Physics 214A
Problem Set 6
Fall 1997

Problem 18.

The rotational motion of a diatomic molecule is specified by two angular variables θ and ϕ and the corresponding conjugate momenta p_θ and p_ϕ. The kinetic energy of rotational motion is

$$\epsilon_{\mathrm{rot}} = \frac{1}{2I}p_\theta^2 + \frac{1}{2I\sin^2\theta}p_\phi^2\,;$$

I is the moment of inertia. Calculate (using classical mechanics) the specific heat, C_v of N such molecules.

Problem 19.

The vibrations of molecules exhibit anharmonicity. The quantum energy levels can be approximated by

$$\varepsilon_n = \epsilon_0\left[n + \frac{1}{2} - x\left(n + \frac{1}{2}\right)^2\right]\,;$$

x is a parameter characterizing the anharmonicity. Calculate the specific heat to first order in x.