Problem 1

a, Calculate the corresponding de Broglie wavelengths of **electrons** with energies of 10, 100, and 1000ev, respectively.

b, Calculate the corresponding de Broglie wavelengths of **photons** with energies of 10, 100, and 1000ev, respectively.

Problem 2

Given the wavefunction of a particle

$$\psi = N \exp\left\{-\frac{|x|}{2a} - \frac{|y|}{2b} - \frac{|z|}{2c}\right\}$$

calculate:

(a) The normalization constant N

(b) The probability of the x coordinate of the particle being in the range of 0 to a

(c) The probabilities of the y coordinate and z coordinates being in the range of $-b \to +b$ and $-c \to +c$, respectively

Problem 3

Assume that a hydrogen atom is in the state

$$\psi(r, \theta, \phi) = \frac{1}{\sqrt{\pi a_1^3}} e^{-r/a_1}$$

in which a_1 is the first Bohr radius. Calculate the average value of the potential

$$U(r) = -\frac{e^2}{r}$$

Problem 4

Consider a particle in an infinite square well of width *d*. Solve the Schrödinger equation to obtain the eigenenergies and eigenfunctions. When the particle is in its ground state, calculate the probability of finding the particle within Δx=0.01*d* at (a) x=0.5*d* (b) x=0.25*d* (c) x=*d*.

Problem 5

Verify that the angular momentum operator **L** obeys the following commutation relation:

$$[L_x, L_y] = i\hbar L_z$$