NAME :

Quiz 4

Philip Cherian

February 8, 2024

(a) Using the definitions given below, rewrite C_V and C_P in terms of derivatives of *state* functions. [2]

$$C_V = \left(\frac{\partial Q}{\partial T}\right)_V, \qquad \text{and} \qquad C_P = \left(\frac{\partial Q}{\partial T}\right)_P. \tag{1}$$

(b) If you are further given that for an ideal (monoatomic) gas, the internal energy $U = (3/2)Nk_BT$, show that

$$C_P - C_V = Nk_B. \tag{2}$$

Use this result to compute $\gamma = C_P/C_V$ for such a gas. [3]

(c) Consider a van der Waals' gas, with an equation of state given by

$$\left(P + a\frac{N^2}{V^2}\right)(V - Nb) = Nk_B T. \tag{3}$$

Compute the following response functions for such a gas: (i) isothermal compressibility $\kappa_T = -(1/V)\left(\partial V/\partial P\right)_T$, (ii) isobaric expansivity $\alpha = (1/V)\left(\partial V/\partial T\right)_P$. [5]