

# Alcohol synthesis

## From alkenes

### Hydration of alkene

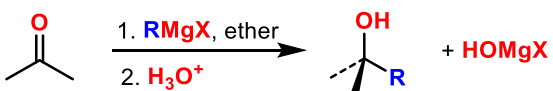
- Acid-catalyzed hydration (Markovnikoff) syn + anti, carbocation, H<sup>+</sup> shift
- Oxymercuration: anti (+ syn) Mercurinium ion, NO H<sup>+</sup> shift
- Hydroboration: Non-Markovnikoff, syn

### Hydroxylation of alkene

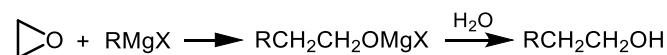
- Using OsO<sub>4</sub> (syn)
- Using KMnO<sub>4</sub> (syn)
- Using peroxyacid (anti)

## Grignard Reaction

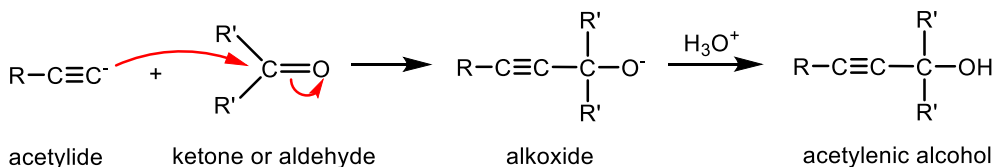
- $\delta^-$  R-MgX  $\delta^+$
- A Grignard reagent
- Formaldehyde → 1° alcohols
  - Aldehyde → 2° alcohols
  - Ketone, Ester → 3° alcohols



### Addition to ethylene oxide

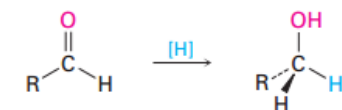


## Addition of acetylide to carbonyl compounds



## Reduction of carbonyl compound

- Aldehyde to 1° alcohol - Ketone to 2° alcohol



An aldehyde

A primary alcohol

Chỉ hoàn nguyên nối đôi C=O còn nối C=C vẫn bảo toàn

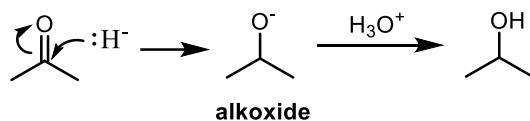


A ketone

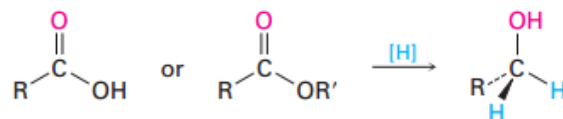
A secondary alcohol

Reagent

- NaBH<sub>4</sub> in H<sub>2</sub>O/Alcohol
- LiAlH<sub>4</sub> in ether/THF
- Coenzyme NADH or NADPH



- Carboxylic acid/Ester to 1° alcohol



A carboxylic acid

An ester

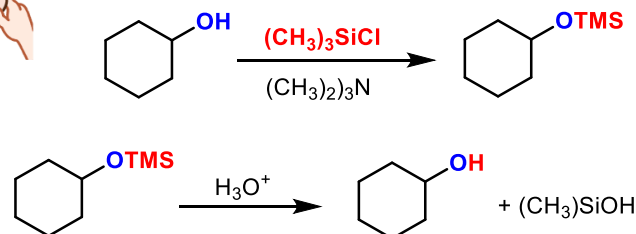
A primary alcohol

NaBH<sub>4</sub> reduce ester slowly, does not reduce carboxylic acid

- LiAlH<sub>4</sub> in ether/THF
- H<sub>3</sub>O<sup>+</sup>



## Protection of alcohols

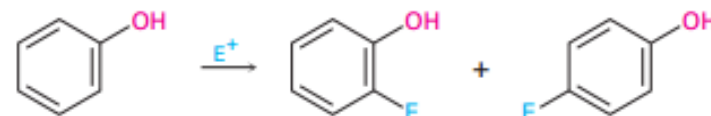


Protect -OH group from oxidizing agents, reducing agents and Grignard reagents

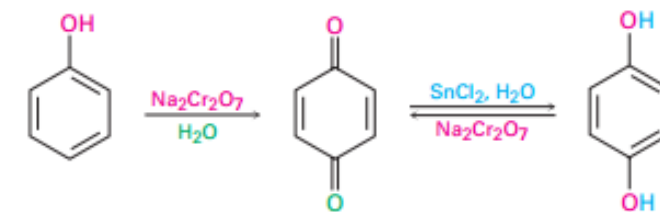
# Reactions of Phenol

## Electrophilic Aromatic Substitution

- OH is strongly activating, ortho- and para-directing
- Electrophilic halogenation, nitration, sulfonation, and Friedel-Crafts reactions



## Oxidation of Phenol: Quinones



- Unlike alcohols, phenol don't have a hydrogen atom on the hydroxyl-bearing carbon
- Oxidizing agents: Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> (common) or Fremy's salt [(KSO<sub>3</sub>)<sub>2</sub>NO]
- Quinones have oxidation and reduction properties