

## CHEMISTRY DAILY PLAN

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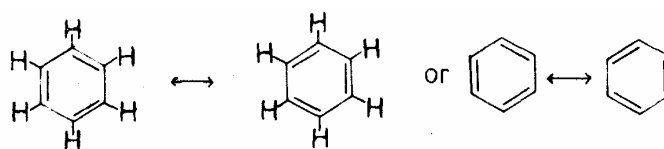
Date:

Subject: Aromatic Hydrocarbons

Time:

Benzene and its derivatives are called **aromatic compounds**. The term "aromatic" is used because of characteristic and often-pleasant odors of these compounds. Benzene, a water insoluble liquid boiling at  $80^\circ$ , has the molecular formula  $C_6H_6$ . Coal tar is an important source of benzene. Some aromatic hydrocarbons are now obtained from the petroleum industry. The ratio of carbons to hydrogens suggests that benzene is unsaturated. Friedrich Kekulé proposed the first reasonable structure for benzene.

The six carbon atoms are located at the corners of a regular hexagon and a hydrogen atom is bonded to each carbon. Single and double bonds alternate around the ring as shown below.

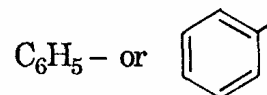


The Kekulé structures for benzene

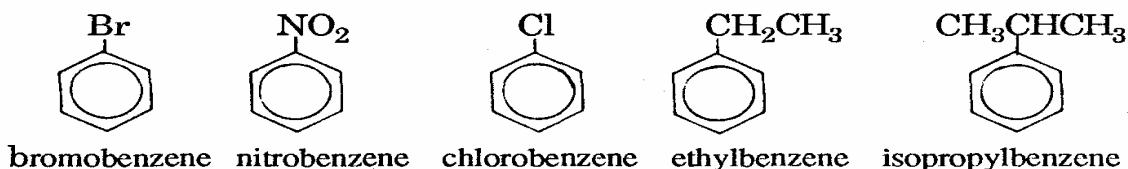
According to the modern concept of structure of benzene, it is a planar hexagon and all the carbon-carbon bond distances are identical and equal to  $1.39\text{Å}$ . The six-member ring of carbon atoms is formed by the overlap of  $sp^2$  orbitals of carbon. The resulting p orbitals (one on each carbon) overlap to form a  $\pi$ -bond. This  $\pi$ -bond is formed by the overlap of six p orbitals, which results in a region of  $\pi$ -electron density above and below the hexagon structure. This structure of benzene is called "**molecular orbital representation**"

### Nomenclature of Aromatic Compounds

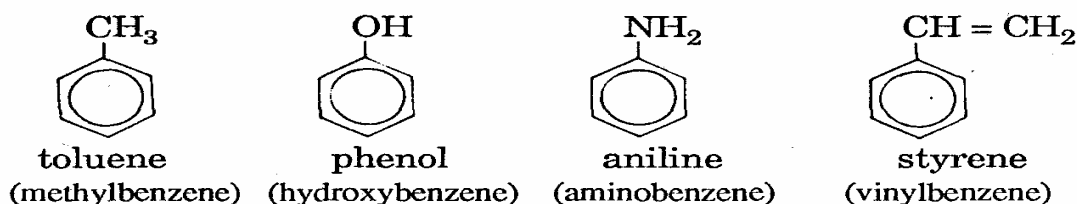
The general class name for aromatic hydrocarbons is **arene**. The group that corresponds to a benzene minus one hydrogen is called the **phenyl group**.



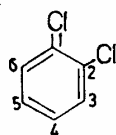
Monosubstituted benzenes are given names as derivatives of benzene.



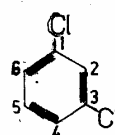
The trivial names are also used for some derivatives of benzene.



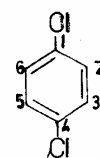
When two substituents are attached to the benzene ring, three isomeric structures are possible. The position and number of each substituents can be indicated by the appropriate number and prefix. The prefixes **ortho-**(o-), **meta-**(m-), and **para-**(p-) are used.



**ortho-dichlorobenzene**  
o-dichlorobenzene  
1,2-dichlorobenzene

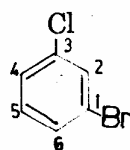


**meta-dichlorobenzene**  
m-dichlorobenzene  
1,3-dichlorobenzene

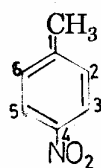


**para-dichlorobenzene**  
p-dichlorobenzene  
1,4-dichlorobenzene

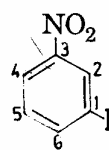
When the substituents of disubstituted benzene are different, the prefixes **ortho-**, **meta-**, and **para-** are also used. The substituents are arranged alphabetically and the lowest number is given to the group named first.



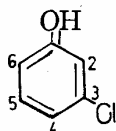
**m-bromochlorobenzene**  
1-bromo-3-chlorobenzene



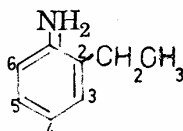
**p-nitrotoluene**  
4-nitrotoluene



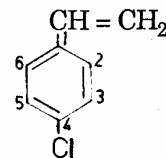
**m-iodinitrobenzene**  
1-iodo-3-nitrobenzene



**m-chlorophenol**  
3-chlorophenol

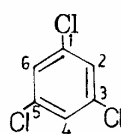


**o-ethylaniline**  
2-ethylaniline

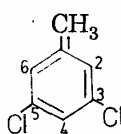


**p-chlorostyrene**  
4-chlorostyrene

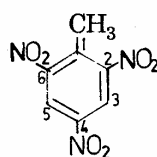
When more than two substituents are attached to the ring, only numbers can be used to indicate the positions of substituents.



1,3,5-trichlorobenzene

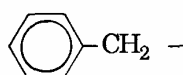


3,5-dichlorotoluene

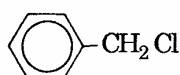


2,4,6-trinitrotoluene

The group that corresponds to toluene minus one of the methyl hydrogens is called **benzyl**.



benzyl



benzyl chloride