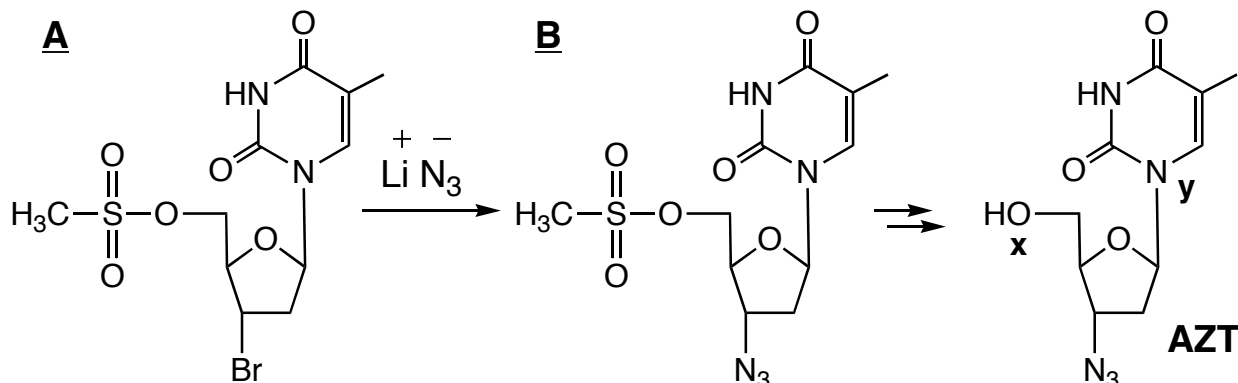
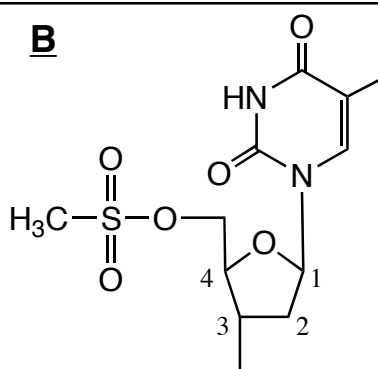


- 1) One synthesis of the HIV drug azidothymidine, AZT, involves a nucleophilic substitution reaction of **A** with azide ion to give **B**. Refer to the scheme below and answer the questions that follow.



A) In the space below, draw the two most valid resonance structures for the azide ion ( $\text{N}_3^-$ ). Circle the major contributor. *Note: for full credit, be sure to show all lone pairs of electrons and charges where appropriate.* (8 points)

B) Complete the Lewis structure of **B** after the azido group has substituted for bromine. *Note: for full credit, be sure to show all lone pairs of electrons and charges where appropriate.* (5 points)



Complete the drawing of the azide group attached to carbon 3.

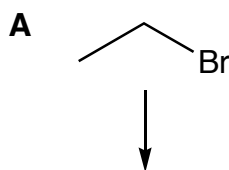
C) What is the overall charge on compound **B**? (2 points)

D) Is oxygen, as in ROH, usually more or less basic than nitrogen, as in  $\text{RNH}_2$ ? Why? (3 pts)

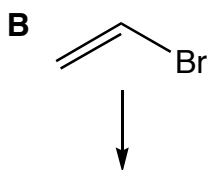
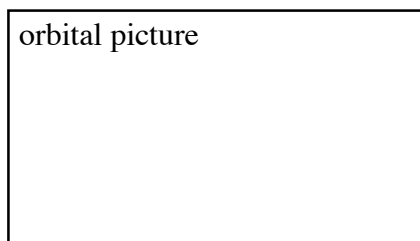
E) Use pictures & words to explain why oxygen **x** in AZT is more basic than nitrogen **y**. *Note: you only need redraw the relevant parts of AZT, rather than the entire molecule.* (8 points)



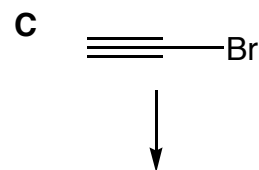
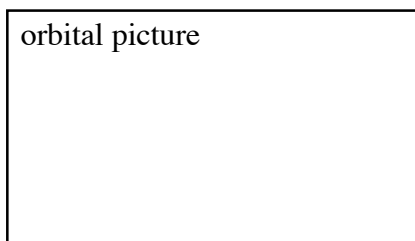
- 4) One possible mechanism of nucleophilic substitution involves the halogen acting as a leaving group to form a carbocation, followed by attack from the nucleophile in a second, separate step. Assume this mechanism is in effect for the following three brominated compounds. Draw Lewis structures for the carbocations that each forms. Then draw an orbital picture for each intermediate in the boxes provided. (9 points)



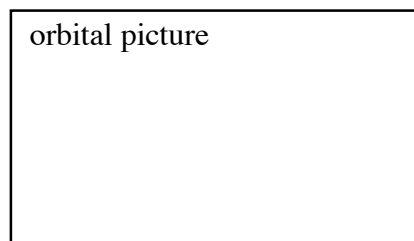
carbocation



carbocation



carbocation

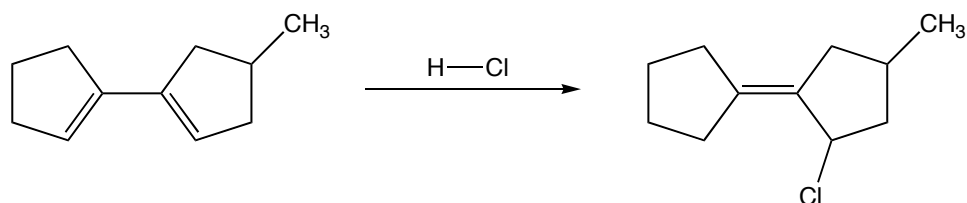


Which compound will undergo substitution the fastest?    **A**    **B**    **C** (circle one, 1 point)

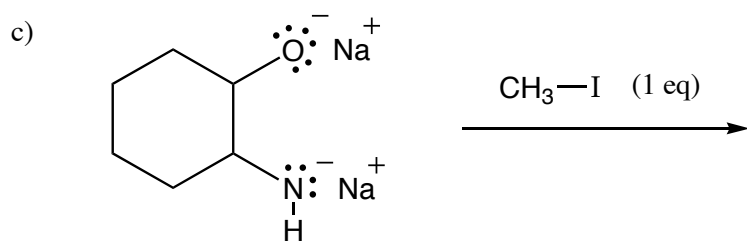
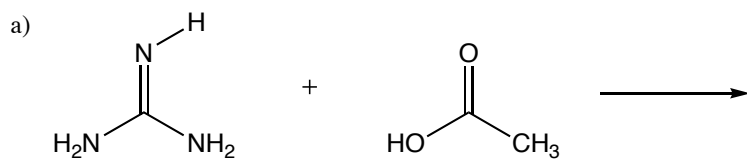
Which compound will undergo substitution the slowest?    **A**    **B**    **C** (circle one, 1 point)

Explain your choices in the space provided. (6 points)

- 5) Using curved arrows, provide a mechanism that explains the following transformation. For full credit, be sure to show the products of each step and indicate formal charges throughout. (8 points)



6) Predict the major product(s) of the following reactions. For full credit, be sure to indicate any nonzero formal charges. (15 points)



7) Provide syntheses that will accomplish the following transformations. If a synthesis requires more than one step, show the products of each step. (10 points)

