Date

Assignment - 2

Q.1 Why should the wave function $\psi(x)$ be a single Value everywhere.

Ans The Probability density of finding the particle is given by $P = \psi\psi^*$. ψ should be single value so the probability has unique value at everywhere

Q.2 What do you mean by a free particle?

Ans Free particle is a particle on which no forces are acting Such particle is characterized by definite momentum energy

Q.3. Why should Schrodinger equation have the Ist order time derivative?

Ans To describe completely the wave function it is necessary to get the first order time derivative

Q.4. Can we represent a matter wave associated with the free particle by a wave function $\psi(x,t) = A\sin(kx - \omega t)$

Ans If this wave function $\psi(x,t) = A\sin(kx - \omega t)$ describe the free particle it must satisfy the one-dimensional time dependent Schrodinger wave Equation

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} = i\hbar\frac{\partial\psi}{\partial t}$$

After taking derivative LHS ≠ RHS Hence, this function does not represent a matter wave

Q.5 why can't a function $e^{i(Kx-\omega t)}$ be used to represent a localised particle in quantum mechanics?

Ans For localized particle ψ^* & ψ must depend on x

$$\psi(x,t) = e^{i(Kx-\omega t)}$$

$$P = \psi^* \psi$$

$$P = e^{-i(Kx-\omega t)} \cdot e^{i(Kx-\omega t)}$$

$$P = 1$$

But, here it is independent of x, so, it fails to represent the localized particle

Q.6 Is the Schrodinger equation valid for realistic particles?

Ans No, Because we used to classical expression

$$E = \frac{P^2}{2m} + V$$

For the derivation of Schrodinger wave equation

Q.7 what are orthogonal wave function?

Two wave functions are said to be orthogonal if it satisfy the following condition

$$\int_{-\infty}^{\infty} \psi_m^* \psi_n \, dx = 0$$

Q.8 The mass of the particle appears in Schrodinger's wave equation but its charge does not. Both charge & the mass effect the motion. why?

The Schrodinger equations & describe the De-broglie wave associated with the particle The De-broglie wavelength depends only on mass Hence, the mass of the Particle appears in Schrodinger wave equation but it charge does not

Q9 which operator is used for calculating the expectation value of momentum

$$P_x \to i\hbar \frac{\partial}{\partial x}$$

$$P_y \to \cancel{i} - \hbar \frac{\partial}{\partial y}$$

$$P_z \Rightarrow -i\hbar \frac{\partial}{\partial z}$$

Q10 which operator is used for calculating the expectation value of energy

$$E \Rightarrow i\hbar \frac{\partial}{\partial t}$$