MiSP Chemical Reactions Lab — Temperature L3

Name ______________________________ Date _____________

“Plop, Plop, Fizz, Fizz” . . . Temperature and Rate of Reaction Activity

Introduction:

Alka-Seltzer in water produces carbon dioxide. It is the same reaction as vinegar and baking soda (sodium bicarbonate) because the Alka-Seltzer has a chemical in it that makes water acidic like vinegar. When the reaction occurs in a closed container, which in this lab is a film canister, 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 temperature affect the time of (and the rate of) a chemical reaction?

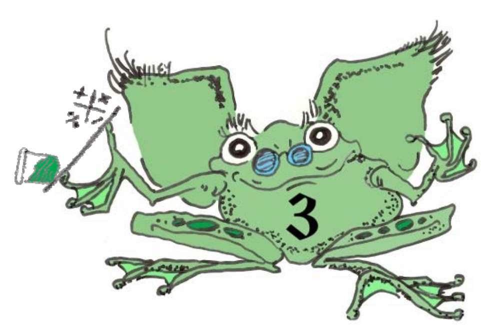
Hypothesis (complete sentence below):

If temperature affects the rate of a chemical reaction, then increasing the temperature

will cause the Alka-Seltzer 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
- thermometer
- 1 25 ml, 50 ml, or 100 ml graduated cylinder
- 1 tray
- 1 waste beaker

Chemicals:

- 1 Alka-Seltzer tablet (or other generic effervescent product) divided into four equal sections — you will need a total of 3 quarter pieces
- Cold water, about 5ºC; room temperature water, about 20ºC; hot water, about 45ºC (your teacher will provide the water at the three different temperatures and will tell you the approximate temperatures)

Procedures:

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

☐ 1. Add 10 ml of cold water to the film canister.

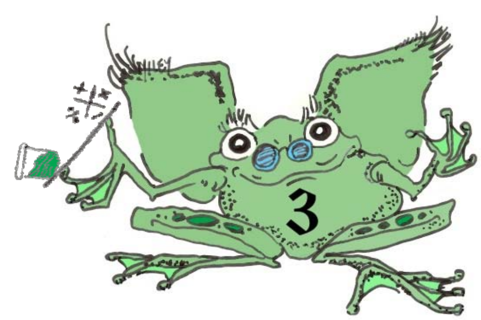
☐ 2. Measure and record the temperature of the cold water.

☐ 3. Drop a quarter tablet of Alka-Seltzer into the water inside the canister, quickly cap, 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).

☐ 3. Repeat this procedure with the warm water.

☐ 4. Repeat this procedure with the hot water.

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



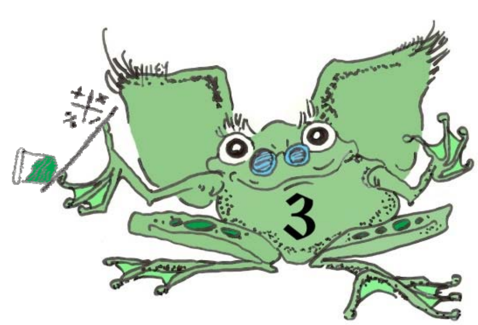
Record your data here:

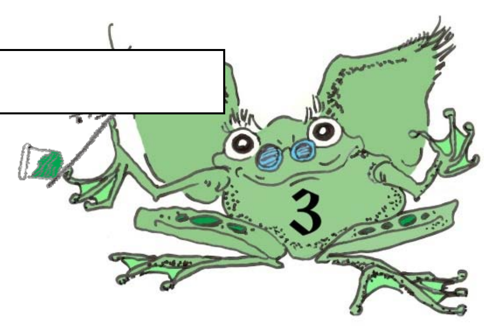
Water Temperature	**LAB GROUP** Time (seconds) until the lid pops	**CLASS AVERAGE** Time (seconds) until the lid pops
Cold: ____ °C		
Room Temperature ____ °C		
Hot: ____ °C		

Graph your data:

Graph the CLASS AVERAGE 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 temperature 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 when the water temperature is:

   a. 30^{o}C ____________________

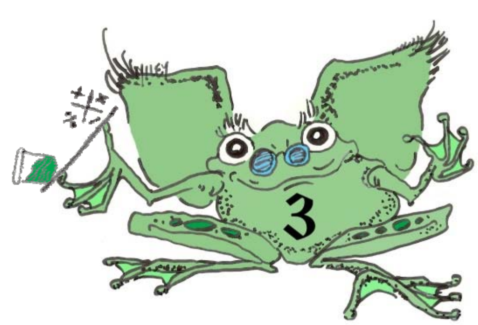
   b. 90^{o}C ____________________

Conclusion:

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

As the temperature of 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 Alka-Seltzer reaction. Use the class average best-fit line. *(When you use the best-fit line, your ordered pairs to determine slope must be from the best-fit line, not from your data chart.)*

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

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Time (seconds) Δy	Δ Temperature (°C) 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 *temperature* and *time of reaction* in your answer.

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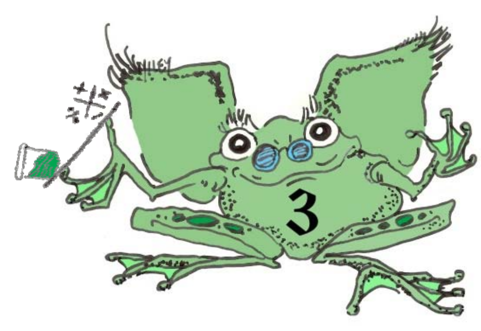
____

6. Determine the *y*-intercept for the class average best-fit line.



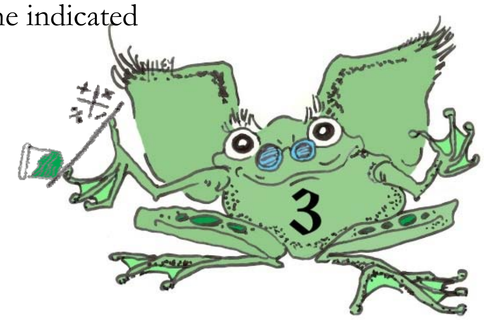
Use the equation for a line to calculate the y-intercept. The equation for a line is $y = mx + b$, where m is the unit rate of change (slope) and b is the y-intercept

Y-Intercept
$m =$ Ordered pair $(x, y) =$ (___ , ___) $y = mx + b$ Solve for b:

7. Based on the unit rate of change (slope) that you calculated above and the y-intercept, write an equation for the temperature / class average time of reaction best-fit line. Remember that the equation for a line is $\boldsymbol{y = mx + b}$ and m is the unit rate of change (slope) and b is the y-intercept.

Equation — Temperature / Time of Reaction Class Average Best-Fit Line

8. Using the equation above, calculate the time (in seconds) for the indicated temperature.



30ºC	90ºC