

Problem 13-19 Osmotic pressure of non-electrolyte solutions

When studying various types of haemoglobin 21.5 mg of protein was dissolved at 5 °C in 1.5 cm³ of water. The osmotic pressure of this solution was found to be 3.75 torr. Determine the mean molar mass of sample under study. Assume the ideal behaviour of the solution.

$$[M = 66.3 \text{ kg mol}^{-1}]$$

Solution:

$$\pi = \frac{m_2}{M_2 \cdot V_1} \cdot RT$$

$$\pi/\text{kPa} = 3.75 \cdot \frac{101.325}{760} = 0.5 \text{ kPa}$$

$$m_2 = 21.5 \cdot 10^{-3} \text{ g}$$

$$V_1 = 1.5 \text{ cm}^3 = 1.5 \cdot 10^{-3} \text{ dm}^3$$

$$T = 278.15 \text{ K}$$

$$M_2 = \frac{m_2}{\pi \cdot V_1} \cdot RT = \frac{21.5 \cdot 10^{-3}}{0.5 \cdot 1.5 \cdot 10^{-3}} \cdot 8.314 \cdot 278.15 = 66\,298.23 \text{ g mol}^{-1}$$

$$\left[\frac{\text{g} \cdot (\text{N m K}^{-1} \text{ mol}^{-1}) \cdot \text{K}}{\text{kPa} \cdot \text{dm}^3} = \text{g mol}^{-1} \cdot \frac{\text{N m}}{(\text{N m}^{-2}) \cdot \text{m}^3} = \text{g mol}^{-1} \right]$$