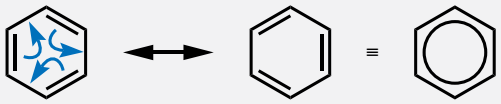
Aromatic molecules

1. Introduction



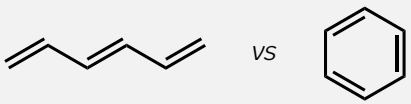
Aromatic molecules are a distinct class of compound with unique reactivity. Defined by a delocalised loop of π electrons around the aromatic ring, which imparts greater stability than we might predict. This stability is often called ***aromatic*** or ***resonance stabilisation***.

2. Rules for aromaticity

Not all molecules that have a ring of delocalised π electrons are aromatic. To be classed as aromatic a molecule must fulfil a number of criteria:

i. It must be cyclic (& planar)

A ring is easy to spot (compare hexatriene and benzene).

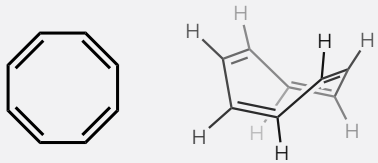


non-aromatic
not a ring

vs

aromatic
cyclic & …

It must be flat so that the p orbitals can overlap and allow delocalisation.

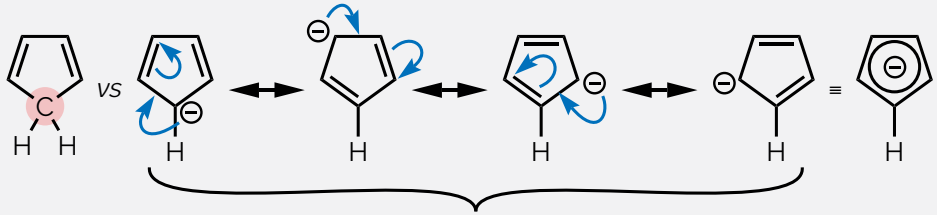


not **anti-aromatic**
non-planar

2b. Rules for aromaticity

ii. The molecule must have an unbroken ring of π electrons

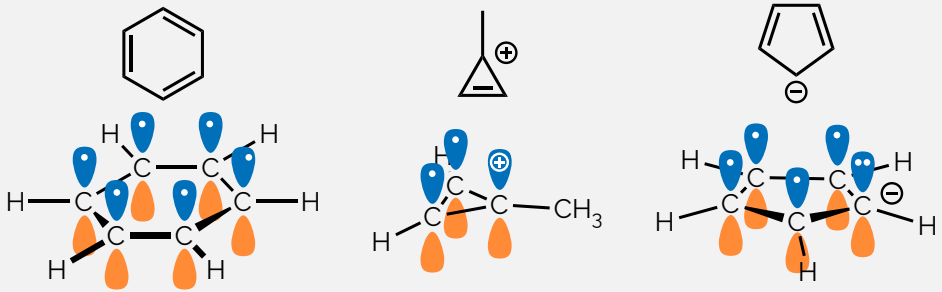
There must be a circle of conjugated π bonds and/or p orbitals. It must be possible to draw a series of resonance structures that show the π electrons are in a ring.



non-aromatic
no ring of
π electrons

aromatic
ring of
π electrons

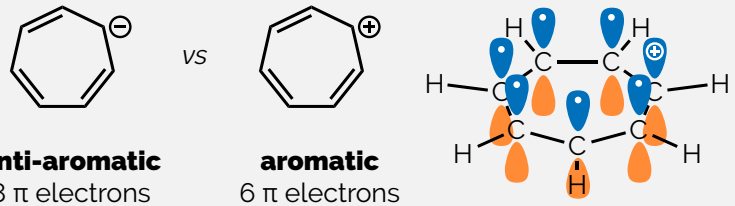
There must be a continuous ring of overlapping 2p orbitals made up of 2p orbitals of a π bond, an empty 2p orbital of a cation, or a lone pair of electrons in a 2p orbital.



2c. Rules for aromaticity

iii. The molecule must have the correct number of electrons

The number of π electrons in a delocalised ring must be a Hückel number, 4n+2 (n = whole number), which is the same as an odd number of pairs of π electrons. An ***anti-aromatic*** compound obeys criteria i & ii but not iii.



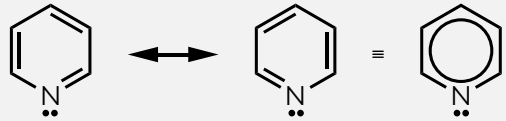
anti-aromatic
8 π electrons

vs

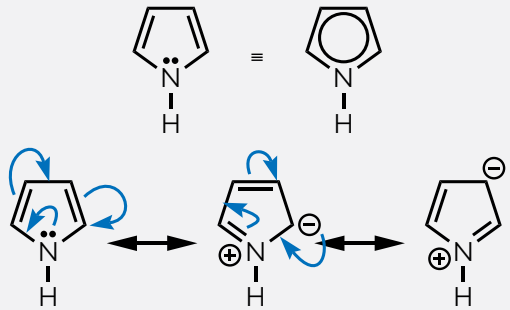
aromatic
6 π electrons

3. Heteroaromatics

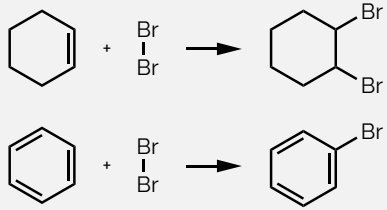
Aromatic rings can contain heteroatoms. The heteroatom can be part of a π bond leaving its lone pair free to react:



Or the lone pair of the heteroatom contributes to the ring of π electrons. It is not free to react in a chemical reaction:



4. Conclusion



Aromatic molecules have a ring of delocalised π electrons. They will be described by multiple resonance structures. This makes them unusually stable, and leads to unique reactivity.