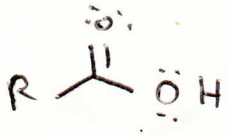
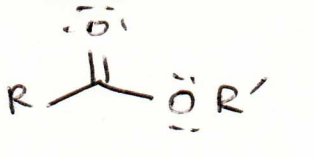
Carboxylic Acids + Derivatives

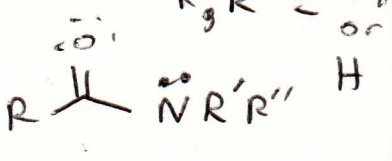


carboxylic acid



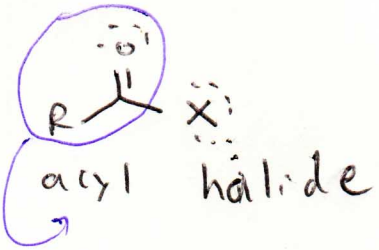
R' = alkyl

ester

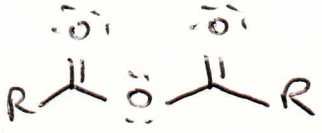


R', R'' = alkyl or H

amide

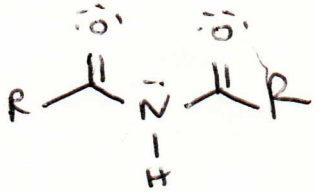


acyl halide



anhydride

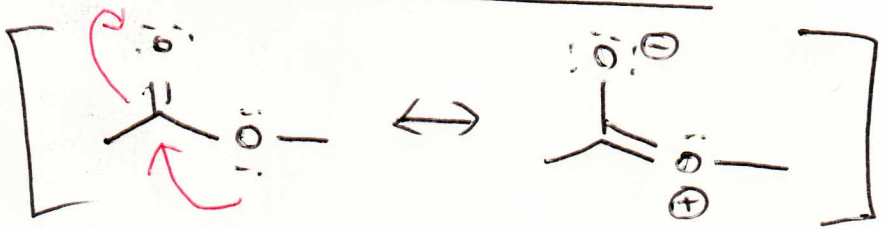
"without water"



imide

nitrile

Order of reactivity

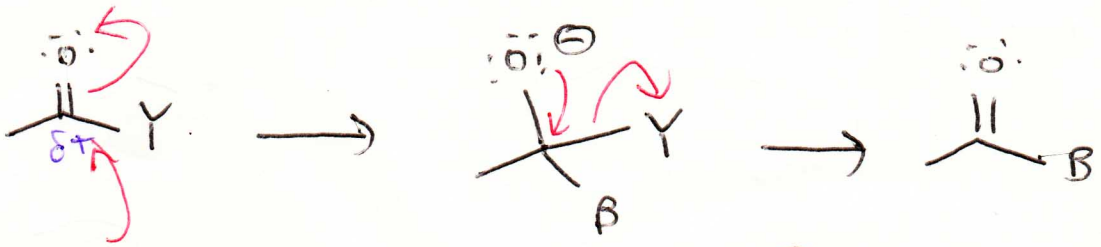


(delocalization)

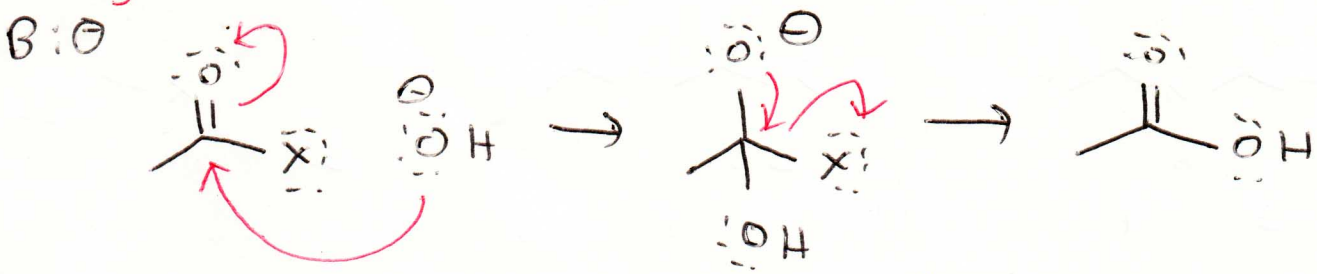
Halogens – Halogens can undergo resonance since halogens have available lone pairs. However, overall, more e⁻ density is withdrawn by a halogen than donated.

- Fluorine - Similar in size to C → good orbital overlap; but, most electronegative element → induction
- chlorine, bromine, iodine – poor orbital overlap (not same size as carbon) → do not donate as much e⁻ density by resonance, yet still have induction.

Cationic



Anionic



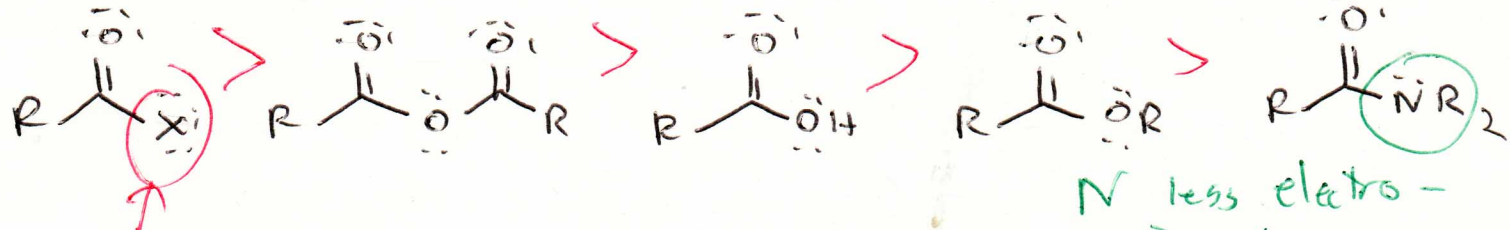
tetrahedral intermediate

— Carboxylic acid derivatives are carbonyl-containing compounds, which means they normally react due to the δ+ on the carbonyl carbon or due to the δ− on the carbonyl oxygen

— Cationic – normally stepwise, acid-catalyzed
→ protonation occurs to cause the formation of a carbocation

— Anionic – normally concerted, base-promoted

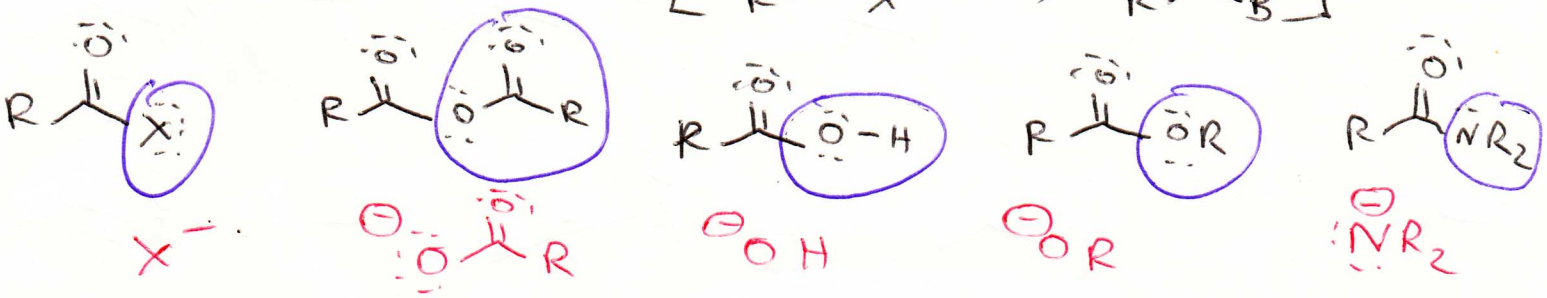
— Any factors that reduce the δ+ on the carbonyl carbon will <u>decrease</u> the reactivity of the carbonyl



withdrawse e⁻ density, makes δ+ bigger on carbonyl

N less electro-negative; lone pair easily delocalizes; makes δ+ smaller

Carbonyl substitution

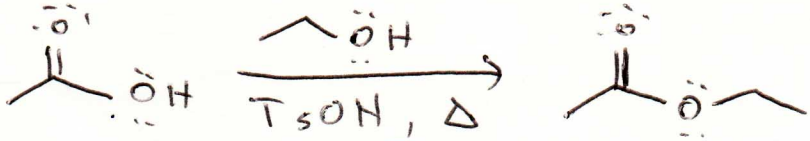


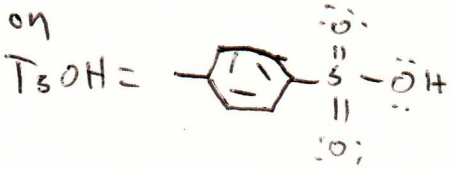
basicity of leaving group

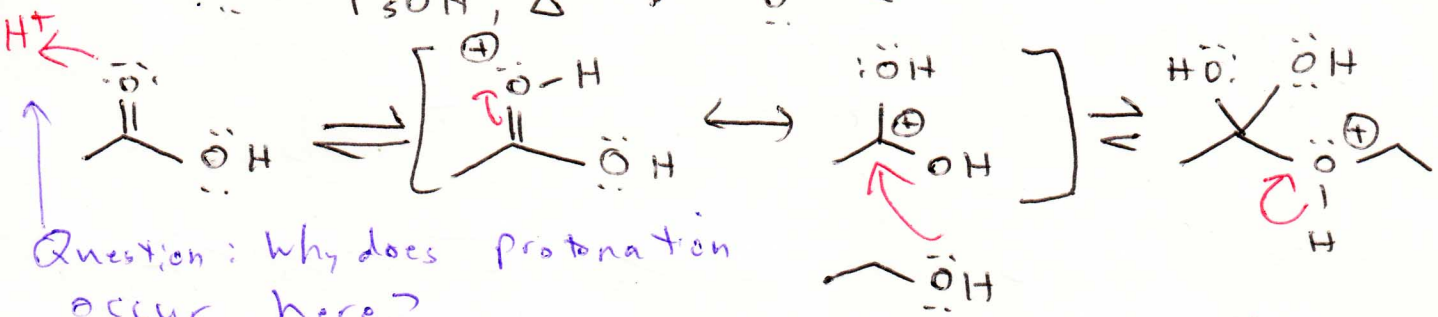
conjugate acid strength

increasing reactivity

Fischer Esterification / Deesterification

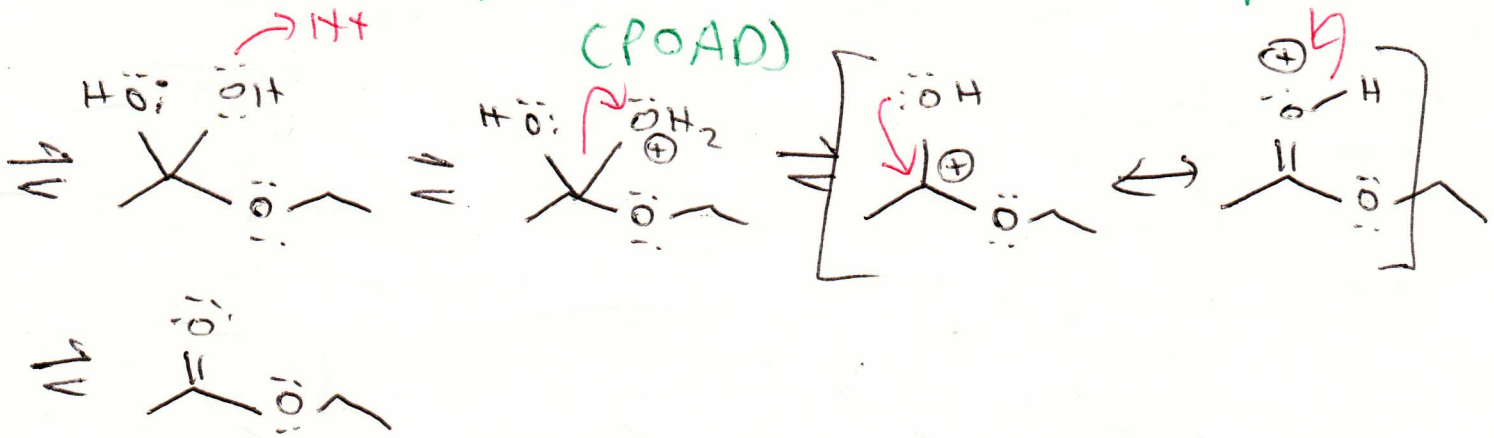


$TsOH =$ 



Question: Why does protonation occur here?

protonate open attack deprotonate



(POAD)