Show that
\[ \frac{\Delta H}{R} \frac{d \ln K}{d(1/T)} = - \frac{\Delta G}{RT} \]

**Solution**

Since
\[ \Delta G = -RT \ln K, \]
\[ \ln K = -\frac{\Delta G}{RT} \]

Differentiate both sides with respect to \((1/T)\) in the above equation gives,
\[ \frac{d(\ln K)}{d(1/T)} = \frac{-1}{R} \frac{d(\Delta G/T)}{d(1/T)} \]
\[ = -\frac{\Delta H}{RT^2} \]

**DISCUSSION**

If \(K_1\) and \(K_2\) are the equilibrium constant at \(T_1\) and \(T_2\) respectively, show further that
\[ \ln \left( \frac{K_1}{K_2} \right) = -\left( \frac{\Delta H}{R} \right) \left( \frac{1}{T_1} - \frac{1}{T_2} \right). \]

This is achieved by definite integral. This relationship indicates that the plot of \(\ln (K)\) versus \(1/(T)\) is a straight line, and the slope is \(-\left( \frac{\Delta H}{R} \right)\). Thus, \(\Delta H\) can be determined by measuring the equilibrium constant at different temperatures.

\[ G^0 = 8.312 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \ln(3166) \]
\[ = 20.0 \text{ kJ/hr} \]

**DISCUSSION**

This example illustrates the evaluation of Gibb's energy when the equilibrium constant is known.

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**Contributors and Attributions**

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