

Chemistry 2542
Summer 2011; Midterm 3 Exam

This exam has 5 problems on 7 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) _____

Key

Scores:

Problem 1: 15

Problem 2: 15

Problem 3: 30

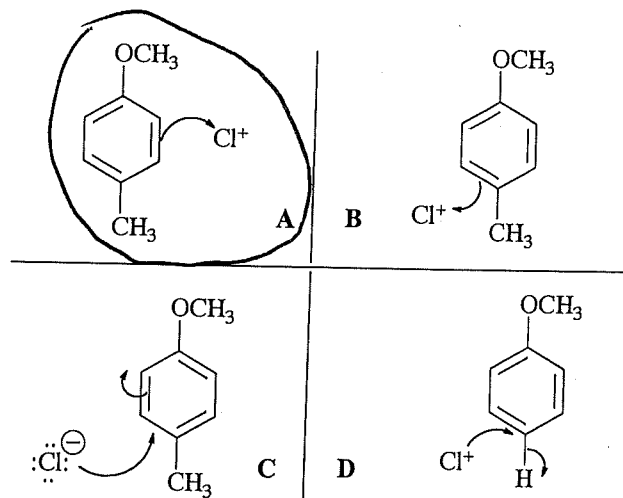
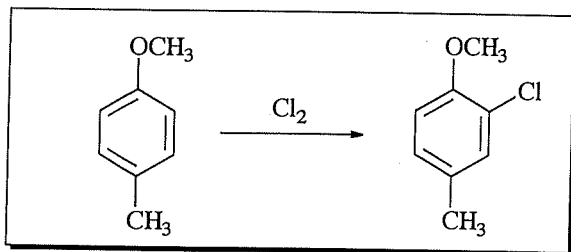
Problem 4: 20

Problem 5: 20

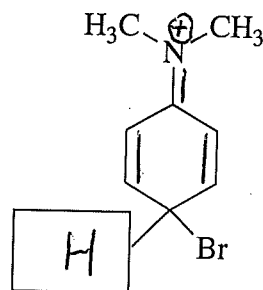
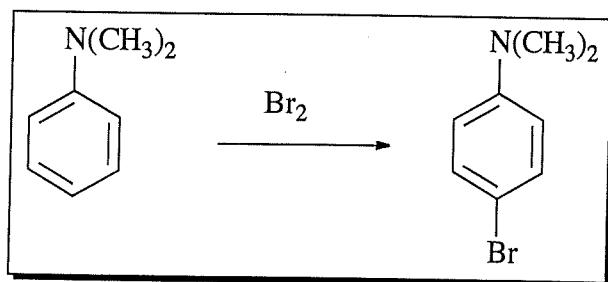
Total: 100

1. (15 pts) Answer the questions on mechanisms of the following reactions.

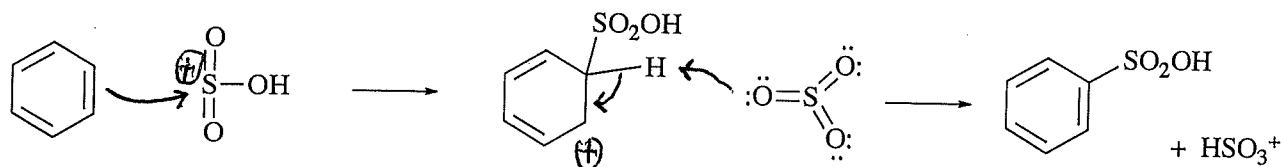
(a) Which one of the following four schemes (A-D) gives the best representation of a step in the mechanism of the reaction in the box (circle the correct answer; 5 pts)



(b) Finish drawing of the most important resonance contributor of the **intermediate** in the reaction shown in the box that explains the directing effect of the $-\text{N}(\text{CH}_3)_2$ group. (1 pt for each of the *five missing fragments*, which include atoms, formal charges, and bonds; 5 pts total):

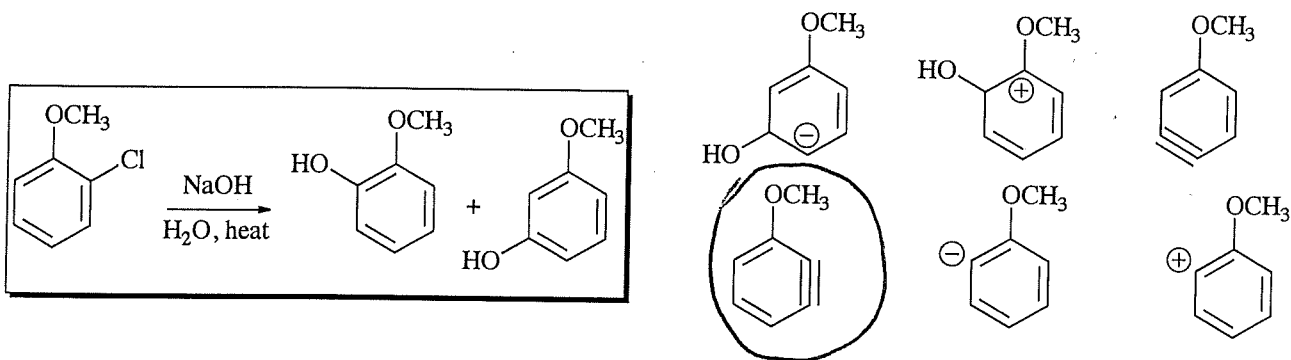


(c) Draw 3 curved arrows and show 2 charges missing in the following mechanism (5 pts; 1 pt each):

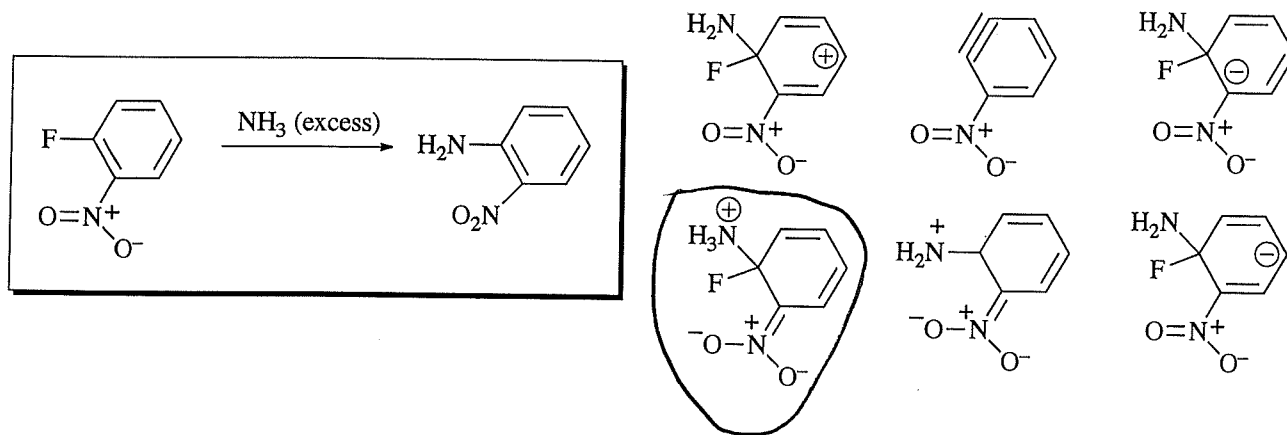


2. (15 pts) Answer the following questions.

(a) Circle the structure of the intermediate in this reaction (5 pts):

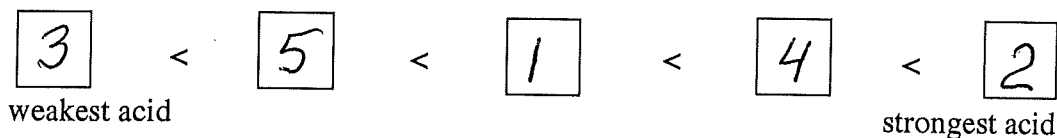


(b) Circle the structure of the *most important resonance contributor* of the intermediate in the following reaction (5 pts):

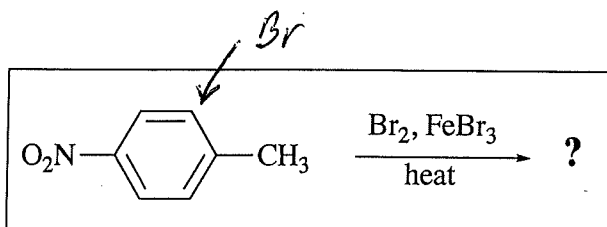


(c) (5 pts) Arrange the following **phenols** in order of **increasing acidity** (place a number 1-5 in the appropriate box, 1 pt each box):

(1) *o*-nitrophenol, (2) 2,4,6-trinitrophenol, (3) *p*-methylphenol, (4) 2,4-dinitrophenol,
(5) phenol

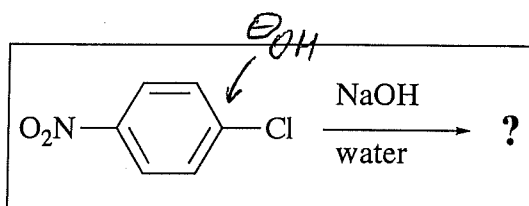


3. (30 pts) Circle the name of a major product in each of the following reactions (5 pts each):



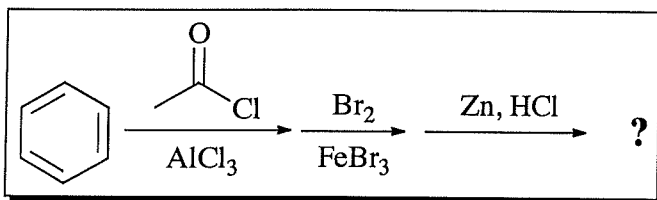
2-bromo-4-nitrotoluene 3-bromo-4-methylaniline

3-bromo-4-aminobenzonitrile *p*-bromotoluene



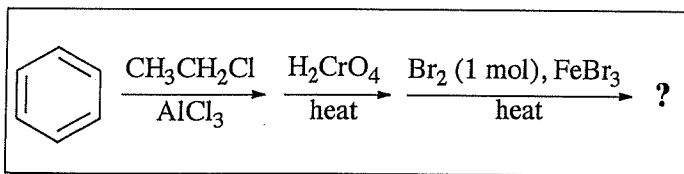
2-chloro-4-nitrophenol *p*-nitrophenol

m-nitrophenol 2-chloro-5-nitrophenol



o-bromobenzoic acid *m*-bromopropylbenzene

m-bromoethylbenzene *o*-bromoethylbenzene

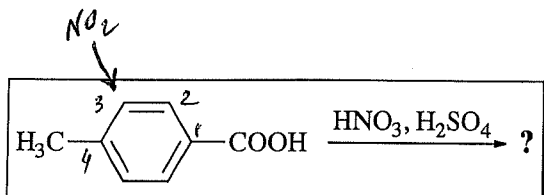


p-ethylbenzoic acid

m-chlorobenzoic acid

p-bromobenzoic acid

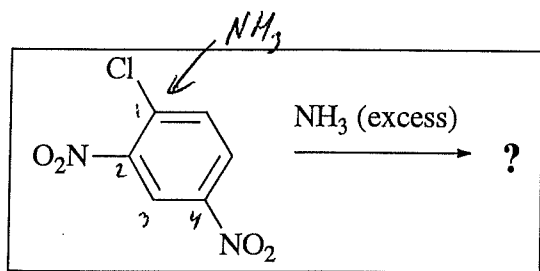
m-bromobenzoic acid



3-methyl-2-nitrobenzoic acid 4-methyl-2-nitrobenzoic acid

4-nitrobenzoic acid

4-methyl-3-nitrobenzoic acid

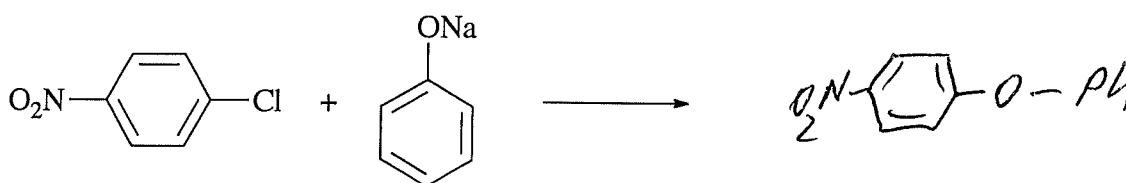
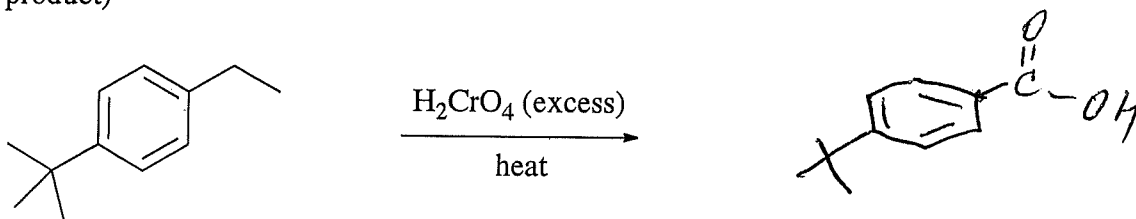


2,4-dinitrotoluene 3,5-dinitroaniline *m*-nitroaniline

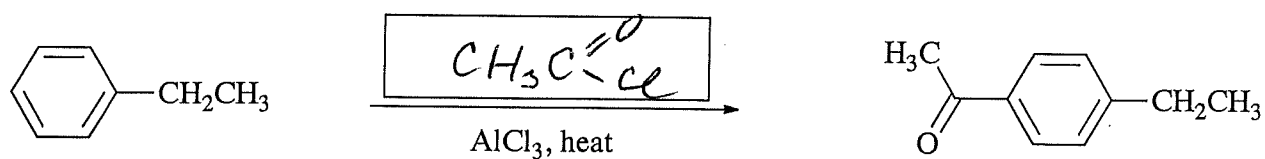
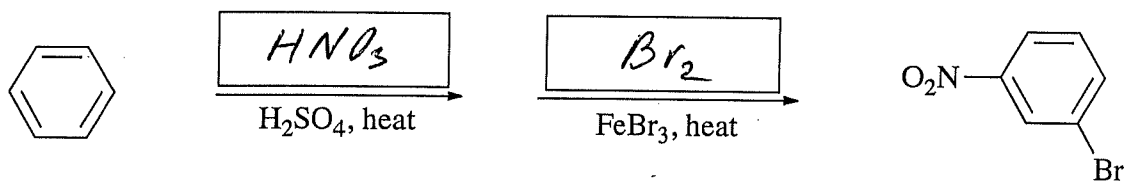
m-nitrophenol 3,5-dinitrophenol 2,4-dinitroaniline

2,4-dinitrophenol 2,4,6-trinitrophenol

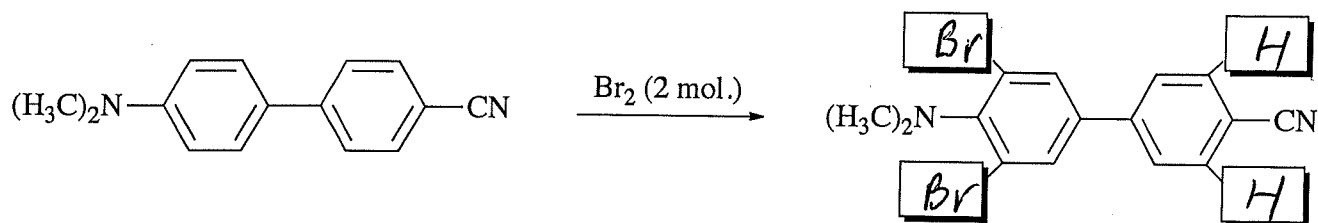
4. (20 pts) (a) Draw the structure of the main product for each the following reactions (5 pts each product)



(b) (6 pts) Place in each box the molecule of a reagent that is required to perform each of the following reactions (2 pts each box):



(c) (4 pts) Complete the following reaction by placing H or Br in the provided boxes (1 pt each box):



5. (20 pts) Answer the following questions:

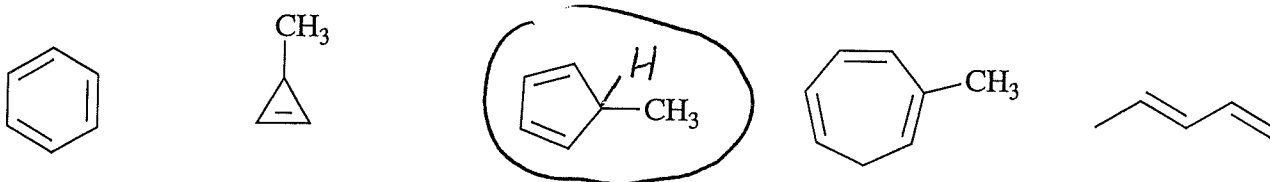
(a) (5 pts) Which one of the following compounds is the **most reactive** in the **Electrophilic Aromatic Substitution** reaction?

benzene benzenesulfonic acid benzoic acid aniline bromobenzene

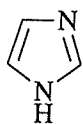
(b) (5 pts) Which one of the following compounds is the **most reactive** in the **Nucleophilic Aromatic Substitution** reaction with NaOH in water?

chlorobenzene 1-chloro-2-nitrobenzene 2,4-dinitroaniline 1,3,5-trinitrobenzene phenol

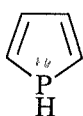
(c) (5 pts) Which one of the following molecules is the most **acidic** hydrocarbon (has the lowest pKa for a C-H bond)?



(d) (5 pts) Which of the compounds shown in the boxes are **aromatic**? (put all appropriate letters A-E in the provided box; no partial credit)



A



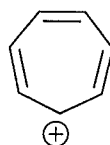
B



C



D



E

ABDE

Aromatic molecules:
(place appropriate letters A-E in the box)