EngineeringRise

Dual nature, uncertainty principle and quantum mechanical model

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
de Broglie wavelength	wavelength = h / (m v) = h / p Valid when: any moving particle, non-relativistic speed	m (with h in J s, m in kg, v in m s^-1)
From kinetic energy	wavelength = h / sqrt(2 m K) Valid when: non-relativistic particle; K is its kinetic energy	m (K in J)
Electron through V volt	wavelength = 1226 / sqrt(V) Valid when: electron accelerated from rest through V volt, non-relativistic	pm (V in volt)
Standing-wave condition	2 pi r = n x wavelength, giving m v r = n h / (2 pi) Valid when: electron in a circular Bohr orbit, n a whole number	J s
Uncertainty principle	delta x x delta p is at least h / (4 pi); delta v at least h / (4 pi m delta x) Valid when: simultaneous position and momentum of one particle along the same axis	delta x in m, delta p in kg m s^-1, delta v in m s^-1
Radial nodes	n - l - 1 (total nodes n - 1, angular nodes l) Valid when: orbitals of hydrogen-like species; n principal, l azimuthal quantum number	number
2s node	r = 2 a0 / Z Valid when: 2s orbital of a one-electron species of nuclear charge Z	pm (a0 = 52.9 pm)
Probability density	psi squared at a point	m^-3
Equal-energy ratio	wavelength 1 / wavelength 2 = sqrt(m2 / m1) Valid when: particles with equal kinetic energy; m1 and m2 their masses	dimensionless

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/atomic-structure/dual-nature-uncertainty-principle-and-quantum-mech

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