Ministry of Higher Education and Scientific Research
AL-Mustaqbal University College of Science
Department of biology

Organic Chemistry

Lecture 6

Aromatic Compounds

By
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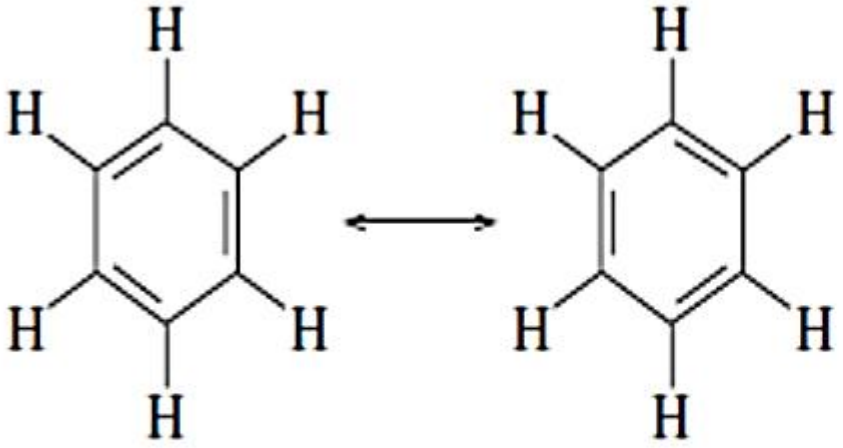
Aliphatic compounds: Aliphatic compounds are open-chain (straight or branched) compounds or cyclic compounds. The families we have studied so far alkanes, alkenes, alkynes, and their cyclic compounds are all members of the aliphatic class.

Aliphatic compounds can have a mix of (single, double or triple) bonds between them. This means that they can be saturated or unsaturated.

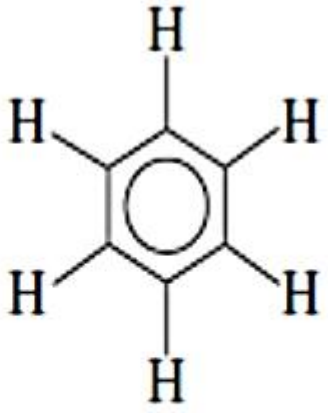
Aromatic Compounds

Aromatic compounds are chemical compounds that containing one or more aromatic rings that contain alternating single and double bonds in its chemical structure (conjugated double bond). Aromatic compounds are characterized by their unique stability.

The simplest aromatic compounds is benzene [C6H6]. A molecule of benzene consists of a ring of six carbon atoms with one hydrogen atom attached to each carbon.



Structures for benzene



Skeletal formula for benzene ring

The unsaturated ring system of benzene, called the **benzene ring** or **benzene system**, exists not only in benzene, but also in a wide variety of other compounds. Organic compounds whose structures contain a benzene ring are called **aromatic compounds.**

Aromatic Conditions

In order for the compound to be called an aromatic, it must fulfill the following conditions :

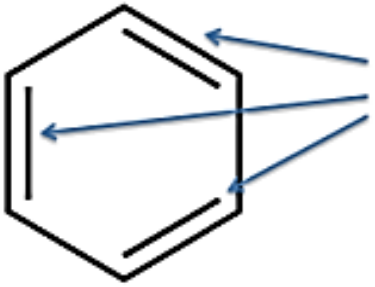
1. The compound contains a ring with conjugated single and double bonds (resonance).
2. The compound must be planar .
3. The compound is not easily subject to addition reactions.
4. React through electrophile replacement
5. Huckle's rule must be applied to the compound

Huckel's Rule

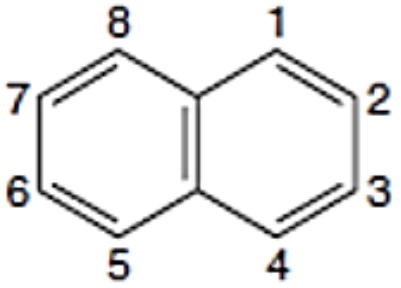
- We saw that there are double bonds in the ring that is present in the chemical structure of aromatic compounds. These double bonds contain electrons called π electrons' The number of (π) electrons is very important in determining if the compound obeys Huckel's Rule or not.

- Huckel's Rule states that an aromatic compound must have a certain number of (π) electrons. The number of (π) electrons must be equal to (4n+2), where n is equal to zero or any positive integer (n = 0, 1, 2,3,…etc.)

Benzene



3 double bonds = 6 pi electrons



Naphthalene

$C_{10}H_8$

Huckel's rule:

$4n + 2 = \text{pi electrons}$

$4n + 2 = 6$

$4n = 4$

$n = 1$

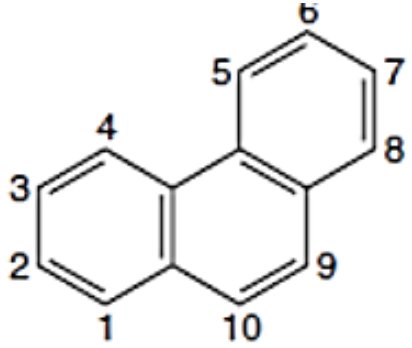
Huckel's rule:

$4n + 2 = \text{pi electrons}$

$4n + 2 = 10$

$4n = 8$

$n = 2$



Phenanthrene
$C_{14}H_{10}$

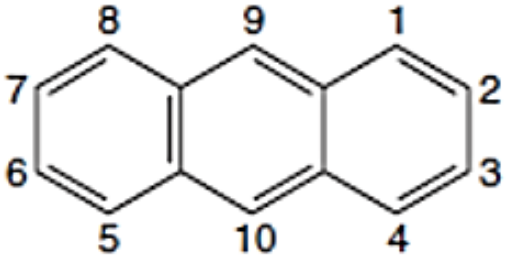
Huckel's rule:

$4n + 2 =$ pi electrons

$4n + 2 = 14$

$4n = 12$

$n = 3$



Anthracene
$C_{14}H_{10}$

Huckel's rule:

$4n + 2 =$ pi electrons

$4n + 2 = 14$

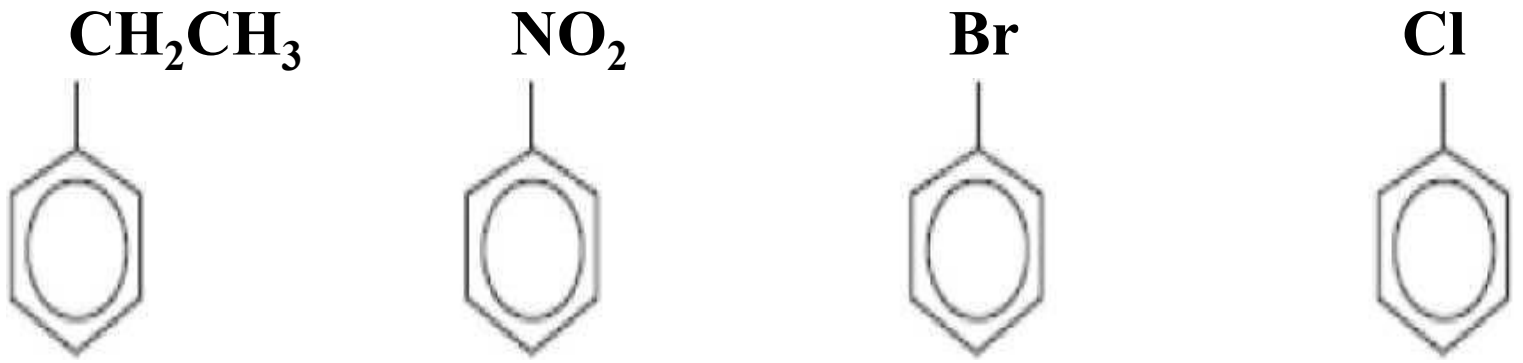
$4n = 12$

$n = 3$

The Nomenclature of Benzene Derivatives

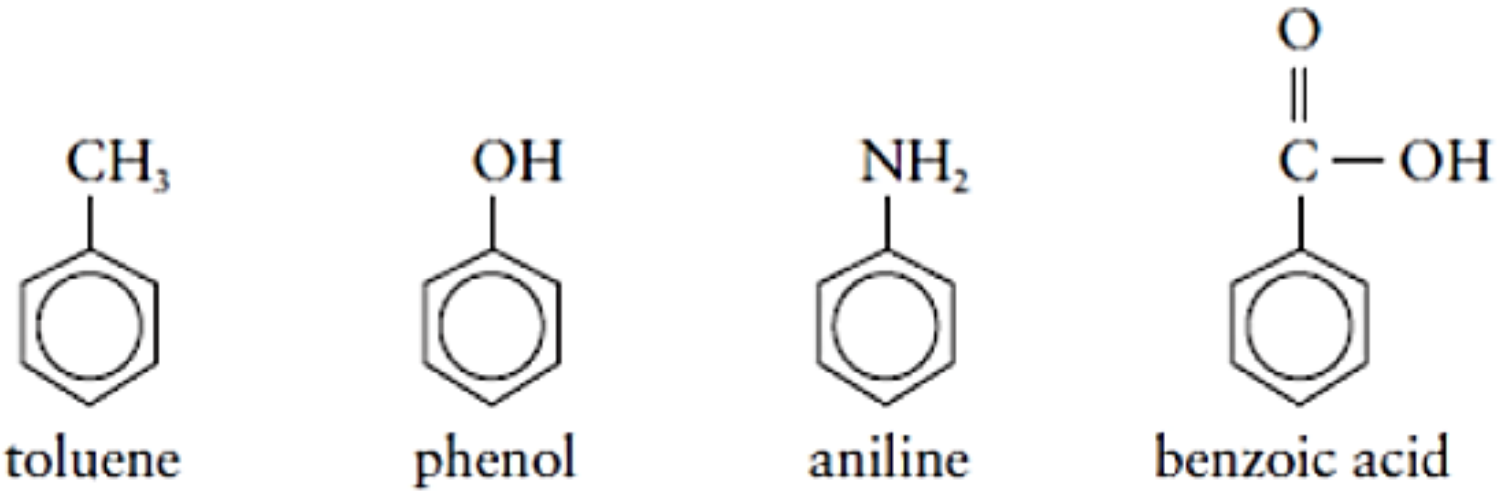
The following guidelines are all based on the IUPAC aromatic nomenclature system

Guideline 1. Mien a single hydrogen of the benzene ring is replaced, the compound can be named as a derivative of benzene:



ethylbenzene **nitrobenzene** **bromobenzene** **chlorobenzene**

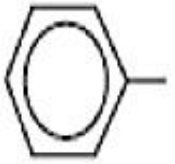
Guideline 2. For other simple and common compounds, the substituent and the benzene ring taken together may form a commonly accepted parent name. Methylbenzene is usually called toluene, hydroxybenzene is almost always called phenol, and aminobenzene is almost always called aniline:

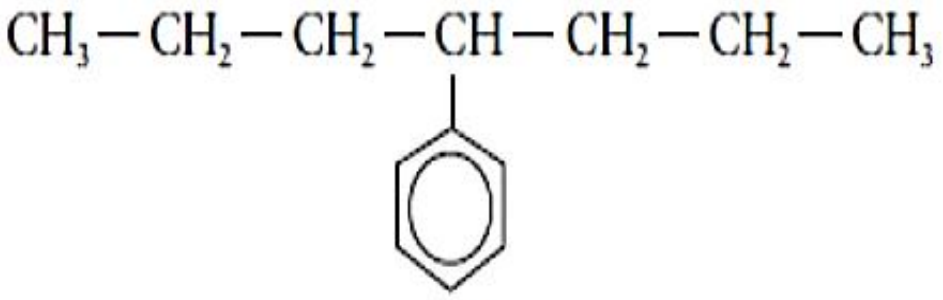


toluene phenol aniline benzoic acid

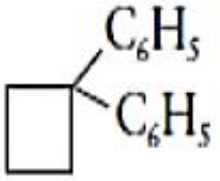
Guideline 3. Compounds formed by replacing a hydrogen of benzene with a more complex hydrocarbon group can be named by designating the benzene ring as the group. This is shown as the benzene ring. C_6H_5, which is also called a phenyl group:

(**phenyl group**: A benzene ring with one hydrogen absent, C_6H_5-)



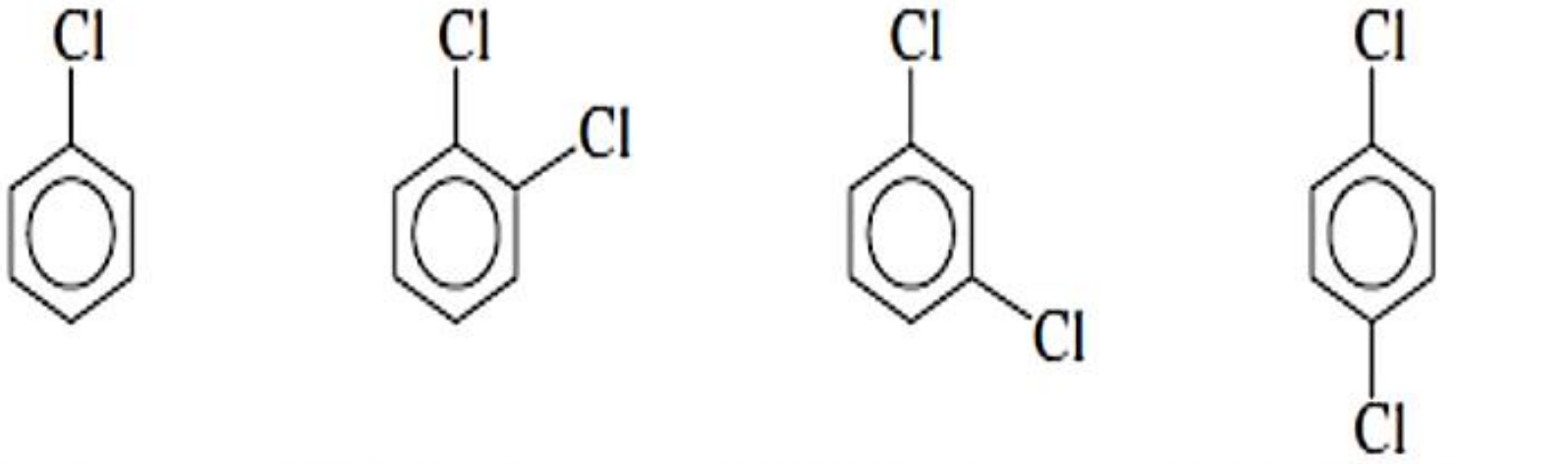


4-phenylheptane



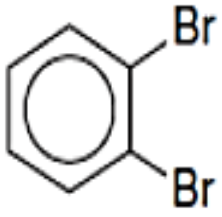
1,1-diphenylcyclobutane

Guideline 4. When benzene has only one substituent, the benzene ring is not numbered. When there are two or more substituents, the benzene ring is numbered to give the lower numbers to the substituents.

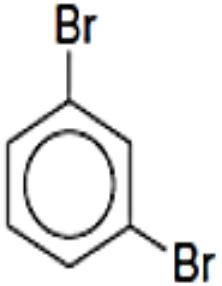


Chlorobenzene 1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene

Guideline 5. When two substituents are present, their relative positions are indicated by the prefixes ortho-, meta-, and para- (abbreviated **o-**, **m-**, and **p-**) or by the use of numbers.

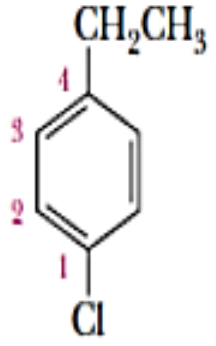


1,2-Dibromobenzene
(*o*-dibromobenzene)
ortho



1,3-Dibromobenzene
(*m*-dibromobenzene)
meta

1,4-Dibromobenzene
(*p*-dibromobenzene)
para



1-Chloro-4-ethylbenzene
(*p*-Chloroethylbenzene)

Thank you