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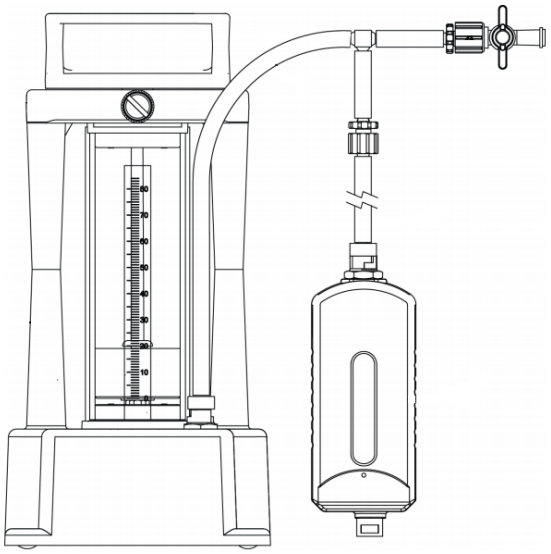
Lab 3 – Ideal Gasses

Part 1: Boyle's Law

What is the relationship between Pressure and Volume of an ideal gas? It is important that while attempting to answer such a question, all other variables remain unchanged.



Equipment Needed

Heat Engine, Pressure Sensor, Tubing, Valve

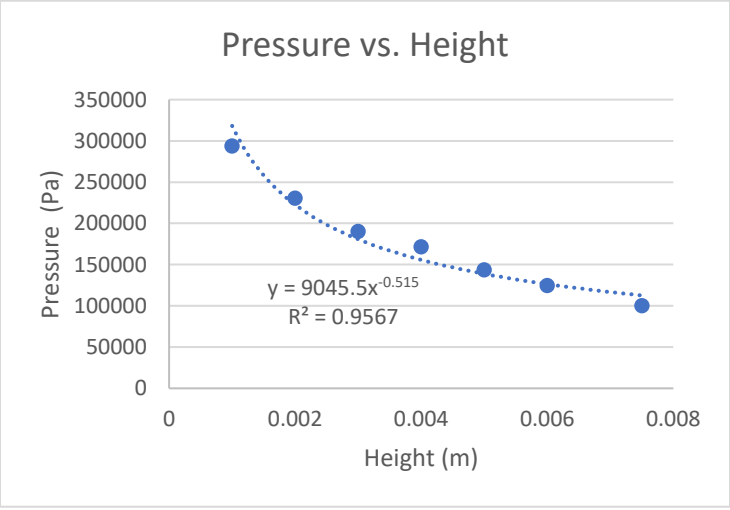
Experimental Design

1. Orient your lab equipment in the method shown.

2. Turn the valve's handle to a position parallel to the tubing to allow air flow (UNLOCKED position). While unlocked, raise the heat engine's piston position to some value of your choosing. Be sure to make room for compressing and expanding the air inside the piston. Once you have established this position, LOCK the valve by orienting the handle to be perpendicular to the tubing.

3. Begin recording various volumes and associated pressures by either manually moving the piston or adding controlled weights. Keep in mind that the side of the piston reads length in MILLIMETERS and not volume. The piston is a cylinder with an inner diameter of 32.5 mm.

4. Below, please paste your data. This should include a data table and a Pressure vs. Volume graph. Please fit both side-by-side on the 1st page. Do not worry about linearizing your data.



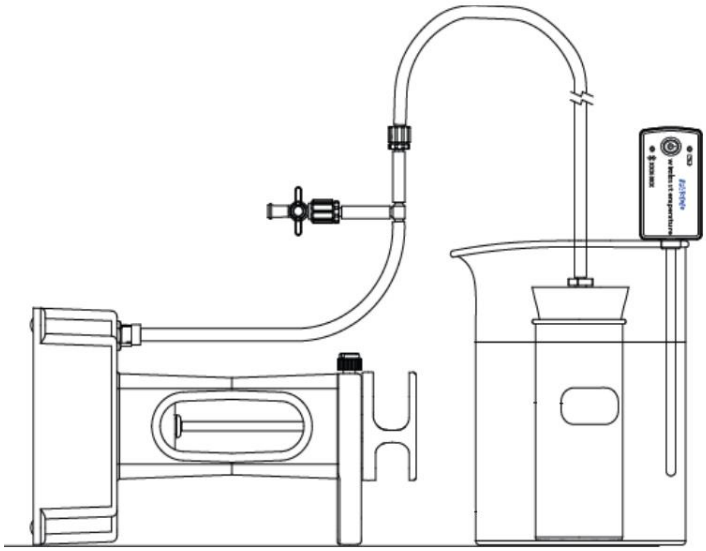
Height (m)	Pressure (Pa)
0.0075	100000
0.006	124500
0.005	143500
0.004	171500
0.003	190000
0.002	230500
0.001	293500

Part 2: Charles' Law

What is the relationship between Volume and Temperature of an ideal gas? It is important that while attempting to answer such a question, that all other variables remain unchanged.

Equipment Needed

Heat Engine, Beaker, Temperature Sensor, Hot Plate, Tubing, Aluminum Air Canister, Microwave, Valve



Experimental Design

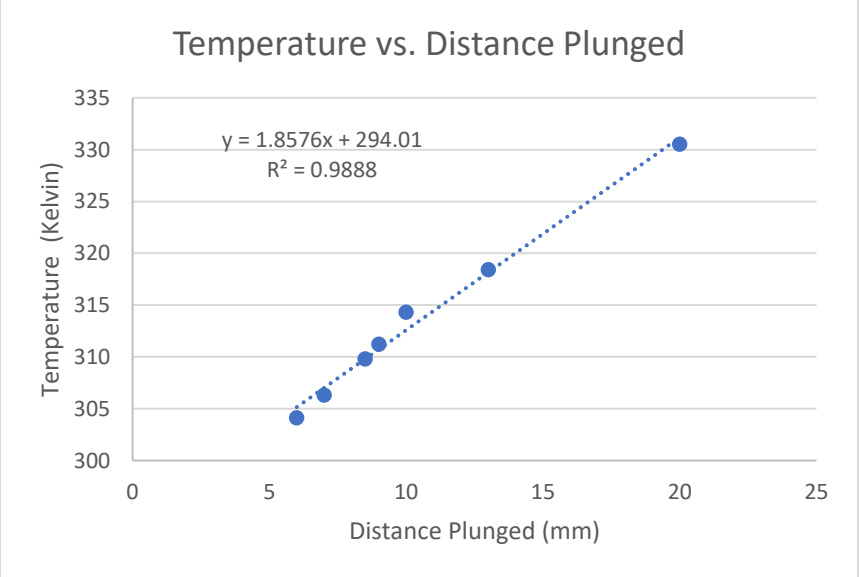
1. Orient your lab equipment in the method shown. Do not submerge the canister in the beaker yet, though.

2. UNLOCK the valve and assure the black rubber stopper is firmly fit into the canister. Adjust the piston to the zero position. LOCK the valve after this.

3. Fill the beaker about half way with room temperature water. Use the microwave to heat the water to *almost* boiling. If the water is too hot, the stopper will pop off and the experiment will have to be repeated. Place the aluminum canister inside the beaker so the entire canister is submerged. One person will have to hold this steady by the STOPPER. Do not touch the aluminum. Another person will need to hold the temperature sensor steady as well, and not let it touch the bottom of the beaker.

4. When the air stops expanding, record the maximum volume and temperature (Kelvin). Slowly reduce the temperature by adding ice in slow intervals. Record volumes and temperatures at intervals of your choosing

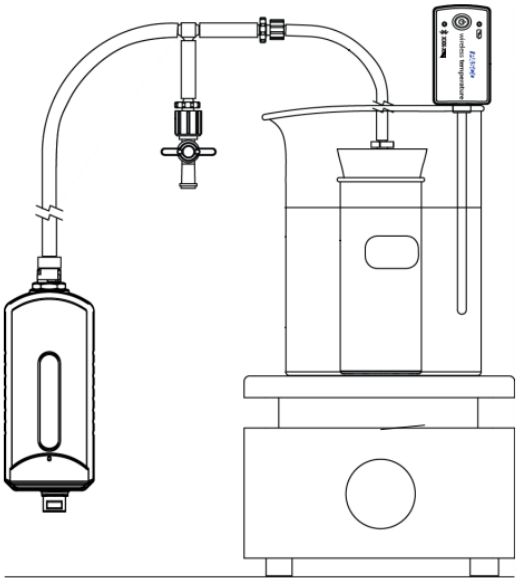
5. Below, please paste your data. This should include a data table and a Volume vs. Temperature graph. Please fit both side-by-side on the 2nd page.



Distance Plunged (mm)	Temperature (Kelvin)
20	330.5
13	318.4
10	314.3
9	311.2
8.5	309.8
7	306.3
6	304.1

Part 3: Gay-Lussac's Law (Goggles and Apron Required)

What is the relationship between Pressure and Temperature of an ideal gas? It is important that while attempting to answer such a question, that all other variables remain unchanged.



Equipment Needed

Beaker, Temperature Sensor, Pressure Sensor, Hot Plate, Tubing, Aluminum Air Canister, Valve

Experimental Design

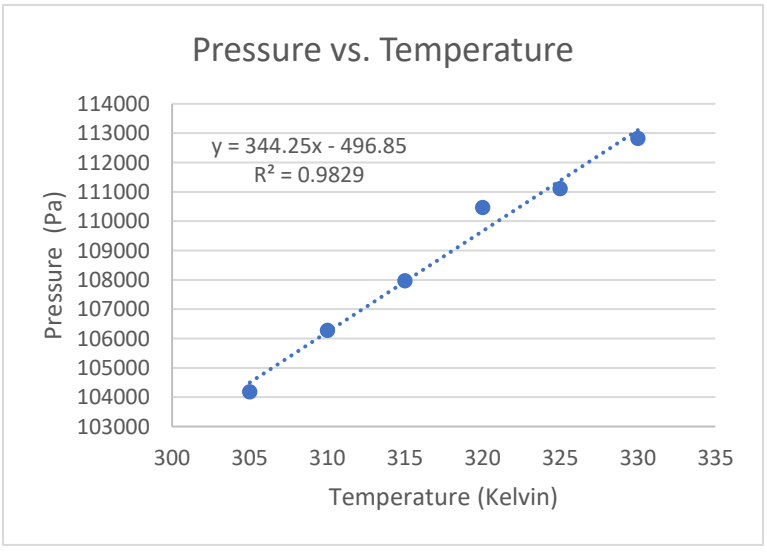
1. Orient your lab equipment in the method shown. Do not submerge the canister in the beaker yet, though.

2. UNLOCK the valve and assure the black rubber stopper is firmly fit into the canister. LOCK the valve after you have done so.

3. Fill the beaker about half way with room temperature water. Place aluminum canister inside, but do not let it touch the bottom. One person will have to hold this steady by the STOPPER. Do not touch the aluminum. One other person will need to hold the temperature sensor steady, and not let it touch the bottom of the beaker.

4. Place the beaker on a hot plate and turn it on. Begin recording pressures and temperatures (Kelvin) at intervals of your choosing. When the temperature reaches 80° C, or when the stopper pops off, stop recording and unplug the hot plate.

5. Below, please paste your data. This should include a data table and a Pressure vs. Temperature graph. Please fit both side-by-side on the 3rd page.



Temperature (Kelvin)	Pressure (Pa)
305	104177
310	106273
315	107960
320	110464
325	111111
330	112822

Questions

1. What is the relationship between Pressure and Volume? Include your regression equation from Part 1.
   The relationship between volume and pressure is a power relationship as shown with the equation $y = 9045.5x^{-0.515}$. This is where x = height in meters and y = pressure in pascals.

2. What is the relationship between Volume and Temperature? Include your regression equation from Part 2.
   The relationship between volume and temperature is linear as shown with the equation y = 1.8576x + 294.01. This is where x = distance plunged in millimeters and y = temperature in kelvin. This means for every increase of plunge depth, on average, temperature increases by 1.857 kelvin. When it was at full volume, our gas had a temperature of 294.01.

3. What is the relationship between Pressure and Temperature? Include your regression equation from Part 3.
   The relationship between pressure and temperature is linear as shown with the equation y = 344.25x - 496.85. This is where x = temperature in kelvin and y =pressure in pascals. This means for every increase of temperature, on average, pressure increases by 344.35 pascals.

4. What are some sources of error that might have occurred during your laboratory experiment?
   Error came from leaks, inconsistent heating within the water, and stretching of pipes that can change volume.