Problem 1. (10 points) Order the following nucleophiles from strongest to weakest for S_N2 reactions.

Br^- I^- NH_3 H_2O

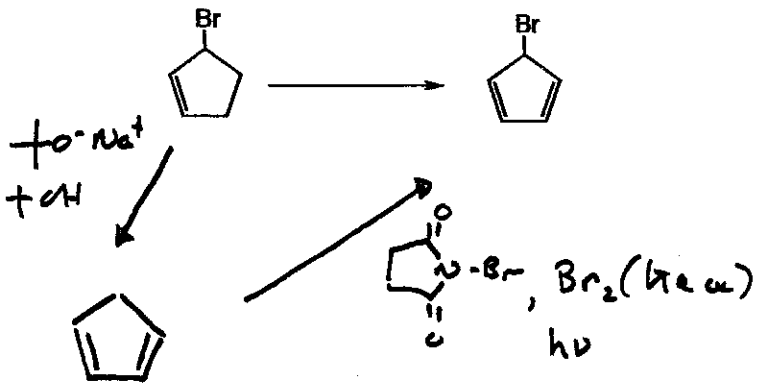
Strongest Weakest

Order the following leaving groups from the best to the worst for S_N1.

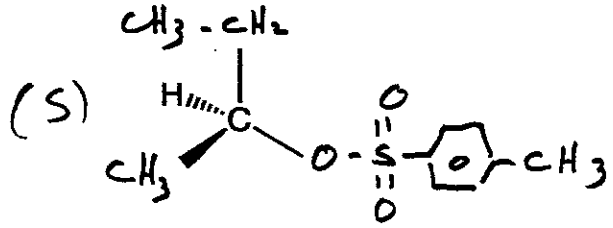
Br^- I^- HO^- $CH_3SO_2O^-$

Best Worst

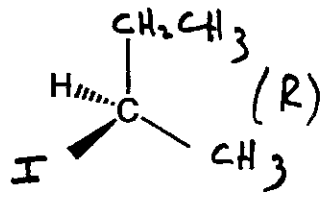
Problem 2. (15 points) How would you carry out the following transformation?



Problem 3. (5 points) (S) 2-butanol reacts with p-toluenesulfonyl chloride in pyridine. Show the structure of the product (Product 1) using the stereocenter provided and indicate if the stereocenter is R or S. What is the final product when I^-, in acetone, reacts with Product 1? Show structure of the final product using the stereocenter provided and indicate if the stereocenter is R or S.

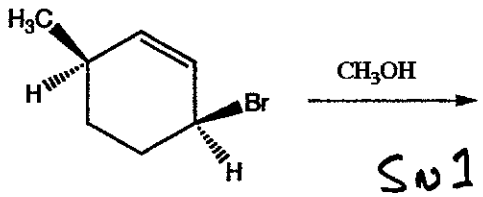


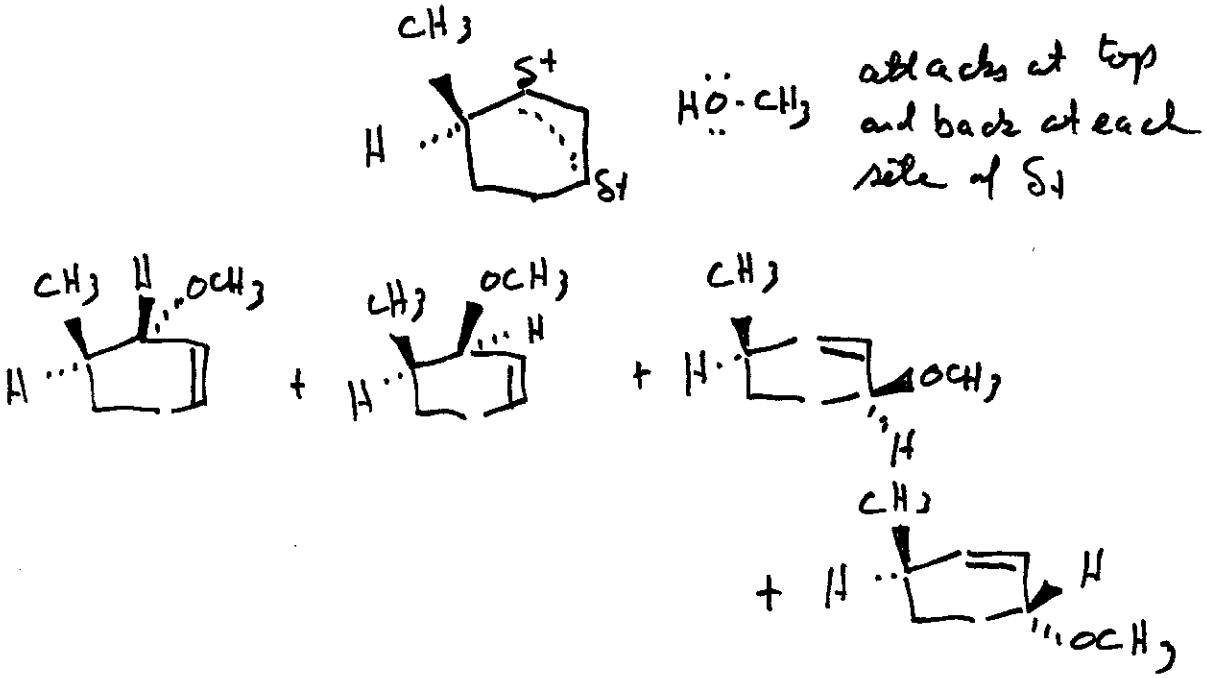
Product 1



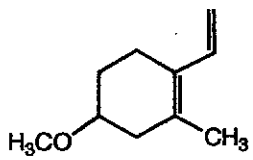
Final Product

Problem 4. (15 points) What **substitution** product or products are formed in the following reaction. Give the mechanism that accounts for formation of the product/products.

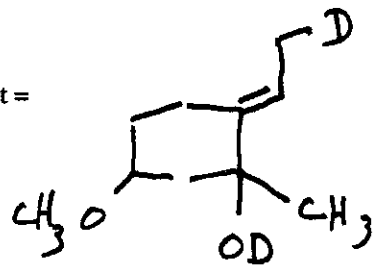




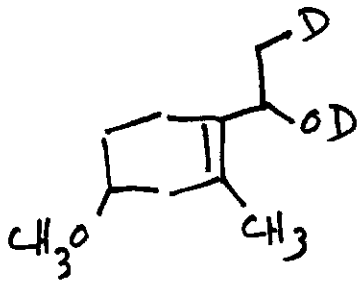
Problem 5. (10 points) Consider the addition of 1 equivalent of D_2O in D_2SO_4 to the following compound. What product corresponds to the one formed under kinetic control and the one formed under thermodynamic control.



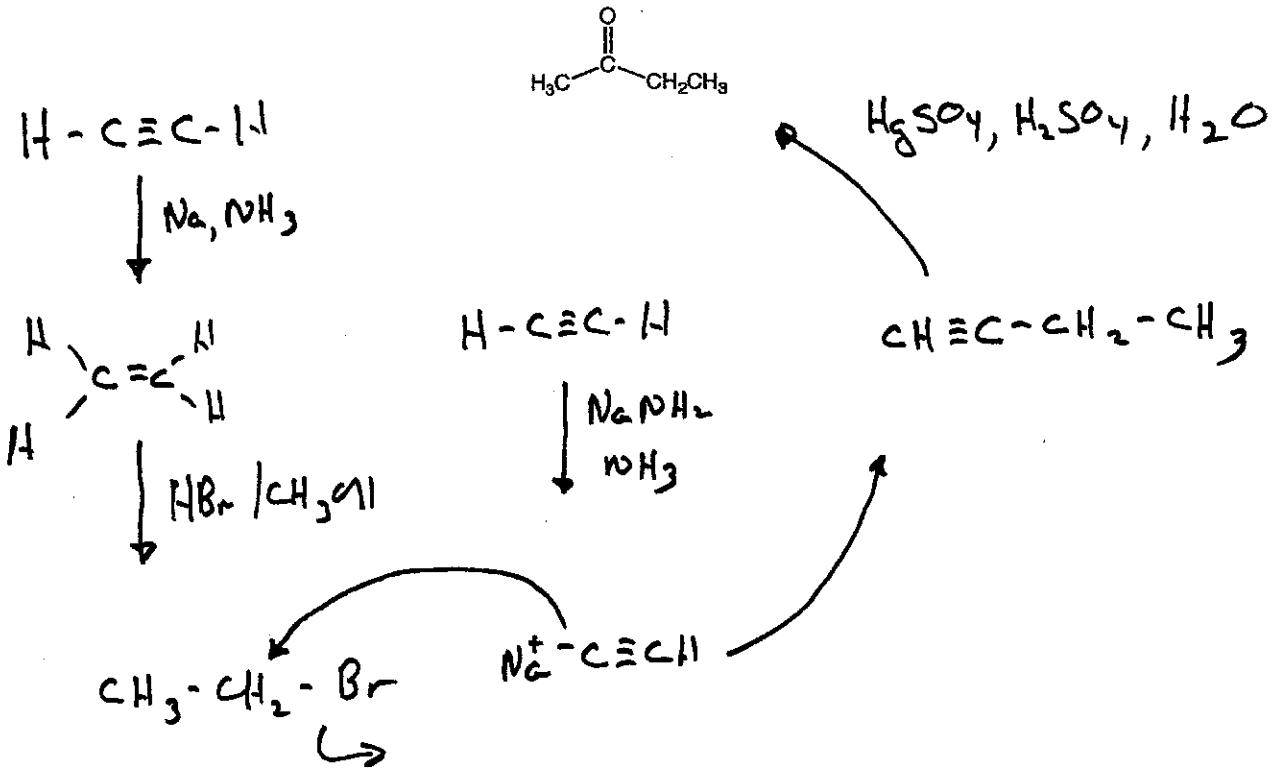
kinetic product =



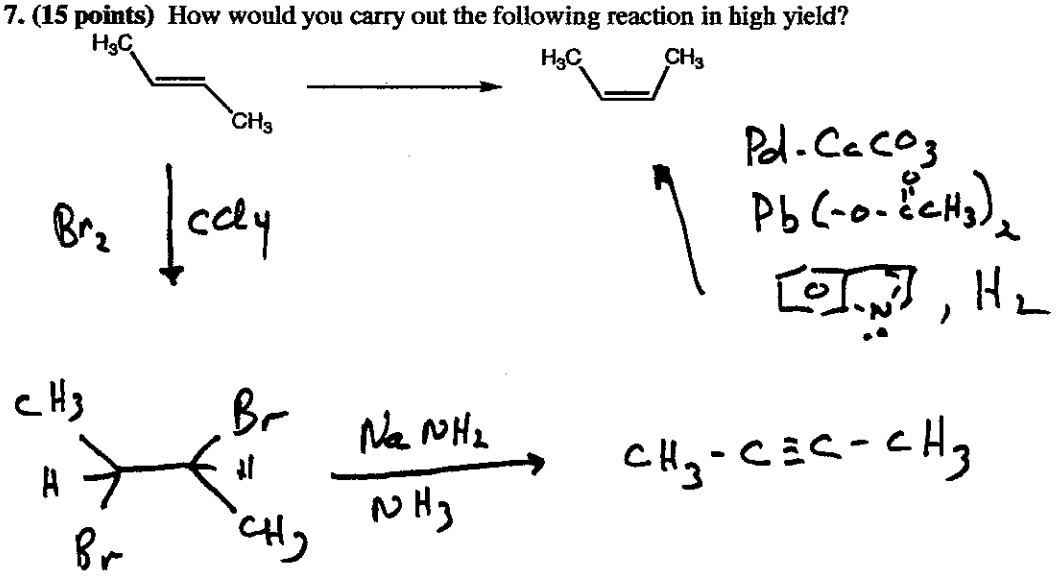
thermodynamic product=



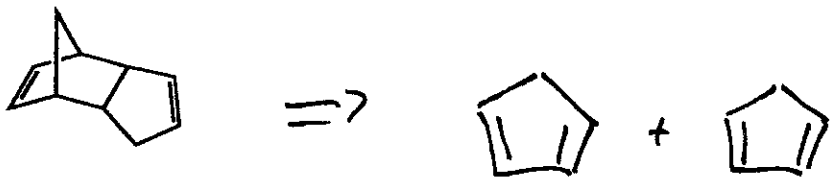
Problem 6. (15 points) Using **acetylene as your only source of carbon found in the product**, how would you synthesize the following molecule?



Problem 7. (15 points) How would you carry out the following reaction in high yield?



Problem 8. (5 points) What two molecules would you use as starting material for the synthesis of the following compound using the Diels-Alder reaction?



Problem 9. (10 points) How would you carry out the following transformation in high yield?