

◆ The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate  $E_a$ .

**Ans:**

Given

$$T_1 = 298\text{K}$$

$$T_2 = (298 + 10)\text{K}$$

We also know that when the temperature is raised by 10 degrees Celsius, the reaction rate doubles. As a result, we'll use the values  $k_1 = k$  and  $k_2 = 2k$ .

$$R = 8.314\text{JK}^{-1}\text{mol}^{-1}$$

On substitution

$$\frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[ \frac{T_2 - T_1}{T_1 T_2} \right]$$
$$\log \frac{2k}{k} = \frac{E_a}{2.303 \times 8.314} \left[ \frac{10}{298 \times 308} \right]$$
$$E_a = \frac{2.303 \times 8.314 \times 298 \times 308 \times \log 2}{10}$$

$$= 52897.78 \text{ J mol}^{-1}$$

$$= 52.89 \text{ kJ mol}^{-1}$$

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