EngineeringRise

Temperature dependence, Arrhenius equation and collision theory

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

Result	Formula	Units or note
Arrhenius equation	k = A e^(-Ea/RT) Valid when: T in kelvin; Ea and A nearly independent of T	k and A in the units of k; Ea in J mol^-1
Logarithmic forms	ln k = ln A - Ea/(RT); log10 k = log10 A - Ea/(2.303 R T) Valid when: T in kelvin; Ea and A nearly independent of T	dimensionless
Slope of ln k against 1/T	slope = -Ea/R Valid when: Arrhenius behaviour; plot of ln k against 1/T is straight	K
Two temperatures	ln(k2/k1) = (Ea/R)(1/T1 - 1/T2) Valid when: T in kelvin; Ea constant between T1 and T2	dimensionless; T in kelvin
Two temperatures (log10)	log10(k2/k1) = (Ea/(2.303 R))(1/T1 - 1/T2) Valid when: T in kelvin; Ea constant between T1 and T2	dimensionless
Gas constant	R = 8.314 J mol^-1 K^-1 Valid when: use with Ea in J mol^-1	J mol^-1 K^-1 (convert Ea from kJ to J first)
Fraction above threshold	fraction = e^(-Ea/RT) Valid when: approximate Boltzmann fraction, Ea much larger than RT	dimensionless
Catalyst ratio	k(cat)/k(uncat) = exp[(Ea - Ea(cat))/RT] when A is unchanged Valid when: same A and same temperature with and without catalyst	dimensionless
Collision theory	k = P Z_AB e^(-Ea/RT); A = P Z_AB Valid when: bimolecular gas reaction; Z_AB is collision frequency factor	L mol^-1 s^-1 for bimolecular reactions

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/chemical-kinetics/temperature-dependence-arrhenius-equation-and-c

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