Thermolabs

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Here we describe our project related to the topic of thermodynamics as devised for a renewed curriculum.

a. Introduction

- New curriculum
- Projects in which simulations, project work and labs are central and serve as link between courses and thereby aim at conceptual development / strengthening
- Here describe thermodynamics
- ...

b. Physics background We here utilize the method devise by Clément and Desormes which make use of an adiabatic process where a pressured has (P_1, T_{atm}) in a cylinder with volume V is suddenly released. In our case we use a fire extinguisher where the gas is released by opening the valve. As the pressure suddenly drops the temperature in the cylinder decreases as the gas is doing work. When the pressure inside the cylinder equals the atmospheric pressure (P_{atm}, T_2) we close the valve. The temperature of the gas inside the cylinder increases to T_{atm}, and hence the pressure increases to a value P_2 - no work is being done and here we make the assumption that the heat capacity of the cylinder is much larger than the heat capacity of the gas. Hence, the entire process can be considered adiabatic.

The first part of the process can be described by the Poisson equations for an adiabatic process:

$$T_1^{\gamma} P_1^{1-\gamma} = T_2^{\gamma} P_2^{1-\gamma} \tag{1}$$

where γ is the specific heat ratio given by $\gamma = \frac{C_p}{C_V}$. We note that $T_1 = T_{atm}$ and $P_2 = P_{atm}$. The second part of the process can be described using Gay-Lussac's relation:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \tag{2}$$

where we consider (again) that $P_1 = P_b$ and $T_2 = T_{atm}$. Rearranging these equations (see Appendix) yields:

$$\gamma = \frac{\ln P_1 - \ln P_b}{\ln P_1 - \ln P_2} \tag{3}$$

Methods

Materials pressure & temperature sensor arduino incl sd card for data logging fire extinguisher

1. Results

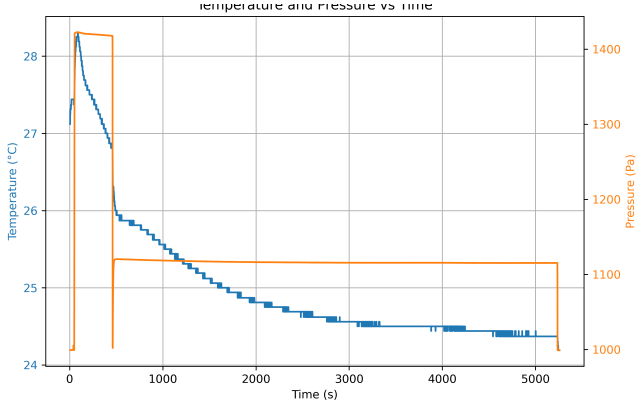

FIG. 1. pressure and temperature as function of time