Chemistry 534
Demo Lab: Using Buoyancy and PV = nRT to find the mass of a H_2 balloon

Purpose: To determine the mass and volume of hydrogen gas using the principle of buoyancy and the ideal gas law.

Procedure:

1. Weigh an empty balloon. Record the mass in the data table.
2. Weigh a 20 cm piece of string. Record the mass.
3. Fill the balloon with hydrogen gas.
4. Attach the balloon to a pressure valve. Record the pressure.
5. Tie the balloon with string.
6. Weigh a bar(cartridge) of staples. Record their mass.
7. Attach the bar to the balloon.
8. Slowly break off small sections of staples until the balloon neither ascends nor descends. It may be necessary to add staples back to the load.
9. Record the mass of the removed staples
10. Record the temperature and atmospheric pressure.

Data:

Mass of empty balloon	
Mass of string	
Pressure of H_2 gas	
Total mass of staples	
Mass of removed staples.	
Atmospheric pressure of air	
Air temperature	

Analysis:

1. Determine the mass of the staples that remained attached.
2. Find the mass of the load (excludes the mass of hydrogen), which is the sum of the masses of the string, empty balloon and attached staples.
3. Since the force of gravity is balanced by the buoyant force, the following formula can be derived:

$m_{load} = V_{balloon}(\rho_{air} - \rho_{H_2})$, where ρ_{air} = density of the air in g/L

ρ_{H_2} = density of hydrogen in g/L

$V_{balloon}$ = balloon's volume in L

m_{load} = total mass excluding H_2.

Use the formula to determine the balloon's volume. Note that you will have to first use the ideal gas law and your T,P data to calculate the densities in g/L. $\rho = \frac{P}{RT}\mathscr{M}$

4. Why *isn't* the pressure of hydrogen the same as that of the atmosphere? After all, the balloon is neither shrinking nor expanding.

5. Find the mass of the hydrogen gas.

Conclusion: