Name:

Exam 1 - PHY 4604 - Fall 2002

Monday, September, 30, 2002

This exam is closed book and notes. You are not allowed (nor will you need) a calculator. Please use the space provided on the exam to do the problems. You may also use the backs of pages if additional space is needed.

1. Short answer section:

   (a) What is Planck's constant numerically?

   (b) What is the continuity equation?

   (c) What is the probability current in one dimension?

   (d) Given $\psi(p)$ how does one determine $\psi(x)$?

   (e) A set of wave functions, $u_n(x)$, for $n = 1, 2, 3 \ldots$ on the interval $[a, b]$ is said to be complete or satisfy the expansion function postulate if:

2. Consider the following wave functions on the interval $[-1, 1]$.

$$u_0(x) = \frac{1}{\sqrt{2}} \tag{1}$$

$$u_1(x) = \frac{\sqrt{3}}{\sqrt{2}}\, x \tag{2}$$

$$u_2(x) = ax^2 + b \tag{3}$$

These wave functions are orthonormal on the interval $[-1, 1]$.

(a) Determine values for the coefficients a and b which make u_2 orthogonal to u_1, u_0 and normalized.

(b) What is the expectation value of x for u_0, u_1, and u_2?

(c) What is Δx for u_1?

3. Consider the potential in one dimension $V(x) = 0$ for $x > 0$, $V(x) = V_o$ for $x < 0$, and $V(x) = \lambda(\hbar^2/2ma)\delta(x)$ at $x = 0$. Suppose $\underline{0 < E < V_o}$.

   (a) What is the form of the solution to the time-independent Schrodinger equation for $x < 0$?

   (b) What is the form of the solution to the time-independent Schrodinger equation for $x > 0$?

   (c) What are the boundary conditions at $x = 0$?

(d) Solve for the wave function for a wave coming **from the right**.

(e) Determine the transmission and reflection probabilities. Is probability conserved?