國立臺灣大學 102 學年度碩士班招生考試試題

1. All gasses at relatively low pressures approach the equation of state PV=RT+BP for 1 mole, where B is independent of P or V. Please derive an expression for the difference $(\partial H/\partial V)_T - (\partial U/\partial V)_T$ for 1 mole of such a gas. (15%)

2. Prove that $Cp = Cv + \left[V - \left(\frac{\partial H}{\partial P}\right)_T\right]\left(\frac{\partial P}{\partial T}\right)_V$ (15%)

3. We blow the bubble with air to grow bigger. Please explain why we need the extra air pressure to grow the bubble in thermodynamics. (10%)

4. Given that solid A does not float on liquid A, explain whether the melting point of the solid will be raised or lowered by pressure. You may use the Clapeyron equation to explain it. (10%)

5. Please explain why polymer solution is not an ideal solution. (5%)

6. An equation for the temperature variation of the latent heat ΔH of a phase change along the equilibrium PT curve was derived by M. Planck as

$$\frac{d\Delta H}{dT} = \Delta Cp + \frac{\Delta H}{T} - \Delta H\left(\frac{\partial \ln \Delta V}{\partial T}\right)_p$$

Please derive the above Planck equation, starting from

$$d\Delta H = \left(\frac{\partial \Delta H}{\partial T}\right)_p dT + \left(\frac{\partial \Delta H}{\partial P}\right)_T dP$$ (15%)

7. Prove that $\left(\frac{\partial S}{\partial E}\right)_H = \frac{-Cp}{T[Cp(P\beta-1)+PV\alpha(1-T\alpha)]}$

where $\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p$, $\beta = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$, S is entropy, E is internal energy and H is enthalpy. (15%)

8. At high pressures and temperatures a quite good equation of state is

P(V-nb)=nRT, where b is a constant. Please show that

$$dV = (V - nb)\left(\frac{dT}{T} - \frac{dP}{P}\right)$$ (15%)

試題隨卷繳回