Department of Physics

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Subject No. PH41023(Statistical Physics-I) Friday 20th January, 2023
Assignment Due date : 23th Jan 2023 Total Marks: 10

Assignment # 2

§1. Show that the difference of heat capacities for a substance is given by the relation

$$C_p \; - \; C_V \; = \; -T \left(\frac{\partial V}{\partial T}\right)^2_p \left(\frac{\partial P}{\partial V}\right)_T$$

§2. Estimate the difference in entropy between 1 g of an ideal gas (M_w=28 g/mol and C_p=28 J/mol-K and L_v=180 J/g) at a temperature 20 C and under a pressure 1 atm; and 1 g of liquid of same gas at a temperature -200 C (which is boiling point of the ideal gas at 1 atm).

§3. Liquid helium-4 has a normal boiling point of 4.2 K. However, at a pressure of 1 mm of mercury, it boils at 1.2 K. Estimate the average latent heat of vaporization of helium in this temperature range.

§4. A thermally insulated box is separated into two compartments (volumes V_1 and V_2) by a membrane. One of the compartments contains an ideal gas at temperature T; the other is empty (vacuum). The membrane is suddenly removed, and the gas fills up the two compartments and reaches equilibrium.
(a) What is the final temperature of the gas?
(b) Show that the gas expansion process is irreversible.