

### Problem 13-05 Freezing point depression – non-electrolyte solutions

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During the celebration you have hidden a bottle of wine on the balcony. In the morning you have found that it is cracked. What was the lowest temperature in the night? Wine contains about 10 wt. % of ethanol. Cryoscopic constant of water is  $K_K = 1.86 \text{ K kg mol}^{-1}$ .

[−4.5°C]

Solution:

$w_2 = 10 \text{ hm.\%}$  of  $\text{C}_2\text{H}_5\text{OH}$ :

$m_2 = 10 \text{ g}$  ,  $m_1 = (100 - 10) \text{ g} = 90 \cdot 10^{-3} \text{ kg}$

$M_2 = 46 \text{ g mol}^{-1}$

$$\underline{m_2} = \frac{n_2}{m_1} = \frac{m_2}{M_2 \cdot (100 - m_2) \cdot 10^{-3}} = \frac{10}{46 \cdot 90 \cdot 10^{-3}} = 2.4155 \text{ mol kg}^{-1}$$

$$-\Delta T_f = K_K \cdot \underline{m_2} = 1.86 \cdot 2.4155 = 4.4928 \text{ K}$$

$$t_f = -4.5^\circ\text{C}$$