AROMATICITY

Huckel's Rule of Aromaticity

Huckel's rule is valid for compounds containing atleast:

(a) One planar ring (i.e., monocyclic)

(b) Conjugated (complete continuous conjugation)

(c) Planarity

(d) (4n+ 2) electrons

where n is either zero or positive integer.

Note:

- In aromatic compounds, electrons spread out across the entire ring, making it stable due to electron delocalization.
- Aromatic compounds possess significant resonance energy.
- Aromatic compounds are more stable than similar compounds without a ring structure.

This compound is aromatic because it follows Huckel's rule of aromaticity.

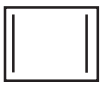
Benzene

When n is equal to 1, a compound with (4n + 2) will have 6π electrons.

6π

Anti-Aromatic Compounds

Cyclic conjugated planar compounds with '4n' π electrons are anti-aromatic compounds (where n = positive integer). Anti-aromatic compounds are less stable than corresponding acyclic counterpart.



In 4nπ rule

cyclobutadiene (antiaromatic)

n = 1= 4π electrons.

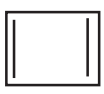
Non-Aromatic Compounds

Compounds that aren't aromatic or anti-aromatic are simply called non-aromatic compounds.

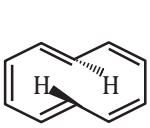
e.g.     Etc.

Annulenes

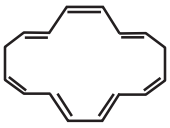
It's a common term for a monocyclic conjugated system. The size of the ring in an annulene is shown by a number in parentheses.

[4]-annulene [6]-annulene [8]-annulene

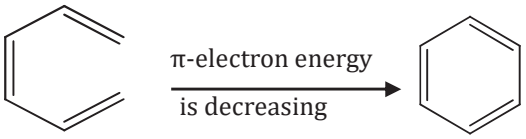


[10]-annulene



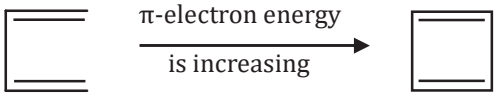
[14]-annulene

Note: [8]-annulene and [10]-annulene are non-planar and hence, they are nonaromatic. [4] amulene is antiaromatic.



1, 3, 5-hexatriene
(non aromatic)

benzene
(aromatic)



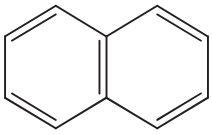
Non aromatic

Anti-aromatic

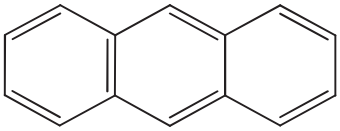
Polycyclic Aromatic Compounds

Aromatic compounds called benzenoids consist of connected benzene rings. On the other hand, no benzenoid aromatic compounds are formed by connecting rings other than benzene.

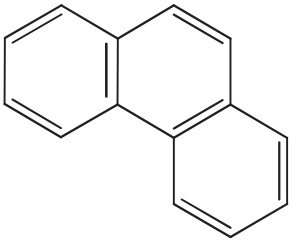
Benzenoid Aromatic Systems



naphthalene

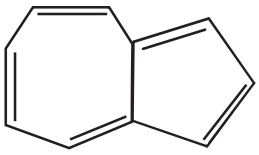


anthracene

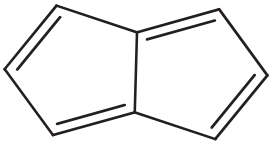


phenanthrene

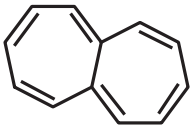
Non-benzenoid Systems



azulene aromatic

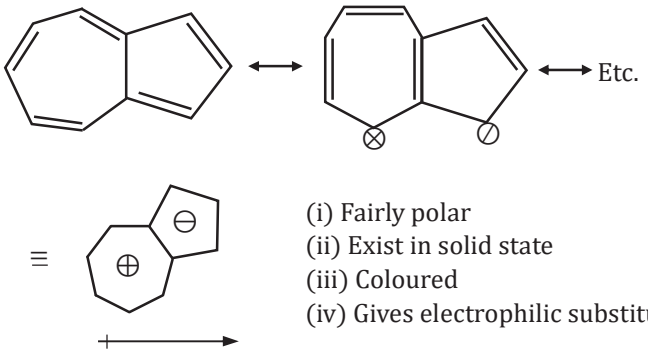


pentalene



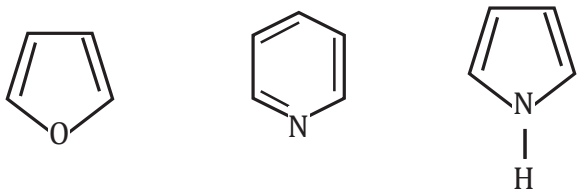
heptalene

Azulene is a blue solid that easily goes through a type of chemical reaction called electrophilic substitution. You can think of it as a mix of a cyclopentadienyl anion and a cycloheptatrienyl cation.



(i) Fairly polar
(ii) Exist in solid state
(iii) Coloured
(iv) Gives electrophilic substitution reactions

Heterocyclic Aromatic Compounds

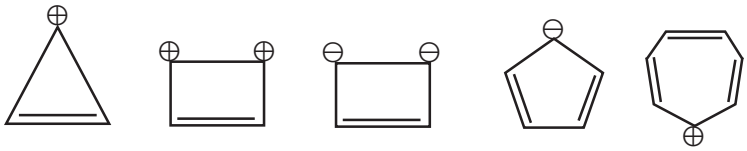


Furan pyridine Pyrrole

Note: In pyridine, the lone pair of nitrogen is not part of the aromaticity, but in pyrrole and furan, the lone pair of nitrogen is involved in the aromaticity.

Aromatic and Antiaromatic Ions

Aromatic ions:



Antiaromatic ions:

Experimental consequence of Aromaticity

Aromatic compounds are not very reactive chemically. Unlike regular alkenes, benzene doesn't undergo addition reactions with bromine or permanganate ions. Instead, aromatic compounds prefer substitution reactions over addition reactions. The high stability of aromatic compounds is linked to their very high resonance energy.