PHY 745 – Problem Set #10

This homework is due Wednesday, February 11, 2009.

Continue reading Chapter 4 in **Tinkham**.

1. Consider a quantum mechanical free particle of mass m confined within a rectangular box of dimensions $-a \leq x \leq a$, $-a \leq y \leq a$, and $-b \leq z \leq b$.

   (a) Check that the eigenstates of the particle all vanish on the 6 planes that bound the box and take the form:

   $$\Psi_{lmn}(x, y, z) = \frac{1}{\sqrt{a^2 b}} \, w_l \left(\frac{l\pi x}{2a} \right) \, w_m \left(\frac{m\pi y}{2a} \right) \, w_n \left(\frac{n\pi z}{2b} \right),$$

   where

   $$w_n(u) = \begin{cases} \cos(u) & \text{if } n \equiv \text{ odd} \\ \sin(u) & \text{if } n \equiv \text{ even} \end{cases}$$

   (b) Now consider these states with reference to the D_4 point group discussed in your text book and in the Notes for Lecture 9 –
   http://www.wfu.edu/~natalie/s09phy745/lecturenote/. From the character table for this point group, for each irreducible representation, find at least one example of a basis function from the $\Psi_{lmn}(x, y, z)$ eigenstates.