Fall Term 2006

22.02 Introduction to APPLIED NUCLEAR PHYSICS

Problem Set #5

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Passed Out: October 12, 2006 DUE: October 24, 2006

1. Suppose system of Question 2 from Problem Set #2 is prepared at $t = 0$, with wavefunction,

$$\psi(x) = a_2\psi_2(x) + a_5\psi_5(x)$$

Evolve the system according to the Schrödinger equation to derive $\psi(x,t)$ and compute the probability that a measurement of the particle's position finds the particle between $x = \frac{L}{2}$ and $x = \frac{L}{2} + \Delta x$, at time t. What is the probability that a measurement of the energy of the system finds: a) $E = E_1$, b) $E = E_2$, c) $E = E_3$, and d) $E = E_5$ where the eigenstate energies are $E_n = \frac{\hbar^2\pi^2}{2mL^2}n^2$?

2. Prove the commutation relation,

$$\left[\widehat{L}_z, \widehat{L}^2\right] = 0$$

and discuss why the same relation holds for the other, (x, y), components of angular momentum.

3. Liboff, problems 9.1, 9.3

4. Suppose a system is in the angular momentum state,

$$\begin{aligned} l &= 5 \\ m &= 4 \end{aligned}$$

What are the possible measurement results for the z component of angular mometum? What are the possible measurement values for the x component of angular momentum?

5. Liboff, problems 9.23, 9.25(a)

6. Liboff, problems 9.30, 9.34, 9.35.