Gas Law Labs

PART I – Determine the Gas Constant, R

When Boyle's Law (relating pressure to volume) and Charles' Law (relating temperature to volume) are combined, the resulting equation PV=nRT contains a constant of proportionality designated by R. This equation is for ideal gases, but most real gases under ordinary conditions conform quite well to ideality. The units of R depend on the units of the other quantities in the equation, but one useful R value is 0.082056 liter atm/mole Kelvin. To use this value the volume must be in liters, the pressure in atmospheres and the temperature in Kelvin.

In this experiment you will use the reaction:

$Mg + 2HCl \rightarrow MgCl_2 + H_2$ (g)

and its stoichiometry to determine the quantity (number of moles) of hydrogen. This value along with measurements of the volume, pressure and temperature allows R to be calculated and compared with the accepted value. The hydrogen gas will be collected over water, so the pressure of the gas must be adjusted to discount the pressure due to the water vapor, i.e.,

$P_{hydrogen} = P_{total} - P_{water}$

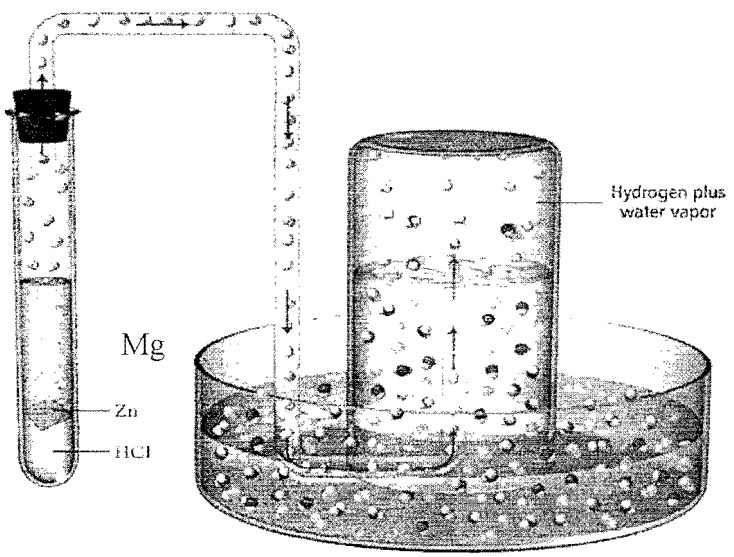
If the levels of water in your buret and the beaker cannot be equalized the weight of the water column pulls downward on the gas trapped in the buret, reducing the gas pressure by the "hydrostatic" pressure of the water column. So the $P_{hydrostatic}$ must be subtracted, i.e.

$P_{hydrogen} = P_{total} - P_{water} - P_{hydrostatic}$

Procedures:

1. Accurately weigh approximately 0.015 grams of magnesium ribbon.
2. Make sure the stopcock in your buret is closed, then add approximately 8 mL concentrated HCl to the buret. Wash down any acid on the walls of the buret with a wash bottle and slowly fill the buret completely with water.
3. Crumple your magnesium ribbon and wrap it in a small piece of copper wire. Place the cage in the top of the buret. Make certain the buret is filled to its brim with water.
4. Hold your finger over the buret and quickly invert it into a beaker of water. Clamp the buret in the beaker of water with the buret resting on the bottom of the beaker. **Wash your hands in running water.**
5. Allow the reaction to reach equilibrium (when there is no further production of hydrogen).
6. Measure the temperature of the water, record the gas volume in the buret, and note the differences in mm between the water levels in the beaker and the buret.
7. Remove the buret and measure the uncalibrated space in the bottom. Add this to the recorded volume.
8. Repeat the experiment.
9. From your recorded data determine the value of the gas constant in units of liter atm/mole K for each experiment trial. Average your class's determinations (two for each student).

Data



Gas Law Lab Report Rubric

Table of Contents	Points Earned	Points Possible
Includes the title, page numbers, and date of experiment		2
Title		
Capitalized appropriately, relates to the experiments, NOT underlined, but rather just centered at the top of the lab report		1
Problem Statement		
- Independent variable, dependent variables, constants (at least 3), and the control are stated		5
- Purpose and Problem are testable and clearly stated		2
Hypothesis		
States what you are doing, what you predict will happen, and why you think that will happen. If…Then…Because		3
Materials		
A list of all materials used in the experiment		1
Procedure		
Write a complete, **DETAILED** procedure.		3
Data		
Organized table that shows the data you have collected during the experiment		3
Lab Questions		
1. For a party, you need to fill 100 balloons with a capacity of 5.0 L each with helium. The barometer reading for the day is 740 mmHg and the temperature is 27 °C. Under what pressure would this gas be if it were bought in a 20.0 L cylinder at 20 °C?		3
2. Define STP		1
3. Calculate the density of manganese(III) sulfide vapor at 3025 torr and at a temperature of 1275 °C?		3
4. Propane gas, C_3H_8, is collected over water at 30.0 °C. The atmospheric pressure on that day was recorded at 0.986 atm. of pressure. Calculate the volume of propane gas that must be collected to obtain 7.55 grams of propane gas? (At 30.0 °C the vapor pressure of water is 31.824 torr.)		5
5. A sample of inert gases mixed together with a pressure of 2580 torr contains 25.0 % nitrogen gas and 75.0 % radon gas by mass. What are the partial pressures of the individual gases?		3
Questions:		
1. Using the Ideal Gas Law and measured values, calculate the number of moles of butane released into the flask.		3
2. The molecular mass is defined as grams/mole. Calculate the molecular mass of butane (using the mass in your data table).		3