Factors Affecting Reaction Rates

Chapter 6.2
Factors Affecting Reaction Rates

1. Chemical Nature
2. Concentration
3. Surface Area
4. Temperature
5. Catalysts
Chemical Nature of Reactants

- The chemical properties of a pure substance (such as reactivity) can affect reaction rate.
- For example: many metals react with oxygen to form metal oxides.

\[
\begin{align*}
\text{Na} + O_2 &\rightarrow \text{Na}_2O \\
\text{Fe} + O_2 &\rightarrow \text{Fe}_2O_3 \\
\text{Au} + O_2 &\rightarrow \text{Au}_2O
\end{align*}
\]
Concentration of Reactants

- Concentration refers to the amount of a substance per unit volume
- It applies to solutions
- As the concentration of reactants increases, the rate of reaction also increases

\[ \text{Mg}_\text{(s)} + \text{HCl}_\text{(aq)} \rightarrow \text{MgCl}_\text{2(aq)} + \text{H}_2\text{(g)} \]

0.5 M HCl

1.0 M HCl
But we *already* know this...

\[ C_4H_9Cl_{(aq)} + H_2O_{(l)} \rightarrow C_4H_9OH_{(aq)} + HCl_{(aq)} \]
Surface Area

- Surface area is the total area of all of the surfaces of a solid figure.
- It applies to solids.
- As surface area increases, the rate of reaction also increases.

\[
\text{Surface area of 2 cm cube} = 6 \times (2 \times 2) \text{ cm}^2 = 24 \text{ cm}^2
\]

\[
\text{Surface area of 1 cm cube} = 8 \times (6 \times (1 \times 1)) \text{ cm}^2 = 48 \text{ cm}^2
\]
Temperature of the Reaction System

• As temperature increases, the rate of reaction also increases
Presence of a Catalyst

• A **catalyst** is a substance that alters the rate of a chemical reaction without itself being permanently changed.

![MnO₂ catalyst diagram](image)

\[
2\text{H}_2\text{O}_2 \xrightarrow{\text{MnO}_2} 2\text{H}_2\text{O} + \text{O}_2
\]

hydrogen peroxide \hspace{2cm} MnO₂ \hspace{2cm} water \hspace{2cm} oxygen

• Manganese dioxide (solid) is a **heterogeneous catalyst** because it is in a different phase than the reactants (liquid hydrogen peroxide).

• **Homogeneous catalysts** are in the same phase as the reactants.

• A **biological catalyst** (or biocatalyst) is a catalyst made by a living system.

• Most biological catalysts are large protein molecules called enzymes (ex: lactase is an enzyme used to digest milk sugar).
HOMEWORK

Required Reading:
   p. 362-365
(remember to supplement your notes!)

Questions:
   p. 365 #1-5