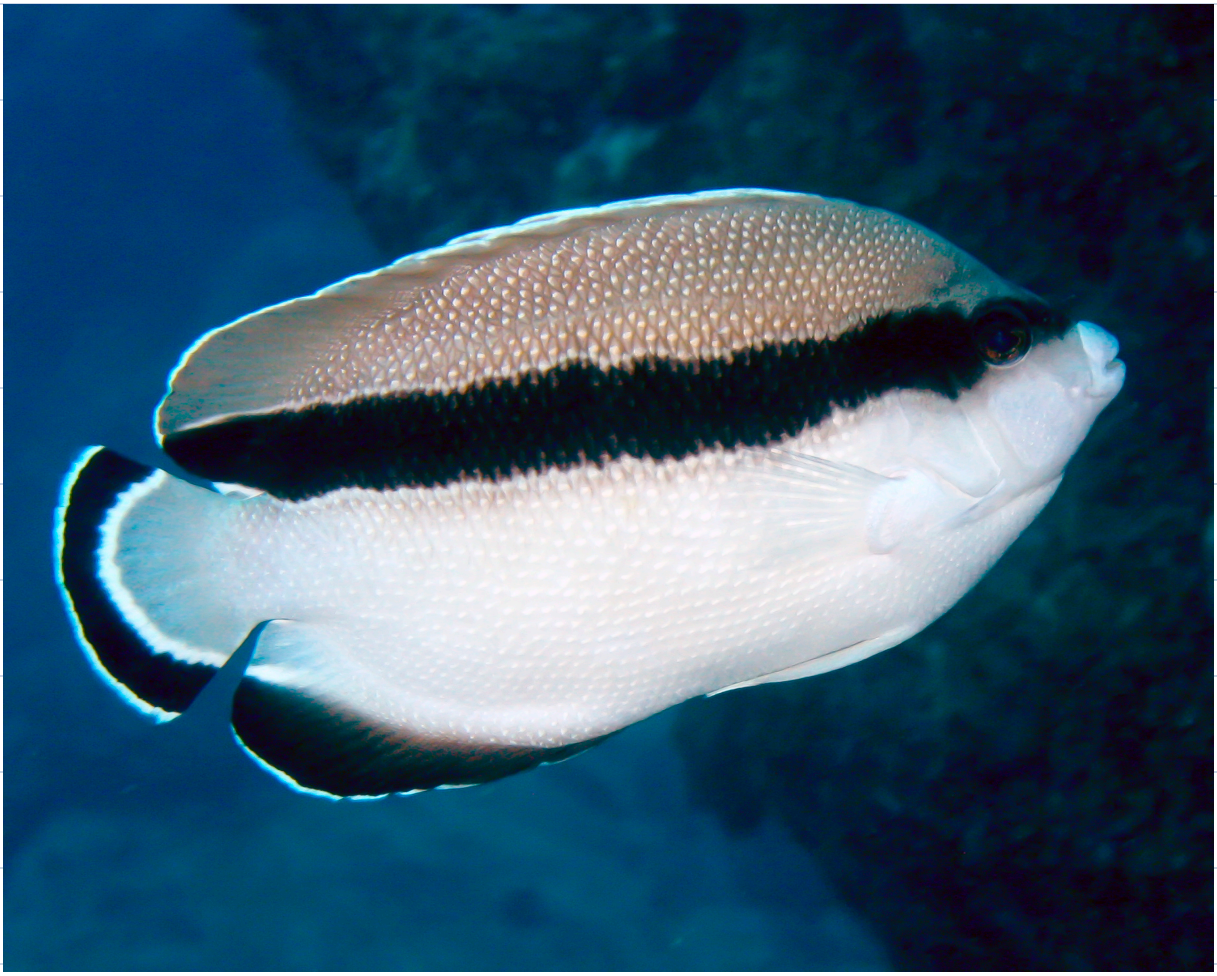


For mechanisms, keep the following in mind:

1) Identify the bonds to be made and broken in the overall reaction

2) Avoid "mixed media errors"

   a) In acid, all the intermediates are positively-charged or neutral

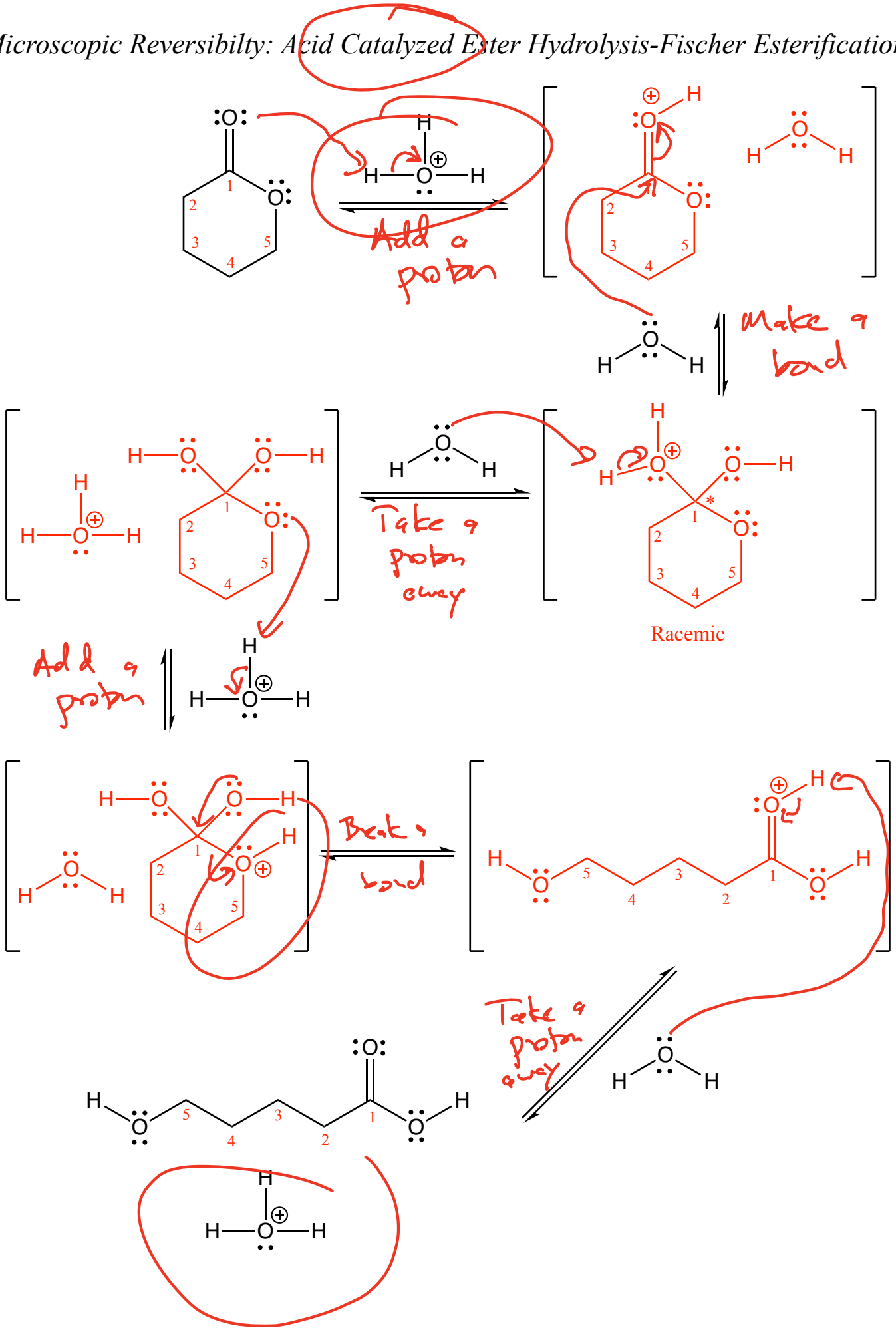
   b) In base, all the intermediates are negatively-charged or neutral

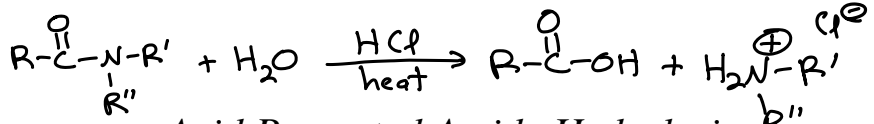
   c) In neutral solution → the intermediates could be positively-charged, negatively-charged or neutral

3) When in doubt transfer a proton → protons move very fast

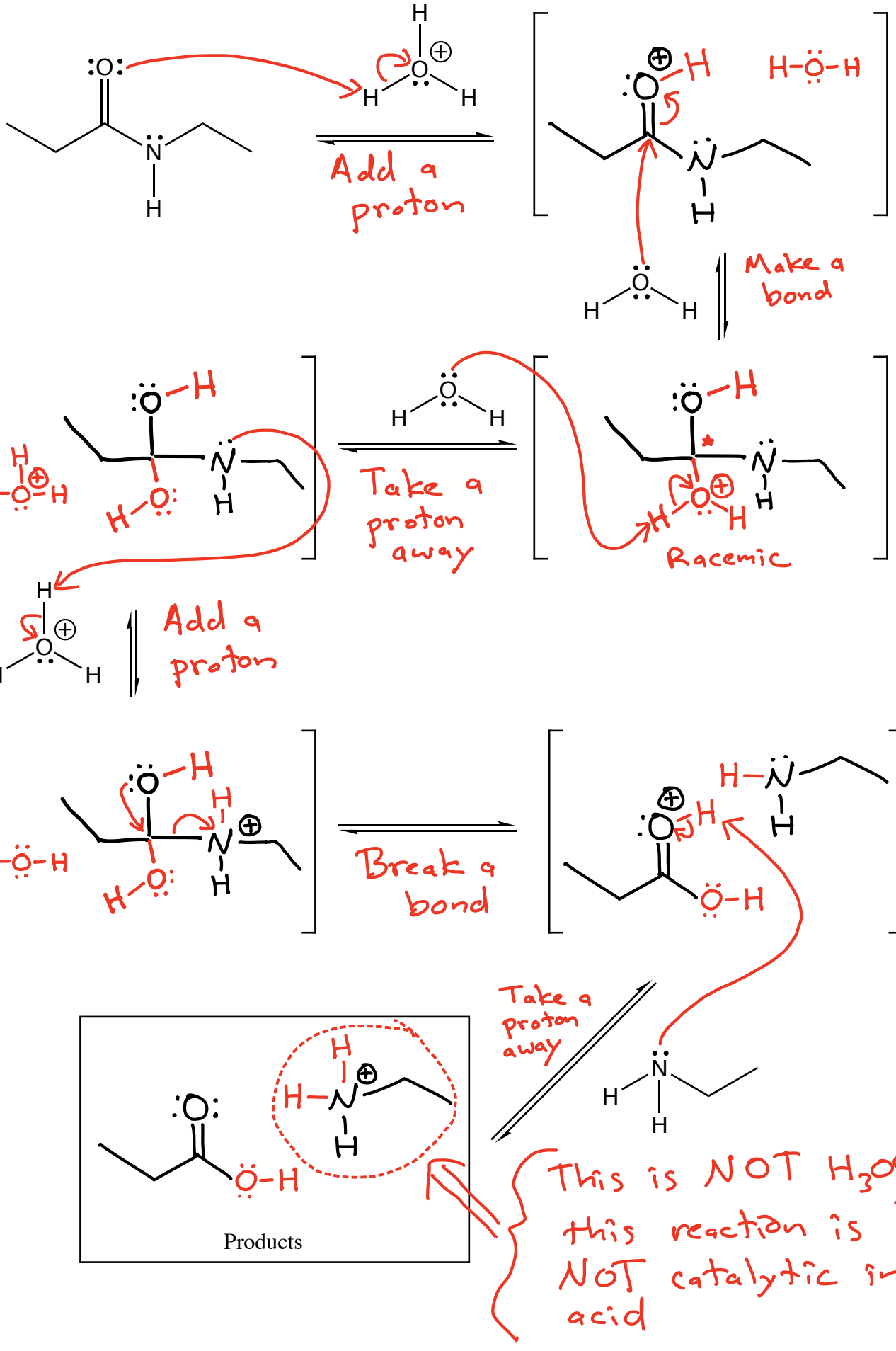
4) Analyze each intermediate carefully to predict the next step

*Microscopic Reversibilty: Acid Catalyzed Ester Hydrolysis-Fischer Esterification*

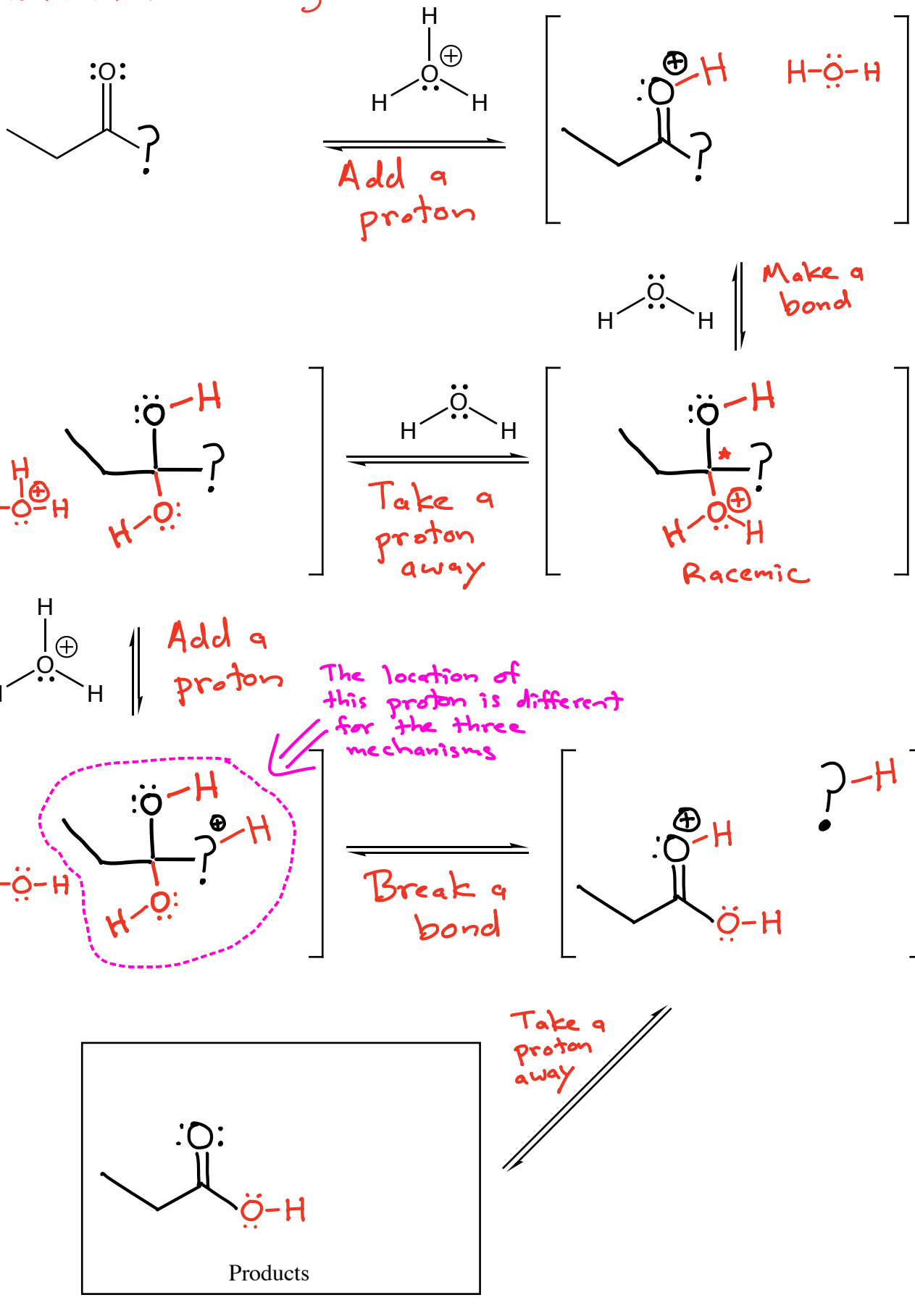


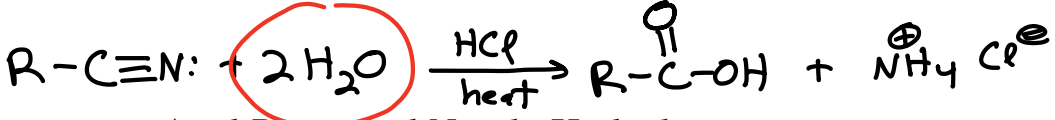


*Acid Promoted Amide Hydrolysis*

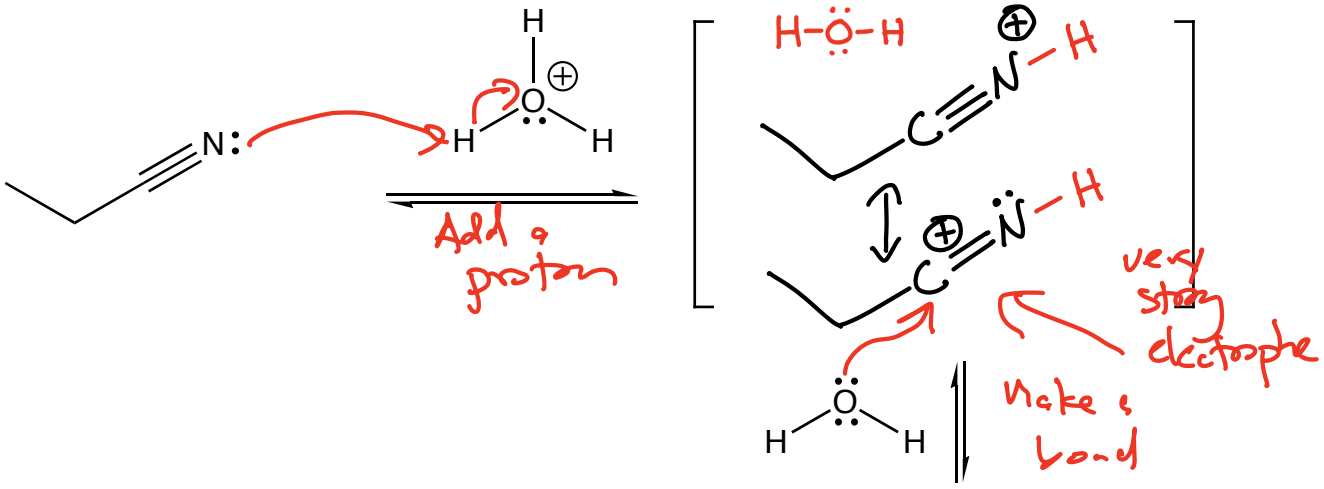


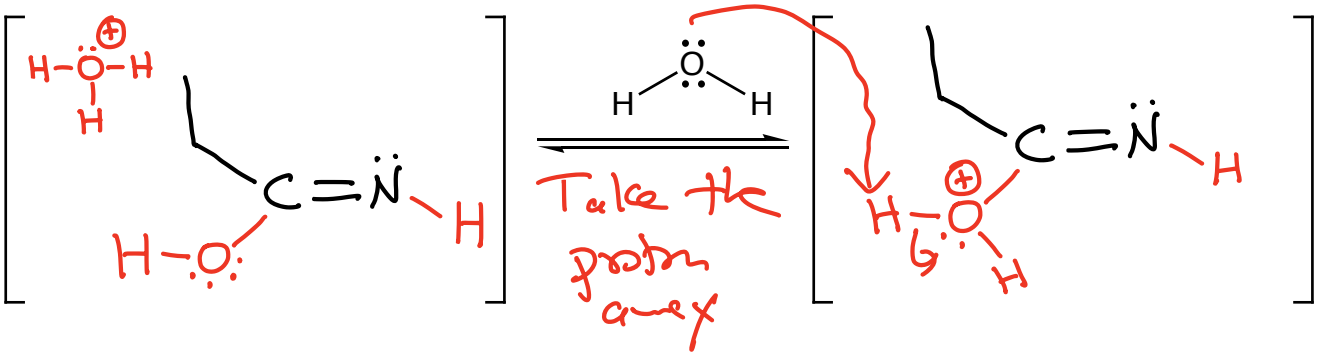
The following mechanism applies to which reaction we have seen? Trick Question → it applies to three reactions → Anhydride, ester and amide hydrolysis in acid! "Same song different verse!"



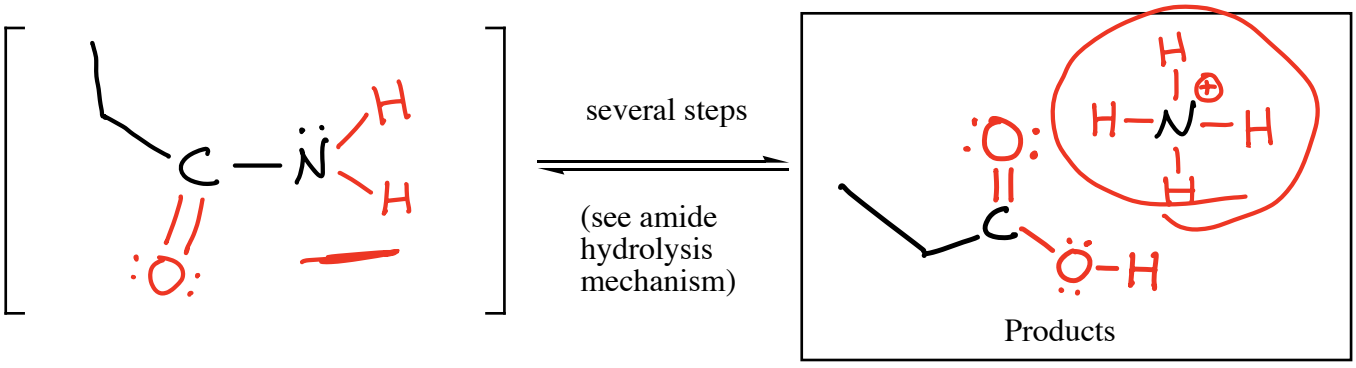


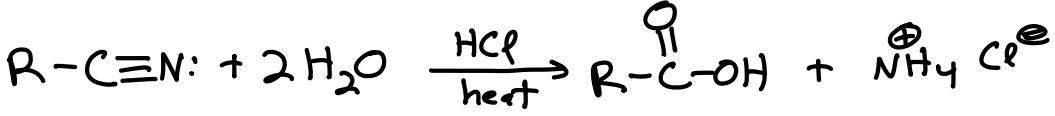

*Acid Promoted Nitrile Hydrolysis*



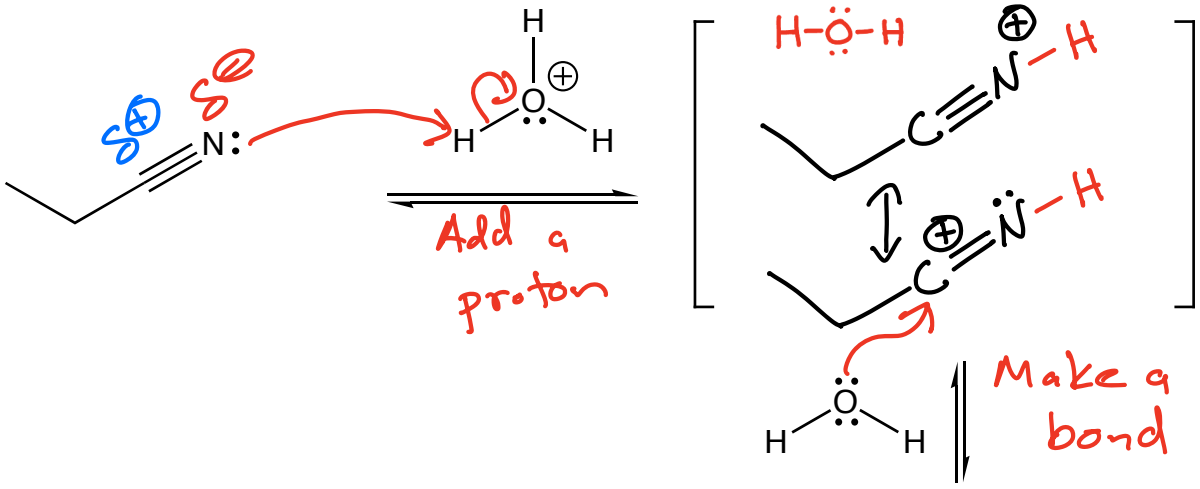



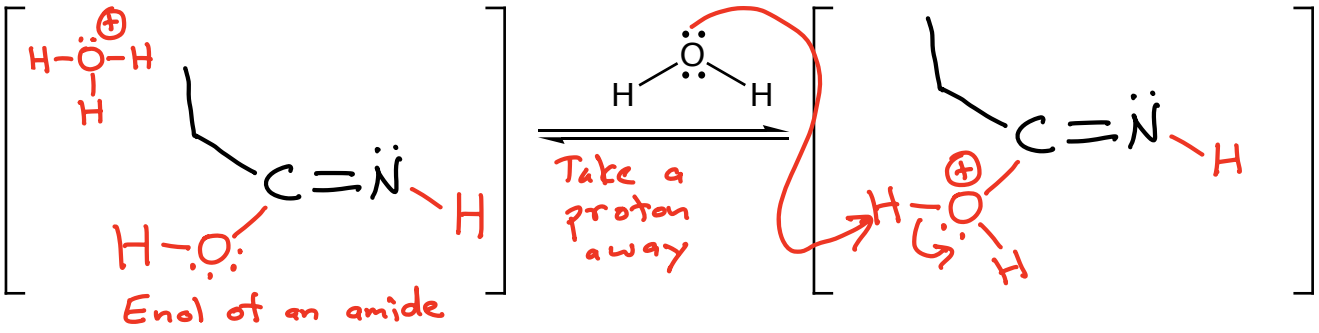

tautomerization



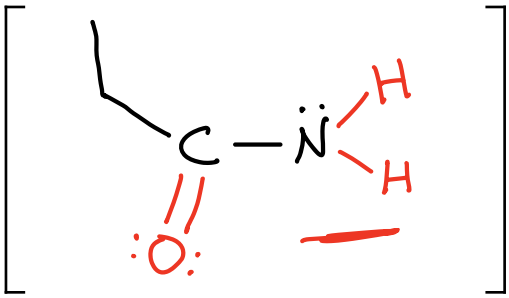



*Acid Promoted Nitrile Hydrolysis*



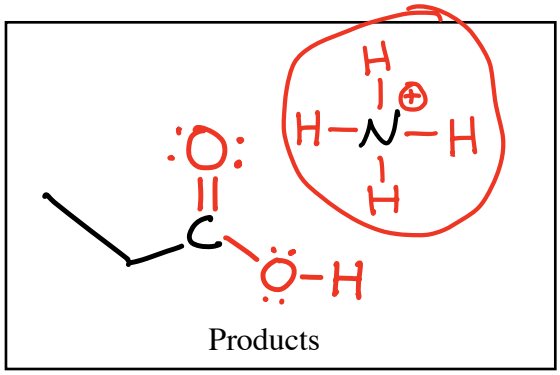




tautomerization

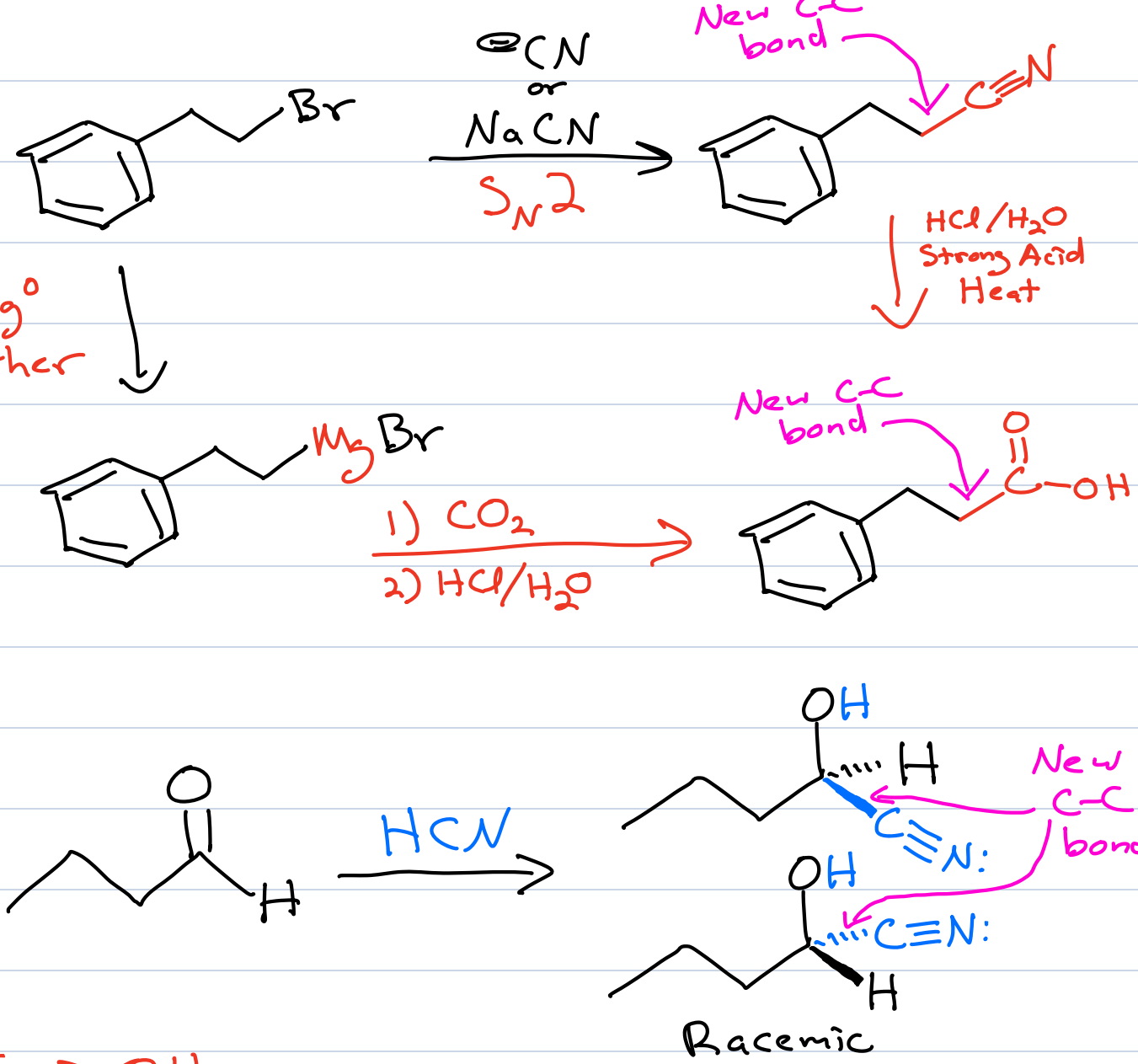



several steps

(see amide hydrolysis mechanism)

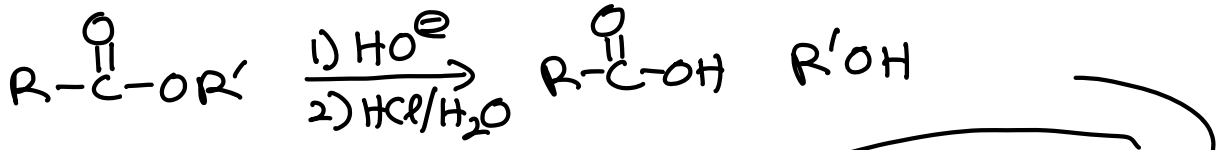



These conditions are strong enough to hydrolyze amides according to the mechanism we saw as "Acid Promoted Hydrolysis of an Amide"

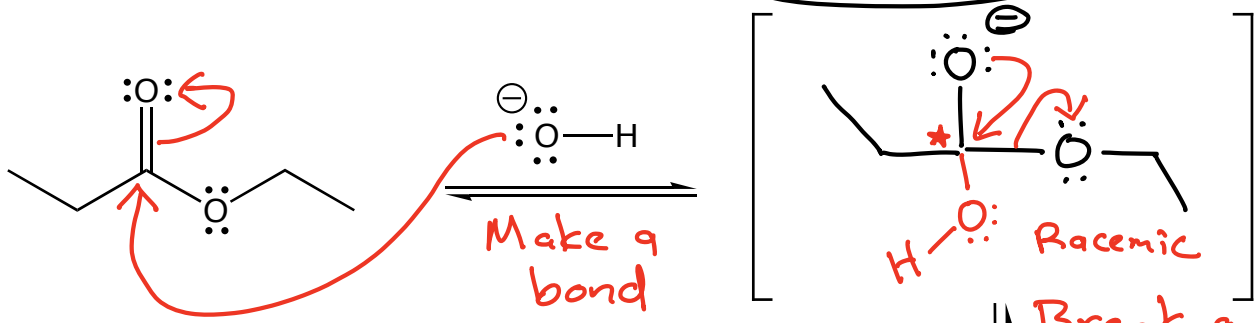


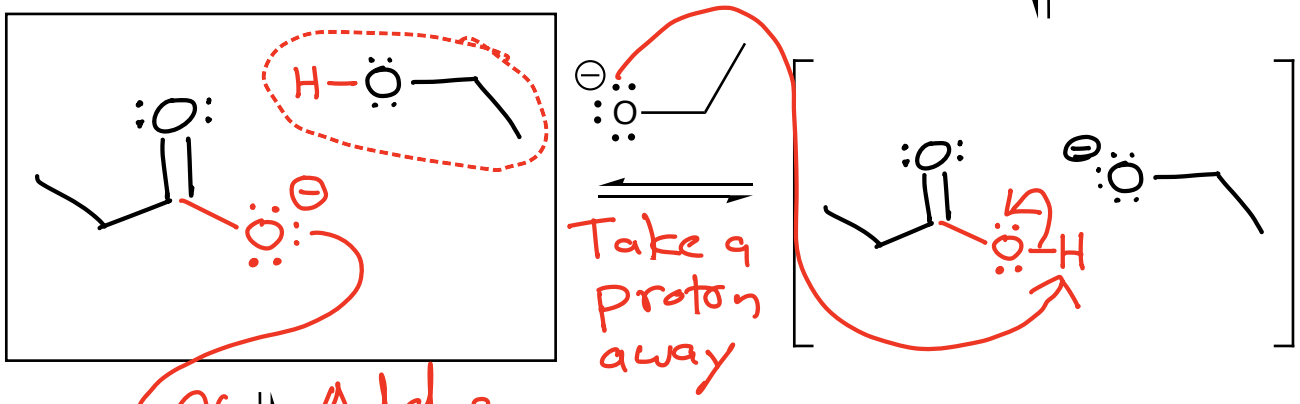

KRE → OH group on an α (alpha) carbon of a carboxylic acid → New C-C bond adding 1 carbon atom

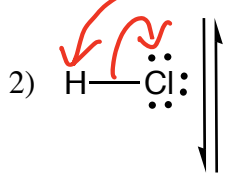
α-hydroxy acid




*Base-Promoted Ester Hydrolysis - Saponification*

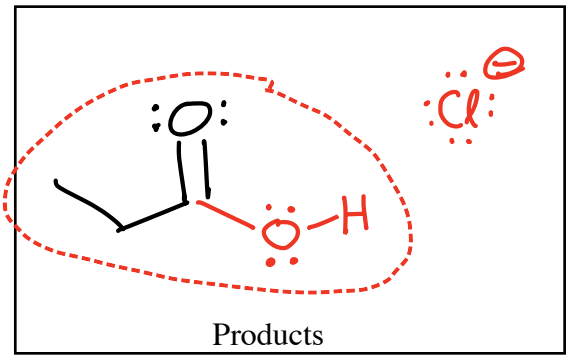


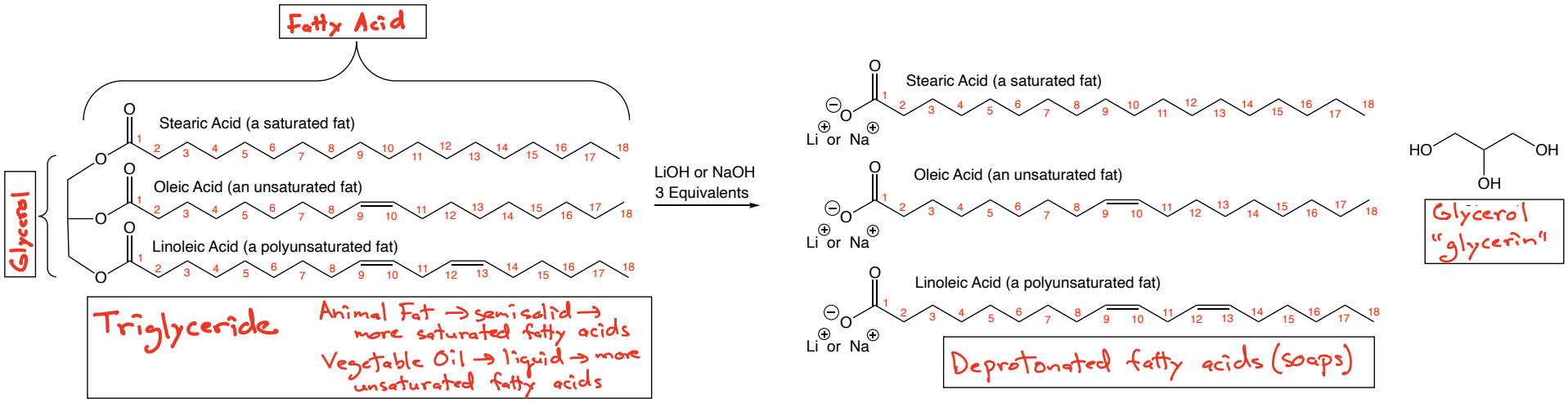

NOT catalytic in base

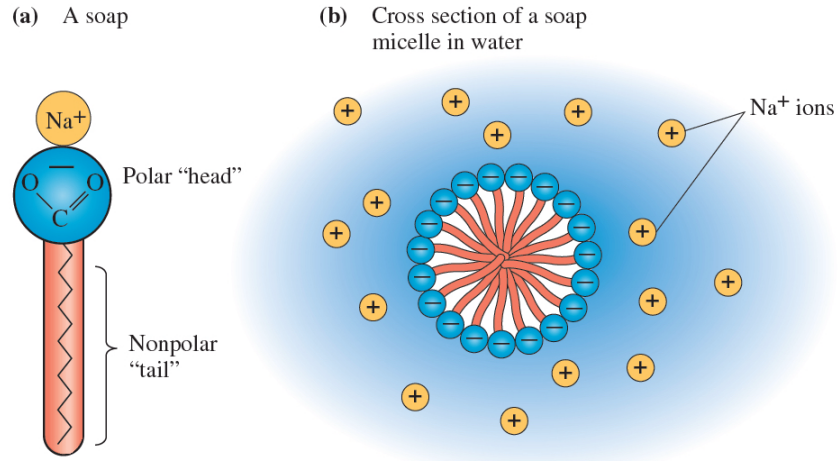
Mechanism B

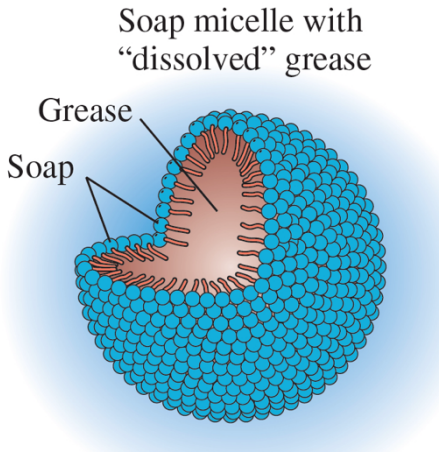


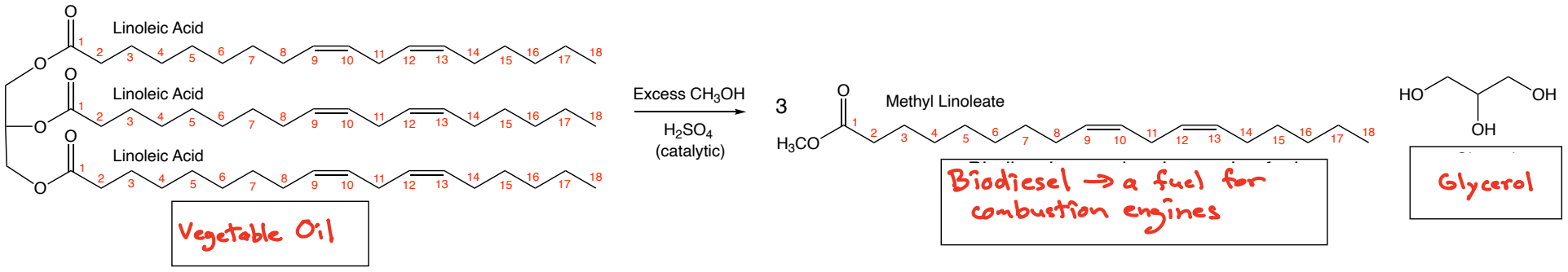

Driving force → converts $HO^{\ominus}$ to $R-C(=O)-O^{\ominus}$

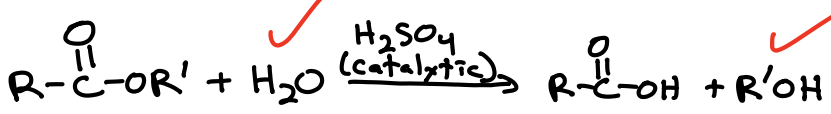
More stable anion → favored → MOTIVE


Fatty Acid
Glycerol
Stearic Acid (a saturated fat)
Oleic Acid (an unsaturated fat)
Linoleic Acid (a polyunsaturated fat)
Triglyceride
Animal Fat → semisolid → more saturated fatty acids
Vegetable Oil → liquid → more unsaturated fatty acids
LiOH or NaOH
3 Equivalents
Li or Na
Deprotonated fatty acids (soaps)
HO
OH
OH
Glycerol "glycerin"

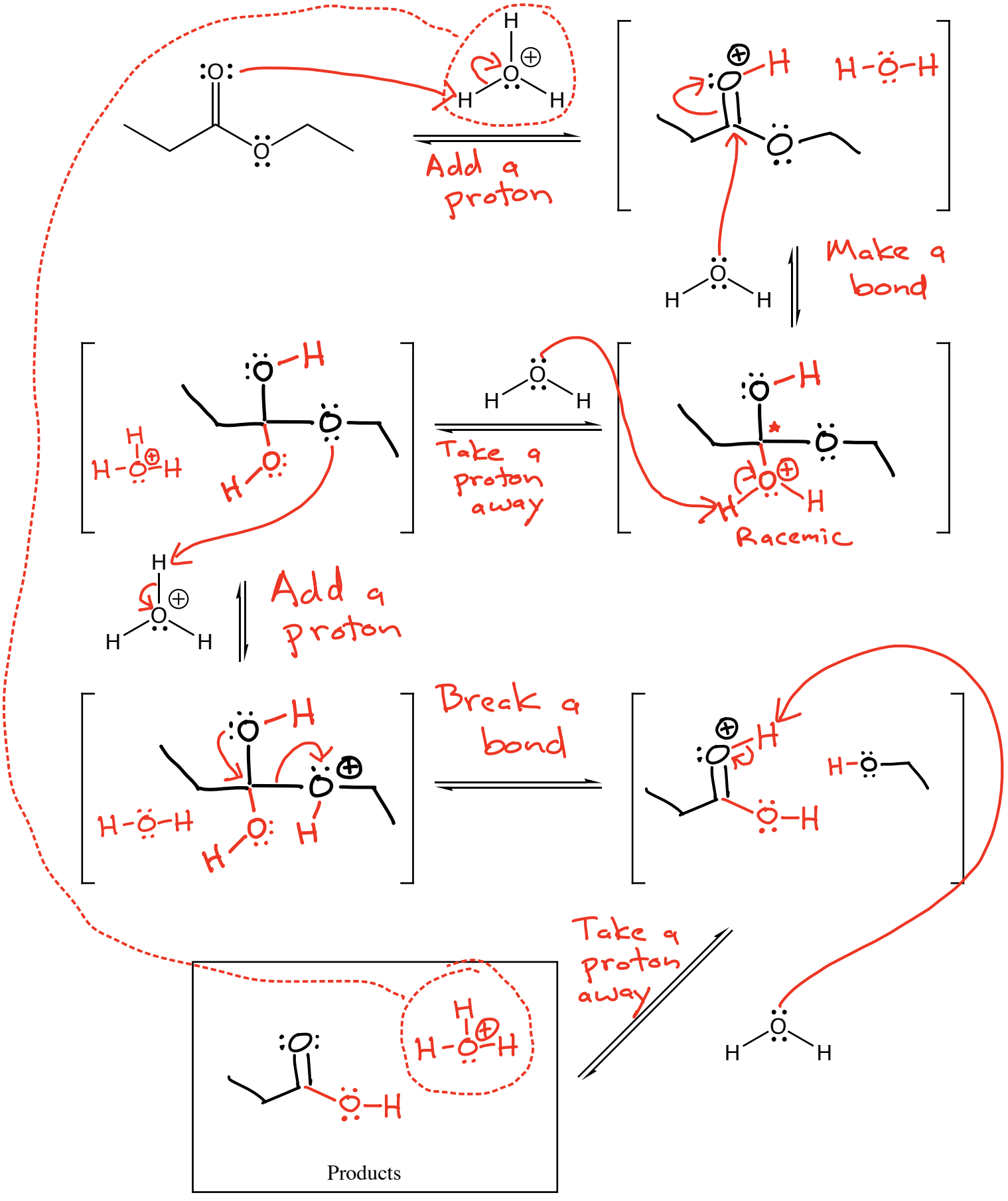

(a) A soap
(b) Cross section of a soap micelle in water
Na+
Polar "head"
Nonpolar "tail"
Na+ ions

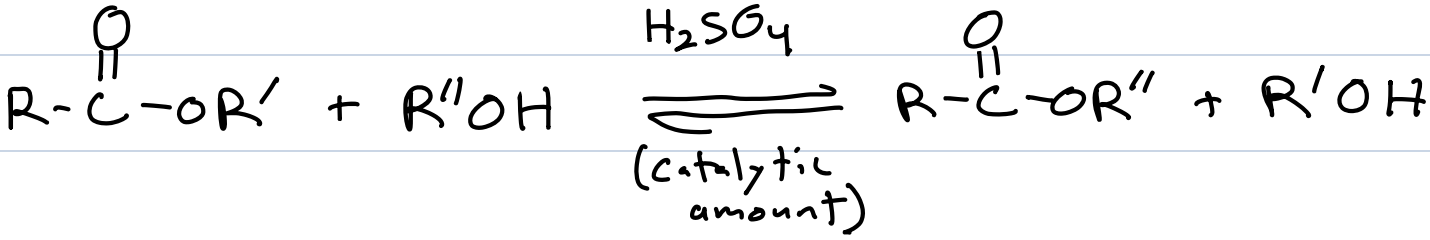

Soap micelle with "dissolved" grease
Grease
Soap


Linoleic Acid
Linoleic Acid
Linoleic Acid
Vegetable Oil
Excess CH3OH
H2SO4
(catalytic)
3
H3CO
Methyl Linoleate
Biodiesel → a fuel for combustion engines
HO
OH
OH
Glycerol

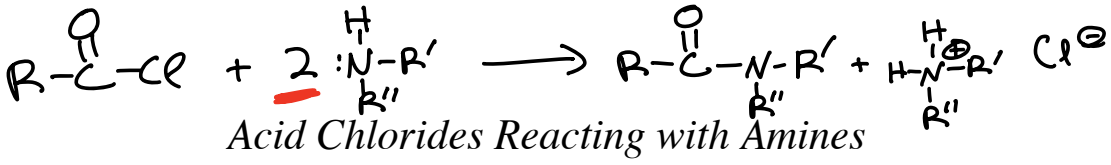



*Acid Catalyzed Ester Hydrolysis*

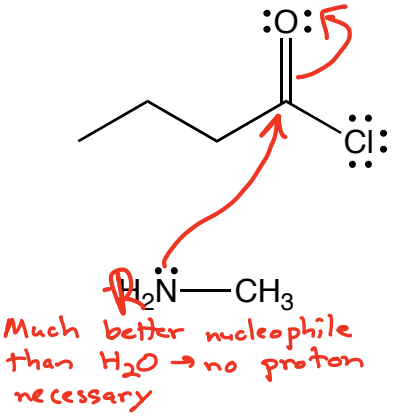




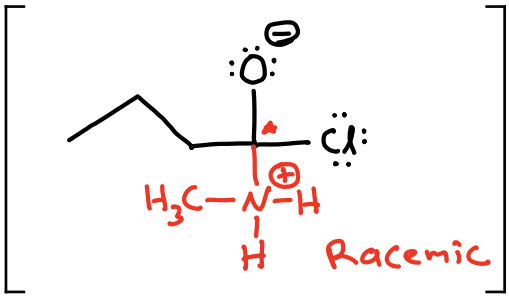

Transesterification → the chemistry behind biodiesel production (see handout)



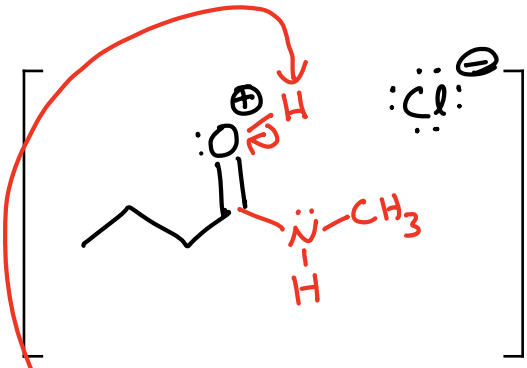
*Acid Chlorides Reacting with Amines*



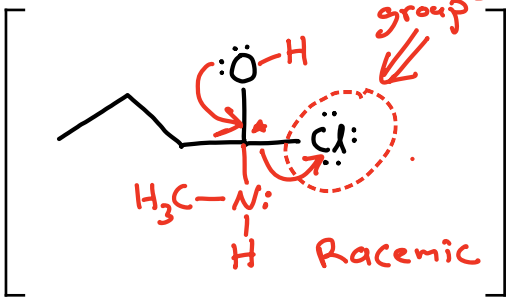

Make a bond

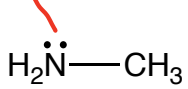



Proton transfer

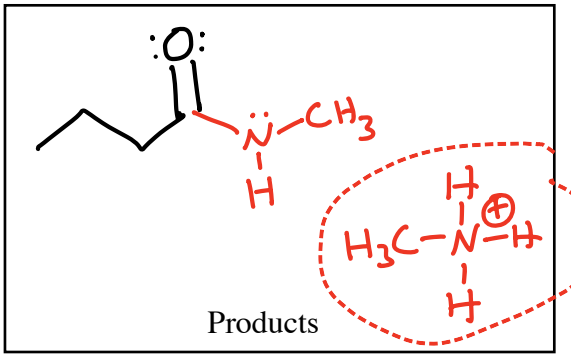


Break a bond



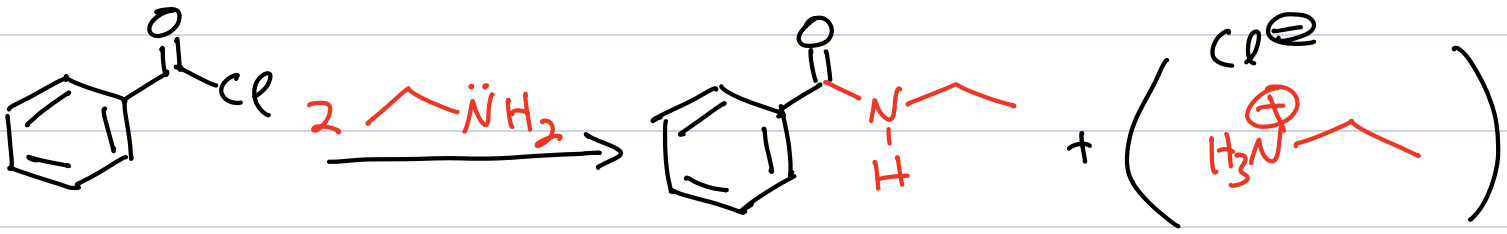
Take a proton away

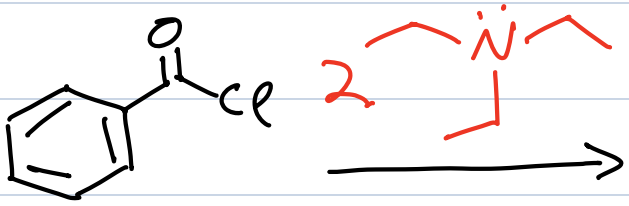



NOT a nucleophile so we need 2 equivalents of amine for this reaction

Remember — you need two equivalents of the amine!

Examples





No Reaction → the amine must have at least one H atom so that a stable amide can be made.