Chemistry 2522

Spring Semester 2006; Midterm 3 Exam

April 26, Wednesday, 1:00 to 1:50 pm

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

Printed Name (**LAST**, First) _____

Your grades will be available Friday, April 28, morning before class.

Good Luck!

Chemistry 2522
Spring 2006; Midterm 3 Exam

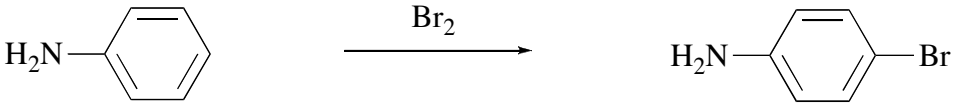
This exam has 8 problems on 6 pages. Make sure your copy is complete and correct.

Printed Name (***Last***, First) _____

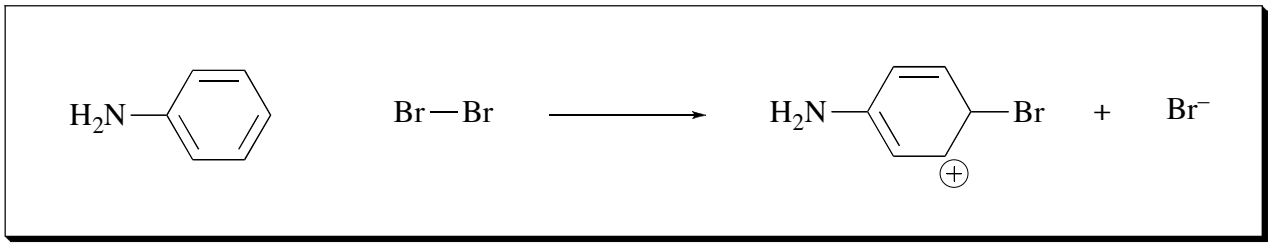
Scores:
1._____
2._____
3._____
4._____
5._____
6._____
7._____
8._____

Total: _____

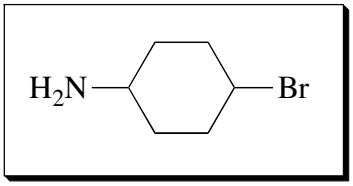
1. (8) Answer questions (a) and (b) on the **mechanism** of the following reaction:



(a) In the provided box, draw **two curved arrows** explaining the initial step (*electrophilic addition*) in the mechanism of this reaction (4 pts):

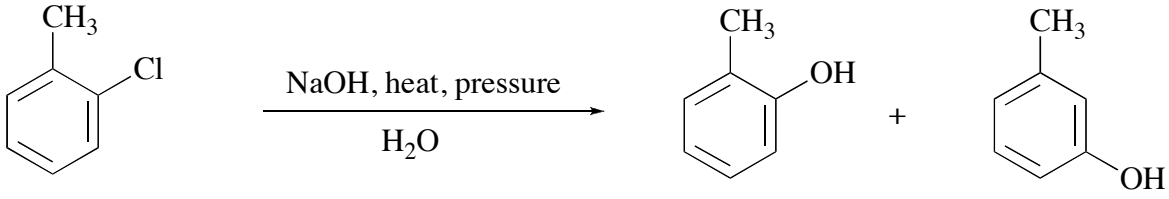


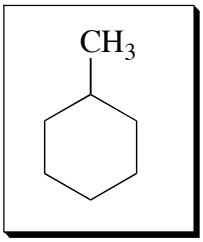
(b) In the provided box, finish drawing of the **most important resonance contributor** of the carbocationic intermediate that explains the *para* directing effect of the amino group (4 pts; 1 point for each of the four missing fragments):



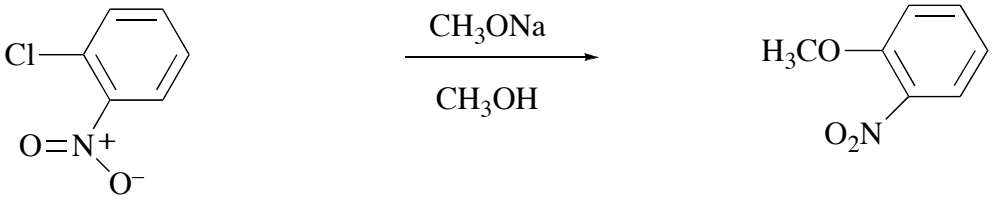
2. (9) Using provided boxes, answer questions on the **mechanisms** of the following reaction:

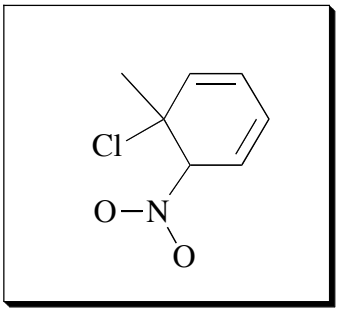
(a) Finish drawing of the **benzyne intermediate** for the following reaction (4 pts; 1 pt for each missing fragment):





(b) In the provided box, finish drawing of the **most important resonance contributor** of the intermediate in the following reaction (5 pts; 1 point for each of the five missing fragments):





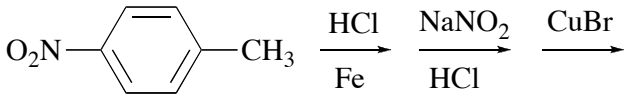
3. (8 pts) Arrange the following **amines** in order of **increasing basicity**:

(***1***) ammonia; (***2***) *p*-cyanoaniline; (***3***) aniline; (***4***) 2,4-dicyanoaniline;
(***5***) 2,4-dimethylaniline; (***6***) cyclohexanamine

☐ < ☐ < ☐ < ☐ < ☐ < ☐

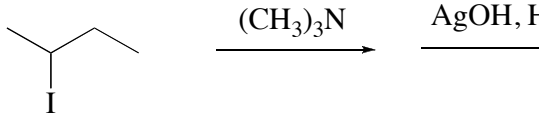
weakest base (2 pts) — 1 pt — 1 pt — 1 pt — 1 pt — strongest base (2 pts)

4. (16) Circle the **major organic product** obtained from each of the following sequences of reactions (4 pt each):



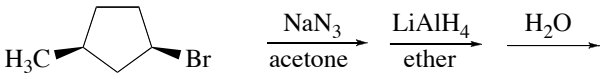
2-bromo-4-nitrotoluene 3-bromo-4-methylaniline

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



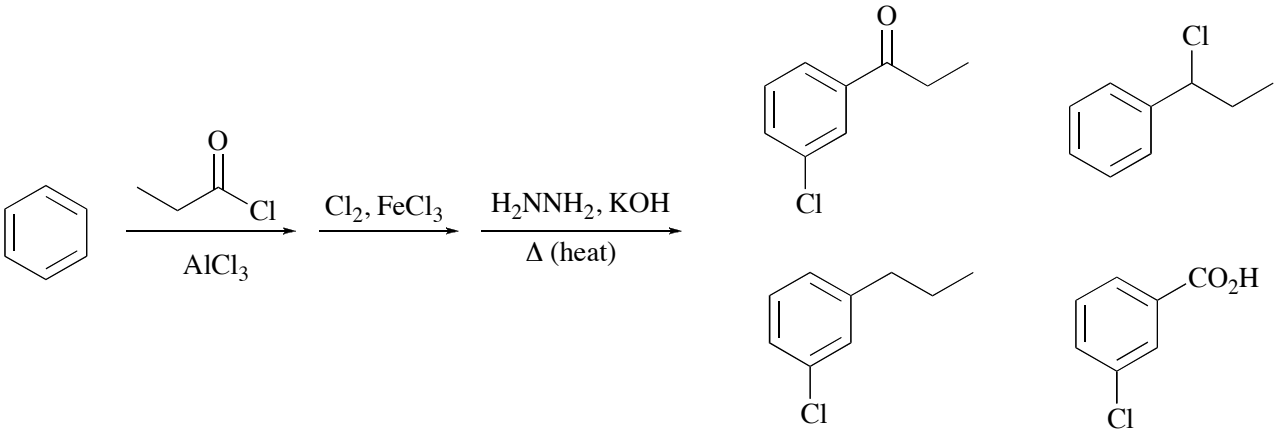
(2-butyl)dimethylamine 1-butene

2-butene 2-butylamine 2-butanol

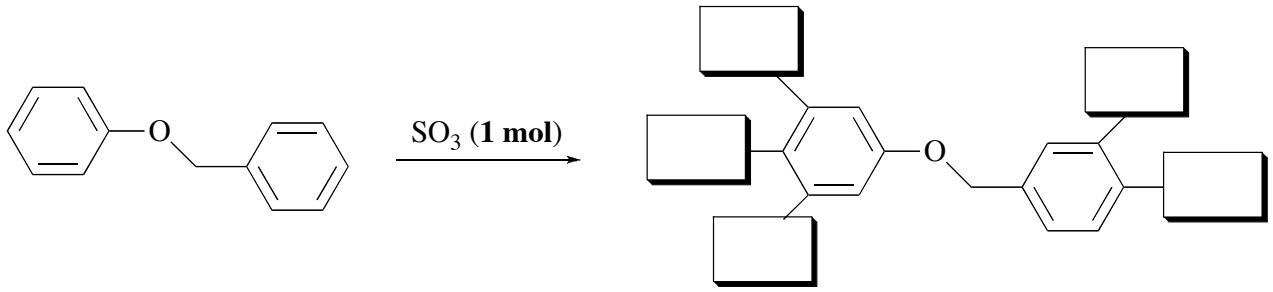


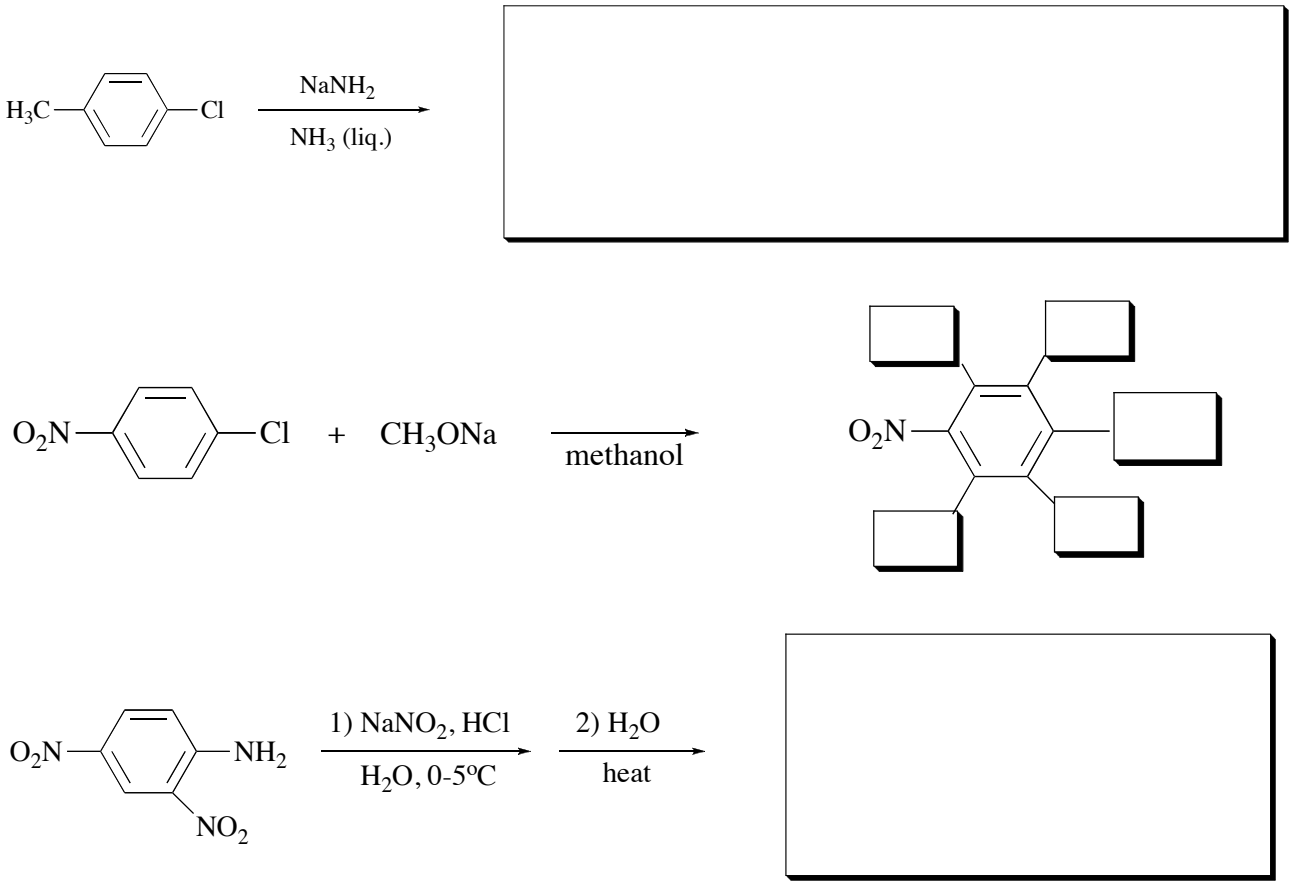
cis-3-methylcyclopentanol *cis*-3-methylcyclopentanamine

methylcyclopentane *trans*-3-methylcyclopentanamine

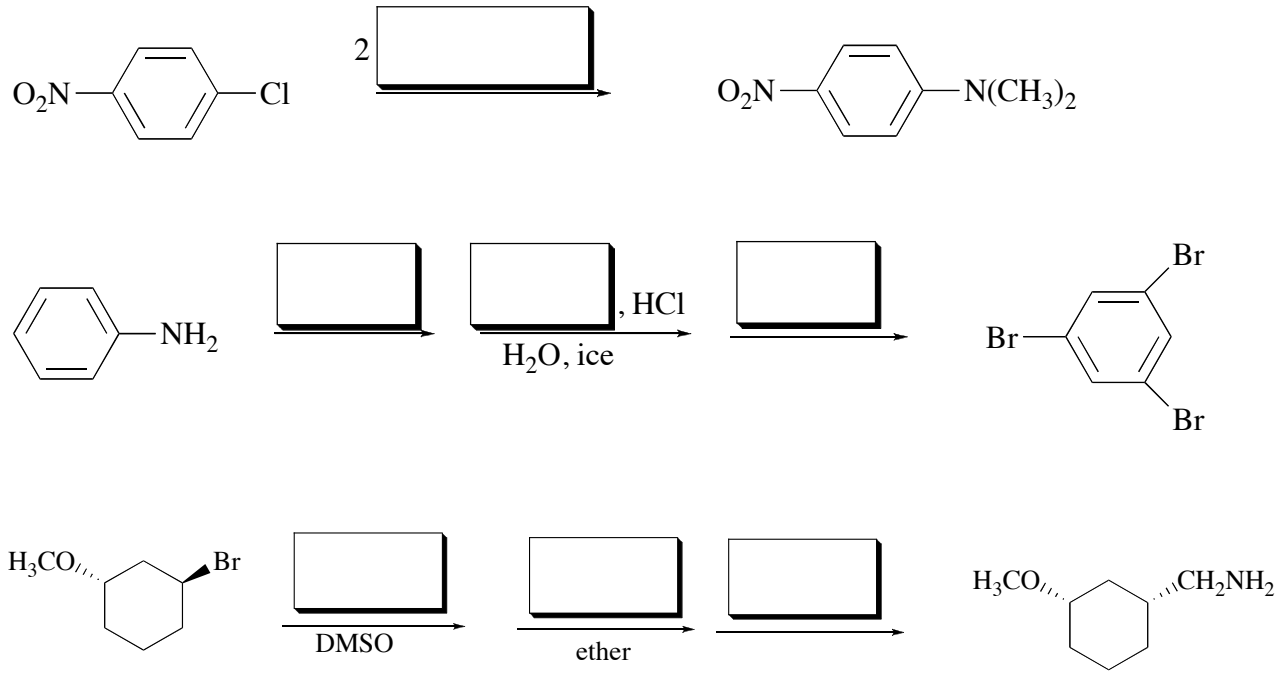


5. (20) Complete the following reaction by placing **appropriate substituents** (H or other groups) in the provided boxes (1 pt each box), or by drawing the structure of the main products (5 pts each):

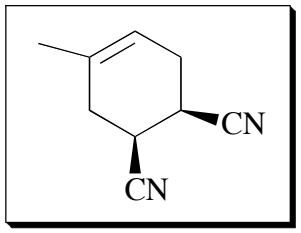




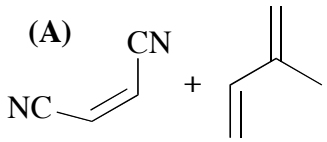
6. (14, 2 pts each box) Draw the molecule of a reagent that is required to perform each of the following reactions in the box above the arrow:



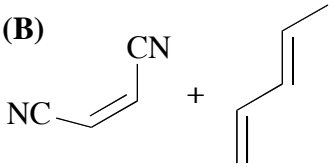
7. (5) What pair of reactants is required to synthesize the compound in the box (circle the answer):



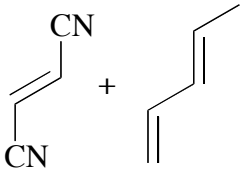
(A)



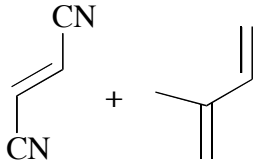
(B)



(C)

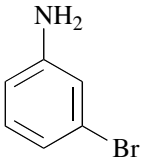


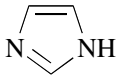
(D)

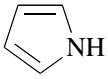


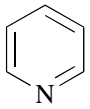
8. (20, 5 pts each) For each of the following questions (a)-(c) **circle** the item that is the correct answer.

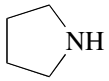
(a) Which of the following compounds is the weakest base?











CH_3NH_2

(b) Which one of the following compounds is the **least reactive** in the **Electrophilic Aromatic Substitution** reaction?

benzene nitrobenzene 4-methoxyphenol benzyl alcohol aniline toluene

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

H_3N^+– –CN $–CF_3$ $(CH_3)_3P^+$– $–SO_3H$ PhS– $(CH_3)_2S^+$– $–CO_2CH_3$

(d) Which one of the following compounds is the **most reactive** in the **Nucleophilic Aromatic Substitution** reaction?

chlorobenzene 1,3,5-trinitrobenzene *p*-chloronitrobenzene 1,3-dinitrobenzene phenol