ScienceCube

Reaction Rate According to Concentration

1. **Explain the reaction process between metal and acid.**
2. **Compare and explain the reaction rate according to the concentration of acid**

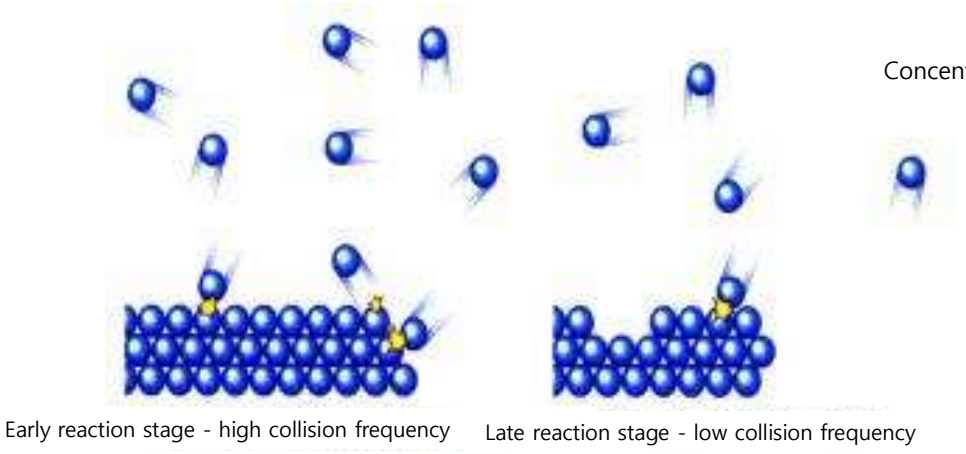
Fundamental Concept

1. Definition of Reaction Rate

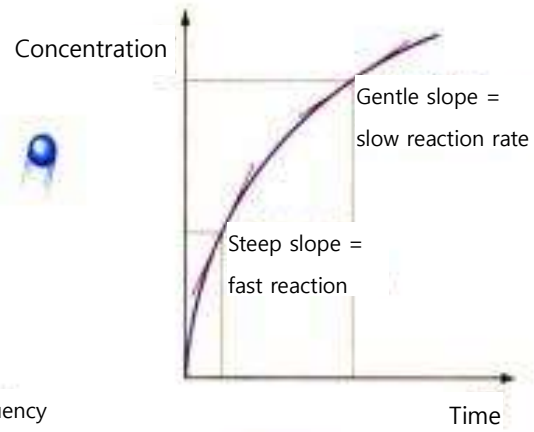
(1) The degree to which a chemical reaction occurs quickly or slowly.

(2) In gas-generating reactions, it is expressed in mL/s, mL/min, etc., and in reactions where mass changes, it is expressed in g/s, g/min, etc.

(3) The slope of the tangent on the concentration change graph over time represents the reaction rate.



Reaction rate and collision frequency



Reaction rate and concentration of products

2. Factors Affecting Reaction Rate

(1) Concentration and Reaction Rate

- Definition: Number of particles per unit volume.

- Amount of solute in the solution

- For gases, pressure represents concentration: The more gas molecules in the same volume, the higher the pressure..

- The higher the concentration of reactants, the faster the reaction rate. This is because the number of particles per unit volume increases, leading to more

Increase in concentration → Increase in the number of particles → Increase in the number of collisions → Increase in the number of effective collisions → Increase in reaction rate

(2) Gas Pressure and Reaction Rate

Applying high pressure decreases the volume, bringing particles closer together and increasing the frequency of collisions, thereby increasing the reaction rate

Increase in external pressure → Decrease in volume → Effect of increasing concentration per unit volume → Increase in reaction rate

(3) Surface Area and Reaction Rate

- Applies to reactions between solids and liquids, and solids and gases.

- For a solid with a constant mass, increasing the surface area increases the reaction rate.

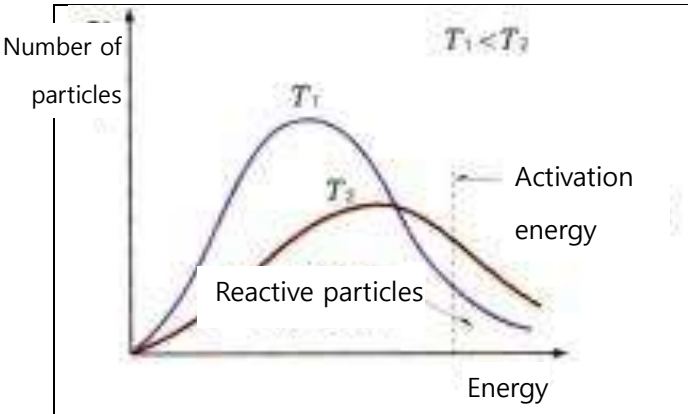
Increase in surface area → Increase in contact area between reactants → Increase in the number of collisions → Increase in reaction rate

(4) Temperature and Reaction Rate

- As temperature increases, the speed of molecular motion increases, and so does

the kinetic energy, leading to more frequent collisions between molecules..

Increase in temperature → Increase in the number of particles with energy above activation energy → Increase in reaction rate



Temperature and Activation Energy

Changing the temperature increases the number of particles reaching the activation energy but does not change the total number of particles or the activation energy itself.

Increasing the temperature increases the number of effective collisions and the reaction rate

Experiment

Materials Needed

Interface, Science# Program, 2 gas pressure sensors (B), 2 250 mL flasks with side arm, approximately 20 cm silicone tube, 2 rubber stoppers (size 10), magnesium ribbon, dilute hydrochloric acid (1M, 2M), marker,

Preparation of Experimental Apparatus

1. Connect the gas pressure sensor and the side arm of the flask using the silicone tube.

2. Prepare 1.0M and 2.0M dilute hydrochloric acid, and cut two pieces of magnesium ribbon, each 5 cm long.
3. Add 150 mL of 1.0M and 2.0M dilute hydrochloric acid to the two flasks with side arms, respectively.
4. Seal the flasks with rubber stoppers and mark the position where the rubber stopper is inserted with a marker.

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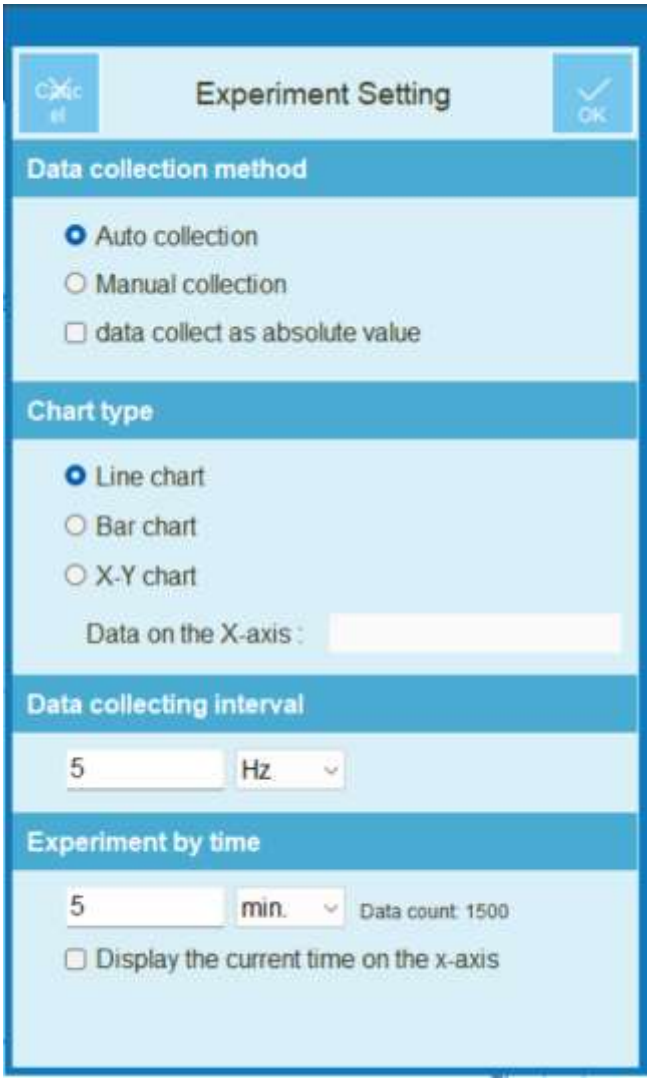
Interface Setup

1. Run the Science# program.
2. Connect the two gas pressure sensors to the interface.
3. Click to set up the experimental environment as shown below or click to automatically set up



4. Click  to zero the two gas pressure sensors.

Data Collection

1. Click  to start data collection.
2. Open the rubber stopper, place the prepared magnesium ribbon into each flask containing dilute hydrochloric acid, and seal tightly with the rubber stopper, pressing it to the marked position.
3. Once the reaction of the magnesium ribbon is complete, click  the stop button to end the experiment.

Data Analysis

Recording Data

1. Plot and compare the changes in gas pressure inside the flasks when magnesium ribbon is added to 1.0M and 2.0M dilute hydrochloric acid.

2. Record the changes in gas pressure inside the flasks when magnesium ribbon is added to 1.0M and 2.0M dilute hydrochloric acid in the table below..

Category	1.0M Dilute Hydrochloric Acid	2.0M Dilute Hydrochloric Acid
Initial Gas Pressure in Flask (hPa)		
Final Gas Pressure in Flask (hPa)		
Change (hPa)		
Time to Reach Maximum Value (s)		

- Collected data can be analyzed in both graph and table formats.

Data Application

1. How does the slope of the graph change as the concentration of dilute hydrochloric acid increases?

2. Explain what the slope of the graph represents.

3. Describe why the change in gas pressure inside the flask varies according to the concentration of dilute hydrochloric acid.

4. Describe how the slope of the graph changes over time and explain the reason.