EngineeringRise

Projectile motion

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

Result	Formula	Units or note
Time of flight (level ground)	T = 2 u sin(theta)/g Valid when: launch and landing at the same level; constant g, no air resistance	s
Maximum height	H = u^2 sin^2(theta)/(2g) Valid when: constant g, no air resistance; height above the launch point	m
Range (level ground)	R = u^2 sin(2 theta)/g Valid when: launch and landing at the same level; constant g, no air resistance	m
Maximum range and its angle	R_max = u^2/g at theta = 45 degrees Valid when: level ground, same speed; 45 degrees gives maximum range	m
Trajectory equation	y = x tan(theta) - g x^2/(2 u^2 cos^2(theta)) = x tan(theta) (1 - x/R) Valid when: origin at launch point, constant g, no air resistance; any landing height	m
Velocity at time t	vx = u cos(theta); vy = u sin(theta) - g t; tan(phi) = vy/vx Valid when: constant g, no air resistance; theta is the angle above horizontal	m/s
Horizontal launch from height h	t = sqrt(2h/g); range = u sqrt(2h/g); v = sqrt(u^2 + 2gh) Valid when: horizontal launch from height h onto level ground, no air resistance	s (m, m/s)
Complementary angles	R(theta) = R(90 degrees - theta); T1/T2 = tan(theta) Valid when: same speed, level ground; theta and 90 - theta, T1/T2 for angle theta over its complement	dimensionless ratio
Two simultaneous projectiles	separation = |u1 - u2| t (both in air) Valid when: same start point and time; u1, u2 are launch velocity vectors; before either lands	m

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/kinematics/projectile-motion

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