Ques:- Schrondinger wave equation :-

→ This wave equation is a fundamental equation in quantum mechanics & describes the variation of wave function ψ in space & time.

→ Time dependent schrondinge Wave eqn

→ Wave function = $\psi = \psi_0 e^{-i\omega t}$

$$\frac{\partial \psi}{dt} = -i\omega \psi_0 e^{-i\omega t}$$

$$\frac{\partial \psi}{\partial t} = -i(2\pi\nu)\psi$$

But $E = h\nu$ $\quad \nu = E/h$.

$$\rightarrow \frac{d\psi}{dt} = -i2\pi\left(\frac{E}{h}\right)\psi$$

$$\frac{\partial \psi}{dt} = \frac{-i \cdot E}{\hbar}\psi \qquad \left(\hbar = \frac{h}{2\pi}\right)$$

$$E\psi = -\frac{\hbar}{i}\frac{d\psi}{dt}$$

$$E\psi = i\hbar\frac{d\psi}{dt}.$$

On Time independent eqn :-

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$$\nabla^2\psi + \frac{2m}{\hbar^2}(E-V)\psi = 0$$

$$\nabla^2\psi + \frac{2m}{\hbar^2}[E\psi - V\psi] = 0$$

$$\nabla^2\psi + \frac{2m}{\hbar^2}\left[i\hbar\frac{\partial\psi}{\partial t} - V\psi\right] = 0$$

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

$$\left[\nabla^2 - \frac{2mV}{\hbar^2}\right]\psi = -\frac{2m}{\hbar^2}i\hbar\frac{\partial\psi}{\partial t}$$

$$\left(\frac{-\hbar^2}{2m}\nabla^2 + V\right)\psi = i\hbar\frac{\partial\psi}{\partial t}$$

$$\Rightarrow \boxed{\frac{-\hbar^2}{2m}\nabla^2 + V = H} \rightarrow \text{Hamiltonian operator}$$

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