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Matter waves and the de Broglie relation

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

Result	Formula	Units or note
de Broglie relation	lambda = h/p = h/(m v) Valid when: any particle; h/(m v) form needs speed much less than c	m (h = 6.63 x 10^-34 J s)
With kinetic energy	lambda = h/sqrt(2 m K) Valid when: non-relativistic particle; K is its kinetic energy in joule	m (K in joule)
Charge q through V	lambda = h/sqrt(2 m q V) Valid when: non-relativistic charge q released from rest and accelerated through V	m
Electron through V volt	lambda = 12.27/sqrt(V) angstrom Valid when: electron from rest through V volt, non-relativistic; result in angstrom	angstrom (1 angstrom = 10^-10 m)
Thermal particle	lambda = h/sqrt(3 m k T) Valid when: particle in thermal equilibrium at T using mean K = 3kT/2	m (k = 1.38 x 10^-23 J/K)
Ratio, same speed	lambda1/lambda2 = m2/m1 Valid when: particles with the same speed, non-relativistic	dimensionless
Ratio, same kinetic energy	lambda1/lambda2 = sqrt(m2/m1) Valid when: particles with the same kinetic energy, non-relativistic	dimensionless
Ratio, same potential	lambda1/lambda2 = sqrt(m2 q2/(m1 q1)) Valid when: particles accelerated from rest through the same potential V	dimensionless
Photon against particle (equal lambda)	E/K = 2 m c lambda/h Valid when: photon and non-relativistic particle having the same wavelength	dimensionless

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/dual-nature-of-matter-and-radiation/matter-waves-and-the-de-broglie-rel

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