Physics 224 **Fall 2002**

Discoveries and Inventions of Modern Physics **due 11:00 am Tuesday Oct. 15**

PROBLEM SET 2

Oct. 10 Colloquium: "Dynamic Contrast Magnetic Resonance Imaging in Cancer and Neuro Studies"

Professor Lydia Su, UCI

3:30 pm, 101 Rowland Hall

1. Consider a nonrelativistic free particle in a cubic container of edge length L and volume $V = L^3$. Assume that the particle is confined in the container so that the potential is zero inside the container and infinite outside.

   (a) Each quantum state s of this particle has a corresponding kinetic energy ε_s which depends on V. What is $\varepsilon_s(V)$?

   (b) Find the contribution to the gas pressure $p_s = -(\partial\varepsilon_s/\partial V)$ of a particle in this state in terms of ε_s and V.

   (c) Use this result to show that the mean pressure $< p >$ of any ideal gas of particles is always related to its mean total kinetic energy $< E >$ by $< p >= \frac{2}{3} < E > /V$.

2. Eisberg and Resnick: 1.16

3. Eisberg and Resnick: 11.3 (Note that in terms of the notation used in class $\varepsilon_F = \mu$.)

4. Eisberg and Resnick: 11.5 (Note that in terms of the notation used in class $\alpha = -\beta\mu$.)

5. Plot the blackbody distribution spectrum $\rho_T(\eta)$ versus $\eta = \hbar\omega/kT$ at T=3 K.

6. Eisberg and Resnick: 1.19 (Hint: Use the result of the previous problem and the result stated in problem 1.18.)

7. Eisberg and Resnick: 1.12