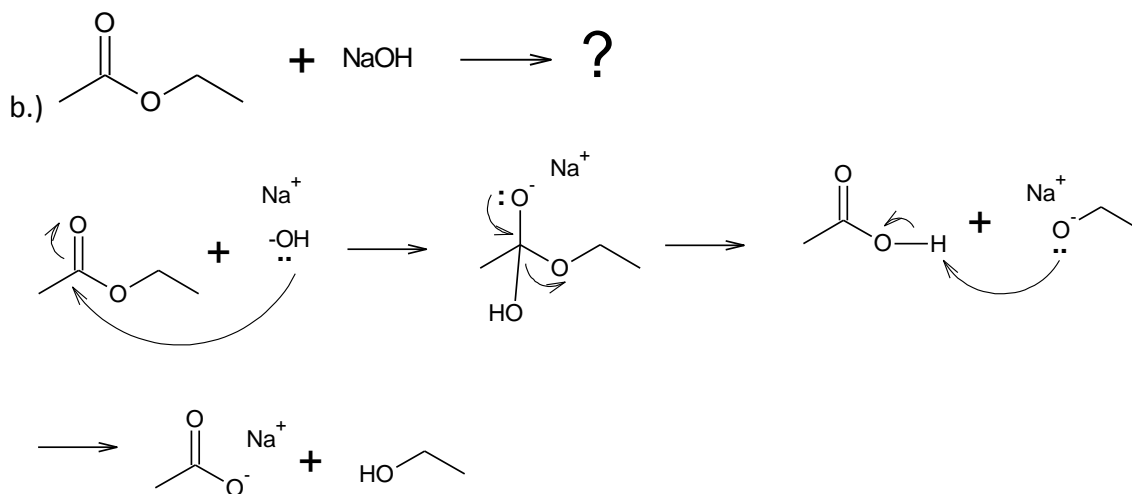
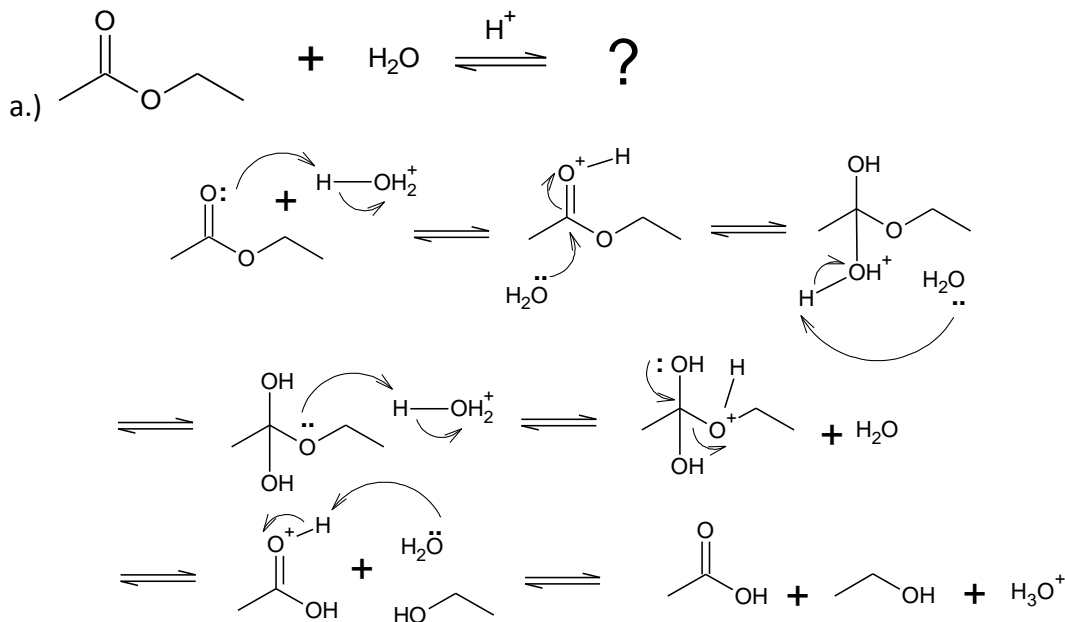


1.) Give the complete arrow-pushing mechanisms for the following reactions. Show all formal charges and any lone pairs or bonds involved in the reaction. (52 pts)



2.) Give **two** reasons why the addition of an acid catalyst for the hydrolysis of an ester *increases* reaction rate/ease. (10 pts, 5 pts ea)

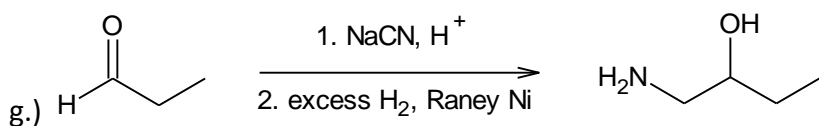
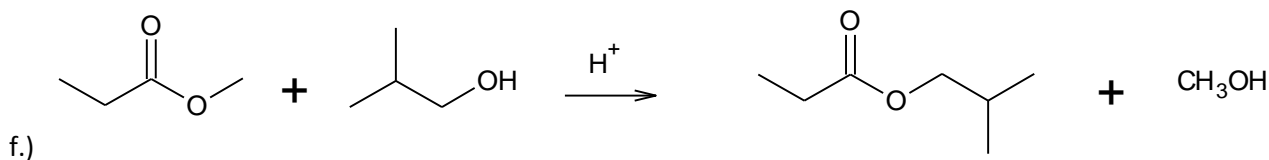
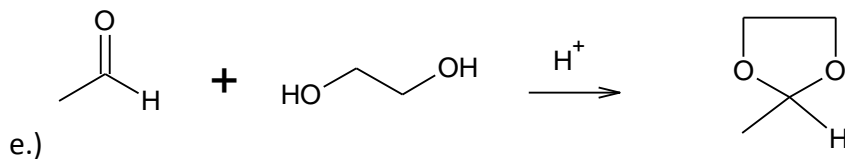
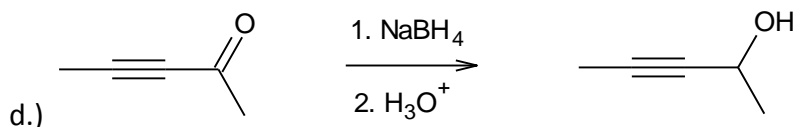
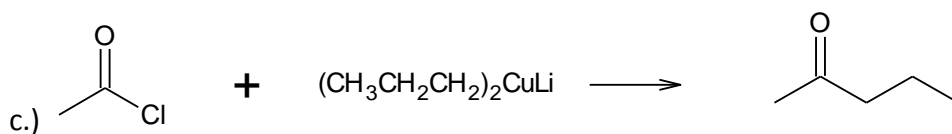
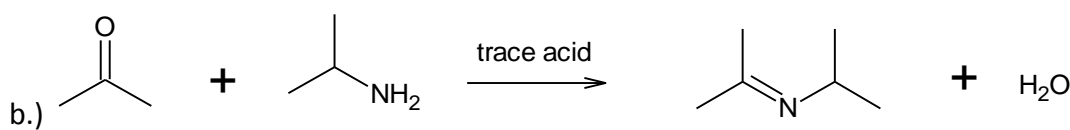
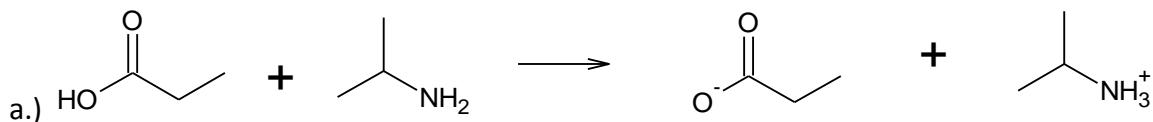
(1) protonating the carbonyl O makes the C more electrophilic (oxygen is more electron poor with a + formal charge, so will withdraw more electron density away from the C)

(2) protonating the ether O makes it a better leaving group (an oxide ion is a strong base, so poor leaving group, while an OH when it leaves becomes an alcohol, a very weak base)

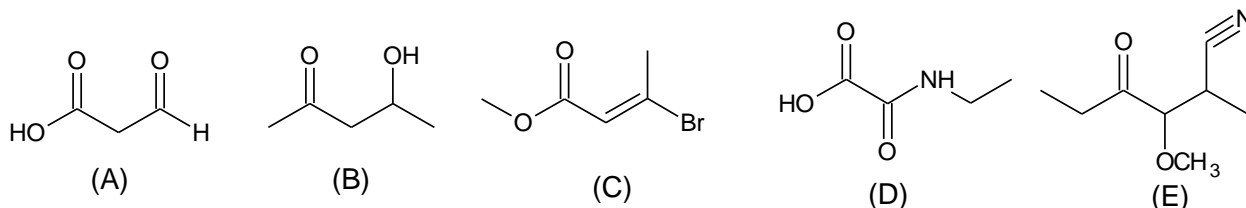
3.) Which has the *more acidic*  $\alpha$ -hydrogen: an ester or a ketone? **Explain.** (10 pts)

Ketone. An ester has preexisting resonance that already makes the oxygen partially negative, lessening its ability to delocalize the formal charge on the resulting carbanion in its conjugate base form once it has been deprotonated.

4.) Give the structure of the **major organic product(s)** of each reaction. (70 pts, 10 pts ea)



5.) Give the correct systematic (IUPAC) name for the following compounds. If the molecule has a common name, you may include it for extra credit. (30 pts, 6 pts ea)



(A) 3-oxopropanoic acid OR  $\beta$ -oxopropionic acid

(B) 4-hydroxy-2-pentanone

(C) E-methyl-3-bromo-2-butanoate OR E-methyl-3-bromo- $\alpha$ -en-butyrate

(D) 2-amido-N-ethylethanoic acid OR  $\alpha$ -amido-N-ethylacetic acid

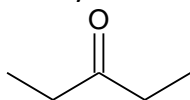
(E) 3-methoxy-2-methyl-4-oxo-1-hexanenitrile

6.) **Explain** why transesterification (ester + alcohol) requires an acid catalyst but aminolysis (ester + amine) does *not*. (10 pts)

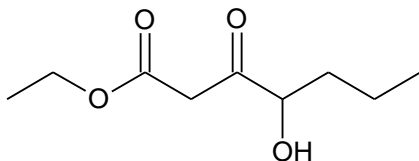
- (1)  $\text{H}^+$  cannot be used with basic amines as they will neutralize, not react
- (2)  $\text{NH}_2^-$  is a better nucleophile than  $\text{OH}^-$  since N is less electronegative (stronger base)

7.) Give the line-angle structures of the following compounds. (18 pts, 6 pts ea)

a.) diethyl ketone



b.) ethyl 4-hydroxy-3-oxoheptanoate



c.) 3-cyano-N,N-dimethylpentamide

