NAME :

Quiz 11

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March 19, 2024

(a) Recall that the fundamental equation of an ideal gas in the entropy representation is

$$S = Ns_0 + NR\ln\left[\left(\frac{U}{U_0}\right)^c\left(\frac{V}{V_0}\right)\left(\frac{N}{N_0}\right)^{-(c+1)}\right], \qquad \text{where} \quad s_0 = (c+1)R - \left(\frac{\mu}{T}\right)_0. \tag{1}$$

Use this to find $U(S,V,N)$, and show that: [5]

$$T(S,V,N) = \frac{U}{cRN}. \tag{2}$$

(b) You are given that the Helmholtz free energy is $F(T,V,N) = U - TS$. Find F for an ideal gas using the expressions in the previous part. Find the corresponding equations of state – i.e. the equations for $S(T,V,N)$, $P(T,V,N)$, and $\mu(T,V,N)$ – by taking appropriate partial derivatives of F. [5]