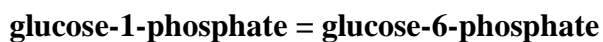


Problem 5-03 Reaction Gibbs energy and direction of chemical reaction

The equilibrium constant of the reaction



at the temperature of 38 °C is $K = 16.707$ (the standard state: infinite dilution, $c^{\text{st}} = 1 \text{ mol dm}^{-3}$, activity coefficients are equal to one). Find out if this reaction in the mixture of 8.2 mmol dm⁻³ of glucose-1-phosphate and 0.137 mol dm⁻³ glucose-6-phosphate will occur spontaneously to glucose-6-phosphate.

$$[\Delta_r G = 0.049 \text{ J mol}^{-1} \approx 0, \text{ reaction is nearly in equilibrium}]$$

Solution:

glucose-1-phosphate \equiv G1F

glucose-6-phosphate \equiv G6F

$$T = 38.05 + 273.15 = 311.15 \text{ K}$$

$$K = 16.71$$

$$\Delta_r G^\ominus = -RT \ln K = -8.314 \cdot 311.15 \cdot \ln 16.707 = -7284.268 \text{ kJ mol}^{-1}$$

$$\Delta_r G = \Delta_r G^\ominus + RT \ln \frac{a_{\text{G1F}}}{a_{\text{G6F}}}$$

$$a_i = \gamma_i \cdot \frac{c_i}{c^{\text{st}}} \quad \gamma_i = 1$$

$$c_{\text{G1F}} = 8.2 \text{ mmol dm}^{-3} = 0.0082 \text{ mol dm}^{-3}$$

$$c_{\text{G6F}} = 0.137 \text{ mol dm}^{-3}$$

$$\Delta_r G = -7284.268 + 8.314 \cdot 311.15 \cdot \ln \frac{0.137}{0.0082} = -7284.268 + 7284.317 = 0.049 \text{ J mol}^{-1}$$

$$\Delta_r G = 0.049 \text{ J mol}^{-1} \approx 0, \text{ reaction is nearly in equilibrium}$$