Thou Shalt Not Forget

Credit: Dan Reid

Unit 9 – Solutions

1. A solution is a homogeneous mixture.
2. Solute is the dissolved substance in a solution. Solvent is the dissolving medium in a solution.
3. Molarity = (moles of solute)/(L of solution)
4. Mole fraction = X_{solute} = (moles solute)/(moles of solute + moles solvent)
5. Heat of solution is the amount of heat energy absorbed (endothermic) or released (exothermic) when a specific amount of solute dissolves in a solvent.
6. To make a solution it must go through the following steps:
   1) overcome attractions btwn solute particles (spread solute apart) = endothermic ΔH_{solute}
   2) overcome attractions btwn solvent molecules (spread solvent apart) = endothermic $\Delta H_{solvent}$
   3) form new attractions btwn solute particles and solvent molecules (combine) = exothermic ΔH_{mix}

   Therefore the overall $\Delta H_{solution} = \Delta H_{solute} + \Delta H_{solvent} + \Delta H_{mix}$
7. When (solute-solvent attractions) < (solute-solute + solvent-solvent) then solution will only form if the energy difference is small enough to be overcome by increase in entropy.
8. "Like dissolves like" – polar dissolves best with polar, nonpolar with nonpolar.
9. Raoult's Law: $P_{solution} = X_{solvent} P^0_{solvent}$
10. VP of a solvent in a solution is always lower than the VP of the pure solvent. Solute particles replace some of the solvent molecules at the surface. Rate of vaporization is reduced, amount of vapor reduced.
11. Vapor pressure of the solution is directly proportional to the amount of solvent in the solution.
12. Vapor pressure of liquid-liquid solutions where both are volatile: $P_{Total} = X_A P^0_A + X_B P^0_B$
13. Ideal solutions don't exist in real life, some come close. Negative deviations = lower than predicted vapor pressure = strong attraction between solvent and solution. Positive deviations = higher than predicted vapor pressure = weak attraction between solvent and solution.
14. Dissociation of ionic compounds impacts vapor pressure more than nonionic solutes because one compound breaks into more than one particle and vapor pressure is affected by the number of particles.
15. Solubility of most solids increase with increasing temp and increased surface area of the solid. Solubility of most gases decrease with increase temp and increase with increased pressure above the solution.
16. Solubility is measured at specific temps and pressures. At a specific temp/pressure - Saturated solution has the solute and the solvent in dynamic equilibrium, cannot dissolve more. Unsaturated solution has less solute than when saturated. Supersaturated has more solute than saturated (you make this by heating solvent up, dissolving a lot of solute, then slowly cooling it down)
17. Electrolytes conduct electricity when aqueous. Nonelectrolytes do not conduct electricity when aqueous.
18. Colligative properties only depend on the number of solute particles present, not the identity of the particles. Boiling point elevation, freezing point depression, osmotic pressure. More particles, more of an impact.

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Unit 9 – Solutions

1. Give an example of a homogeneous solution.
2. Identify the solute and solvent in a glass of sugar water.
3. What is the molarity of 30g of salt dissolved in 500mL of water?
4. What is the mole fraction of calcium chloride if there are 25 grams dissolved in 300mL of water?
5. The $\Delta H_{solution}$ for NaOH is -445.1 kJ/mol. How much heat is released when 45g of NaOH is dissolved?
6. When making a solution it was determined that the ΔH_{solute} = 35 kJ/mol, $\Delta H_{solvent}$ = 28kJ/mol, and ΔH_{mix} = -81kJ/mol. What is the $\Delta H_{solution}$ and is the overall process endo or exothermic?
7. If the (solute-solvent) attractions are weaker than the (solute-solute + solvent-solvent) attractions, will ΔHsolution be endo or exothermic? What is driving this mixing process?
8. Which substance is most likely to dissolve in water and why? CH_4, CO_2, CF_3Br
9. The vapor pressure of an aqueous solution is 24.9 mmHg. What is the mole fraction of solute in the solution if the vapor pressure of pure water is 25.756mmHg?
10. Which is predicted to have a lower vapor pressure? A salt solution with 20g of salt, or 40g of salt?
11. As the amount of solvent increases in a solution does the vapor pressure increase or decrease?
12. A as a vapor pressure of 35mmHg. B has a vapor pressure of 15mmHg. If a solution is 2moles of A and 8 moles of B, what is the total vapor pressure?
13. Which pair would make the more ideal solution? CH_4 and I_2, or H_2S and CH_3Br. Why?
14. Which would impact the vapor pressure of a solvent more? C6H12O6 or NaCl? Why?
15. Describe how to increase the solubility of a solid, and how to increase the solubility of a gas.
16. Solution X is considered saturated when it has dissolved 45g in 500mL of water. If you have a solution of 80g in 1L is it a saturated, unsaturated, or super saturated solution?
17. Which will conduct electricity? H_2S of Li_2S? Why?
18. Which will impact the boiling point and freezing point more? $CaCl_2$ or CaS?