EngineeringRise

Centre of mass and rigid body kinematics

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

Result	Formula	Units or note
Centre of mass of particles	x_cm = (sum m x)/(sum m) Valid when: point masses or a rigid body; same origin and axis for all terms	m
Two particles	distance from m1 = m2 d/(m1 + m2) Valid when: two point masses; d is their separation, answer measured from m1	m
Hole (negative mass)	x_rem = -(m_hole x_hole)/(M - m_hole) Valid when: uniform body with a hole; positions from the same origin as the full body	m
Centre-of-mass motion	M a_cm = F_ext Valid when: any system of particles; F_ext is the net external force only	N
Semicircular ring, disc, solid hemisphere	2R/pi, 4R/(3 pi), 3R/8 from the centre Valid when: uniform bodies; distances along the symmetry axis from the centre	m
Constant angular acceleration	w = w0 + alpha t; theta = w0 t + alpha t^2/2; w^2 = w0^2 + 2 alpha theta Valid when: constant angular acceleration about a fixed axis; angles in radians	rad/s (rad)
rpm to angular speed	w = 2 pi N/60 Valid when: N in revolutions per minute; w in rad/s	rad/s
Point at distance r	v = w r; a_t = alpha r; a_c = w^2 r Valid when: point on a rigid body rotating about a fixed axis; w in rad/s	m/s (m/s^2)

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/rotational-motion/centre-of-mass-and-rigid-body-kinematics

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