Ideal Gas Law Lab

Objective: Determine the number of moles of air in a sealed container, as well as its mass; extrapolate from the data to determine the temperature (in Kelvins) at zero pressure.

Procedure:

1. Immerse the bulb completely in a bath of room temperature water. Clamp the bulb in place with its bottom about a centimeter or so above the bottom of the beaker. When the pressure stabilizes, record both the temperature of the bath in Celsius and gauge pressure of air in the bulb in lb/in^2.

2. Start heating the bath. CAUTION—THE BUNSEN BURNER FLAME IS ALMOST INVISIBLE. DO NOT BURN YOURSELF. The thermometer should NOT be resting on the bottom of the beaker, and it should not be used as a stirring rod. Gently stir the water with the stirring rod to keep the temperature uniform as you are heating it.

3. As the system is heating, take pressure and temperature measurements every 10 degrees or so until the temperature reaches about 65 degrees, or so. Shut off the flame and let everything cool while you do the following steps. THE METAL STAND MAY STAY HOT FOR A LONG TIME.

4. Record the temperature in °C and gauge pressure in lbs. per square inch (psi) on a piece of paper.

5. Set up an Excel spreadsheet that will allow you to enter your data. Use the spreadsheet to calculate:

- Temperature in Kelvins
- Gauge pressure in N/m^2
- Absolute pressure in N/m^2
- Number of moles of gas in the bulb.

The volume of the bulb is 535 cm^3. Do not forget to convert this to SI units. Make sure your Excel spreadsheet displays all values with the correct significant figures.

6. Calculate the average and standard deviation for the number of moles of air in the bulb.

7. Calculate one value of the mass of air in the bulb (in grams) from the average number of moles. The molar mass of air is 28.8 grams per mole. It is important that you get the right answer. As always do a reality check to make sure that your calculation makes sense.

8. Plot absolute pressure, P (in pascals), vs. absolute temperature, T (in Kelvins); fit a linear function to this data and determine what the temperature should be for P = 0.0 Pa. Compare your value with the accepted value for absolute zero.

Your report for this lab should include:

- Your spreadsheet with all values and calculations; each column should be clearly labeled and list the correct units;
- The plot of P vs. T, with the best fit line and its equation;
- Your value of T for P = 0.0 Pa, based on the equation of your best fit line, along with an explanation for any difference from 0 K.