Formal charge and oxidation state are both counting systems, in which the number of electrons around an atom in a molecule are compared to the number of electron that atom would have in its unreacted, elemental state. The only difference between the systems is how the electrons in bonds are distributed.

Formal charge Each bond is treated as if it is purely covalent, meaning one electron is given to each in the bond (per bond) → homolytic cleavage

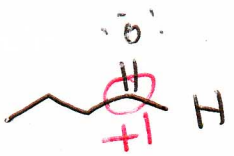
Oxidation state Each bond is treated as if it is purely ionic, meaning both electrons in the bond are given to the more electronegative element

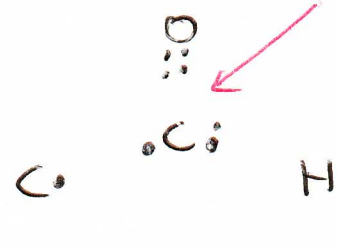
→ heterolytic cleavage

* If a bond is composed of two of the same atom, it is treated as a covalent bond since neither atom is more electronegative than the other

- Each atom that is more electronegative than carbon (N, O, Cl, Br) will cause a +1 O.S. on the carbon it is attached to (per bond)
- Each atom less electronegative than carbon (H, B) will cause a −1 O.S. on the carbon it is attached to (per bond)

- If a carbon is attached to another carbon, neither carbon causes a change in O.S. on the other





C effectively has 3 e⁻

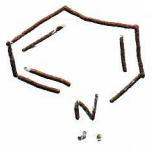
unreacted C has 4

→ +1

Oxidation

selective oxidation of primary alcohols

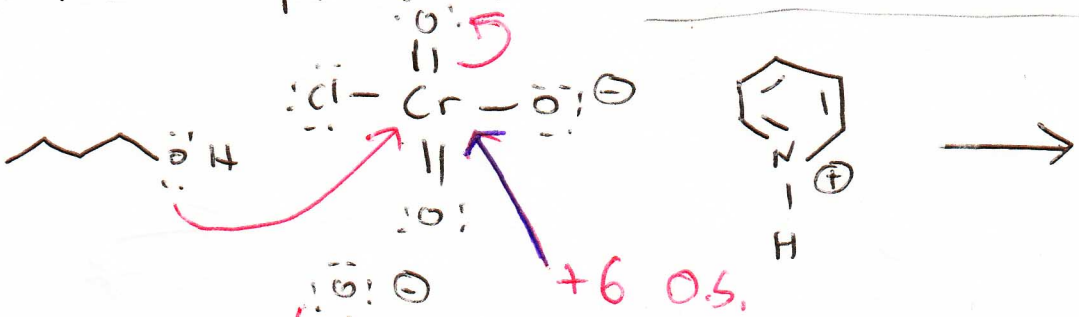
* anhydrous conditions



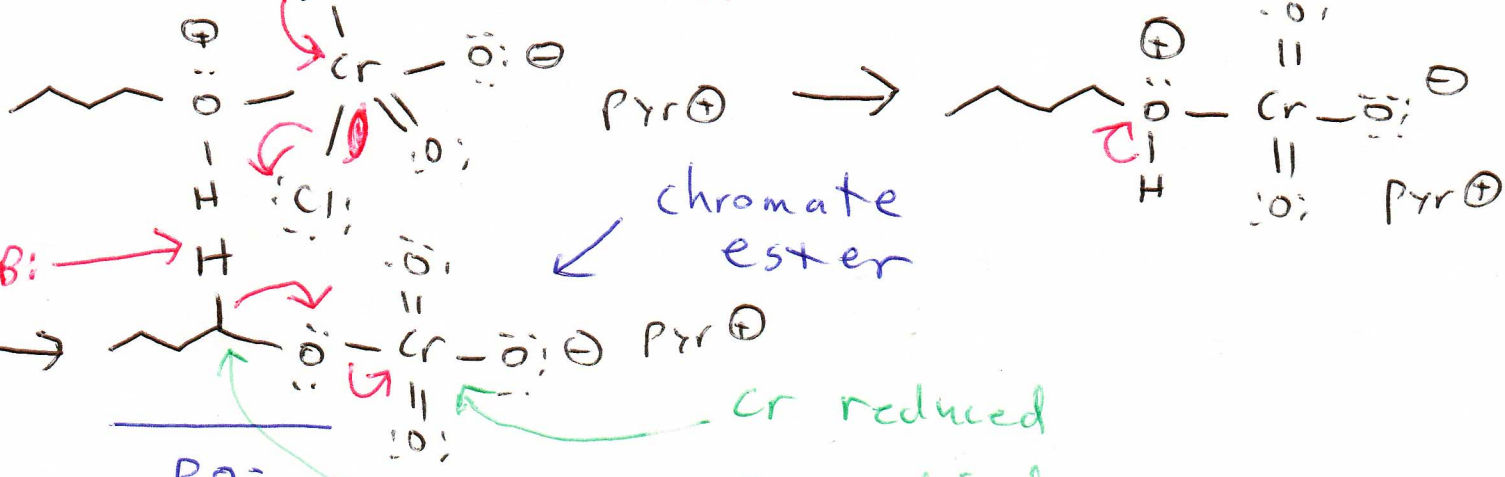
pyridine

pyridinium cation

PCC - pyridium chloro chromate



+6 O.S.

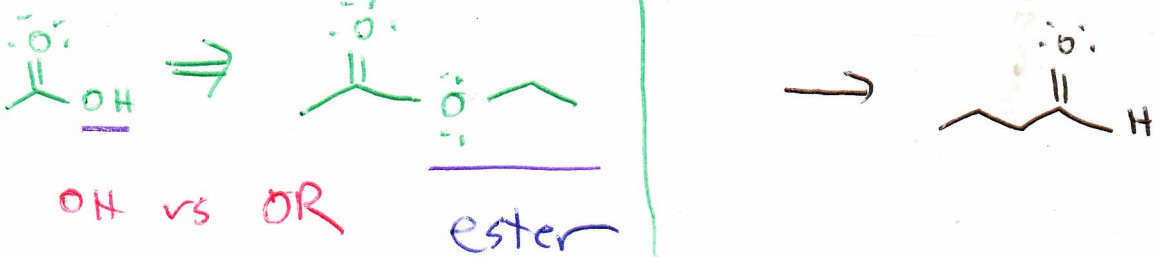


chromate ester

Cr reduced

C oxidized

RO⁻

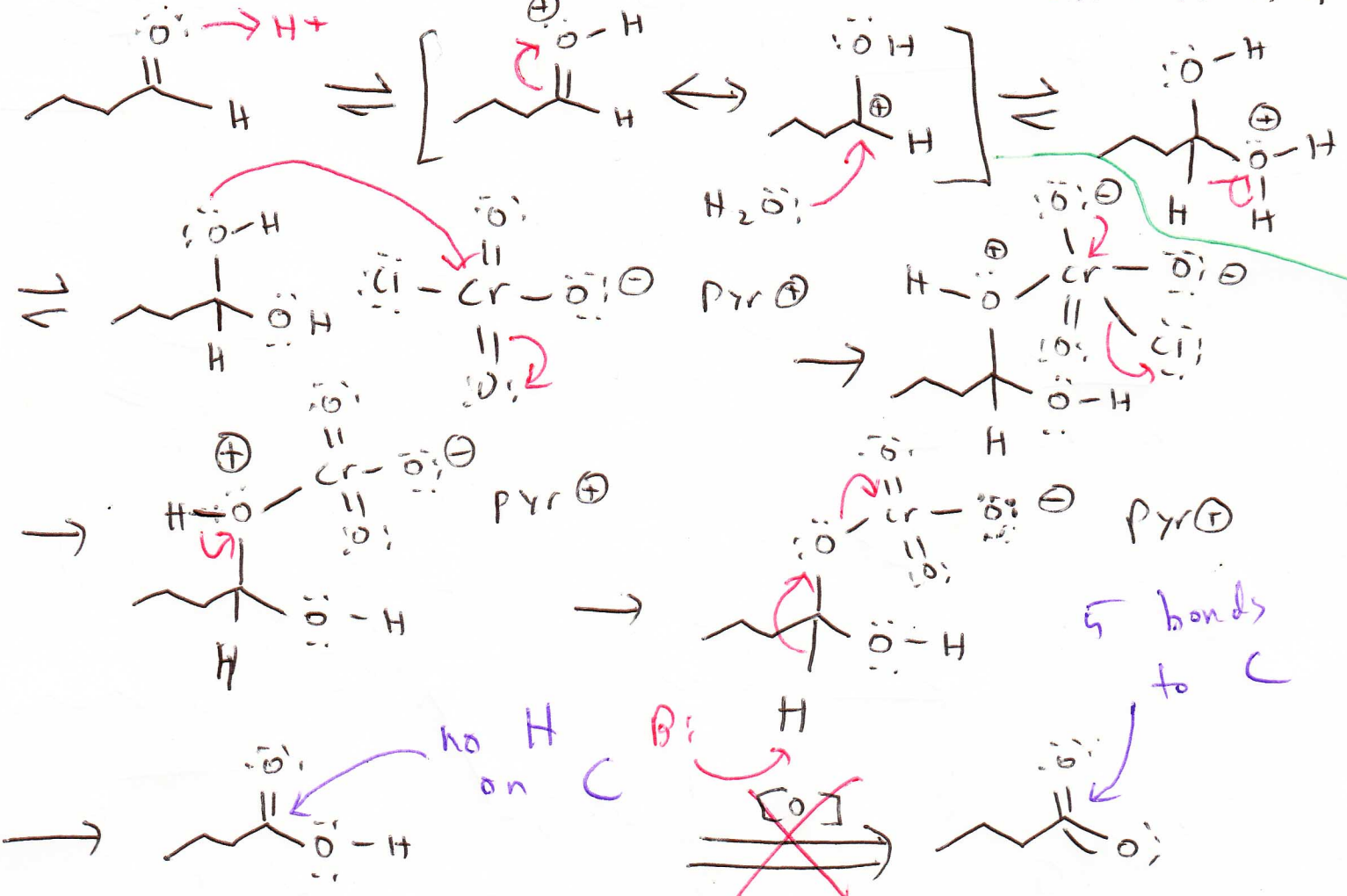


OH vs OR

ester

1° alcohol can be selectively oxidized to an aldehyde.

- If an equilibrium can be established, it will be established, meaning there will always be some ~~~~ non-zero quantity of products present, even if the formation of products is unfavorable,

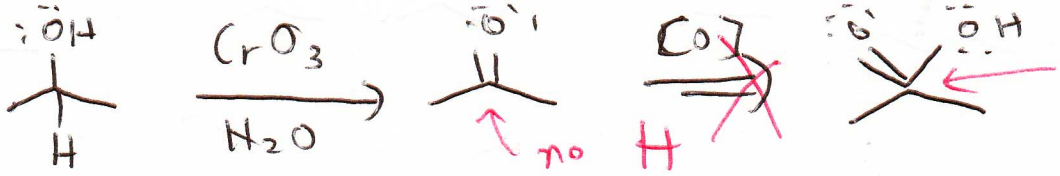


In the presence of water, a 1° alcohol will over oxidize to a carboxylic acid.

When aqueous conditions are used, aqueous CrO_3 is used instead of PCC (cheaper)

Jones – CrO_3, H_2O, trace H_2SO_4

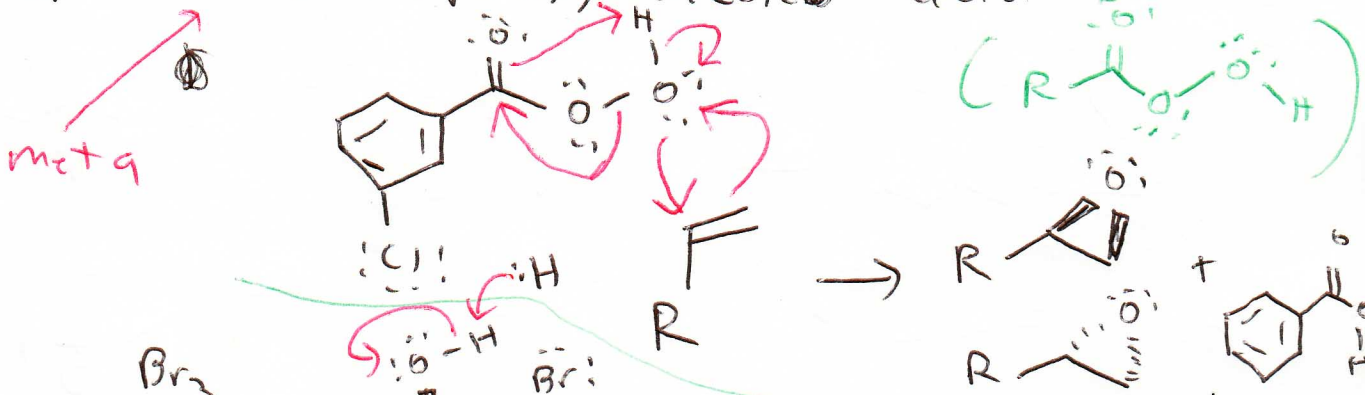
2° alcohols can only be oxidized to ketones

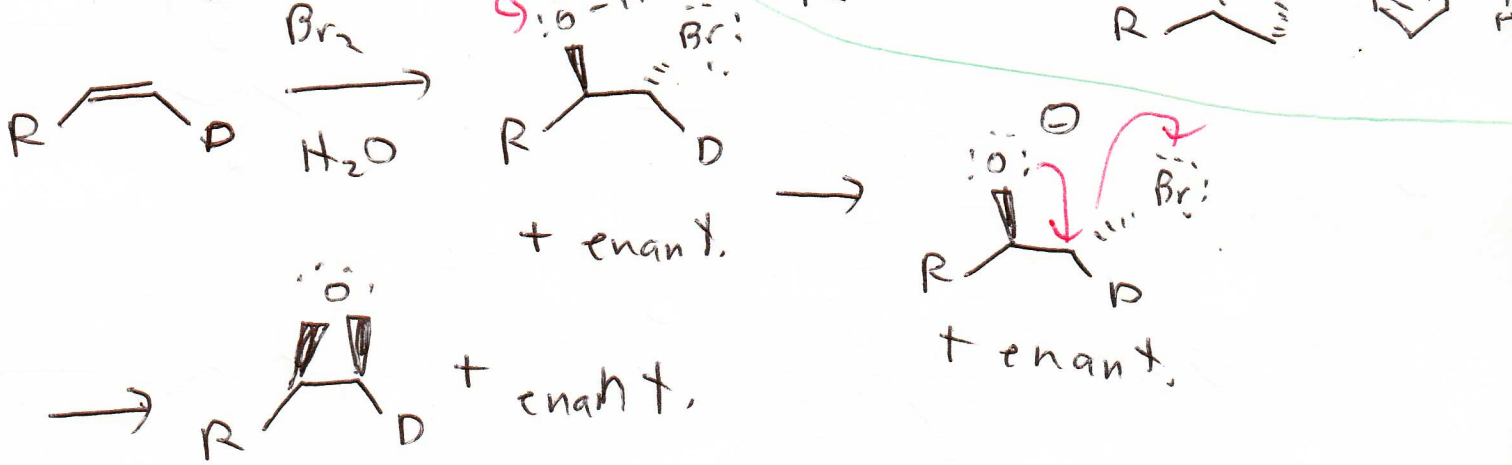


end of quiz #1

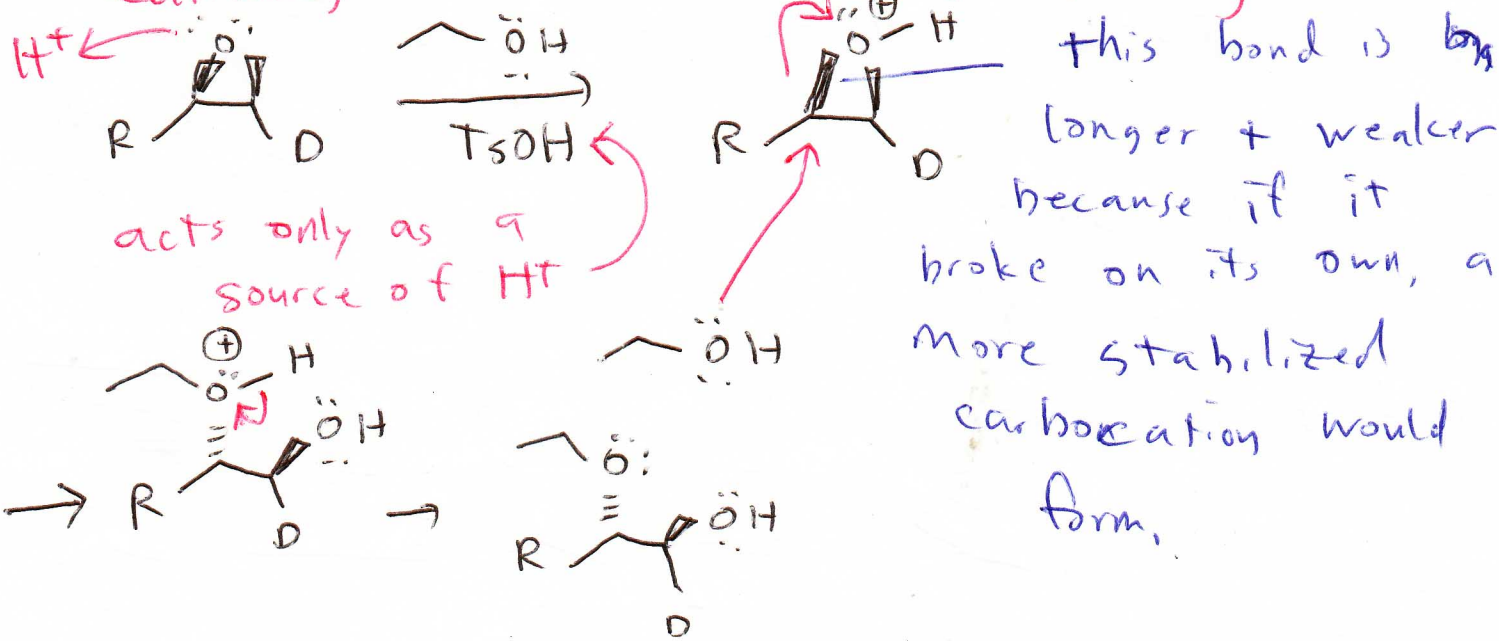
Epoxides

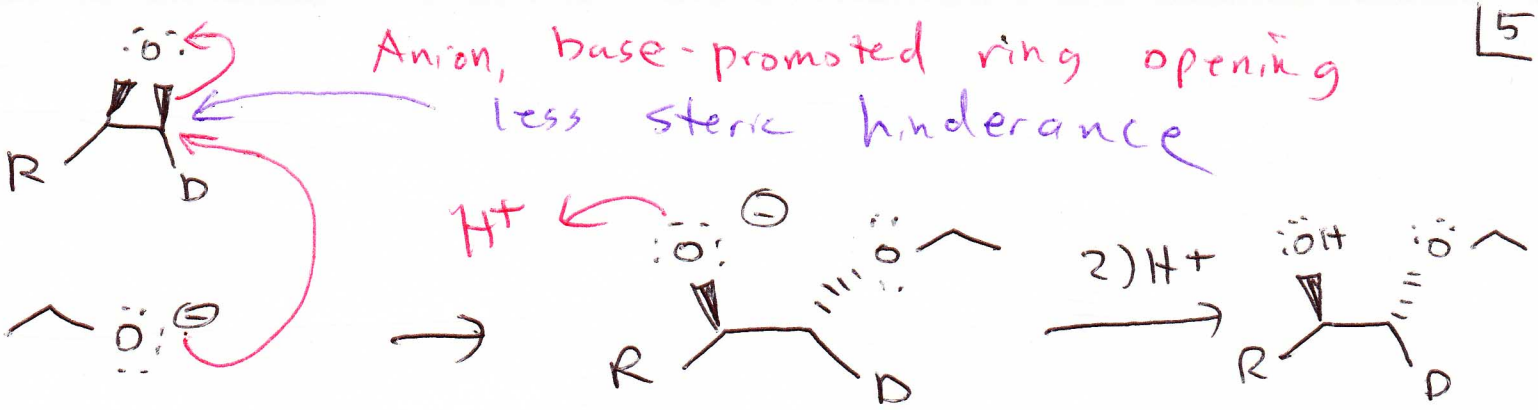
MCPBA - m-chloroperoxybenzoic acid





Cationic, acid-catalyzed ring opening




Anion, base-promoted ring opening
less steric hinderance
R
D
H+
2) H+
OH
R
D
R
D