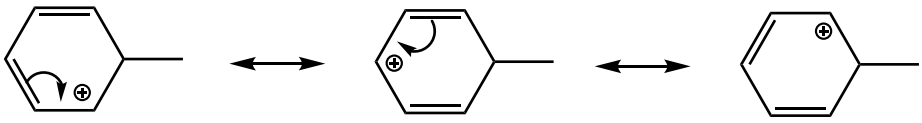
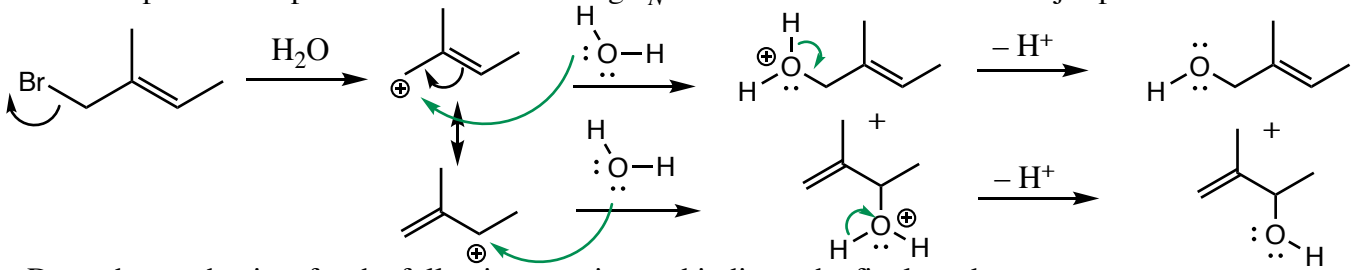
CHM 224 **NAME:**
Test 1
Chapters 17, 18, 19

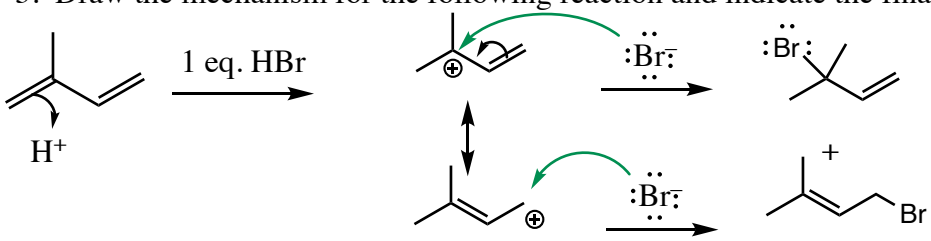
1. Draw all of the important resonance forms for the carbocation below (use proper arrow conventions):



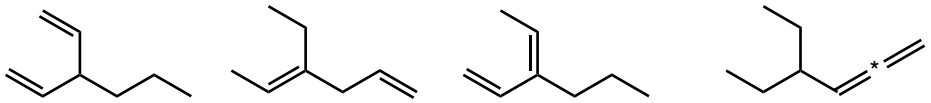
2. Draw the products expected from the following *S_N1 reaction* ***and*** indicate the major product:



3. Draw the mechanism for the following reaction and indicate the final products.



4. Which one of the following isomeric compounds is **most** stable and which is **least** stable?



A isolated B isolated C conjugated D cumulated

most stable: C

least stable: D

5, 6. Complete the following questions (2 pts each):

A. Kekule arrived at the structure of benzene by envisioning this animal: **snake**

B. Anti-aromatic molecules prefer to react with electrophiles by this type of reaction: **addition**

C. Aromatic molecules have this type of ring current in NMR spectroscopy: **diamagnetic**

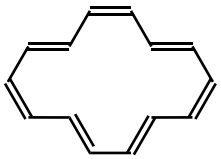
D. To be aromatic, all atoms in a cyclic molecule must have this type of hybridization: **SP^2**

E. An aromatic number of pi electrons fits this Huckel equation: **4n+2**

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

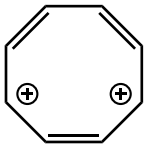
A. aromatic molecules are more stable than would be predicted
B. the heat of hydrogenation of anti-aromatic molecules is much higher than predicted
C. aromatic molecules exhibit alternating bond lengths
D. anti-aromatic molecules are planar

8. Which of the following molecules is expected to be aromatic?



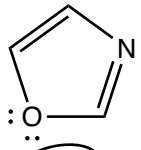
A

cyclic, all SP^2 hybridized
14 pi electrons



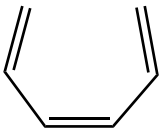
B

cyclic, all SP^2 hybridized
6 pi electrons



C

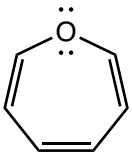
cyclic, all SP^2 hybridized
6 pi electrons



D

NOT cyclic

9. Will the oxygen atom in the molecule below adopt SP^2 or SP^3 hybridization? Briefly explain



The oxygen would retain SP^3 hybridization because if it was SP^2 hybridized, it would have 8 pi electrons (an anti-aromatic number of pi electrons!) in the pi system because it can only place on set of lone pair electrons into the pi system.

10. Which one of the carbocations below is **most** stable and which is **least** stable?

A

cyclic, all SP^2 hybridized
4 pi electrons!
anti-aromatic

B

2° allylic

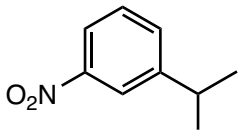
C

cyclic, all SP^2 hybridized
2 pi electrons!
aromatic!

most stable: C

least stable: A

11. Provide an acceptable chemical name for the following compound:

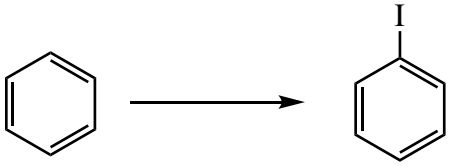


1-isopropyl-3-nitrobenzene

or

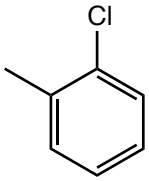
meta-isopropylnitrobenzene

12. What is the product of the following reaction?



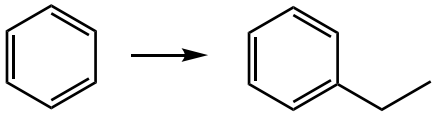
A. HI, $KMnO_4$
B. HI, FeI_3
C. I, AlI_3
D. I_2, $CuCl_2$

13. Which one of the following are acceptable name(s) for the following molecule (may be more than one):



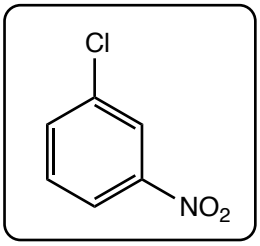
A. 2-chlorotoluene
B. 1-chloro-2-methylbenzene
C. ortho-chloromethylbenzene
D. ortho-chlorotoluene

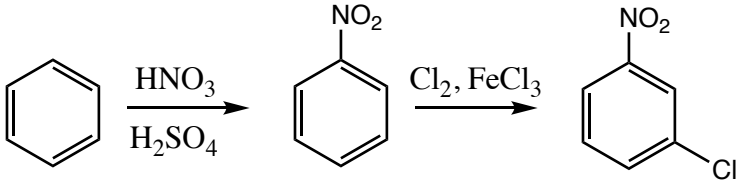
14. Provide the reagent(s) necessary to carry out the following reaction:



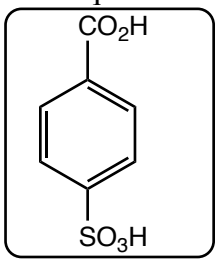
$CH_3CH_2Cl, AlCl_3$

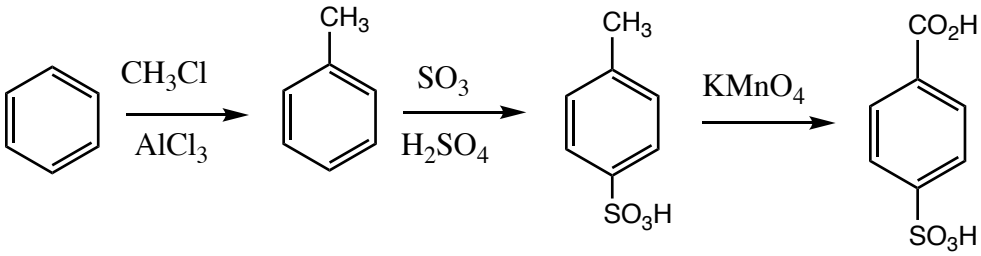
15. What sequence of reactions can be used to synthesize the following compound starting from benzene?



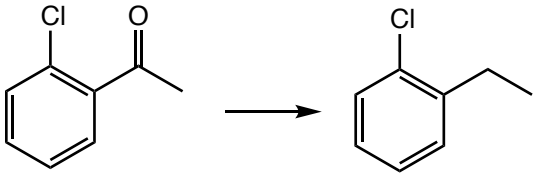


16. What sequence of reactions can be used to synthesize the following compound starting from benzene?





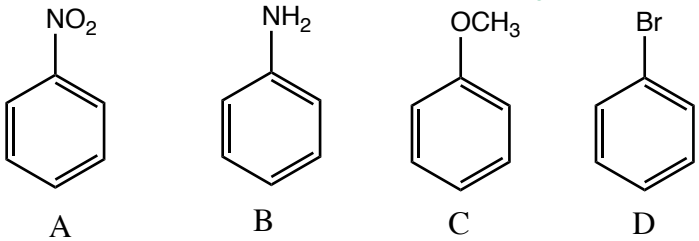
17. Which reagent should be chosen to complete the following reaction (may be more than one)?



A. $KMnO_4$
B. $AlCl_3, CH_3CH_2Cl$
C. $Zn(Hg), HCl$
D. $I_2, CuCl_2$
E. N_2H_4, KOH

18. Order the following substituted benzenes according their expected rate of reaction with an electrophile from most reactive >>>> least reactive:

strong electron-withdrawing | strongest electron-donating | strong electron-donating | weak electron-withdrawing



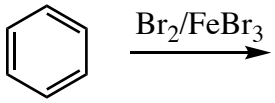
A B C D

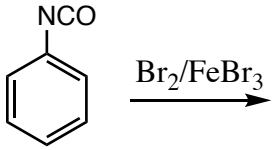
B > C > D > A

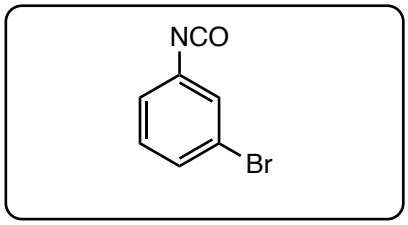
most reactive — least reactive

19. The rate of reaction of $Br_2/FeBr_3$ with benzene was compared with the reaction of the same reagent with a benzene ring substituted with the isocyanate (–N=C=O) group. The rate of reaction with the isocyanate-substituted ring was 1,000 x slower than that of benzene iself. Based on this data, is the isocyanate group an activiating or deactivating group? Predict the major product(s) of reaction of $Br_2/FeBr_3$ with the isocyanate-substituted compound.

- because the isocyanate group is SLOWING the reaction with Br2/FeBr3 relative to benzene, it is acting as a deactivating group
- groups are deactivating because they withdraw electron density from the benzene ring to which they are attached.
- electron-withdrawing groups are meta-directors







the isocyanate group is (circle one):

activating

deactivating

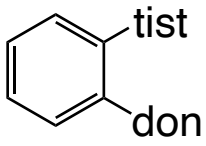
structure of major product(s)?

20. Which functional group is common to the structures of most explosives?

A. $–CH_2CH_3$
B. $–NO_2$
C. $–NH_2$
D. –OH

e.g., tri**nitro**toluene, **nitro**glycerine

Bonus point! What is the name of the following compound?



orthodontist!