0.1 Assignment 1

1. Give a brief account of the early experimental discoveries that could not be explained by classical physics. How did quantum physics give an account of these experiments?

2. Outline the postulates of quantum mechanics.

3. What is a wavefunction as used in quantum mechanics? What are the characteristics of acceptable wavefunctions in quantum mechanics?

4. Obtain the time dependent Schrodinger equation for a particle under a potential V_o

5. What is a Hermitian operator? Prove that the operators $i\frac{d}{dx}$ and $\frac{d^2}{dx^2}$ are Hermitian.

6. Normalize the wavefunction $\psi(x) = Axe^{-ax^2}$ between $-\infty < x < \infty$.

7. The wavefunction of the particle at time t = 0 is given by $\psi(x, 0) = A \sin \frac{5\pi x}{a} \cos \frac{2\pi x}{a}$. Normalize this wavefunction.

8. Consider a one-dimensional particle which is confined within the region $0 \leq x \leq a$ and whose wavefunction is $\psi(x, t) = \sin(\frac{\pi x}{a})\exp(-i\omega t)$. Find the potential V(x) and calculate the probability of finding the particle in the interval $\frac{a}{4} \leq x \leq \frac{3a}{4}$.

9. The wavefunction of a particle in a state is $\psi = N\exp(-\frac{x^2}{2a})$, where $N = (\frac{1}{\pi a})^{\frac{1}{4}}$. Show that $(\Delta x)(\Delta p) = \frac{\hbar}{2}$.