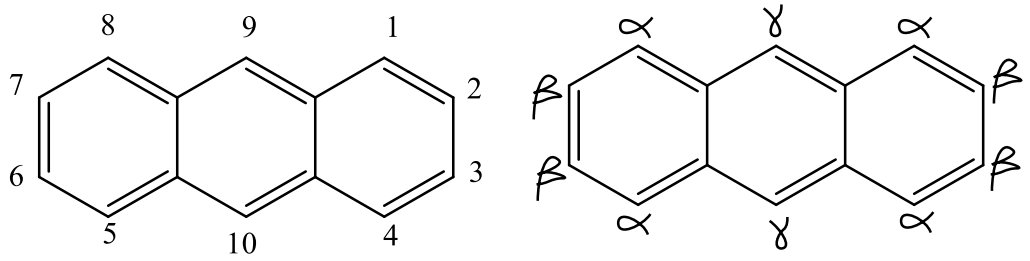
ANTHRACENE

Molecular formula $C_{14}H_{10}$

Anthracene is an example of condensed polynuclear hydrocarbons containing three benzene rings fused with each other in a linear manner.



α- position equivalent to 1,4,5,8
β- position equivalent to 2,3,6,7
γ- position equivalent to 9,10

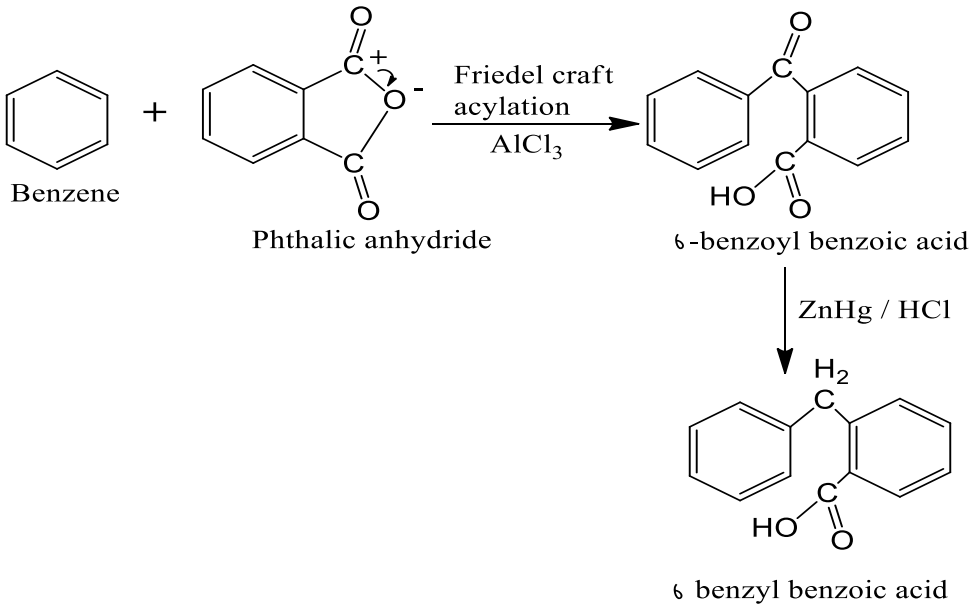
If monosubstitution is carried out in anthracene, three monosubtituted product are obtained, α or 1- substituted, β or 2 substituted and γ or 9 substituted.

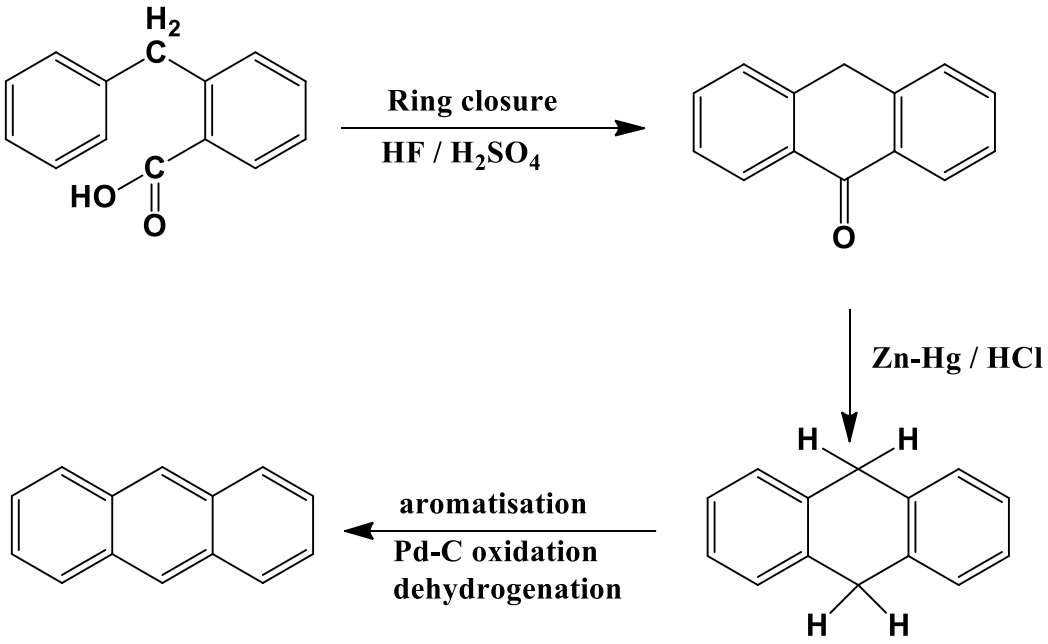
Methods of Preparation

1. Haworth synthesis

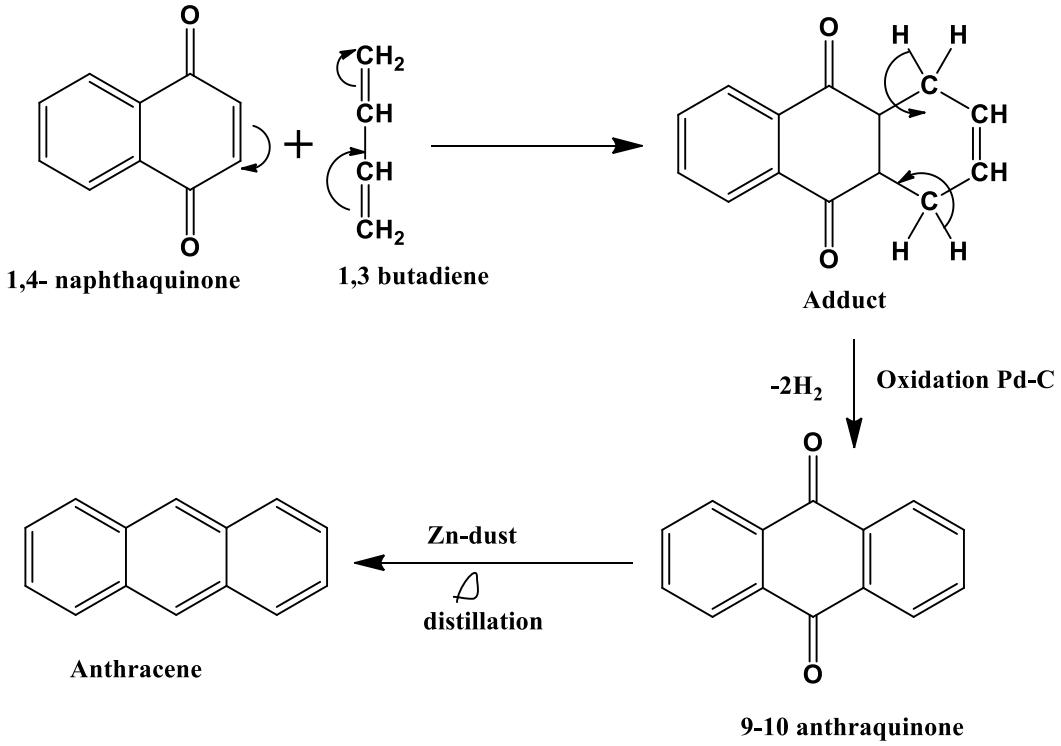
It involve mainly four type of reactions-

a) Friedel craft acylation
b) Clemmensen reduction
c) Ring closure
d) Aromatization





2. Diel's Alder reaction



1,4- naphthaquinone

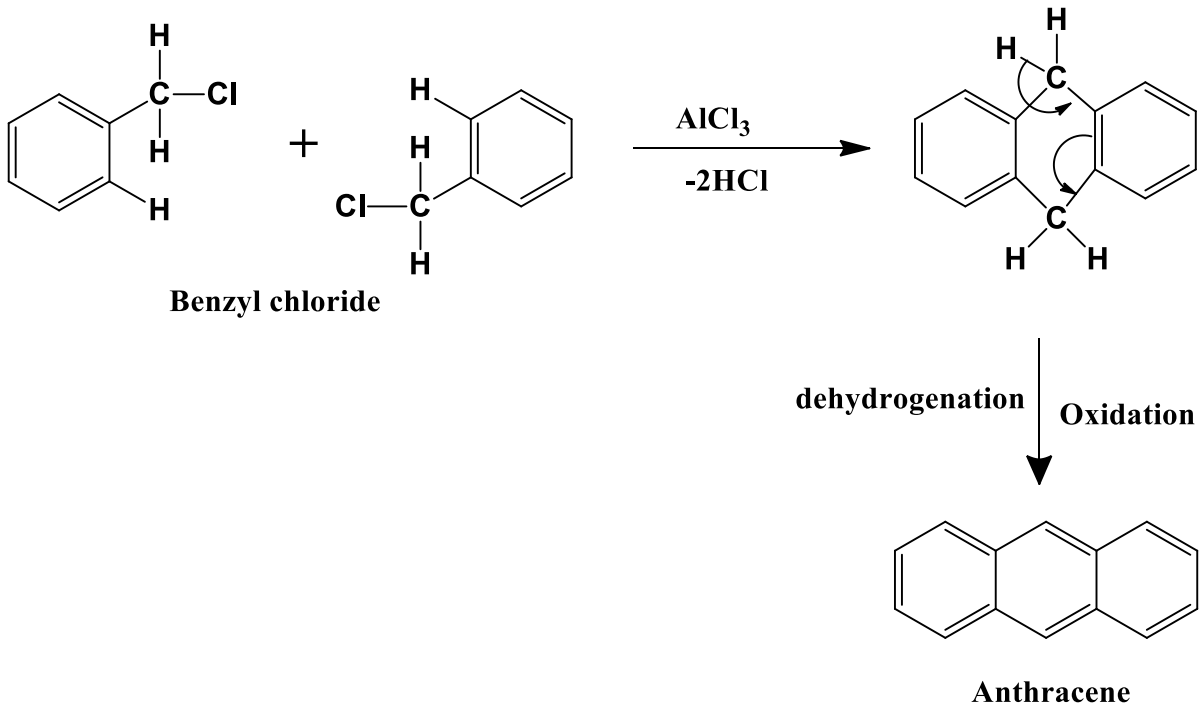
1,3 butadiene

Adduct

Anthracene

9-10 anthraquinone

3.



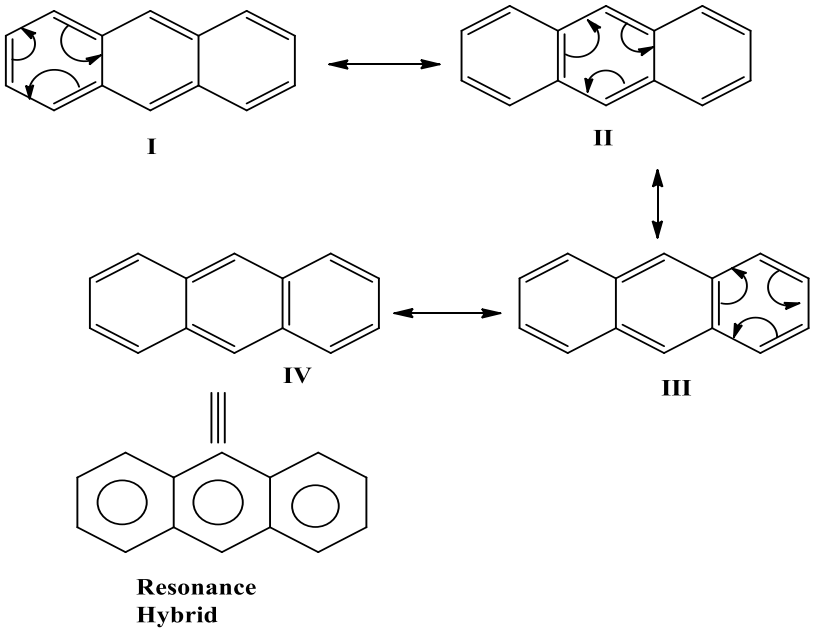
Benzyl chloride

Anthracene

Chemical Properties

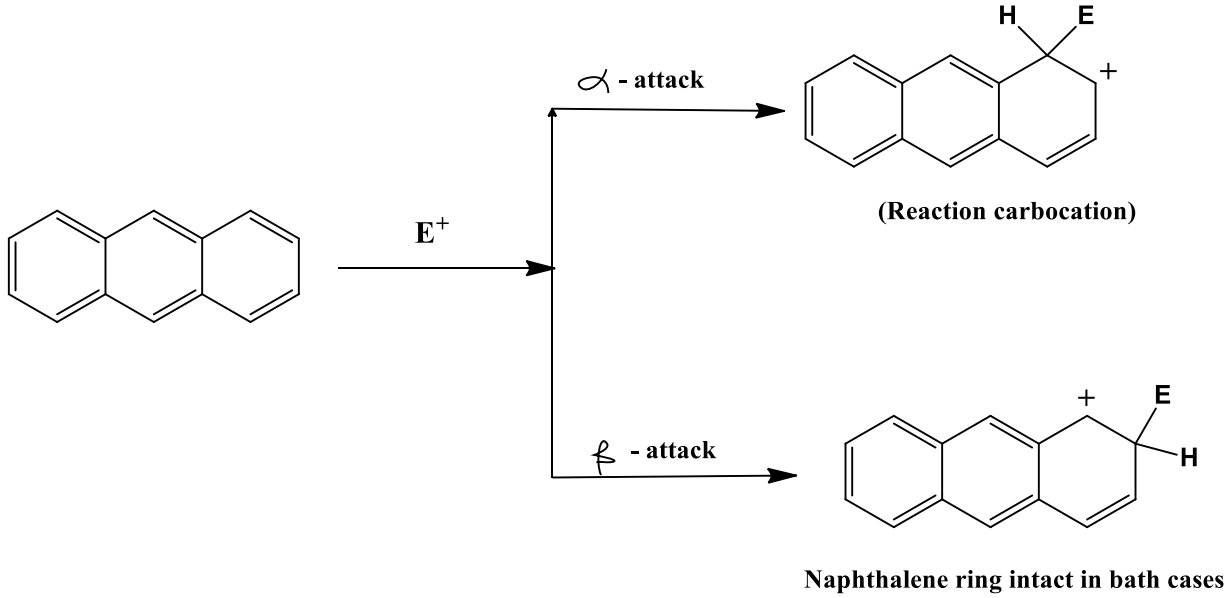
1. Anthracene is a well known aromatic compound. It has cyclic, Planner structure and follow Huckel's rule having total no. of $14\pi e^-$ (n=3).

2. **Resonating structure**



3. Electrophillic substitution reaction

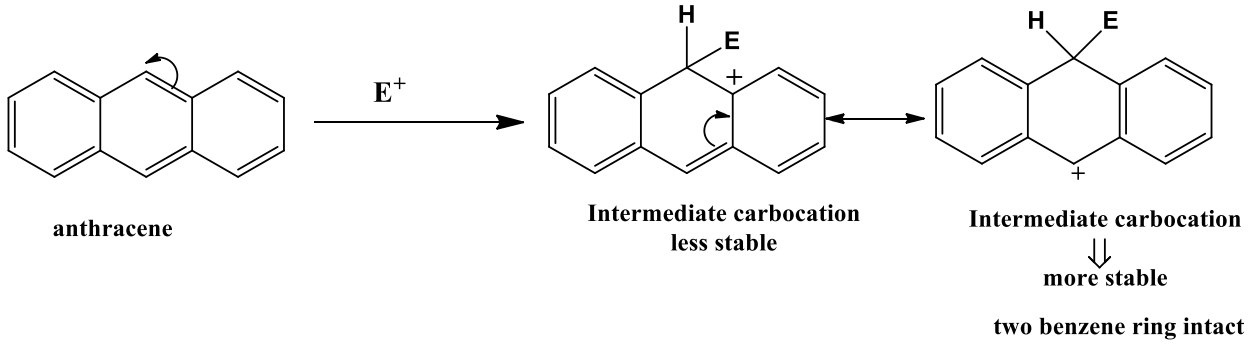
- Anthracene is aromatic in nature and hence undergo characteristics reactions of aromatic reaction i.e. electrophillic substitution reaction.
- There are three different positions in this compound, where, monosubstitution can be take place, α, β, γ. This can be decided on the basis of loss in resonance energy in substitution on the three positions.
- Electrophillic attack on α and β positions left a naphthalene ring intact.



The resonance energy of anthracene = 351.5 KJ/mol

- The resonance energy of naphthalene is 255.2 KJ/mol so in α and β substitution the loss in resonance energy is = Resonance energy of anthracene – Resonanace energy of naphthalene
  = 351.5 – 255.2
  = 96.8 KJ/mol

Electrophillic attack on γ position



The resonance energy of one benzene ring is 150.6 KJ/ mol.

For two benzene ring = 150.6 x 2 = 301.2 KJ / mol

So during γ substitution loss in resonance energy= Resonance energy of anthracene – Resonance energy of two benzene ring

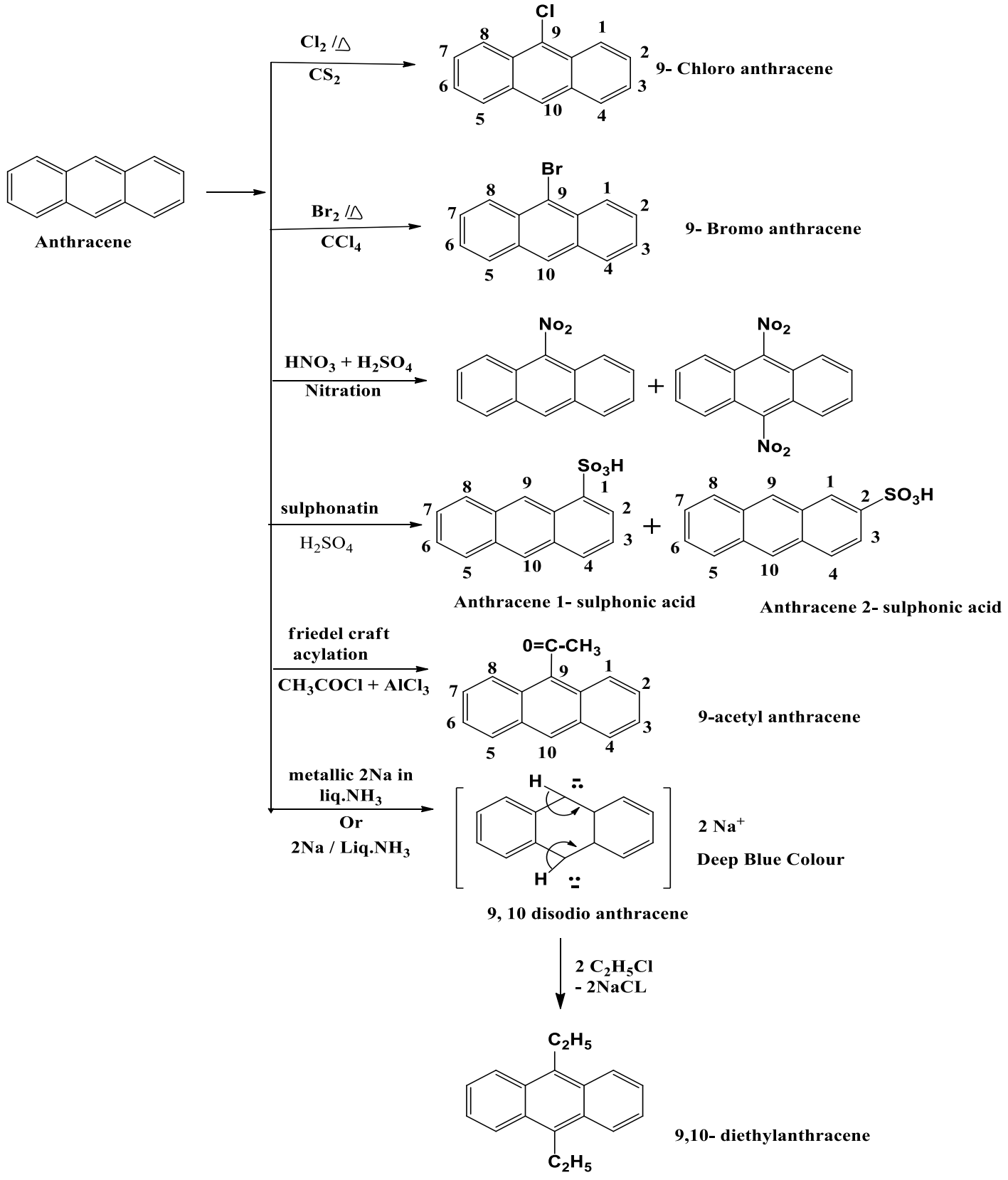
= 351.5- 301.2

= 50.3 KJ/ mol

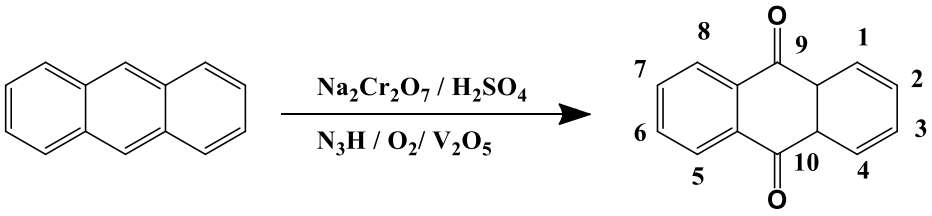
Therefore, from energy point of view, electrophillic attack at γ position is favoured as compared to that of α and β positions.

Note: On Comparing with benzene, anthracene is found to be less aromatic than benzene. This is due to its lower resonance energy is expected. Anthracene three benzene ring are fused with each other in leniar manner (fashion) so, its resonance energy must have been three times of benzene, i.e. = 3 x 150.6 (benzene resonance energy) = 451.8 KJ/mol. But the actual resonance energy of anthracene is only 351.5 KJ/mol, which is much lesser than expected value. This less resonance energy makes anthracene less aromatic in nature.

Eg.

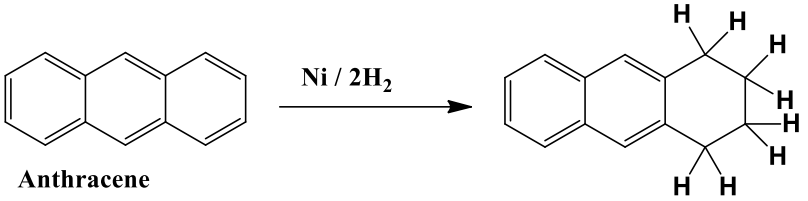

Anthracene
Cl2 /△
CS2
9- Chloro anthracene
Br2 /△
CCl4
9- Bromo anthracene
HNO3 + H2SO4
Nitration
No2
No2
No2
sulphonatin
H2SO4
So3H
SO3H
Anthracene 1- sulphonic acid
Anthracene 2- sulphonic acid
friedel craft
acylation
CH3COCl + AlCl3
0=C-CH3
9-acetyl anthracene
metallic 2Na in
liq.NH3
Or
2Na / Liq.NH3
2 Na+
Deep Blue Colour
9, 10 disodio anthracene
2 C2H5Cl
- 2NaCL
C2H5
C2H5
9,10- diethylanthracene

4. Oxidation reaction



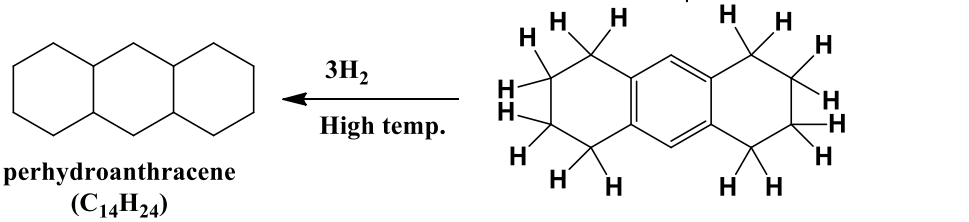
9,10- anthraquinone

5. Reduction



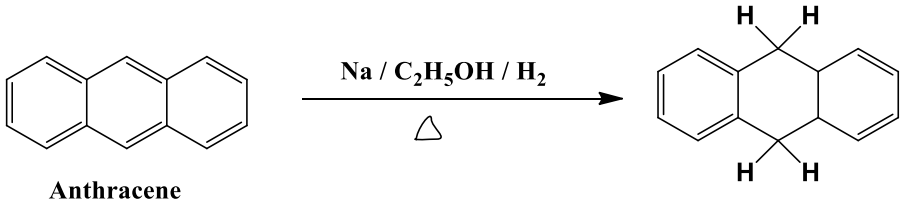
Anthracene

1,2,3,4 tetrahydroanthracene



perhydroanthracene
($C_{14}H_{24}$)

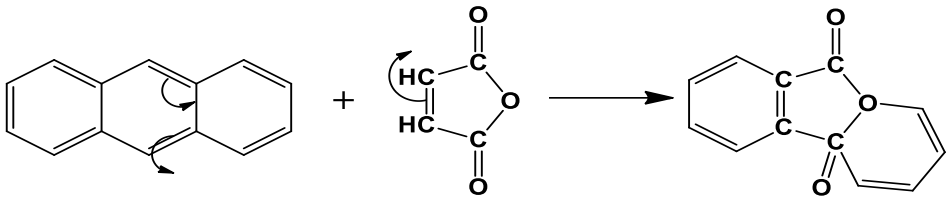
1,2,3,4,5,6,7,8 octahydro anthracene



Anthracene

9,10- dihydroanthracene

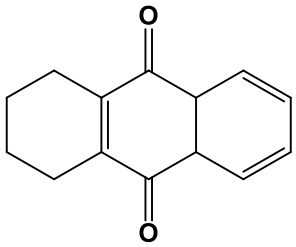
6. Diel's Alder Reaction



anthracene maleic acid anhydride diel's alder adduct

Anthracene Derivatives

i) 9,10 anthraquinone (anthraquinone)



ii) Alizarin