

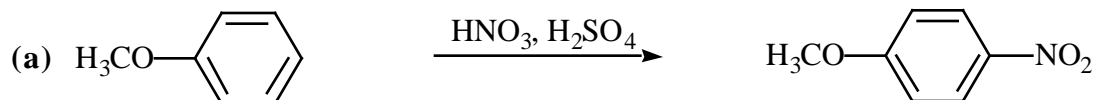
Chemistry 2522, Spring Semester 2000
Sample Midterm 3 Exam

Ch 21 from p. 814 and Chs 22, 23, 24 of Brown & Foote text

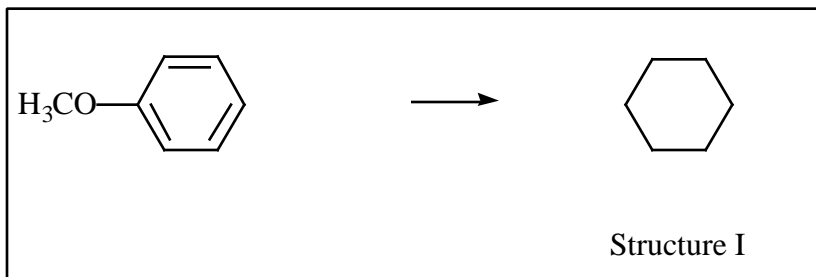
This exam has 6 problems (100 pts) on 4 pages. Make sure your copy is complete and correct.

Answer key is available in PDF format at: www.d.umn.edu/~vzhdanki/2522/

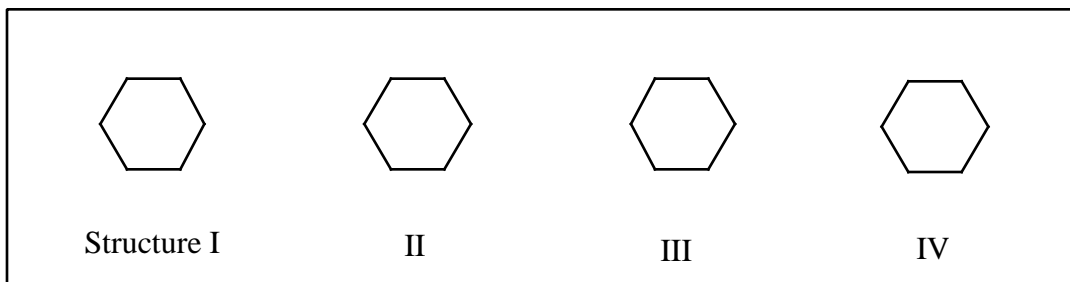
1. (26 pts) Using provided boxes and templates, answer the questions on **mechanisms** of the following reactions:



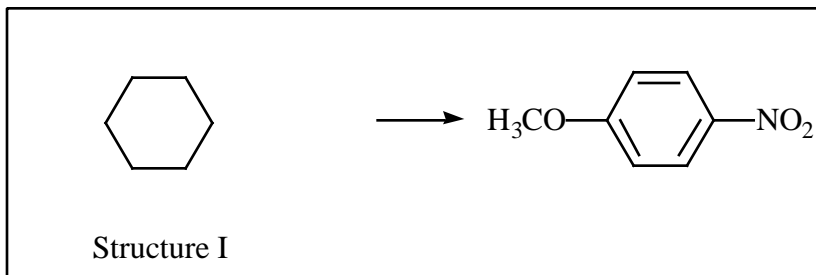
In the provided box, write the **Lewis structure** of the actual **electrophile** (E^+) in this reaction (2 pts)



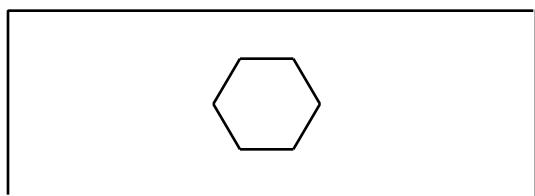
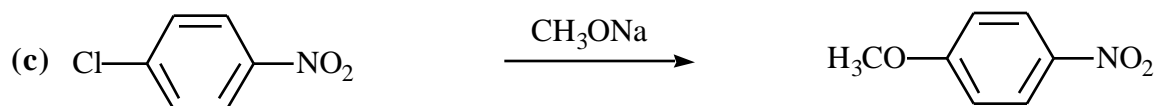
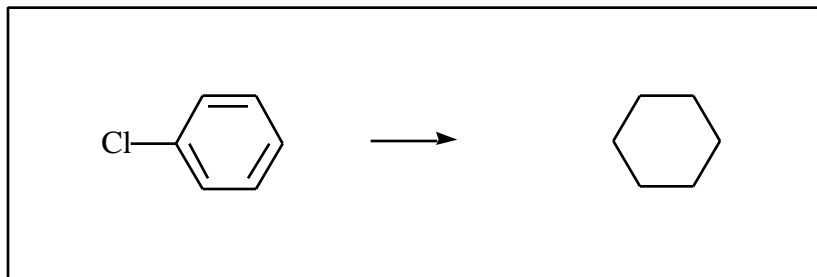
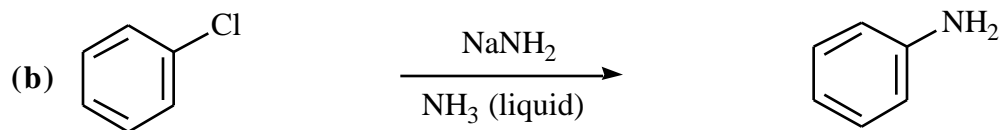
In the provided box, write the **first step** in the reaction mechanism. Using provided six-membered ring, show the structure of the **intermediate** (Structure I) 4 pts



Using provided templates, write all **four resonance** contributors of the **intermediate** in this reaction (start from Structure I) 4 pts



Using curved arrows, provided templates, and other essential reagents, write the **final step** in the reaction mechanism 4 pts

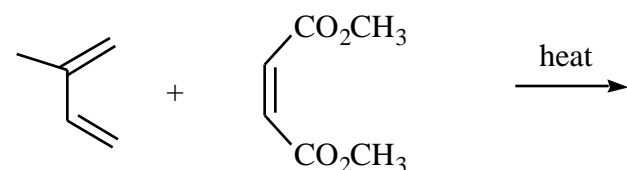
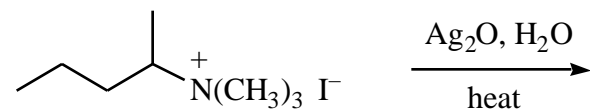
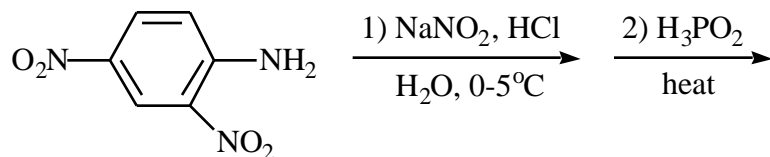
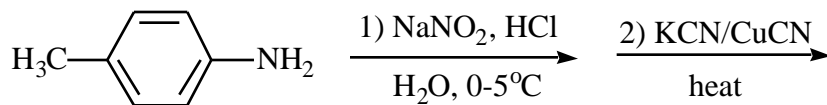
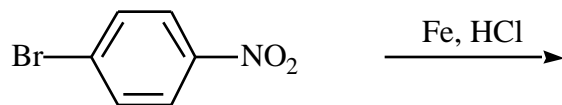
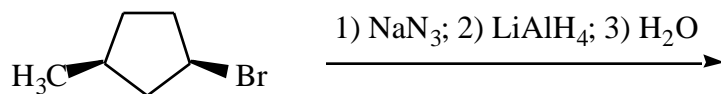
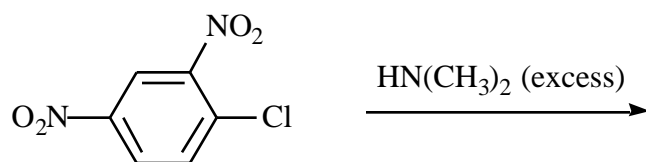
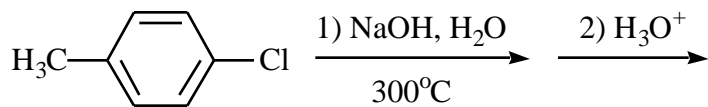
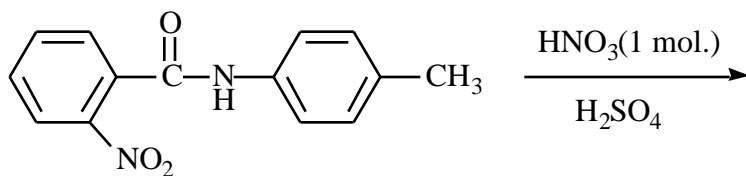


2. (11 pts) (a) (6 pts) Arrange the following compounds in order of **increasing basicity**:

- (1) aniline; (2) *o*-nitroaniline; (3) *m*-nitroaniline; (4) 2,4-dimethylaniline;
(5) 2,4,6-trinitroaniline; (6) benzylamine

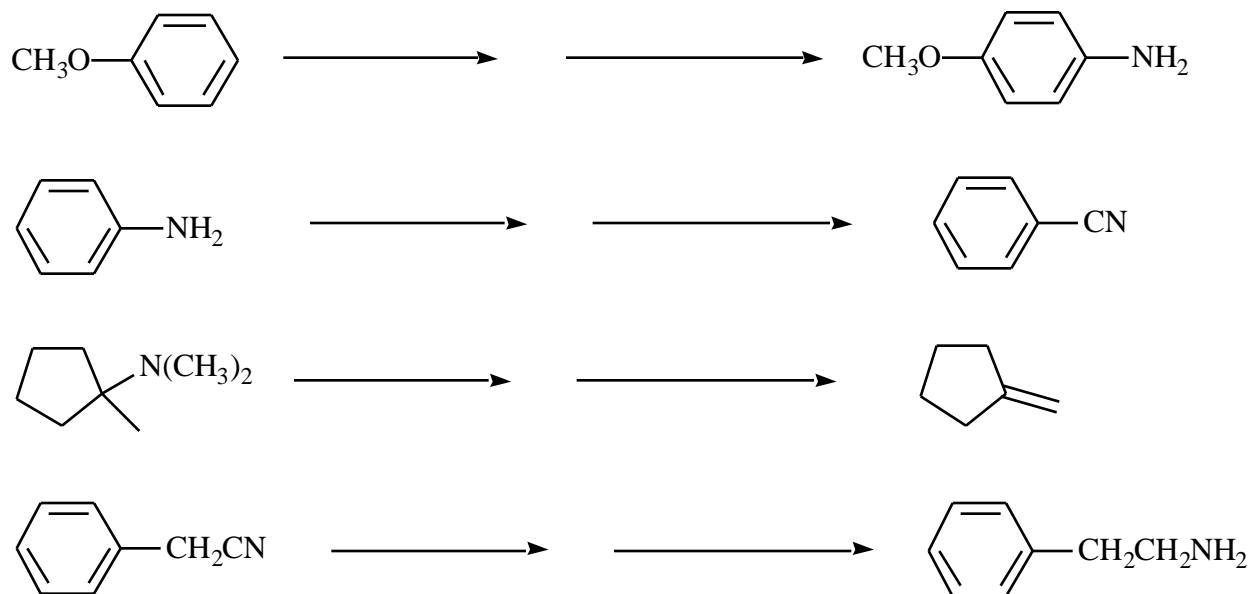
(b) (5 pts) Draw the important resonance contributor of ***o*-nitroaniline** that explains its **low basicity**:

3. (27; 3 pts each) Complete the following equations:



4. (16) Give the **reagents on the arrow** that can be used to convert the reactant to the indicated product

in high yield. (2 pts each reagent)



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

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

benzene nitrobenzene 1-chloro-2,4,6-trinitrobenzene toluene phenol bromobenzene

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

2,4,6-trinitrotoluene nitrobenzene 1-chloro-2,4-dinitrobenzene toluene phenol aniline

(c) Predict which of the following groups will be ***m*-directing** in aromatic electrophilic substitution:

$(\text{CH}_3)_2\text{S}^+-$ $\text{Na}^+ \text{O}^-$ CH_3CH_2- $\text{Ph}_2\text{P}-$ $\text{Ph}-$ $\text{Ph-CH}_2\text{CH}_2-$ $(\text{CH}_3)_2\text{N}-$

(d) Predict which of the following groups will be ***o,p*-directing** in aromatic electrophilic substitution:

H_3N^+- $\text{PhO}-$ $-\text{CF}_3$ $(\text{CH}_3)_3\text{P}^+-$ $-\text{NO}_2$ $(\text{CH}_3)_2\text{S}^+-$ $-\text{CO}_2\text{H}$