Physics 202H - Introductory Quantum Physics I Homework #10

Fall 2004 Due 5:01 PM, Monday 2004/11/29

[40 points total]

"Journal" questions. Briefly share your thoughts on the following questions:
– How do you feel about the usefulness and/or effectiveness of these "Journal" types of activities? What do you think their best aspect has been? What change to their format or content might improve their usefulness and/or effectiveness? Why?
– Any comments about this week's activities? Course content? Assignment? Lab?

---

1. For a free particle the wave function is $\Psi(x,t) = A\mathrm{e}^{\mathrm{i}(kx-\omega t)}$. What value do you get for A if you normalize this wave function over all space? How can we address this difficulty? Limit your discussion to about 50 words or so. [10]

2. (From Eisberg & Resnick, Q 6-11, pg 227) Exactly what is meant by the statement that the reflection coefficient is one for a particle incident on a potential step with total energy less than the step height? What is meant by the statement that the reflection coefficient is less than one but greater than zero if the total energy is greater than the step height? Can the reflection coefficient ever by greater than one? Limit your discussion to about 50 words or so. [10]

3. (From Eisberg & Resnick, P 6-2, pg 228) Repeat the step potential calculation of Section 6-4, but with the particle initially in the region $x > 0$ where $V(x) = V_0$, and traveling in the direction of decreasing x towards the point $x = 0$ where the potential steps down to its value $V(x) = 0$ in the region $x < 0$. Show that the transmission and reflection coefficients are the same as those obtained in Section 6-4. [10]

4. (From Eisberg & Resnick, P 6-3, pg 228) Prove that the sum of the reflection and transmission coefficients equals one (Eisberg & Resnick, Equation 6-43, pg 197), for the case of a step potential with $E > V_0$. [10]

Headstart for next week, Week 11, starting Monday 2004/11/29:
– Read Chapter 6 "Solutions of Time-Independent Schroedinger Equation" in Eisberg & Resnick
– – Section 6.5 "The Barrier Potential"
– – Section 6.6 "Examples of Barrier Penetration by Particles"
– – Section 6.7 "The Square Well Potential"
– – Section 6.8 "The Infinite Square Well Potential"