




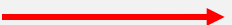
Introduction to the Organic Chemistry

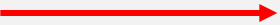
Electron arrays of some basic elements

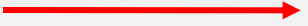
Valence Electrons

H (Hydrogen): $1s^1$  1

C (Carbon): $1s^2 2s^2 2p^2$  4

N (Nitrogen): $1s^2 2s^2 2p^3$  5

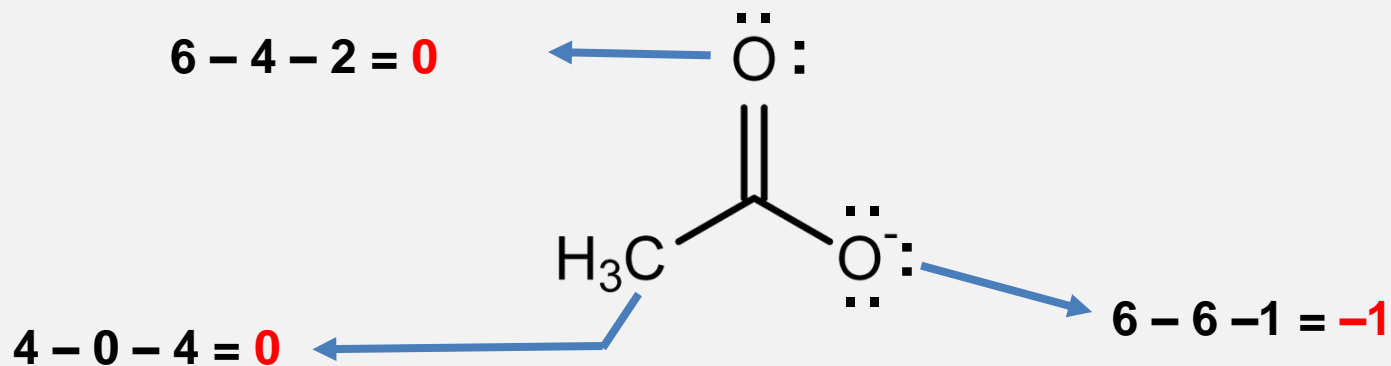
O (Oxygen): $1s^2 2s^2 2p^4$  6

F (Fluoro) : $1s^2 2s^2 2p^5$  7

Valence electrons are the electrons present in the outermost shell of an atom.

Formal Charges

$$\text{Formal charge} = (\text{Group number}) - \left(\begin{array}{c} \text{number of electrons} \\ \text{in lone pairs} \end{array} \right) - \left(\begin{array}{c} \text{number of} \\ \text{covalent bonds} \end{array} \right)$$




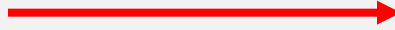
Electronegativity

Electronegativities generally increase from left to right across a period and decrease down a group.

electropositive elements



Metals of Group I and Group II tends to give electrons



IA	IIA		IIIA	IVA	VA	VIA	VIIA
H 2.3							
Li 1.0	Be 1.5		B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2		Al 1.5	Si 1.8	P 2.2	S 2.5	Cl 3.0
K 0.8							Br 2.8
Rb 0.8							I 2.5
Cs 0.7							

İndüktif Etki

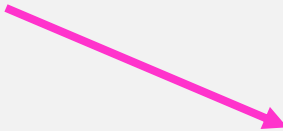
The inductive effect: Effect on electron density in one portion of a molecule due to electron-withdrawing or electron-donating groups elsewhere in the molecule.

Substituents with -I inductive effects

If an element is more electronegative from hydrogen, the inductive effect of the element is (-) and is shown as -I.

$-\overset{\oplus}{\text{N}}\text{H}_3$	$-\text{F}$
$-\overset{\oplus}{\text{N}}\text{R}_3$	$-\text{Cl}$
$-\text{NO}_2$	$-\text{Br}$
$-\text{CN}$	$-\text{OH}$
$-\text{COOH}$	$-\text{OR}$
$-\text{COOR}$	$-\text{SH}$
$-\text{CHO}$	$-\text{SR}$
$-\text{C}=\text{CH}_2$	$-\text{C}\equiv\text{CH}$

Alkyl groups and alkali metals (Li, Mg) show **+I inductive effect**.



Less electronegative than hydrogen (electropositive)

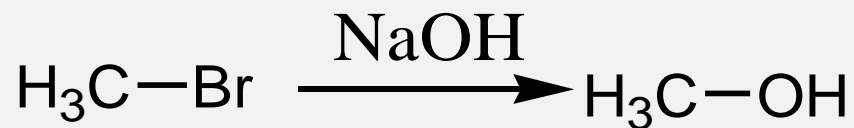
Substituents with +I inductive effects



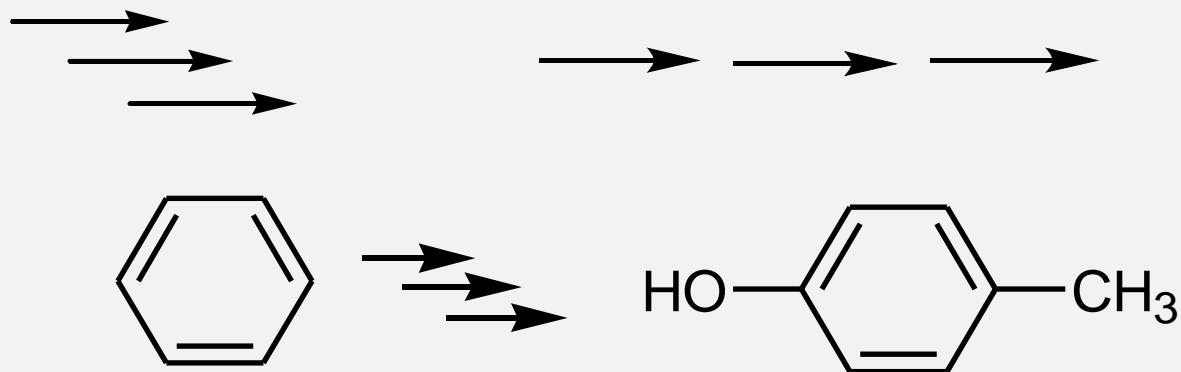
An **inductive effect** is an electronic effect due to the polarisation of only σ **bonds** within a molecule or ion.

Various Arrow Used in Organic Chemistry

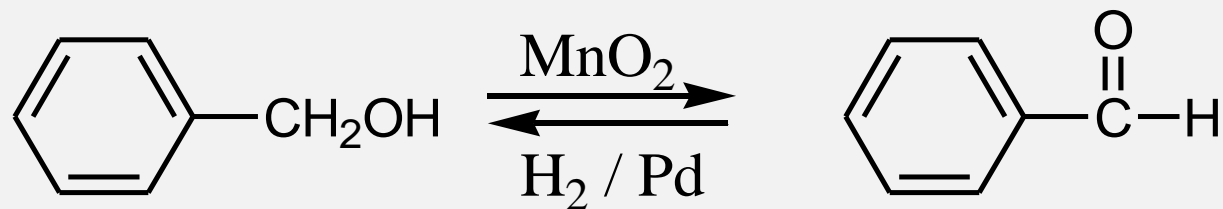
1) For a one-step reaction



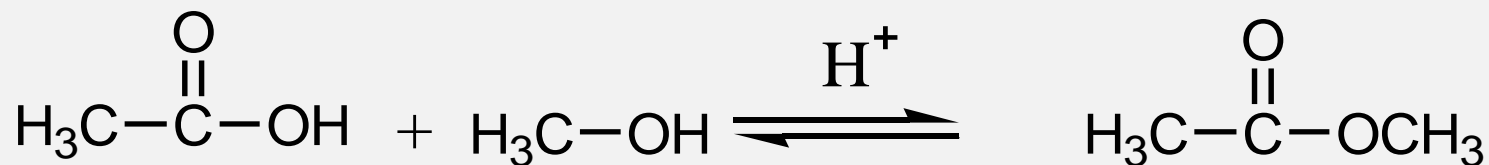
2) In order to achieve the final product in more than one step,



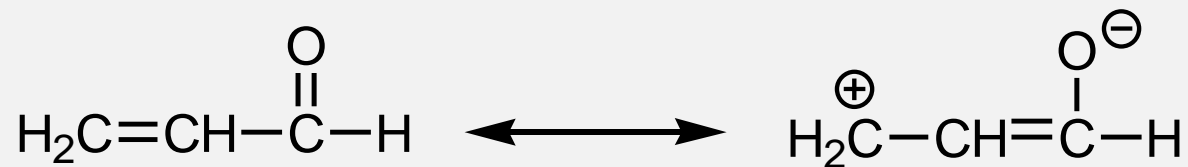
- 3) In order to show that the final product can be synthesized from starting compound or the starting compound can be obtained from final product by using different reagents in a one-step reaction equation.



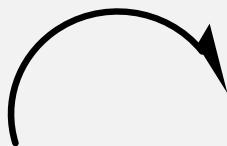
4) Equilibrium reactions



5) Mesomers (Resonance)



6) Direction of movement of an electron

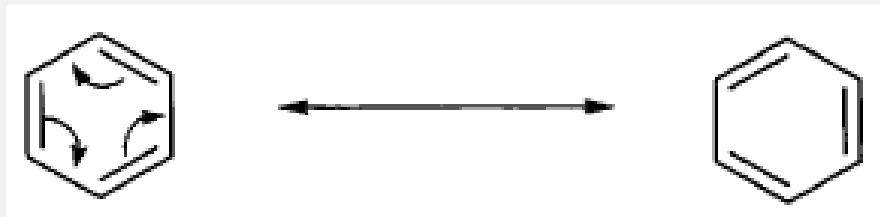


7) Direction of movement of two electrons

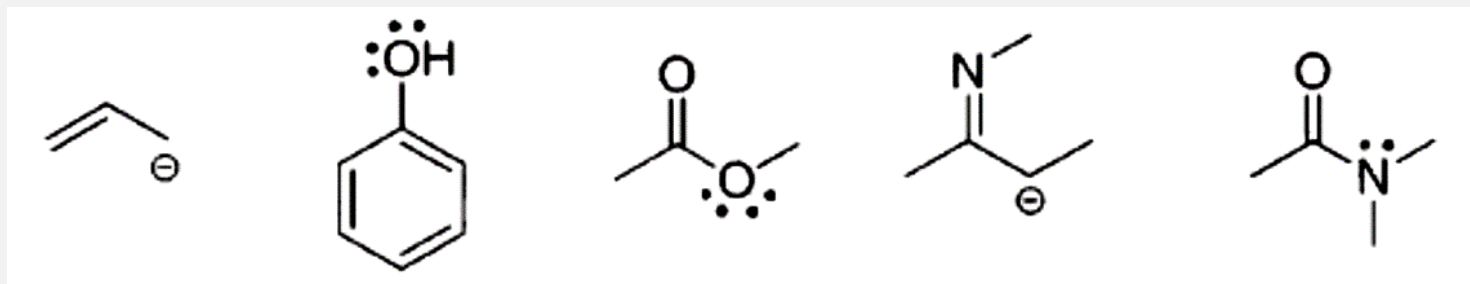


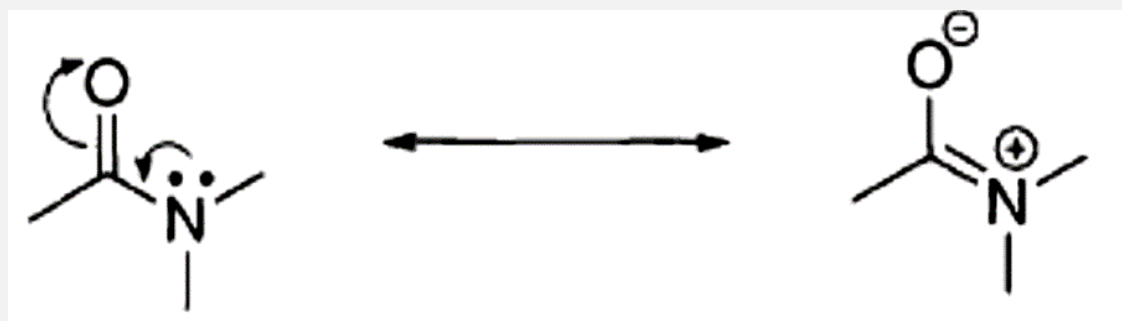
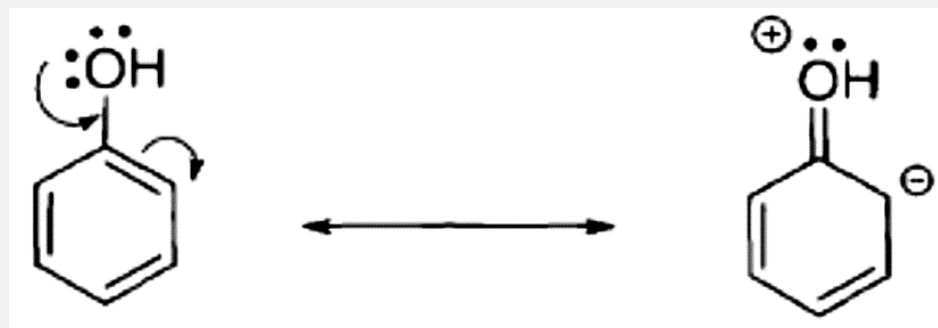
Mesomerism (Resonance)

1) Compounds with conjugated π bonds

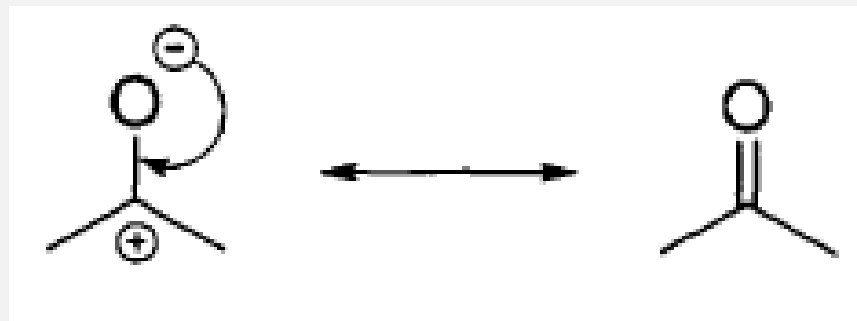
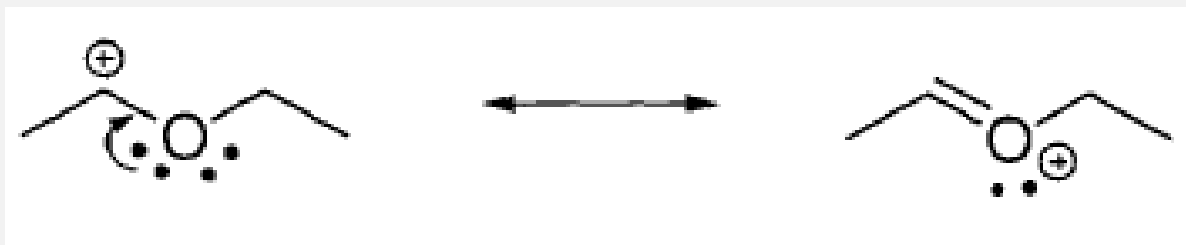


2) Compounds bearing the unpaired electron pair on the atom adjacent to the π bond

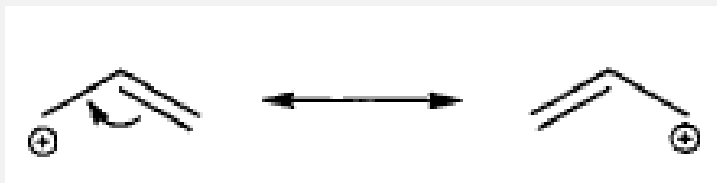




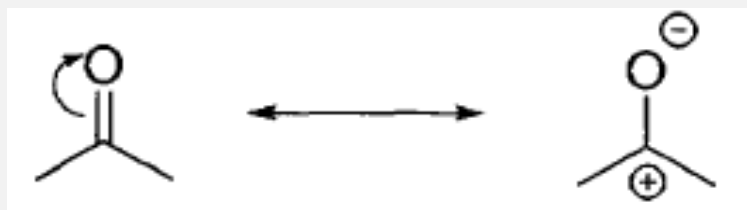
3) Compounds bearing unpaired electron pair on an atom adjacent to a positively charged carbon



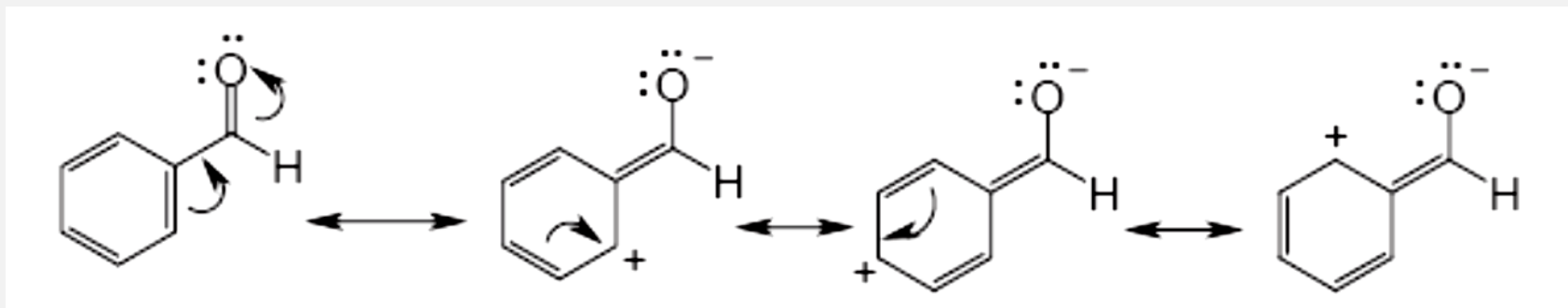
4) The presence of a π bond (or conjugate π bonds) adjacent to the positive charge



5) The presence of a π bond between two different atoms



Benzaldehyde molecule:



-M effect

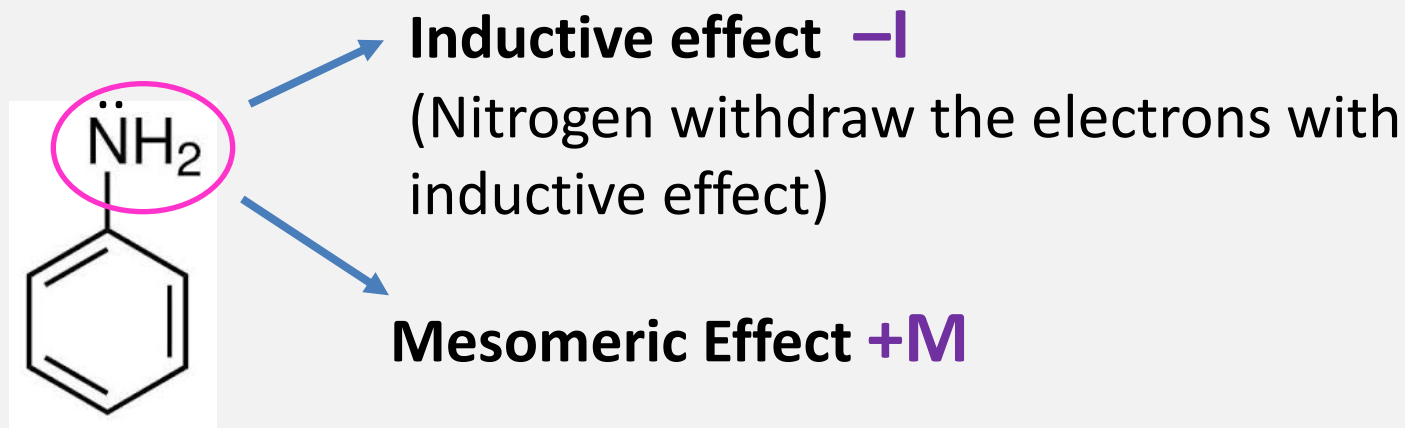
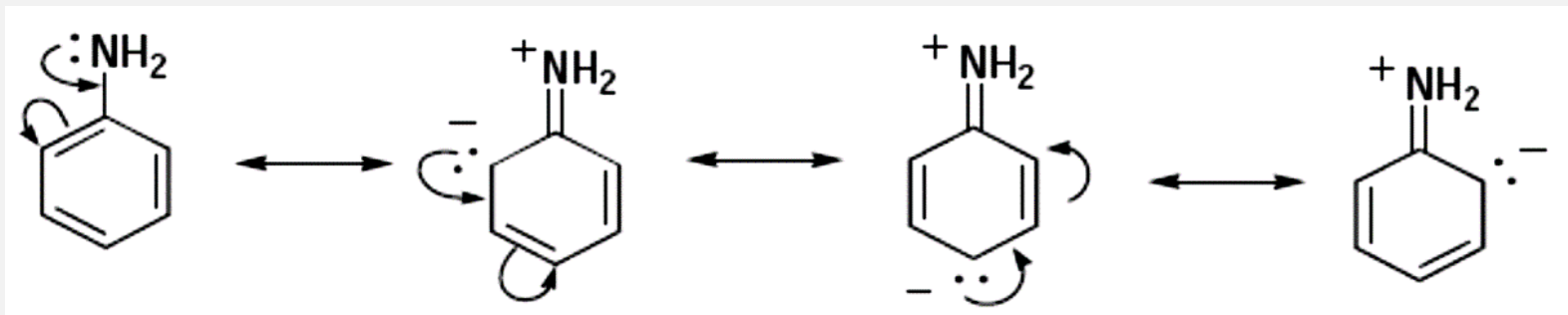


the electrophilic substitution reaction takes place at the position of *meta*

Substituents with -M Effect

—C(=O)H	—C(=NH)H
—C(=O)R	$\text{—C}\equiv\text{N}$
—C(=O)Cl	$\text{—N}^+\text{(=O)}_2^-$
—C(=O)OH	$\text{—S(=O)}_2\text{CH}_3$
—C(=O)OR	$\text{—S(=O)}_2\text{OH}$
—C(=O)NH_2	

Substituents with -M Effect



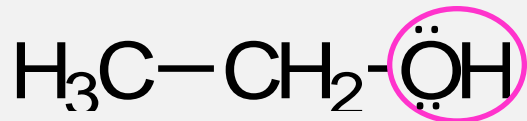
The mesomeric effect is dominant from the inductive effect and the electrophilic substitution reaction occurs in *ortho*, *para* positions.

Substituents with +M Effect

Groups with + M effect active groups are usually heteroatoms with free electrons in their outer orbit.

<u>-OH</u>	<u>-F</u>
<u>-OR</u>	<u>-Cl</u>
<u>-NH₂</u>	<u>-Br</u>
<u>-SH</u>	<u>-I</u>
<u>-SR</u>	

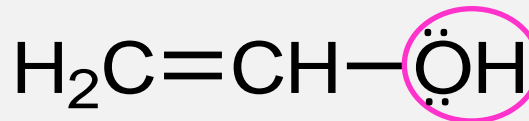
Etil alkohol



Since the electronegativity of oxygen atom is greater than carbon, the inductive effect of the hydroxyl substituent is $-I$ inductive effect

There is no mesomeric effect since there is no π bond or empty p orbital.

Hidroksieten

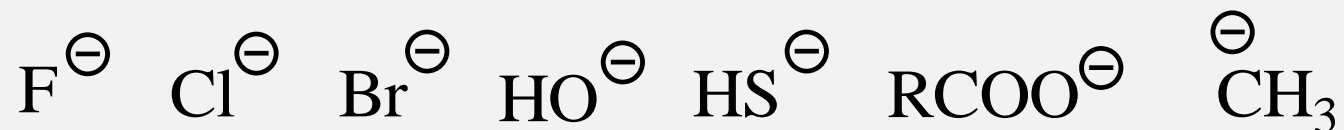


Since a pair of unpaired electrons on the O atom are jointly used with the π bond, the mesomeric effect is $+M$

Nucleophiles

A nucleophile is a chemical species that donates an electron pair to an electrophile to form a chemical bond in relation to a reaction.

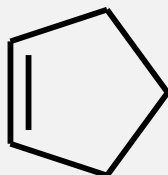
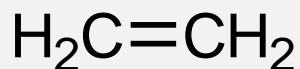
a) Anion: An anion may be defined as an atom or molecule that is negatively charged.



b) Lewis bases: A Lewis base is a compound that has an electron pair.



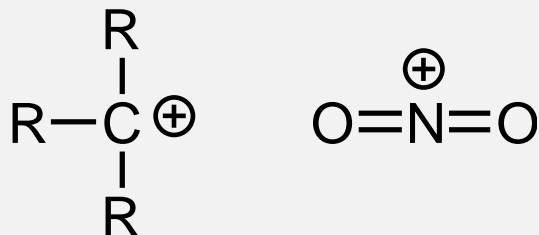
c) Double bond between carbon-carbon



Electrophile

Electrophiles are positively charged or neutral species having vacant orbitals that are attracted to an electron rich centre. It participates in a chemical reaction by accepting an electron pair in order to bond to a nucleophile.

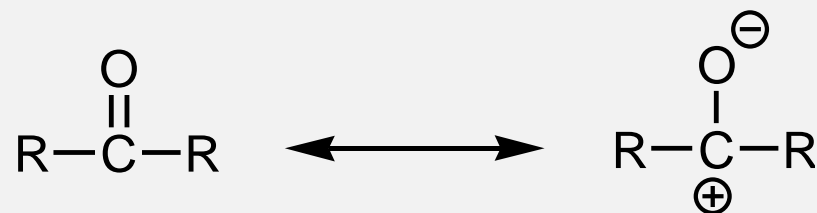
a) Cations:



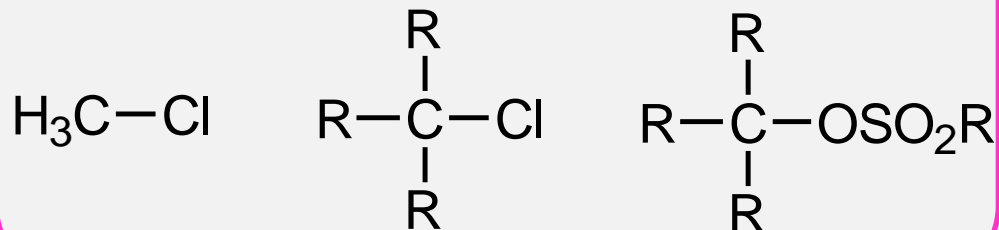
b) Lewis acide:



c) Carbon of carbonyl:



d) Compounds with bond polarisation



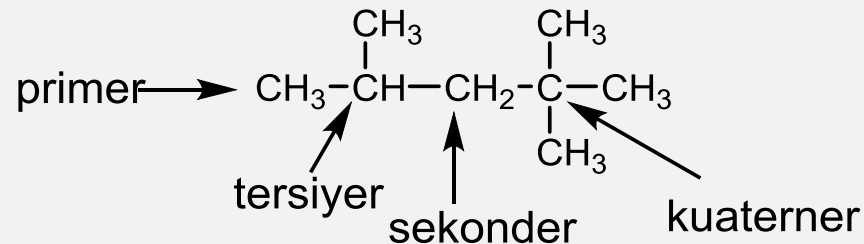
Primary, Secondary, Tertiary ve Quaterner Terms

If the carbon atom bound to one carbon atom, it is **primer**,

If the carbon atom bound to two carbon atom, it is **seconder**,

If the carbon atom bound to three carbon atom, it is **tertiary**,

If the carbon atom bound to four carbon atom, it is **quaterner**,

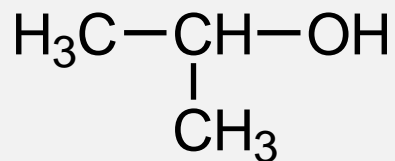


Primary, Secondary, Tertiary ve Quaterner Terms

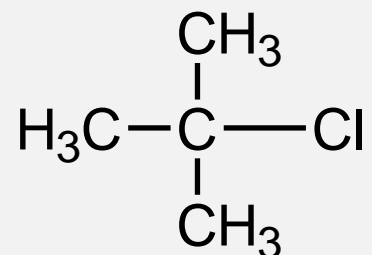
In alkyl halides and in alcohols, the number of alkyl groups attached to the carbon atom to which the substituent is attached is checked.



Primary alkyl halides



Secondary alcohol



Tertiary alkyl halides

Primary, Secondary, Tertiary ve Quaterner Terms

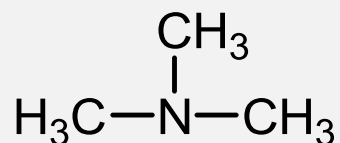
- In amines, the number of alkyl groups attached to the nitrogen is checked.



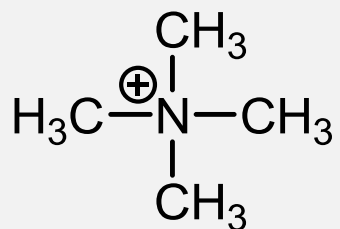
Primary amine



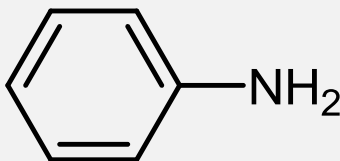
Secunder amine



Tertiary amine



Quaterner amine



Primary aromatic amine

Classification of Organic Reactions

Organic reactions are classified as following:

A) Radical Reactions

a- Radical substitution (S_R)

b- Radical addition (A_R)

B) Ionic Reactions

a- Substitution reactions (S)

b- Addition reactions (A)

c- Elimination reactions (E)

C) Transposition Reactions

Substitution Reactions (S)

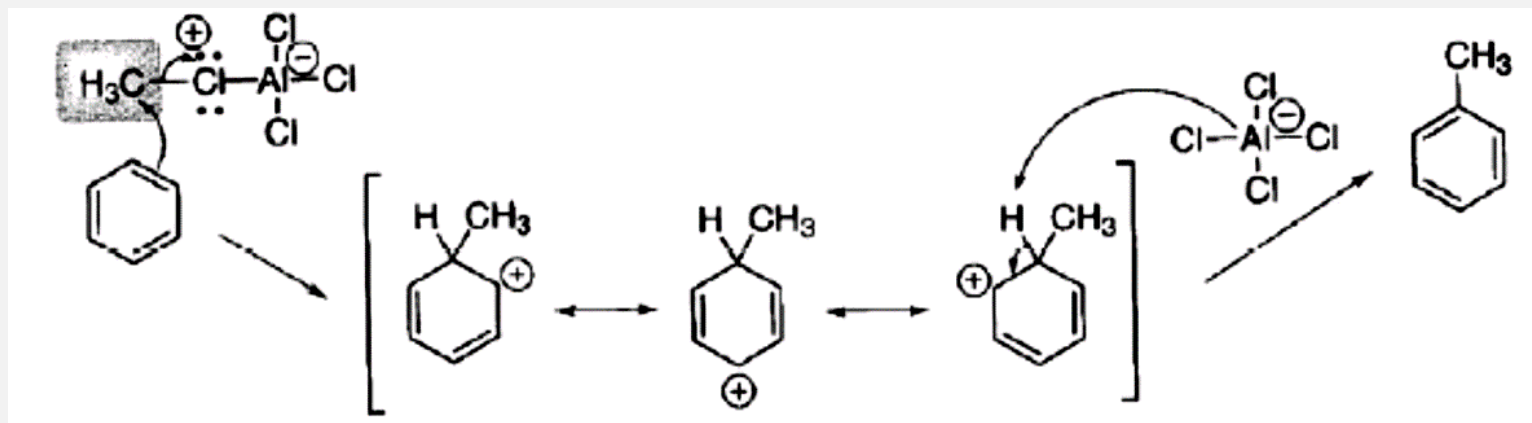
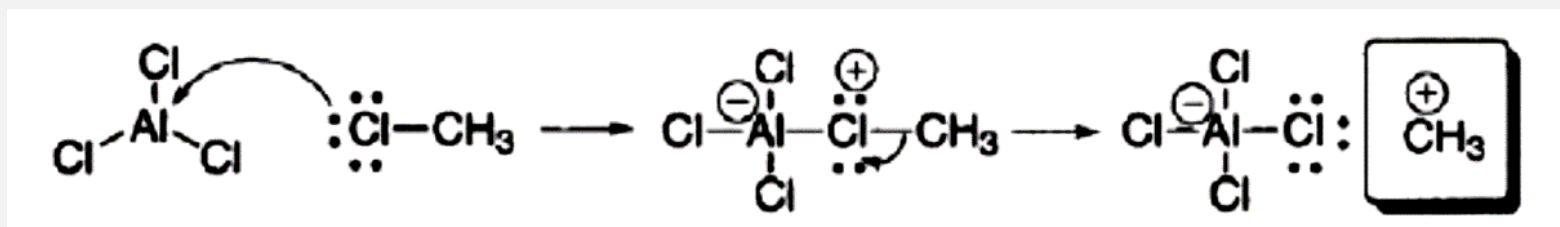
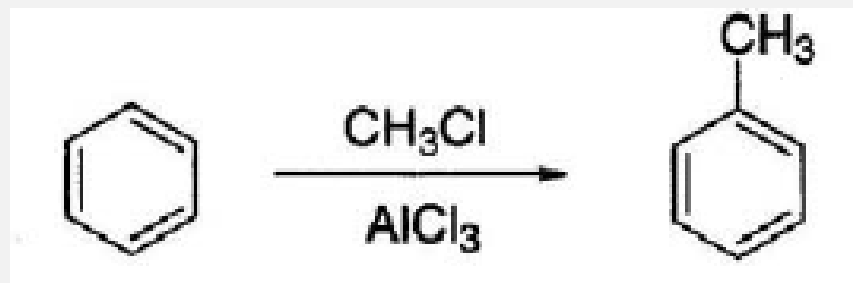
Substitution reaction is a chemical reaction during which one functional group in a chemical compound is replaced by another functional group. There are two types, electrophilic and nucleophilic.

Electrophilic Substitution (SE)

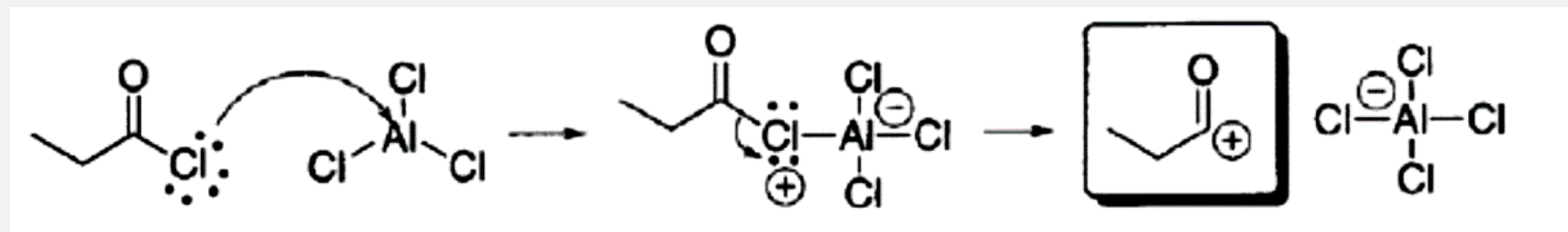
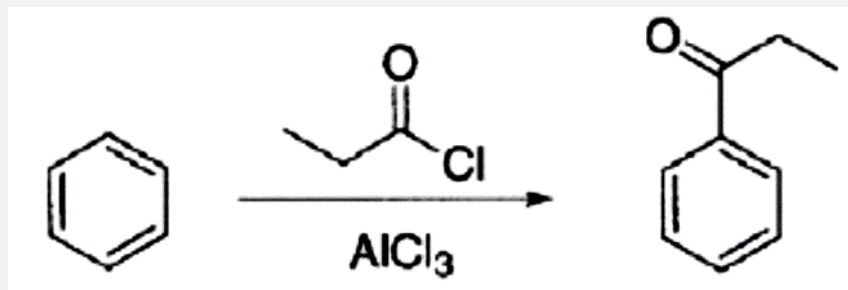
These reactions are usually substitutions in aromatic structures and occur in three steps.

1. Formation of electrophilic unit
2. Addition of electrophilic unit to aromatic ring and re-aromatisation of ring
3. neutralisation of leaving proton

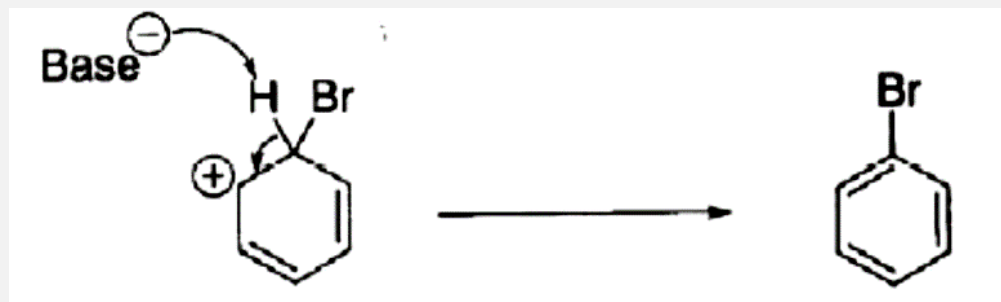
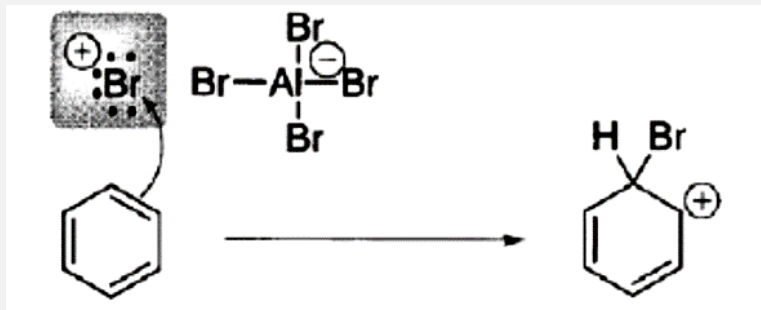
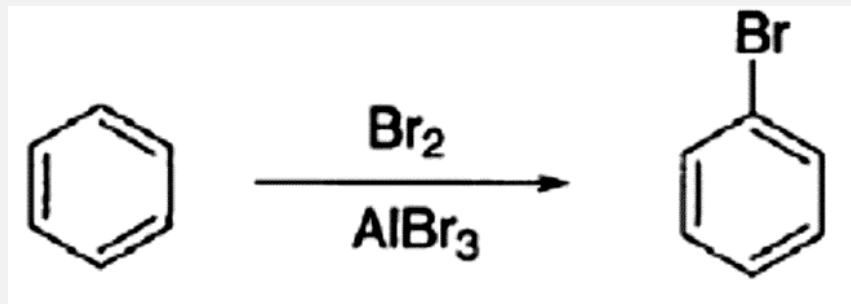
Friedel-Crafts Alkylation



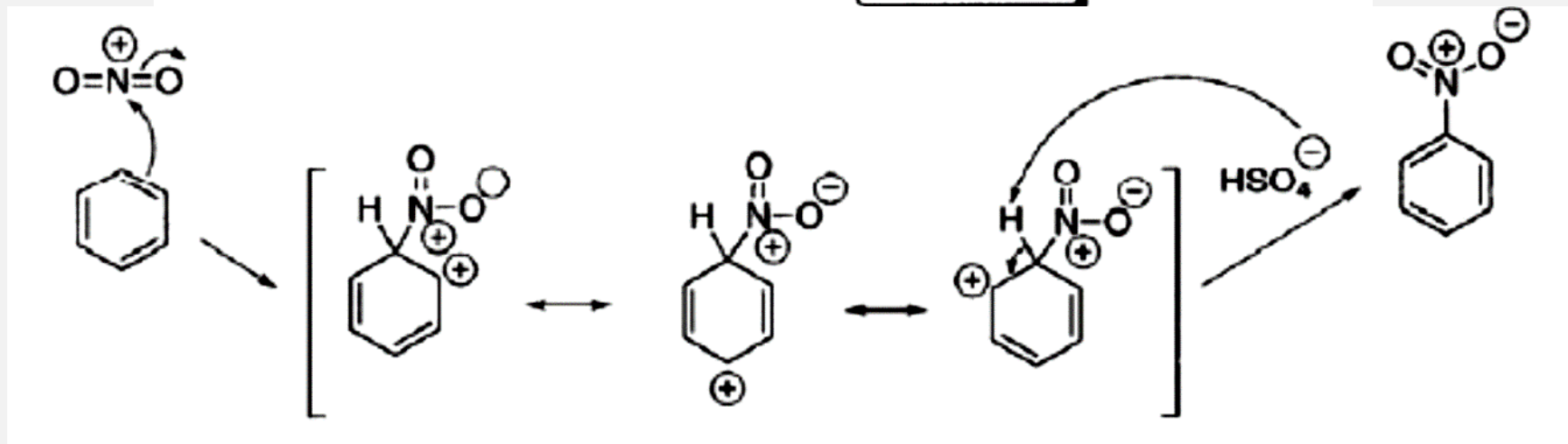
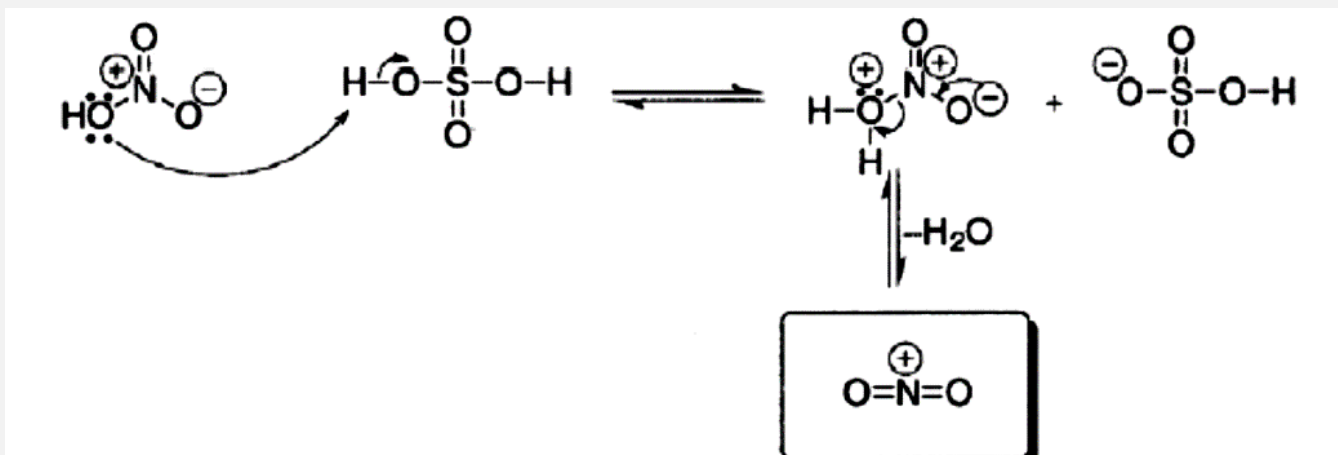
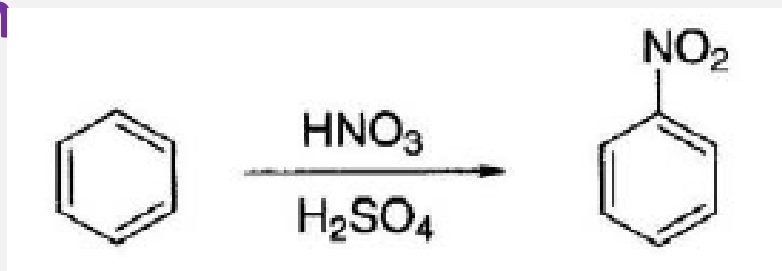
Friedel-Crafts Acylation



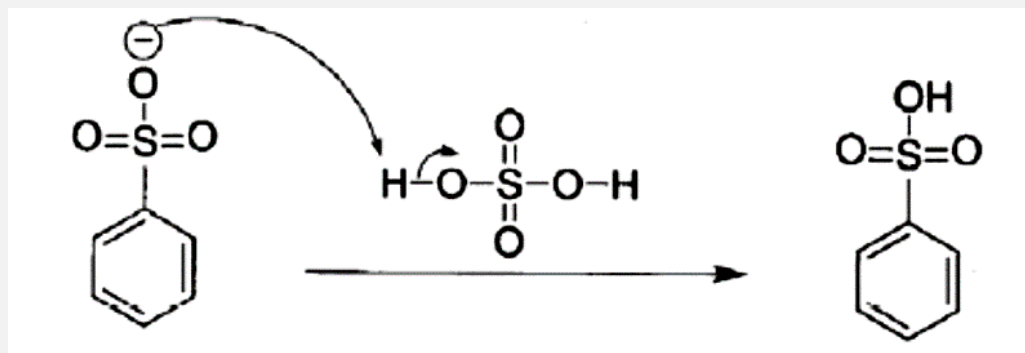
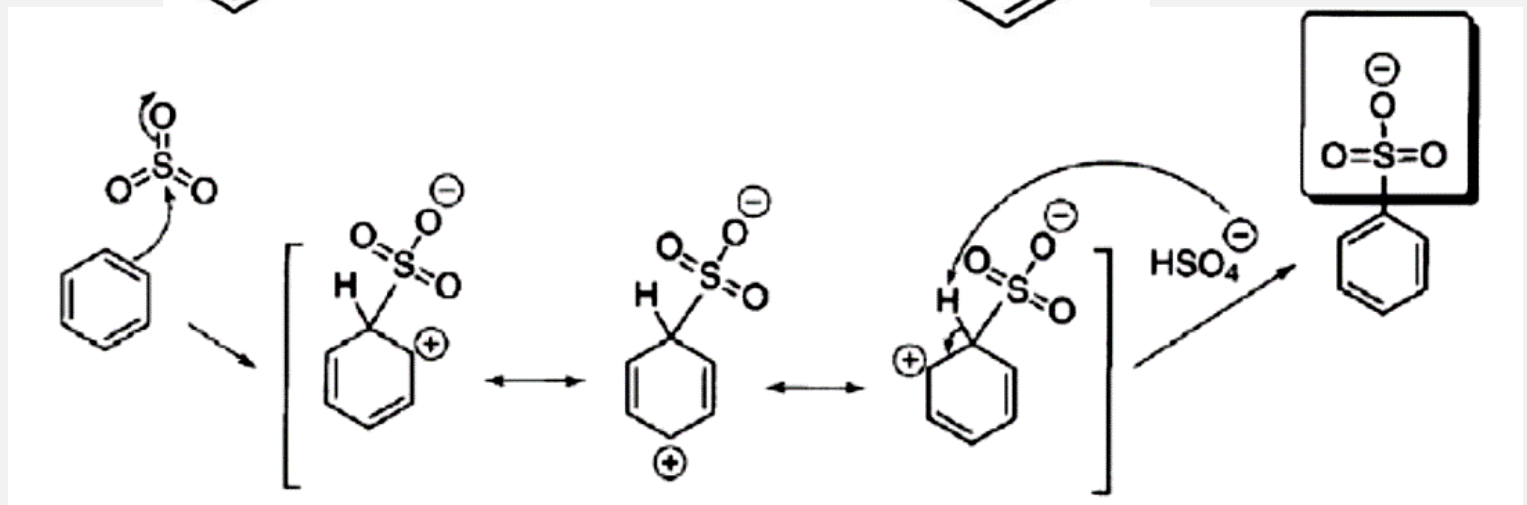
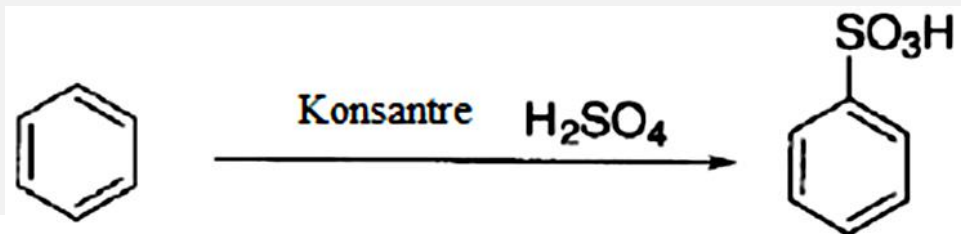
Synthesis of Bromobenzene



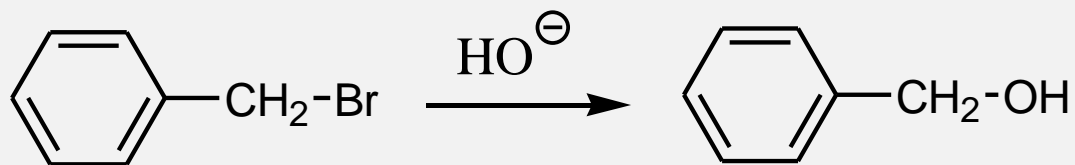
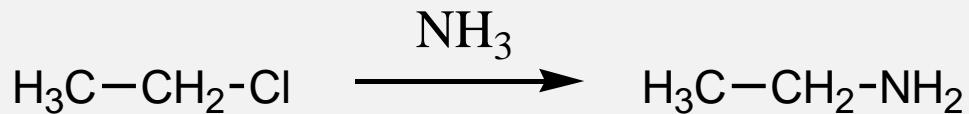
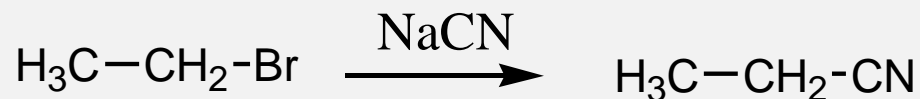
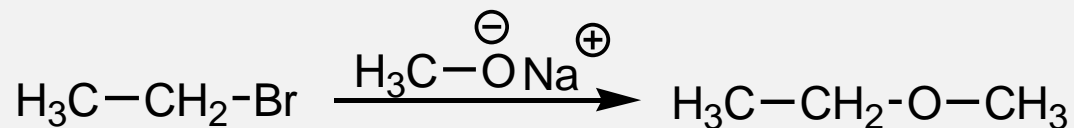
Nitrosation



Sulfonation



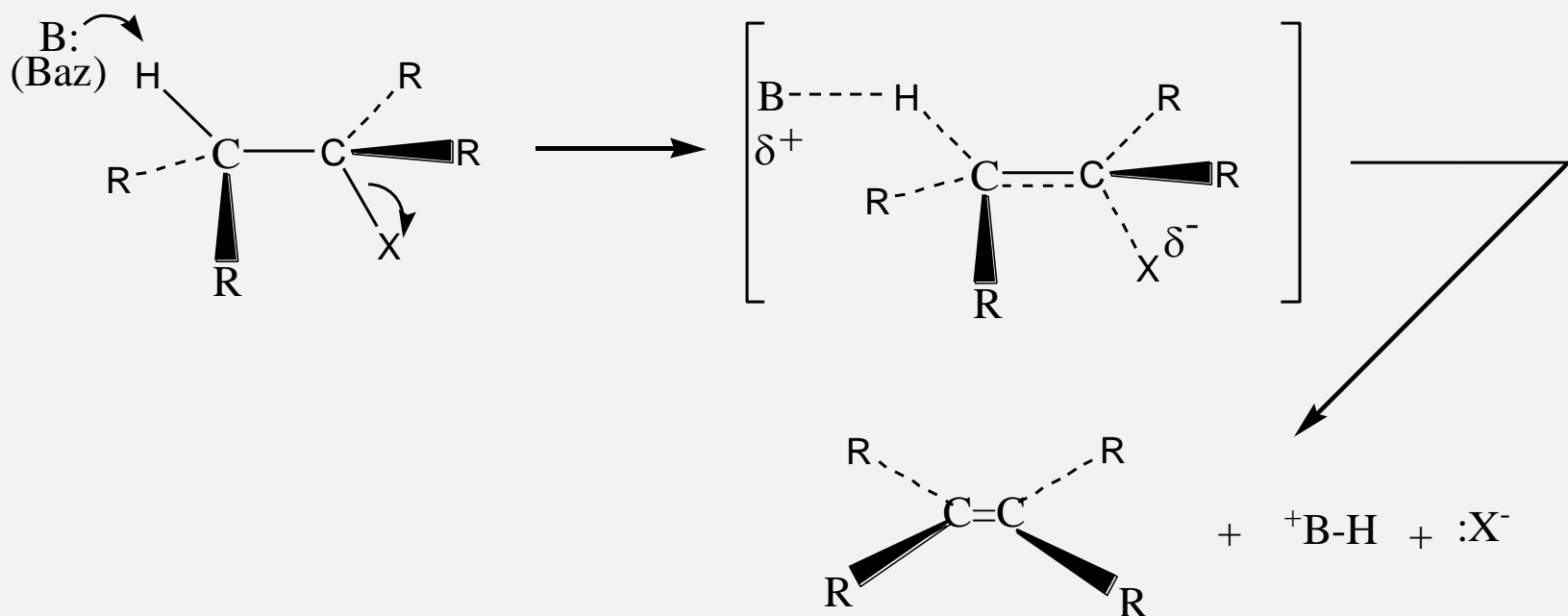
Nucleophilic Substitution Reactions



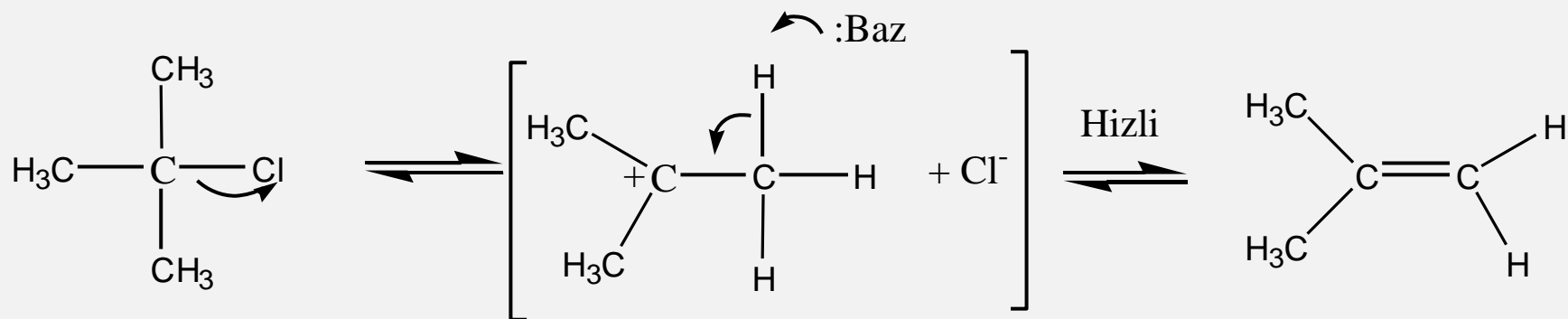
Elimination Reactions (E):

It is the formation of a unsaturated compound from saturated molecule. There are two types, E_1 ve E_2 according to reaction kinetics. These reactions are parallel to the SN_1 and SN_2 reactions.

E2 Reactions:

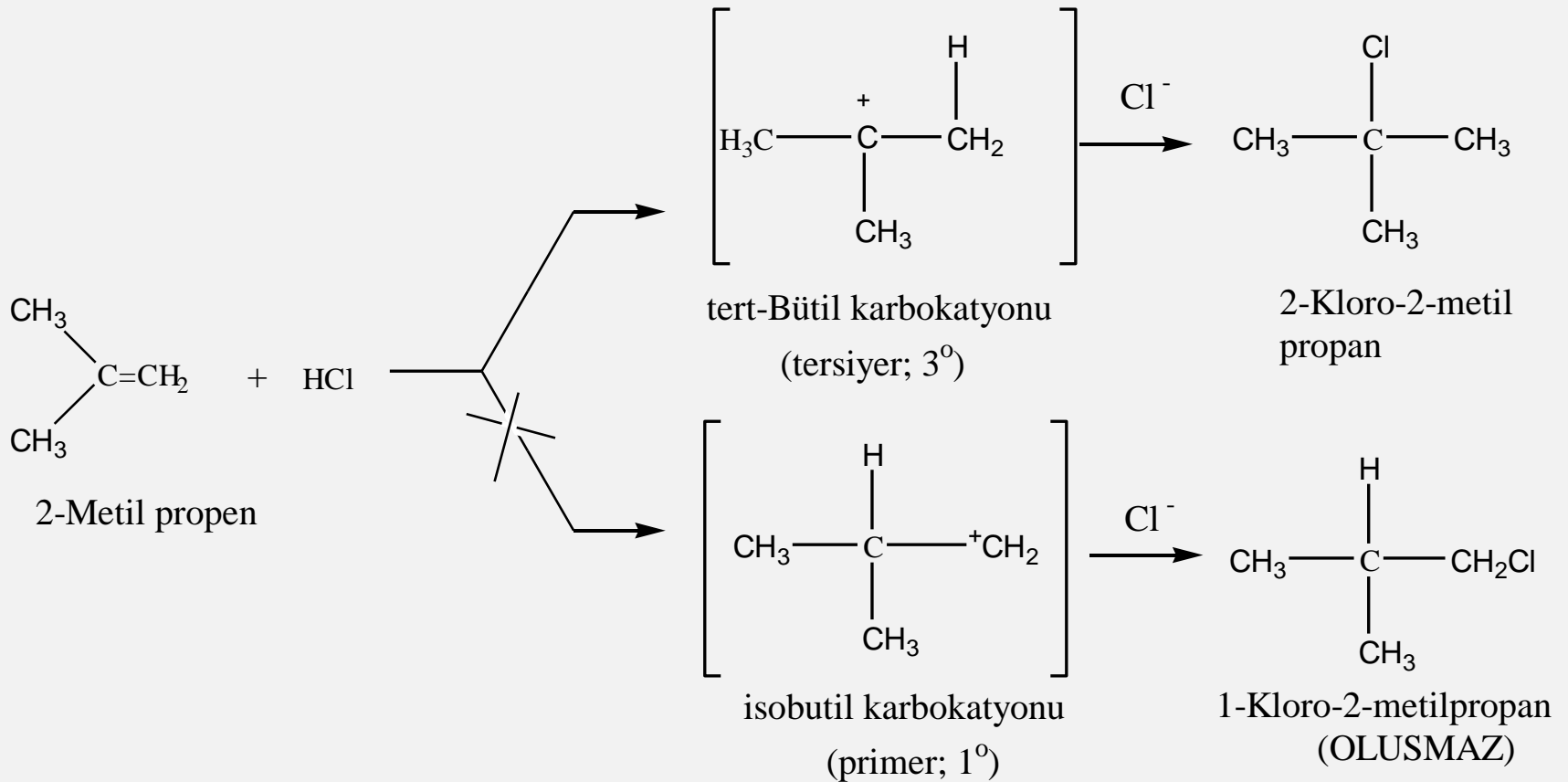


E₁ Reactions:

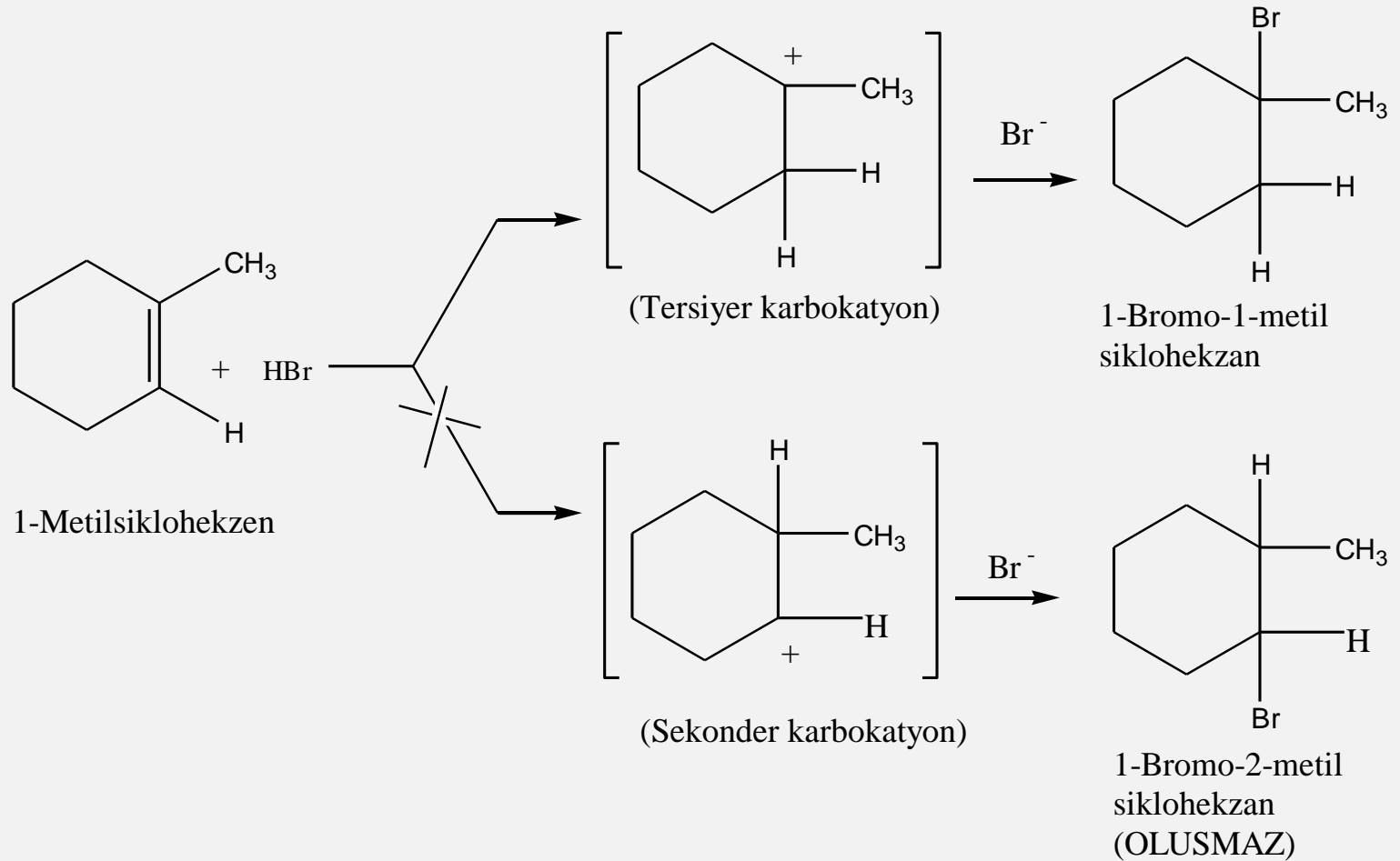


Reaction	Structure of RX	Reactivity of Nu:	Conc. Of Nu:	Solvent
SN2	1>2>3 Only this reaction and E2 will most likely react with a primary RX	Strong nucleophile favors reaction	High concentration of nucleophile favors reaction	Aprotic polar solvent favors a SN2 reaction if <u>either</u> of the reactants is charged ex: DMF DMSO Acetone
E2	3>2>1 Major product is more substituted alkene unless *the base is large *the alkyl halide is an alkyl fluoride *the alkyl halide contains one or more double bonds	Strong Base favors reaction	High concentration of base favors reaction	Aprotic polar solvent favors a E2 reaction if <u>either</u> of the reactants is charged ex: DMF DMSO Acetone
SN1	3>2>1 Forms a carbocation	Not effected by strength of nucleophile but a weak nucleophile favors it by not favoring a SN2 reaction	Not effected but low concentration disfavors a SN2 reaction	Protic polar favors a SN1 reaction if the reactant is not charged. Ex: H2O, CH3OH, etc.
E1	3>2>1 Forms a carbocation	Weak base favors E1 reaction by disfavoring E2 reaction	Not effected but a low concentration of base favors E1 by disfavoring a E2 reaction	Protic polar favors a E1 reaction if the reactant is not charged. Ex: H2O, CH3OH, etc.

Electrophilic Addition(A_E):

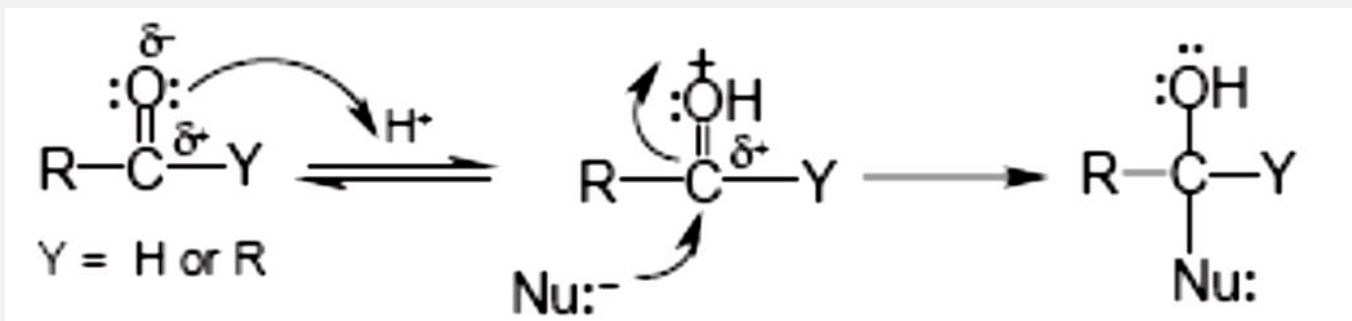
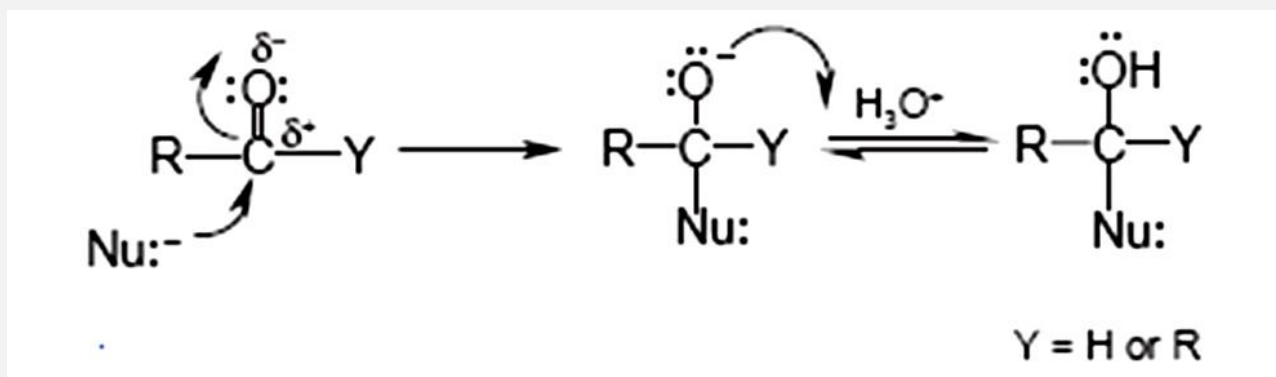


Electrophilic Addition(A_E):



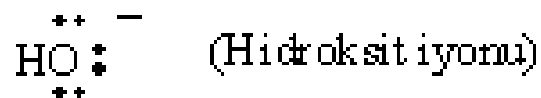
Nucleophilic addition (A_N):

Nucleophilic addition reactions are an important class of reactions that allow the interconversion of **C=O** into a range of important functional groups.



Nucleophiles involved in Nucleophilic addition reactions:

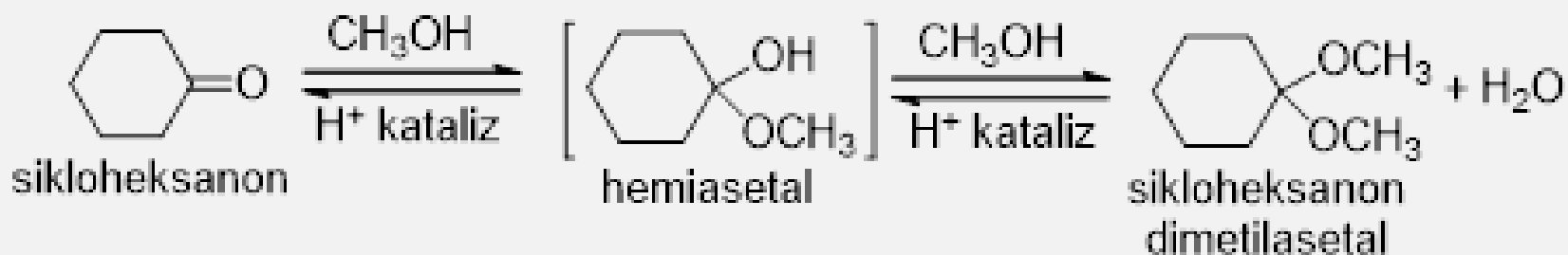
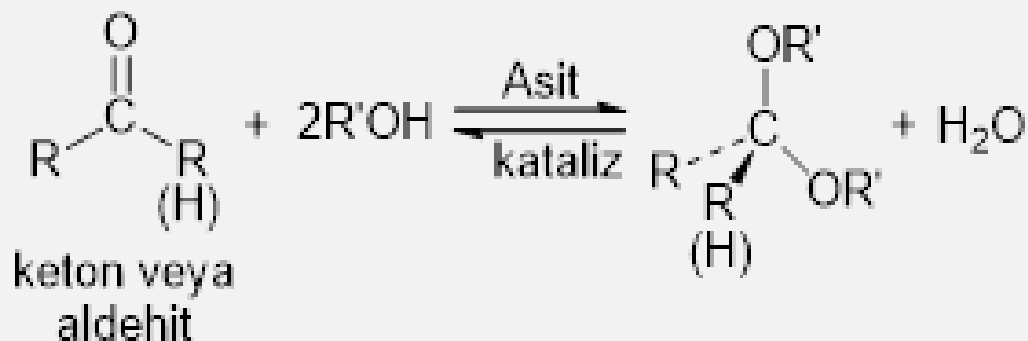
Nucleophiles with negative charges



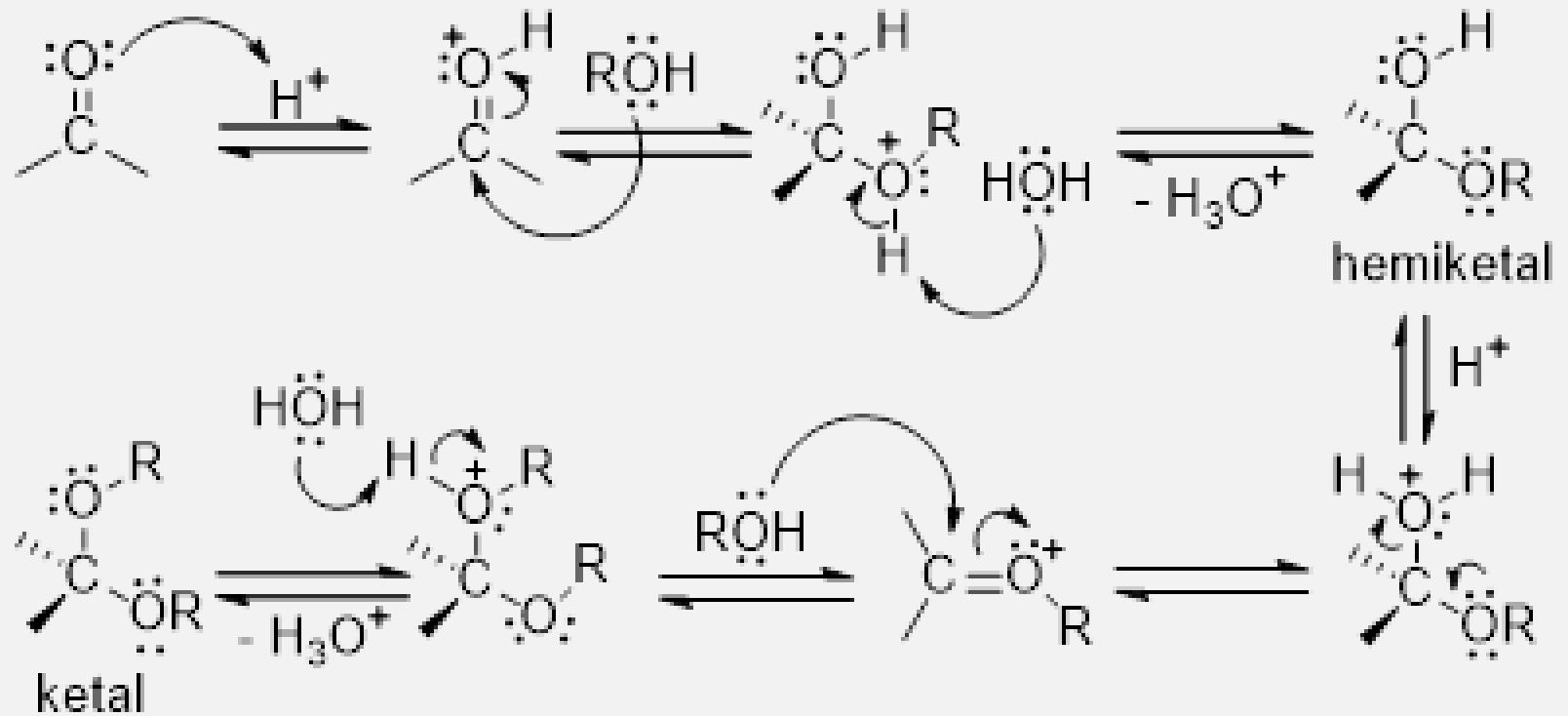
Neutral Nucleophiles



Addition of alcohol to aldehyde give hemiacetal and acetal and hemiketale and ketale are obtained with the same reaction with ketone.



Reaction mechanism

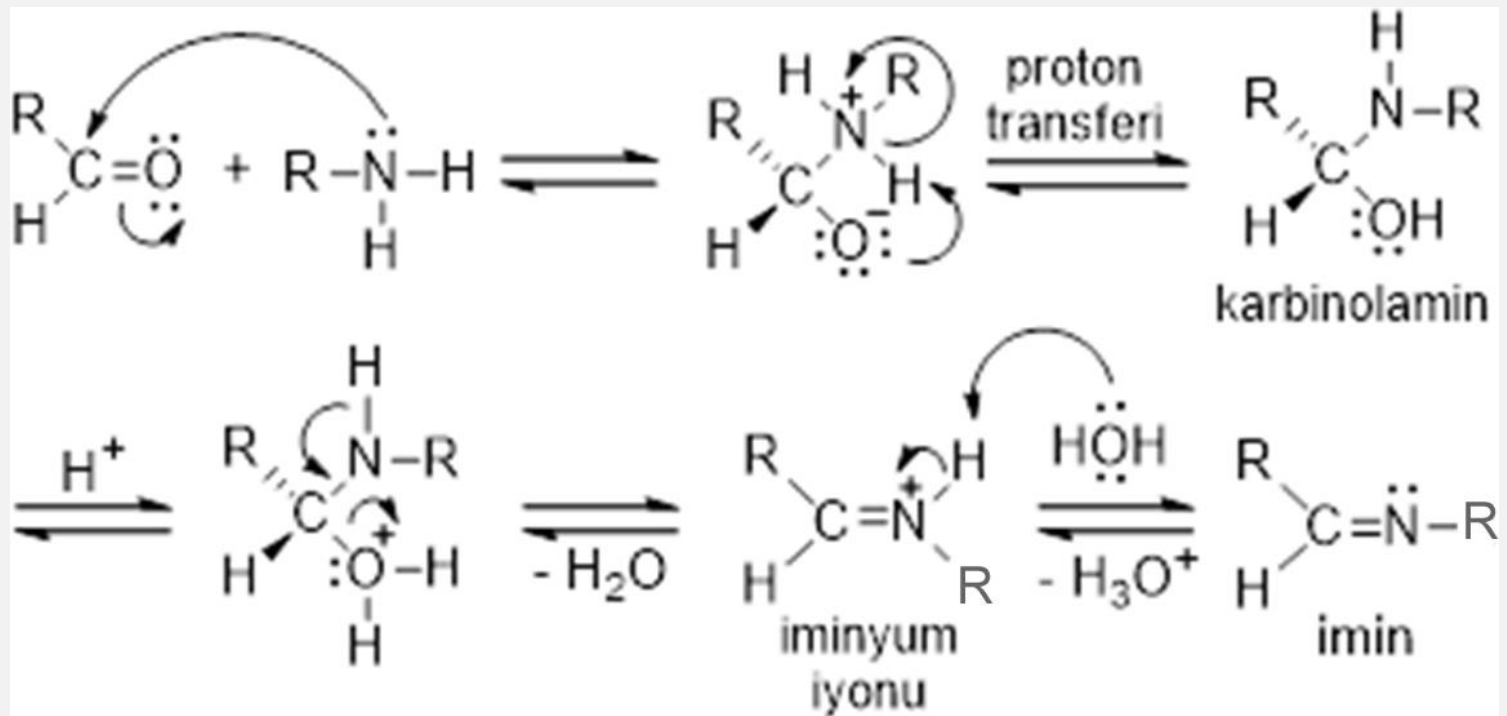


Imine ve enamine formation

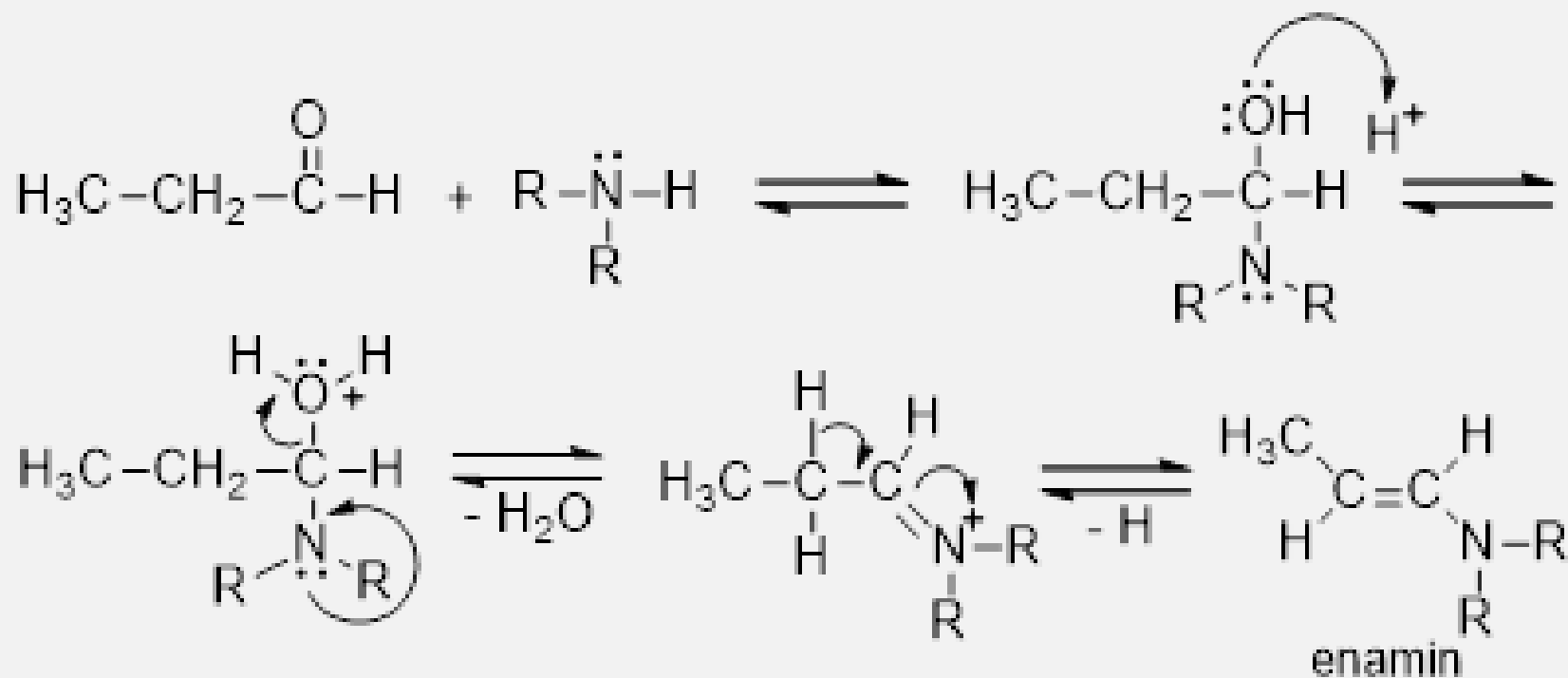
Addition of primary amines to aldehyde and ketone give imine ($R_2C=NR$), while addition of secondary amine give enamine compounds.



Mechanism of imine formation



Mechanism of enamine formation



Mechanism of grignard reaction formation



Nucleophilic addition