University of California, Berkeley
Physics H7C Fall 1999 (*Strovink*)

PROBLEM SET 9

1.
Rohlf 5.31.

2.
Rohlf 6.12.

3.
Rohlf 6.29.

4.
Rohlf 6.32.

5.
Rohlf 7.4.

6.
Rohlf 7.5.

7.
Show that the "conservation of probability" law

$$\frac{\partial}{\partial t}\left(\psi^*\psi\right) + \frac{\partial}{\partial x} j = 0, \quad \text{where}$$
$$\frac{\hbar}{2mi}\left(\psi^* \frac{\partial \psi}{\partial x} - \frac{\partial \psi^*}{\partial x}\psi\right) \equiv j,$$

and j is the *probability current* in one dimension x, holds if $\psi(x,t)$ is a solution of the Schrödinger equation with a potential $V(x)$, provided that $V(x)$ is real. Therefore absorptive potentials are *imaginary*.

8. A particle of mass m is bound in an infinitely deep one-dimensional potential well extending from $x = 0$ to $x = L$. At $t = 0$ it is described by a wavefunction of the form

$$u(x) \propto \sin(\pi x/L) + \sin(2\pi x/L).$$

(a.)
Normalize $u(x)$.
(b.)
When the particle's energy E is measured for the first time, what value(s) could be obtained?
(c.)
What is the expectation value $\langle \mathcal{H} \rangle$ of the particle's kinetic energy? (Cogent arguments can substitute for some algebra here, and are encouraged.)
(d.)
At what time t_0 is the probability for the particle to be located on the *right-hand* side of the well ($L/2 < x < L$) a maximum? Reasoning rather than detailed calculation is needed. Please supply it.