Problem Set Chapters 18

Organic Chemistry for Life Sciences: CHM 224

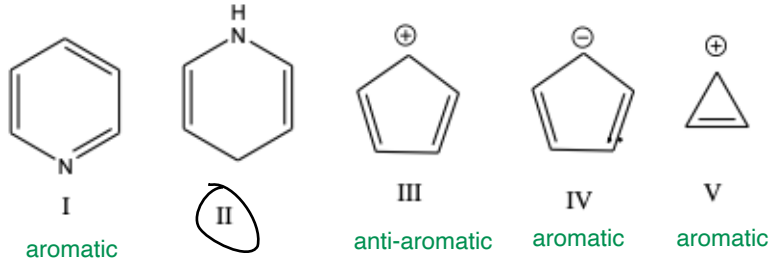
Name_____

DUE: Monday, January 29th in class

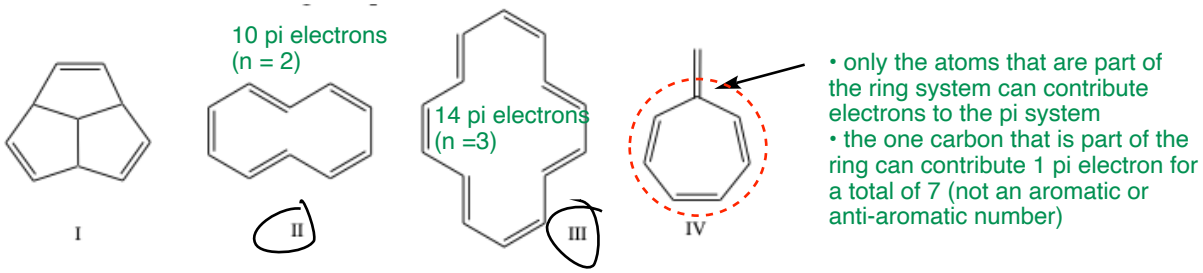
1. Which of the following statements are true (may be more than one answer)?

A. Aromatic compounds must be cyclic and planar, but antiaromatic may or may not be
B. Aromatic compounds must be monocyclic (only one cyclic structure present).
C. Antiaromatic compounds must have a conjugated system with a p orbital at every vertex
D. Aromatic compounds must satisfy Hückel's rule.
E. None of these
F. All of these

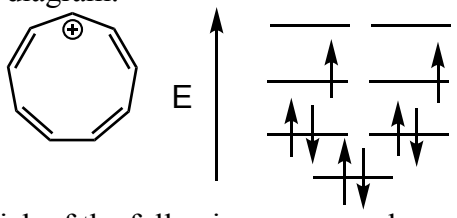
2. Which of the following compound are **nonaromatic** (may be more than one answer)?



3. Which of the following compound are **aromatic** (may be more than one answer)?

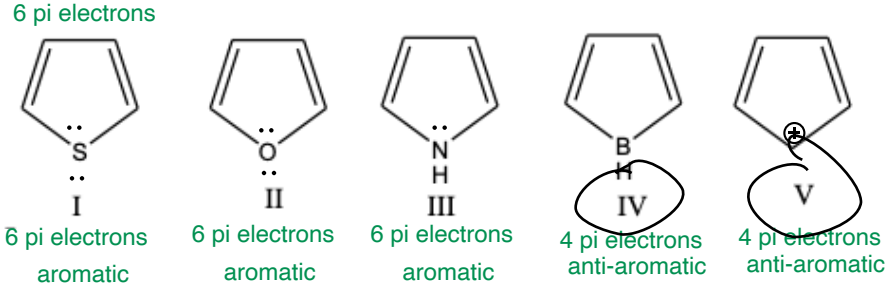


4. Is the following molecule aromatic? Confirm your answer including the use of a Huckel pi molecular orbital diagram.

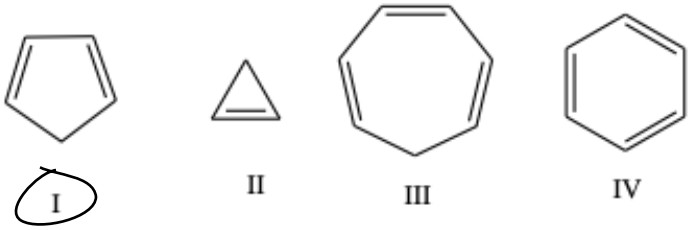


• cyclic ring structure with all SP2 hybridized atoms (including the carbocation carbon)
• 8 pi electrons = non Huckel number
• **this molecule cannot be aromatic as it will lead to unfilled orbitals in the orbital diagram**

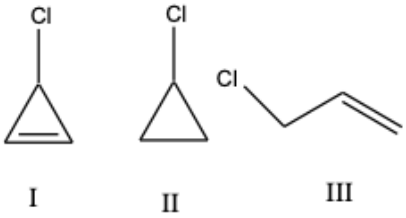
5. Which of the following compound are **antiaromatic** (may be more than one answer)?



6. Which of the compounds below is expected to be unusually acidic (may be more than one answer):



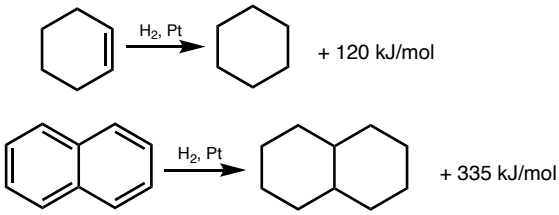
7. Which of the following correctly ranks the order in which the compounds below will undergo an SN1 reaction (from fastest to slowest):



A. I > II > III
B. I > III > II
C. II > I > III
D. II > III > I
E. III > I > II
F. III > II > I

- RDS for SN1 reactions is formation of a carbocation intermediate
- the more stable the carbocation, the faster the SN1 reaction
- Carbocations below are formed from I, II and III. Of these I (aronmatic) > III (1° allylic) > II (2°)

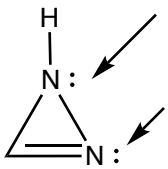
8. Prove that naphthalene is aromatic using the heat of hydrogenation data below (experimental values provided) by comparing predicted and actual data (HINT: for prediction purposes, ttreat all of the C=C bonds in naphthalene as if they are the same kind of bond as in cyclohexene).



- there are 5 C=C bonds in naphthylene
- 5 x 120 = 600 kJ/mol would be the predicted heat of hydrogenation if there was no particular stabilization (or destabilization)
- 600 (predict) – 335 (actual) = 265 kJ/mol MORE stable than predicted!
- **this substantial stabilization suggests that naphthylene is aromatic!**
- the molecule has 10 pi electrons = 4n+2 where n= 2, so it is a Huckel number

9. Jimmy wakes up 45 minutes into class, raises his hand, and says that the compound below is aromatic because it has 6 pi electrons. Is Jimmy correct? Briefly explain your answer.


Jimmy

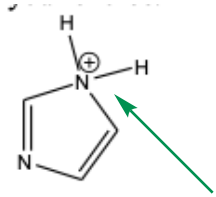


this lone pair would be part of pi system if the molecule was planar (required for aromaticity)

since this lone pair is on a nitrogen that is already part of a double bond, it cannot be part of the pi system

- this compound has a total of 4 pi electrons, if it was planar
- the compound would be anti-aromatic, not aromatic!
- sorry Jimmy…stay awake next time!!

10. To which class of compounds does the following belong?



A. aromatic
B. anti-aromatic
C. nonaromatic
D. not sure, but probably one of the above

this N is SP^3 hybridized, which means there is NOT a circuit of uninterrupted p orbitals. This molecule is neither aromatic nor anti-aromatic!