MiSP Chemical Reactions Concentration Lab L2

Name ______________________________ Date _____________

"Plop, Plop, Fizz, Fizz" ... Concentration and Rate of Reaction Activity

Introduction:

Baking soda (sodium bicarbonate – Na_2CO_3) in an acid solution like vinegar produces carbon dioxide. When the reaction occurs in a closed container (a film canister is used in this lab), the gas pressure builds up until the lid "pops." The faster the chemical reaction, the faster the carbon dioxide gas pressure builds up, and the shorter the time until the lid pops. In other words, if two reactions in film canisters are compared, the one that pops in the shortest time is the one with the fastest rate of reaction.

Problem:

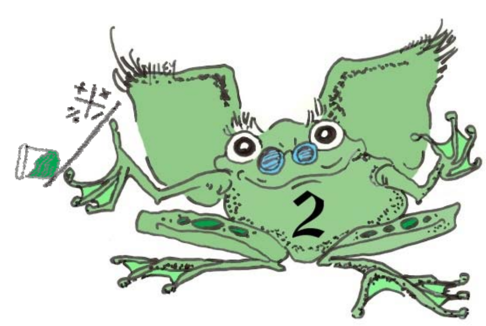
How does concentration affect the time of (and the rate of) a chemical reaction?

Hypothesis (complete sentence below):

If concentration affects the rate of a chemical reaction, then increasing the concentration of vinegar will cause the baking soda reaction to ______________________________

____.

Safety notes: GOGGLES SHOULD BE WORN. All precautions for safe handling of chemicals should be followed.



Materials:

- 1 timer
- 1 film canister with cap
- 1 25 ml, 50 ml, or 100 ml graduated cylinder
- 1 tray
- 1 waste beaker

Chemicals:

- Sodium bicarbonate (baking soda)
- Stock solutions of 75% distilled white vinegar, 50%, and 25%

Procedures:

Do your work on the tray to help control spills. Check off each step as you complete it.

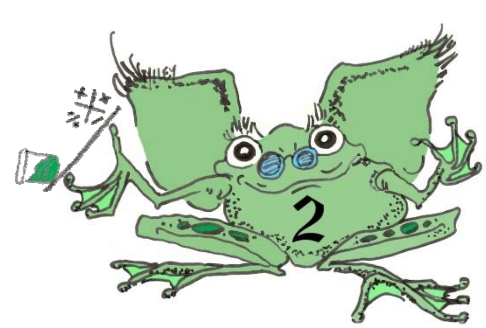
☐ 1. Measure 0.3 g of sodium bicarbonate/baking soda in a dry film canister.

☐ 2. Measure and add 10 ml of 75% white vinegar to the film canister, quickly cap the canister, and begin timing the reaction. Stop timing when the lid of the film canister pops off. Record the time in seconds. Dispose of the used solution in the canister in your waste beaker (or sink). Rinse and thoroughly dry the film canister.

☐ 3. Repeat this procedure with 50% white vinegar.

☐ 4. Repeat this procedure with 25% white vinegar.

☐ 5. Give your data to your teacher and determine a class average for each temperature.



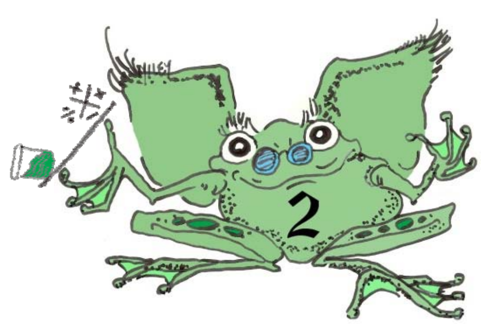
Record Your data here:

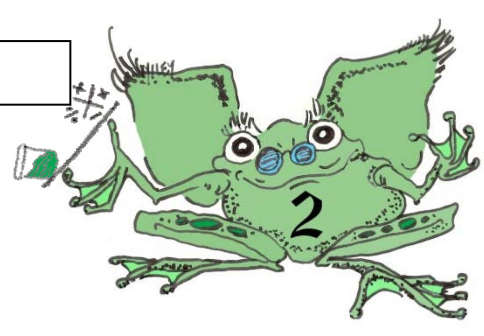
Vinegar Concentration	**Lab Group Data** Time (seconds) until the lid pops	**Class Average** Time (seconds) until the lid pops
75%		
50%		
25%		

Graph your data:

Graph the data on the next page.

- Label the *x*-axis.
- Label the *y*-axis.
- Draw a best-fit line.

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Discussion Questions:

1. Which concentration of distilled white vinegar caused the fastest reaction (the lid popped off in the shortest time)?

   ____

2. Suggest a reason based on chemistry for your answer in #1.

   ____

   ____

3. Use the graph to predict the number of seconds for the lid to pop off using the following concentrations of distilled white vinegar:

   a. 10% ____________________

   b. 60% ____________________

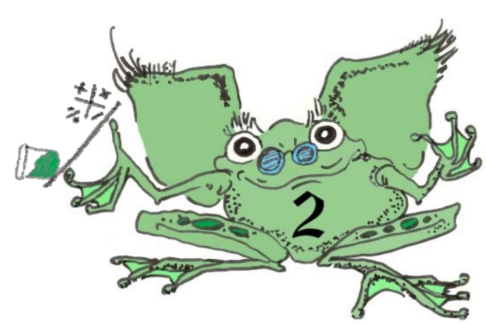
   c. 100% ____________________

Conclusion:

Review your data and write a conclusion statement by completing this sentence:

As the concentration of a substance in a chemical reaction increases, the rate of reaction

______________________________________ .



4. Use the information from the graph and the formula below to calculate the unit rate of change (slope) for the baking soda reaction. Use the class average best-fit line. *(When you use the best-fit line, your ordered pairs to determine the slope must be from the best-fit line, not from your data chart.)*

$$\textbf{Unit Rate of Change} = \frac{\Delta \text{Time (seconds) until the lid popped (g)}}{\Delta \text{ Vinegar Concentration (\%)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Time (seconds) Δy	Δ Vinegar Concentration (%) Δx	**Unit Rate of Change (slope)** $\Delta y/\Delta x$

5. Look at the unit rate of change calculated in #4. Why is the unit rate of change (slope) a negative number? Use the terms *vinegar concentration* and *time of reaction* in your answer.