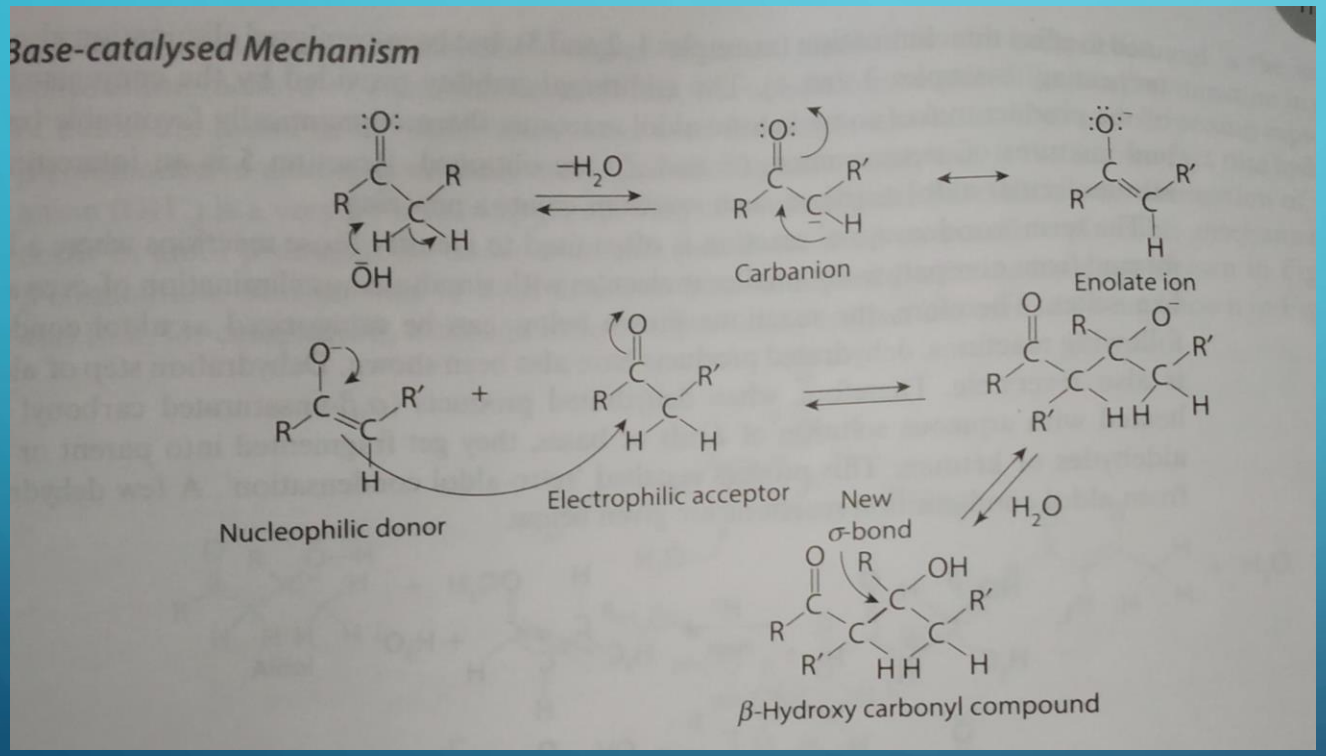
- THE STABILITY OF CARBANION INCREASES WITH THE INCREASE IN % OF S-CHARACTER OF ANIONIC CARBON. FOR EXAMPLE : THE ORDER OF STABILITY OF DIFFERENT CARBANION HAVING DIFFERENT S-CHARACTER OF ANIONIC CARBON.



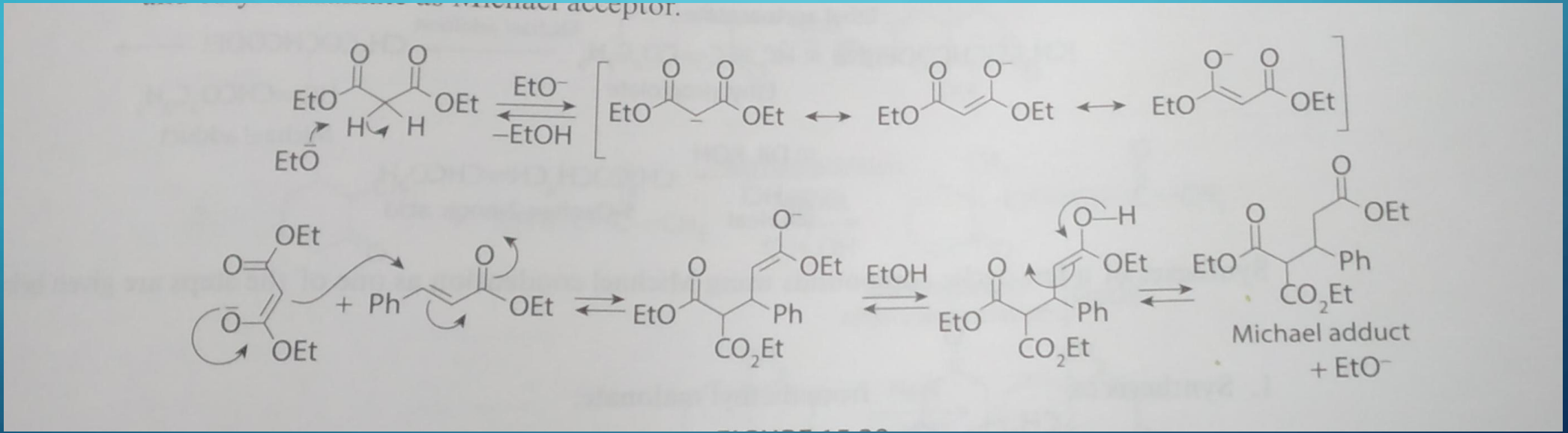
REACTION INVOLVING CARBANION

- THERE ARE VARIOUS ORGANIC REACTIONS WHICH INVOLVE CARBANION AS REACTION INTERMEDIATE. FOR EXAMPLE :
- 1. ALDOL CONDENSATION
- 2. MICHAEL ADDITION
- 3. BENZOIN CONDENSATION
- 4. REACTIONS INVOLVING GRIGNARD REAGENT

ALDOL CONDENSATION



MICHAEL ADDITION



REFERENCES

- 1. REACTION MECHANISMS IN ORGANIC CHEMISTRY BY SUBRATA SEN GUPTA, OXFORD UNIVERSITY PRESS
- 2. STRUCTURES AND REACTIONS ARE COPIED FROM INTERNET.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