

Rate of Reactions

An Inquiry Approach

Background Information

The rate of a chemical reaction describes how fast the reaction occurs. How can the rate of a reaction be measured? What effect does temperature have on the rate of a chemical reaction?

Concepts

- Reaction Rate
- Kinetic theory
- Temperature
- Collision theory

Background

The greater the rate of a chemical reaction, the less time is needed for a specific amount of reactants to be converted to products. This is analogous to “the greater the rate or speed of a car, the less time is needed to get someplace.” The rate of a reaction can be determined therefore by observing either the disappearance of reactants or the appearance of products as a function of time. Some of the factors that may affect the rates of chemical reactions include the nature of the reactant, the concentration of the reactant, the reaction temperature, the surface area of a solid reactant, and the presence of a catalyst. In this experiment, the effect of temperature on the rate of a chemical reaction will be investigated.

Beginning Question

How do we determine the effect of temperature on the rate of reaction of magnesium with hydrochloric acid?

Pre-Lab Questions

1. Write the balanced equation for the reaction of magnesium metal with hydrochloric acid.
2. What visible signs of reaction should be observed as the reaction proceeds? How will you be able to determine when the reaction has ended?
3. What measurements must be made to determine the effect of temperature on the rate of the reaction?
4. The independent variable in an experiment is the variable that is changed by the experimenter, while the dependent variable responds to (depends on) changes in the independent variable. Choose the dependent and independent variables for this experiment.
5. What other variables will affect the reaction times in this experiment? How can these variables be controlled?
6. If a 4-cm strip of magnesium ribbon is used in one reaction trial, and if 1 meter of magnesium ribbon weighs 7.5 g, how many moles of magnesium are used in one trial?
7. How many trials should be run to get a reliable straight line of temperature versus rate?

8. Read the *Materials* section. Write a step-by-step procedure for the experiment, including the specific safety precautions that must be followed.

Materials

Copper wire, 18-gauge, 20-cm length* , Ice, Hydrochloric acid, HCl, 1 M, Metric ruler, Magnesium ribbon, Mg, 24-cm strip ☺ Stopwatch/timer/cell phone, 3 Beakers, 250 or 400-mL, Test tube rack, Graduated cylinder, 25mL, Test tubes, medium, Hot plate or burner, Thermometer

*Build copper wire "cages" to keep the magnesium suspended in the hydrochloric acid and to prevent it from floating. The copper wire will not react with the acid.

☺ Cut into smaller, equal-length pieces for the experiment

Procedure Guidelines

1. Verify the procedure with your instructor and review all safety precautions.
2. Carry out the procedure and record all data in a suitable data table.
3. Keep the amount of magnesium strip consistent for each trial. No more than 2 cm per trial.
4. NO HEATING HCl on hot plate or burner. HCl must be heated SAFELY putting a TT of your sample into a beaker of hot water. Make an ice bath for your cold temperature and put a TT of your sample in it. Both TT must reach THERMAL EQUILIBRIUM, so let them sit for 5 minutes each.
5. The maximum volume of HCl will be 10.0 mL.

Reading, Errors, & Reflection

1. Calculate the average reaction rate of the reaction and the temperature.
2. Write a paragraph describing how temperature affects the rate of a chemical reaction. Include a discussion of the possible errors involved in the experiment and their effect on the results.
3. The collision theory of reaction rates states that the rate of a reaction depends on the number of collisions between molecules, the average energy of the collisions, and the effectiveness of the collisions. Does the effect of temperature on the reaction rate support the collision theory of reaction rates? Explain.

Resources:

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