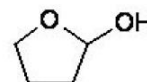
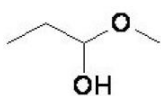
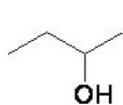
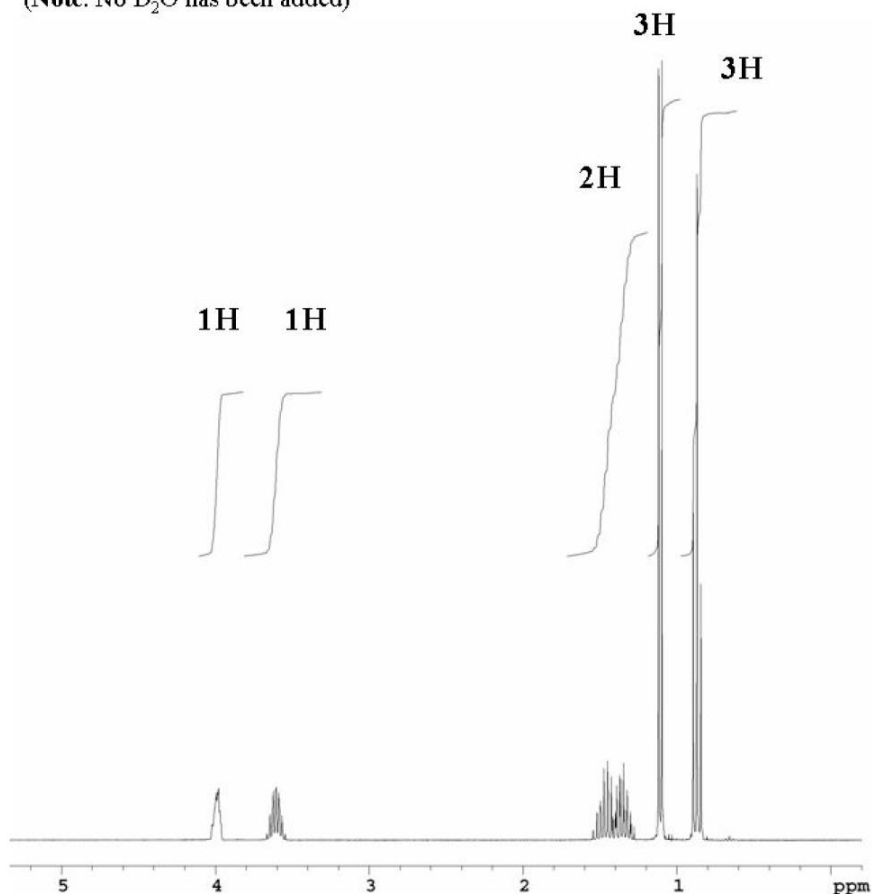


In the FT NMR method, the FT stands for \_\_\_\_\_ .  
 The basic idea is that a short pulse using a range of radio frequencies are used to flip the spins of all of the hydrogen \_\_\_\_\_ at once. Then, the nuclear spins \_\_\_\_\_ back to the +1/2 spin state and when they do, they \_\_\_\_\_ electromagnetic radiation at the precise frequency at which they absorb.

(5 pts each) Circle the molecule that corresponds to the spectrum shown.



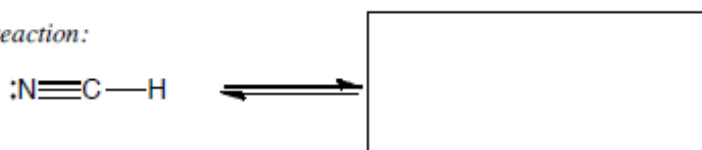
(Note: No D<sub>2</sub>O has been added)



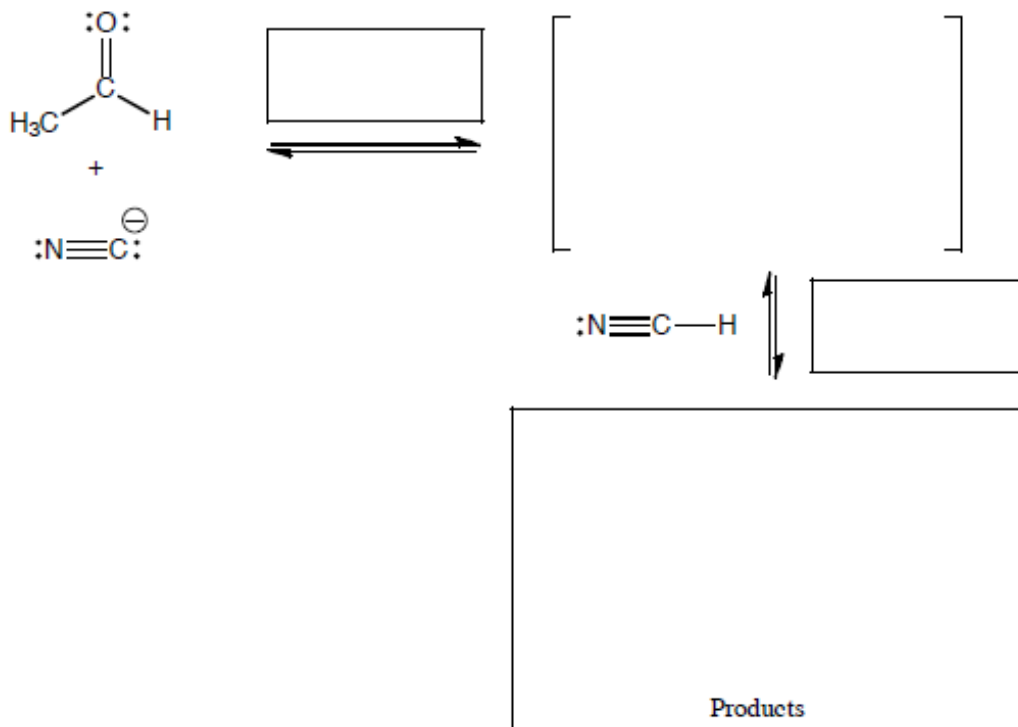
Complete the mechanism for the following reaction of an aldehyde with HCN. Be sure to show arrows to indicate movement of **all** electrons, write **all** lone pairs, **all** formal charges, and **all** products for each step. Remember, I said **all** the products for each step. **IF A NEW CHIRAL CENT IS CREATED IN AN INTERMEDIATE, MARK IT WITH AN ASTERISK. IF A CHIRAL CENTER IS CREATED IN THE PRODUCTS YOU NEED TO DRAW BOTH ENANTIOMERS AND LABEL THE PRODUCT MIXTURE AS RACEMIC IF RELEVANT.** I realize these directions are complex, so please read them again to make sure you know what we want.

*HCN Reacting with an Aldehyde*

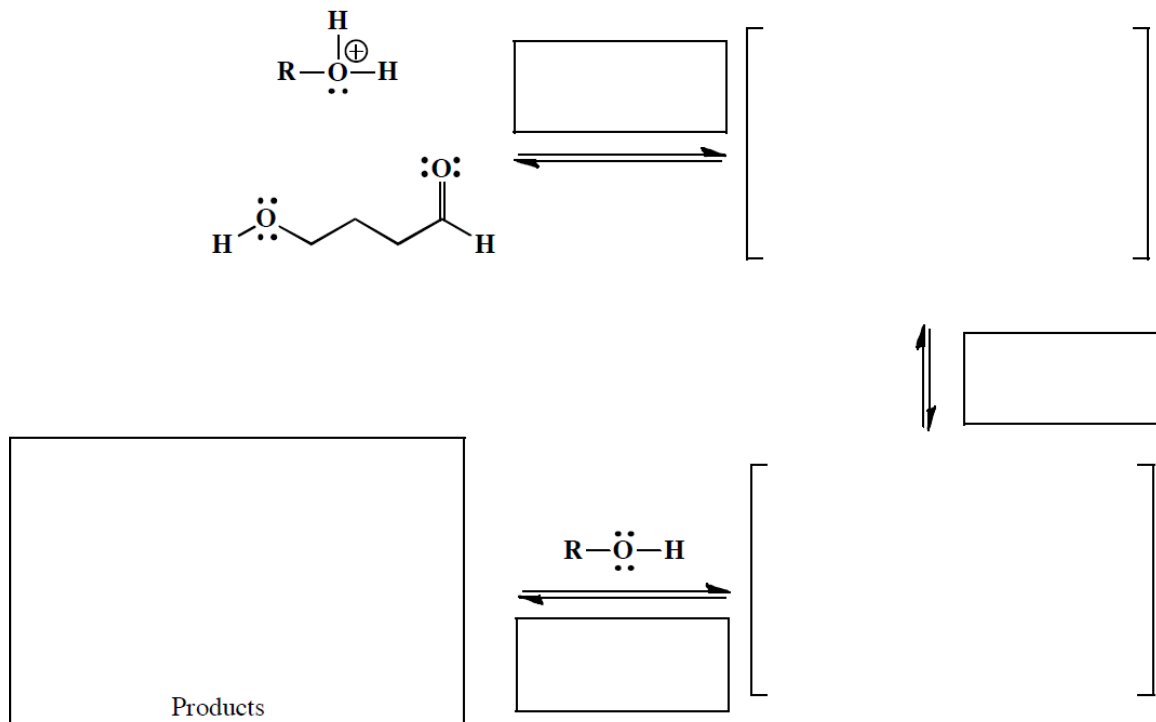
*Equilibrium present in reaction:*



*Actual reaction:*



Complete the mechanism for the following reaction. **Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step.** Remember, I said all the products for each step. **IF A NEW CHIRAL CENTER IS CREATED IN AN INTERMEDIATE, MARK IT WITH AN ASTERISK. IF A CHIRAL CENTER IS CREATED IN THE PRODUCTS YOU NEED TO DRAW BOTH ENANTIOMERS, AND LABEL THE PRODUCT MIXTURE AS RACEMIC IF RELEVANT.** I realize these directions are complex, so please read them again to make sure you know what we want.



(3 pts) In the boxes provided adjacent to the first two sets of arrows, write which of the four basic mechanistic elements are involved (i.e. "Make a bond", "Add a proton", etc.

$$\begin{array}{c} \updownarrow \\ \text{NOTICE THIS} \\ \updownarrow \end{array} \quad \begin{array}{c} \updownarrow \\ \text{NOTICE THIS} \\ \updownarrow \end{array} \quad \begin{array}{c} \updownarrow \\ \text{NOTICE THIS} \\ \updownarrow \end{array} \quad \begin{array}{c} \updownarrow \\ \text{NOTICE THIS} \\ \updownarrow \end{array}$$

(4 pts) In one sentence, state whether the pH changes during this reaction, and why or why not that is the case.

These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned. Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. If you make a racemic mixture, draw both structures and make sure to write "racemic" next to them.

(13 pts) **All of the carbon atoms of the products must come from the starting materials for this one!**

