Problem Set 8
Phy 211 - Fall 2002
Assigned: Friday, Nov. 1; Due: Thursday Nov. 7
DUE AT THE BEGINNING OF CLASS

Problem 1: Bloch's Theorem

Consider the Hamiltonian for a particle moving in a periodic potential, $V(x) = V(x+a)$.

a) Show $[T(a), \hat{H}] = 0$, where $T(a)$ is the translation operator. Note that in general the Hamiltonian is not invariant under arbitrary translations but only under translations by a.

b) Show that the eigenfunctions of $T(a)$ are of the form:

$$\psi(x) = e^{ikx}u(x) \ \text{, where} \ \ u(x) = u(x+a)\,,$$

where k is arbitrary. This is Bloch's Theorem.

Problem 2: Angular Momentum Eigenfunctions

Shankar, Problem 12.3.3 and 12.3.4

Problem 3: Particles In More than One Dimension

Shankar, Problem 10.2.1 and 10.2.2

Problem 4: 2-D Oscillator in Radial Coordinates

Shankar, Problem 12.3.7

Problem 5: Particle in a Magnetic Field (Graduate Student Problem)

Shankar, Problem 12.3.8