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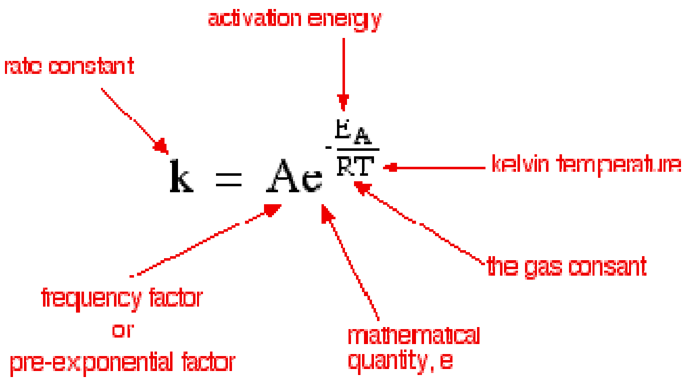
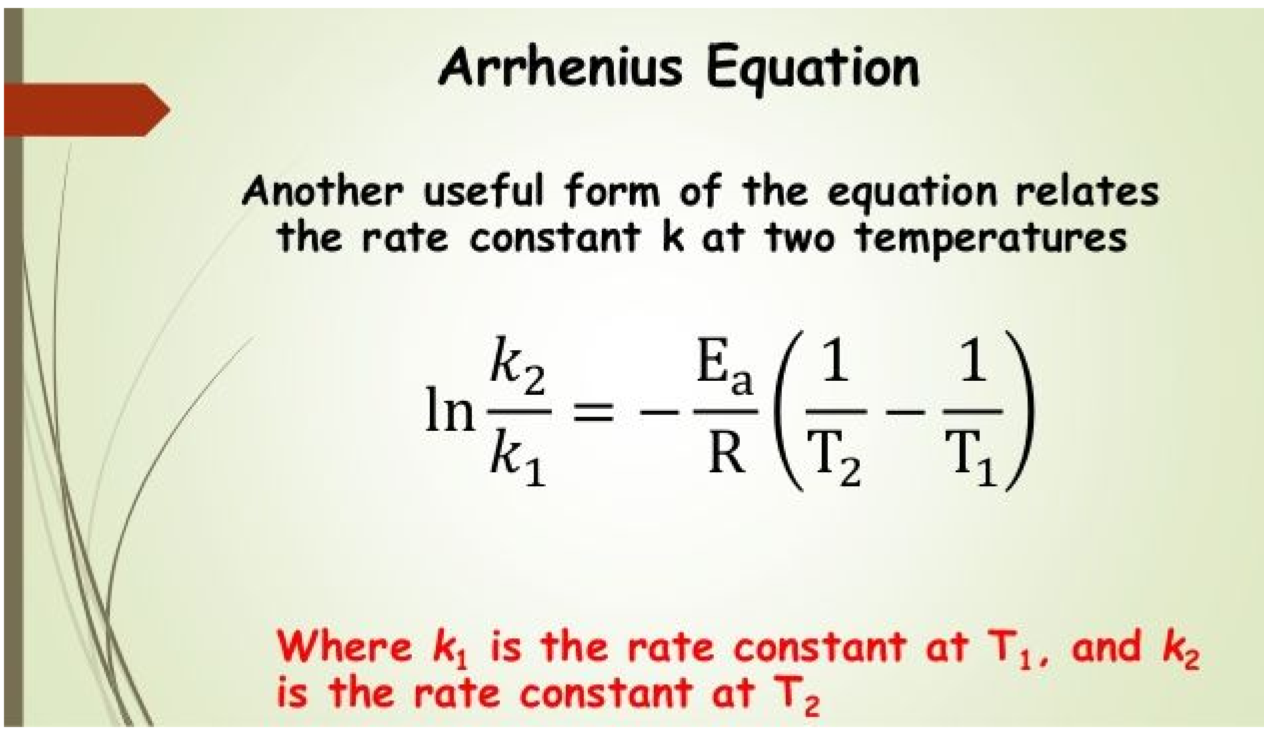
Arrhenius equation

- The effect of temperature on the rate of equation and hence rate constant (k) was shown by Arrhenius and this equation is called Arrhenius equation.

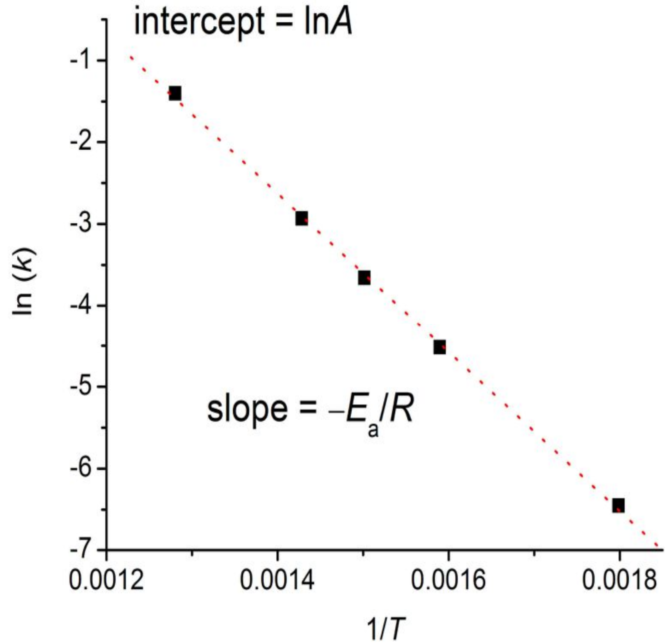


$$k = Ae^{-\frac{E_A}{RT}}$$

- For two different temperatures T1 and T2



Plot of log k versus 1/T



- The two quantities A and Ea are collectively called Arrhenius Parameters.
- The factor $e^{-Ea/RT}$ in the Arrhenius equation is called Boltzmann factor.
- A is dimensionless and has the unit Time $^{-1}$. That is why A is called as frequency factor.

Temperature dependent of k

- Derivative of Arrhenius equation with respect to Temperature

- The positive value of Ea, the temperature dependence will be greater for reactions with large value of Ea.

$k = Ae^{-Ea/RT}$

$dk/dT = Ae^{-Ea/RT}.\ Ea/RT^2$

$= k.Ae^{-Ea/RT}.$

Parameters

- Only reactions whose Ea falls in the range of 50-55 kJmol^{-1} are found to double their rate for this range (from 298 to 308 K) of temperature.

- The fraction of molecules having energy equal to or greater than activation energy (Ea) is given by the expression:

$$x = n/N = e^{-Ea/RT}$$

$$\log x = - Ea/2.303RT$$

- Arrhenius Constant $(A) = PZ_{AB}$ where P is the orientation or probability or steric factor and Z_{AB} represents collition frequency of reactants A and B.

- The Ea of a reaction cannot be negative.

- The Ea of a reaction can not be negative.
- Rate constant cannot be greater than or equal to A

Thank you