

Activation energy

In the organic synthesis laboratory chemists report the common experience that reactions tend to increase their rates by a factor two for each 10 °C that the temperature is increased. Perhaps without being fully conscious of the reason they imply that the activation energy for many reactions is quite similar. If we assume that the reactions are run initially at 300 K, then how large is the activation energy of a typical organic reaction.

Activation energy

Solution: To determine the activation when the reaction rate increases by a factor of two we can calculate E_a using the equation

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

Where $T_1 = 300$ K, $T_2 = 310$ K and $k_2/k_1 = 2$.

$$E_a = \frac{-8.31 \ln 2}{\left(\frac{1}{310} - \frac{1}{300}\right)} = 53,500 \text{ J/mol}$$