Arrhenius Equation: Rate Constant at Another Temperature

Rate constant of a reaction at a new temperature from its value at a known temperature and the activation energy, with the pre-exponential factor and half-life.

Method: S. Arrhenius (1889); CODATA gas constant

Input parameters

Unit system: SI

Parameter	Value	Unit
Rate constant at T_1 (first order) For other orders enter the constant in your own units; k_2 comes out in the same units and the half-life does not apply.	1.0000e-04	1/s
Temperature at which k_1 was measured	25.000	°C
Activation energy	50.000	kJ/mol
New temperature	35.000	°C

Calculated results

Parameter	Value	Unit
Rate constant at T_2	1.9243e-04	1/s
Rate ratio	1.9243	
Pre-exponential factor	57,494	1/s
Half-life at T_2 (first order)	60.036	min

Formula and method

$$k_2 = k_1 \exp\left[-\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)\right]$$

$$A = k_1 e^{E_a/(RT_1)}, \quad t_{1/2} = \frac{\ln 2}{k_2}$$

Variables

k_1	Rate constant at T_1 (first order)	1/s
T_1	Temperature at which k_1 was measured	K
E_a	Activation energy	J/mol
T_2	New temperature	K
k_2	Rate constant at T_2	1/s
k_2/k_1	Rate ratio	-
A	Pre-exponential factor	1/s
$t_{1/2}$	Half-life at T_2 (first order)	s
R	Universal gas constant	J/(mol·K)

Method and standards

The Arrhenius relation between rate constant and absolute temperature with the CODATA gas constant.

Assumptions and limits

- Constant activation energy over the range.
- The half-life ln 2/k_2 applies to a first-order reaction only; for other orders ignore it.
- At extreme activation energies and low temperatures the pre-exponential factor overflows and is not shown.

References

- S. Arrhenius (1889); CODATA gas constant

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.