6.1 Rate of Reaction

- Reaction rates vary from the formation of stalagmites (calcium carbonate) to the nearly instantaneous reaction of exploding dynamite.
- We want to speed up some reactions like the drying of paint. We also want to slow down some reactions like the corrosion of metals.
- The study of reaction rates is called Chemical Kinetics.
- The study of determining if a reaction will occur is called Thermodynamics

Describing Reaction Rates

- The rate of a chemical reaction is defined as the change in concentration of a specific reactant or a specific product per unit time.
- Standard Unit = mol/L·s (or mL/s if volumes of gas are produced)
- E.g. $2A + B \rightarrow AB$

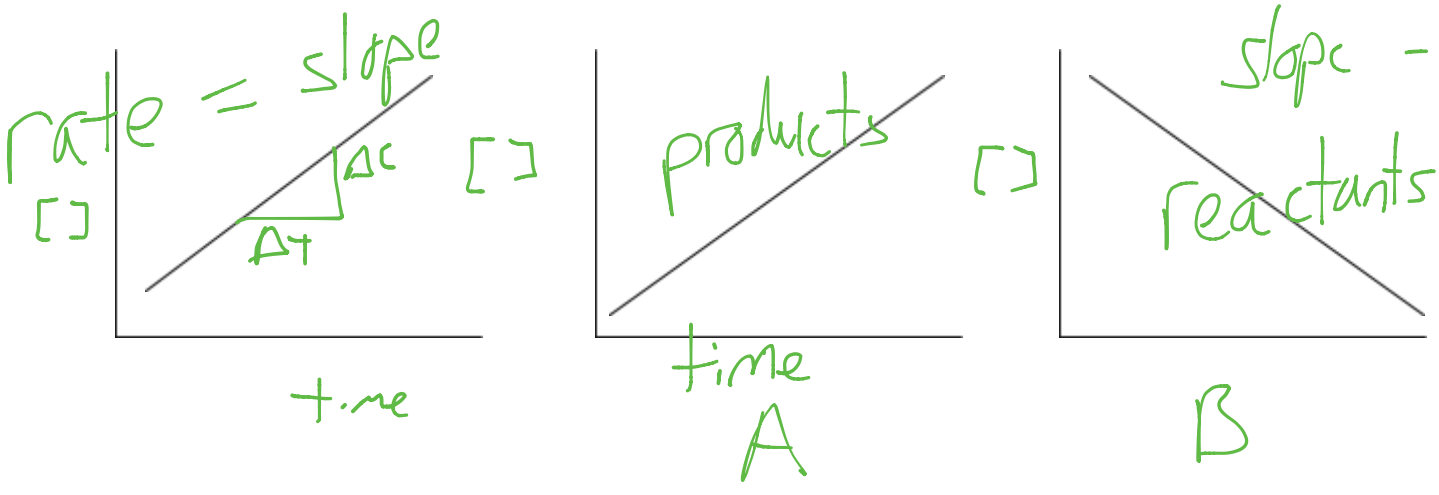
$$\text{rate} = \frac{\text{decrease in [A]}}{\text{time}}$$

square brackets mean "concentration of"

Note: Rate of reaction is always positive.

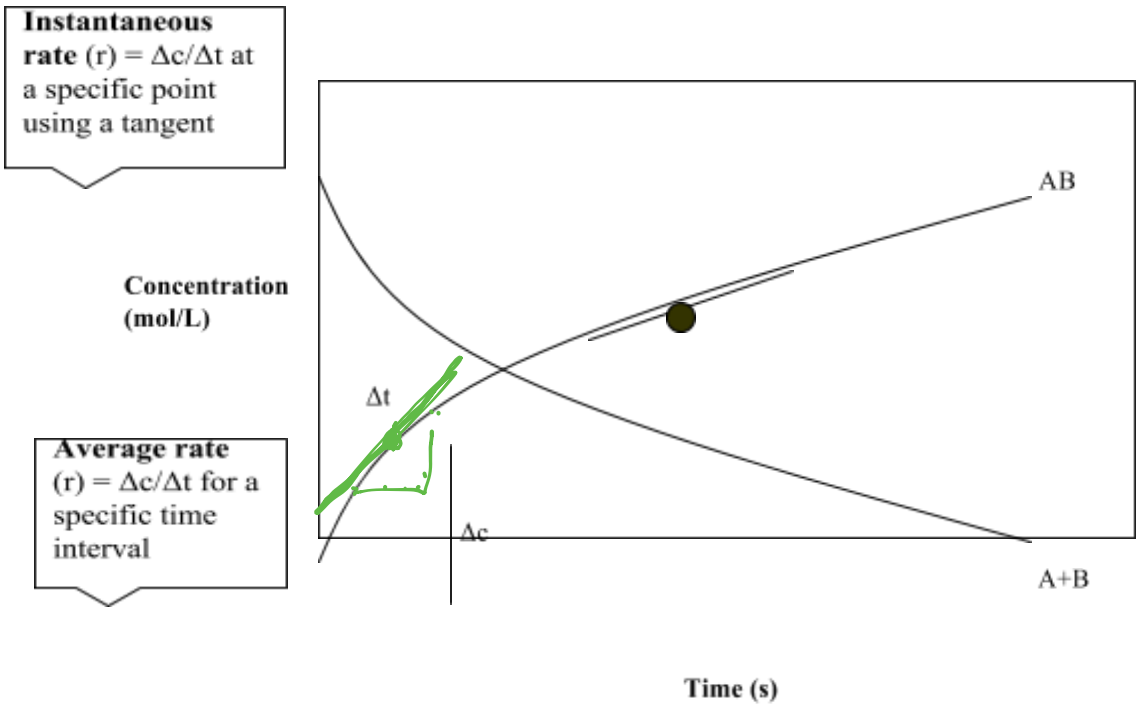
$$r = \frac{\text{change in concentration}}{\textbf{elapsed time}} = \frac{\Delta c}{\Delta t}$$

- A reaction rate with respect to a reactant will be negative
- A reaction rate with respect to a product will be positive
- A reaction rate is also connected to the coefficients of a balanced chemical equation
- Examples of common rates – (looks like displacement / velocity / acceleration)



- Rates are usually determined at the beginning of a reaction due to the maximum amount of reactant present (max. collisions/sec.) Collision Theory is very important for understanding rates. (chapter 6.4)
- Most reaction rates change over time
- Rates are determined experimentally using many observations creating a graph and then calculating the slope at particular instances

Reaction: A + B □ AB



Measuring Reaction Rates

- Reaction rates can be measured by directly measuring changes in concentration of the components or by measuring changes in concentration-related properties such as colour, density, electric conductivity, volume and pressure.

- Atomic absorption spectrometers, spectrophotometers, conductivity meters, and gas chromatographs are the favourite tools for measuring concentration.

Homework: Practice 1,2,3,4,5,6,7,8,11 and Questions 1,2

6.2 Factors Affecting Reaction Rates

- Nature of Reactants: Reactions between simple ions are almost instantaneous; reactions between more complex ions take longer.

- Concentration of the Reactants: The rate of reaction increases as the concentrations of the reactants increase.

- Temperature: Reactions occur faster at higher temperatures. In general a 10ºC increase in temperature doubles the reaction rate.

- Catalysts: A catalyst is any reagent that increases the rate of reaction but is not consumed during the reaction.

- Surface Area: Increasing the surface area of the solid phase of a heterogeneous reaction increases the rate of the reaction.

Homework: **Practice 1,2,3,4** **Questions 1,2**

6.1 Rate of Reaction

- Reaction rates vary from the formation of stalagmites (calcium carbonate) to the nearly instantaneous reaction of exploding dynamite.
- We want to speed up some reactions like the drying of paint. We also want to slow down some reactions like the corrosion of metals.
- The study of reaction rates is called Chemical Kinetics.
- The study of how or why a reaction occurs.

Describing Reaction Rates

- The rate of a chemical reaction is defined as the change in concentration of a specific reactant or a specific product per unit time.
- Unit = mol/L·s (or mL/s if volumes of gas are produced)

- E.g. $A + B \rightarrow AB$

square brackets mean "concentration of"

$$\text{rate} = \frac{\text{decrease in [A]}}{\text{time}}$$

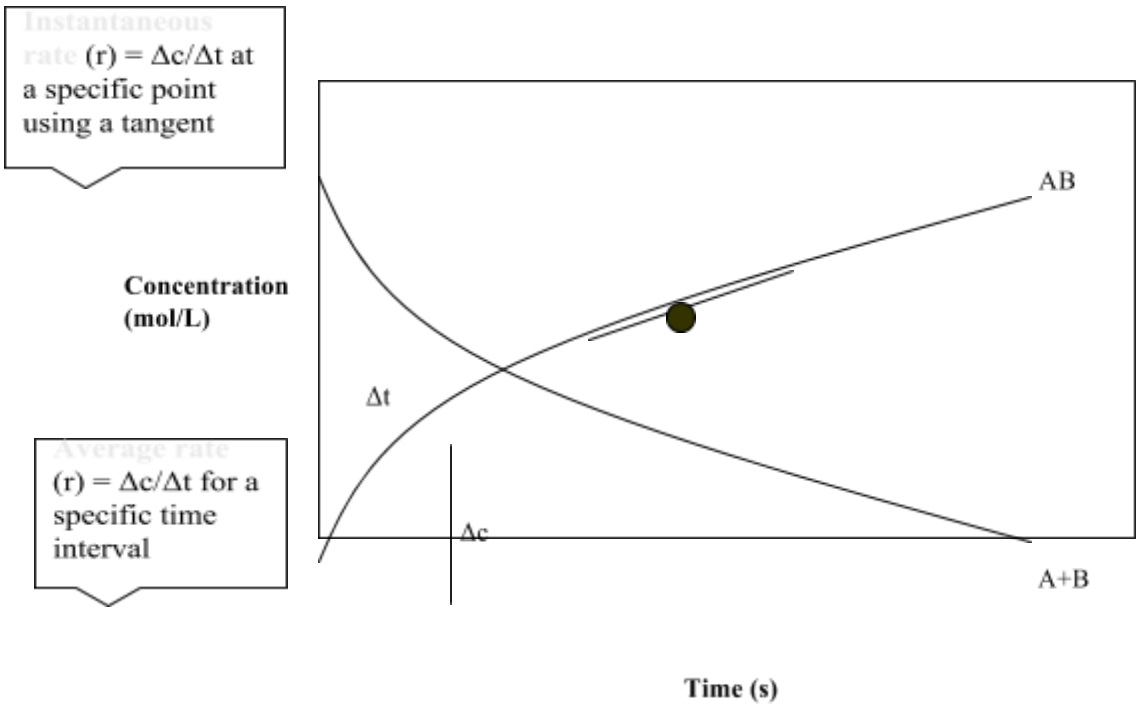
Note: Rate of reaction is always positive.

$$r = \frac{\text{change in concentration}}{\textbf{elapsed time}} = \frac{\Delta c}{\Delta t}$$

- A reaction rate with respect to a reactant will be negative
- A reaction rate with respect to a product will be positive
- A reaction rate is also connected to the coefficients of a balanced chemical equation
- Examples of common rates – (looks like displacement / velocity / acceleration)

- Rates are usually determined at the beginning of a reaction due to the maximum amount of reactant present (max. collisions/sec.) Collision Theory is very important for understanding rates. (chapter 6.4)
- Most reaction rates change over time
- Rates are determined experimentally using many observations creating a graph and then calculating the slope at particular instances

Reaction: A + B □ AB



Measuring Reaction Rates

- Reaction rates can be measured by directly measuring changes in concentration of the components or by measuring changes in concentration-related properties such as colour, density, electric conductivity, volume and pressure.

- Atomic absorption spectrometers, spectrophotometers, conductivity meters, and gas chromatographs are the favourite tools for measuring concentration.

Homework: Practice 1,2,3,4,5,6,7,8,11 and Questions 1,2

6.2 Factors Affecting Reaction Rates

- Nature of Reactants: Reactions between simple ions are almost instantaneous; reactions between more complex ions take longer.

- Concentration of the Reactants: The rate of reaction increases as the concentrations of the reactants increase.

- Temperature: Reactions occur faster at higher temperatures. In general a 10ºC increase in temperature doubles the reaction rate.

- Catalysts: A catalyst is any reagent that increases the rate of reaction but is not consumed during the reaction.

- Surface Area: Increasing the surface area of the solid phase of a heterogeneous reaction increases the rate of the reaction.

Homework: Practice 1,2,3,4 Questions 1,2