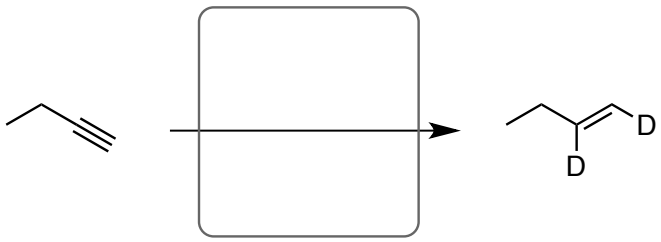
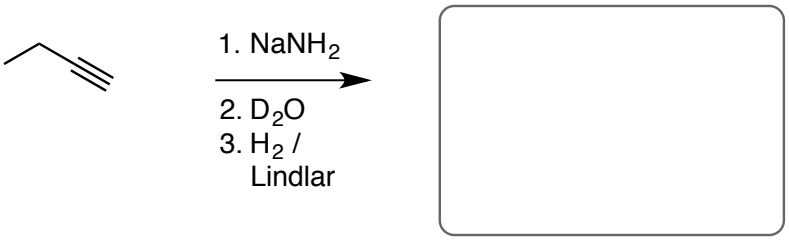
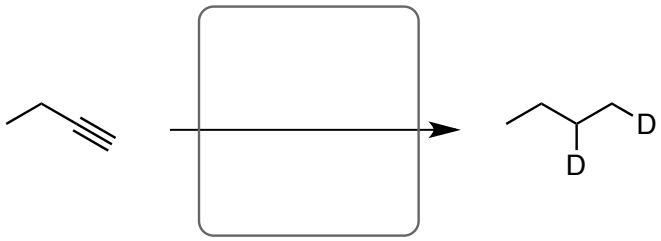
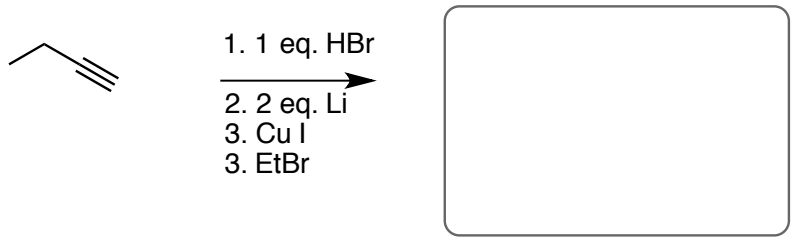
Name:_____

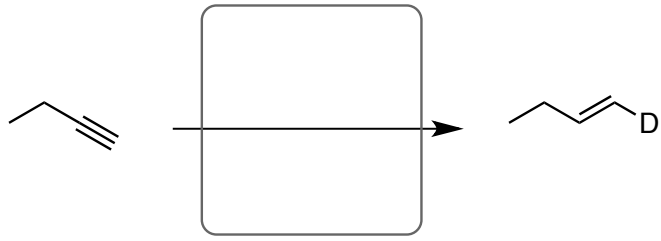
1. 24 pts. Fill in the appropriate products and reagents in the reactions below.

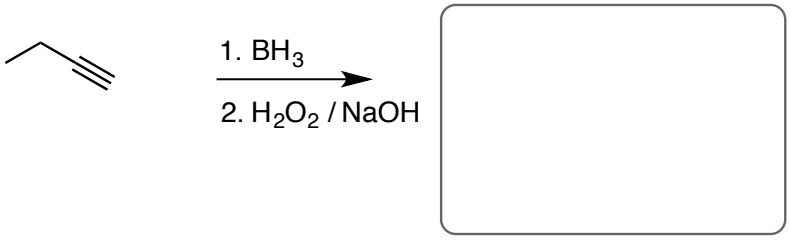








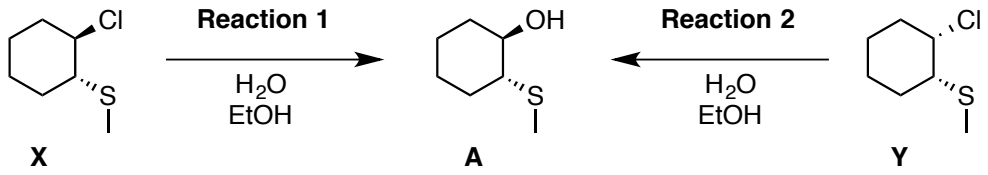




pts. this pg.

Name:_____

2a. The reactions below yield the same product **A** (only *trans* enantionmers, no *cis*), however, at *extremely different rates*. Reaction **1** is faster than reaction **2** by a factor of 1,000,000! This clearly shows that **different mechanisms** are involved. Interestingly, the rate-limiting step does not depend on the concentration of water (EtOH is the solvent) AND both mechanisms yield one *strained* intermediate that is similar in both processes. Draw the structure of such characteristic intermediate below, *including dashes and wedges* (3pts).



X **A** **Y**

Characteristic Intermediate

Chemical Formula: $C_7H_{13}S^+$

2b. 4 pts. Considering the two possible chair conformations, draw the mechanism for **Reaction 1** that accounts for the formation of the *characteristic intermediate*.

2c. 4 pts. Considering the representation of **Y** shown above, draw the mechanism for **Reaction 2** that accounts for the formation of the *characteristic intermediate*.

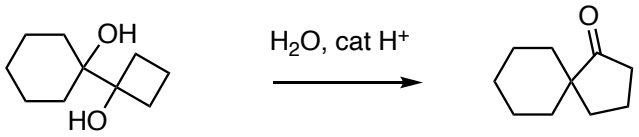
2d. 3 pts. Starting from the *characteristic intermediate,* show how it accounts for the formation of **A.** Note: you only need to show the formation of the enantiomer shown above (**A**).

2e. 3 pts. Briefly explain why **Reaction 1** is faster than **Reaction 2**:

pts. this pg.

Name:_____

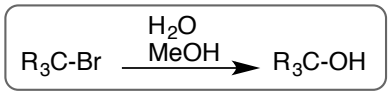
3. 15 pts. Draw a suitable mechanism for the reaction below.

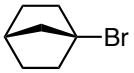
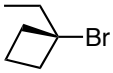
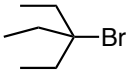


pts. this pg.

Name:_____

4a. 9 pts. Consider the generic reaction in the box. When three alkyl bromides, **a**, **b**, and **c**, are reacted under those conditions, drastically different rates of reactivity are observed: compound **c** reacts much faster than **b** and **a**. **BRIEFLY** explain the trend. Specify the type of mechanism: **E1, E2, S_N1, or S_N2.**

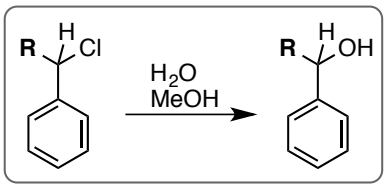


R_3C-Br = **a**  **b**  **c** 

extremely slow (practically no reaction) | very slow | fast

Circle one: **E1** **E2** **S_N1** **S_N2**

4b. 9 pts. Now consider the generic reaction in the box below, where **R** can be methyl (Me) or *tert*-butyl (tBu). When R = Me, the reaction proceeds 500 times faster than when **R** = tBu. **BRIEFLY** explain the trend. Specify the type of mechanism: **E1, E2, S_N1, or S_N2.**



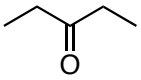
if **R** = Me, the reaction is much faster than
if **R** = tBu

Circle one: **E1** **E2** **S_N1** **S_N2**

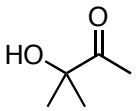
pts. this pg.

Name:_____

5a. 10 pts. Synthesize the product shown below. You can only use **acetylene** as your only sources of carbon to make the product. If you need any Gilman or Grignard reagents, you will have to synthesize them from sources of carbon noted. Note: this product is formed exclusively, not as a mixture of products.



5b. 10 pts. Using *any* **alkyl halides containing only one carbon** and **acetylene** (C_2H_2) as your only sources of carbon, propose the synthesis of the products below. You can use acetylene to make any compounds you may need.



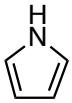
pts. this pg.

Name:_____

7 pts. **5a.** The pK_b is shown for the Brønsted bases below: **X** and **Y**. Explain the differences in basicity.

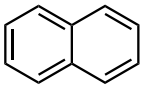
X = 

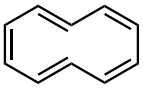
$pK_b = 8.8$

Y = 

$pK_b = 13.6$

7 pts. **5b.** Are both compounds **A** and **B** aromatic? Explain your answer.

A = 

B = 

pts. this pg.