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Physics

Assignment -9

Que-1) Why should the function $\psi(x)$ be a single value everywhere?

Ans-1 The probability density of finding the particle, given by $P = \psi\psi^*$, ψ should be single value so that the probability has unique value everywhere.

Que-2) What do you mean by a free particle?

Ans-2) Free particle is a particle on which no forces are acting such particle is characterised by definite momentum & energy.

Que-3 Why should schrondinger equation have the 1st order time derivative.

Ans-3 To describe completely the wave function it is necessary to get the first order time derivative.

Que-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-4) On this function $\psi(x,t) = A\sin(kx - \omega t)$ describe the free particle it must satisfy the one dimensional time dependent schrondinger 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 doesn't represent a matter wave.

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Qus-5) Why can't a function $e^{i(kx-\omega t)}$ be used to represent a localised particle in quantum mechanics?

Ans-5) For localised particle ψ^* and 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 localised particle.

Qus-6) Is the Schrondinger equation valid for realistic particle?

Ans-6) No, because we use the classical expression

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

for the derivation of schrondinger wave equation

Qus-7) What are orthogonal wave function.

Ans-7) Two wave functions are said to be orthogonal if it satisfy the following condition:

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

Qus-8) The mass of the particle appears in schrondinger's wave equ but its charge does not. both charge & the mass effect the motion. why?

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Ans- The Schrondinger equation describe the De-broglie waves associated with the particle. The De-Broglie wavelength depends only on mass. Hence, the mass of the particle appears in schrondinger wave equation but its ~~leng~~ charge does not.

Qus-9) Which operator is used for calculating the expectation value of momentum?

Ans-9)

$$P_x \rightarrow -i\hbar \frac{\partial}{\partial x}$$

$$P_y \rightarrow -i\hbar \frac{\partial}{\partial y}$$

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

Qus-10) Which operator is used for calculating the expectation value of energy.

Ans-10)

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