Types of Chemical Reactions

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5 general types

• Combination/synthesis/addition
• Decomposition/analysis
• Single-Replacement
• Double-Replacement
• Combustion/burning
Combination Reactions

• aka SYNTHESIS or ADDITION reactions
• Two or more substances combine to form a new compound
  \[ A + B \rightarrow AB \]
• Reactants may be elements or compounds
• Examples:
  
  \[ 2 \text{ K} + \text{ Cl}_2 \rightarrow 2\text{KCl} \]
  \[ 3 \text{ S}_\text{(s)} + 3 \text{ O}_2\text{(g)} \rightarrow 2 \text{ SO}_3\text{(g)} \]
  \[ \text{SO}_2\text{(g)} + \text{H}_2\text{O}_\text{(l)} \rightarrow \text{H}_2\text{SO}_3\text{(aq)} \]
Decomposition Reactions

• aka ANALYSIS (splitting apart)
• A compound is split into two simpler compounds or elements
  \[ AB \rightarrow A + B \]
• Often need heat
• Rapid decomposition reaction = explosion
• Example:
  
  heat
  \[ \text{CaCO}_3(s) \quad \overset{\text{heat}}{\rightarrow} \quad \text{CaO}_2(s) + \text{CO}_2(g) \]
Single-Replacement Reactions

• One element is replaced by another in a compound
  
  \[ AB + C \rightarrow CB + A \]

• {Unofficially called the ‘teenager reaction’}

• Examples:
  
  \[ Mg + Zn(NO_3)_2 \rightarrow Mg(NO_3)_2 + Zn \]

  \[ Cl_2 + 2 NaBr \rightarrow 2 NaCl + Br_2 \]
Double-Replacement Reactions

• Involve an exchange of positive and negative ions, usually in aqueous solutions
  \[ AB + CD \rightarrow AD + CB \]

• Examples:
  \[ \text{Na}_2\text{S}_{(aq)} + \text{Cd(NO}_3\text{)}_2_{(aq)} \rightarrow \text{CdS}_{(s)} + 2 \text{NaNO}_3_{(aq)} \]
  \[ \text{Ca(OH)}_2_{(aq)} + 2 \text{HCl}_{(aq)} \rightarrow \text{CaCl}_2_{(aq)} + 2 \text{H}_2\text{O}_{(l)} \]
Combustion Reactions

• Element or compound reacts with O_2, often producing CO_2 + H_2O and releasing heat and/or light
• Commonly called “burning” when a fuel is the reactant
• Many fuels are hydrocarbons (C\text{\textsubscript{x}}H\text{\textsubscript{y}}), such as CH\text{\textsubscript{4}} (methane) or C\text{\textsubscript{2}}H\text{\textsubscript{5}}OH (ethanol)

\[
\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}
\]

\[
\text{C}_2\text{H}_5\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}
\]
2 Important Biochemical Reactions

• Photosynthesis

\[
\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2
\]

• Cell respiration

\[
\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2
\]