Name:________________

Lab: Temperature & Chemical Weathering

Background: Whether it's the granite of a New Hampshire mountain breaking down into sand and clay or the limestone of Kentucky decomposing to form rich soil, all chemical weathering processes involve water. What effect does the temperature of the water have on the rate at which chemical weathering occurs?

As you know, carbonic acid is a weak acid that forms when carbon dioxide dissolves naturally in rain, in streams, or in groundwater. A common chemical weathering process is the reaction between carbonate rocks, such as limestone and marble, with carbonic acid. In this lab activity, you will observe a model of this reaction. By changing the temperature of the water, you can model the effect of the temperature on the rate of the reaction between carbonate rocks and carbonic acid.

Procedure:

1. Arrange 5 beakers in a row. Assign each beaker a number from 1 to 5. Add 200 mL of water to each beaker. The water temperature in each beaker will need to be adjusted to fall within the following temperatures (use ice or hot H_2O as needed to make adjustments). Remove any pieces of ice before beginning the experiment.
   - Beaker 1: 0^o – 10^oC
   - Beaker 2: 10^o – 20^oC
   - Beaker 3: 20^o – 30^oC
   - Beaker 4: 30^o – 40^oC
   - Beaker 5: 40^o – 50^oC
2. Record the exact temperature of each beaker in DATA TABLE A – OBSERVED DATA.
3. Drop one of the antacid tablets into beaker 1. Start the stopwatch at the instant the tablet enters the water. Stop the stopwatch when the last piece of the tablet dissolves. (It is not necessary to wait for all of the bubbling to stop; wait only for all pieces of the tablet to disappear.) Read the time on the stopwatch. Record the time in DATA TABLE A to the nearest whole second on Data Table A.
4. Repeat steps 2 and 3 for each of the remaining beakers.
5. Copy the temperature and time data for Beaker 1 from Data Table A to DATA TABLE B – THEORETICAL DATA. Then add 10^o C to the temperature reading for Beaker 1 and record that as the temperature for Beaker 2. In the same way, continue to add 10^oC to each temperature reading for Beakers 3, 4 and 5.
6. For the time values on Data Table B, divide each reading in half to get the next reading. For example, the time for Beaker 2 will be one half the time for Beaker 1 and so on. When you divide the values, round to the nearest whole second.
7. Create a graph (on graph paper!) of the data for the 5 trials. The x-axis will be Temperature (^oC) and the y axis will be Time (sec). Connect the 5 points with a smooth curve. Label the curve OBSERVED DATA.
8. On the same graph, plot the values from Data Table B. Connect the points with a smooth curve. Label this curve THEORETICAL DATA.

DATA TABLE A – OBSERVED DATA

Beaker Number	Temperature (°C)	Time (seconds)
1		
2		
3		
4		
5		

Class Copy
Use your own paper

DATA TABLE B – THEORETICAL DATA

Beaker Number	Temperature (°C)	Time (seconds)
1		
2		
3		
4		
5		

Class Copy
Use your own paper

Analysis Questions:

1. What do you think is the relationship between the temperature and the rate of reaction?

2. This experiment simulates the chemical weathering of limestone by hydrolysis. What is hydrolysis?

3. What is the relationship between the temperature and the rate of natural chemical weathering?

4. Are all of the temperatures recorded in this lab likely to occur on Earth's surface? EXPLAIN.

5. Would a limestone building weather more rapidly in Alaska or Hawaii? EXPLAIN your answer.

6. Which of the areas in Question 5 would have thicker soil? WHY?

7. How would the rate of the reaction have been different if the tablets had been ground into a powder before they were dropped into the water? WHY would this make a difference?

8. Would a graph for the reaction described in question 7 result in a curve above or below the line of your observed data? WHY?

9. List three factors that might change the surface area of rocks. How would these affect weathering rate?

10. On your graph, is the line for the theoretical data above, below, or the same as your line for the observed data? What does this mean about the rate of the reaction you observed compared with the theoretical rate of reaction? What change in the procedure might have made your observed results more like the theoretical results?

11. Many historic buildings are facing the dissolution of the once finely chiseled features on the sculptures. Historic cemeteries are also facing this problem on tombstones. EXPLAIN the process at work here.

12. Describe how you would design an experiment to explore the effects of various strengths of acid solutions would have on the rate of chemical weathering.