Quantum Mechanics 1 – Assignment #5

due September 27 in class

I will denote the book by Griffiths and Schroeter by **GS**. For this assignment, all the problems come from the GS book:

Problem 1: Using the equations below, evaluate the transmission coefficient for an electron with a total energy of 2 eV that is incident on a 4 eV rectangular potential barrier with a width of 10^{-10} m. Repeat for a barrier with width 10^{-9} m.

$$T = \left[1 + \frac{\sinh^2(k_{II}a)}{4\frac{E}{V_0}\left(1 - \frac{E}{V_0}\right)} \right]^{-1} ,$$

where

$$k_{II}a = \sqrt{\frac{2mV_0a^2}{\hbar^2}\left(1 - \frac{E}{V_0}\right)} .$$

Note: If the exponents are very large, the formula for T reduces to

$$T \approx 16\frac{E}{V_0}\left(1 - \frac{E}{V_0}\right)e^{-2k_{II}a} , \quad k_{II}a \gg 1 .$$

Problem 2: A proton and a deuteron (a particle with the same charge as the proton but twice its mass) are trying to penetrate a 10 MeV potential barrier whose width is 10^{-14} m. Both particles have a total energy of 3 MeV. (a) Using qualitative arguments only, predict which one has a larger success probability. (b) Evaluate the probability for each particle.

GS problems: 2.47, 2.61, 2.64, 3.4, 3.32