

Introduction to KINETICS

Overall Concept

Chemical reaction rates depend on the factors that influence the frequency of collision of the reactant molecules

Background Knowledge:

1. Write a balanced equation for the combustion of methane, CH_4 .
2. Which has more surface area; a sugar cube or powdered sugar? (assume equal mass)
3. Enzymes are catalysts that drive biological reactions. Why are enzymes necessary?
4. What is the "building block" for each of the following types of organic molecules?
 - a. Carbohydrate:
 - b. Protein:
 - c. Lipid:

Part 1: Collision Theory

Objective: Students understand that chemical reactions are not instantaneous because molecules must collide with sufficient energy and in the proper orientation in order to react with one another.

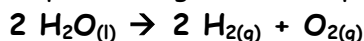
Conclusion:

Part 2: Measurements that Indicate Reaction Rate

Objective: Students know the rate of reaction is the decrease in concentration of the reactants or the increase in concentration of products with time.

Q: You own a deli that makes the best cheese sandwiches in town! How could you determine the productivity of your employees?

Example: In the following reaction representing the decomposition of water,



1. The rate of the reaction is best described as:

- | | |
|------------------------------------------------------|----------------------------------------------|
| a. the rate at which H_2O disappears | c. the rate at which H_2 disappears |
| b. the rate at which O_2 disappears | d. all of the above |

2. In the space below, draw a graph that represents the relative amounts of reactants and products over time. Label time on the x-axis and concentration on the y-axis.

Part 3: Factors that Affect Reaction Rate

Objective: Students know reaction rates depend on such factors as the concentration, temperature, and pressure.

I. Concentration of Reactants:

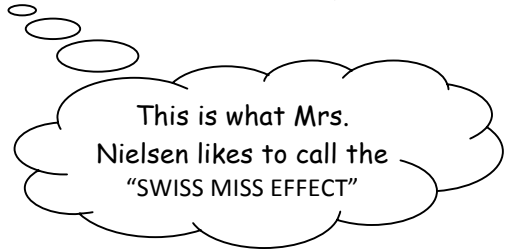
Q: Which will burn more rapidly; a log in Earth's atmosphere (78% N_2 , 21% O_2 , 1% other gases) or a log in an atmosphere of pure oxygen?

Why?

II. Temperature:

Q: Which dissolves more rapidly; chocolate powder in hot water or chocolate powder in cold water?

Why?



III. Pressure:

Q: Are there more traffic collisions on crowded freeways or less crowded freeways? (assume the cars are traveling at the same speed in each situation)

Why?

Conclusion:

Examples:

- _____ 1) Which of the following will dissolve most rapidly?
- a. powdered sugar in hot water
 - b. powdered sugar in cold water
 - c. a sugar cube in hot water
 - d. a sugar cube in cold water
- _____ 2) Which of the following will increase the rate of a reaction involving gases?
- a. decreasing the volume of the container
 - b. decreasing the temperature
 - c. increasing the volume of the container
 - d. decreasing the concentration of reactants

Part 4: Understanding Energy Diagrams

Objective: Students know the definition and role of the activation energy in a chemical reaction.

Activation Energy:

Label the key parts of the energy diagram below:

- *Reactants
- *Products
- *Activation Energy

Example: In the space below, draw an energy diagram that accurately represents the following:

- Energy of Reactants: 10 kJ
- Energy of Products: 50 kJ
- Activation Energy (forward reaction): 70 kJ
- Activation Energy (reverse reaction): 30 kJ

Part 4: The Role of Catalysts

Objective: Students know the role a catalyst plays in increasing the reaction rate

- * Catalysts in biological systems are called _____.
- * As a macromolecule, biological catalysts are classified as _____, and therefore are made up of _____.
- * Catalysts act by lowering the _____ of a reaction.

Example: On the energy diagram below, draw the effect of adding a catalyst.

1. Write the overall equation for this reaction.

2. How much energy do the reactants have?

3. How much energy do the products of this reaction have?

4. What is the activation energy (forward reaction)
 - without a catalyst?

 - with a catalyst?

5. What is the activation energy (reverse reaction)
 - without a catalyst?

 - with a catalyst?