This assignment asks you to derive the principle results for §6-5, on the barrier of finite potential and finite spatial extent, for the case where the energy, $E$, of the particle is less than the height of the barrier, $V_0$, i.e., for the case $E < V_0$.

You are asked to perform problem P6-5, which is one of the longest problems in the book. This problem is weighted at 50% of the assignment. Do not even think of coming to me for help unless you have 3 or 4 pages of hard algebra. My solution is 7 pages long and contains 15 numbered equations.

1. Using the method of solution for an ordinary differential equation of constant coefficients, derive equations (6-46) and (6-47) for $\psi(x)$ from the time-independent Schrödinger equation, (5-43). Write a brief statement explaining why we can set the constant, $D$, equal to zero.

2. Write down the expression for the wave function, $\Psi(x, t)$, in each of the three regions.

3. Show that the probability density, $P(x) = \Psi^* \Psi$, is a constant in the region $x > a$. Give a physical interpretation of this result.

4. Problem 6-5: asks you to derive (6-49), the transmission coefficient for the barrier potential when $E < V_0$. Start by finding relations between the amplitudes of the waves by enforcing the condition that $\psi$ and $\psi'$ be continuous at $x = 0$ and $x = a$, and then follow closely the hint given in the problem.

5. Problem 6-6: asks you to derive (6-50), an approximation of the transmission coefficient from (6-49) under certain conditions.

6. Make a plot of equation (6-50) for the transmission coefficient of a particle in energy conditions that are the same as that in Figure 6-15, i.e., where $\frac{2mV_0a^2}{\hbar^2} = 9$. Look at where your plot deviates from Figure 6-15, and state why this deviation occurs.

Grading

- You can share concepts, but all work must be completely original
- Write neatly and legibly
- Line up equal signs in a straight vertical column, and never have more than one equal sign on a line
- Define all non-standard variables
- Do not skip essential lines of algebra
- Develop ideas logically from start to finish
- Include a statement at the end of each problem interpreting the result
- Label your diagrams with a title, axis labels and units; all plots must be computer plots
- Take pride in your work
- All assignments are weighted equally