

Chemistry 210 -- EXAM 4 (Fall 2003 - Dr. Robertson)

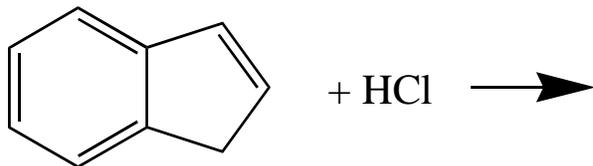
***** BEFORE BEGINNING EXAM, PLEASE READ THE FOLLOWING *****

The exam consists of this cover sheet, which contains an extra credit problem, which is optional. There are 10 problems to solve. The time limit for this exam is 2 hours. Please read problems carefully so that you understand the entire problem. *No work = no credit.*

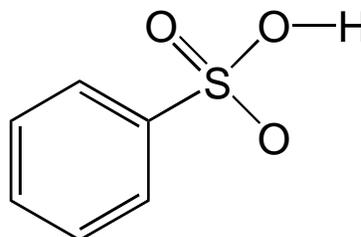
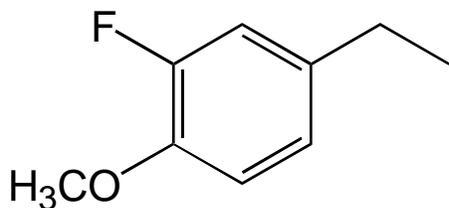
Signed _____

OPTIONAL EXTRA CREDIT (4 points total):

(2 Points) Show (i) the correct reaction mechanism and (ii) correct product for the following reaction (consider this an "allylic" type reaction for correct placement of the Cl atom in the 5-membered ring):



(2 Points) Give the correct names for the following compounds:



For reactions, if you need the structure of a reactant, you can ask for it, for a 1 point deduction.

16 1. Show structures for:

2-phenylethanol

isopropylbenzene

p-nitrotoluene

m-xylene

p-aminobenzoic acid

phenol

Benzylbromide

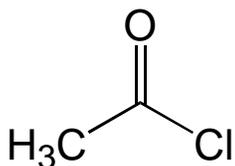
naphthalene

8 2. Show the structure of a benzyl free radical. Then, show 3 additional resonance structures derived from this free radical. Show the *major* product for the free radical chlorination of toluene (which undergoes a free-radical substitution).

- 8 3. (i) Starting with toluene, show the product if you under nitration reactions to produce a molecule have three nitro groups attached. (ii) What is the name of this compound?

- 12 4. (i) What is Hückels Rule for aromaticity (3 pts)? (ii) Show structures for: cyclopentadiene, furan, and pyridine (2 pts each). (iii) Which of these compounds is aromatic (3 pts)? (If you need structures, for each structure you need, I will give you the structure for *two* points.)

- 8 5. (i) Show how you could produce an acylium ion from acetyl chloride (structure is shown) and AlCl_3 as catalyst (4 pts). (ii) Draw one resonance structure of this ion (2 pts). (iii) Which of these resonance forms is more stable (2 pts)?



- 10 6. (i) Show the reaction mechanism for bromination of phenol, including the catalyst required to produce the bromine ion (Br^+ , the electrophile) from Br_2 (6 pts). (*Intermediate resonance structures are not needed.*) (ii) Show the structure for the original reaction intermediate (as a carbocation), making certain it is in a correct *ortho*-, *meta*-, or *para*- position. Only one correct structure is required.
- 12 7. (i) Starting with aniline show *all* possible resonance structures (4 resonance contributors) for nitration at its *para* position (8 pts). (ii) Why is *ortho* (or *para*) substitution is favored over *meta* (4 pts)?
- 5 8. Show the reaction pathway (mechanism) for a Birch reduction (hydrogenation) of toluene, including the correct final reaction product. (This reaction uses Na as the electron donor, and ethanol as the proton donor.)

- 16 9. Show the *major* product (*no* reaction mechanism required) for bromination of the following (draw the structure of the compound listed first, then attach the bromine ion to the correct carbon):

toluene

aniline

Phenol

m-xylene

benzoic acid

p-aminobenzoic acid

Nitrobenzene

methylbenzoate

- 5 10. You want to produce pure, without any side products, octyl benzene. Show how you could use a Friedel-Crafts *acylation* reaction, followed by catalytic hydrogenation, to produce this product.