Nathan Gillispie Lab Partners: Peyton Strickland, Kelsi Sogge Lab date: August 31, 2022

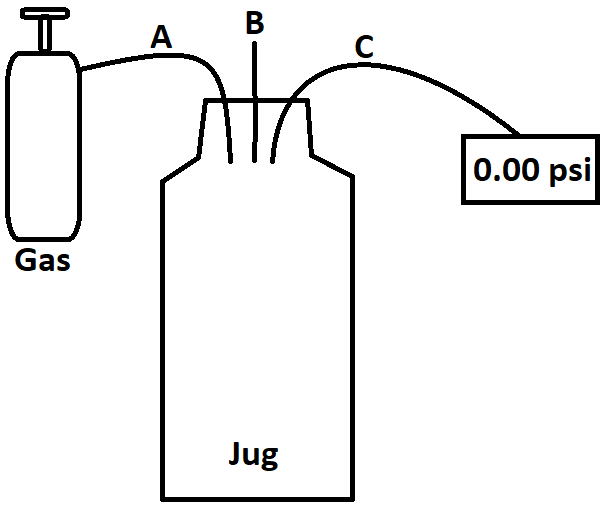
The Calculation of Heat Capacity Ratios of Nitrogen and Argon Using Adiabatic Expansion

# Introduction:

The heat

|  |  |  |
| --- | --- | --- |
|  |  | (1) |

# Experimental Methods:

The apparatus consists of a 5-gallon jug connected to a pressure gauge and gas cylinder. The 5-gallon glass jug was used as a vessel to contain argon and nitrogen for the process. This was defined as the system. Before beginning the experiment, the vessel was filled with either argon or nitrogen. The procedure for both was identical: the vessel was lowered upside down into a water bath with a tube allowing air in the vessel to be displaced by the water. The same tube was plugged into a regulator on the gas cylinder and the gas was allowed to displace the water in vessel until gas flowed freely out the surface of the water. The vessel was quickly raised out of the water bath and capped with the 3-holed rubber stopper. All tubes were connected as shown in figure 1. Tube C was attached to a digital pressure gauge to determine the difference between ambient atmospheric pressure and the pressure in the vessel Pgauge. Tube A was attached to the gas canister and tube B was clamped closed.

**Figure 1.** Vessel with a gas canister to the left and pressure gauge to the right. The system is closed by a rubber stopper.

# Data and Results:

**Table 1.** Data and calculations for gamma with uncertainties. P3 ­for argon is higher on average which corresponds to the difference in gamma values for nitrogen and argon. The argon trial 1 seems to be a statistical error though as it has a lower P3 than either nitrogen trial. The temperature drop for each is similar.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | P1, gauge (psi) | P3, gauge (psi) | P1 (psi) | P3 (psi) |  | γ |
| N2 trial 1 | 1.66±0.01 | 0.45±0.01 | 16.409±0.006 | 15.20±0.02 | -29.8±.2 | 1.39±0.08 |
| N2 trial 2 | 1.64±0.01 | 0.43±0.01 | 16.389±0.006 | 15.18±0.02 | -29.5±.2 | 1.37±0.08 |
| Ar trial 1 | 1.63±0.01 | 0.41±0.01 | 16.379±0.006 | 15.16±0.02 | -29.4±.2 | 1.35±0.08 |
| Ar trial 2 | 1.71±0.01 | 0.58±0.01 | 16.459±0.006 | 15.33±0.02 | -30.7±.2 | 1.54±0.10 |

Our pressure gauge only measures pressure difference, so we have to add atmospheric pressure to our gauge measurements to get the absolute pressure. In other words, the calculation of P1 and P3 are relative to the measurement of P2. This value was 30.03±0.01inHg as acquired from IBM’s Weather Data API at 2:00 PM, August 31, 2022. [1] The conversion from inHg to psi went as follows:

# Conclusion:

In this experiment, the heat capacity ratio is calculated from the pressures before adiabatic expansion and after thermal expansion of nitrogen and argon. Our ratios were calculated to be and

Safety:

Despite being quite abundant in

# References:

1. *Site-Based Observations - v1*; The Weather Company: Atlanta, GA, 2022. <https://ibm.co/v1cSBO> (accessed August 31, 2022)
2. Branca M.; Soletta I., “CP / CV Ratios Measured by the Sound Velocity Method W Using Calculator-Based Laboratory Technology”, *J. Chem. Educ.* **84**, 3, 462 (2007). doi: 10.1021/ed084p462
3. *Nitrogen;* MSDS No. 001040; Airgas: Radnor, PA, August, 31, 2021. <https://www.airgas.com/msds/001040.pdf> (accessed 9/27/22)
4. *Argon;* MSDS No. 001004; Airgas: Radnor, PA, January, 5, 2021. <https://www.airgas.com/msds/001004.pdf> (accessed 9/27/22)

# Calculations: