PHYS 225 – Spring 2011 **Marie Lopez del Puerto**

HW #21

1. Derivation for Exam 3: Show that, for the 3D particle-in-a-box with energies given by

$$E = \frac{\pi^2 \hbar^2}{2mL^2}(n_x^2 + n_y^2 + n_z^2)$$

the density of states is $$g(E) = 8\pi\sqrt{2}\left(\frac{m}{h^2}\right)^{3/2} E^{1/2}$$

2. Density of states in one and two dimensions.

a. Show that the density of states (number of states per unit length per unit energy) for a particle in a box in one dimension is

$$g_1(E) = \frac{1}{\pi}\left(\frac{2m}{\hbar^2 E}\right)^{1/2}$$

b. Show that in two dimensions, the density of states (number of states per unit area per unit energy) is

$$g_2(E) = \frac{m}{\pi\hbar^2}$$

which is independent of E!

c. Make a sketch of g_1, g_2, and g_3 (the three dimensional density of states) vs. E.

3. (Kasap Example 4.7) Density of states in a band Given that the width of an energy band is typically ~10eV, calculate the following, in per cm^3 and per eV units:

a. The density of states at the center of the band.
b. The number of states per unit volume within a small energy range kT about the center.
c. The density of states at kT above the bottom of the band.
d. The number of states per unit volume within a small energy range kT to $2kT$ from the bottom of the band.