

### Problem 13-06 Freezing point depression – non-electrolyte solutions

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Cryoscopic constant of water is  $K_K = 1.86 \text{ K kg mol}^{-1}$ . What minimum mole amount of methanol you must add to 2.6 kg of water to prevent its freezing at temperatures  $t > -10^\circ\text{C}$ ?

[ $n_2 = 14 \text{ mol}$ ]

Solution:

$$-\Delta T_f = K_K \cdot \underline{m}_2$$

$$m_1 = 2.6 \text{ kg}$$

$$K_f = 1.86 \text{ K kg mol}^{-1}$$

$$\Delta T_f = 10^\circ$$

$$\underline{m}_2 = \frac{\Delta T_f}{K_K} = \frac{10}{1.86} \left[ \frac{\text{K}}{\text{K kg mol}^{-1}} \right]$$

$$\underline{m}_2 = \frac{n_2}{m_1}$$

$$n_2 = m_1 \cdot \underline{m}_2 = 2.6 \cdot \frac{10}{1.86} = 13.9785 \text{ mol}$$

$$n_2 = 14 \text{ mol}$$