NAME :

Quiz 13

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March 26, 2024

(a) A certain physical system has an entropic fundamental relation

$$S = \frac{4}{3} b^{1/4} U^{3/4} V^{1/4}. \tag{1}$$

Use this to find $U(S,V,N)$, and $T(S,V,N)$. Show that [6]

$$F(T,V,N) = -\frac{1}{3} b V T^4. \tag{2}$$

(b) Prove the following relations *in general*:

$$P = -\left(\frac{\partial F}{\partial V}\right)_{T,N}, \qquad S = -\left(\frac{\partial F}{\partial T}\right)_{V,N}, \quad \text{and} \quad \mu = \left(\frac{\partial F}{\partial N}\right)_{T,V}. \tag{3}$$

From the expression of the Helmholtz free energy given above, find S, P, and μ for this system. [4]