2: Reactions to Know

1. Addition to Alkenes

- Alkyl halide formation

$$\rightarrow$$
 $\xrightarrow{\text{HX}}$

X = Br, Cl, or I.

Halogen ends up on the more substituted carbon (Markovnikov Addition).

- Alcohol formation: Markovnikov

- Alcohol formation: anti-Markovnikov

$$\begin{array}{c|c} & 1. \text{ BH}_3 \\ \hline & 2. \text{ H}_2\text{O}_2, \\ & \text{OH}^- \end{array} \hspace{0.5cm} \begin{array}{c} \text{H} \\ \text{OH} \end{array} \hspace{0.5cm} \text{(Hydroboration)}$$

- 1,2-Glycol formation (dihydroxylation): syn addition

(anti addition could be achieved through: 1) epoxide formation, followed by 2) epoxide ring opening.)

- Alkane formation (reduction of double bond)

- Bromo(and chloro) ether formation

2. Reduction of Alkynes

- cis-Alkene formation

- trans-Alkene formation

$$\frac{\text{Na}}{\text{NH}_3} \xrightarrow{\text{H}} \text{(cis product formed)}$$

3. Cleavage of Double Bonds

- aldehyde formation

- ketone formation

$$\begin{array}{c|c}
R & 1. O_3 & 2 & R \\
R & 2. Zn/CH_3COOH & R
\end{array}$$
(reductive conditions)

- carboxylic acid formation

R
H
H
$$\frac{1. O_3}{2. H_2O_2, NaOH}$$
 2 R
HO
(oxidative conditions)

4. C-C Bond Formation

- Wittig Reaction

- Grignard Reaction

$$\begin{array}{c} R \\ \hline \\ R \end{array} \begin{array}{c} 1. \ R'MgX \\ \hline \\ 2. \ H_2O \end{array} \begin{array}{c} R \\ \hline \\ R \end{array} \begin{array}{c} R \\ \hline \\ R \end{array} \begin{array}{c} OH \end{array} \qquad \text{(forms alcohols from ketones/aldehydes)}$$

- Alkynylation

R
$$\longrightarrow$$
 H $\xrightarrow{\text{strong base}}$ R \longrightarrow $\stackrel{\bigcirc}{=}$ $\stackrel{\bigcirc}{=}$ M $^{\oplus}$ + Base-H (strong base: nBuLi, NaNH₂, and etc. M=Li or Na, respectively.)

R \longrightarrow $\stackrel{\bigcirc}{=}$ + R'-L \longrightarrow R \longrightarrow R \longrightarrow R' + L $\stackrel{\bigcirc}{=}$ (L=leaving group)

5. Oxidation

- carboxylic acid formation

- ketone/aldehyde formation

ROH
$$R'$$
 H R' H R' R' R' (secondary alcohol) (ketone)

ROH PCC R O (PCC=pyridinium chlorochromate)

H H (primary alcohol) (aldehyde)

6. Reduction

- alcohol formation

$$\begin{array}{c} R \\ RO \end{array}$$

$$\begin{array}{c} LiAIH_4 \\ R'O \end{array}$$

$$\begin{array}{c} R \\ R' \end{array}$$

$$\begin{array}{c} R \\ OH \end{array}$$

7. Functional Group Conversion

- conversion of -OH into a better leaving group

