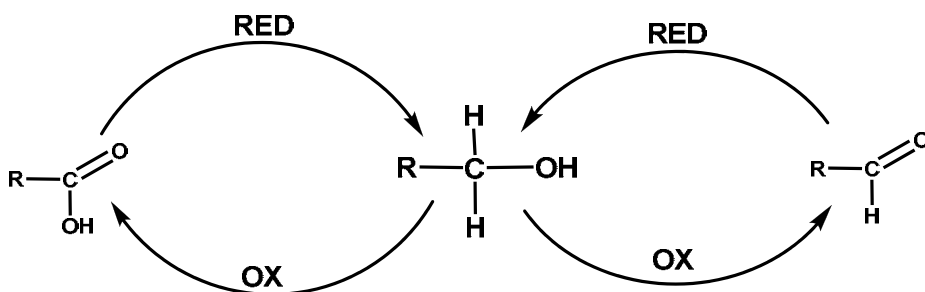


## Chapter 12 (student outline): Alcohols from Carbonyl Compounds

- Oxidation (-H) of alcohols to form carbonyls
- Reduction (+H) of carbonyls to form alcohols
- Grignard reaction: forming alcohols and new C-C bonds

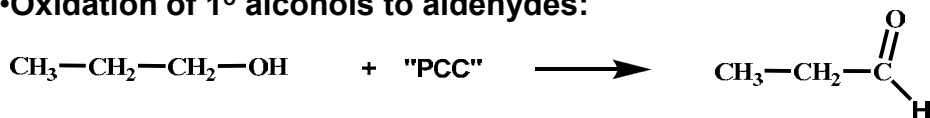
### Oxidation/Reduction Reactions in Organic Chemistry: Alcohols/Carbonyls



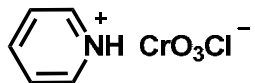
- Oxidation of alcohols involves loss of H, hybridization change, and additional C-O bonds.
- Reduction of carbonyls involves addition of H, hybridization change, and loss of C-O bonds.

## Reagents for Alcohol Oxidation

•Oxidation of 1° alcohols to aldehydes:



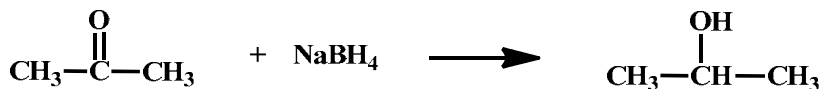
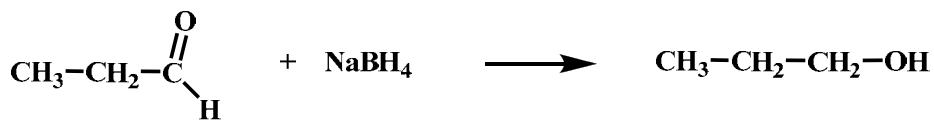
PCC = Pyridinium chloro chromate



•Oxidation of 2° alcohols to ketones:



## Reduction of the Carbonyl Group to Alcohols with NaBH<sub>4</sub>



## **Grignard Reaction – Multistep Synthesis**

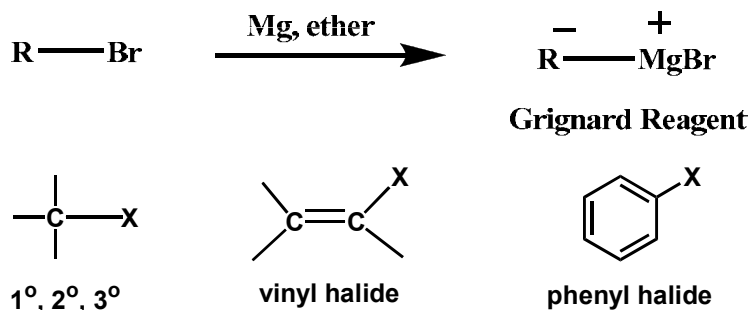
- **Multistep Synthesis:**
  - series of separate reactions
  - reactions flow continuously left-to-right (not balanced)
  - reagents are written over the reaction arrows
  - NOT a mechanism

## **Grignard Reaction**

- **Multistep Synthesis Format:**
  - series of separate reactions
  - reactions flow continuously left-to-right (not balanced)
  - reagents are written over the reaction arrows
  - NOT a mechanism

# Grignard Reaction – Step by step

Part I. For carbon to be a nucleophile it must be activated by forming an organometallic compound.

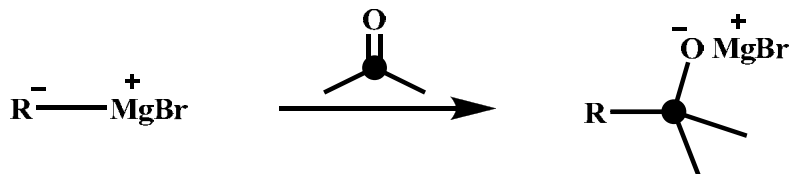


Alkyl halides react with Mg metal in ether solvent to form the “Grignard Reagent” containing a coordinate covalent bond. The metal stabilizes the carbon anion.

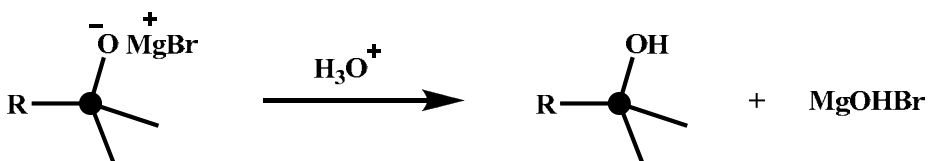
Part II. The Grignard reagent is:

- (1) a strong base and
- (2) a good nucleophile.

The key reaction is addition to electrophilic C-O compounds to form alcohols:



**Part III. Add dilute acid to neutralize the basic salt.**



## **Performing a Grignard Synthesis**

- Study the target molecule and the list of available reagents.
- Locate the new bond formed in the target molecule.
- From the reagent list (stockroom) identify the reactants needed to make the target molecule.
- Identify the reactant you will use to make the Grignard reagent.
- Is this reagent an alkyl halide? If not, convert to an alkyl halide.
- Step #1: React alkyl halide with Mg in ether to make Grignard Reagent.
- Step #2: React Grignard reagent with an epoxide.
- Step #3: Acid/base neutralization.