Ans Schrodinger's equation, which is the fundamental equation of quantum mechanics, is a wave equation is the variable V.

- Time independent Schrodinger wave eq.

Consider a system of stationary wave to be associated with particle and the position coordinate of the particle (x, y, z) and ψ is the periodic displacement at any instant time 't'.

The general wave equation in 3-D in differential form is given as.

$$\nabla^2 \psi = \frac{1}{v^2} \frac{\partial^2 \psi}{\partial t^2}$$

Where, v = Velocity of wave and

$$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2} = \text{Laplacian operator}$$

The wave function may be written as

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

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Differentiating eq w.r.t time, we get

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

Again differentiating eq, we get

$$\frac{\partial^2 \psi}{\partial t^2} = i^2 \omega^2 \psi_0 e^{-i\omega t}$$

$$\frac{\partial^2 \psi}{\partial t^2} = -\omega^2 \psi$$

Putting these Value in eq

$$\nabla^2 \psi = -\frac{\omega^2}{v^2} \psi$$

But

$$\omega = 2\pi \nu = \frac{2\pi v}{\lambda} = \frac{\omega}{v} = \frac{2\pi}{\lambda}$$

From eq and eq, we get

$$\nabla^2 \psi = -\frac{4\pi^2}{\lambda^2} \psi$$

From de-Broglie's wavelength

$$\lambda = \frac{h}{mv}$$

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then,

$$\nabla^2 \psi = \frac{-4\pi^2 m^2 v^2}{h^2} \psi$$

if E and V are the total energy and Potential energy of a particle of E_k is kinetic energy, then

$$E_k = E - V \quad \text{or} \quad \frac{1}{2} m v^2 = E - V$$

$$m^2 v^2 = 2m(E - V)$$

From ② and ③ we get

$$\nabla^2 \psi = \frac{-4\pi^2 \, 2m \, [E - V] \psi}{h^2}$$

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

This is required time - independent Schrodinger wave equation