Problem 13-12 Freezing point depression of electrolyte solution, dissociation degree

0.44 g of the compound AB_2 (M = 76 g mol^{-1}) was dissolved in 200 g of water. AB_2 is a weak electrolyte, in the aqueous solution of the given concentration dissociated from 80 %. At which temperature the freezing of this solution begins? Cryoscopic constant of water is 1.86 K kg mol^{-1}.

[–0.14°C]

Solution:

$AB_2 = A^{2+} + 2\ B^-$

$(m_0)_{AB2} = 0.44$ g

$m_{H2O} = 200$ g

$$(\underline{m_0})_{AB2} = \frac{m_{AB2}}{M_{AB2} \cdot m_{H2O}} = \frac{0.44}{76 \cdot 200 \cdot 10^{-3}} = 0.02895 \text{ mol kg}^{-1}$$

$\underline{m}_{AB2} = \underline{m}_0 \cdot (1 - \alpha)$

$\underline{m}_{A2+} = \underline{m}_0 \cdot\cdot\ \alpha$

$\underline{m}_{B-} = 2\ \underline{m}_0 \cdot\cdot\ \alpha$

$\Sigma\underline{m} = \underline{m}_0 \cdot (1 + 2\ \alpha)$

$-\Delta T_f = K_f \cdot \Sigma\underline{m} = K_f \cdot \underline{m}_0 \cdot (1 + 2\ \alpha) = 1.86 \cdot 0.02895 \cdot (1 + 2 \cdot 0.8) = 0.14°$