

Self-Test 7.2, 7th + 8th Ed.

Salt A, $V_A / (\text{cm}^3 \text{mol}^{-1}) = 6.218 + 5.146b - 7.147b^2$

$V_B^* = 18.079 \text{ cm}^3 \text{mol}^{-1}$ (molar volume of water)

Derive an expression for the partial molar volume of water, V_B .

G.D. $dV_B = - \frac{n_A}{n_B} dV_A$

integrate $V_B - V_B^* = - \int_{V_A^*}^{V_A} \frac{n_A}{n_B} dV_A$

side $\frac{dV_A}{db} = 5.146 - 14.294b$

so, $dV_A = (5.146 - 14.294b) db$

sub in: $V_B = V_B^* - \int_0^b \frac{n_A}{n_B} (5.146 - 14.294b) db$

side $b = \frac{n_A}{n_B M_B} = \frac{\text{mol solute}}{\text{kg solvent}}$

multiply second term by $\frac{M_B}{M_B}$:

$$V_B = V_B^* - \int_0^b \frac{n_A}{n_B} \frac{M_B}{M_B} (5.146 - 14.294b) db$$

$$V_B = V_B^* - M_B \int_0^b (5.146b - 14.294b^2) db$$

$$= 18.079 - (18.015 \times 10^{-3} \text{ kg mol}^{-1}) \left[\frac{5.146}{2} b^2 - \frac{14.294}{3} b^3 \right]$$

$$V_B / (\text{cm}^3 \text{mol}^{-1}) = 18.079 - 0.0464b^2 + 0.0858b^3$$