

CH302H – Principles of Chemistry II: Honors
Fall 2016, Unique 49420

Homework, Week 7

1. Many people add salt to boiling when cooking pasta. A commonly repeated statement is that this is done to raise the temperature of the water, thus decreasing cooking time. Determine how much salt would have to be added to 1 L of water to raise its boiling point by 5°C.

2. The pressure inside a can of a typical carbonated beverage (coke, sprite, etc.) at room temperature is approximately 2.0 atm. The Henry's law constant for CO₂(g) at 25°C is 1.65 x 10⁵ atm. The volume of a standard coke can is 12 fluid oz, or approximately 0.35 L.

a) What is the vapor pressure of CO₂(g) inside the can?

b) What is the mole fraction of CO₂ dissolved in water under this pressure?

c) Explain what happens after the can is opened and define the new equilibrium point of the system. What is the mole fraction of CO₂ dissolved in water after the system has reached equilibrium?

3. Colligative properties of a solution result only from dissolving a solute in a solvent, not from the chemical identity of either species. .

a) When two pure species are mixed, is the entropy of the mixture greater than, less than, or equal to the entropy of the pure species? Justify your answer.

b) Use your answer in part a) to explain i) boiling point elevation and ii) freezing point depression in terms of entropy.

4. Determine which of the following molecules is a Bronsted-Lowry acid, and draw its conjugate base.

a) Cl⁻ b) HSO₄⁻ c) NH₄⁺
d) NH₃ e) H₂O f) HCN

5. Niacin (C₅H₄NCOOH, also called vitamin B₃) is an essential nutrient whose deficiency in the diet leads to a nasty disease called pellagra.

a) Write a balanced equation for the equilibrium reaction of niacin with water. This will require determining if the molecule is an acid or a base.

b) Niacin is structurally very similar to pyridine: C₅H₅N. Would you predict the *K_a* of niacin to be greater than or less than the *K_a* of pyridine? Justify your answer.

6. The *K_a* of HIO₃ is 0.016 at 25°C. Determine the pH of an aqueous solution of 0.10 M HIO₃.

