Problem 13-01 Vapour pressure lowering

10 cm^3 of glycerine was dissolved in 500 cm^3 of water at the temperature of 50 °C. What is the lowering of vapour pressure of the solvent above this solution? The saturated vapour pressure of water at given temperature is 12.332 kPa, water density is 0.988 g cm^{-3} and the density of glycerine 1.26 g cm^{-3}.

[Δp_1 = 61.228 Pa]

Solution:

V_1 = 500 cm^3 , ρ_1 = 0.988 g cm^{-3}, $m_1 = V_1 \cdot \rho_1 = 500 \cdot 0.988$ [$cm^3 \cdot$ (g cm^{-3})]
p_1^s = 12.332 kPa
M_1 = 18.016 g mol^{-1}

V_2 = 10 cm^3 , ρ_2 = 1.26 g cm^{-3}, $m_2 = V_2 \cdot \rho_2 = 10 \cdot 1.26$ [$cm^3 \cdot$ (g cm^{-3})]
$M_2 = 3 \cdot 12.011 + 8 \cdot 1.008 + 3 \cdot 16 = 92.097$ g mol^{-1}

$$p_1^s - p_1 = x_2 \cdot p_1^s$$

$$x_2 = \frac{\frac{m_2}{M_2}}{\frac{m_2}{M_2} + \frac{m_1}{M_1}} = \frac{\frac{10 \cdot 1,26}{92.097}}{\frac{10 \cdot 1.26}{92.097} + \frac{500 \cdot 0.988}{18.016}} = 0.004965$$

$$\Delta p_1 = p_1^s - p_1 = x_2 \cdot p_1^s = 0.004965 \cdot 12.332 = 0.061228 \text{ kPa} = 61.228 \text{ Pa}$$

$$p_1 = p_1^s - x_2 \cdot p_1^s = 12.332 \cdot (1 - 0.004965) = 12.2708 \text{ kPa}$$