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Homogeneous and linear differential equations

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

Result	Formula	Units or note
Homogeneous test	F(t x, t y) = F(x, y) for dy/dx = F(x, y) Valid when: first-order equation dy/dx = F(x, y), t > 0	dimensionless
Substitution	y = v x; dy/dx = v + x dv/dx Valid when: homogeneous equation: F depends only on y/x	v dimensionless
Separated form	dv/(F(v) - v) = dx/x Valid when: homogeneous equation with F(v) not equal to v	dimensionless
Linear form	dy/dx + P y = Q (P, Q functions of x) Valid when: first-order linear; P and Q continuous in x	n/a (as in the equation)
Integrating factor	IF = e^(integral of P dx) Valid when: linear equation in standard form (coefficient of y' is 1)	dimensionless
Linear solution	y IF = integral of Q IF dx + C Valid when: linear equation in standard form; C is the constant	units of y (IF is dimensionless)
Linear in x	dx/dy + P(y) x = Q(y); IF = e^(integral of P dy) Valid when: equation linear in x with y as variable	n/a (as in the equation)
Standard integrating factors	P = n/x -> x^n; P = 1/(x ln x) -> ln x; P = tan x -> sec x Valid when: x > 0 for x^n; x > 1 for ln x; cos x > 0 for sec x	dimensionless
Mixing, constant volume	S = c V + (S0 - c V) e^(-q t/V) Valid when: constant volume V; inflow = outflow = q; well mixed; inflow concentration c	kg (q in L/min, V in L, t in min)

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/mathematics/differential-equations/homogeneous-and-linear-differential-equatio

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