EngineeringRise

Applications of derivatives: rate of change, monotonicity, maxima and minima

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

Result	Formula	Units or note
Related rates	dy/dt = (dy/dx)(dx/dt); sphere: dV/dt = 4 pi r^2 dr/dt Valid when: quantities differentiable in time; sphere formula for radius r	units of y per second
Ladder constraint	x^2 + y^2 = L^2 => x dx/dt + y dy/dt = 0 Valid when: x and y are the legs of a ladder of fixed length L	metres per second
Monotonic	f prime > 0 increasing; f prime < 0 decreasing Valid when: f differentiable on the interval considered	not applicable
First derivative test	f prime changes + to - at c: local maximum; - to +: local minimum Valid when: f continuous at c, differentiable on both sides near c	not applicable
Second derivative test	f prime(c) = 0 and f double prime(c) < 0: maximum; > 0: minimum Valid when: f double prime exists at c	not applicable
Closed interval	greatest and least values are among f(a), f(b) and f at stationary points Valid when: f continuous on [a, b]	units of f
Standard optima	x(L - 2x) is greatest at x = L/4; x + c/x has least value 2 sqrt c at x = sqrt c (x > 0) Valid when: x(L - 2x): 0 < x < L/2; x + c/x: x > 0, c > 0	square units; units of x
Circle and sphere rates	dA/dt = 2 pi r dr/dt; dS/dt = 8 pi r dr/dt Valid when: circle area A and sphere surface S with radius r changing in time	area per second

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/mathematics/limits-continuity-and-differentiability/applications-of-derivatives-rate

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