

# Chemistry 2542

## Spring Semester 2008; Midterm 1 Exam

February 20, Wednesday, 1:00 to 1:50 pm

This exam has 6 problems (100 pts) on 8 pages. Make sure your copy is complete and correct.

Printed Name (LAST, First) \_\_\_\_\_

Your graded exams will be available Friday, February 22, before class.

Good Luck!

**Chemistry 2542**  
**Spring 2008; Midterm 1 Exam**

This exam has 6 problems on 8 pages. Make sure your copy is complete and correct.

Printed Name (Last, First) \_\_\_\_\_

**Scores:**

Problem 1: \_\_\_\_\_

Problem 2: \_\_\_\_\_

Problem 3: \_\_\_\_\_

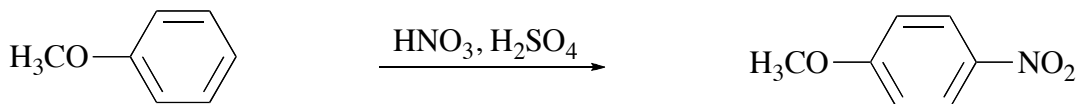
Problem 4: \_\_\_\_\_

Problem 5: \_\_\_\_\_

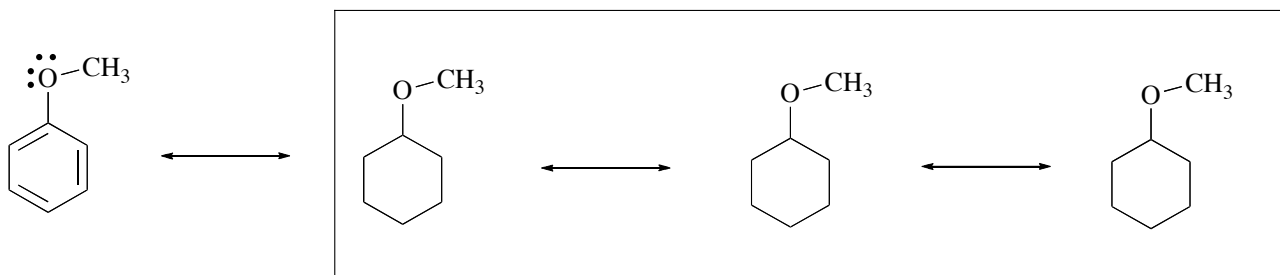
Problem 6: \_\_\_\_\_

Total: \_\_\_\_\_

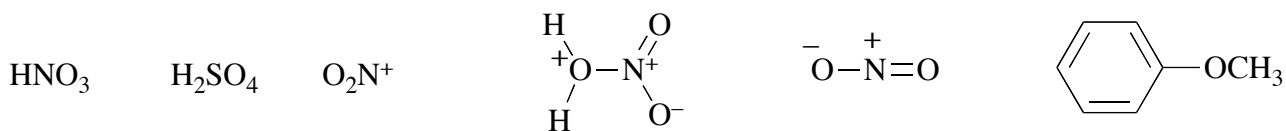
1. (15 pts) Answer the questions on mechanism of the following reaction:



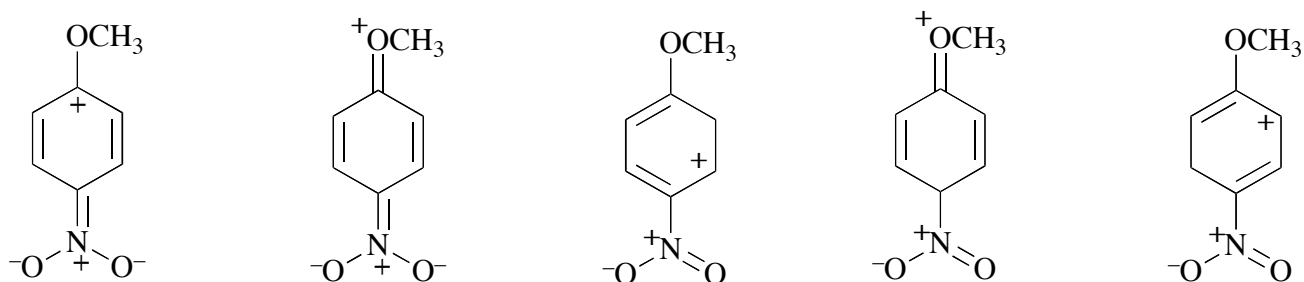
(a) (9 pts) In the provided box, finish drawing of three resonance contributors of the starting compound that explains the activating and directing effects of the methoxy group (3 pts each contributor; don't forget to show nonbonding electron pairs and formal charges):



(b) (3 pts) Circle the structure of the **electrophile** in this reaction

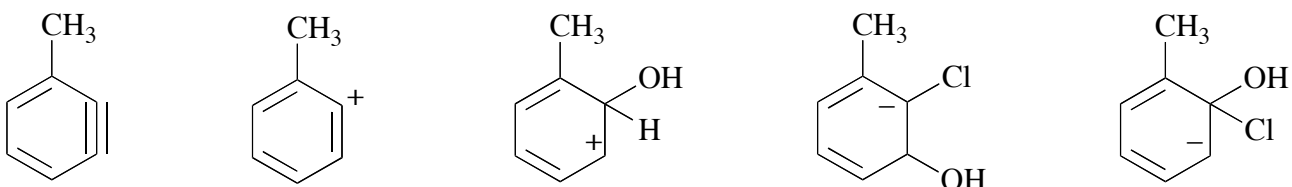
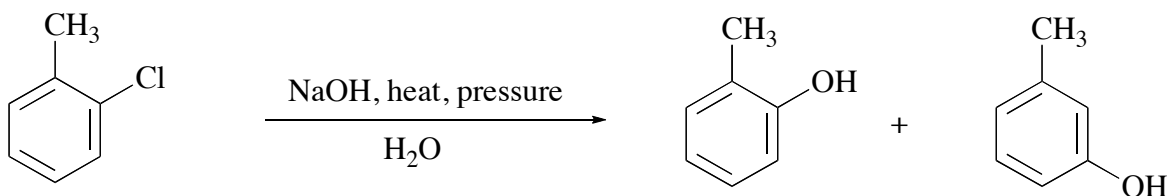


(c) (3 pts) Circle the structure of the **intermediate** in this reaction

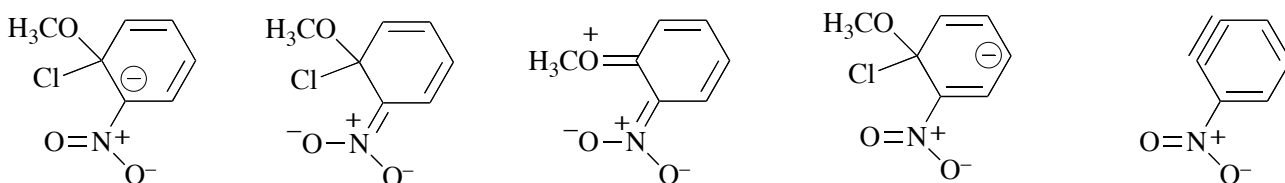
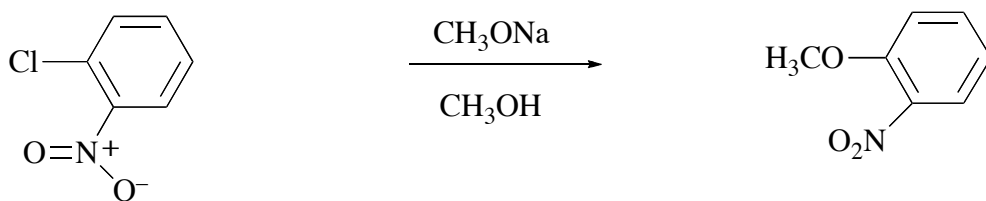


2. (15 pts) Answer the following questions.

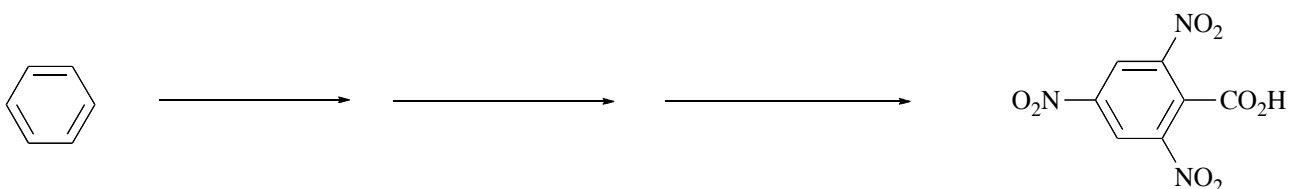
(a) (3 pts) Circle the structure of the **intermediate** in this reaction:



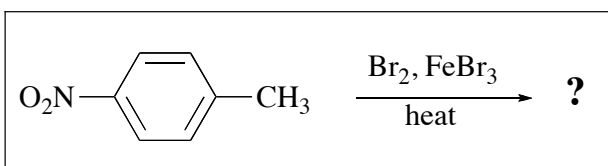
(b) (3 pts) Circle the structure of the *most important resonance contributor* of the intermediate in the following reaction:



(c) (9 pts) Place the **reagents on the arrow** that are required to perform the following synthesis:

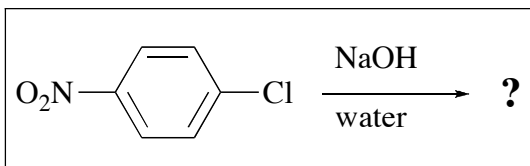


3. (30 pts) (a) (10 pts) Circle the structure of the **major product** in each of the following reactions:



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

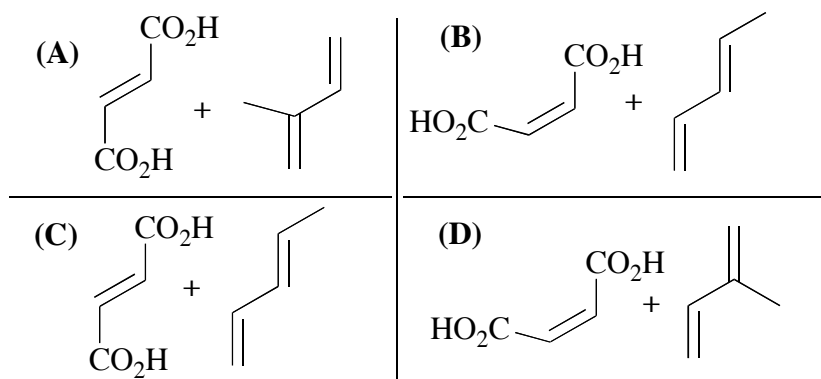
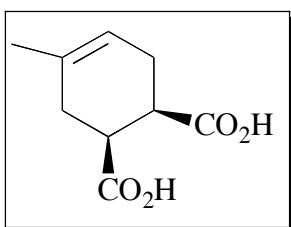
3-bromo-4-aminobenzonitrile    *p*-bromotoluene



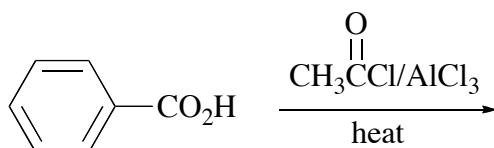
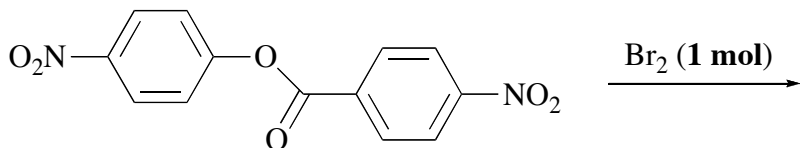
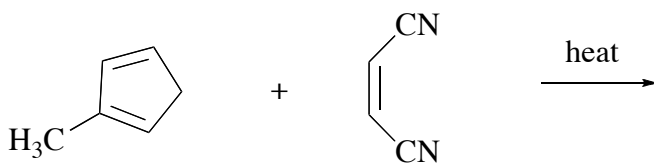
2-chloro-4-nitrophenol    *p*-nitrophenol

*m*-nitrophenol    2-chloro-5-nitrophenol

(b) (5 pts) What pair of reactants is required to synthesize the compound in the box (circle the answer):



(c) (15 pts) Complete the following equations, showing the **stereochemistry** of the product(s) when appropriate.

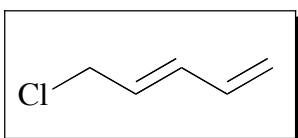


4. (10 pts) Answer the following questions on the IUPAC nomenclature:

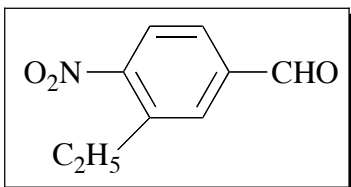
(a) Circle the correct **IUPAC name** of the compounds in the boxes (2 pts each):



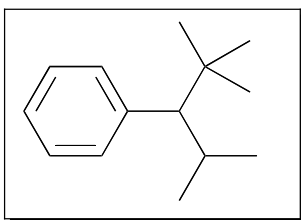
2,3,5-heptatriene      2,4,5-heptatriene  
2,5-heptadiene      2,3,5-hexatriene      2,4,5-hexatriene



(2Z)-1-chloro-2,4-pentadiene      (2E)-1-chloro-2,4-pentadiene  
(3Z)-5-chloro-1,3-pentadiene      (3E)-5-chloro-1,3-pentadiene  
(1E,3E)-5-chloro-1,3-pentadiene

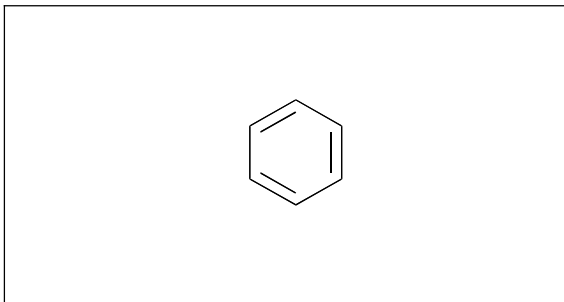


3-ethyl-4-nitrophenol      3-ethyl-4-nitroaniline  
3-ethyl-4-nitrobenzaldehyde      5-ethyl-4-nitrobenzaldehyde  
3-ethyl-4-nitrobenzoic acid      2-ethyl-1-nitro-4-benzaldehyde



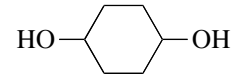
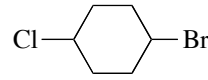
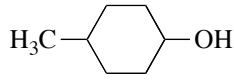
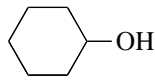
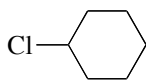
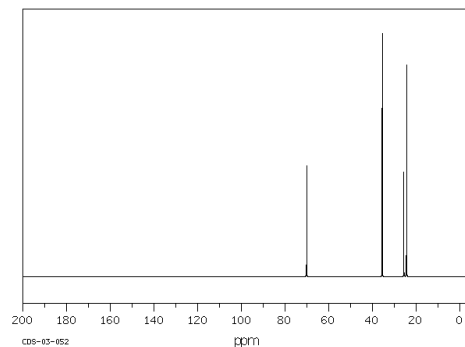
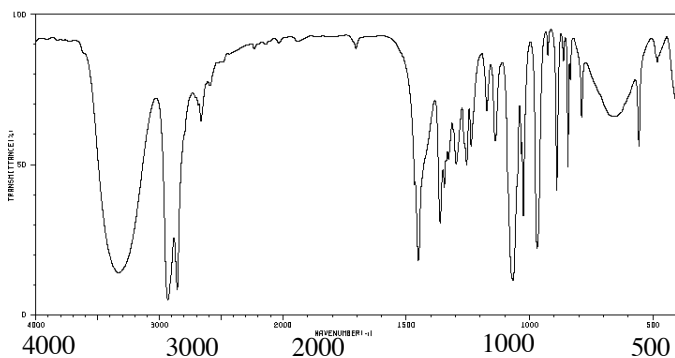
*tert*-butylbenzene      isooctylbenzene      isopropylbenzene  
2,2,4-trimethyl-3-phenylpentane      2,4,4-trimethyl-3-phenylpentane  
*tert*-butyl(isopropyl)benzene

(b) Finish drawing of *m*-bromoaniline in the provided box (2 pts):

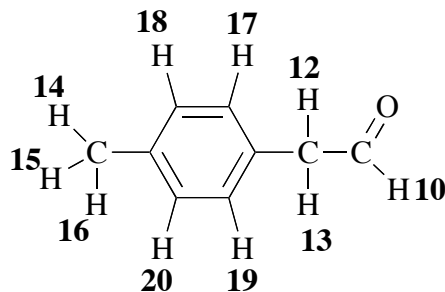


5. (15 pts) Answer the following spectroscopy questions:

(a) (5 pts) Circle the structure of the compound which gives these infrared and  $^{13}\text{C}$  NMR spectra:



(b) (5 pts) Into how many peaks would you expect the  $^1\text{H}$  NMR signals of the indicated protons to be split (put number of peaks in each box; 1 pt each)?



H10

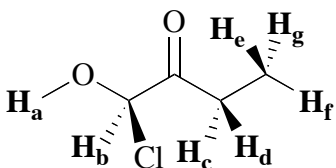
H12

H17

H18

H14

(c) (5 pts) Identify the indicated protons ( $\text{H}_a$ - $\text{H}_g$ ) in the following molecule as **unrelated**, **homotopic**, **enantiotopic**, or **diastereotopic** (write one word in each box; 1 pt each)



$\text{H}_a$  and  $\text{H}_b$

$\text{H}_b$  and  $\text{H}_c$

$\text{H}_c$  and  $\text{H}_d$

$\text{H}_e$  and  $\text{H}_g$

$\text{H}_g$  and  $\text{H}_f$

6. (15, 5 pts each) For each of the following questions (a)-(c) **circle** the item that is the correct answer.

(a) Which of the following groups will be ***o,p*-directing** in aromatic electrophilic substitution:



(b) Which one of the following compounds is the **least reactive** in the aromatic electrophilic substitution reaction?

aniline      benzene      *p*-chlorophenol      methoxybenzene      benzaldehyde      toluene      phenol

(c) Which one of the following molecules is **not aromatic**?

