Activation energy

The decomposition of ethyl iodide was measured at elevated temperature. For the reaction

$$C_2H_5I \rightarrow C_2H_4 + HI$$

At 600 K the rate constant was measured to be $1.6 \times 10^{-5}\ s^{-1}$ and at 700 K the rate constant was found to be $6.36 \times 10^{-3}\ s^{-1}$. Determine the activation energy and prefactor.

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At 600 K, k = 1.6 x 10^{-5} s^{-1}

At 700 K k = 6.36 x 10^{-3} s^{-1}

Solution: To calculate E_a use the equation

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

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Solution: Use the equation

$$E_a = \frac{-8.31 \ln \frac{6.36\ x\ 10^{-3}}{1.6\ x\ 10^{-5}}}{\left(\frac{1}{700} - \frac{1}{600}\right)} = 209{,}000\ J/mol$$

Activation energy

Solution: We can obtain the prefactor from the Arrhenius equation

$$k = Aexp\{-E_a/RT\}$$

Therefore,

$$A = \frac{k}{exp\{-E_a/RT\}}$$

$$A = \frac{1.6\ x\ 10^{-5}}{exp\{-209000/(8.31)(600)\}}$$

$$A = 2.56\ x\ 10^{13}\ s^{-1}$$