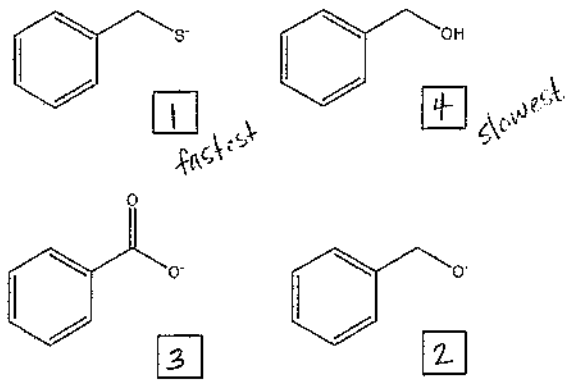
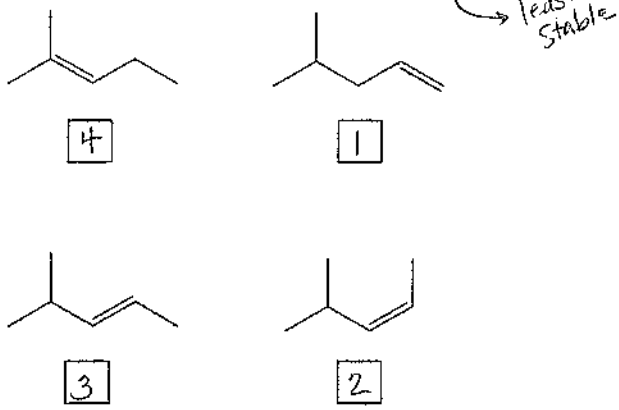
1. (6 pts) Rank the following in order of nucleophilicity (1-4, 1 = best) in a polar protic solvent.



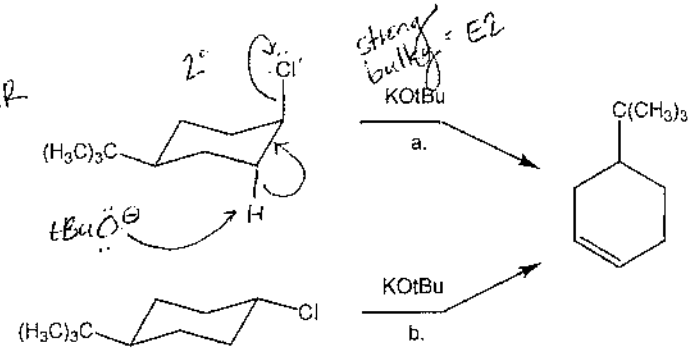
2. (6 pts) Rank the following in order of heat of hydrogenation (1-4, 1 =most exothermic).

least stable



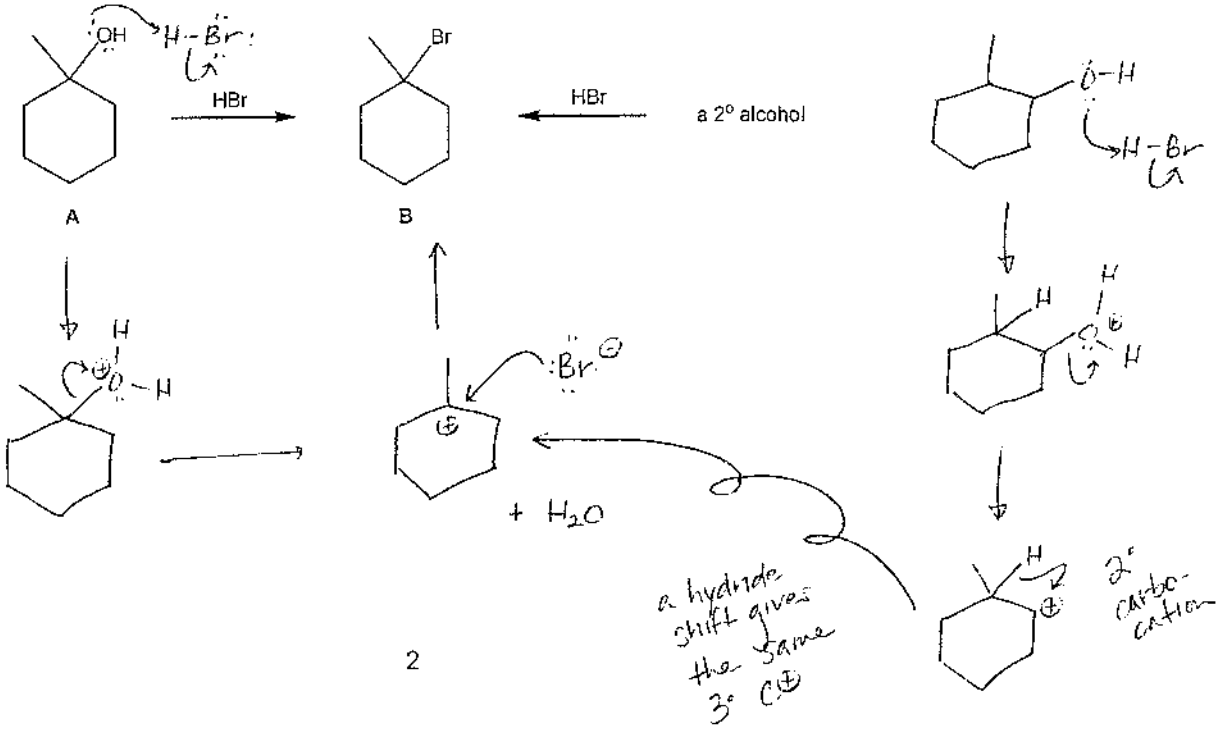
3. (10 pts) Which of the following reactions, a or b, will have a faster rate of reaction? Clearly explain. For full credit, a mechanism must be part of your answer.

FASTER



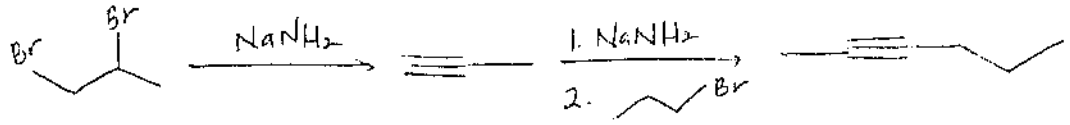
2° R-X plus strong base = E2; the X leaving group and the β-H must be anti for fastest E2 mechanism to occur. This is possible in a as shown.
For b, the chair would have to invert its conformation into an less favorable chair before E2 could occur.

4. (14 pts) (a) Provide a curved arrow mechanism for the reaction of A to B, shown below. (b) Propose the structure of a secondary alcohol that would react to form product B under the same reaction conditions.

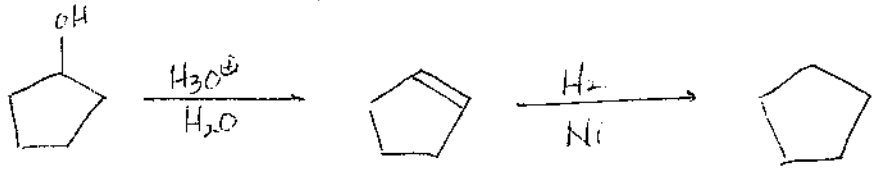


5. (22 pts) For parts a through c, outline a synthesis starting from the given reactant. You may use any other needed reagents. More than one reaction may be necessary. Mechanisms are not required.

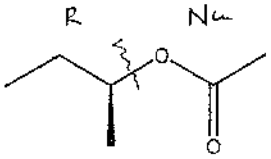
a. 1,2-dibromopropane ⟶ ? ⟶ 2-hexyne

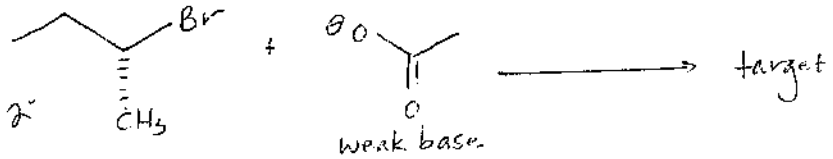


b. cyclopentanol ⟶ ? ⟶ cyclopentane



c. alkyl halide of your choosing ⟶ ? ⟶

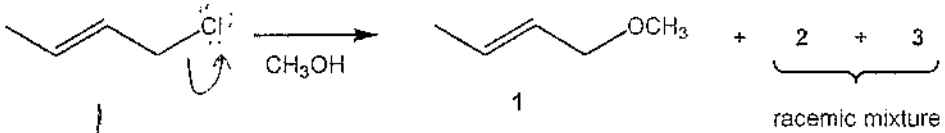


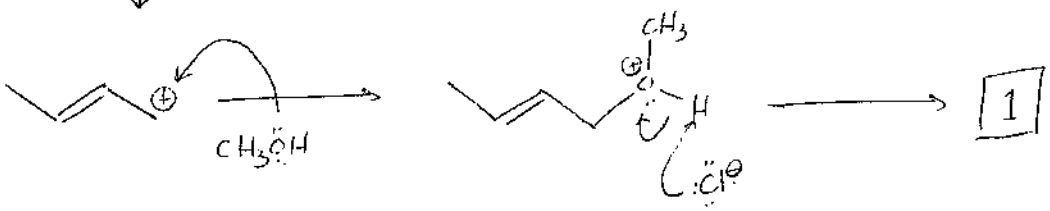


6. (14 pts) The substrate below undergoes a substitution reaction to yield products 1, 2, and 3 (2 and 3 constitute a racemic mixture). The rate of the reaction was shown to be independent of CH_3OH concentration. Draw the structures of 2 and 3 and provide a curved arrow mechanism that explains the formation of all products.

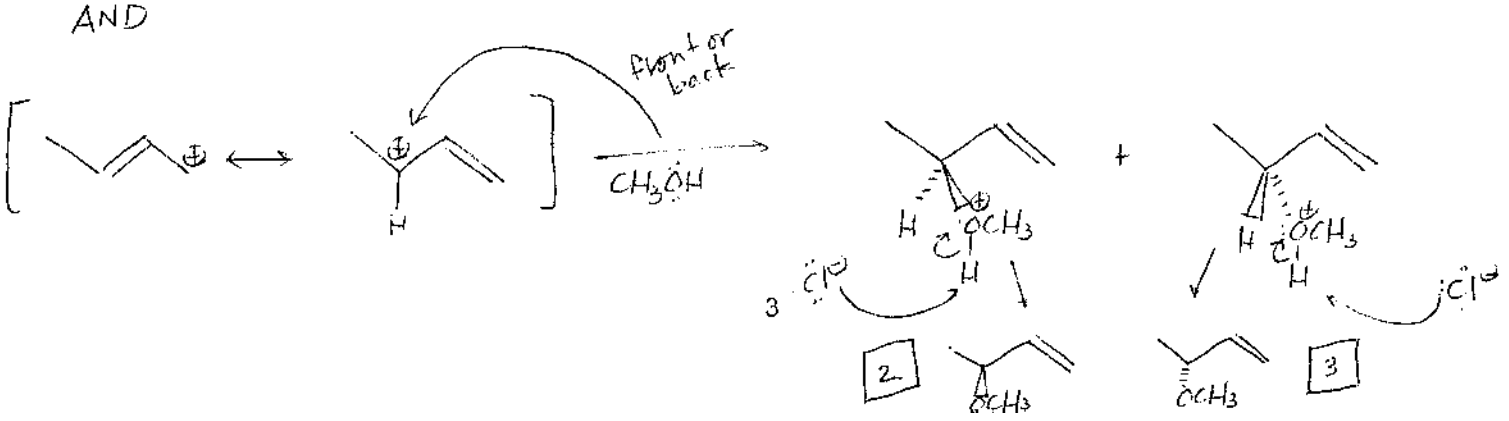
1st order

1° but allylic

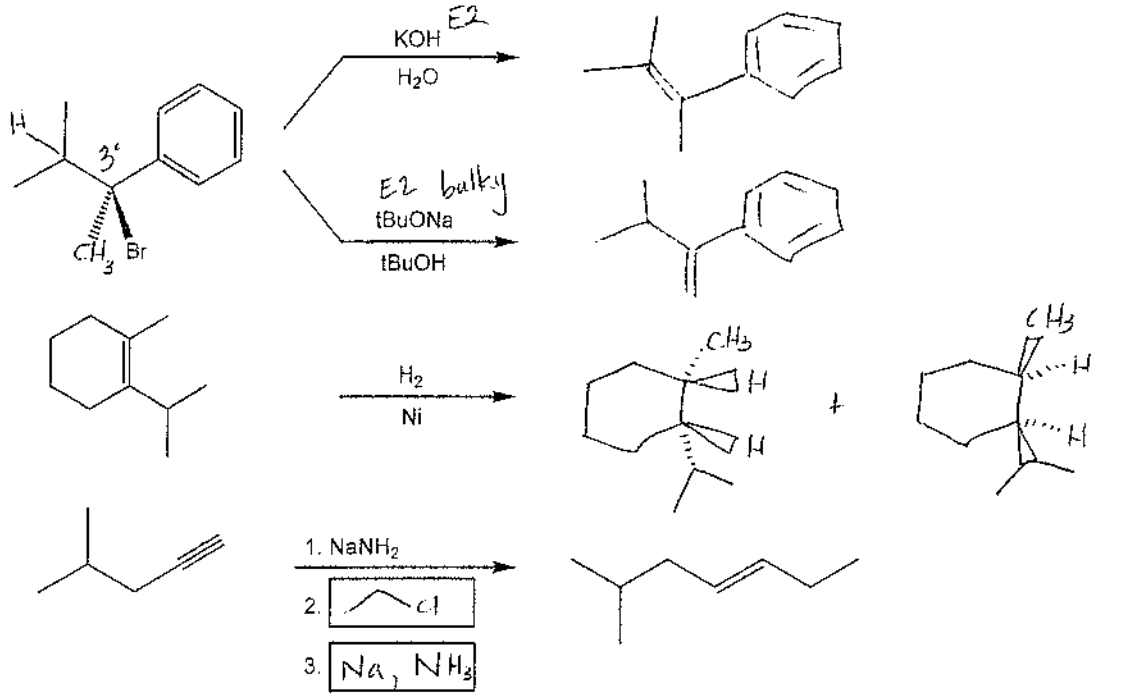




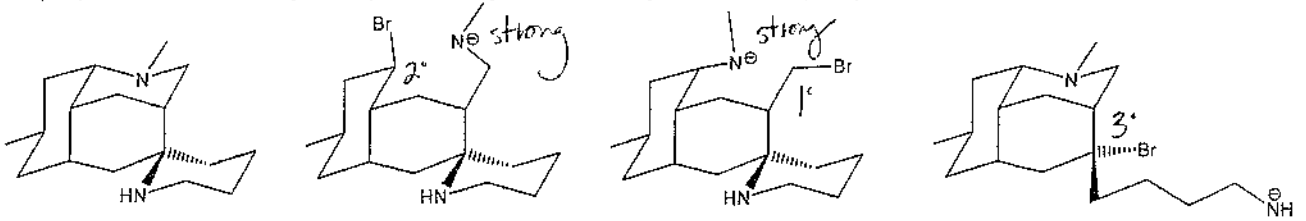
AND



7. (16 pts) Give the structure of the major product(s) or the necessary reagents for the 4 syntheses shown below.



8. (12 pts) **Nankakurine A** is a naturally occurring molecule isolated from a moss. Researchers have proposed different ways of synthesizing its two nitrogen containing rings using intramolecular SN2 reactions.



Nanakakurine A A B C

a. For construction of the top ring, two different disconnections are possible (see structures **A** and **B**). Is **A** or **B** a better precursor for the successful synthesis of Nankakurine A? Clearly explain.

B is better = 1° plus strong base gives desired SN2

for A = 2° plus strong base gives E2

b. Another chemist proposed that the lower nitrogen-containing ring could be synthesized using an intramolecular SN2 reaction starting with molecule C. Evaluate this suggestion. Would you expect this reaction to successfully produce Nankakurine A? Clearly explain.

3° plus strong base gives E2, not desired SN2.

This 3° should never be able to do SN2, only SN1/E1 if a weak base was chosen