Physics 831 Quiz #8 - Friday, Nov. 10

YOUR NAME:_____

1. Consider a long one-dimensional chain of N coupled three-dimensional harmonic oscillators. The chain supports both longitudinal and transverse modes with the same speed of sound c_s.

   (a) What is the specific heat per oscillator, $(dE/dT)/N$, at low temperature? Express expansion as
   $$C/N = AT^n.$$
   Find the power n, and solve for A in terms of the temperature T, c_s, and the density of oscillators per unit length, $\rho = N/L$.

   (b) What is the specific heat per oscillator at high temperature? Express your answer in terms of the same three variables.

2. A cloud of radioactive buckeye pollen is suspended in liquid between two parallel plates separated by a distance L. While between the plates, the motion of the pollen is diffusive, described by a diffusion constant D. When pollen touches the plates, the noxious weed grains are annihilated by a high voltage electric field. At a time $t = 0$, the pollen density is given by
   $$\rho(x, t = 0) = A_0 \sin(\pi x/L).$$

   (a) Find an expression for $\rho(x, t > 0)$.

   (b) What fraction of the pollen survives as a function of t.