

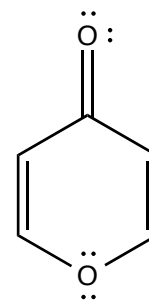
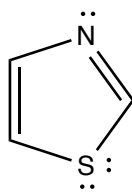
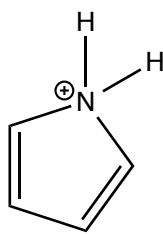
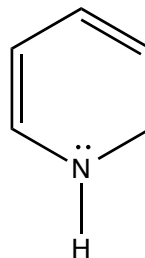
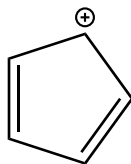
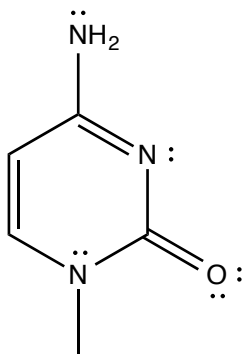
Name \_\_\_\_\_

Signature \_\_\_\_\_

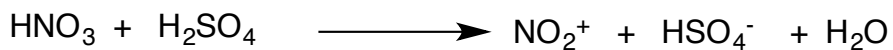
You are required to answer all question sets. Please note that some of the question sets offer you a choice of questions - do only the number of questions asked for. Please write legibly and draw clearly. Points will be deducted for illegible and unclear answers. The point total for this exam is 100 and the value of each question set is shown in parenthesis beside that set. **READ ALL QUESTIONS CAREFULLY AND APPORTION YOUR TIME ACCORDINGLY.**

**PART ONE: STRUCTURE, MECHANISM, AND REACTIVITY** – For each of the sets below, circle the answer(s) as indicated.

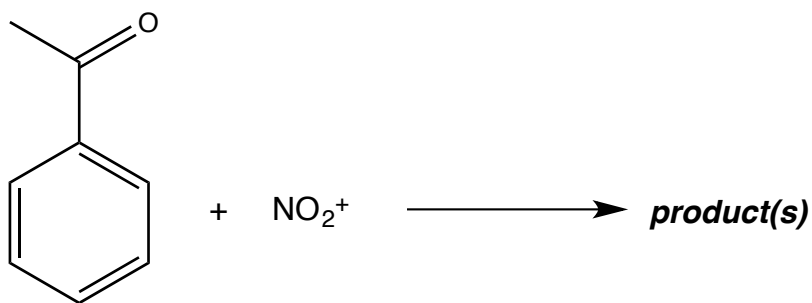
1. Consider the structures below. Circle all that are **aromatic**. You may assume planarity in all cases. **(12)**



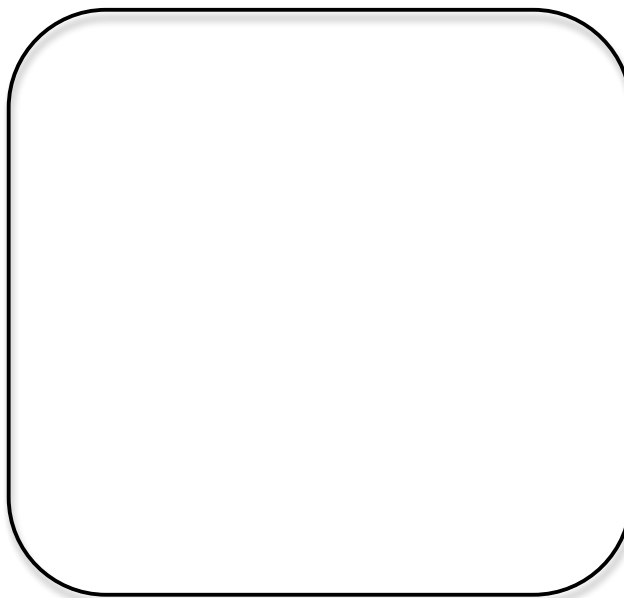
2. a. Draw the stepwise mechanism of the reaction below using mechanistic arrows to show electron movement. For full credit your mechanism must account for the formation of all products. (3)



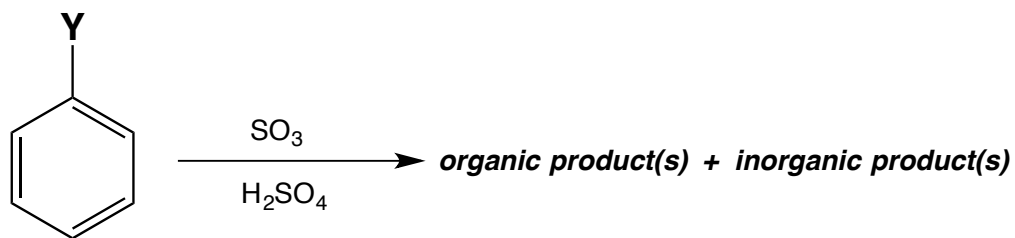
- b. Draw the **resonance hybrid** of the arenium ion formed during the EAS reaction below. *Place your answer in the box provided.* Remember to show the resonance of the "NO<sub>2</sub>" group and the carbonyl in your hybrid. (6)



**Answer**



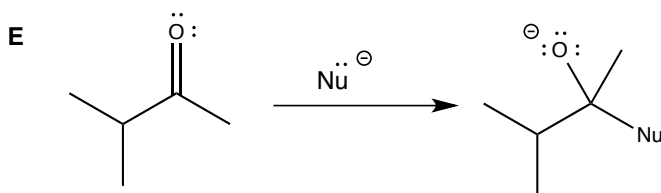
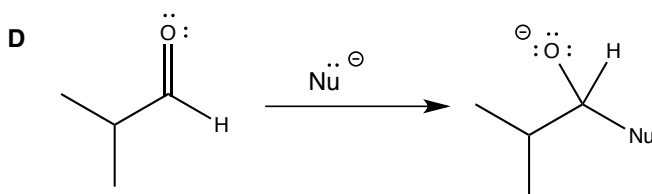
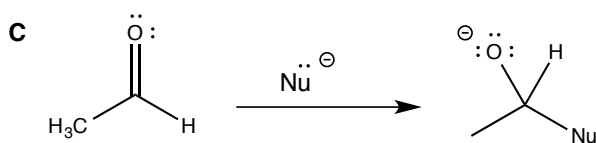
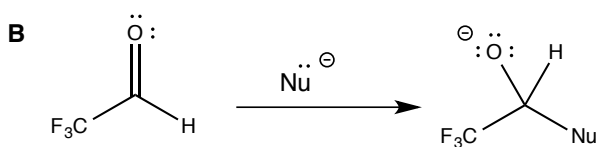
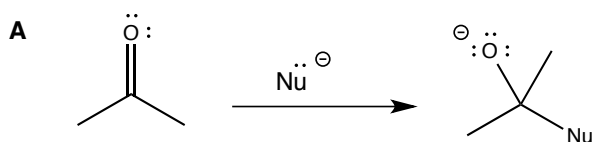
3. Consider the following reaction:



Which of the following statements (A-E) regarding the above reaction is TRUE? Circle **all possible answers**. (6)

- A. The product of the reaction will be less activated toward electrophilic aromatic substitution than the starting material.
- B. Water is a by-product of this reaction.
- C. The reaction rate will be faster if Y = Br than if Y = CH<sub>3</sub>.
- D. If Y = OCH<sub>3</sub>, an isomeric mixture of organic products will result.
- E. The slow step of the reaction involves the formation of a non-aromatic ion.

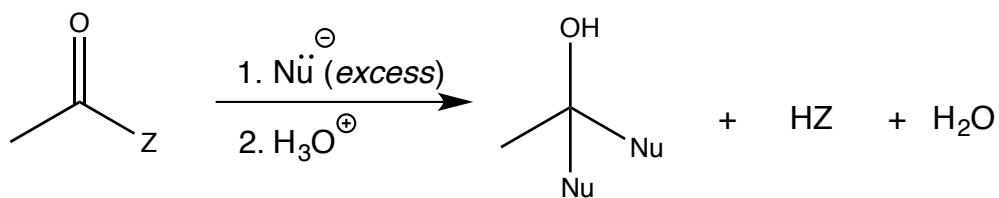
4. Circle which of the reactions (A-E) below would be the most favorable. (4)



5.

a. Draw the stepwise mechanism of the following reaction using mechanistic arrows to indicate electron movement.

(6)



b. Consider the reaction in part a. For each of the following pairs (A-C), circle which would lead to the more favorable reaction.

(3)

A. Z = Cl or Z = OCH<sub>3</sub>

B. Z = OCOR or Z = NHCH<sub>3</sub>

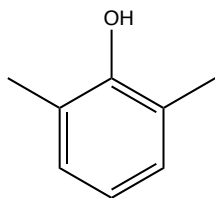
C. Z = NH<sub>2</sub> or Z = OH

**PART TWO: PREDICT THE PRODUCT**

For **five (5)** of the following reactions **6-12** predict the major organic product(s) showing stereochemistry where appropriate. **(30)**

*Check the corresponding boxes for the FIVE answers that you want graded, otherwise 6-10 will be graded automatically.*

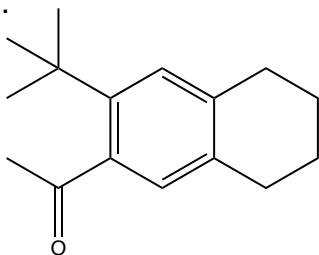
6.



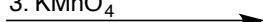
1.  $\text{K}_2\text{CO}_3/\text{CH}_3\text{CH}_2\text{OTs}$
2.  $\text{HNO}_3/\text{H}_2\text{SO}_4$
3.  $\text{H}_2/\text{Pd-C}$



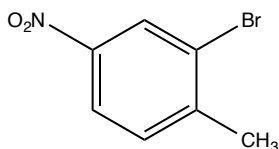
7.



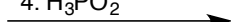
1.  $\text{Br}_2/\text{FeBr}_3$
2.  $\text{NH}_2\text{NH}_2, \text{OH}^-, \text{heat}$
3.  $\text{KMnO}_4$



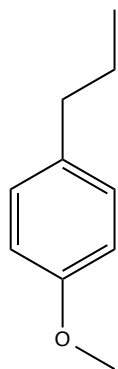
8.



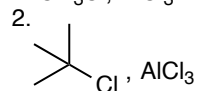
1.  $\text{Br}_2/\text{FeBr}_3$
2.  $\text{Fe}/\text{HCl}$
3.  $\text{NaNO}_2, \text{HCl}$
4.  $\text{H}_3\text{PO}_2$



9.



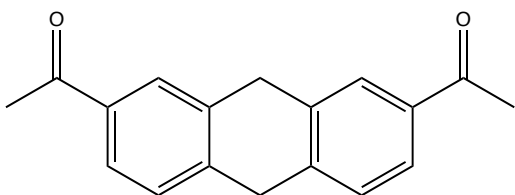
1.  $\text{CH}_3\text{Cl}, \text{AlCl}_3$



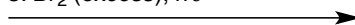
3.  $\text{KMnO}_4$  (excess)



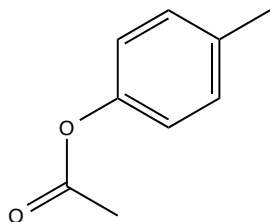
10.

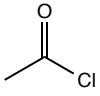


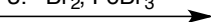
1.  $\text{Br}_2$  (excess)/ $\text{FeBr}_3$
2.  $\text{Zn(Hg)} + \text{HCl}$  / heat (excess)
3.  $\text{Br}_2$  (excess),  $h\nu$



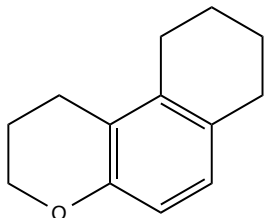
11.



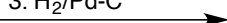
1. ,  $\text{AlCl}_3$
2.  $\text{Cl}_2$ ,  $\text{FeCl}_3$
3.  $\text{Br}_2$ ,  $\text{FeBr}_3$



12.

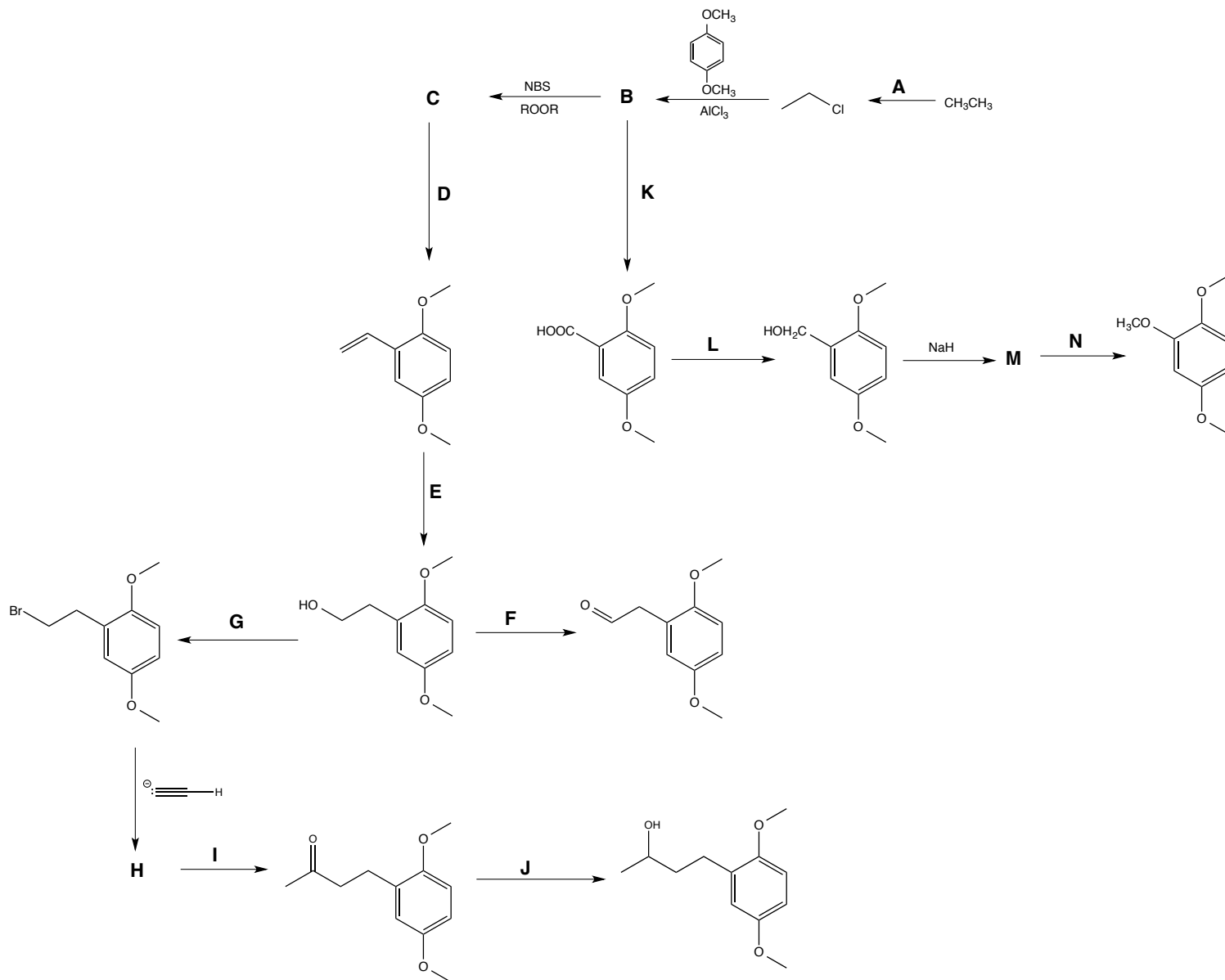


1.  $\text{Cl}_2$ ,  $\text{FeCl}_3$
2.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$
3.  $\text{H}_2$ /Pd-C



**PART THREE: SYNTHESIS**

A. Fill in the missing reagents and/or products in the synthetic scheme outlined below. **Place your answers in the table provided on the next page.** **(14)**

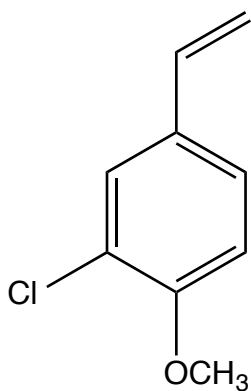


Letter	Missing Reagent/Product	Letter	Missing Reagent/Product
A		H	
B		I	
C		J	
D		K	
E		L	
F		M	
G		N	



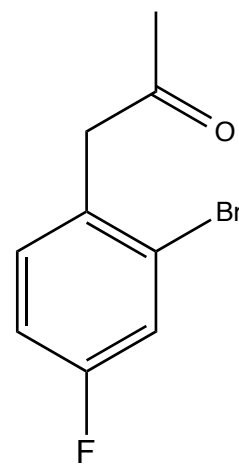
- B.** Propose a reasonable synthesis for one (**1**) of the two structures below **A** or **B**. You must start from the indicated organic substrates, but you may use any inorganic reagents you need. *You may also use any necessary organic acids, bases, oxidizing, or reducing agents.* **(16)**

You may use the blank page following the questions to write your answers.



**A**

or



**B**

from benzene and organic substrates of 2 carbons or less

