Question #83450

For the reaction

A (aq) ---> B (aq)

the variation in standard free enthalpy is 3.18 kJ at 25 oC and 4.67 kJ at 45 oC. Calculate the value of the equilibrium constant for this reaction at 75 oC.

Solution:

The equilibrium constant for this reaction is:

$$K = e^{-\frac{\Delta G}{RT}}$$

To calculate the free enthalpy at 75°C, assume that free enthalpy changes linearly in this range of temperature (ΔG=-RTlnK). So, if we use the method of the least squares, we get the variation in standard free enthalpy at 75 °C:

$$a = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2} = \frac{2 * 2432.7 - 616 * 7.85}{2 * 189928 - (616)^2} = 0.0745$$

$$b = \frac{\sum y \sum x^2 - \sum x \sum xy}{n\sum x^2 - (\sum x)^2} = \frac{7.85 * 189928 - 616 * 2432.7}{2 * 189928 - (616)^2} = -19.021$$

$$\Delta G = aT_3 + b = 0.0745 * 348 - 19.021 = 6.905\ kJ$$

Now it is possible to calculate the equilibrium constant for this reaction at 75°C:

$$K = e^{-\frac{6.905}{8.314 * 348} = 0.092}$$

Answer:

The value of the equilibrium constant for this reaction at 75°C is 0.092.