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Moment of inertia, radius of gyration and axes theorems

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

Result	Formula	Units or note
Definition	I = sum m r^2 = integral of r^2 dm Valid when: rotation about a stated axis; r is distance from that axis	kg m^2
Radius of gyration	k = sqrt(I/M) Valid when: any rigid body; I about the same axis as k	m
Ring, disc (central normal axis)	M R^2; M R^2/2 Valid when: uniform ring and disc; axis through centre, perpendicular to plane	kg m^2
Ring, disc (diameter)	M R^2/2; M R^2/4 Valid when: uniform ring and disc; axis along a diameter	kg m^2
Solid sphere, hollow sphere (diameter)	2 M R^2/5; 2 M R^2/3 Valid when: uniform solid sphere and thin hollow shell; axis along a diameter	kg m^2
Thin rod (centre, end)	M L^2/12; M L^2/3 Valid when: uniform thin rod; axis perpendicular to rod, through centre or end	kg m^2
Rectangular plate (central normal axis)	M (a^2 + b^2)/12 Valid when: uniform thin rectangular plate; axis through centre, perpendicular to plate	kg m^2
Parallel axes theorem	I = I_cm + M d^2 Valid when: I_cm is about an axis through the centre of mass; second axis parallel at distance d	kg m^2
Perpendicular axes theorem	I_z = I_x + I_y (plane lamina) Valid when: thin plane lamina only; x and y in the plane, z perpendicular, meeting at one point	kg m^2

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/rotational-motion/moment-of-inertia-radius-of-gyration-and-axes-theorem

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