Chemistry 2302

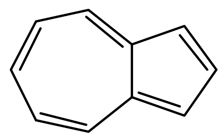
Workshop 4 Solutions
Aromatic, Or Not?

1. For each of the following molecules, circle whether the molecule is aromatic, anti-aromatic, or neither.

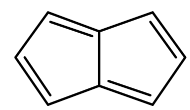
AROMATIC

ANTI-AROMATIC

NEITHER



10 π electrons



8 π electrons

AROMATIC

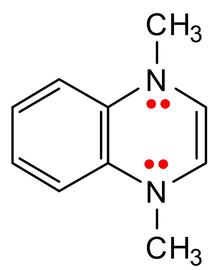
ANTI-AROMATIC

NEITHER

AROMATIC

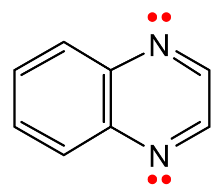
ANTI-AROMATIC

NEITHER



If the molecule were flat, with *sp*^{2}-hybridized nitrogens, then it would have **12 π electrons** and be **anti-aromatic**.

But the nitrogens can stay *sp*^{3}-hybridized if they choose. (Seems likely they would.) if so, the right hand ring would be **non-aromatic**, and the left-hand (benzene) ring would be **aromatic**.



10 π electrons (both nitrogens are *sp*^{2} with only two σ bonds, so lone pairs are in third *sp*^{2})

AROMATIC

ANTI-AROMATIC

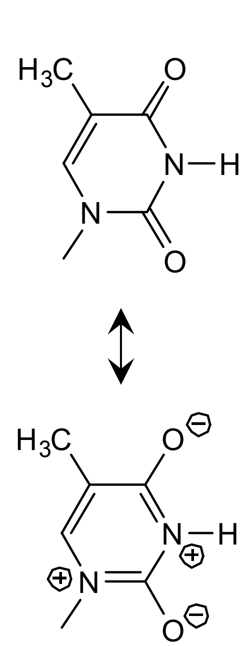
NEITHER

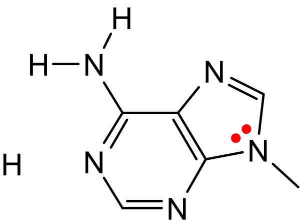
sp^2,

AROMATIC

ANTI-AROMATIC

NEITHER





10 π electrons

AROMATIC

ANTI-AROMATIC

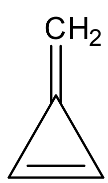
NEITHER

This is a 6 π electron resonance structure, so the molecule is aromatic.

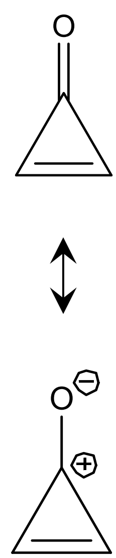
AROMATIC

ANTI-AROMATIC

NEITHER



3 π electrons
(if we count one of the two electrons from the top double bond as belonging to the ring carbon)



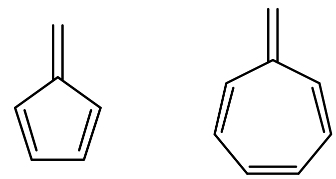
AROMATIC

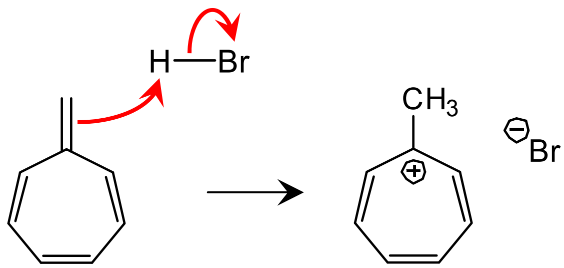
ANTI-AROMATIC

NEITHER

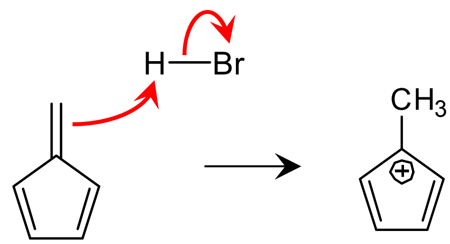
This is a 2 π electron resonance structure, so the molecule is aromatic.

2. One of the molecules on the right will react with aqueous HBr just one way, to yield one product, selectively. The other will react with one molecule of aqueous HBr in a variety of ways, to yield a variety of products. Which molecule has which reactivity pattern, and what HBr adducts would you expect from each?

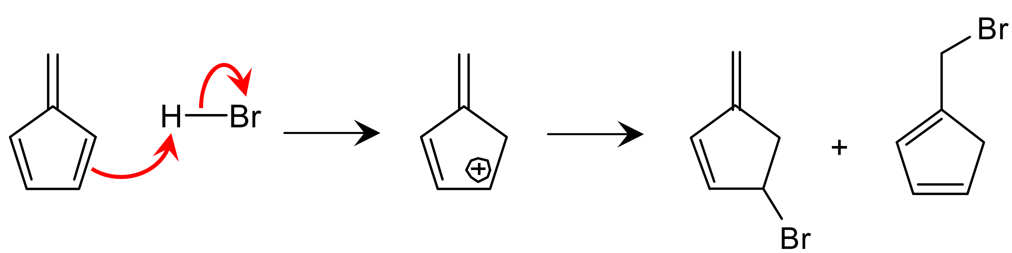




6 π electrons, aromatic.
So this cation is formed specifically. In addition, the cation is stable as a salt in water, so the Br^- doesn't even add; this is the product.



4 π electrons, anti-aromatic.
So this cation would <u>not</u> be formed. Instead, HBr would add somewhere else on the molecule, to generate a cation that would be stabilized by resonance but not anti-aromatic:



(+ others from other protonation locations)