Catalytic Hydrogenation

H adds to both sides of C=\text{C}

excess hydrogen is always present

syn addition

\[
\text{alkane}
\]

Hydroxylation

OH is added to both sides of C=\text{C}

syn addition

\[
\text{vicinal diol}
\]

Addition of X_2

halogen is added to both sides of C=\text{C}

Cl_2 or Br_2 may be used (diiodides are not very stable)

anti addition

\[
\text{vicinal dihalide}
\]

Addition of X_2 with H_2O

OH is added to more substituted side, halogen to less

Cl_2, Br_2, or I_2 may be used

anti addition

\[
\text{halohydrin}
\]
Epoxidation
reagent may be abbreviated PhCO$_3$H
syn addition

\[ \text{alkene} + \text{PhCO}_3\text{OH} \rightarrow \text{epoxide} \]

Cyclopropanation
carbene is formed in each case
syn addition

\[ \text{alkene} \xrightarrow{\text{CH}_2\text{N}_2, \text{heat or light}} \text{cyclopropane} \]
\[ \text{alkene} \xrightarrow{\text{CH}_2\text{I}_2, \text{Zn, CuCl}} \text{cyclopropane} \]

\[ \text{alkene} \xrightarrow{\text{CHBr}_3, (\text{CH}_3)_3\text{COK}} \text{cyclopropane} \]

Polymerization
acid creates carbocation; peroxide creates radical
carbocation or radical react with another alkene

\[ \text{alkene} \xrightarrow{\text{H}_2\text{SO}_4, \text{heat or light}} \text{polymer} \]
\[ \text{alkene} \xrightarrow{\text{ROOR, heat or light}} \text{polymer} \]

Oxidative cleavage:
cyclic compounds give dicarbonyl compounds
if the C=C is symmetrical, only one product is formed

\[ \text{alkene} \xrightarrow{\text{O}_3, (\text{CH}_3)_2\text{S}} \text{aldehydes and/or ketones} \]
\[ \text{alkene} \xrightarrow{\text{O}_3, \text{H}_2\text{O}_2} \text{carboxylic acids and/or ketones} \]