Aromatic Compounds

Benzene and all those compounds which resemble with benzene in their chemical properties are known as aromatic compounds.

Characteristics of Aromatic Compounds

- Cyclic
- Planar
- Fully conjugated
- obeys Huckel rule
- Aromatic compound shows unique stability
- They have pleasant aroma (Fragrance)

Aromatic Compounds

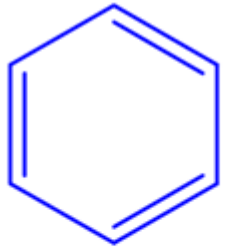
Aromatic compounds shows different properties than aliphatic analogues and alicyclic compounds.

Examples

- benzene undergoes substitution reaction easily rather than addition reaction.
- Aromatic amines are weak bases as compared to aliphatic amines.
- phenols shows weak acidic properties while aliphatic alcohols are neutral in nature.

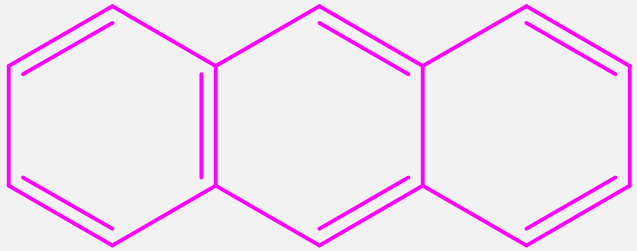
Aromatic Compounds

Huckel Rule: Any fully conjugated, cyclic, planar system which contains (4n+2) π-electrons (2, 6, 10, 14, 18, etc.) is said to be aromatic.



(4n+2) π-electrons

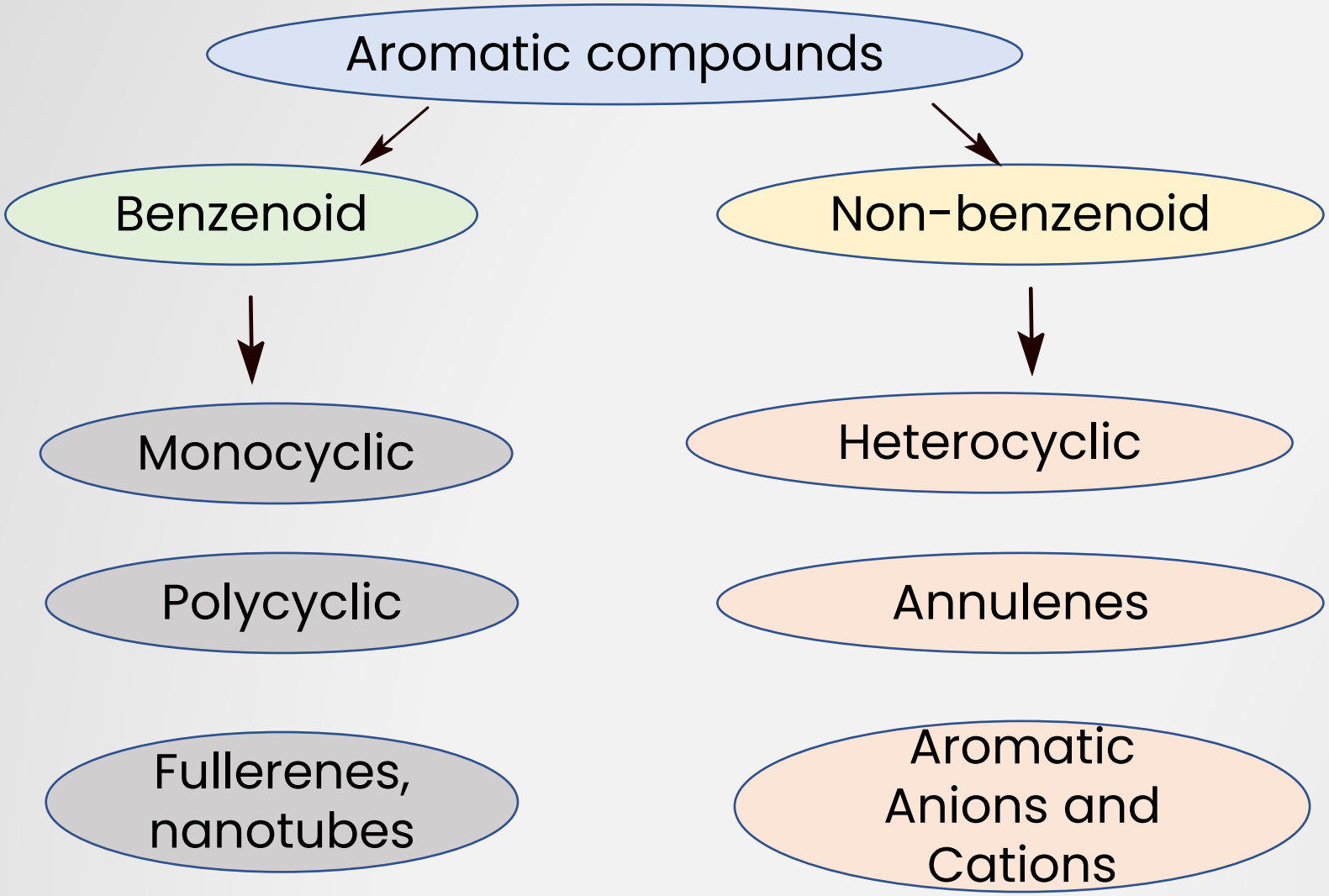
= 6 π-electron



N= 3

(14 π-electrons

Classification



Classification

Benzenoid compounds

Compounds containing one or more fused or isolated benzene rings.

a) Monocyclic Benzenoid Compounds

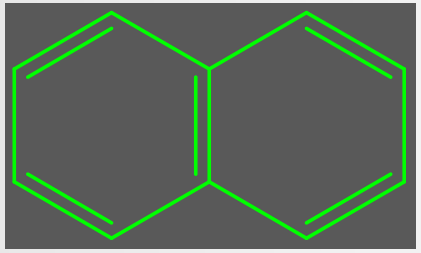
Example: Benzene

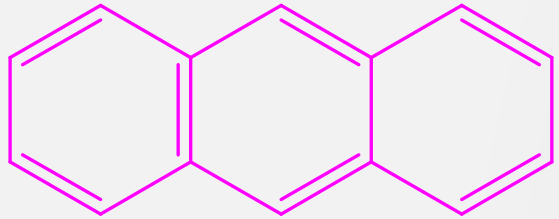
b) Polycyclic Benzenoid Compounds

Contain more than one ring formed by same atoms (carbon)

Further Classified as bicyclic, tricyclic tetracyclic etc.

Example Naphthalene, anthracene etc.

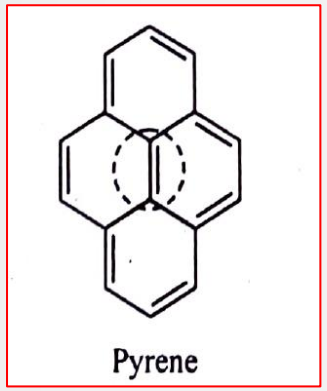


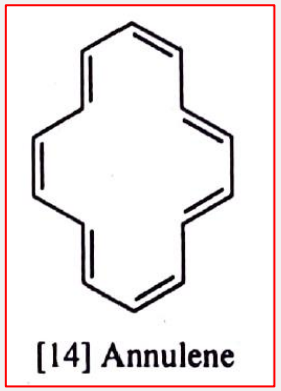


Classification

Pyrene

- Pyrene has 16 pi electrons which is non huckel number.
- One of the pi bond is not participating in delocalization so it cannot be considered in the 4n+2 electrons. So it has only 14 delocalized pi electrons and its aromatic.
- At periphery system is similar to [14] annulene and is aromatic

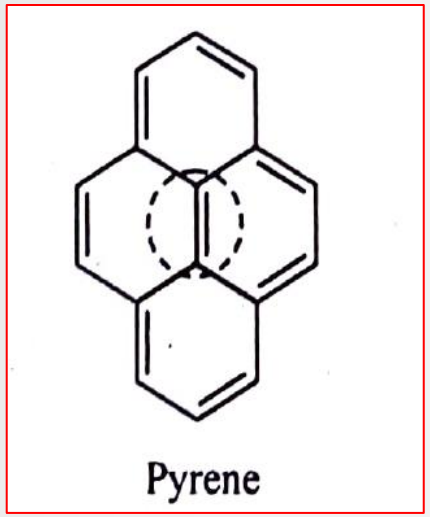

Pyrene


[14] Annulene

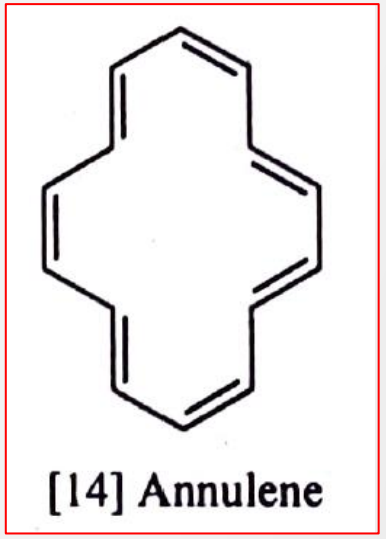
Classification

Pyrene

- Pyrene is a polycyclic aromatic hydrocarbon consisting **of four fused benzene rings**. The chemical formula is $C_{16}H_{10}$.
- It has 16 pi electrons which is non huckel number.
- One of the pi bond is not participating in delocalization so it cannot be considered in the 4n+2 electrons. So it has only 14 delocalized pi electrons and its aromatic.
- At periphery system is similar to [14] annulene and is aromatic



Pyrene

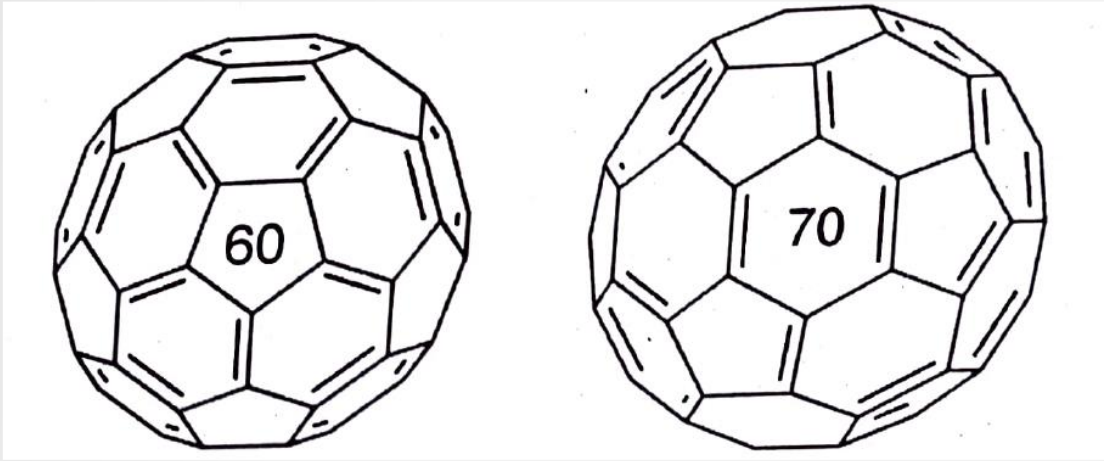


[14] Annulene

Classification

Fullerenes

- W. Kratschmer, D. Huffman and co workers (1990) reported first practical synthesis of C60 called Buckminsterfullerene.
- Kroto, curl and Smalley (1996) get Noble Price for Fullerenes found in both C60 and C70.

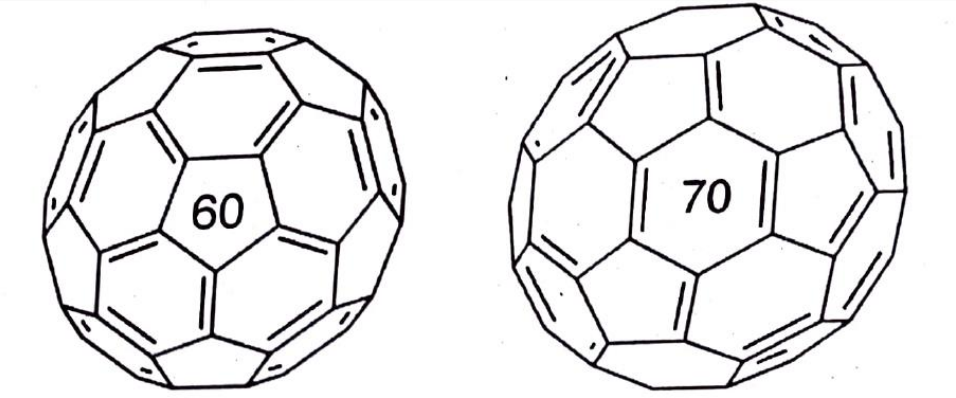


Fullerene -60 and Fullerene-70

Classification

Fullerenes

Structural features
It is composed of pentagons and hexagons
C60 has 20 hexagonal faces while C70 has 25
All carbon are SP2 hybridized
Each carbon have three sigma bonds with three other atoms
Remaining electrons are involved in delocalization.

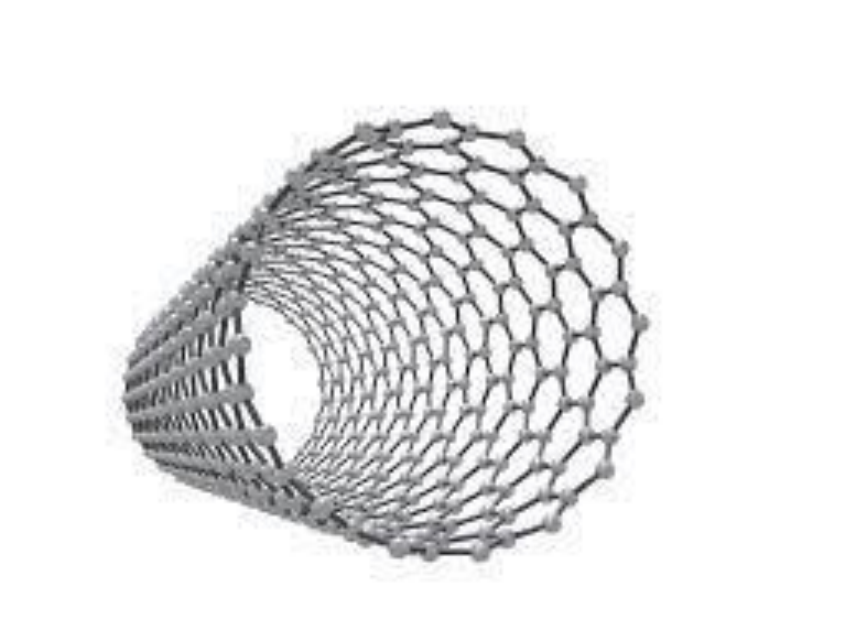


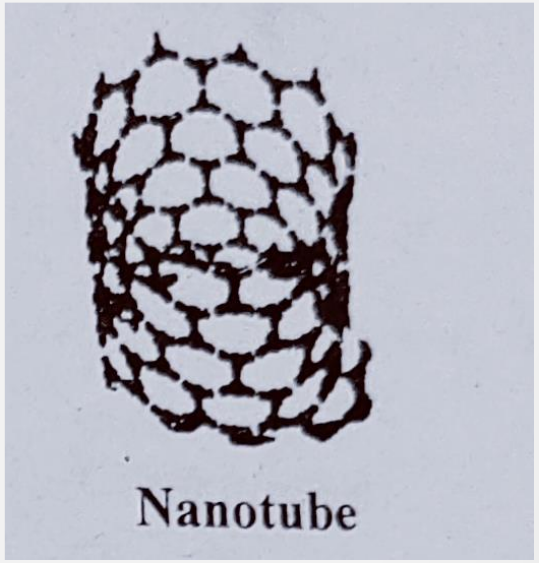
Fullerene -60 and Fullerene-70

Classification

Nanotubes

Carbon nanotubes are composed of cylindrical graphite sheets. Like graphite CNTs are also made up of SP2 hybridized carbons and arranged in hexagonal maner.



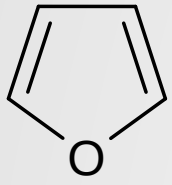


Classification

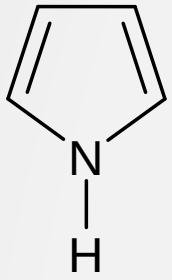
Heterocyclic compounds

The cyclic compounds in which one or more carbon atoms forming a ring are replaced by hetero atom are called heterocyclic compounds.

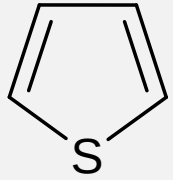
Monocyclic



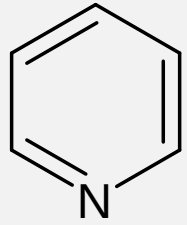
Furan



Pyrrole



Thiophene

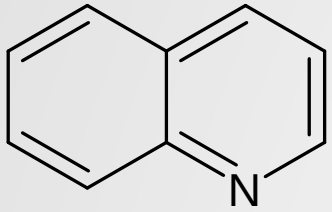


Pyridine

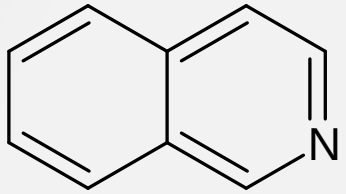
Classification

Heterocyclic compounds

Polycyclic Aromatic Compounds



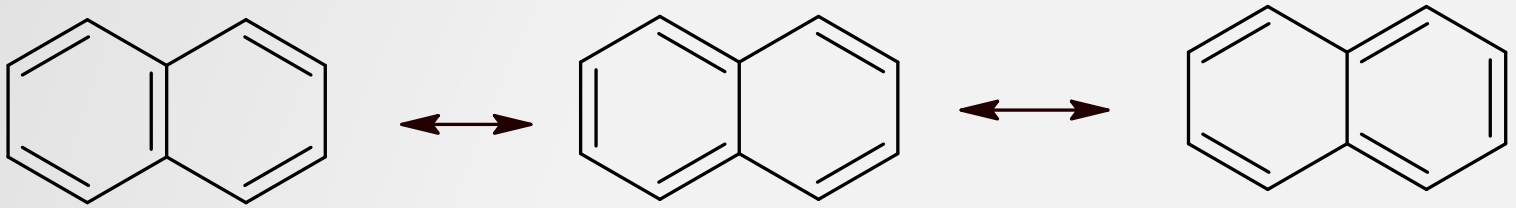
Quinoline



Isoquinoline

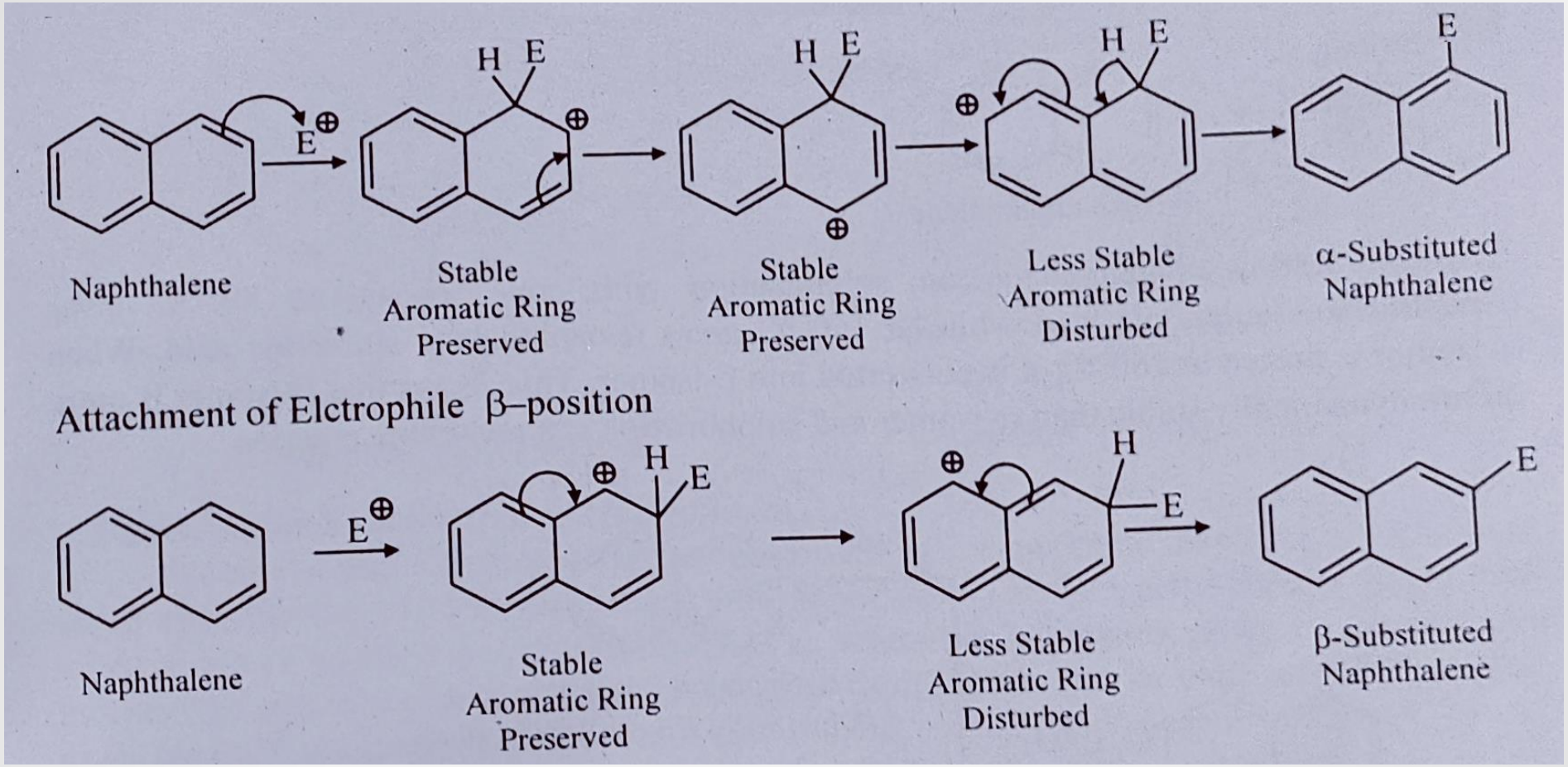
Naphthalene

Naphthalene is an aromatic hydrocarbon having two fused benzene rings

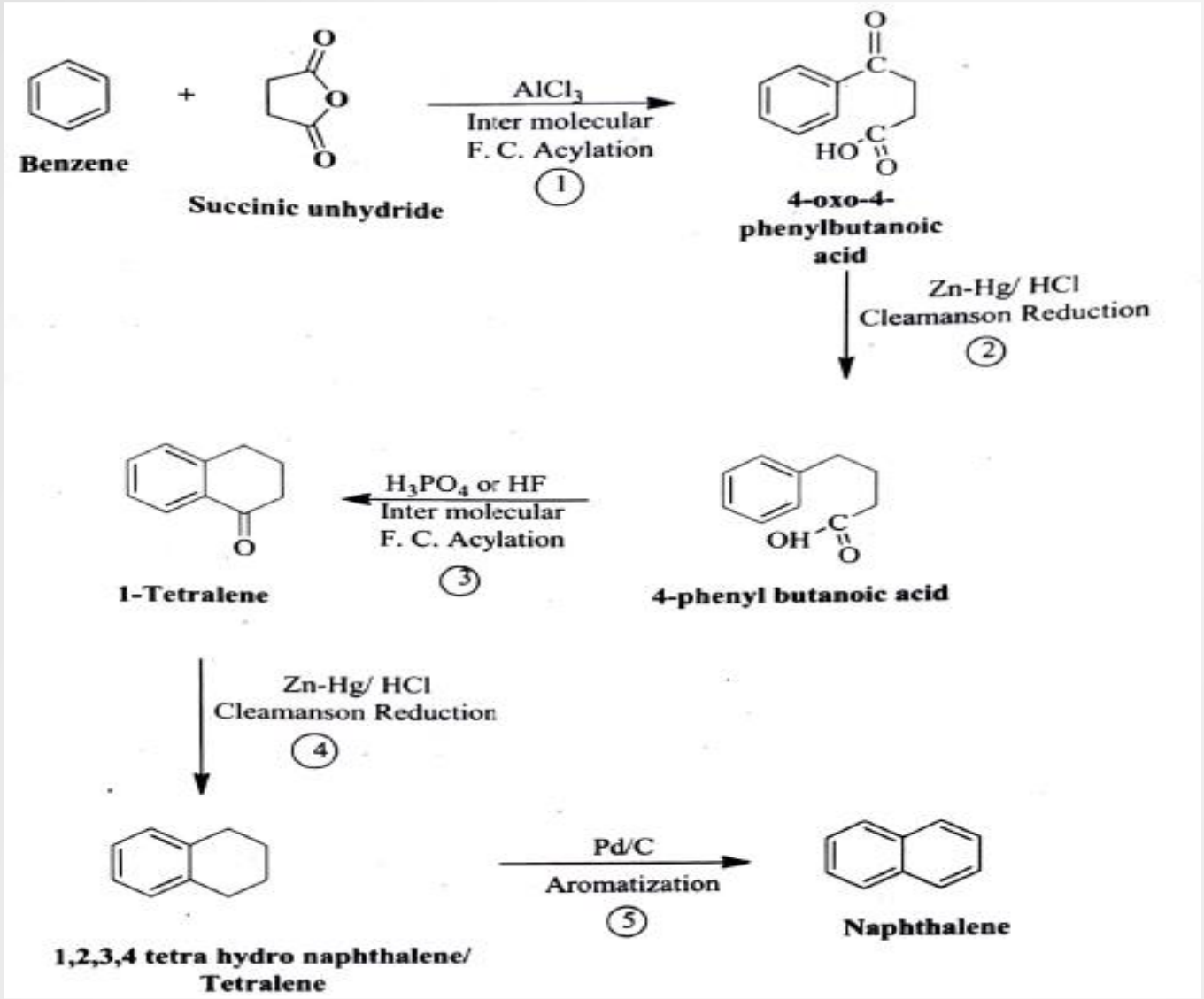


Naphthalene

Electrophilic substitution reactions take place at 1 or 2 position.
In most of the cases 1 substituted product is obtained, as carbocation formed at α position is stabilized more effectively as compare to β position.



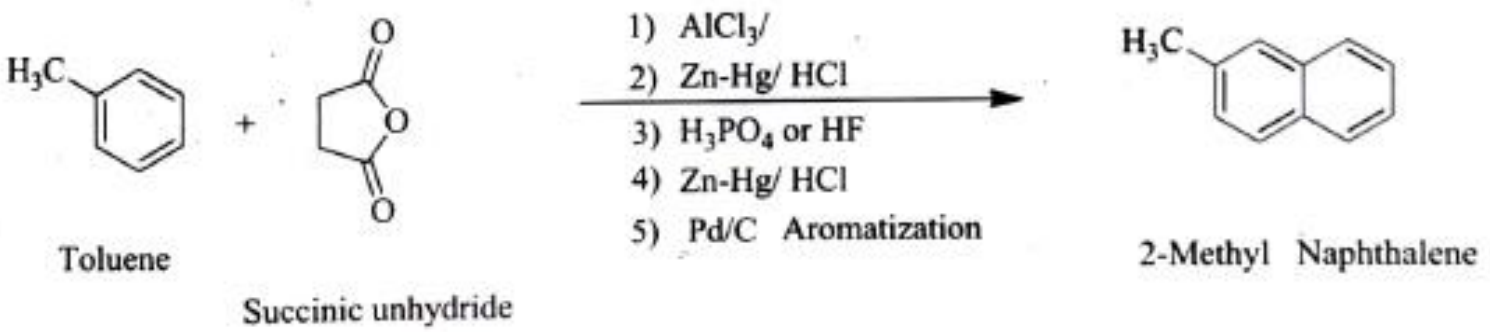
Naphthalene



From Benzene and Succinic anhydride

Naphthalene

b. From substituted Benzene and succinic anhydride:



Toluene

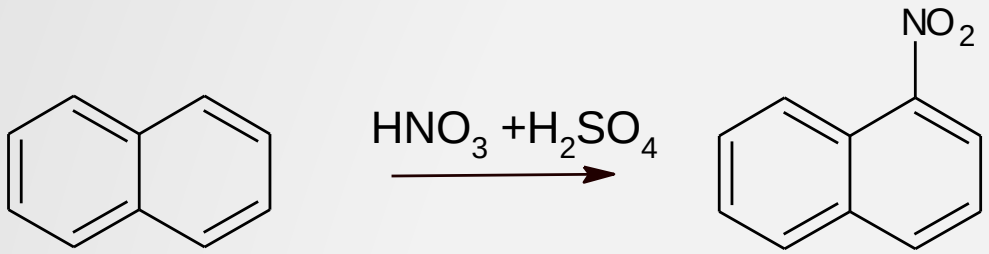
Succinic unhydride

2-Methyl Naphthalene

Reactions of Naphthalene

Nitration

Naphthalene on treatment with nitrating mixture produce α nitro naphthalene

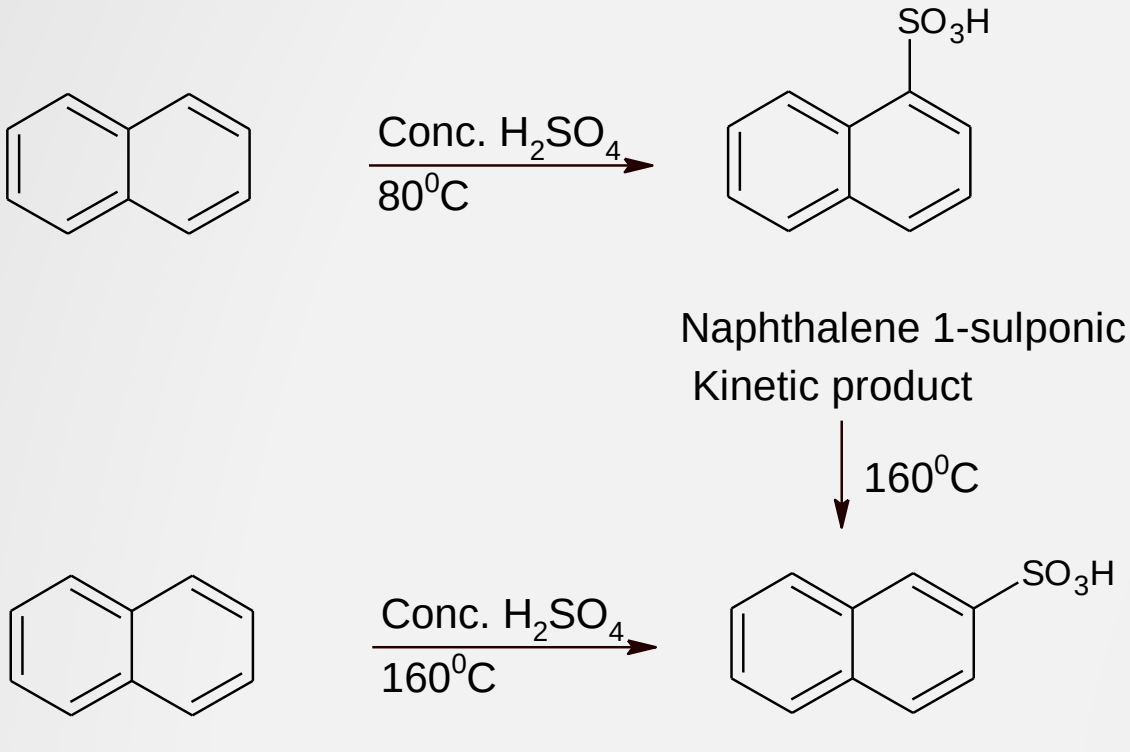


1 nitro naphthalene

Reactions of Naphthalene

Sulphonation

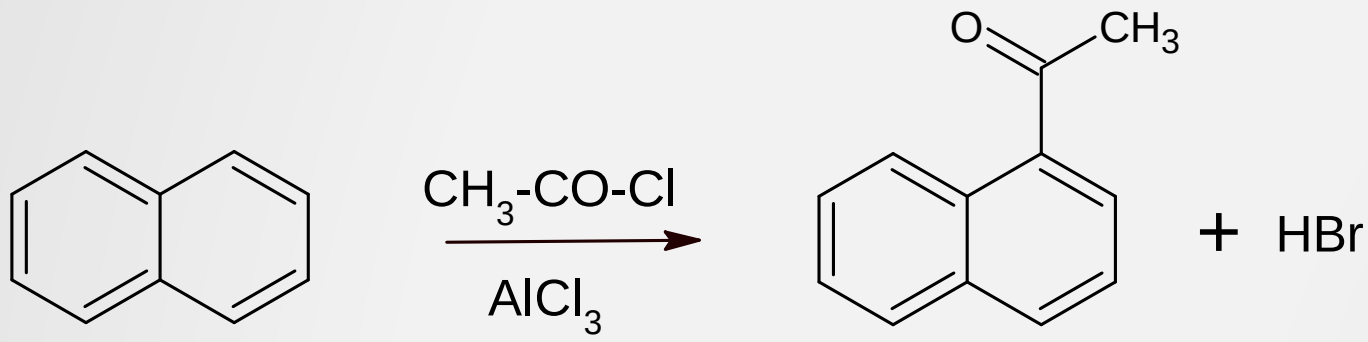
Naphthalene on treatment with concentrated sulfuric acid at 80^0C gives naphthalene α-sulphonic acid while at higher temperature naphthalene 2-sulphonic acid is formed.



Reactions of Naphthalene

Friedel Craft Acylation

Naphthalene on treatment with acyl chloride in presence of Lewis acid catalyst (Solvent: carbon disulphide, carbon tetrachloride and dichloroethane) gives 1 acetyl naphthalene.



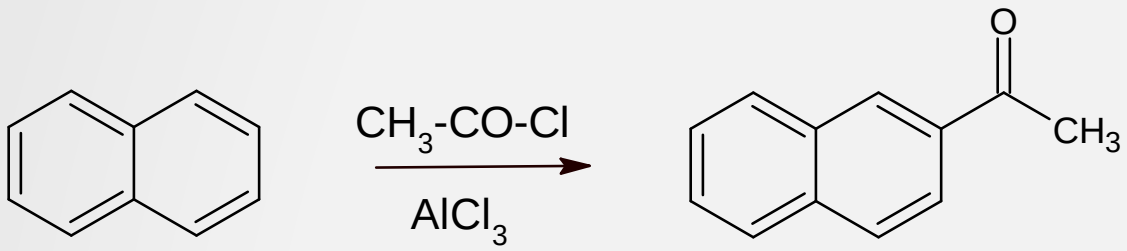
1-Acetyl naphthalene

Solvent CS_2,CCl_4, $C_2H_2Cl_2$

Reactions of Naphthalene

Friedel Craft Acylation

Naphthalene on treatment with acyl chloride in presence of Lewis acid catalyst (Solvent: nitrobenzene) gives 2 acetyl naphthalene.



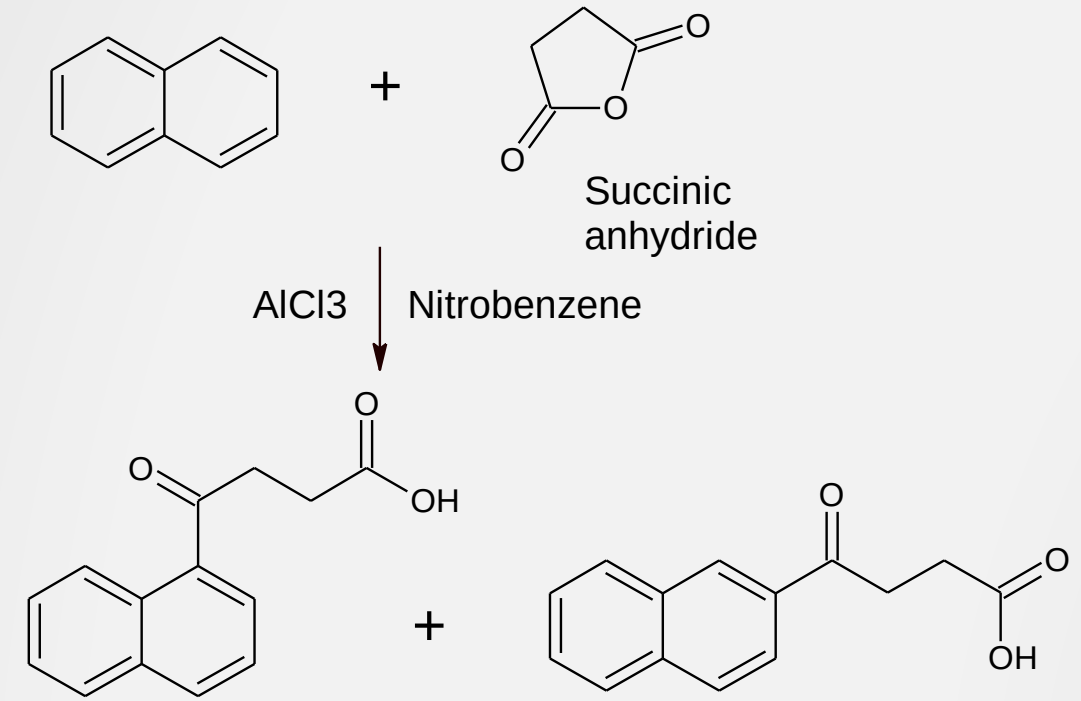
2-Acetyl naphthalene

Solvent Nirtobenzene

Reactions of Naphthalene

Friedel Craft Acylation

Naphthalene on treatment with succinic anhydride in presence of Lewis acid catalyst (Solvent: nitrobenzene) gives mixture of 1-naphthoyl propanoic acid and 2-naphthoyl propanoic acid .

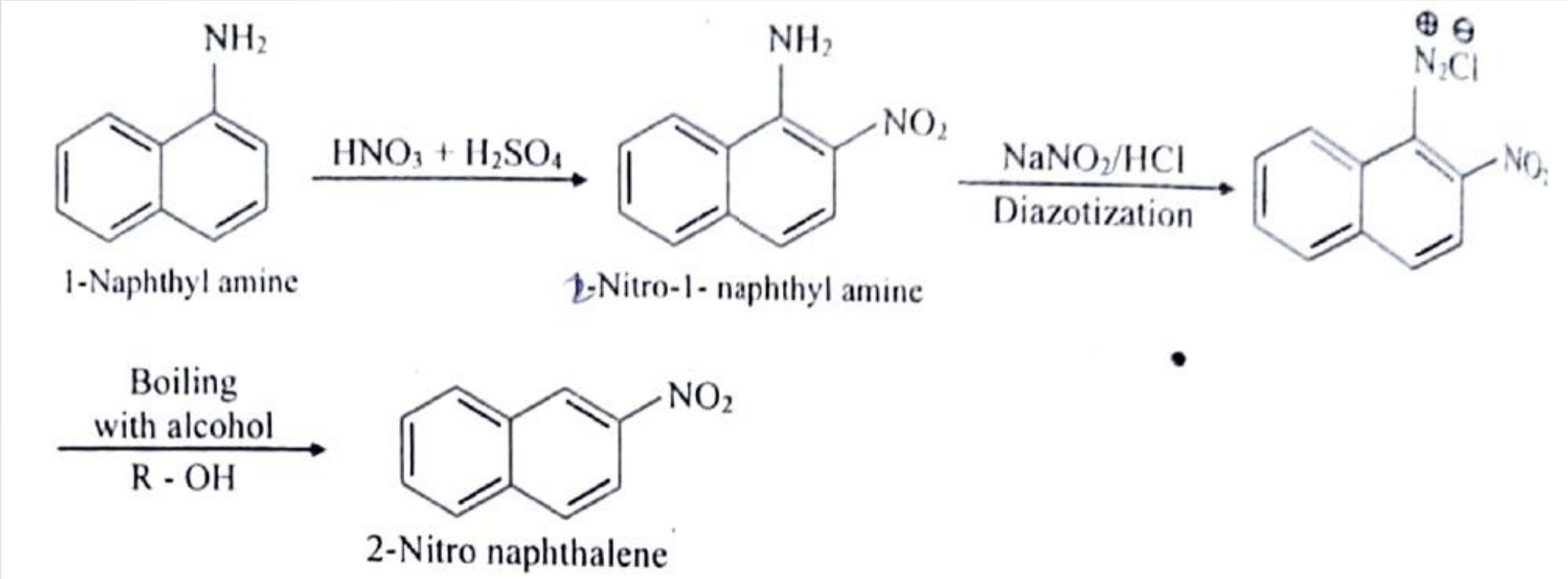


4-(1-Nahthyl)-4-oxobutanoic acid

4-(2-Naphthyl)-4-butanoic acid

Reactions of Naphthalene

Synthesis of 2-nitronaphthalene



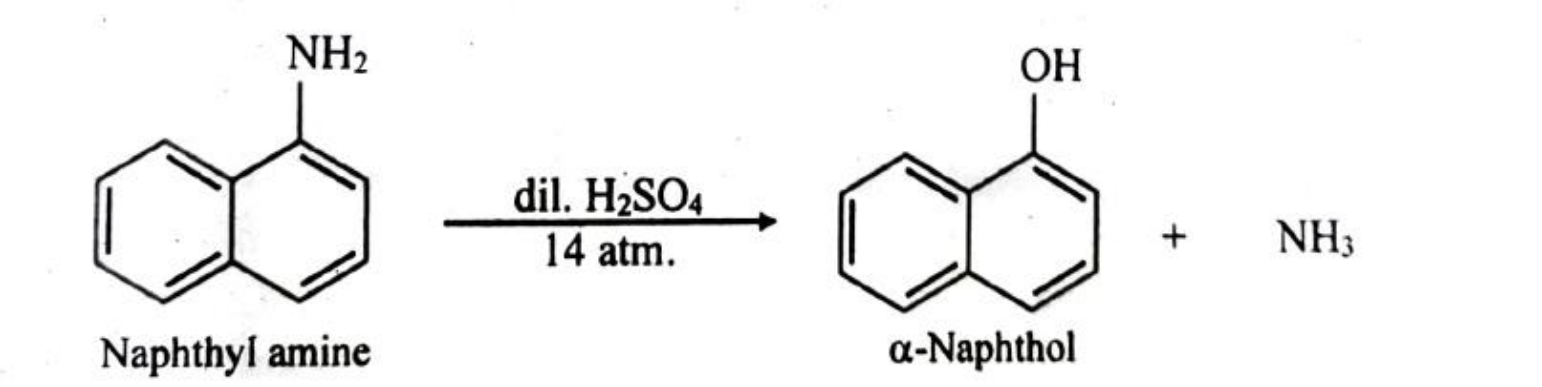
Reactions of Naphthalene

Nucleophilic Substitution reactions

- Nucleophilic aromatic substitution take place and removal of good leaving group take place easily.
- Presence of electron withdrawing group increase the rate of reaction

1)Preparation of Naphthol

Acidic hydrolysis of Naphthyl amine at high pressure produce 1-naphthol

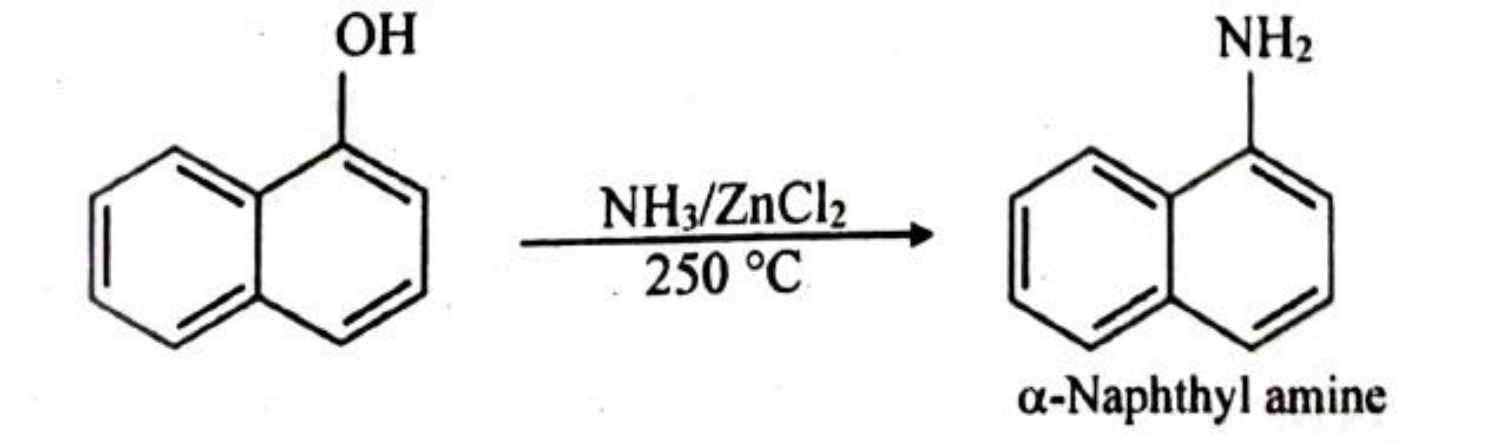


Reactions of Naphthalene

Nucleophilic Substitution reactions

1)Preparation of 1-Naphthyl amine from 1-Naphthol

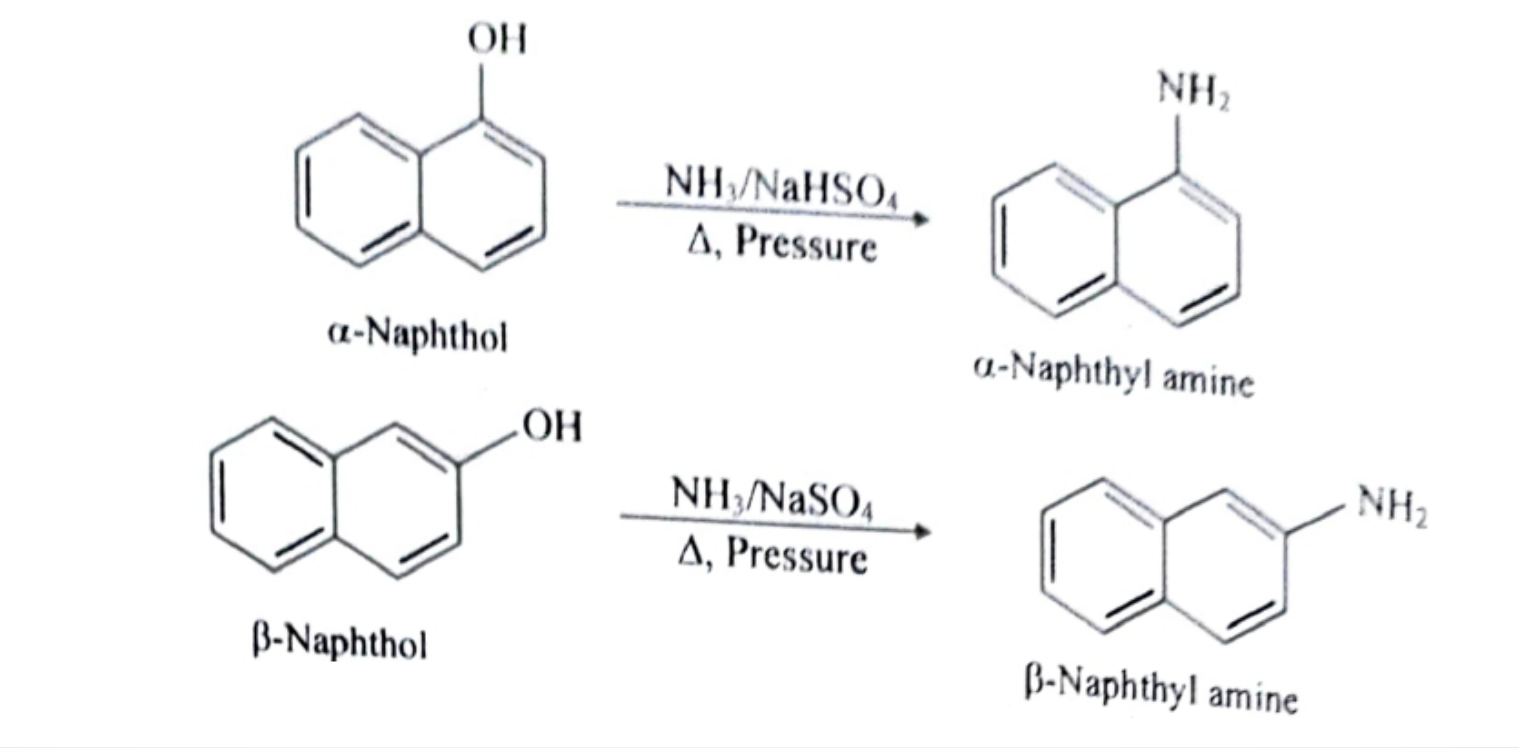
Direct amination of 1-naphthol produce 1-naphthyl amine



Reactions of Naphthalene

Bucherer reactions

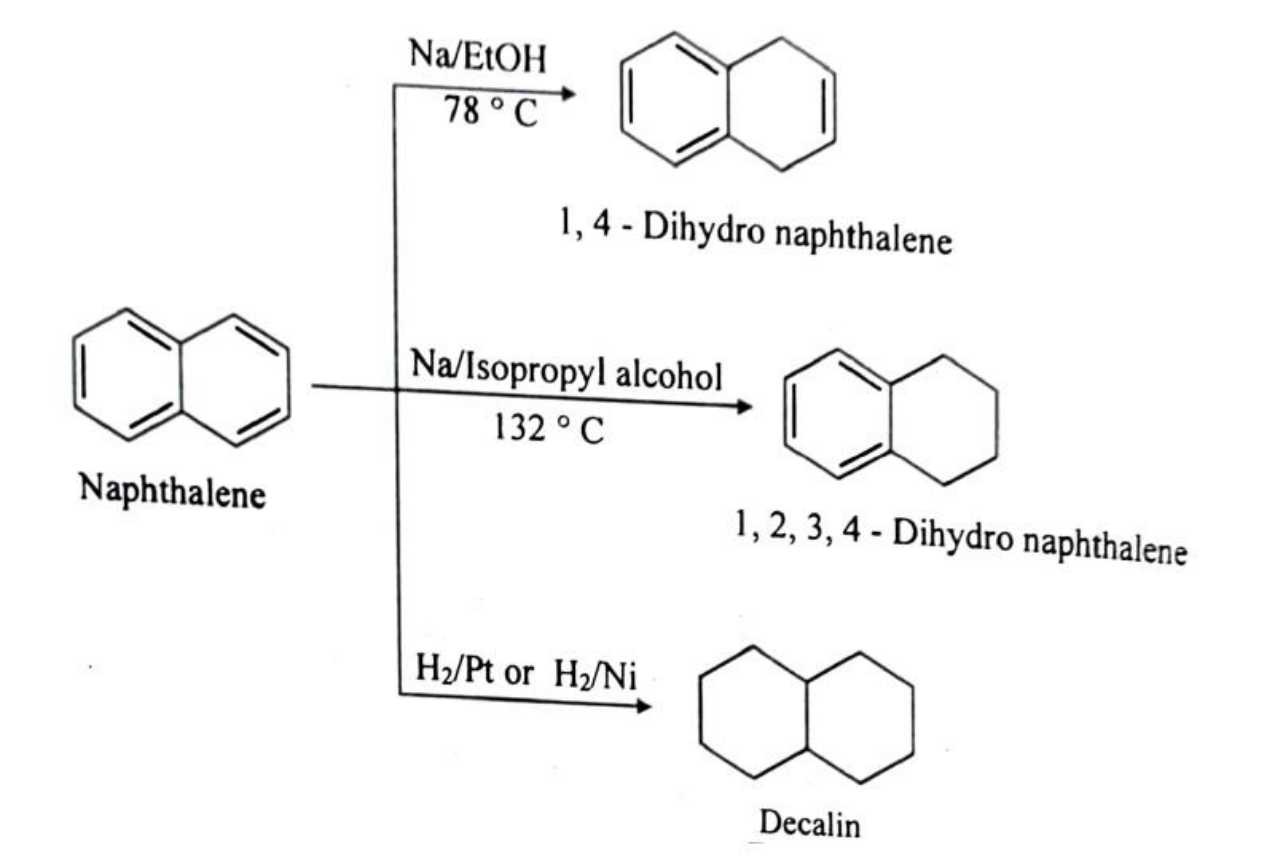
1 and 2 naphthyl amine can be obtained from corresponding naphthol by heating with bisulphite and ammonia at high pressure



Reactions of Naphthalene

Reduction Reactions

Selective reductions of naphthalene can be carried out by selection proper reagent




Thank You so Much