

# Endothermic and Exothermic Reactions

There is a video of me doing the lab. Follow along with these directions. I do part I and II in the video, **you take over from analyzing the data.**

Important—there is a endo exo lab.ambl file. That is the lab data. To open it, you must first open Vernier graphical analysis chrome add on (I show you how to get it in the video) and from that app you can open the endo exo lab.ambl file. You probably have to download instead of opening directly from my site.

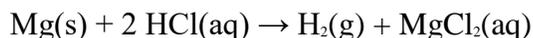
Once you complete this there is a google doc in google classroom you must answer questions on and attach a screen shot of your final work with the graph.

Many chemical reactions give off energy. Chemical reactions that release energy are called exothermic reactions. Some chemical reactions absorb energy and are called endothermic reactions. You will study one exothermic and one endothermic reaction in this experiment.

In Part I, you will study the reaction between citric acid solution and baking soda. An equation for the reaction is:



In Part II, you will study the reaction between magnesium metal and hydrochloric acid. An equation for this reaction is:



Another objective of this experiment is for you to become familiar with using data-collection equipment. In this experiment, you will use the program to collect and display data as a graph or list, to examine your experimental data values on a graph, and to print graphs and data lists.

## OBJECTIVES

- Study one exothermic and one endothermic reaction.
- Become familiar with using Graphical Analysis.
- Collect and display data on a graph.

## Endothermic and Exothermic Reactions

### PROCEDURE

1. Obtain and wear goggles.

#### Part I Citric Acid Plus Baking Soda

2. Launch Graphical Analysis. Connect the Temperature Probe to your Chromebook, computer, or mobile device.
3. Click or tap Mode (bottom left) to open Data Collection Settings. Change Rate to 0.5 samples/s and End Collection to 300 s. Click or tap Done.



Figure 1

4. Click or tap View, , and choose Graph and Table.
5. Place a polystyrene foam cup into a 250 mL beaker and onto a ring stand. Measure out 30 mL of citric acid solution into the polystyrene foam cup. **DANGER:** Citric acid solution,  $C_6H_8O_7$ : Causes skin and eye irritation. Secure the Temperature Probe to the ring stand using a utility clamp. Lower the Temperature Probe into the citric acid solution. Ensure the Temperature Probe is in the solution.
6. Weigh out 10.0 g of  $NaHCO_3$ , sodium hydrogen carbonate, commonly called baking soda on a piece of weighing paper. Do not add baking soda to citric acid yet.
7. You are now ready to begin collecting data.
  - a. Click or tap Collect to start data collection.
  - b. After about 20 seconds have elapsed, add the baking soda to the citric acid solution. Gently stir the solution to ensure good mixing.
7. Dispose of the reaction products in the waste container in the fume hood. Rinse out your foam cup to use it again in Part II. Rinse your foam cup with water, you will reuse it in part II.
8. When data collection is complete, a graph of temperature vs. time is displayed. To examine the data pairs on the displayed graph, click tap any data point. (**Note:** You can also drag the Examine flag.) Determine the initial temperature,  $t_1$  and final (or minimum) temperature,  $t_2$ . Record the temperature values in your data table.

#### Part II Hydrochloric Acid Plus Magnesium

9. Measure out 30 mL of HCl solution into the polystyrene foam cup. Lower the Temperature Probe into the HCl solution. Slowly stir the solution. **DANGER:** Hydrochloric acid solution, HCl: Causes severe skin and eye damage. Do not breathe mist, vapors, or spray. May cause respiratory irritation. May be harmful if swallowed. **Note:** The Temperature Probe must be in the HCl solution for at least 30 seconds before doing Step 11.
10. Obtain a piece of magnesium metal from your instructor. **DANGER:** Solid magnesium, Mg: Keep away from heat, sparks, open flames, and hot surfaces—flammable solid.

11. Do not close the screen or open a new file. We are going to continue with one file with both data sets. Click or tap Collect to start data collection, the previous data set will be stored automatically. After about 20 seconds have elapsed, add the Mg to the HCl solution. Gently stir the solution to ensure good mixing. **Caution:** *Do not breathe the vapors.*
12. Dispose of the reaction products in the waste container in the fume hood. Rinse the Temperature Probe.

### **Analyzing Data**

13. Determine the initial temperature,  $t_1$ , and the final (or maximum) temperature,  $t_2$ . Record the temperature values in your data table.
14. A good way to compare the two curves is to view both sets of data on one graph. Click or tap “Temperature (°C)” the y-axis label and select the data set you want to view. Dismiss the dialog to view the graph.
15. To change the scale of your graph, click or tap Graph Tools, , Edit Graph Options and adjust your x-axis range and y-axis range to something more suitable for your graph or autofocus on your data by clicking .
16. To label your graph, click or tap Graph Tools, , and choose Add Annotation. Enter **endothermic reaction** in the edit box, and then drag the box where you want it on your graph. Repeat this process to label the **exothermic reaction**.
17. To add a title to your graph, click or tap Graph Tools, , and choose Edit Graph Options. Enter a title for the graph, **Endothermic and Exothermic Reactions**, and then dismiss the box.
18. Take a screenshot by clicking control + windows switch key (a square with two lines after it), or a selected screen shot by control + Shift + windows shift key then click and drag the area you wish to screen shot. Once you take a screen shot it is saved to your clipboard, click control + v to paste your image onto the appropriate location. Alternatively you can save the graph image from graphical analysis. In the top left file menu click Export...Graph Image. A screen will pop up asking you name your image and where to save it. You should save it to your google drive. Either way works fine, the screenshot or image will then be inserted into the google doc in google classroom.