# Organic Chemistry c3444y-Section 1

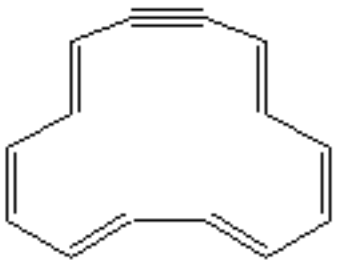
## Problem Set 1 - Aromaticity

## Due in class Wednesday Feb. 6

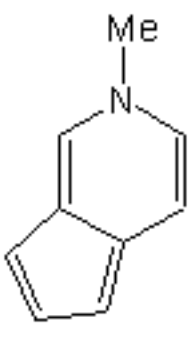
(Relevant Book Problems in Chapter 15: 15.23-15.26, 15.29-15.34, 15.36-15.38, 15.40)

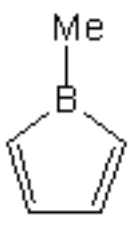
Reading for this week: Chapter 15 (except 15.10).
Reading for next week: Chapter 16.

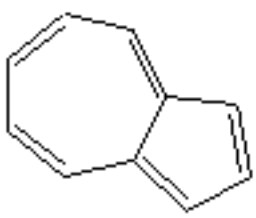
1. Would you expect the illustrated compound to display the properties of an aromatic, antiaromatic, or non-aromatic molecule? Explain briefly and concisely using clear drawings where appropriate. Remember! Orientation matters....

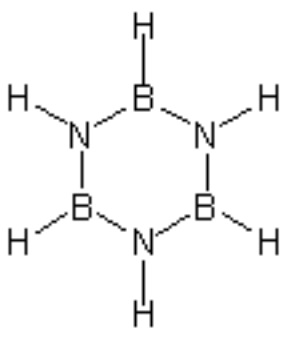


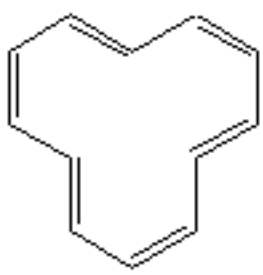
2. Consider the following molecules. Decide which would be expected to have significant aromatic character, which would be expected to have significant anti-aromatic character, and which would be expected to be simply non-aromatic. Explain (briefly!) your decisions, using drawings where appropriate.



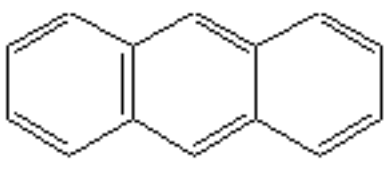


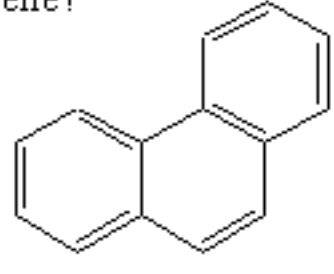
3. Recall our in class analysis of the structure of naphthalene and anthracene. Use resonance theory to explain the greater resonance energy of phenanthrene relative to anthracene. In other words why is phenanthrene "more aromatic" than anthracene?

<u>Resonance Energy</u>

Benzene = 36 kcal/mol
Naphthalene = 61 kcal/mol
Anthracene = 84 kcal/mol
Phenanthrene = 92 kcal/mol



Anthracene

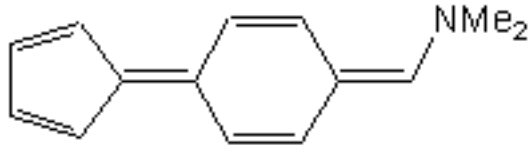


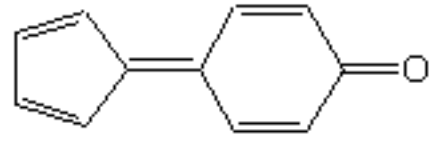
Phenanthrene

Begin by drawing all possible neutral resonance structures for phenanthrene. (Hint: phenanthrene and anthracene do not have the same number of possible neutral resonance structures.)

4. Like anthracene, phenanthrene will do many normal reactions of alkenes. For example, in the presence of an appropriate catalyst, $H_2$ will add to phenanthrene. Draw the product of this reaction and explain why this product is formed. How much resonance energy is lost in this transformation?

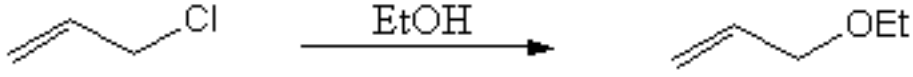
5. Make a prediction as to the relative stability of the illustrated compounds. Would you expect either of them to have any significant aromatic character? Would you expect either of them to have any significant antiaromatic character? Use resonance structures to provide a simple explanations for your answer. (*We haven't discussed C=O bonds yet, but all you need to keep in mind when drawing resonance structures is the substantially greater electronegativity of O relative to C.)*



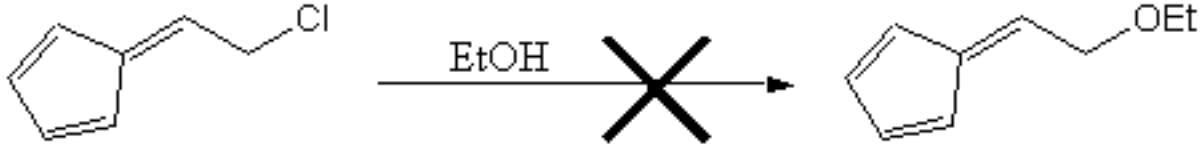




6. Provide a simple explanation for the observation that reaction i. proceeds readily, but reaction ii. does not.

i.




ii.




7. It has been shown (by our own Prof. Katz in 1964) that the following anion spontaneously rearranges to a *monocyclic* anion with unusual stability. What is this anion, how is it formed, and what is the reason for its stability?