Problems of Colligative properties of solutions

1) 89 g of an unknown solute is added to 130 mL of water. The melting point of the resulting solution is −3.26 °C. Estimate the molar mass of the solute.
Data: K_f = 1.86 K·kg·mol^{-1}; Density of water = 1 g/mL.

2) We prepare a solution by mixing an unknown solute with water. The boiling point of the resulting solution is 105.5 °C. Calculate the melting point of the solution.
Data: K_f = 1.86 K·kg·mol^{-1}; K_b = 0.52 K·kg·mol^{-1}.

3) We want make an aqueous solution by mixing 190 mL of water with urea, ($CO(NH_2)_2$). Find out the grams of solute needed if the boiling point of the resulting solution must be 103.1 °C.
Data: K_b = 0.52 K·kg·mol^{-1}; Water density = 1 g/mL.

4) We dissolve 115 g of urea, ($CO(NH_2)_2$) in 490 mL of water. Find out the melting point of the resulting solution.
Data: K_f = 1.86 K·kg·mol^{-1}; Density of water = 1 g/mL.

5) 45 g of an unknown substance is added to 140 mL of water. If the boiling point of the resulting solution is 105.06 °C, find out the molar mass of the unknown substance.
Data: K_b = 0.52 K·kg·mol^{-1}; Density of water = 1 g/mL.

6) We prepare a solution by mixing an unknown solute with water. The melting point of the resulting solution is −18 °C. Calculate the boiling point of the solution.
Data: K_f = 1.86 K·kg·mol^{-1}; K_b = 0.52 K·kg·mol^{-1}.

7) We want make an aqueous solution by mixing 270 mL of water with ethylene glycol, ($C_2H_6O_2$). Determine the grams of solute needed if the melting point of the solution must be −12.6 °C.
Data: K_f = 1.86 K·kg·mol^{-1}; Density of water = 1 g/mL.

8) We add 110 g of ethylene glycol, ($C_2H_6O_2$) to 170 mL of water. Find out the boiling point of the resulting solution.
Data: K_b = 0.52 K·kg·mol^{-1}; Density of water = 1 g/mL.

9) At a temperature of 50 °C an aqueous solution has 77 g of an unknown solute and 150 g of water. If the vapor pressure lowering of the solvent in the solution is 13.1 mmHg, estimate the molar mass of the solute.
Data: The vapor pressure of pure water at 50 °C is 92.511 mmHg.

10) We add 116 g of sucrose, ($C_{12}H_{22}O_{11}$) to water to form 370 mL of solution at a temperature of 25 °C. Determine the osmotic pressure of the resulting solution.

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11) We dissolve 65 g of an unknown substance in water to form 340 mL of solution at a temperature of 25 °C. Estimate the molar mass of the solute if the osmotic pressure of the resulting solution is 13.5 atm.

12) A solution is prepared by mixing 99 g of ethylene glycol, ($C_2H_6O_2$) with 230 g of water at a temperature of 35 °C. Determine the vapor pressure lowering of the solvent in the resulting solution.
Data: The vapor pressure of pure water at 35 °C is 42.175 mmHg.

Answers:

1) 391 g/mol.
2) −19.7 °C.
3) 68 g.
4) −7.28 °C.
5) 33 g/mol.
6) 105.03 °C.
7) 113 g.
8) 105.43 °C.
9) 56 g/mol.
10) 22.4 atm.
11) 347 g/mol.
12) 4.685 mmHg.