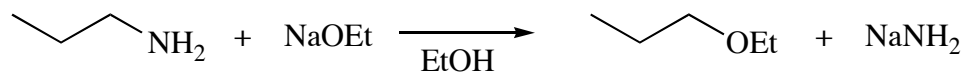


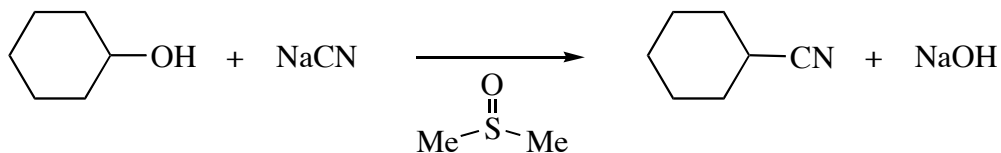
Workshop #8 Substitution / Elimination Reactions

1. For each of the potential S_N2 reactions shown below explain whether the reaction is likely or not (i.e. have $K \gg 1$ and/or proceed at a reasonable rate).

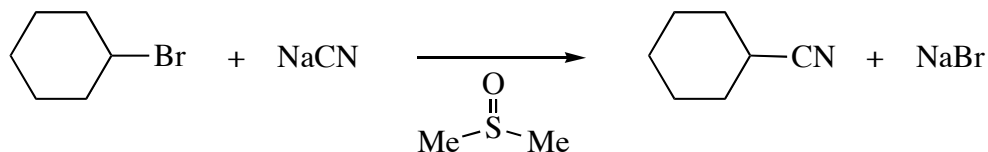
(a)



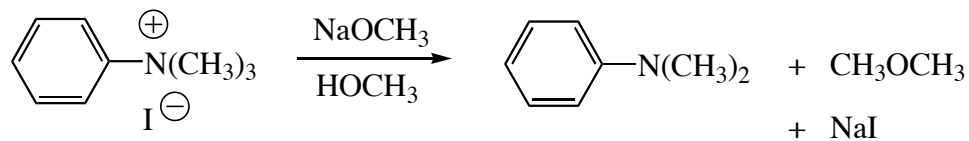
(b)



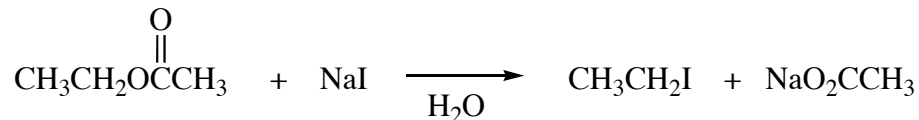
(c)



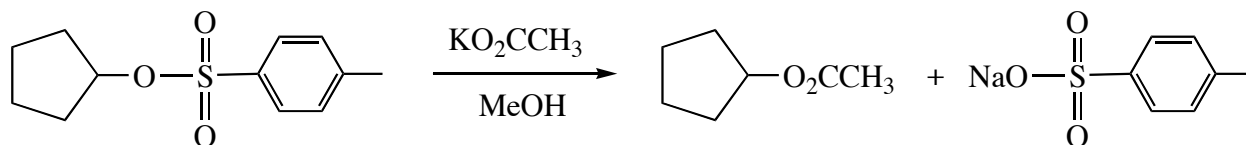
(d)



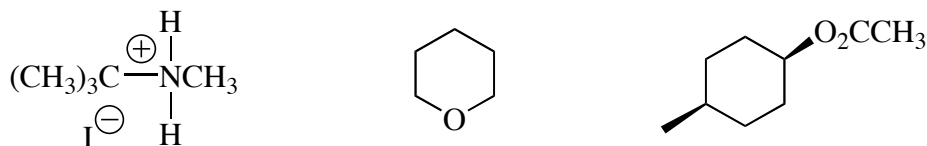
(e)



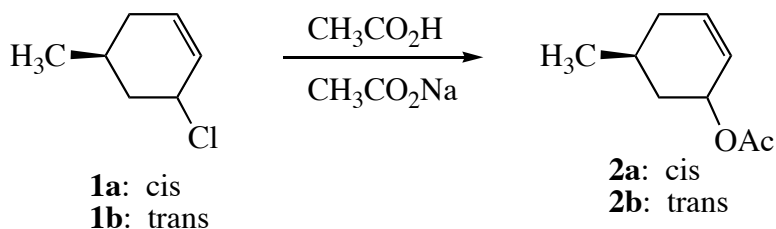
(f)



2. Propose S_N2 reactions that would lead to the following products.



3. *Cis*- and *trans*-5-methyl-2-cyclohexenyl chloride (**1a** and **1b**) both react in acetic acid (HOAc) containing sodium acetate (NaOAc) to give the corresponding 5-methyl-2-cyclohexenyl acetates, **2a** and **2b**.



The following facts about the reaction are known:

- (i) The rate of product formation was found to be first order in [**1a**] or [**1b**] and zero-order in [NaOAc].
 - (ii) The same **2a:2b** product ratio (5:95) was obtained whether **1a** or **1b** was the reactant.
 - (iii) Starting with optically active **1a** or **1b**, the acetate products **2a** and **2b** were both found to be racemic.
 - (iv) Acetates **2a** and **2b** were both found to be stable under the reaction conditions (i.e. they do not interconvert).
- (a) Propose a reaction mechanism consistent with the above observations. **Clearly explain how your hypothesis is consistent with each observation.**
 - (b) A kinetic study determined the rate of product formation and the rate of loss of optical activity during the reaction with optically active **1a** as reactant. Interestingly, it was found that the latter rate was ca. 3 times greater than the former. To investigate the origin of this result, the reaction was stopped at partial conversion and the chloride was isolated from the reaction mixture. The recovered chloride consisted of only **1a**, however, its optical rotation was found to be only ca. 50% of its original value.

Modify your mechanistic proposal from part (a) to account for these observations. **Clearly explain how your hypothesis is consistent with each observation.**