EngineeringRise

Collisions in one and two dimensions

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

Result	Formula	Units or note
Momentum conservation (1D, with signs)	m1 u1 + m2 u2 = m1 v1 + m2 v2 Valid when: no external impulse during the collision; velocities with signs along one line	kg m/s
Elastic, head-on: speed rule	v2 - v1 = u1 - u2 Valid when: elastic head-on collision along one line (kinetic energy conserved)	m/s
Elastic head-on, final velocities	v1 = ((m1 - m2) u1 + 2 m2 u2)/(m1 + m2); v2 = ((m2 - m1) u2 + 2 m1 u1)/(m1 + m2) Valid when: elastic head-on collision along one line, signed velocities	m/s
Perfectly inelastic: common velocity	v = (m1 u1 + m2 u2)/(m1 + m2) Valid when: bodies stick together after a collision along one line	m/s
Energy lost, perfectly inelastic	loss = 0.5 x (m1 m2/(m1 + m2)) x (u1 - u2)^2 Valid when: perfectly inelastic collision (bodies stick together)	J
Coefficient of restitution	e = (v2 - v1)/(u1 - u2) = sqrt(h2/h1) for a ball and floor Valid when: head-on collision; height form only for a ball dropped on a fixed floor	no unit
General inelastic, target at rest	v2 = (1 + e) m1 u/(m1 + m2); v1 = (m1 - e m2) u/(m1 + m2) Valid when: head-on collision, m2 initially at rest, m1 has speed u, restitution e	m/s
2D collision: components	sum of px and sum of py each conserved; K from vx^2 + vy^2 Valid when: no external impulse in the plane; resolve along two perpendicular axes	kg m/s (J)
Equal masses, elastic, one at rest, oblique	v1 + v2 perpendicular; v1^2 + v2^2 = u^2 Valid when: elastic oblique collision, equal masses, one initially at rest	m/s

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/work-energy-and-power/collisions-in-one-and-two-dimensions

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