# Pre-Lab Information

Purpose Explore the rate of a chemical reaction at different temperatures and with different reactant particle sizes.

Time Approximately 45 minutes

Question What are the effects of temperature and a reactant’s particle size on reaction rate?

Hypothesis 1 If you increase the temperature of a reaction, then the reaction rate will increase because particles experience more collisions at higher temperatures.

Hypothesis 2 If you decrease the particle size of a reactant, then the reaction rate will increase because more of the reactants’ surface area is exposed allowing more particles to make contact with each other.

Variables Independent variables: particle size, temperature   
Dependent variable: reaction rate

Summary The reaction between effervescent tablets and water will produces CO2 gas, which you can observe in the form of bubbles; when the bubbling stops, the reaction is complete. You will measure the reaction times and rates for tablets dissolved at four temperatures and broken into three different particle sizes.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Behavior in the lab needs to be purposeful. Use caution when using the hot plate, as it can cause burns.
* Check glassware such as graduated cylinders and beakers for cracks and chips prior to use.
* Use the right gear, such as chemically resistant gloves and oven mitts, when performing the experiment.
* Report all accidents—no matter how big or small—to your teacher.

# Procedure

1. **Gather Materials**

|  |  |
| --- | --- |
| * 250 mL graduated cylinder * Thermometer * Water * Timer * Four 250 mL beakers | * Seven 1,000 mg effervescent tablets * Two pieces of filter paper * 600 mL beaker * Ice * Hot plate |

**Variation of Temperature**

1. **Measure the Reaction Rate at ≈ 20°C (Room Temperature)**
   1. Using a graduated cylinder, fill a 250 mL beaker with 200 mL of water.
   2. Measure the temperature of the water and record it in the correct row of Table A.
   3. Reset the timer. Start the timer as you place a full tablet into the beaker.
   4. Record the reaction time on the Data Sheet in the correct row of Table A.
   5. Compute the reaction rate to the nearest mg/L/sec. Record it in the last column of Table A.
2. **Measure the Reaction Rate at ≈ 40°C**

Repeat Step 2, heating the water to approximately 40°C using a hot plate during sub-step **a**.

1. **Measure the Reaction Rate at ≈ 65°C**

Repeat Step 2, heating the water to approximately 65°C using a hot plate during sub-step **a**.

1. **Measure the Reaction Rate at ≈ 5°C**

Repeat Step 2, chilling the water to approximately 5°C inside an ice bath during sub-step **a**.   
(To create an ice bath, place 100 mL of ice and 100 mL of water in a 600 mL beaker of ice water and wait until the temperature reaches approximately 5°C. To save time, you may wish   
to set up the ice bath, using an additional 250 mL beaker, while working on Step 4.)

**Variation of Particle Size**

1. **Measure the Reaction Rate for a Full Tablet**
   1. Using a graduated cylinder, fill a 250 mL beaker with 200 mL of water.
   2. Reset the timer. Start the timer as you place the tablet in the beaker.
   3. Record the reaction time on the Data Sheet in the appropriate row of Table B.
   4. Compute the reaction rate to the nearest mg/L/sec. Record it in the last column of Table B.
2. **Measure the Reaction Rate for a Partially Broken Tablet**

Repeat Step 6, but this time break the tablet into eight small pieces on a piece of filter paper. Make sure to place all of the pieces into the beaker at the same time.

1. **Measure the Reaction Rate for a Crushed Tablet**

Repeat Step 6, but this time crush the tablet into tiny pieces on a piece of filter paper. Make sure to place all of the pieces into the beaker at the same time.

**Clean-Up**

1. Dispose of all samples according to your teacher’s directions.

# Data

Record your data either in your lab notebook or in the space below.

\*Reaction rate is usually computed as a change in concentration (e.g., molarity) per change in time. The tablet is not pure NaHCO3, so the molarity cannot be computed accurately. (In addition, the quantities in this lab are quite small, and the resulting values would be small decimal values.) Instead, compute the following as a measurement of reaction rate.

Reaction rate = 

**Table A: Variation of Temperature**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Measured Reaction** **Temperature (°C)** | **Mass of Tablet  (mg)** | **Volume of Water  (L)** | **Reaction Time (s)** | **Reaction Rate\*** **(mg/L/sec)** |
| **≈ 20°C** |  | 1,000 | 0.2 |  |  |
| **≈ 40°C** |  | 1,000 | 0.2 |  |  |
| **≈ 65°C** |  | 1,000 | 0.2 |  |  |
| **≈ 5°C** |  | 1,000 | 0.2 |  |  |

**Table B: Variation of Particle Size (All at Room Temperature)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Relative Particle Size (Small, Medium, Large)** | **Mass of Tablet  (mg)** | **Volume of Water  (L)** | **Reaction Time (s)** | **Reaction Rate\*** **(mg/L/sec)** |
| **Full  Tablet** |  | 1,000 | 0.2 |  |  |
| **Broken Tablet** |  | 1,000 | 0.2 |  |  |
| **Crushed Tablet** |  | 1,000 | 0.2 |  |  |