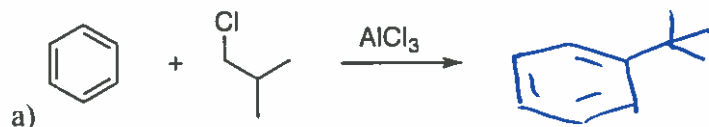
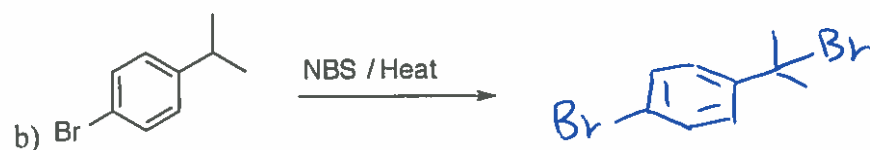


1) Provide the products of the following reactions (all reactions have an appropriate aqueous work up). If no reaction would occur, write NR. If a reaction would produce stereoisomers, draw the isomers and indicate if they will be produced in equal or unequal amounts (3 pts each).

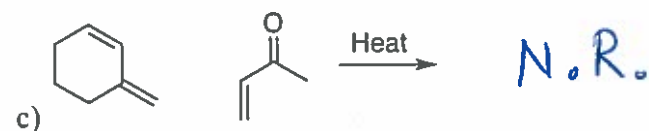
• Also, indicate if any of these reactions are under thermodynamic control (4 pts total).



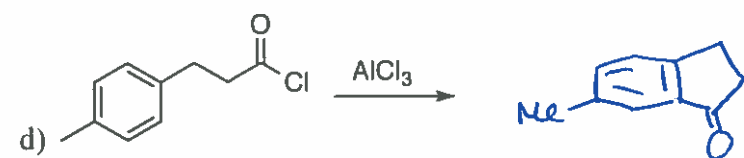
Thermodynamic control?
NO



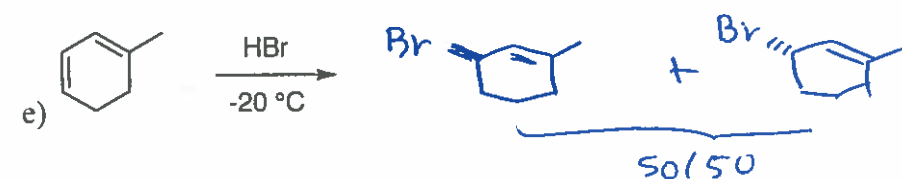
Thermodynamic control?
NO



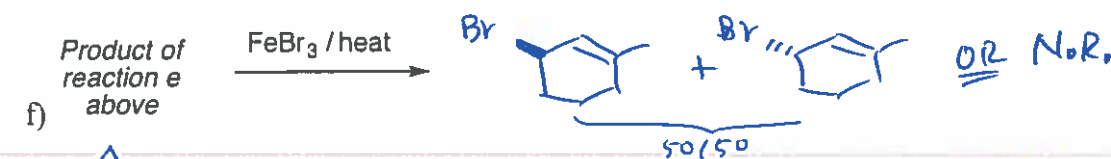
Thermodynamic control?
NO



Thermodynamic control?
NO



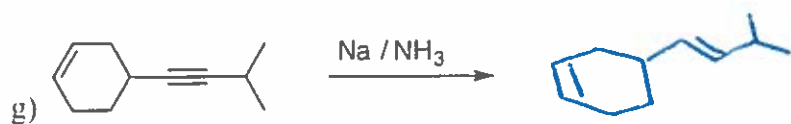
Thermodynamic control?
NO



Thermodynamic control?
YES

↑ if the wrong product for e was written, then students could get full credit by drawing correct thermodynamic product

Problem 1 continued:



Thermodynamic control?

No



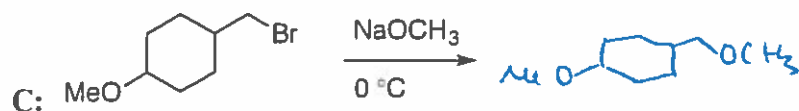
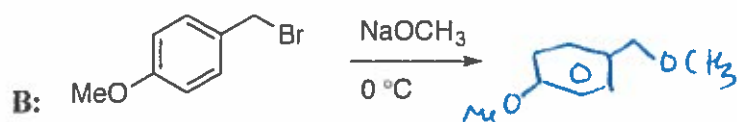
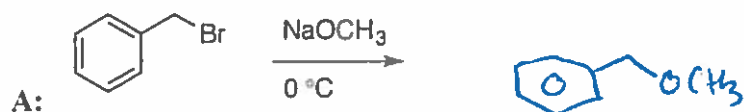
Thermodynamic control?

No

2) Provide the products of the three reactions shown below (3 pts). and indicate the one that will proceed fastest and the one that would proceed the slowest. (2 pts each).

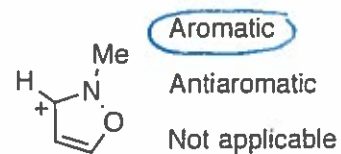
Circle the slowest of the reactions below A or B or **C**

Circle the fastest of the reactions below A or **B** or C



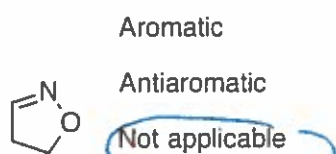
3a) Are the structures drawn below aromatic, antiaromatic or is this designation not applicable (6 pts)?

3b) Provide the hybridization of all nitrogen, and oxygen atoms for the compounds above (6 pts).



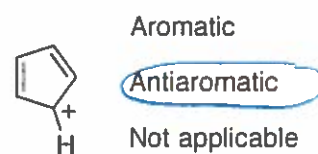
Hybridization of N sp²

Hybridization of O sp²

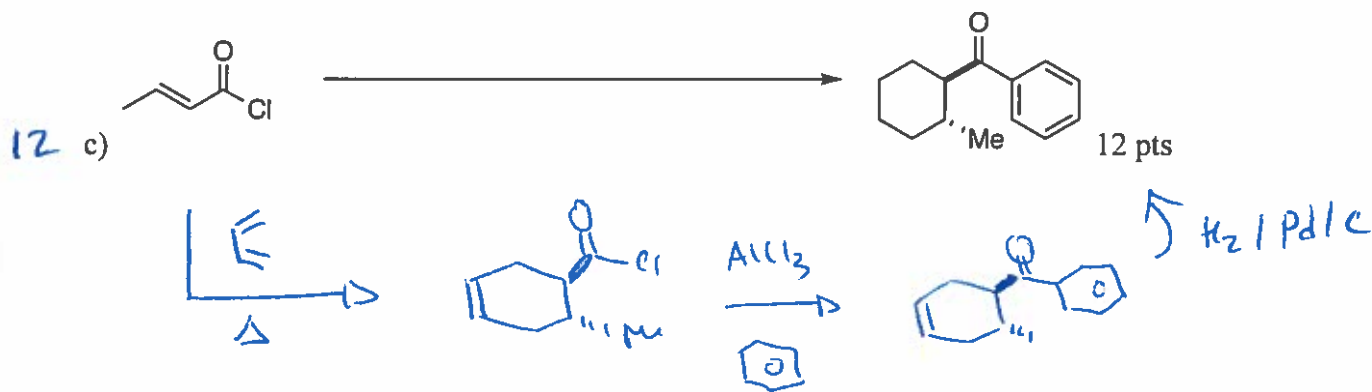
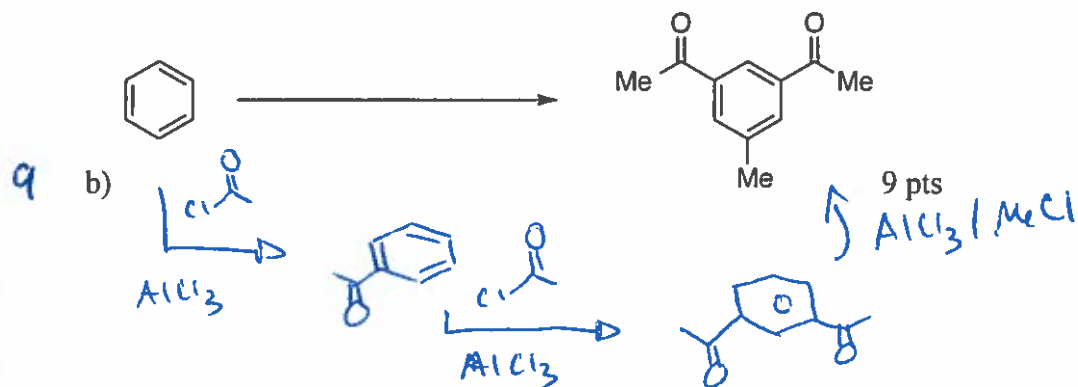
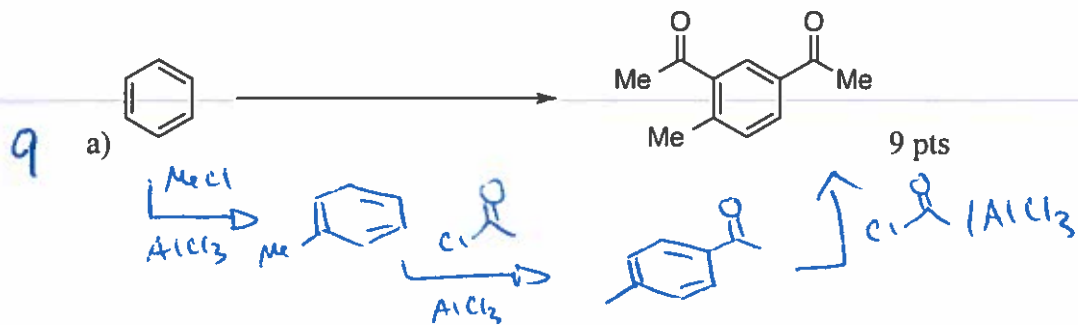


Hybridization of N sp²

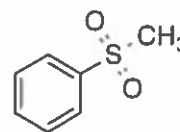
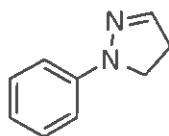
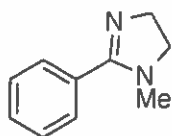
Hybridization of O sp³



4) Complete the following syntheses using any organic molecule of 6 carbons or less and any reagents you need. Provide the reagents and any relevant conditions but you do not have to show the synthesis of the 6-carbon or less molecule you use. If your synthesis requires more than one step, **you must provide the product after each step**. All chiral products are racemic mixtures and you do not need to show mechanisms



5) The molecules below contain substituents on benzene that we have not necessarily discussed in class; however, we have discussed the factors that make substituents activating or deactivating, or ortho/para vs. meta directors. Based on these factors, predict if the substituents on each molecule below will be activating or deactivating, and ortho/para or meta directors (6 pts).



Activating or **deactivating**

Activating or deactivating

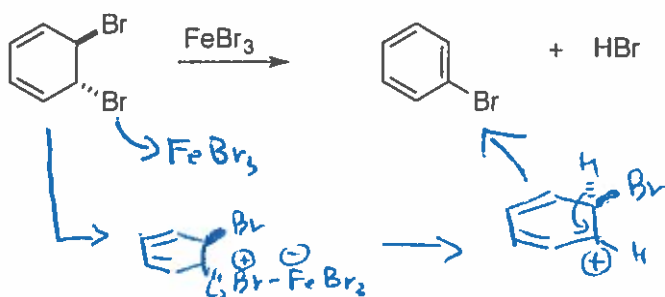
Activating or **deactivating**

Ortho/para or **meta**

Ortho/para or meta

Ortho/para or **meta**

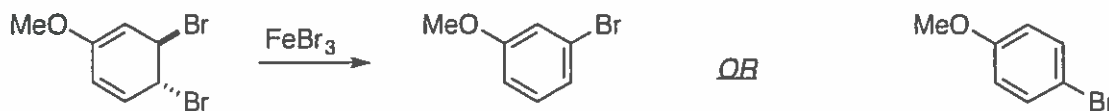
6a) If the dibromide shown below is treated with FeBr_3 , one equivalent of HBr is lost to produce bromobenzene. Provide the most likely mechanism for this transformation. Show every intermediate with the proper charges and all the arrows required for each step of the reaction including any workup steps (6 pts).



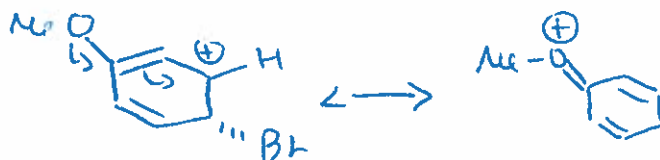
6b) Two possible products can be formed in the reaction below. Based on the mechanism, circle the product you would predict to be major (3 pts).

6c) Explain your prediction by drawing the structure of the intermediates that leads to the major and minor products. Explain why the major intermediate is preferred in one sentence (6 pts).

Circle the major product



Draw intermediate leading to major product here and explain why it is preferred:



The cation is stabilized by delocalization of charge onto the oxygen