
PROBLEM SET 1

1. Eisberg and Resnick: Problem 6.19 (Note the difference between “Questions” and “Problems” in Eisberg and Resnick.)
2. Eisberg and Resnick: Problem 6.20
3. In class we counted the states in a 3D box. Do the same for a 2D box. In particular find
 - (a) the energy eigenstates $E(n_x, n_y)$
 - (b) the density of states $N(\omega)$ for photons that have only *one* polarization
4. Consider a nonrelativistic free particle in a cubical container of edge length L and volume $V = L^3$.
 - (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 $p_r = -(\partial\varepsilon_s/\partial V)$ of a particle in this state in terms of ε_s and V .
 - (c) Use this result to show that the mean pressure $\langle p \rangle$ of any ideal gas of particles is always related to its mean total kinetic energy $\langle E \rangle$ by $\langle p \rangle = \frac{2}{3} \langle E \rangle / V$.
5. Consider the case of the orbital angular momentum quantum number $\ell = 2$ and the spin angular momentum number $s_z = 1/2$.
 - (a) What are the possible values of the total angular momentum number j ? ($\vec{J} = \vec{L} + \vec{s}$)
 - (b) For each value of j , what are the possible values of j_z ?