	Trial One	Trial Two	Trial Three	Trial Four	Trial Five	Trial Six
Mass of Magnesium (g)	0.015	0.0159	0.015g	0.16	0.158	0.015
Temperature of Water Bath (K)	293°K	293°K	294.2K	293K	284.5K	288K
Hydrostatic Difference (mm)	401mm	171mm	13.7mm	295mm	8mm	401mm
Atmospheric Pressure (kPa)	102.05kPa	102.05kPa	102.05kPa	100.1kPa	102.0	102.05
Water Pressure (Pa)	2338.8Pa	2338.8Pa	2348.7	2346		2338.8
Volume of Gas (mL)	14.9mL	22.4mL	15.1mL	15.15	14.4	14.1

0.0159g

Data Analysis:

1. Use stoichiometry to convert the mass of magnesium to moles of Hydrogen.
2. Convert your measured temperature of the water bath to Kelvin.
3. Calculate the pressure of the hydrogen gas:
   a. $P_{hydrostatic}$ = Hydrostatic difference (mm)÷ 13.6 (density of Hg)
      ** note the units from hydrostatic pressure are in mmHg. You will need to convert these to atm)
   b. P_{H2O} read from table below and convert to atm
   c. $P_{atm=}$ use current weather data (up-to-date info from noaa) and convert to atm
      $P_{atm} = P_{H2} + P_{H2O} + P_{hydrostatic}$
4. Convert Volume of H_2 gas to liters.
5. Calculate the value of R using the ideal gas law.
6. Calculate your error based on the published value for the universal gas constant. PAY CLOSE ATTENTION TO UNITS!

PART II – Determine the Molecular Mass of Butane

Purpose: To experimentally determine the molecular mass of butane.

Materials: 125 mL Erlenmeyer flask, wax pencil, trough, thermometer, graduated cylinder, butane lighter, and index card.

Discussion: According to Avogadro, the molar volume of any gas at STP is 22.4 liters. In this experiment the mass of a specific volume of butane gas will be determined. **Butane has the chemical formula C_4H_{10}.** This information can be used to determine the experimental mass of one mole of butane or the molecular mass of the gas.

Procedure:

1. Fill the trough ¾ full of water.
2. Measure and record the mass of the butane canister.
3. Fill the Erlenmeyer flask completely with water.
4. Cover the top of the flask and invert the flask so that it is upside down in the trough of water.
5. Hold the butane canister under the water so that it is directly under the flask opening.
6. Press the release lever and collect approximately 100 + mL of gas.
7. Remove the canister and dry it with a paper towel. Set aside.
8. Carefully raise and lower the flask until the water level inside the flask is equal to the water level outside the flask. This is to equalize the pressure so that the pressure inside is equal to the atmospheric pressure. Mark the water level with a wax pencil.
10. Remove the flask and fill it with water up to the recorded mark.

11. Pour the water in the flask into a graduated cylinder and measure and record the volume of water. This is equal to the VOLUME OF GAS COLLECTED.
12. Measure and record the temperature of the water in the trough.
13. Measure and record the atmospheric pressure.

Data

Mass of butane canister before the experiment (g)	27.49
Mass of butane canister after the experiment (g)	26.28
Mass of butane (g)	1.129
Volume of butane (L)	0.187 L
Temperature of butane (K)	~~21°C~~ 294°K
Atmospheric Pressure (Pa)	100.1 kPa

The gas in the flask is not all from the butane lighter. There is also WATER VAPOR. Since you are only interested in the pressure due to butane, you must subtract the pressure due to the water vapor. The table below will give you the water vapor pressure based on temperature. Use the equation below to calculate the pressure of DRY BUTANE.

$$P_{butane} = P_{atmosphere} - P_{water}$$

Temperature (°c)	Pressure, (Pa)	Temperature (°C)	Pressure (Pa)
15	1705.6	23	2810.4
16	1818.5	24	2985.0
17	1938.0	25	3169.0
18	2064.4	26	3362.9
19	2197.8	27	3567.0
20	2338.8	28	3781.8
21	2487.7	29	4007.8
22	2633.7	30	4245.5

Pressure of Dry Butane 2487.7 Pa

Questions:

1. How would your results be affected if you had bubbles in your flask in step 2?
2. Why is it necessary to raise or lower the cylinder until the water levels inside and outside are equal? How would your results be affected if the water level inside the flask was higher than outside?
3. Why is it necessary to find the pressure of the dry gas in calculation #2? How would your results be affected if you did not make this correction to the pressure?
4. Propane (C_3H_8) is another member of the hydrocarbon series. If you wanted to buy 1000 grams of compressed gas to take on a camping trip, would you get more moles of propane or butane?
5. You could not use this procedure to find the molar mass of oxygen or carbon dioxide. Why not?