Chapter 13 Practice Problems

1. 5.12 g of Mg(NO₃)₂ is dissolved in 800.2 g of water. The Kᵇ for water is 0.512°C/m. Assume complete dissociation of the salt in solution.
   a. What is the boiling point elevation in °C? At what temperature will the solution boil at 760 torr?
   b. Would you expect the actual boiling point of this solution to be higher or lower than what you calculated? Explain.
   c. Would you expect a NaNO₃ solution of equal molality to that of Mg(NO₃)₂, above, to have a higher or lower boiling point than that of the magnesium nitrate solution, above? Explain

2. How many grams of ethanol, CH₃CH₂OH, are needed to raise the boiling point of 500.0 mL of water by 2.5°C? The boiling point elevation constant Kᵇ = 0.512 °C/molality.

3. Assuming the van’t Hoff factor for NaCl to be 1.84, calculate the freezing point of an aqueous 0.500 molal NaCl solution? For water, Kᶠ = 1.86°C/m.

4. The solubility of an unknown gas in water at 20.0°C is 0.20 g/L when the partial pressure of the gas above the solution is 200. torr. What is the solubility of the gas in g/L when its partial pressure is 300. torr?

5. Vinegar is 5.0% acetic acid, CH₃COOH.
   a. Calculate the molarity, M, of vinegar if 5.0% is w/v.
   b. Calculate the molality, m, of vinegar if 5.0% is w/w.

6. A 20.0% (w/w) aqueous solution of HCl has a density of 1.10 g/mL. Calculate the molarity of the solution.

7. How does each of the following affect the vapor pressure of a liquid in a closed container? Explain your responses.
   a. Decreasing the temperature
   b. Increasing the volume of liquid
   c. Increasing the volume of the container at constant temperature
   d. The addition of a nonvolatile solute
   e. The addition of a volatile solute

8. Ethylene glycol, a non-volatile liquid with formula C₂H₆O₂ and molar mass 62g/mol, is added to 2102 g of water. At 89°C, the vapor pressure of this resulting solution is found to be 460 torr. How many grams of the non-volatile liquid were added to the water? The vapor pressure of pure water is 526 torr at 89°C.

9. At 25 °C the vapor pressure for pure CHCl₃ is 172.0 torr, while that for pure CCl₄ is 98.3 torr. What is the vapor pressure of an ideal solution containing 61.1g of, CHCl₃, and 70.9g of carbon tetrachloride, CCl₄ at 25°C?

10. Explain why the formation of a solution between ethanol (“alcohol”) and water is exothermic. Would the temperature of the solution increase, decrease or stay the same as the ethanol is added to the water? Explain.

11. Explain why the formation of a solution between ammonium nitrate, NH₄NO₃, and water is endothermic. Would the temperature of the solution increase, decrease or stay the same as the ammonium nitrate dissolves in the water? Explain.