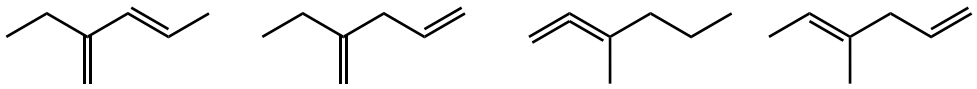
CHM 224
Test 1
Chapters 17, 18, 19

NAME:

1. From the series of compounds below, label the most and least stable isomer:



A — *conjugated diene most stable*

B — *isolated diene*

C — *conjugated diene least stable*

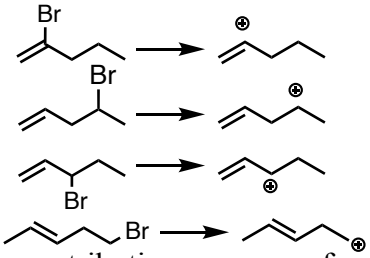
D — *isolated diene*

MOST STABLE: A

LEAST STABLE: C

2. Which one of the following compounds is expected to undergo an ***S_N1 reaction the fastest and which one the slowest***?

A. 1-bromo-1-pentene
B. 4-bromo-1-pentene
C. 3-bromo-1-pentene
D. 5-bromo-2-pentene



formation of very unstable vinyl carbocation is ***extremely* SLOW**!

formation of fairly stable 2° carbocation is ***somewhat* fast**!!

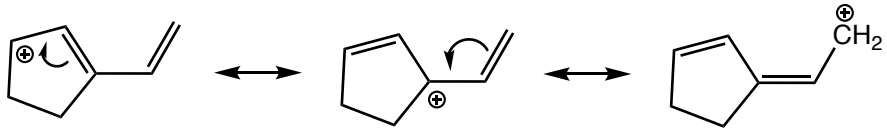
formation of very stable 2° allylic carbocation is ***extremely* FAST**!

formation of unstable 1° carbocation is ***very* slow**!

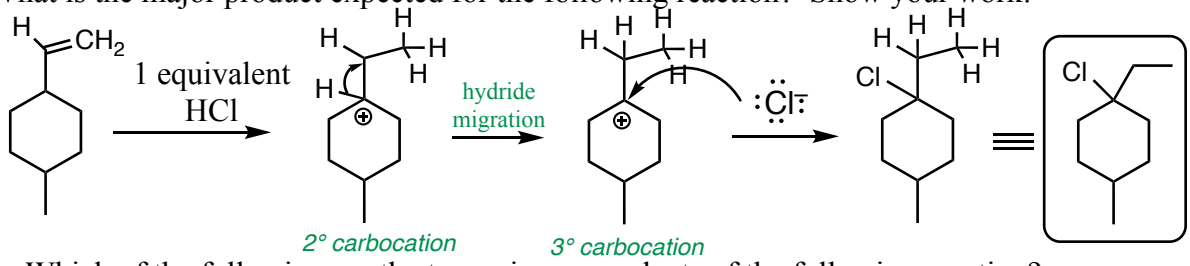
fastest: C

slowest: A

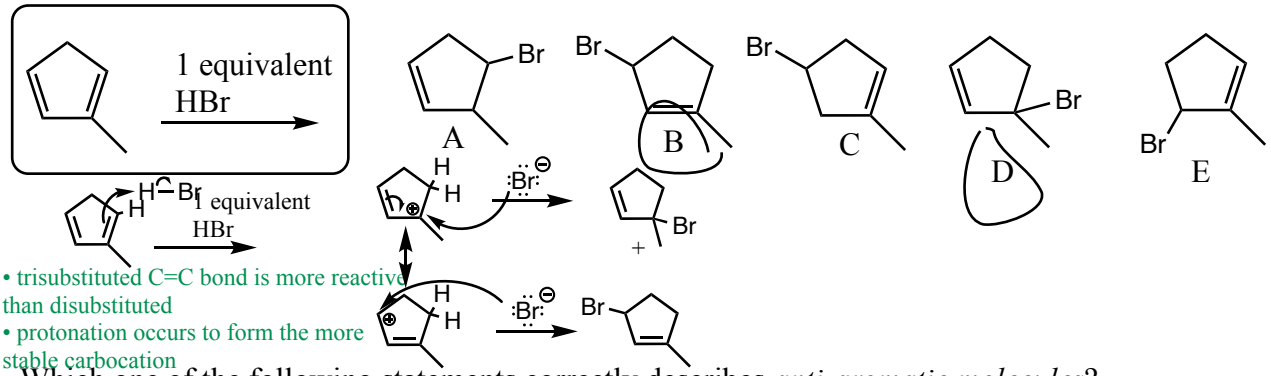
3. Draw all reasonable contributing resonance forms for the carbocation below using curved arrows and appropriate conventions:



4. What is the major product expected for the following reaction? Show your work:



5. 5. Which of the following are the two primary products of the following reaction?

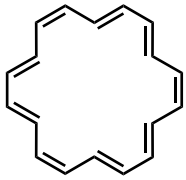


- trisubstituted C=C bond is more reactive than disubstituted
- protonation occurs to form the more stable carbocation

6. Which one of the following statements correctly describes *anti-aromatic molecules*?

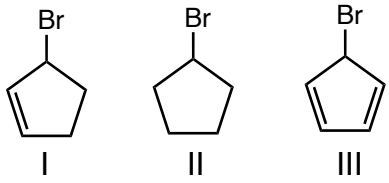
A. they typically exhibit non-alternating bond lengths and undergo substitution reactions
B. they typically exhibit alternating bond lengths undergo substitution reactions
C. they typically exhibit alternating bond lengths and undergo addition reactions
D. they typically exhibit non-alternating bond lengths and undergo addition reactions

7. Answer the questions regarding the structure of the compound provided below:



A. What is the number of pi electrons? **18 pi electrons**
B. Is there a value for "n" that satisfies the Huckel rule? **n = 4**
C. Is there an even or odd number of pairs of electrons? **odd**
D. Is this compound predicted to be aromatic? **yes**
E. The type of ring current exhibited in NMR spectroscopy would be: **diamagnetic**

8. Which of the following correctly ranks the order in which the compounds below will undergo an S_N1 reaction (from fastest to slowest):

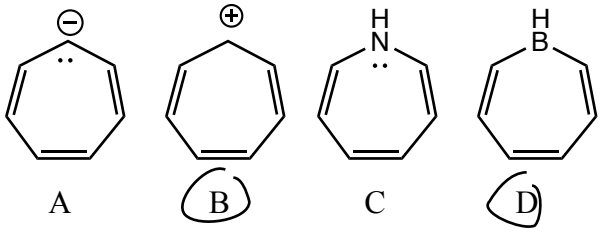


I 2° allylic
II 2°
III anti-aromatic

• the rate of an S_N1 reaction is dependent on the stability of the carbocation formed
• the more stable the carbocation the faster the reaction

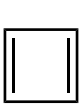
A. I > II > III
B. I > III > II
C. II > I > III
D. II > III > I
E. III > I > II
F. III > II > I

9. Which of the following compounds are predicted to exhibit **aromaticity**?

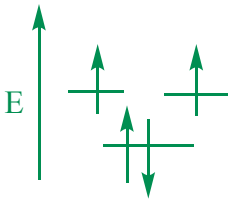


• compounds B and D are both cyclic arrays of SP2 hybridized atoms with 6 pi electrons (a Huckel number and an odd number of pairs of electrons) = aromatic
• compounds A and C both have a lone pair available from the carbon (in A) or nitrogen atom (in C). If these atoms adopted SP2 hybridization, the total number of pi electrons would be 8 which is NOT a Huckel number and equals an even number of pairs of electrons. Neither is aromatic!

10. Cyclobutadiene is a rare example of an anti-aromatic compound because:

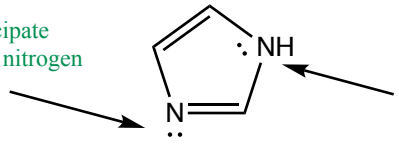


A. It has two unpaired electrons in its pi orbitals and is planar
B. It has two unpaired electrons in its pi orbitals and is nonplanar
C. It has no unpaired electrons in its pi orbitals and is planar
D. It has no unpaired electrons in its pi orbitals and is nonplanar



11. Answer the two questions below based on the structure provided:

this lone pair CANNOT participate in pi system because it is on a nitrogen atom that is already part of a double bond



this lone pair WILL contribute to the pi system when the nitrogen atom adopts SP2 hybridization

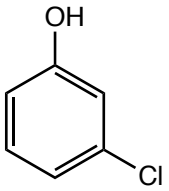
i. Do you predict the compound to be aromatic or antiaromatic? Clearly describe how you account for pi electrons, including lone pairs.

If the nitrogen atom at the top right adopts SP2 hybridization, it will contribute its pi electrons into the cyclic ring of other SP2 hybridized atoms. The total number of pi electrons will be 6, which is a Huckel number (n = 1) and an odd number of pairs of electrons. This compound will be aromatic!

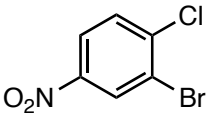
ii.The predicted heat of hydrogenation for the compound above is 240 kJ/mol. The actual (experimental) heat of hydrogenation was determined to be 130 kJ/mol. Does this information support your answer above (use specific data, not just yes or no).

The actual heat of hydrogenation is 110 kJ/mol less than that predicted which proves that this compound is much more stable than predicted consistent with it being aromatic!

13. Draw the structure of meta-chlorophenol

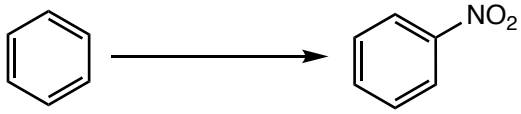


14. Provide an acceptable name for the following compound:



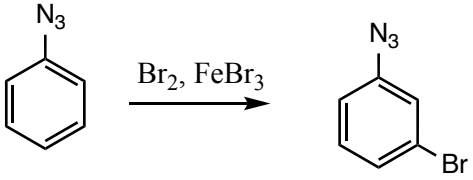
2-bromo-1-chloro-4-nitrobenzene

15. Provide the reagents necessary to complete the following reaction:



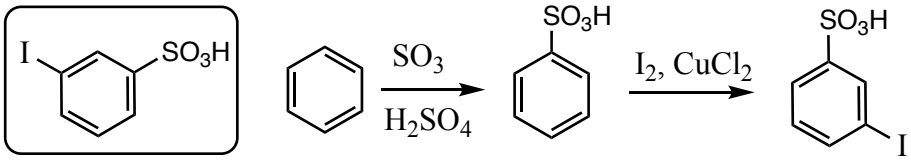
Reagents: HNO_3, H_2SO_4

16. Azidobenzene (below) reacts *fifty times slower than benzene* towards Br_2, $FeBr_3$. Given this information, what would you predict to be the major product(s) of the following reaction?



- that it reacts SLOWER than benzene implies the group is electron-withdrawing
- EWD groups are meta-directors

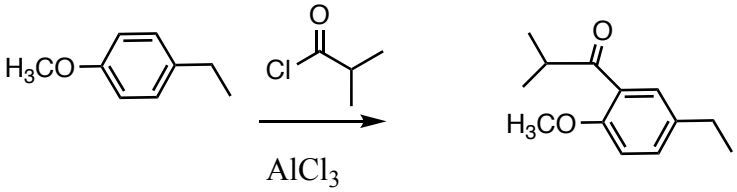
17. Provide a synthesis of the following compound starting with benzene.



18. Which one of the following substituents *deactivates* the reaction of the benzene ring with electrophiles to the greatest extent?

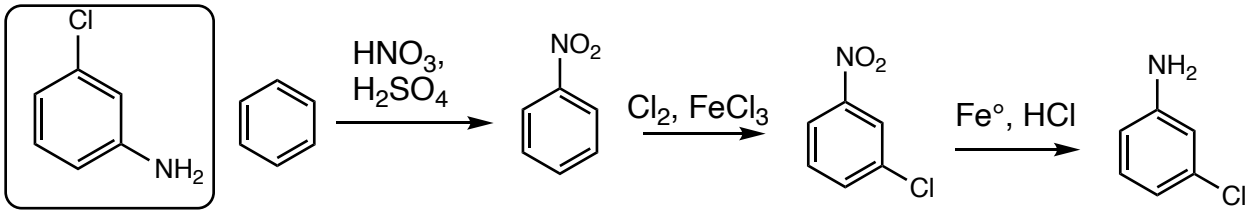
A. OH B. CN C. F D. SO_3H E. NH_2

19. What is the expected major product of the following reaction:

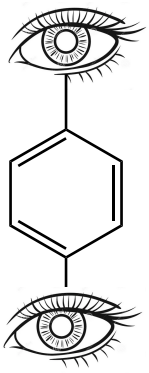


- the OCH_3 (OR) group and the ethyl (R) groups are both electron donating
- the OCH_3 (OR) group is the stronger donor of the two, so it is the primary director
- the OCH_3 group is an ortho,para director. The para position is already occupied, so the incoming electrophile goes ortho

20. Provide a synthesis for the following compound starting with benzene.



Bonus! (1 pt). What is the name of the following compound?



para-sight

parasite!!