

BOND LENGTHS

C-C : 1.54 Å

C=C : 1.34 Å

C≡C : 1.19 Å

C-H : 1.09 Å

C=O : 1.23 Å

C-O : 1.43 Å

In Benzene, C-C, C=C : 1.39 Å

pKa VALUES

Carboxylic Acid = 5

Water = 7

Phenol = 10

Alcohols = 16 - 18

Koracademy.com

BOND ANGLES

Alkanes = 109.5° (Tetrahedral)

Alkenes = 120° (Planar)

Alkynes = 180° (Linear)

Benzene = 120° (Planar)

Alkyl Halides = 109.5° (Tetrahedral)

Amines = 109.5° (Trigonal Pyramidal)

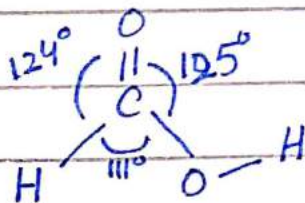
Alcohols = 105°

Phenol = 109°

Ether = 105°

Aldehyde = 120°

Carboxylic Acid = close to 120° (Trigonal Planar)



Koracademy.com

TESTS

1. For Presence of Double bond

Bromination of Alkenes

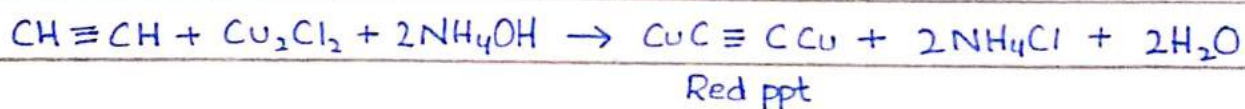
color changes from brown to colorless

2. For Locating Position of Double Bond

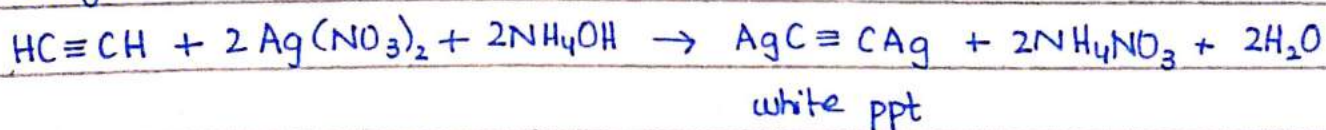
Ozonolysis of Alkenes

3. For distinguishing 1-alkynes from non-terminal alkynes

* Formation of red ppt when ammoniacal solution of cuprous chloride (Cu_2Cl_2) is added to alkyne shows that it is terminal alkyne.



* Formation of white ppt when ammoniacal solution of silver nitrate is added to alkyne shows that it is terminal alkyne.



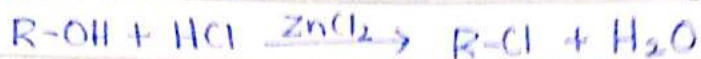
4. For Detection of Acid

Add Na metal in acid. If H_2 gas is released, presence of acid is confirmed

Koracademy.com

5. Lucas Test

This test is used to distinguish between primary, secondary and tertiary alcohols. In this test alcohols are treated with a solution of HCl and $ZnCl_2$ (Lucas Reagent) to form alkyl halides. $ZnCl_2$ act as catalyst.



The three types of alcohols undergo this reaction at different rates:

- Tertiary Alcohols react with Lucas Reagent immediately.
- Secondary Alcohols react somewhat slower
- Primary Alcohols react even more slower.

6. For Fe^{+2}

Put Ammonia in Fe^{+2} → Orange ppt forms

Koracademy.com

7. For Fe^{+3}

Ammonia in Fe^{+3} → Brown ppt

$NaOH$ in Fe^{+3} → Brown ppt

CO_3^{-2} in Fe^{+3} → Brown ppt

Thiocyanate ions (SCN^-) in Fe^{+3} → Intense blood red solution

8. Baeyer's Test

Baeyer's Test for unsaturation is used for determining the presence of carbon-carbon double bonded compounds i.e alkenes or alkynes. This test uses dilute potassium permanganate to oxidize C-C double or triple bond

9. For Differentiating Between Alkene and Alkyne (Tollen's Reagent)

Alkene + Tollen Reagent \rightarrow No ppt

Alkyne + Tollen Reagent \rightarrow white ppt

10. Molisch's Test

Test used for the presence of carbohydrates, based on the dehydration of carbohydrate by H_2SO_4 or HCl to produce an aldehyde which condenses with two molecules of phenol, resulting in a violet ring.

11. Benedict's Test

It is used to test for simple carbohydrates. The Benedict's test identifies reducing sugars which have free ketone or aldehyde functional groups.

This solution can be used to test for the presence of glucose in urine.

Koracademy.com

12. Tollen's Test

Also known as silver mirror test, is a qualitative laboratory test used to distinguish between an aldehyde and ketone. It exploits the fact that aldehydes are readily oxidized whereas ketones are not.

13. Fehling's Test

used to distinguish b.w aldehydes and ketones.

Aldehydes give positive test

14. Iodoform Test

Used to distinguish:

- (i) Methyl ketones from other ketones
- (ii) Acetaldehyde from other aldehydes
- (iii) Ethanol from methanol

Koracademy.com

CATALYSTS

1. Finely Divided Iron

In Haber Bosch process for synthesis of ammonia

2. V_2O_5

→ In conversion of SO_2 to SO_3 for the manufacture of H_2SO_4 by contact process

→ In oxidation of alcohols

→ In hydrogenation of olefins (alkenes)

3. $TiCl_4$ (Ti: Titanium)

In the polymerization of ethene to polyethene polymer.

4. Ni, Pt, Pd

In catalytic hydrogenation of unsaturated hydrocarbons.

5. Cu

In oxidation of ethanol to acetaldehyde

6. $K_2Cr_2O_7$

Potassium dichromate (VI) solution acidified with dilute sulphuric acid oxidizes secondary alcohols to ketones and primary alcohol to formaldehyde.

It cannot oxidize tertiary alcohols.

7. Silver (Ag) as Ag_2O

Epoxidation of Alkene
(Addition of O_2)

Koracademy.com

8. Lewis catalyst (FeCl_3 or AlCl_3)

→ For Halogenation of Benzene

→ AlCl_3 : Friedel-Craft's Alkylation +
Friedel - Craft's Acylation

9. Anhydrous ZnCl_2

→ Reaction of HCl with Alcohols to produce Alkyl chloride

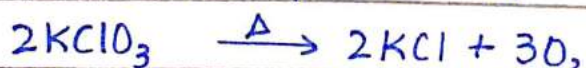
→ Reaction of ether with Acetyl chloride

10. Persulphate ion ($\text{S}_2\text{O}_8^{-2}$)

In industrial preparation of PVC (Poly Vinyl chloride)

11. Manganese dioxide (MnO_2)

→ In thermal decomposition of potassium chlorate



→ For decomposition of hydrogen peroxide

Koracademy.com

CATALYST NAMES

1. Lindlar's Catalyst

BaSO_4 + Quinoline

To stop the hydrogenation of alkynes at alkene stage by poisoning Pd catalyst.

2. Lewis catalyst

FeCl_3 or AlCl_3

3. Lucas Reagent

ZnCl_2 / HCl

Koracademy.com

RULES

1. Fajan's Rule

The smaller the cation, the greater is the amount of covalent character in the compounds.

2. Markovnikov's Rule

When an unsymmetrical (or polar) reagent is added to an unsymmetrical alkene, the positive part of the reagent attaches itself to that carbon atom involved in the double bond, holding greater number of hydrogen atoms.

Koracademy.com

TEMPERATURE

1. For Dehydration of Alcohols to produce Alkenes

170°C

2. Hydrogenation of Alkenes

If Ni is used → 200 - 250°C

If Pt/Pd is used → 25°C

3. Epoxidation of Alkene

300°C

4. Polymerization

100 - 300°C

Koracademy.com

5. Hydration of Alkynes

80°C

6. Hydrogenation of Benzene

150°C

7. Nitration of Benzene

60°C

8. Sulphonation of Benzene

If H_2SO_4 is used → 100°C

If fuming H_2SO_4 is used → 25°C

9. Friedel-Craft's Acylation

40°C

10. Free Radical Halogenation of Alkanes
UV light or 400°C

11. Reduction of Aldehydes and ketones to Alcohols
 200°C

12. Preparation of Phenol from Benzene sulphonic Acid
 $300 - 350^{\circ}\text{C}$

13. Dow process (Preparation of phenol from chlorobenzene)
 350°C

14. Preparation of Phenol by Hydrolysis of Diazonium Salts
 50°C

15. Dehydration of Alcohols to produce ether
 140°C

16. Industrial Preparation of PVC
 50°C

Koracademy.com

17. In Combustion Analysis:
 850°C

PRESSURE

1. Hydrogenation of Alkenes

1 - 1.5 atm

2. Polymerization

1000 - 2000 atm

3. Reduction of Aldehydes and Ketones to Alcohols

10 atm

4. Dow Process

150 atm

Koracademy.com

IN THE PRESENCE OF

1. Dehydration of Alcohols

conc. Sulphuric Acid

2. Dehydrohalogenation of Alkyl Halides

Alcoholic solution of KOH or NaOH

3. Hydration of Alkenes

cold conc. sulphuric acid

4. Halogenation of Alkenes

Inert solvent CCl_4

5. Dehydrohalogenation of Vicinal Dihalides

Liquid Ammonia (NH_3)

6. Dehydration of Tetra halides

Alcohol

7. Reaction of Alkynes with Na metal

Liquid Ammonia

8. Hydration of Alkynes

HgSO_4 and H_2SO_4

Mercuric sulphate and sulphuric acid

9. Nitration of Benzene

H_2SO_4

Koracademy.com

10. Friedel - Craft's Acylation

CS_2

11. Reaction of Alcohol with Thionyl chloride to produce R-X
Pyridine

12. Preparation of Grignard Reagent
Anhydrous or dry ether
⁴(or Diethyl ether)

13. Reaction of Acetylene with HCl to form vinyl chloride
 $HgCl_2$ or $CuCl$

Koracademy.com

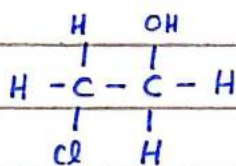
TERMINOLOGIES

1. Epoxide : An organic compound whose molecule contains a three-membered ring involving an oxygen atom and two carbon atoms.

2. Glycol : Any of a class of organic compounds belonging to alcohol family. In the molecule of glycol two hydroxyl groups are attached to different carbon atoms.

3. Hypohalous Acids : $X^{+6} - OH^{-6}$

4. Halohydrins : Organic compounds having hydroxyl group and halogen at adjacent carbon atoms.



Koracademy.com

5. Vicinal Dihalides : Compounds having two halogen atoms on adjacent carbon atoms.

6. Sodium Amide : NaNH_2

7. Fuming Sulphuric Acid: conc. H_2SO_4 in which SO_3 has been dissolved

8. Diazonium Group : $[R - \overset{+}{N} \equiv N]$

9. Alkoxide : RO^- (from ROH)

10. Carboric Acid: Liquid phenol containing 5% of water

11. Cumene: Iso propyl benzene

12. Oxonium Ion: Any oxygen cation with three bonds

13. Amalgum: Alloy in which Hg is present

14. Immine: $R-\overset{\overset{H}{\parallel}}{C}-H$

15. Oxime: $R-\overset{\overset{NOH}{\parallel}}{C}-H$

16. Hydrazine: NH_2NH_2

Koracademy.com

16. Hydrazone: $R-\overset{\overset{NNH_2}{\parallel}}{C}-H$

18. Cyanohydrins: Compounds with a hydroxyl and a cyano (CN) group attached to the same carbon

19. Hemi acetal: containing both alcohol and ether functional groups on same carbon

20. Acetal: having two ether functional groups at same carbon

21. Dehydrating Agent: Phosphorus pentoxide (P_2O_5)
used to produce acetic anhydride or ethanoic anhydride by heating acetic acid at high temperature in the presence of P_2O_5

22. Adipic Acid: Hexane dioic acid

23. Common Flocculating Agent: Aluminium sulphate $Al_2(SO_4)_3$, also referred to as alum

24. Soda lime: mixture of CaO and $NaOH$

$NaOH \rightarrow$ caustic soda

$CaO \rightarrow$ Quick lime

25. Iodoform: Also known as triiodomethane is the organo iodine compound with formula CHI_3 . It is a pale yellow, crystalline, volatile substance. It has a penetrating and distinctive odour (sometimes referred to as smell of hospitals)

26. Potash Alum: A coagulating Agent

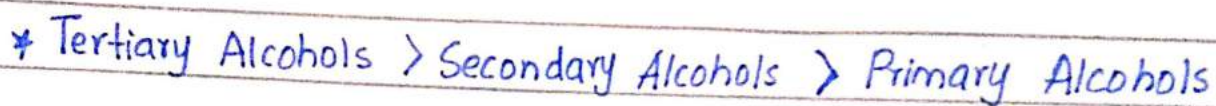
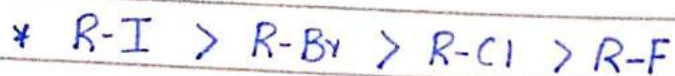
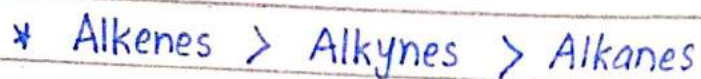
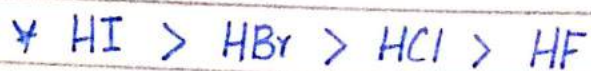
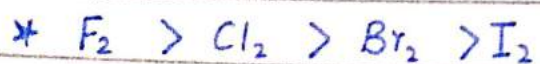
27. Wood spirit: Methanol

28. Formalin: 40% formaldehyde + 8% methyl alcohol + 52% water

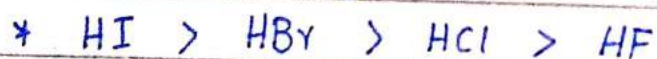
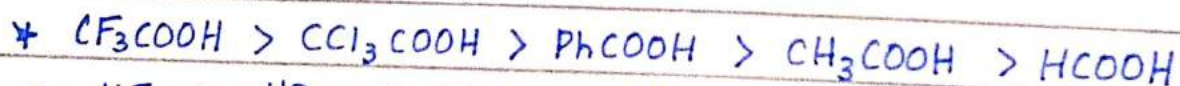
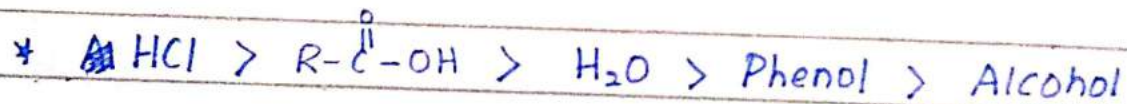
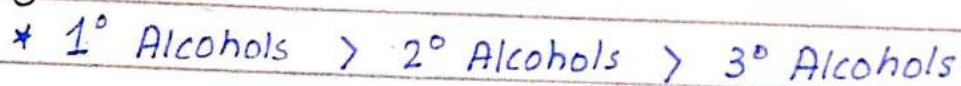
Koracademy.com

ORDER

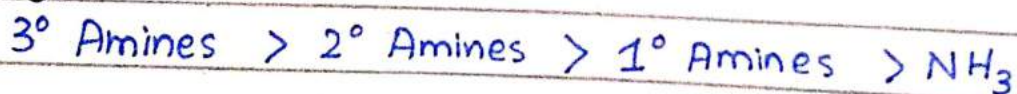
1. Reactivity Order



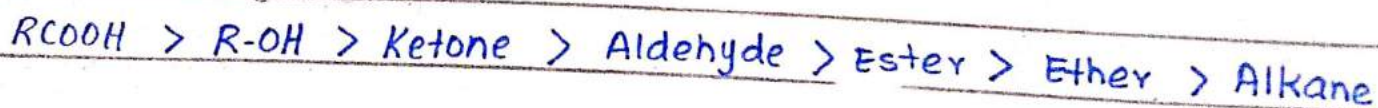
2. Acidity Order



3. Basicity Order



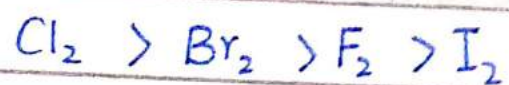
4. Boiling Point



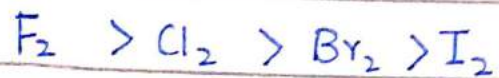
bcz 3° Amine have no hydrogen bonding

Koracademy.com

5. Bond Energy Order



6. Oxidation Power Order



7. Reducing Power Order



Koracademy.com

STRENGTH OF BONDING (INTER MOLECULAR FORCES)

1. Alkane : Dispersion Forces
2. Ether : Weak Dipole
3. Ester : Moderate Dipole
4. Aldehyde : Strong Dipole
5. Ketone : Stronger Dipole
6. Alcohol : Hydrogen Bonding
7. Carboxylic Acid : Hydrogen Bonding

Koracademy.com

ANGLE STRAIN

The deviation in cycloalkanes from the normal tetrahedral angle of 109.5° is called Angle strain.

Bond Angle In Cyclopropane = 60°

Greater the angle strain, less stable the molecule may be and more reactivity of molecule.

Angle strain in cyclopropane = $109^\circ - 60^\circ = 49^\circ$

Angle strain in cyclobutane = $109^\circ - 90^\circ = 19^\circ$

* BONDING SPECIES

A substitution reaction may be initiated by an electrophile, nucleophile or free radical.

1. ELECTROPHILE

- electron loving having affinity for e^-
- electron deficient species
- act as Lewis acid as they accept electron
- +vely charged species (H^+ , CH_3^+ etc) or may be neutral (SO_3 , BF_3 etc)

Koracademy.com

2. NUCLEOPHILE

- nucleus lover
- electron ~~deficient~~^{rich} species
- act as Lewis ~~acid~~^{base} as they ~~accept~~ donate electrons
- -vely charged (O^- , F^- , Br^- etc) or may be neutral (NH_3 , SO_2 , H_2O etc)

3. FREE RADICAL

- Have unpaired electron
- Produced as a result of homolysis
- Cl^{\cdot} , CH_3^{\cdot} etc

* TYPES OF BOND FISSION

Bond Fission is of two types:

1. Homolytic Fission
2. Heterolytic Fission

Koracademy.com

1. HOMOLYTIC FISSION

- in which shared electron pairs are equally distributed among bonded atoms.
- resulting species have unpaired electron and are called free radicals.
- similar groups are produced
- product is paramagnetic due to unpaired e^{-}
- The reactions carried out by homolytic fission are called radical reactions.

2. HETEROLYTIC FISSION

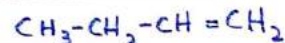
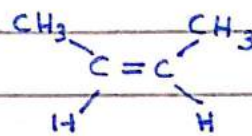
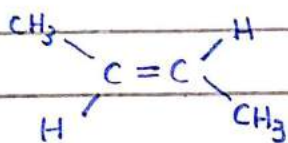
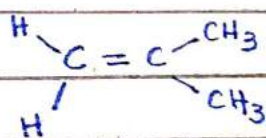
- shared e^{-} pair is taken by 1 of bonded atom only
- ions are produced
- electrophile (+ve) and nucleophile (-ve) are produced
- products are diamagnetic
- The reactions carried upon by heterolytic fission are called ionic or polar reactions.

RELATIVE STABILITY OF ALKENES

The extent of stability of alkene depends on:

1. Position of double bond in the molecule. The compound is more stable if double bond is in mid.
2. Number and nature of substituents, attached (More substituted alkene are more stable)
3. Relative positions of substituents on doubly bonded carbon atoms.

Isobutylene > Trans-2-Butene > Cis-2-Butene > 1-Butene



Koracademy.com

ISOMERISM

Isomers have same molecular formula but differ from each other in their structure, physical and chemical properties.

Koracademy.com

TYPES OF ISOMERISM

1. Structural Isomerism
2. Stereo isomerism

1. STRUCTURAL ISOMERISM

Arrangement of atoms is different in different isomers without any reference to space.

Further Five Types:

(i) CHAIN ISOMERISM (SKELETAL ISOMERISM)

Same molecular formula but different carbon chains or skeletons e.g n-butane and isobutane

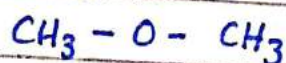
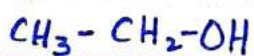
(ii) POSITION ISOMERISM

Differ in position of functional group or position of double or triple bond

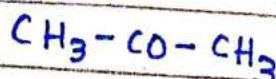
(iii) FUNCTIONAL GROUP ISOMERISM

having different functional groups e.g

a. Ethyl Alcohol and Dimethyl ether

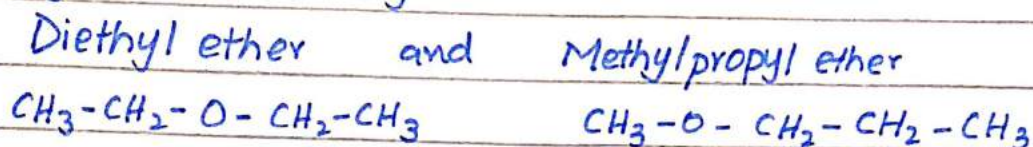


b. Propionaldehyde and Acetone



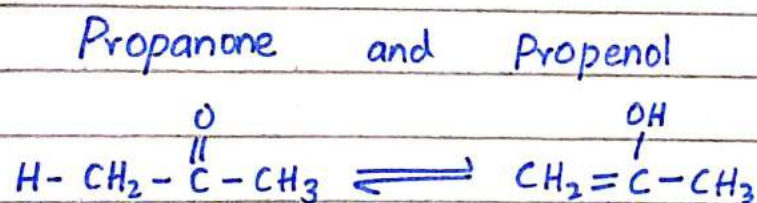
(iv) METAMERISM

This type of isomerism is exhibited due to the unequal distribution of carbon atoms (or alkyl groups) on either side of functional group. Isomers belong to the same homologous series e.g



(v) TAUTOMERISM

They differ from each other only in position of electrons and protons. These isomers are in dynamic equilibrium with each other e.g



2) STEREOISOMERISM

These isomers have different configuration (Three dimensional arrangement of atoms in space is called configuration)

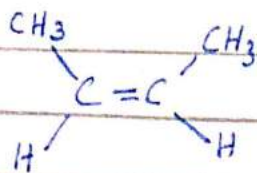
Stereoisomerism is of two types

- (i) Geometric or cis-trans isomerism
- (ii) Optical isomerism

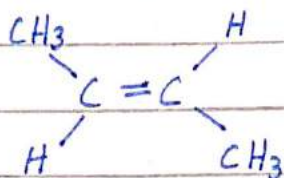
Koracademy.com

(i) GEOMETRIC ISOMERISM (CIS-TRANS ISOMERISM)

Differ only in respect of arrangement of atoms or groups about the double bond.



cis-2-Butene



trans-2-Butene

These are two different compounds and have different boiling points.

(ii) OPTICAL ISOMERISM

These isomers differ in their interaction towards plane polarized light.

These isomers mostly contain chiral carbon.

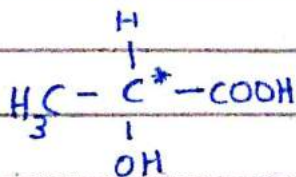
A carbon atom which is bonded to four different groups is called asymmetric or chiral carbon atom.

Optical Isomers are:

- 1) Non super-imposable
- 2) Mirror Images
- 3) also called enantiomers

Koracademy.com

Example: Lactic Acid (2-Hydroxy Propanoic Acid)



Optical isomers have basically the same properties (melting point, boiling point etc) but there are a few exceptions (uses in biological mechanisms and optical activity)

BENZENE

Koracademy.com

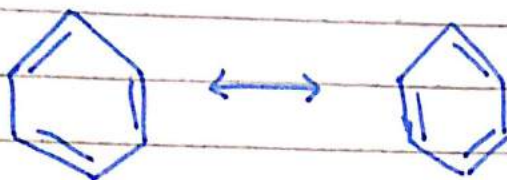
Ortho = (1,2) adjacent positions

Meta = (1,3) alternate positions

Para = (1,4) opposite positions

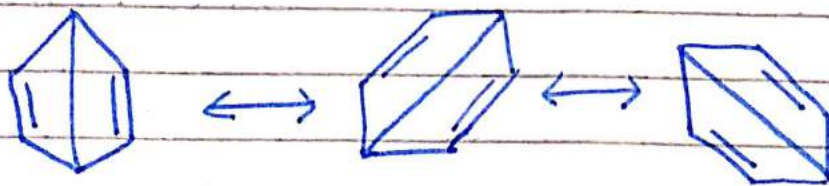
KEKULE STRUCTURES

Kekule structures contribute 78% to the actual structure and 39% each.



DEWAR STRUCTURES

Dewar structures contribute 2.2% to the actual structure 7.3% is contributed by each structure.



RESONANCE ENERGY OF BENZENE

152 kJ/mol

The measured heat of hydrogenation of benzene (208 kJ/mol) is less than the expected value (360 kJ/mol) of the most stable canonical form by an amount of 152 kJ/mol.

DELOCALIZED ELECTRONS

When the shared electrons are attracted by more than two nuclei, such electrons are called delocalized electrons.

In benzene the π electronic cloud makes a continuous sheet above and below all the six nuclei and the π electrons are thus delocalized.

REACTIONS OF BENZENE

The main types of reactions of benzene are:

1. Addition Reactions
2. Electrophilic Substitution Reactions
3. Oxidation Reactions

ELECTROPHILES FOR :

1. Nitration : NO_2^+
2. Sulphonation : SO_3
3. Alkylation : R^+
4. Acylation : $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}^+$

Koracademy.com

SUBSTITUENT EFFECTS

1. Attacking electrophile may get the position on ortho, meta or para on monosubstituted benzene.

* ORTHO/PARA DIRECTING GROUPS

- Ortho/Para directing groups increase the reactivity of benzene.
- Halo group is ortho/para directing but deactivating

Examples of Ortho/Para Directing:

Phenol (-OH), Aniline (-NH₂), Halogens (-Cl, -Br, -I),
Toluene (-CH₃), -C₂H₅, -OCH₃, -OR, -NHR,
-NR₂

* META DIRECTING GROUPS

Meta directing groups withdraw the electrons of benzene towards themselves so the reactivity of benzene decreases.

Examples of Meta Directing:

- NO₂
- CHO (Benzaldehyde)
- COOH (Benzoic Acid)
- CN
- SO₃H
- COR
- ⁺NH₃
- COOR
- ⁺NR₃

Koracademy.com

ALKYL HALIDES

NUCLEOPHILIC SUBSTITUTION REACTIONS

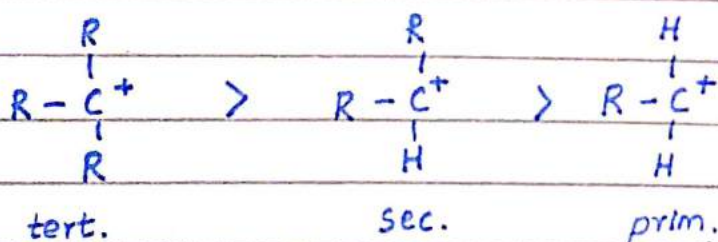
The rate of nucleophilic substitution reaction depends upon the following factors:

1. Nature of substrate (Alkyl Halide)
2. Nature of attacking nucleophile
3. Nature of leaving group
4. Nature of solvent

CARBOCATION AND THEIR STABILITY

"A radical species in which carbon carries positive charge is called carbocation"

Order of stability of carbocation:



Koracademy.com

- Greater is the number of alkyl groups, greater is the stability of carbocation
- The stability of carbocation comes from the stabilization of the positive charge of carbocation by electron donating alkyl groups directly attached.

MECHANISMS

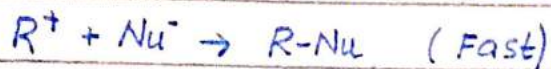
There are two ways for S_N Reactions to occur

1. Unimolecular nucleophilic substitution (S_N1)
2. Bimolecular nucleophilic substitution (S_N2)

SN1 REACTIONS

1. Molecularity of SN1 reaction is one.

2. The reaction is:



3. Rate = $k[R-X]$

4. Coming nucleophile may attack from any side

5. Tertiary alkyl halides generally give SN1 reactions

6. Order of reaction is 1

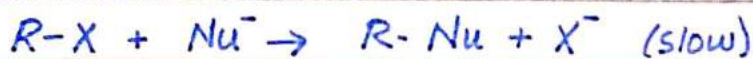
7. It is a two step mechanism

8. It is favored in polar solvents

SN2 REACTIONS

1. Molecularity of SN2 reaction is two

2. The reaction is:



3. Rate = $k[R-X][Nu^-]$

4. Coming nucleophile only attacks from backside

5. Primary alkyl halides generally give SN2 reactions.

6. Order of reaction is 2

7. It is a single step mechanism

8. It is favored in non-polar solvents

NOTE :

Koracademy.com

Secondary alkyl halide can give both reactions depending upon nature of solvent and structure of alkyl group.

In Polar Solvent \rightarrow SN1

In non-polar Solvent \rightarrow SN2

ELIMINATION REACTIONS

"The reactions where the attack takes place on an electrophilic hydrogen attached to β -carbon of alkyl halide, resulting in formation of alkene"

→ E and SN Reactions can take place simultaneously and often competition occurs.

E-1 REACTIONS

→ Two step mechanism

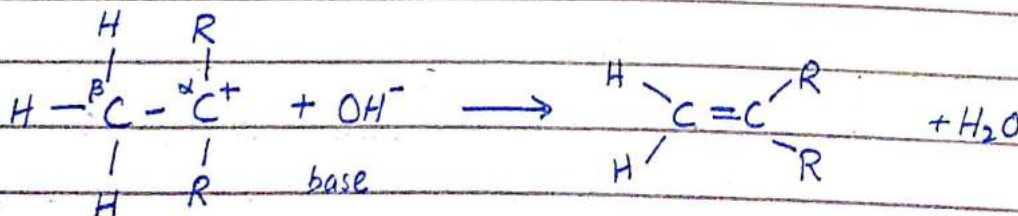
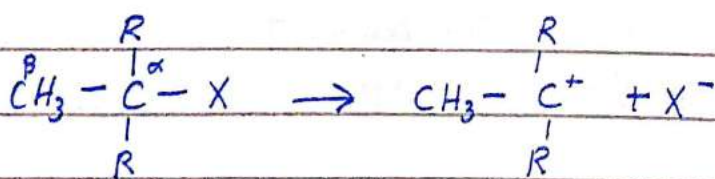
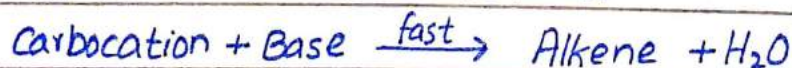
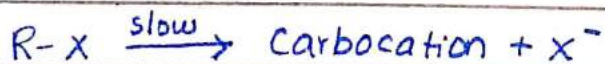
→ Molecularity is one

→ Rate = $k [R-X]$

→ Tertiary Alkyl Halides generally give E-1 reactions

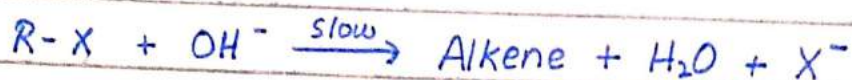
→ Order of Reaction is 1

→ Reaction:



E-2 REACTIONS

- One step mechanism
- Molecularity is two
- Rate = $k [R-X] [Base]$
- Primary alkyl halides generally give E-2 reactions
- Order of reaction is 2
- Reaction:



SUBSTITUTION VS. ELIMINATION

- The reaction is substitution or elimination depends upon whether attacking specie is better base or better nucleophile.
- Better base favors elimination
- Stronger nucleophile favors substitution
- Generally, greater the alkyl groups on substrate favors elimination over substitution. Bcz greater the alkyl groups on substrate creates greater steric hindrance when nucleophile approaches towards α -carbon of substrate

* Ethoxide ($C_2H_5O^-$) is strong base

* Thioalcohol ($C_2H_5S^-$) is strong nucleophile

Koracademy.com

POINTS

- Alcohols are not acidic enough to react with aqueous NaOH or KOH
- Carboxylic Acids cannot be reduced with H_2/Ni or $Na + C_2H_5OH$
- Being acidic, phenol reacts with NaOH or Na metal to form salt

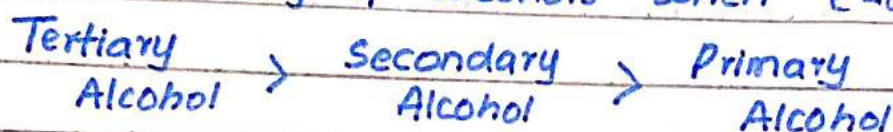
Koracademy.com

REACTIVITY OF ALCOHOLS

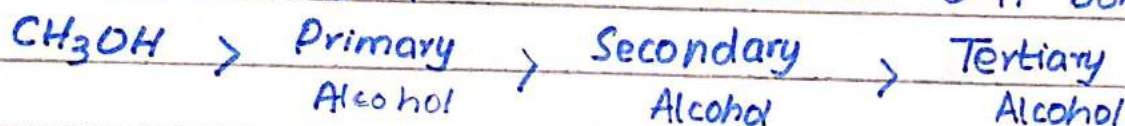
* Alcohols react with other reagents in two ways:

1. Reactions in which C-O bond breaks
2. Reaction in which O-H bond breaks

* Order of reactivity of alcohols when C-O bond breaks



* Order of Reactivity of alcohols ~~with~~ when O-H bond breaks:



→ Nucleophile breaks C-O bond of alcohol

→ Attacking electrophile breaks C-H bond of alcohol.

REACTIVITY OF PHENOL Koracademy.com

* Phenols exhibit two types of reactions:

1. Reactions due to hydroxyl group
2. Reactions due to aromatic ring

* Due To OH Group : O-H bond is broken to form salts, ethers, esters etc.

* Due To Benzene Ring: Electrophilic substitution - Reactions

REACTIVITY OF ETHERS

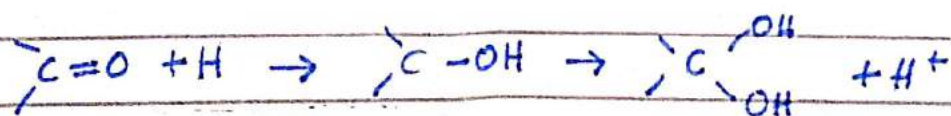
Ethers are quite stable compounds. They do not react with bases, active metals, oxidising agents and reducing agents. They are also stable to dilute acids. However, they form oxonium salts with strong concentrated acids.

REACTIVITY OF CARBONYL COMPOUNDS

- C=O is highly polar due to electronegativity difference
- C=O undergo nucleophilic addition reaction.
- These reactions are catalyzed, either by acid or base
- Nucleophilic oxygen and electrophilic carbon both are present in carbonyl compounds.
- The presence of base increase the nucleophilic character of the reagent while the presence of acid increase the electrophilic character of the carbonyl carbon atom

ACID - CATALYZED REACTION

- Acid catalyze the addition of weak nucleophile by protonating carbonyl oxygen.
- Acid increase the electrophilic nature of carbonyl carbon

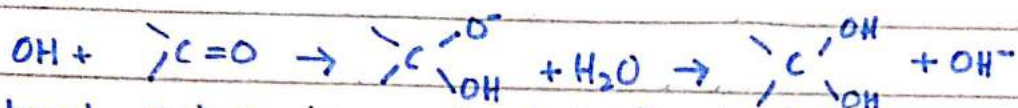


Carbonyl carbon is sp^2 hybridized (trigonal planar) which convert into sp^3 hybridized carbon (tetrahedral)

BASE - CATALYZED REACTION

→ Base reacts with reagent and generate nucleophile.

→ Base increase the nucleophilic nature of carbonyl oxygen.



→ Carbonyl carbon is sp^2 hybridized (trigonal planar) which convert into sp^3 hybridized carbon (tetrahedral)

RELATIVE REACTIVITY OF ALDEHYDES AND KETONES

Ketones are less reactive than aldehydes due to:

- 1) Steric hindrance
- 2) Electronic effect

→ As the number of R-group increases, electron donating effect and steric hindrance both increase and makes carbonyl group less polar so decreases its reactivity

Koracademy.com

REACTIVITY OF CARBOXYLIC ACIDS

- The reactivity of carboxylic acids is similar to alcohols and carbonyl compounds (aldehydes and ketones)
- Carboxyl group is a combination of carbonyl group and hydroxyl group
- Carbonyl carbon in carboxylic acids is less electropositive than carbonyl carbon in aldehyde or ketones so they do not undergo addition or condensation reactions.
- Not attacked by nucleophiles as compared to aldehydes and ketones.
- Carbonyl group attracts electrons from $-O-H$ bond and make it easier to lose H^+ ion.

Koracademy.com