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# Rutherford and Bohr models, hydrogen spectrum

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

| Result | Formula | Units or note |
|---|---|---|
| **Orbit radius** | r_n = 0.529 n^2/Z Valid when: Bohr model, one-electron atom or ion of charge Z | angstrom |
| **Orbit speed** | v_n = 2.19 x 10^6 Z/n Valid when: Bohr model, one-electron atom or ion of charge Z | m/s |
| **Energy of level n** | E_n = -13.6 Z^2/n^2 Valid when: Bohr model, one-electron atom or ion; zero energy at infinity | eV |
| **Angular momentum** | m v r = n h/(2 pi) Valid when: Bohr quantisation for a circular orbit of the single electron | J s |
| **Photon energy of a jump** | E = 13.6 Z^2 (1/n1^2 - 1/n2^2) Valid when: one-electron atom; electron jumps from n2 down to n1 | eV |
| **Rydberg form** | 1/lambda = R Z^2 (1/n1^2 - 1/n2^2), R = 1.097 x 10^7 Valid when: one-electron atom; transition from n2 to n1; R = 1.097e7 per m | per metre |
| **Wavelength from energy** | lambda = 1240/E Valid when: E in eV gives wavelength in nm (hc = 1240 eV nm) | nm (E in eV) |
| **Lines from n levels** | n(n - 1)/2 Valid when: atoms spread over all levels up to n, every transition possible | number |
| **Closest approach (head-on)** | d = 2 Z k e^2/K, k e^2 = 1.44 MeV fm Valid when: head-on alpha, fixed target nucleus, only Coulomb force, Z of target | fm |
| **Time period and frequency** | T proportional to n^3/Z^2; f proportional to Z^2/n^3 Valid when: Bohr orbits of a one-electron atom with charge Z | s (Hz) |

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/atoms-and-nuclei/rutherford-and-bohr-models-hydrogen-spectrum

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