UNIT 5 – Readiness Assessment Quiz Name:_____
Vanden Bout/LaBrake UTEID:_____
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CH302

I. MYTH BUSTERS: Soda Freezing Demonstration.

Sometimes when you purchase a bottle of soda from a vending machine, the soda will freeze when you open the bottle. One explanation found on the www is that although the soda is cooled to below 0 °C in the vending machine, the soda remains a liquid because the dissolved gas depresses the freezing point. However, as soon as the soda is opened, it freezes because the concentration of the dissolved solute decreases when the CO_2 gas bubbles out of solution.

Let's look at a demo and do some calculations to check this explanation.

2 bottles of club soda: one is on ice (0 °C), the other is in a salt/ice bath (-8 °C).

1. Describe the two bottles from a macro perspective before and after the bottles are opened.
2. Using the concepts of Henry's Law and Freezing Point Depression, prove that the 'myth" is correct/incorrect. The following questions will help you determine the molar concentration of solute in the carbonated water, which will allow you to calculate the freezing point depression, which will help confirm your explanation for the observed effect.
   a) Use the concept of Henry's Law to explain the observed "degassing" of the soda upon opening the bottle.
   b) Assume the partial pressure of CO_2 inside the bottle above the liquid is 2 atm. The Henry's Law constant for CO_2 is 0.117 M * atm^{-1}. Determine the molar concentration of the gas, CO_2
   c) Determine the freezing point depression of the soda (K_f = 0.5 °C $molal^{-1}$).
   d) Does your answer support your explanation for why one of the soda's froze upon opening and the other did not? Explain.

FULL CLASS DISCUSSION BE PREPARED TO ANSWER/EXPLAIN

II. Revisit Solutions/Solubility "Cold Solution"

Sodium Acetate Dissolves in Water and the Solution Gets Cold.

1. Describe what happens when sodium acetate dissolves in water using a macroscopic description and a microscopic description including a picture.
2. Describe what happens thermodynamically when sodium acetate dissolves in water (include ΔS, ΔH, ΔG)

Supersaturated solution of sodium acetate

3. When one crystal of sodium acetate is added to a super saturated solution of sodium acetate what happens to the solution?

4. Do you expect that the test tube should feel warm or cool? Explain, thermodynamically, your choice of warm or cool?
5. The sodium acetate concentration in the supersaturated tube was 20 molar. The Ksp for $NaCH_3CO_2$ = 25. In this case is Q > Ksp or < Ksp at room temperature. Does this calculated value of Q fit with your observation?

FULL CLASS DISCUSSION BE PREPARED TO ANSWER/EXPLAIN

III. Now let's think about free energy and vapor pressure lowering.

1. Consider two covered beakers: one containing 100 mL of pure water the other with 100 mL of 0.3 M KNO_3 solution. Which has the lower free energy? Which has the lower vapor pressure?
2. Given the vapor pressure of pure water is 25 Torr at room temperature, calculate the vapor pressure of the solution.
3. The two beakers are placed together in a vacuum bell jar in which all the gas has been evacuated, and they are uncovered. What, if anything, will happen?
4. Will the pure water or the solution evaporate faster? If so, which one.
5. What will be the final result of this phenomena (evaporation will stop, evaporation will continue until the free energy is the same in both beakers, evaporation will never start)?
6. What will the final concentration be in each of the beakers?
7. Draw what you think the picture will look like at the end of the process

FULL CLASS DISCUSSION BE PREPARED TO ANSWER/EXPLAIN

IV. Think about the common ion effect in the case of suppressing the dissolution of a toxic metal.

1. Your friend is serving a home made salsa out of a hand crafted pottery dish that was painted with a paint containing lead II carbonate. Lead II carbonate is a white substance that is added to paints to help the colors stay mixed. You caution your friend that according to the EPA a safe concentration of lead in solution is 0.015 mg Pb^{2+}/Liter solution. Your friend says not to worry because he added enough sodium carbonate salt to the salsa to bring that concentration up to .15 molar. Your friend said that this amount of sodium carbonate should limit the lead dissolving into the salsa due to the common ion effect. Given that the Ksp for $PbCO_3 = 7.4 \times 10^{-14}$, determine the concentration of lead ion in the salsa and report whether or not it is below the EPA's standards.
    a. Convert the allowed Pb ion concentration into molar units.
    b. Determine the molar concentration of Pb ion in the salsa.
    c. Is the concentration of Pb ion in the solution more or less than the concentration of ion allowed by the EPA?