

Answer on Question #45858-Physics-Molecular Physics-Thermodynamics

A slightly bruised apple will rot extensively in about 3.5 days at room temperature (22.0 degrees Celsius). If it is kept in the refrigerator at 0.5 degrees Celsius, the same extent of rotting takes about 12 days. What is the activation energy for the rotting reaction?

Solution

$$k_2 = \frac{1}{3.5} \left(\text{rots } \frac{1}{3.5} \text{ of the way per day} \right)$$

$$k_1 = \frac{1}{12} \left(\text{rots } \frac{1}{12} \text{ of the way per day} \right)$$

$$R = 8.3144 \text{ J mol}^{-1} \text{ K}^{-1}.$$

$$T_2 = 273.15 + 22.0 = 295.15 \text{ K}$$

$$T_1 = 273.15 + 0.5 = 273.65 \text{ K}$$

$$\ln \left(\frac{\frac{1}{3.5}}{\frac{1}{12}} \right) = \left(\frac{E_a}{R} \right) \left[\frac{T_2 - T_1}{T_1 T_2} \right] = E_a \cdot \left(\frac{2.7 \cdot 10^{-4}}{8.3144} \right)$$

$$1.232 = E_a \cdot 3.2 \cdot 10^{-5}$$

$$E_a = 38500 \frac{\text{J}}{\text{mol}} = 38.5 \frac{\text{kJ}}{\text{mol}}.$$