

Physics 831 Quiz #5 - Friday, Oct. 20

A molecule of mass m has internal excitations consistent with that of a three-dimensional harmonic oscillator with tightly packed levels, $\hbar\omega \ll T$. Initially, a gas of such molecules is at temperature T_i before expanding and cooling adiabatically to a temperature T_f . Neglect quantum degeneracy of the momentum states for the following questions.

1. Derive an expression for the initial entropy per particle in terms of m , T_i , $\hbar\omega$ and the initial density ρ_i .
2. After adiabatically cooling to T_f , find the density ρ_f . Give answer in terms of T_i , T_f and $\hbar\omega$.