Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pd: \_\_\_\_\_ Ast: \_\_\_\_\_

**Controlling Chemical Reactions Investigation**

**INTRODUCTION:** A **chemical reaction** transforms one set of chemical substances into another by breaking existing **chemical bonds** and creating new ones. This is the process that occurs when you drop an Alka-Seltzer tablet into water. As the tablet “dissolves”, carbon dioxide gas is released, indicating that a chemical reaction occurred.



*Figure 1 – A chemical reaction between Alka-seltzer and water.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C6H8O7 | + | 3NaHCO3 | → | 3H2O | + | 3CO2 | + | Na3C6H5O7 |
| [*citric acid*](http://en.wikipedia.org/wiki/Citric_acid) | *+* | [*baking*](http://en.wikipedia.org/wiki/Sodium_bicarbonate) *soda* | *→* | [*water*](http://en.wikipedia.org/wiki/Water) | *+* | [*carbon dioxide*](http://en.wikipedia.org/wiki/Carbon_dioxide) | *+* | [*sodium citrate*](http://en.wikipedia.org/wiki/Trisodium_citrate) |

The release of gas from an **aqueous** (water based) solution is called **effervescence**.

Chemists are often concerned with controlling the rate (speed) of a chemical reaction. This can be done by changing certain factors such as concentration, **temperature**, and exposed surface area. In this investigation, we will focus on the effects of temperature on a chemical reaction. Remember that temperature is a measure of the **average kinetic energy** of the molecules in a substance; or simply, how fast the molecules are moving. When the temperature of the reactants is increased, their molecules move faster and come into contact more often. When the temperature of the reactants is decreased, however, the molecules move slower and collide less frequently.

**YOUR TASK:** Perform a **controlled** **experiment** to determine the how the temperature of water affects its reaction with the Alka-Seltzer.

The guiding question of this investigation is: ***How does the temperature of the reactants affect the rate of a chemical reaction?***

**MATERIALS:** You will have access to the following materials during your investigation:

* Safety Goggles (*1 each*)
* Plastic Bottles (*3*)
* Alka-Seltzer Tablets (*6*)
* 12” Balloons (*3*)
* Cold Water (*cooler*)
* Room Temp Water (*cooler*)
* Warm Water (*sink*)
* Mortar & Pestle (*1*)
* Plastic Funnel (*1*)

**SAFETY PRECAUTIONS:**

* Wear lab goggles.
* Treat warm water carefully.
* Do not taste the tablets or the water.
* Clean up spills immediately

**PROCEDURES:**

1. Gather your materials. Each group member **MUST WEAR EYE PROTECTION** for the duration of the lab.
2. Remove two Alka-Seltzer tablets from their packaging and place them in the mortar.
3. Use the pestle to *gently* grind the tablets into a powder.
4. Insert the funnel into a balloon and pour all of the powder into the bottom of the balloon.
5. Repeat steps 2-5 for the other two balloons.
6. Fill the 3 plastic bottles with different temperatures of water up to the line drawn at the top of the bottle.
	1. Fill bottle A with cold water from the cooler marked “COLD”.
	2. Fill bottle B with room temperature water from the cooler marked “ROOM”.
	3. Fill bottle C with warm water from the sink. Turn the knob on the left and allow the water to get warm. Be careful not to burn your hand with the warm water (don’t let it get too hot).
7. Carefully place the balloons on the neck of each bottle without spilling the powder into the water.
	1. One group member needs to hold the bottle steady while another group member stretches the neck of the balloon over the neck of the bottle.
8. Line up the 3 bottles next to one another and prepare to begin the reaction.
9. Simultaneously empty the powder from each balloon into the bottles. **The powder MUST be poured into all three bottles at the same time in order to compare the rates of the reaction!**
10. Observe the rate at which the balloons blow up with the gas produced from the reaction. Record your observations on the data sheet on the back of this paper.

**Respond to the following items as you complete the investigation.**

1. Make a prediction about which temperature water will cause the fastest reaction and which will cause the slowest reaction. Explain your reasoning.
2. During the lab, record your observations in the table below.

|  |  |
| --- | --- |
| **Water Temperature** | **Observations During the Reaction** |
| A – Cold Water |  |
| B – Room Temp. Water |  |
| C – Warm Water |  |

1. Based on your observations, how does the temperature of the reactants affect the rate of a chemical reaction?
2. How does the temperature of the water affect the motion of the water molecules?
3. Explain how the motion of the water molecules influences the speed of the chemical reaction?