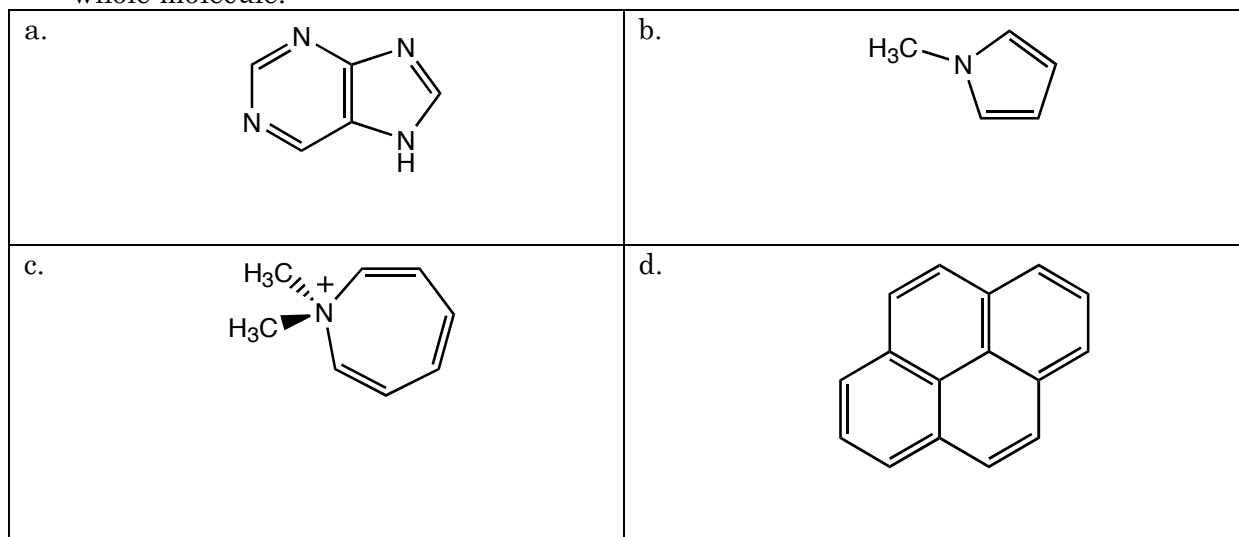


1. (4 pts. each) Label the following molecules as aromatic or not aromatic. Consider the whole molecule.



1. _____

2. _____

3. _____

4. _____

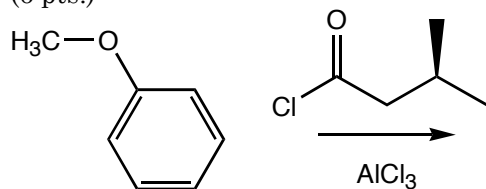
5. _____

6. _____

7. _____

Predict the major product(s) for the following reactions.

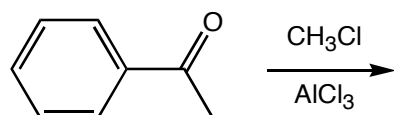
2. (6 pts.)



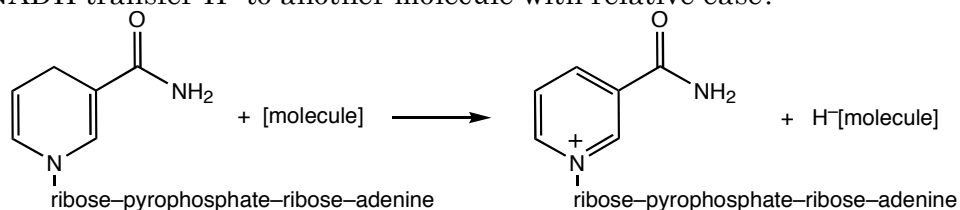
8. _____

9. _____

3. (6 pts.)

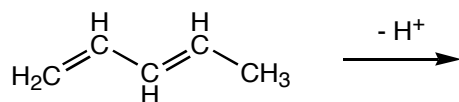


4. (6 pts.) Normally, removing a hydride (an H^-) from a $C-H$ bond is a very difficult thing to do. Nevertheless, nicotinamide adenine dinucleotide (NADH) is capable of doing this very reaction. Why can NADH transfer H^- to another molecule with relative ease?

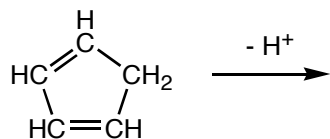


5. 1,3-cyclopentadiene is substantially more acidic than 1,3-pentadiene.

a. (4 pts.) Draw the carbanion that is most likely to form when a proton is removed from 1,3-pentadiene.

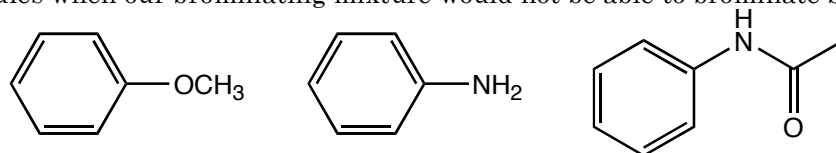


b. (4 pts.) Draw the carbanion that is most likely to form when a proton is removed from 1,3-cyclopentadiene.



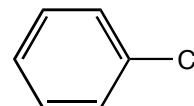
c. (4 pts.) Why is it easier to remove a proton from 1,3-cyclopentadiene than it is to remove a proton from 1,3-pentadiene?

6. (10 pts.) Benzene will not react with a mixture of Br_2 dissolved in HBr , yet in lab we brominated substituted benzene rings using this Br_2 - HBr mixture. Explain why we were able to brominate the following molecules when our brominating mixture would not be able to brominate benzene.



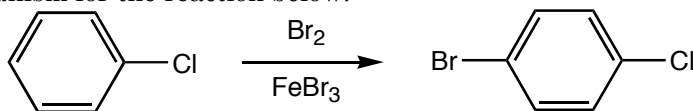
7. (10 pts.) Because of aromaticity, benzene rings are not particularly reactive. In order to get Br_2 to react with a benzene ring, FeBr_3 must be added. Describe the role of the FeBr_3 in the reaction.

Although chlorine substituents deactivate a benzene ring toward electrophilic aromatic substitution, they also direct substitution reactions toward the para position.



8. (10 pts.) Draw resonance structures for chlorobenzene.

9. a. (8 pts.) Draw a mechanism for the reaction below.



- b. (6 pts.) As compared to the intermediate that forms when the bromine attacks at the meta position, does the chlorine atom help to stabilize or destabilize the intermediate that forms when bromine attacks the para position? Draw at least one resonance structure to support your answer.