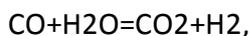


Question #49802, Chemistry, Other

Calculate activation energy, a constant A of the Arrhenius equation, Vant-Goff's coefficient and reaction constant at T3. Use formula of Vant-Hoff's law.



$$k_2, \text{ min}^{-1} \text{ mole}^{-1} = 8.15 \cdot 10^{-3},$$

$$T_2, K = 310,$$

$$k_1, \text{ min}^{-1} \text{ mole}^{-1} = 3.1 \cdot 10^{-4},$$

$$T_1, K = 290,$$

$$T_3, K = 300$$

Answer:

the Arrhenius equation:

$$k = A e^{-E/RT}$$

Vant-Hoff's law:

$$\gamma = (V_2/V_1)^{10/(T_2-T_1)}$$

in single mole concentration $V=k$

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

$$\gamma = \left(\frac{8.15 \cdot 10^{-3}}{3.1 \cdot 10^{-4}} \right)^{10/(310-290)} = 5.127$$

$$k_3 = k_1 \cdot \gamma^{(T_3-T_1)/10} = 3.1 \cdot 10^{-4} \cdot 5.127^{(300-290)/10} = 15.89 \cdot 10^{-4}$$

Energy of activation:

$$E_a = 8.31 \cdot \ln \left(\frac{8.15 \cdot 10^{-3}}{3.1 \cdot 10^{-4}} \right) / \left(\frac{1}{310} - \frac{1}{290} \right) = -122115.933 \text{ J}$$

$$A = e^{-E/RT_3} / k_3$$

$$A = \exp(122115.933 / (8.31 \cdot 300)) / (15.89 \cdot 10^{-4}) = \mathbf{1.18 \cdot 10^{24}}$$