Ph195b – Study problems for 2/11/02

[These problems are from R. L. Liboff, *Introductory Quantum Mechanhics* 3*rd Ed.* (Addison Wesley, 1998).]

1. Calculate the transmission coefficient (ratio of transmitted to incident *probability currents*) for the double potential step,

$$\begin{aligned} V(x) &= 0 \qquad x < 0, \\ &= V_1 \qquad 0 \le x < a, \\ &= V_2 \qquad x \ge a, \end{aligned}$$

where $0 < V_1 < V_2$. Assume that the particle's energy E is greater than V_2.

2. If we call T_1 the transmission coefficient appropriate to the single potential step V_1 and T_2 that appropriate to the single potential step V_2, show that

$$T_2 \le T_1,$$
$$T \ge T_2,$$

where T is the answer to Problem #1. You may quote results from Merzbacher if convenient. Offer a physical explanation for these inequalities.

3. What are the three sets of conditions under which T is maximized? What do these conditions correspond to physically?

4. A student argues that T is the product $T_1 T_2$ on the following grounds. The particle current that penetrates the V_1 barrier is $T_1 J_{inc}$, where J_{inc} is the incident probability current. This current $T_1 J_{inc}$ is then incident on the V_2 barrier so that $T_2(T_1 J_{inc})$ is the current transmitted through the second barrier. What is the incorrect assumption in this argument?