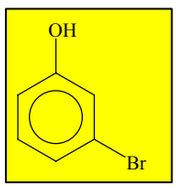
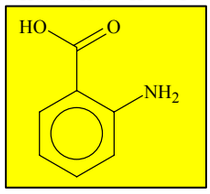
Organic Chemistry II
CMH 2211
Sample Exam 1 Answer Key

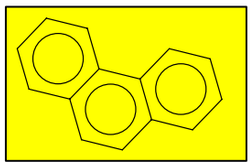
I. Write structures for the compounds shown below:



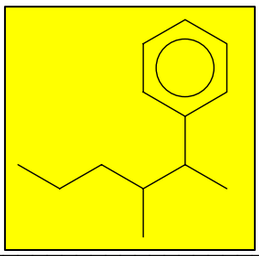
meta-bromophenol



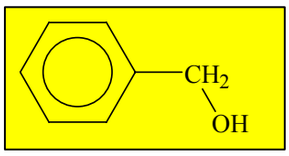
o-aminobenzoic acid



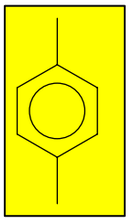
phenanthrene



3-methyl-2-phenylhexane

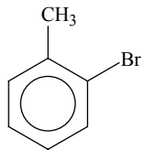


benzyl alcohol

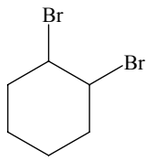


para-xylene

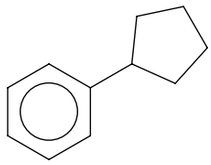
II. Name the compounds whose structures are shown below:



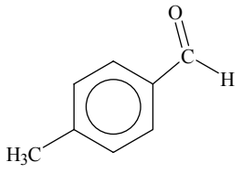
2-bromotoluene



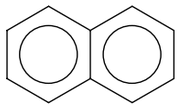
1,2-dibromocyclohexane



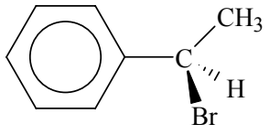
cyclopentylbenzene



4-methylbenzaldehyde



anthracene



(R)-1-bromo-1-phenylethane

III. Fill in the Blank

1. In order for a compound to be aromatic it must satisfy certain rules. The compound or ion must be cyclic and planar, have all atoms in the ring with sp^2 hybridization, and have a Huckle number of electrons in unhybridized p orbitals.

2. Another name for 1,3 dibromobenzene is *meta*-dibromobenzene.

3. Benzene is more stable than you might expect based upon a 6 membered ring and three double bonds. This is because benzene has resonance stabilization.

4. Is 26 a Huckle number? (Y/N) Yes (4*6+2)

5. Benzene ring deactivators have something in common. They all have the atom attached to the ring has a full or partial positive charge.

6. Proton NMR of aromatic compounds show characteristic absorptions in the range of 7 to 8 ppm.

7. Name two ring substituants that will prevent the ring from reacting in a Freidel-Craft reaction. $-NH_2$ and any strong deactivator.

8. 4-Methylbenzioc acid would tend to add a third group at carbon number 3.

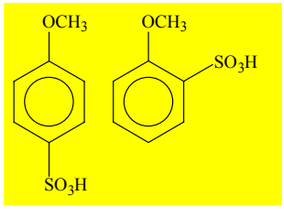
V. Answer the questions below by YES or NO.

a. Is cyclopentadienyl anion aromatic? __YES___
b. Is cyclopentadienyl carbocation aromatic? __NO___
c. Is cyclopentadiene aromatic? __NO___
d. Is cycloheptatriene aromatic? __NO___
e. Does cycloheptatriene have a Huckle # of electrons? __YES___

V. Answer the following:

Consider the reaction of anisole (methoxybenzene) with SO_3 in the presence of H_2SO_4

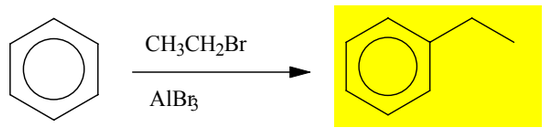
a. Write the formula for the MAJOR product(s) of this reaction.

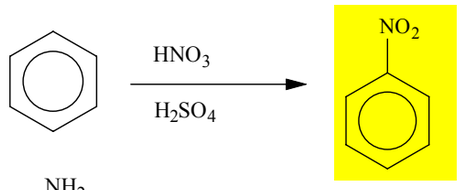


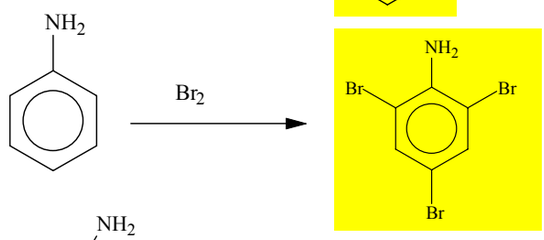
b. What is the electrophile in this reaction?
SO_3 (HSO_3^+)
c. How can it be an electrophile if it has no full positive charge?
Positive formal charge on S
d. Write a series of equations to show the mechanism of the above reaction. First show the mechanism when electrophilic attack is from the *para* position, and then show it from the *meta* position. Show all possible resonance forms of the arenium ion for both *para* and *meta* attack. Include the final step of conversion of the arenium ion to the product in your mechanism. USE KEKULE STRUCTURES.

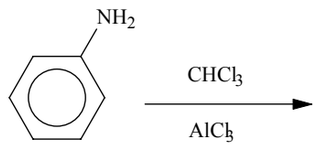
See pages 693, 729, and 730 of your text. Page 693 shows general mechanism of EAS. Page 729 shows EAS with a substituant that has an unshared electron pair, and Page 730 shows the resonance forms for anisole with *o*, *m*, and *p* attack.

VI. Write structural formulas for the the products if a reaction occurs. If no reaction occurs write N.R.

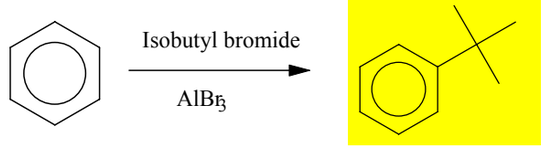
a. 

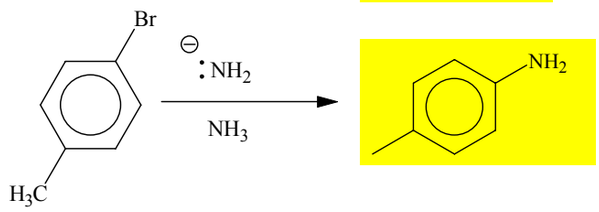
b. 

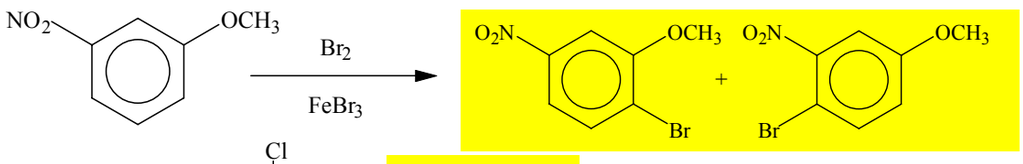
c. 

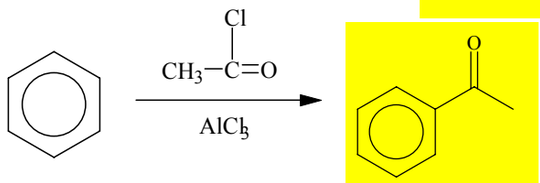
d. 

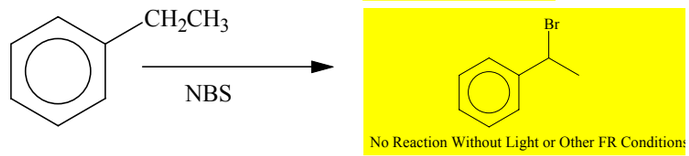
No Reaction

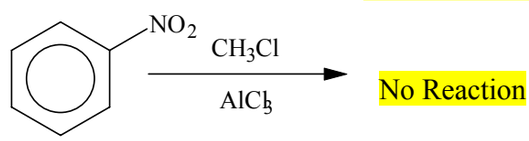
e. 

f. 

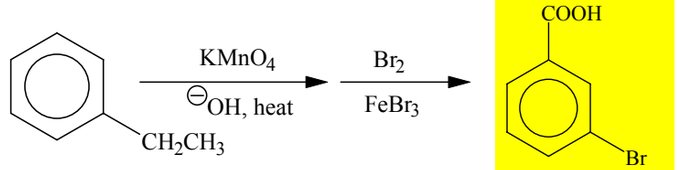
g. 

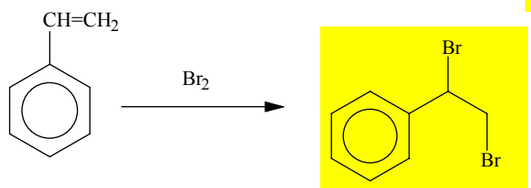
h. 

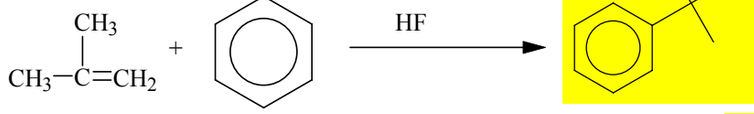
i. 

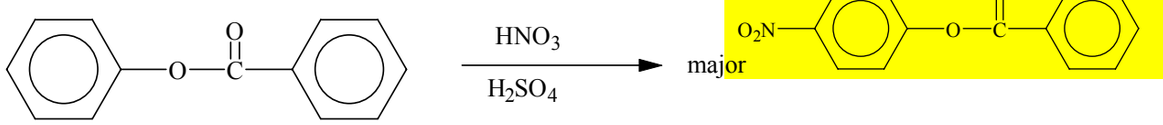
j. 

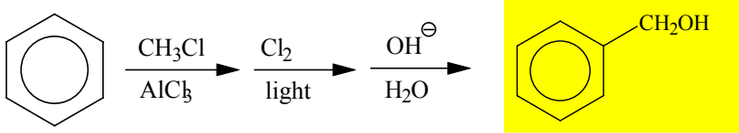
No Reaction

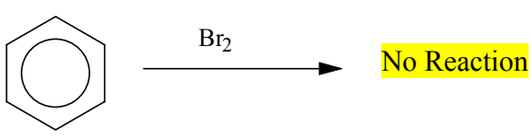
k. 

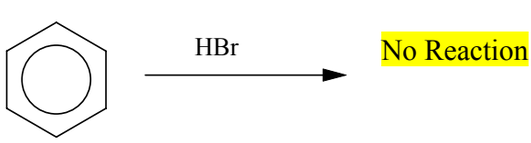
l. 

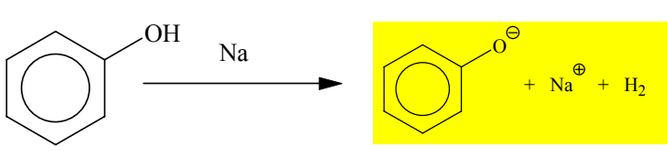
m. 

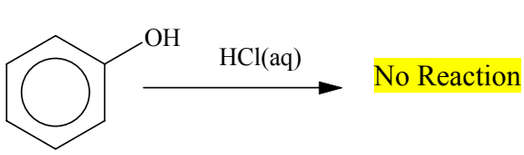
n. 

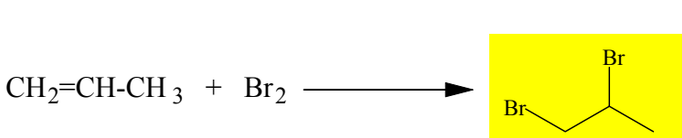
o. 

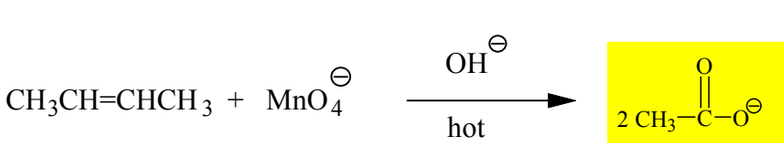
p. 

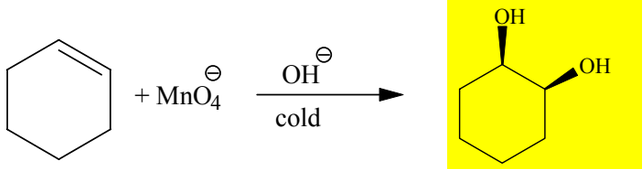
q. 

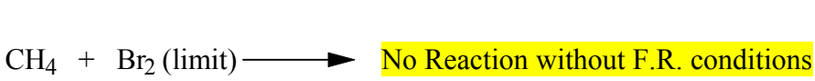
r. 

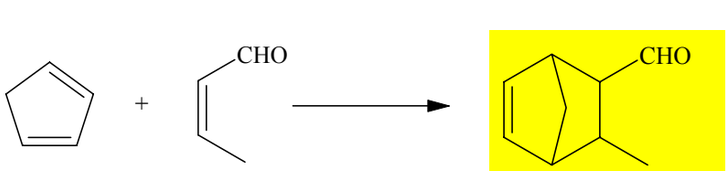
s. 

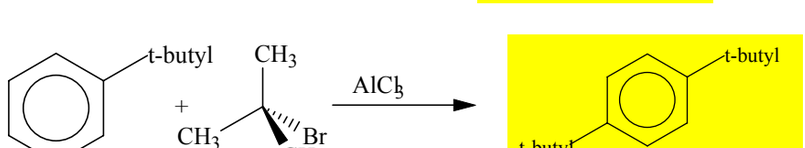
t. 

u. 

v. 

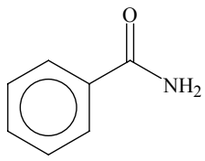
w. 

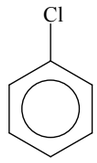
x. 

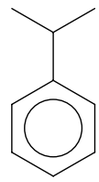
y. 

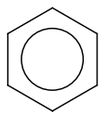
VII. Multiple Choice

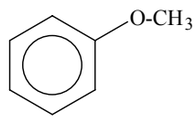
a. 1. Which of these gives mostly the meta product when treated with Br_2 / Fe?

a. 

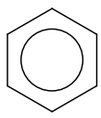
b. 

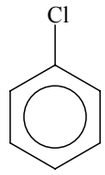
c. 

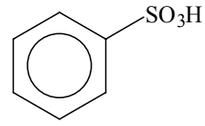
d. 

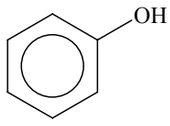
e. 

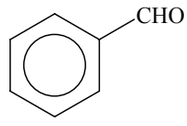
d. 2. Which undergoes electrophilic substitution on the ring most rapidly?

a. 

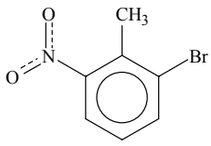
b. 

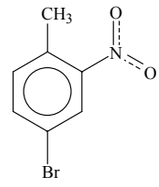
c. 

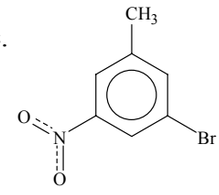
d. 

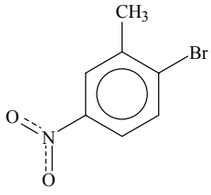
e. 

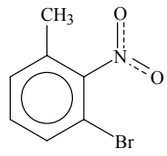
b. 3. In the reaction of 2-nitrotoluene with bromine in the presence of iron , which of the products shown below is the most abundant in the mixture?

a. 

b. 

c. 

d. 

e. 

b. 4. Which is characteristic for the proton NMR pattern of diethyl ether?

a. An upfield singlet and a downfield doublet.
b. An upfield triplet and a downfield quartet.
c. An upfield singlet and a downfield triplet.
d. Two upfield triplets on top of each other.
e. One downfield singlet.

e. 5. Which of the following would be the most likely to undergo a nucleophilic aromatic substitution with hydroxide ion in normal conditions?

a. Benzene
b. Chlorobenzene
c. Benzoic acid
d. p-Chlorotoluene
e. 2,4,6-Trinitro-1-chlorobenzene