Chemistry 2522
Spring 2006; Midterm 3 Exam

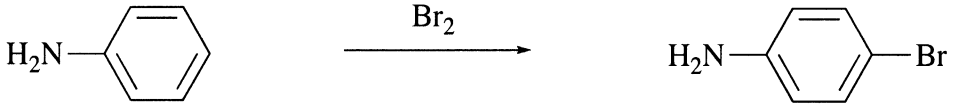
This exam has 8 problems on 6 pages. Make sure your copy is complete and correct.

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

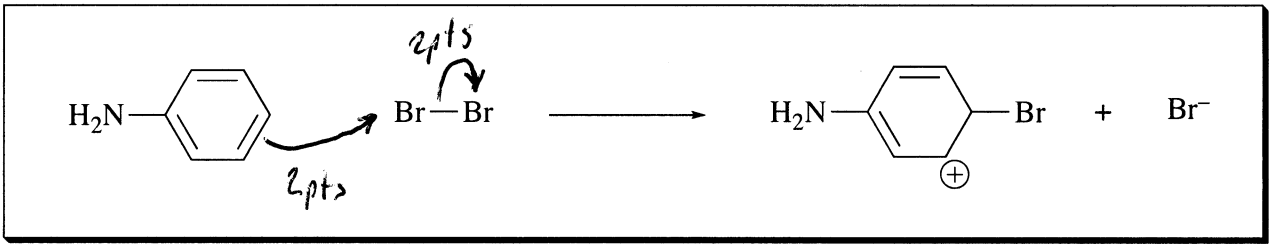
Scores:
1. 8
2. 9
3. 8
4. 16
5. 20
6. 14
7. 5
8. 20

Total: 100

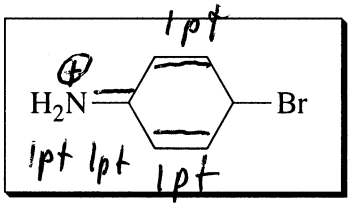
1. (8) Answer questions (a) and (b) on the **mechanism** of the following reaction:



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

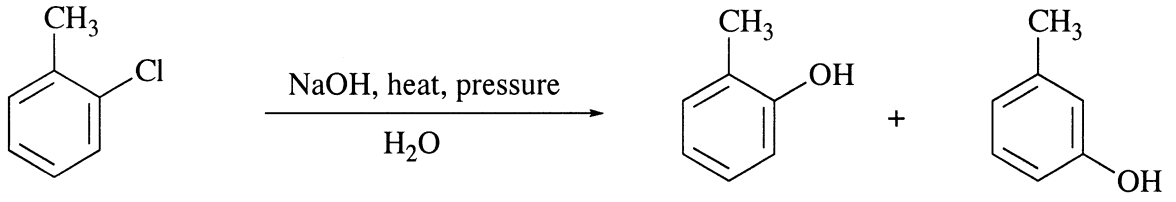


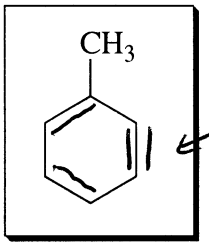
(b) In the provided box, finish drawing of the **most important resonance contributor** of the carbocationic intermediate that explains the *para* directing effect of the amino group (4 pts; 1 point for each of the four missing fragments):



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

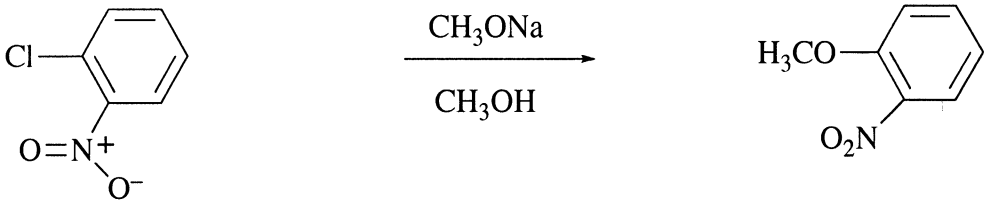
(a) Finish drawing of the **benzyne intermediate** for the following reaction (4 pts; 1 pt for each missing fragment):

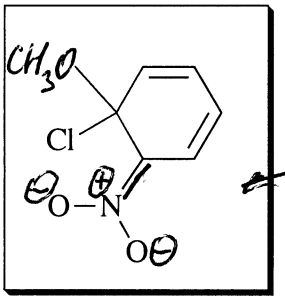




1pt each bond (4 total)

(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 missing fragments):





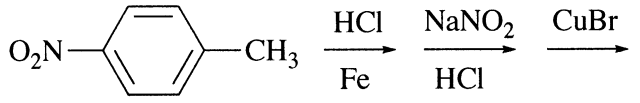
1pt each bond or charge, (5 total)

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

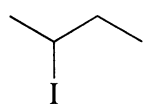
4	<	2	<	3	<	5	<	1	<	6
weakest base (2 pts)		1 pt		1 pt		1 pt		1 pt		strongest base (2 pts)

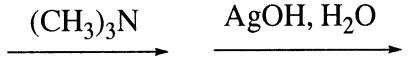
4. (16) Circle the **major organic product** obtained from each of the following sequences of reactions (4 pt each):



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

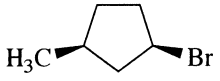
3-bromo-4-aminobenzonitrile *p*-bromotoluene





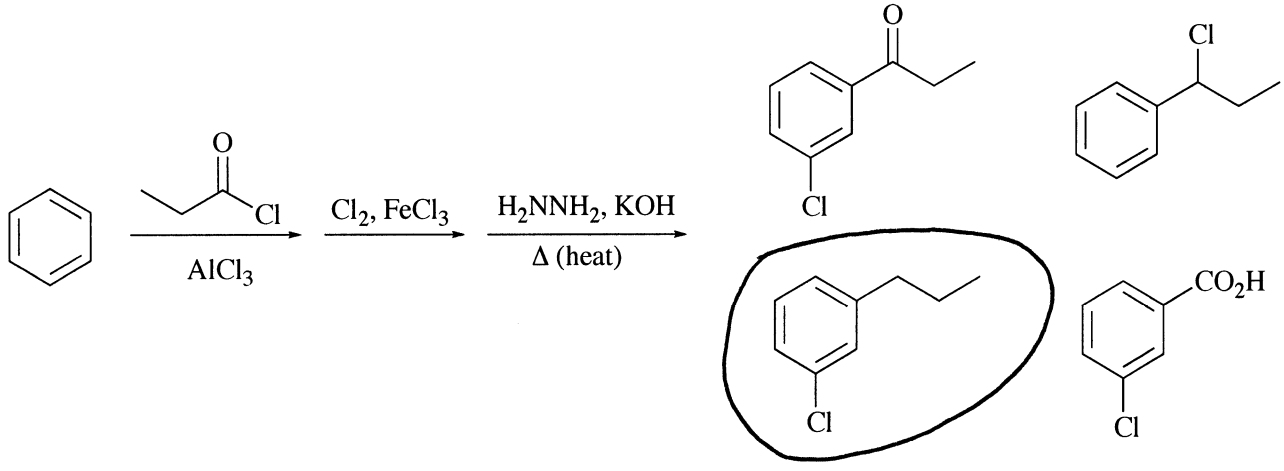
(2-butyl)dimethylamine 1-butene

2-butene 2-butylamine 2-butanol

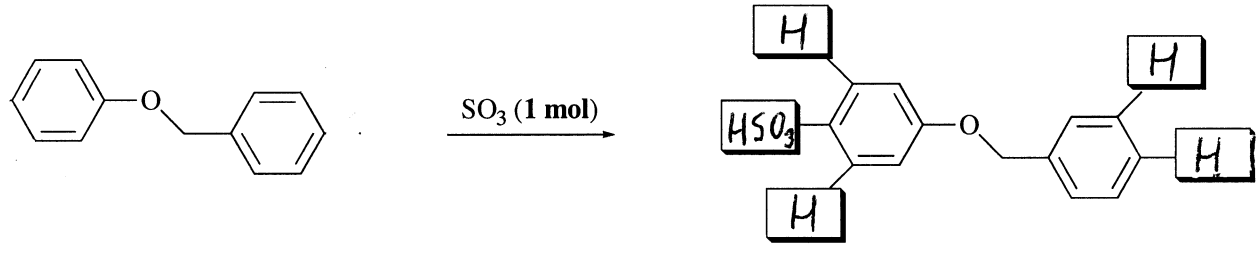


cis-3-methylcyclopentanol *cis*-3-methylcyclopentanamine

methylcyclopentane *trans*-3-methylcyclopentanamine

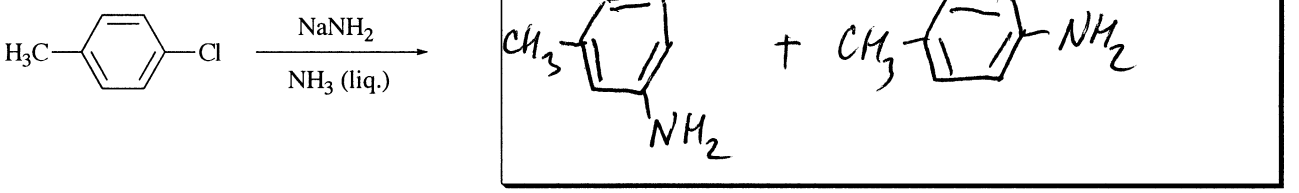


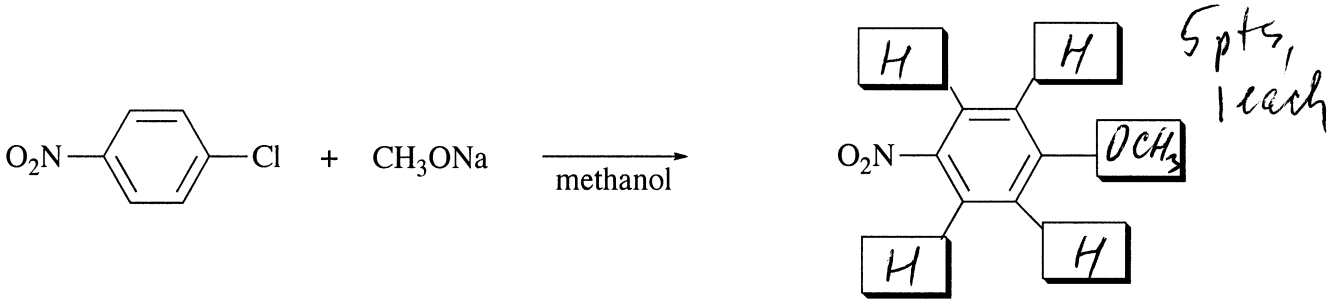
5. (20) Complete the following reaction by placing **appropriate substituents** (H or other groups) in the provided boxes (1 pt each box), or by drawing the structure of the main products (5 pts each):



1pt each

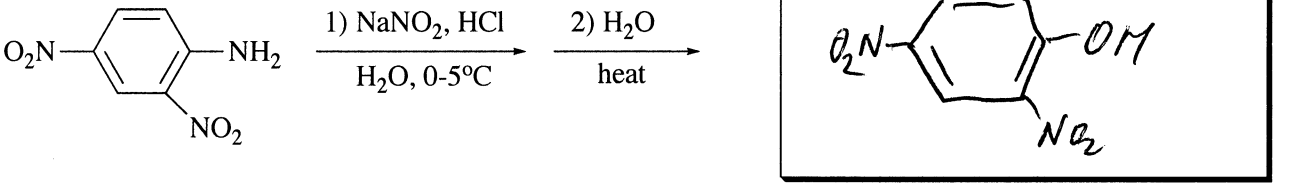
5 3pts 2pts



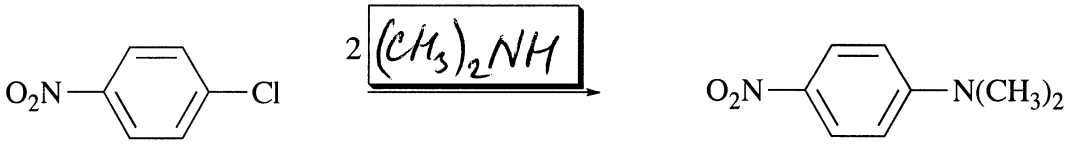


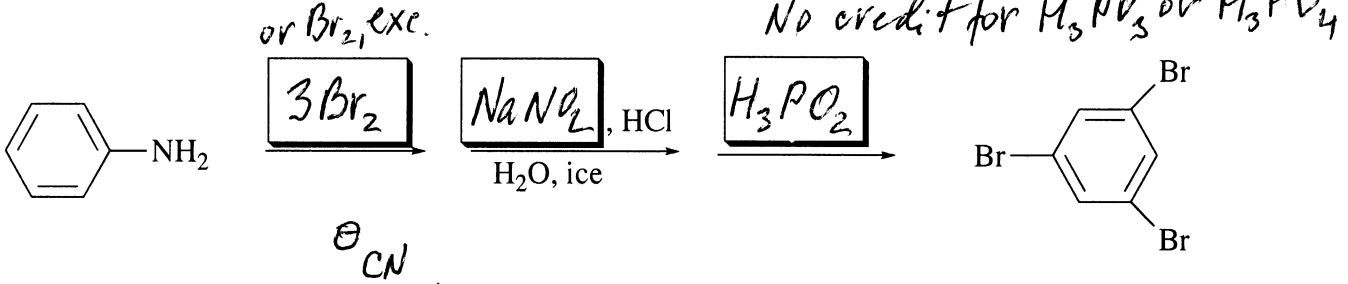
5pts, 1 each

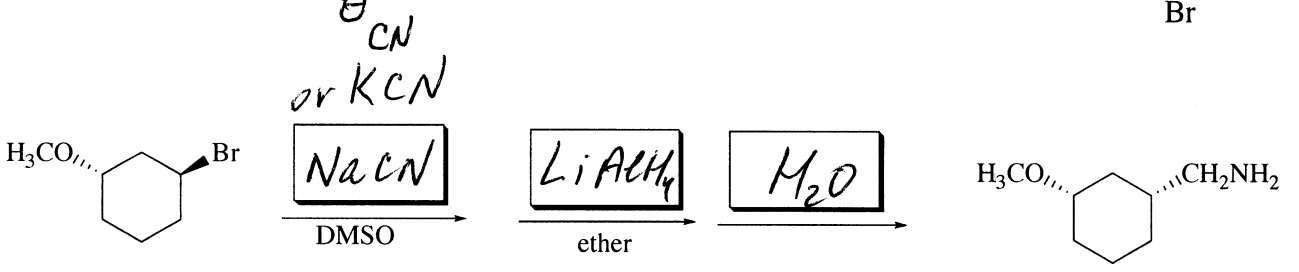
5pts



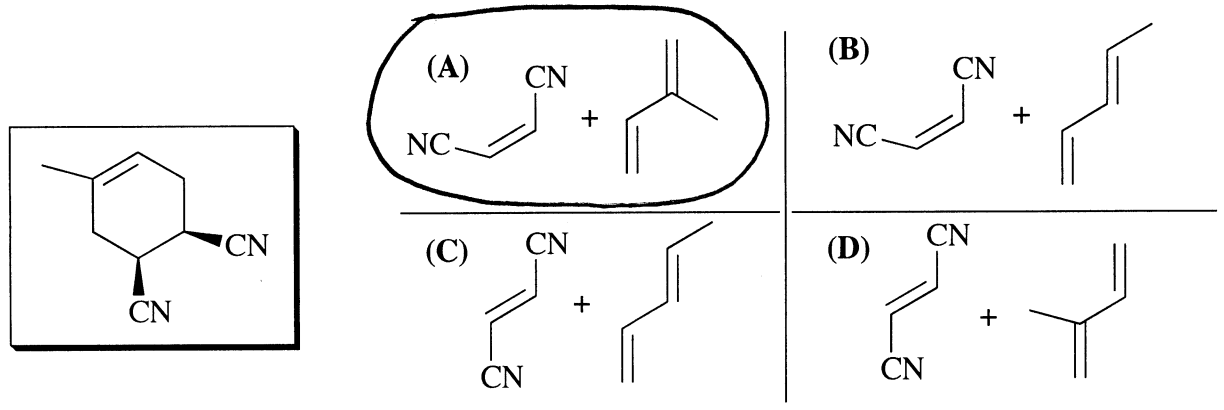
6. (14, 2 pts each box) Draw the molecule of a reagent that is required to perform each of the following reactions in the box above the arrow:





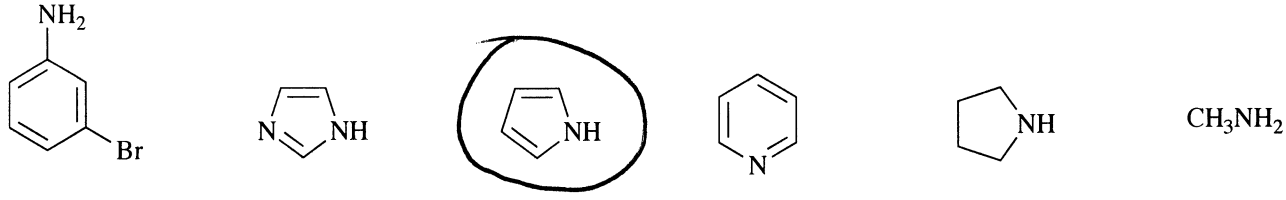


7. (5) What pair of reactants is required to synthesize the compound in the box (circle the answer):



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?



(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