

Each reaction rate coefficient k has a temperature dependency, which is usually given by the Arrhenius equation:

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

E_a is the activation energy and R is the gas constant. Since at temperature T the molecules have energies given by a Boltzmann distribution, one can expect the number of collisions with energy greater than E_a to be proportional to $e^{-\frac{E_a}{RT}}$. A is the pre-exponential factor or frequency factor.

$$\ln k = \ln A - E_a / RT$$

$$\ln A = \ln k + E_a / RT$$

For the first reaction:

$$\ln k_1 = \ln A - E_a / RT \Rightarrow \ln 2k_1 = \ln A - E_a / R(T+10)$$

For the second reaction

$$\ln k_2 = \ln A - E_a / RT \Rightarrow \ln 3k_2 = \ln A - E_a / R(T+10)$$

From this:

$$\ln 2k_1 = \ln A - E_a / R(T+10) \Rightarrow \ln A = \ln 2k_1 + E_a / R(T+10)$$

$$\ln 3k_2 = \ln A - E_a / R(T+10) \Rightarrow \ln A = \ln 3k_2 + E_a / R(T+10)$$

$$\ln 2k_1 + E_a / R(T+10) = \ln 3k_2 + E_a / R(T+10)$$

$$\ln 2k_1 * R(T+10) + E_a = \ln 3k_2 * R(T+10) + E_a \quad (R(T+10) = \text{const})$$

$$\ln 2k_1 + E_a = \ln 3k_2 + E_a$$

$$\ln 2k_1 - \ln 3k_2 = E_a - E_a$$

$$\ln(2k_1/3k_2) = E_a - E_a$$

In that moment when k is the same for both reactions:

$$\ln(2/3) = xE_a - E_a$$

$$-0.405 = xE_a - E_a$$

$$x = 0,595$$

The ratio of E_a is **1: 0.595**