

ALL work must be shown to receive full credit. **Due by 1:00 p.m. on Friday, February 22, 2002.**

PS5.1. Describe all the energy changes which must be considered in the solution process. Indicate the types of interactions which are important in the solution process and discuss what conditions favor and do not favor formation of a solution.

PS5.2. Which substance of each of the following pairs is likely to be more soluble in water? Explain each choice and, for the less soluble of each pair, suggest a better solvent.

a) ammonia(g) or carbon dioxide(g)

b) chlorine(g) or hydrogen chloride(g)

c) hexane(g) or  $C_6H_{12}O_6(s)$

d) capric acid(s) ( $CH_3(CH_2)_8COOH$ ) or acetic acid(l)

PS5.3. Describe the attractive forces present when  $\text{KCl}(s)$ ,  $\text{HCl}(g)$  and methanol( $l$ ) dissolve in water. Use the space below to sketch diagrams depicting at the atomic level how each of the three substances interact with water molecules.

PS5.4. Consider the spontaneous, room temperature, solution process when a solid, or liquid solute is added to a liquid solvent.

a) If  $\Delta H$  is positive what must be happening in terms of the entropy change for the solution process to be spontaneous?

b) If  $\Delta S$  is negative, what must be happening in terms of the enthalpy change for the process to be spontaneous?

PS5.5. A concentrated solution of lactose,  $C_{12}H_{22}O_{11}$ , contains 114.6 g  $C_{12}H_{22}O_{11}$  dissolved in 929 g water. The density of the solution is  $1.043 \text{ g} \cdot \text{mL}^{-1}$ . Calculate;

a) The weight percent  $C_{12}H_{22}O_{11}$  in the solution,

b) the mol fraction of  $C_{12}H_{22}O_{11}$  in the solution,

c) molality of  $C_{12}H_{22}O_{11}$  in the solution,

d) the molarity of  $C_{12}H_{22}O_{11}$  in the solution.

PS5.6. An aqueous solution of sulfuric acid is 2.238 molal and has a density of  $1.124 \frac{\text{g}}{\text{mL}}$ .

Calculate the

a) weight percent sulfuric acid.

b) mole fraction of sulfuric acid.

c) molarity of the solution.

PS5.7. Describe how you would prepare the following aqueous solutions;

a) 250.00 mL of a 0.425 M  $\text{Mg}(\text{NO}_3)_2$  solution.

b) 126 g of a 5.11 % (by weight) solution of KCl.

c) 275. g (grams of solution) of a 0.1.20 molal propylene glycol ( $\text{C}_3\text{H}_8\text{O}_2$ ) solution.

PS5.8. A solution of glucose,  $C_{12}H_{22}O_{11}$ , in water is prepared by mixing 85.0 g  $C_{12}H_{22}O_{11}$  with 446 g of water. The molarity was found to be 0.944 M. Calculate

- the molality of the solution

- the density of the solution

PS5.9. A solution of a compound called potassium acid phthalate, is prepared by dissolving 0.234 g in 100 mLs of water. This solution is then reacted with exactly 10.25 mLs of a 0.137 M NaOH solution. Calculate the molar mass of KHP (potassium acid phthalate).