Problem 1. (10 points) A particle of $10^{-5}$ g moving with a speed of $10^{-1}$ cm/s is confined in a box 1 mm in length. Treat this as a one-dimensional infinite square well, calculate the approximate value of the quantum number $n$? In the ground state, calculate the speed of the particle?

Problem 2. (10 points) An electron moving in a one-dimensional infinite square well of length $L$ is trapped in the $n = 3$ state. Find the probability of finding the electron within the “volume element” $\Delta x = 0.01$ L at $x = L/2$.

Problem 3. (10 points) A proton is in the ground state with energy $E_n$ of a one-dimensional infinite well with $L = 10^{-10}$ m. Compute the force that the proton exerts on the wall during an impact on either wall. (Hint: $F = -dE_n/dL$). How does this result compare with the weight of a proton at the surface of Earth?

Problem 4. (10 points) Sketch (a) the wave function and (b) the probability distribution for the $n = 6$ state for the finite square well potential.

Problem 5. (20 points) Find (a) $<x>$; (b) $<x^2>$; (c) $<p>$, and (d) $<p^2>$ for the first excited state ($n = 2$) in an infinite square well potential.