Name: SOLUTIONS

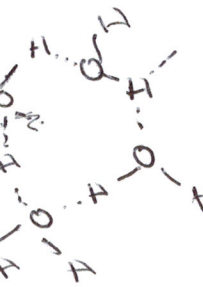
Hour: _____ Date: _____

Unit 9 Homework/Review packet
TASK: Complete 2 problems from each day
DUE: Thursday, June 5

Chapter 15 Review Problems

Day 1: Chapter 15.1 Water and its Properties

1) What is unique about water in the solid state in comparison with most molecular compounds with similar molar masses when they freeze? Draw a diagram of the structure of solid water to support your answer.



Due to Hbonding, water will form a hexagonal structure that has more space between H_2O molecules than liquid water does.

2) Given the extensive hydrogen bonding of water, list three unique properties of water.

1) low vapor pressure 2) high boiling pt. 3) ice less dense than liquid
4) high surface tension

4) What effect does a surfactant have on the surface tension of water?

Breaks Hbonds of water by holding 1 end of water molecule (polar end) and by allowing the other end of the surfact (non polar) to bind with oils. This causes H_2O IMF to ↓.

5) Water (H_2O) and methane (CH_4) have similar molar masses. Methane changes from a liquid to a gas at - 161°C. Water becomes a gas at 100°C. Describe the factor(s) that account for this difference.

CH_4 - London Dispersion forces only (temporary dipoles)
H_2O - 4 Hbonds; dipole
as IMFs ↑ so does the E needed to break these in order for boiling to occur.

Day 2: 15.2 Homogenous solutions

8) Calculate the percent by mass of water in $CuSO_4 \cdot 5H_2O$.

$$\%\ H_2O\ (m/m) = \frac{5\ mol\ H_2O}{1\ mol\ CuSO_4 \cdot 5H_2O} \left| \frac{18\ g\ H_2O}{1\ mol\ H_2O} \right| \frac{1\ mol\ CuSO_4 \cdot 5H_2O}{g\ CuSO_4 \cdot 5H_2O} \times 100\% =$$

12) Why do hydrates easily lose water when heated and regain water when exposed to moisture?

Water of hydration is only held by IMFs with crystalline structure. Since these are weaker than covalent/ionic bonds, less E is needed to evaporate the water out of the structure.

17) Which of the following substances dissolve to a significant extent in water? Explain your answer in terms of the interactions between the solvent and solute:

a. CH_4 X nonpolar
✓b. KCl
c. I_2 X nonpolar
✓d. $BaSO_4$
✓e. Sucrose ($C_{12}H_{2s}O_{11}$)
✓f. $NaHCO_3$

only polar will dissolve in polar solvent

(covalent polar (ex. sugar) Molecule ∴ ionic compounds will dissolve).

40) Describe the process of solvation

Ionic compounds and polar covalent compounds (sugar) will have IMFs with water and will mix. Ionic compounds will break into ions & be surrounded by water Molecules.

66) Explain which properties are responsible for each occurrence

a) Water in tiny cracks in rocks helps break up the rocks when it freezes.

Higher density of ice

b) Water beads up on a newly waxed car

High surface tension

c) A longer time is needed for a teaspoon of water to evaporate when compared to an equal volume of alcohol.

High boiling point

Day 3: 15.3 Heterogeneous solutions

1) List three distinguishing properties for suspensions, colloids and solutions. Which of these are observable?

filteration
uniformity *
Tyndall effect *

2) List 3 examples of suspensions, of colloids and of solutions.

	Suspension	Colloids	Solutions
Example 1	sand water	Mayo	saline
Example 2	Italian dressing	marshmallow	Gatorade
Example 3	lemon juice	shaving cream	Mouthwash

48) Write the formulas for these hydrates:

Sodium sulfate decahydrate $Na_2SO_4 \cdot 10H_2O$

Calcium chloride dehydrate $CaCl_2 \cdot 2H_2O$

Barium hydroxide octahydrate $Ba(OH)_2 \cdot 8H_2O$

error!

49) Name each hydrate

$SnCl_4 \cdot 5H_2O$ Tin (IV) chloride pentahydrate

$FeSO_4 \cdot 7H_2O$ Iron (II) sulfate hepta hydrate

$FePO_4 \cdot 4H_2O$ Iron (III) phosphate tetrahydrate

70) Explain why ethanol (CH_3CH_2OH) will dissolve in both water and gasoline.

polar end will interact with water through dipole-dipole and H-bond interactions.

nonpolar end will interact wl nonpolar gasoline molecules through London Dispersion Forces

Chapter 16 Review/Homework Problems

Day 4: 16.1 Properties of Solutions

1) The solubility of a gas in water is 0.16 g/L at 104 kPa. What is the solubility when the pressure of the gas is increased to 288 kPa? Assume the temperature remains constant.

$C_1 = 0.16$ g/L
$P_1 = 104$ kPa
$C_2 = ?$ (should ↑)
$P_2 = 288$ kPa

$$\frac{C_1}{P_1} = \frac{C_2}{P_2}$$

$$C_2 = \frac{C_1 P_2}{P_1} = \frac{(0.16\ g/L)(288\ \text{kPa})}{(104\ \text{kPa})}$$

$$C_2 = 0.443\ g/L$$

2) A gas has a solubility in water of 3.6 g/L at a pressure of 1.0 atm at 0 °C. What pressure is needed to produce an aqueous solution containing 9.5 g/L of the same gas at 0 °C?

$C_1 = 3.6$ g/L
$P_1 = 1$ atm
$C_2 = 9.5$ g/L
$P_2 = ?$ atm (should ↑)

$$\frac{C_1}{P_1} = \frac{C_2}{P_2}$$

$$P_2 = \frac{C_2 P_1}{C_1} = \frac{(9.5\ g/L)(1\ \text{atm})}{(3.6\ g/L)} = 2.63\ \text{atm}$$

$$P_2 = 2.6\ \text{atm}$$

3) What determines how fast a substance will dissolve?

1) solubility of substance in solution (nonpolar vs polar) (soluble vs. insoluble)

2) what we do to it: stir, heat or break down

6) Name a unit used to express solubility. g/L

8) What would you do to change:

(a) a saturated solid/liquid solution to an unsaturated solution?

Add more liquid ($V_2 > V_1$)

$M_1V_1 = M_2V_2$ (↓ ↑)

(b) a saturated gas/liquid solution to an unsaturated solution?

$$\frac{C_1}{P_1} = \frac{C_2 \downarrow}{P_2 \downarrow}$$

Decrease pressure on system such that $P_2 < P_1$.

Day 5-6:16.2 Concentrations of Solutions

Complete two questions for this day, but ALSO determine the equation needed for EACH question.

10) A solution has a volume of 2.0L and contains 36.0 g of glucose ($C_6H_{12}O_6$). If the molar mass of glucose is 180 g/mol, what is the molarity of the solution?

Equation needed: $M = \frac{mol}{L\ solution}$ Answer: 0.1 M glucose solution

1) $g_{glucose} \rightarrow mol_{glucose}$
2) M

$$M = \frac{36.0\ g\ glucose \mid 1\ mol\ glucose \mid}{\mid 180\ g\ glucose \mid \quad 2.0\ L} = 0.1\ \frac{mol}{L}$$

11) A solution has a volume of 250 mL contains 0.70 mol NaCl. What is its molarity?

Equation needed: $M = \frac{mol}{L\ solution}$ Answer: 2.8 M NaCl solution

$$M = \frac{0.70\ mol\ NaCl}{0.25\ L\ solution} = 2.8\ \frac{mol}{L}$$

12) How many moles of solute are in 250 mL of 2.0M $CaCl_2$? How many grams of $CaCl_2$ is this?

Equation needed: $M = \frac{mol}{L\ solution}$ Answer: (8 mol CaCl2 = 890 CaCl

$$2.0\ M\ CaCl_2 = \frac{X\ mol\ CaCl_2}{0.25\ L\ solution}$$

$$(2.0\ \tfrac{mol}{L})(0.25\ L) = 8\ mol\ CaCl_2 \mid \frac{110.98\ g\ CaCl_2}{1\ mol\ CaCl_2} = 887.87\ g\ CaCl$$

13) If 10.0 mL of propanone (C_3H_6O or acetone) is diluted with water to a total solution volume of 200 mL, what is the percent by volume of propanone in the solution?

Equation needed: $\%\ (v/v) = \frac{V_{solute}}{V_{solution}}$ Answer: _____

$$\%\ propanone = \frac{10\ mL\ propanone}{200\ mL\ solution} \times 100\% = 5\%\ propanone\ solution\ (v/v)$$

14) A bottle of the antiseptic hydrogen peroxide (H_2O_2) is labeled 3% (v/v). How many ml of H_2O_2 are in a 400.0 mL bottle of this?

Equation needed: $\%\ (v/v) = \frac{V_{solute}}{V_{solution}}$ Answer: 12 mL H_2O_2

$$\frac{X\ mL\ H_2O_2}{400\ mL\ solution} \times 100\% = 3\%\ H_2O_2\ solution\ (v/v)$$

$$(0.03)(400\ mL) = 12\ mL\ H_2O_2\ are\ contained\ in\ this\ solution$$

15) Calculate the grams of solute required to make 250 g of 0.10% $MgSO_4$ (m/m).
Equation needed: $\%_{(M/m)} = \frac{\text{Mass}_{solute}}{\text{Mass}_{solution}}$ Answer: 0.25 g $MgSO_4$

$$\frac{x\ g\ MgSO_4}{250\ g\ solution} \times 100\% = 0.10\%$$

$$x\ g\ MgSO_4 = (250\ g)(0.001) = 0.25\ g\ MgSO_4$$

16) How many milliliters of a solution of 4.00M KI are needed to prepare 250.0 mL of 0.760M KI?
Equation needed: $M = \frac{mol}{L\ solution}$ Answer: _____

$M_1V_1 = M_2V_2$

$$x\ (4.0\ M\ KI) = (250\ mL)(0.76\ M\ KI)$$

$$x = \frac{(250\ mL)(0.76\ M\ KI)}{(4.0\ M\ KI)} = 47.5\ mL$$

Day 7-8: 16.3 Colligative Properties of Solutions and Calculations

30) Why does a solution have a depressed boiling point and an elevated boiling point compared with the pure solvent?

Adding solute lowers vapor pressure above liquid due to water's ~~increased~~ attraction to the solute. Thus, like needing to ~~boil~~ heat liquids to a higher temp at low altitudes, we must heat water solution more to bring it to a boil (to break the water-ion interactions)

34) How many grams of sodium fluoride are needed to prepare a 0.400m NaF solution that contains 750 g of water?

$m = \frac{mol\ solute}{kg\ water}$

$$0.400\ \frac{mol}{kg} = \frac{X\ mol\ NaF}{0.75\ kg}$$

$$\left(0.400\ \frac{mol}{kg}\right)(0.75\ kg) = 0.30\ mol\ NaF$$

35) Calculate the molality of a solution prepared by dissolving 10.0 g NaCl in 600g of water. $m = \frac{mol}{kg}$

$$10\ g \left|\frac{1\ mol\ NaCl}{58\ g\ NaCl}\right| \frac{}{0.6\ kg\ water} = 0.48\ m\ NaCl\ solution$$

Day 9-10: Ch 16.4: ~~Calculations involving~~ Colligative Properties

38) What is the ~~freezing point depression~~ of an aqueous solutions of 10.0 g of glucose ($C_6H_{12}O_6$) in 50.0 grams of water? Given Kf = 1.86 °C/m

$\Delta T_f = K_f \cdot i \cdot m = (1.86\,^\circ C/m)(1)(1.11\,m) = \boxed{2.07\,^\circ C}$

$i = 1$

$m = \dfrac{10\,g \mid 1\ mol\ C_6H_{12}O_6 \mid}{180\,g\ C_6H_{12}O_6 \mid 0.05\ kg\ water} = 1.11\,m$

39) Calculate the freezing point depression of a benzene solution containing 400 g of benzene and 200 g of a molecular compound (C_3H_6O). Kf for benzene is 5.12 °C/m

$\Delta T_f = K_f \cdot i \cdot m = (5.12\,^\circ C/m)(1)(8.61\,m) = \boxed{44.1\,^\circ C}$

$i = 1$

$m = \dfrac{200\,g \mid 1\ mol\ C_3H_6O \mid}{58.08\,g\ C_3H_6O \mid 0.4\ kg\ benzene} = 8.61\,m$

40) What is the boiling point of a solution that contains 1.25 mol $CaCl_2$ in 1400 g of water?

$T_b = 100^\circ C + \Delta T_b$ where $\Delta T_b = K_b \cdot i \cdot m$

$= (0.515\,^\circ C/m)(3)(0.893\,m)$

$i = 3$

$m = \dfrac{1.25\ mol\ CaCl_2}{1.4\ kg\ water} = 0.893\,m$

$T_b = 100^\circ C + 1.38\,^\circ C = \boxed{101.38\,^\circ C = T_b}$

41) What mass of NaCl would have to be dissolved in 1.000 kg of water by raising the boiling point 2.00 °C?

$\Delta T_b = K_b \cdot i \cdot m$

1) $m = \dfrac{K_b \cdot i}{\Delta T_b} = \dfrac{(0.515\,^\circ C/m)(2)}{(2^\circ C)}$ oops! $= \dfrac{\Delta T_b}{K_b \cdot i} = \dfrac{2^\circ C}{(0.515\,^\circ C/m)(2)}$

$= 1.94\ \dfrac{mol\ solute}{kg\ water}$

2) $\dfrac{1.94\ mol\ solute}{kg\ water} \mid \dfrac{1\ kg\ water}{} \mid \dfrac{58\,g\ NaCl}{1\ mol\ NaCl} = \boxed{112.52\,g\ NaCl}$

61) Calculate the grams of solute required to make the following solutions?

a) 2500 g of saline solution (0.90% NaCl m/m)

$$\%\ NaCl\ (m/m) = \frac{g\ NaCl}{g\ solution} = \frac{x\ g\ NaCl}{2500\ g} \times 100\% = 0.90\%$$

$$\frac{(2500\ g)(0.90\%)}{100\%} = 22.5\ g\ NaCl$$

b) 0.050 kg of a 4.0% (m/m) $MgCl_2$

$$4\%\ MgCl = \frac{x\ g\ MgCl_2}{0.05\ kg} \times 100\%$$

$$\frac{(0.05\ kg)(4\%)}{100\%} = 0.002\ kg\ MgCl_2$$

72) What is the freezing point of each solution?

a) 0.50 mol glucose($C_6H_{12}O_6$) in 1000g water

$$T_f = 0^\circ C - \Delta T_f = 0^\circ C - [K_f \cdot i \cdot m]$$

$$= 0^\circ C - \left[(1.86^\circ C/m)(1)\left(\frac{0.50\ mol}{1\ kg}\right)\right]$$

$$T_f = -0.93^\circ C$$

b) 1.50 mol NaCl in 1000g water

$$T_f = 0^\circ C - \Delta T_f = 0^\circ C - [K_f \cdot i \cdot m]$$

$$= 0^\circ C - \left[(1.86^\circ C/m)(2)\left(\frac{1.50\ mol\ NaCl}{1\ kg}\right)\right]$$

$$T_f = -5.58^\circ C$$