EngineeringRise

Integrated rate laws and half-life

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

Result	Formula	Units or note
Zero order (integral)	[A] = [A]0 - kt Valid when: zero-order reaction, until [A] reaches 0	mol L^-1 s^-1 (k in this unit)
Zero order half-life	t1/2 = [A]0 / (2k); completion time = [A]0 / k Valid when: zero-order reaction; rate independent of [A]	s
First order (integral)	ln([A]0/[A]) = kt, k = (2.303/t) log10([A]0/[A]) Valid when: first-order reaction in A, constant temperature	s^-1 (k in this unit)
First order exponential	[A] = [A]0 e^(-kt) Valid when: first-order reaction in A, constant temperature	mol L^-1
First order half-life	t1/2 = 0.693 / k (independent of [A]0) Valid when: first-order reaction only; not valid for zero or second order	s
Fraction left	(1/2)^n after n half-lives Valid when: first-order reaction (constant half-life), n half-lives	dimensionless
Time for x percent	t = (2.303/k) log10(100/(100 - x)) Valid when: first-order reaction; x is percent reacted, 0 <= x < 100	s
Linear plots	zero: [A] against t (slope -k); first: ln[A] against t (slope -k) Valid when: zero order for [A] vs t; first order for ln[A] vs t	slope in mol L^-1 s^-1 (zero) or s^-1 (first)
Gas, A giving B + C	Pt = P0 + x; p(A) = 2P0 - Pt Valid when: first-order A giving B + C, gas, constant V and T, only A at start	mm Hg or atm

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/chemical-kinetics/integrated-rate-laws-and-half-life

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