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Schrodinger wave equation →

Schrodinger derived an equation based on de-Broglie dual behaviour of electrons and Heisenberg uncertainty principle is known as Schrodingers wave equation.

The equation is named after Erwin Schrodinger, who postulated the equation in 1925, and published in 1926, forming the basis for the work that resulted in his Nobel prize in physics in 1933.

The total energy of electron or any particle are given by,

$$E = K.E + P.E$$

K.E = Kinetic energy P.E = Potential energy

$$E = \frac{1}{2}mv^2 + V \quad \text{—— (1)}$$

K.E can be expressed as

$$\frac{1}{2}mv^2 = \frac{1}{2}m \cdot \frac{mv^2}{m} = \frac{1}{2} \times \frac{(mv)^2}{m}$$

Now substitute the value of mv from de-Broglie's equation ($mv = \frac{h}{\lambda}$) we get,

$$\frac{1}{2}mv^2 = \frac{\left(\frac{h}{\lambda}\right)^2}{2m} = \frac{\frac{h^2}{\lambda^2}}{2m}$$

$$K.E = \frac{h^2}{2\lambda^2 m} \quad \text{—— (2)}$$

Putting the value of $\frac{1}{2}mv^2$ from eqn (2) into eqn. (1) we get,

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

$$\frac{h^2}{2\lambda^2 m} = E - V \quad \text{—— (3)}$$

$$\lambda^2 = \frac{h^2}{2m(E-V)} \quad \text{——— (4)}$$

For moving particle like electron in the x-direction can be expressed as.

$$\frac{\partial^2\psi}{\partial x^2} + \frac{4\pi^2\psi}{\lambda^2} = 0 \quad \text{——— (5)}$$

Now put the value of λ^2 from eqn. (4) into eqn. (5) we get

$$\frac{\partial^2\psi}{\partial x^2} + 4\pi^2\psi \times \frac{2m}{h^2}(E-V) = 0$$

$$\frac{\partial^2\psi}{\partial x^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{——— (6)}$$

Eqn. (6) can be written as

$$\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{——— (7)}$$

Where, m = mass of electron

V = Potential energy of electron

E = Total energy of electron

ψ = wave function of electron

Applications → (1) To explain the behaviour of micro particle.

(2) To determine the total energy

(3) To determine the translational energy

(4) To analyse molecular motion.

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