

Lab: The Determination of Absolute Zero (this is a typed up lab report)

Students: Please read the following information given below (there is nothing to print out for this lab), and then come to class on your lab day with the following already prepared in your notebooks:

- 1) Date, 2) Partner, 3) Title, 4) Purpose, 5) Materials, 6) Safety,
- 7) Procedures/Observations, and 8) Data Table

Figure 1



Data for this lab should be collected in your notebooks and later, rewritten in the Data section of the typed up lab report. The data, calculations, and questions will be due one week after performing the lab in class (your next lab class) in the form of a typed up lab report.

Background Information:

Pressure is caused by the collisions of gas particles with each other and whatever objects they may collide with. When the temperature is lowered, the particles move more slowly, decreasing the frequency and strength of these collisions. In turn, the pressure falls. The instrument at the right (Absolute Zero Apparatus) is used to measure pressure.

Absolute zero can be defined as the temperature at which matter does not move. At absolute zero, even subatomic vibrations are put to a grinding halt. Because the pressure in this experiment is caused by the movement of a gas, theoretically the pressure would cease to exist when the gas stops moving (a.k.a. absolute zero). When the linear relationship, discovered in this experiment, is extrapolated to the point where the pressure is zero, the corresponding temperature is absolute zero.

About the Lab:

In this lab the relationship between pressure and temperature of a fixed mass of gas at constant volume will be observed. Temperature and pressure data will be collected. This data will be used to estimate the value of absolute zero based on the results obtained during the lab. The value for absolute zero will be estimated by drawing a graph and then completing a computer generated graph.

Temperature and pressure data from the following experiments will be gathered and then entered into a student generated data table (Tap water, Ice, Ice with salt, Hot tap water, Boiling water, and Boiling water with salt). The six experiments will be set-up throughout the classroom, one per lab island. Students will rotate around the room, spending no longer than 5 minutes at each lab island, collecting the necessary data. The absolute zero apparatus, Figure 1, will be completely submerged in the six different beakers. The data collected will then be graphed, Temperature vs Pressure. One hand drawn graph will be submitted along with one computer generated graph.

Please use MicroSoft Excel to prepare a graph (chart type "Scatter") of Pressure vs Temperature. Make sure that each graph has a title, the axes are properly labeled (including appropriate units), that there are major gridlines for both axis, and then place the chart on a new sheet. To extend the x-axis, double click on the x-axis, select the scale tab, and change the minimum number. Before submitting, make sure you write your name and your lab partner's name on the graphs.

Answer the Following Questions:

1. Find the % difference between the experimental absolute zero (use your graph) and the theoretical absolute zero, $-273\text{ }^{\circ}\text{C}$.
2. Identify & explain several factors that might account for differences between the observed and accepted values.
3. Explain how the apparatus and the class's experimental graph could be used to determine the temperature of a swimming pool without a thermometer.
4. Ice at the freezing point has a temperature of 0°C . Does it have heat content? Explain.