SARC CHM2046 Chapter 14 Worksheet

1. Describe the following enthalpies as endothermic (positive) or exothermic (negative)
    a. ΔH_{solute}
    b. $\Delta H_{solvent}$
    c. $\Delta H_{mixture}$
2. Describe whether the solution will form and what drives the formation
    a. $\Delta H_{mix} \approx \Delta H_{solvent} + \Delta H_{solute}$
    b. $\Delta H_{mix} < \Delta H_{solvent} + \Delta H_{solute}$
    c. $\Delta H_{mix} > \Delta H_{solvent} + \Delta H_{solute}$
        i. (the enthalpy of mixture is slightly greater than the sum of the enthalpy of solute and solvent)
    d. $\Delta H_{mix} \gg \Delta H_{solvent} + \Delta H_{solute}$
        i. (the enthalpy of mixture is much greater than the sum of the enthalpy of solute and solvent)
3. True or False: the heat of hydration is equal to the sum of the enthalpy of solvent and enthalpy of mixture, i.e., $\Delta H_{hydration} = \Delta H_{solvent} + \Delta H_{mixture}$.
4. The lattice energy of compound ABC is -50 kJ/mol. The enthalpy of solution is 40 kJ/mol. What is the heat of hydration?
    a. 90 kJ/mol
    b. -10 kJ/mol
    c. -90 kJ/mol
    d. 10 kJ/mol

5. The lattice energy of compound $LiCl$ is -25 kJ/mol and the heat of hydration is -3*10^4 J/mol. How much energy is required/released when 50 grams of $LiCl$ is completely dissolved?
    a. 5.9 kJ/mol
    b. -5.9 kJ/mol
    c. -33 Kj/mol
    d. -26 kJ/mol
    e. 29 kJ/mol
6. Henry's Constant for butyric acid is $1.2 * 10^{-5} \frac{M}{atm}$ at 20-25 C. What is the gas pressure when the solubility of butyric acid is $4.0 * 10^{-4}\ M$?
    a. 33 atm
    b. 0.030 atm
    c. 4.8 * 10^-9 atm
    d. 66 atm
7. Henry's Constant for butyric acid is $1.2 * 10^{-5} \frac{M}{atm}$ at 20-25 C. What is the solubility when the gas pressure of butyric acid is 540 torr?
    a. 8.5*10^-6 M/atm
    b. 0.00648 M/atm
    c. 0.0000169 M/atm
    d. We can not answer this question without knowing the molecular weight of butyric acid.
8. The solubility of butyric acid would decrease if we increase the temperature.
    a. True

b. False

9. If we dissolve 50 grams of propane in 80 grams of methane (CH_4), what is the percent by mass of propane (C_3H_8)?
10. What is the parts per million of propane?
11. What is the parts per billion of propane?
12. What is the mole fraction of propane?
13. What is the mole fraction of methane?
14. We dissolve 25 grams of ethanol in 77 grams of water. What is the molality of the solution?
15. We have a solution that is 34% LiF (solute) by mass. If the solution has a density of 4.23 g/mL, what is the molarity of the solution?
16. We dissolve 43 grams of LiF 0.489 L of water. The density of water is 1 g/mL What is the molality of the solution?
17. A solution contains 47% of molecular bromide (Br_2) per mass. What is the molality of the solution?
18. A solution contains 35 grams of KCl and 40 grams of CH_3Cl. What is the mole fraction of KCl? What is the mole fraction of CH_3Cl?
19. Choose the solution with the lowest vapor pressure.
    a. 20 grams of methane CH_4 in 2 L of water.
    b. 45 grams of pentane (C_5H_{12}) in 2 L of water.
    c. 46 grams of hexane (C_6H_{14}) in 2 L of water.

20. The vapor pressure of a pure solvent is 10 atm. A nonvolatile solute, SiO_2, is added until the solution is 39% SiO_2 by mass. What was the magnitude of the decrease in vapor pressure?
21. A solution contains 42 grams of ethanol and 68 grams of water. The freezing point depression constant for water is 1.86 C kg / mol. What is the freezing point depression?
22. A solution contains 42 grams of ethanol and 68 grams of water. The boiling point elevation constant for water is 0.51 C kg / mol. What is the boiling point elevation?
23. List the van't hoff factor for each of the following compounds.
    a. KCl
    b. C_3H_8
    c. KNO_3
    d. $MgCl_2$
    e. Na_2O
    f. HCl
    g. MgO
    h. $MgSO_4$
24. A solution contains 24 grams of KNO_3 and 89 grams of water. The freezing point depression constant for water is 1.86 C kg / mol. What is the freezing point depression of this solution?
25. A solution consists of 34 grams of HCl in 5 L of solution. What is the osmotic pressure at a temperature of 0 C?
26. The vapor pressure of pure water is 0.023 atm. 40 grams of $MgCl_2$ is added to 60 grams of water. What is the vapor pressure of the solution?