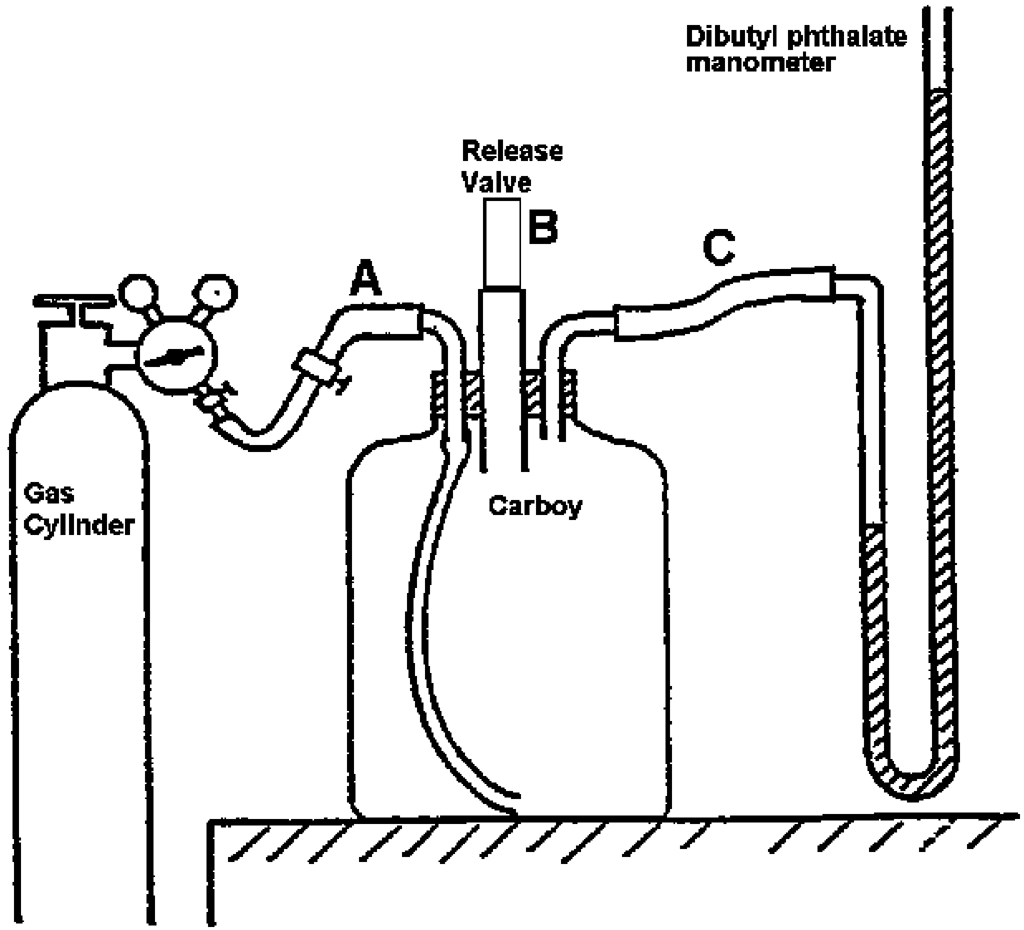
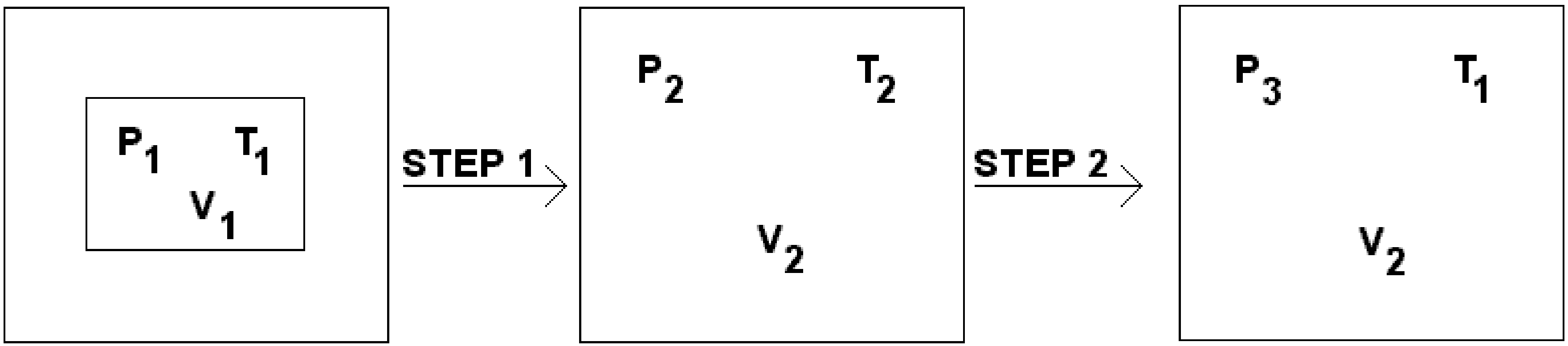
Chemistry 2201 Exp: GASES

Determining the Heat Capacity of a gas at constant pressure(C_p) and constant volume (C_V).

Acieved by measuring 3 pressures of a fixed amount of gas.

Clément and Desormes Method





NOTE: Gas is compressed.

P_1, T_1, V_1: Initial pressure, temperature and volume of the gas.

P_1 greater than atmospheric pressure(P_2).

V_1 is the compressed volume of gas under study. Not volume of container.

Step 1:

Gas is allowed to expand from P_1 to atmospheric pressure(P_2).

As gas expands it cools from T_1(room temperature) to T_2. Occupies volume of vessel(V_2).

Heat flows into vessel. Volume constant. Pressure increases to P_3 as gas heats back to room temperature.

Assume gas behaves Ideally.
For an ideal gas the internal energy only depends on temperature.

By measuring three pressures P_1, P_2, and P_3 the heat capacity ratio(γ) is determined.

$$\gamma = \frac{\ln\left(P_1/P_2\right)}{\ln\left(P_1/P_3\right)} = \frac{\ln P_1 - \ln P_2}{\ln P_1 - \ln P_3}$$

Can determine C_P and C_V from γ.

$$\gamma = \frac{C_P}{C_V} = \frac{C_V + R}{C_V} \qquad\qquad C_P = C_V + R$$

Pressure measured using dibutyl phthalate manometer. Measures pressure difference in vessel to atmospheric pressure.

$$\text{cm DP} \times \frac{\text{density DP}}{\text{density Hg}} = \text{cm Hg}$$

Density: dibutyl phthalate = 1.046 g·cm^{-3}
mercury = 13.55 g·cm^{-3}