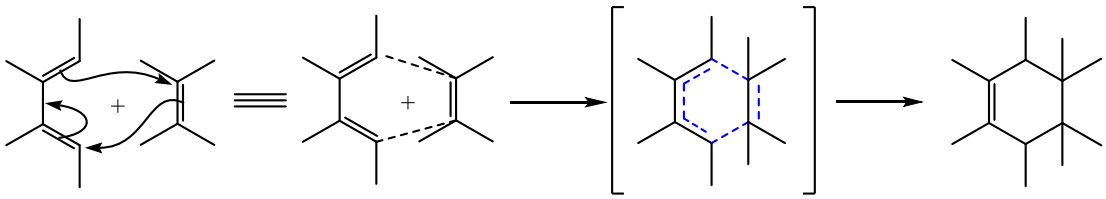
Mechanism of Diels – Alder reaction:

The reaction occurs after the approach of diene and dienophile in a parallel way to each other and in a vertical way to the newly formed bonds.
Broadly speaking, there are three possible mechanisms that have been considered for the Diels – Alder reaction.

In mechanism (a) there is a cyclic six – centered transition state and no intermediate. The formation of the new single bond occurs at the same time (simultaneously) which is known as concerted or pericyclic mechanism.

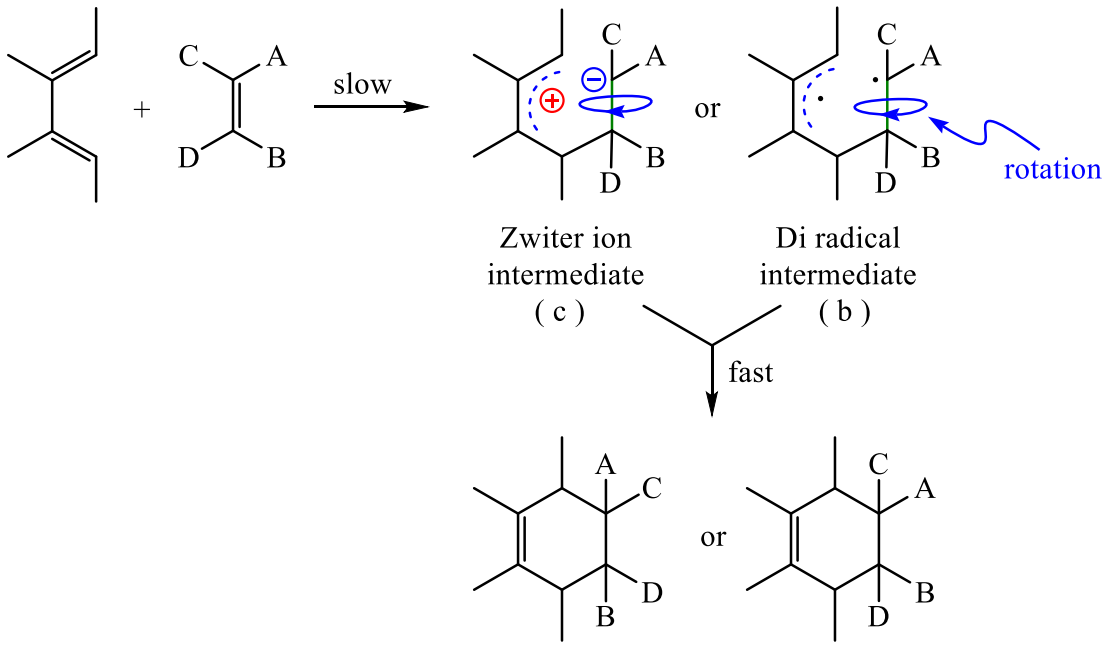


(Concerted or Pericyclic mechanism)

Note: *The reaction occur in one step.*

In mechanism (b), one end of the diene fastens to one end of the dienophile first to give a diradical and then, in the second step, the other end becomes fastened. The first step is the (R.D.S.) i.e. slow step while the second step is fast.

The third mechanism (c) is similar to (b) but the first step involve the formation of intermediate which is a di ion (zwitter ion), this step is also slow (i.e. R.D.S.), while the second step is fast.



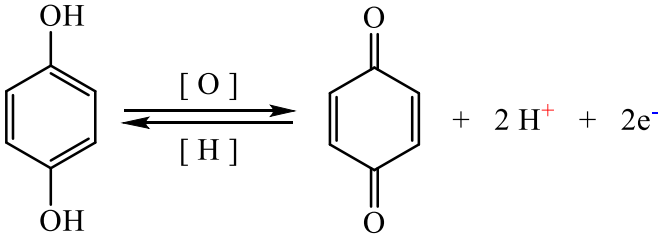
(Mechanisms b & c)

All of the above mechanisms are possible but the main evidence that support mechanism a (one step cyclic mechanism) is the reaction is stereospecific in both of the diene and dienophile.

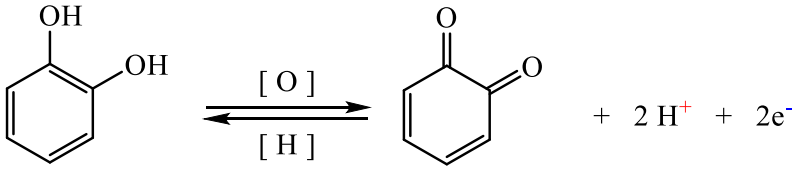
Note: *A completely di radical (b) or di ion (c) probably would not be able to retain its configuration.*

3:8) Quinones:

Quinones are a special type of α,β-unsaturated ketones, these are cyclic di ketones of such a structure that they are converted by reduction into hydroquinones. The simplest quinones are 1,4-benzoquinone and 1,2-benzoquinone which also called *p*-benzoquinone and *o*-benzoquinone respectively. The latter compounds prepared by oxidation of hydroquinone and catichol by the use of mild oxidizing agents like ferric ion (Fe^{+3}) or silver ion.



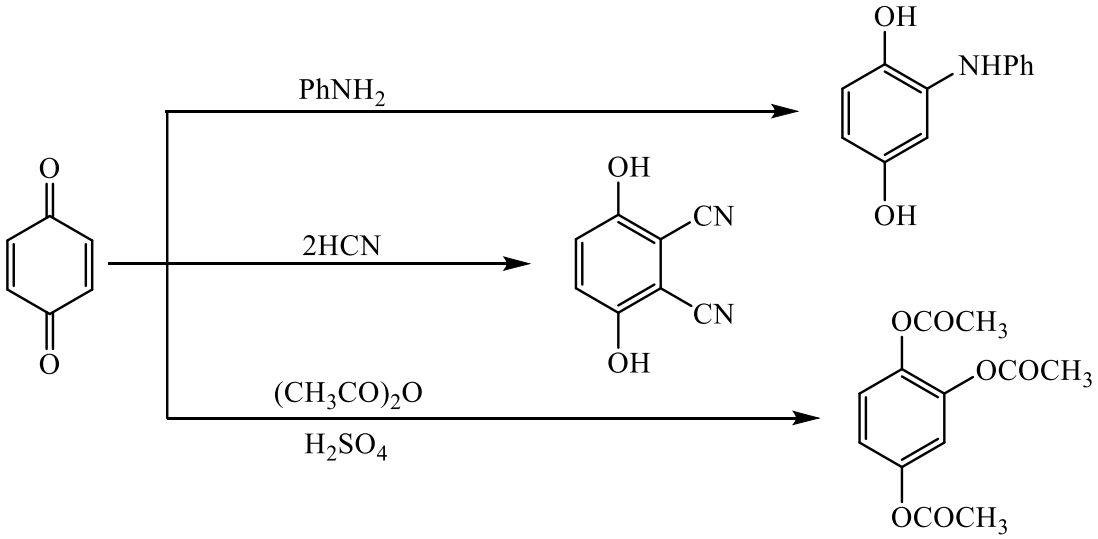
Hydroquinone 1,4-Benzoquinone



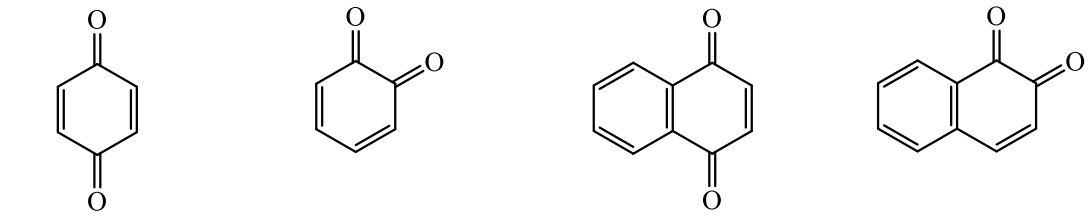
Catichol 1,2-Benzoquinone

Simple hydroquinones are colorless, on the other hand all quinones are colored, due to their highly conjugation.
The capability of hydroquinone to reduce silver ion is the basic feature in the chemistry of photography.
Hydroquinones can be oxidized by either ferric chloride, manganese dioxide – sulfuric acid or by dichromate. The best oxidizing agent is silver oxide in dry ether in the presence of anhydrous sodium sulfate that abstract water from the reaction medium during oxidation.

Simple quinones undergoes nucleophilic addition as the following:



The last reaction is known as Thiele acylation.
Many compounds that contain the quinone system have been used as a dyes such as:



1,4-Benzoquinone yellow | 1,2-Benzoquinone red | 1,4-Naphthoquinone yellow | 1,2-Naphthoquinone yellow - red