Answer on Question #56062 - Chemistry - General chemistry

Question:

Calculate the freezing point and boiling point of each of the following solutions:
1. the freezing point of the solution: 222 g of sucrose, C12H22O11, a nonelectrolyte, dissolved in 1.40 kg of water (Kf=1.86∘C)
Express your answer using one decimal place.

2.the boiling point of the solution: 222 g of sucrose, C12H22O11, a nonelectrolyte, dissolved in 1.40 kg of water (Kb=0.52∘C)
Express your answer using one decimal place.

Answer:

1. The change of the freezing point can be found using the following equation:

    $\Delta t = K_f \times C$, where K_f – the cryoscopic constant (K_f = 1.86 K kg mol^{-1} for water) and C – the molality of the solution.

    $C = v/M$, where v – the number of moles of dissolved compound and M – the mass of the solvent.

    $v = m/M_r$, where m – the mass of sucrose and M_r – the molecular weight of sucrose.

    v = 222 g/342 g mol $^{-1}$ = 0.65 mol

    C = 0.65 mol/1.40 kg = 0.46 mol/kg

    Thus, $\Delta t = K_f \times C$ = 1.86 K kg mol^{-1} × 0.46 mol/kg = 0.86 K

    The freezing point of the solution is 0 ^{o}C - Δt = -0.86 ^{o}C.

2. The change of the boiling point is found:

    $\Delta t = K_b \times C$, where K_b – the embullioscopic constant (K_b = 0.52 K kg mol^{-1} for water) and C – the molality of the solution.

    Thus, $\Delta t = K_b \times C$ = 0.52 K kg mol^{-1}× 0.46 mol/kg = 0.24 K

    The boiling point is 100 ^{o}C + Δt = 100.24 ^{o}C.