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Physical Pharmacy

Non-electrolytes 5

Nonelectrolytes

Example : 1

A solution is prepared from 25.0 g of benzene and 2.50 g of an unknown compound. Determine the molar mass of the compound and the boiling point of the solution , If you know that: Tf of solution is 4.3oC. The Tf of benzene is 5.5 oC, Tb of benzene is 80.1° C ,Kf for benzene is 5.12 oC/m and Kb is 2.53 oC/m

Answer

Since we want to calculate the Mwt of the compound ...We have to calculate the molality of the solution

$\Delta T_f = K_f\, m$

$\Delta T_f = T_{f\,solvent} - T_{f\,solution}$

$= 5.5 - 4.3 = 1.2\,^{\circ}C$

$m = \Delta T_f / K_f = m = 1.2/5.12 = 0.234$

m = Wt / Mwt x 1000/ Wt of solvent

0.234 = 2.5 / Mwt x 1000/ 25

Mwt = 427.35

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Example : 1

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Answer

$\Delta T_b = K_b\, m$

$= 2.53 \times 0.234 = 0.592^{\circ}C$

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$0.592 = T_{b\ solution} - 80.1$

$T_{b\ solution} = 80.692^{\circ}C$ (Elevation)

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Nonelectrolytes

Example : 2

What will be the freezing point of a water solution that has a boiling point of 101.70°C (Kf(water)=1.86°C/m, Kb(water)=0.51°C/m)?

Answer

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

We have to calculate ΔT_f to find the T_f solution

$\Delta T_f = K_f\ m$

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$\Delta T_b = 101.7 - 100 = 1.7^{\circ}C$

$\Delta T_b = K_b\ m$

$m = \Delta T_b / K_b$

$m = 1.7/0.51 = 3.33$

$\Delta T_f = K_f\ m =$

$1.86 \times 3.33 = 6.193^{\circ}C$

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

$6.193 = zero - T_{f\ solution}$

$T_{f\ solution} = -6.193\ C$ (Depression)

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Nonelectrolytes

Example : 3

An aqueous solution of sucrose of unknown concentration is found to have a freezing point of - 0.912°C, What is the normal boiling point and the partial vapor pressure (in mmHg) of water at 25 °C of this solution, If you know thatKf = 1.86°C/m Kb=0.51oC/m P° = 23.8 mmHg

Answer

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$\Delta P = P_{solvent} - P_{solution}$

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

ΔT_f = zero – (- 0.912)= 0.912°C

$\Delta T_f = K_f\ m$

$0.912 = 1.86 \times m$

$m = 0.912/1.86 = 0.49$

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Answer

$\Delta T_b = K_b\ m$

$= 0.51 \times 0.49 = 0.249\ °C$

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$0.249 = T_{b\ solution} - 100$

$T_{b\ solution} = 100.249\ °C$ (Elevation)

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Nonelectrolytes

Example : 3

An aqueous solution of sucrose of unknown concentration is found to have a freezing point of - 0.912°C, What is the normal boiling point and the partial vapor pressure (in mmHg) of water at 25 °C of this solution, If you know thatKf = 1.86°C/m Kb=0.51oC/m P° = 23.8 mmHg

Answer

$\Delta P / P^{\circ} = 0.018$

$\Delta P = P^{\circ} 0.018\ m$

$= 23.8 \times 0.018 \times 0.49 = 0.209$ mmHg

$\Delta P = P_{solvent} - P_{solution}$

$0.209 = 23.8 - P_{solution}$

$P_{solution} = 23.59$ mmHg (Lowering)

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Example : 4

If you know that the boiling point elevation of an aqueous solution containing 55 g glycerol and 250 g water is 1.22°C. Calculate the boiling point and the freezing point of this solution, if you know that Kf= 1.86 °C/m Kb-0.51°C/m and the Mwt of glycerol is 92 g/ mole

Answer

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$1.22 = T_{b\ solution} - 100$

$T_{b\ solution} = 101.22\ °C$ (Elevation)

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

$\Delta T_f = K_f\ m$

$m = Wt / Mwt \times 1000 / Wt\ of\ solvent$

$m = 55 / 92 \times 1000 / 250 = 2.39$

$\Delta T_f = 1.86 \times 2.39 \approx 4.45°C$

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

$4.45 = zero - T_{f\ solution}$

$T_{f\ solution} = -4.45\ °C$(depression)

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Nonelectrolytes

Q14

The freezing point lowering of a solution containing 1g. of new drug and 100g of water is 0.573oC if you know that Kf = 1.86 oC/m Kb=0.51oC/mWhat will be the Mwt, boiling point and freezing point of the above solution?

Answer

$\Delta T_f = K_f\, m$

$0.573 = 1.86 \times m$

$m = 0.573/1.86 = 0.308$

m = Wt / Mwt x 1000/ Wt of solvent

0.308 = 1 / Mwt x 1000/ 100 = 32.46 g/mol

$\Delta T_b = K_b\, m$

$= 0.51 \times 0.308 = 0157°C$

$\Delta T_b = T_{b\ solution} - T_{b\ solvent}$

$0.157 = T_{b\ solution} - 100$

$T_{b\ solution} = 100.157°C$

$\Delta T_f = T_{f\ solvent} - T_{f\ solution}$

$0.573 = zero - T_{f\ solution}$

$T_{f\ solution} = -0.573°C$

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Thank You !

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