

## Chapter 16 Review- Honors

## Part 1: Completion

A solution is a homogeneous mixture composed of a solute which is dissolved in a solvent. The solubility of a compound tells how many grams of solute can be dissolved in a given amount of solvent. A saturated solution contains the maximum amount of solute for a given amount of solvent at a constant temperature. A solution which contains less is called unsaturated and a solution that contains more is called supersaturated. One factor that can affect the solubility is temp/pressure. Typically, as you raise the temperature, the solubility increases. Henry's law describes the solubility of a gas in a solution. The concentration of a solution is a measure of the amount of solute that is dissolved in a given amount. The molarity is moles of solute per liters of solution.

## Part 2: Problems

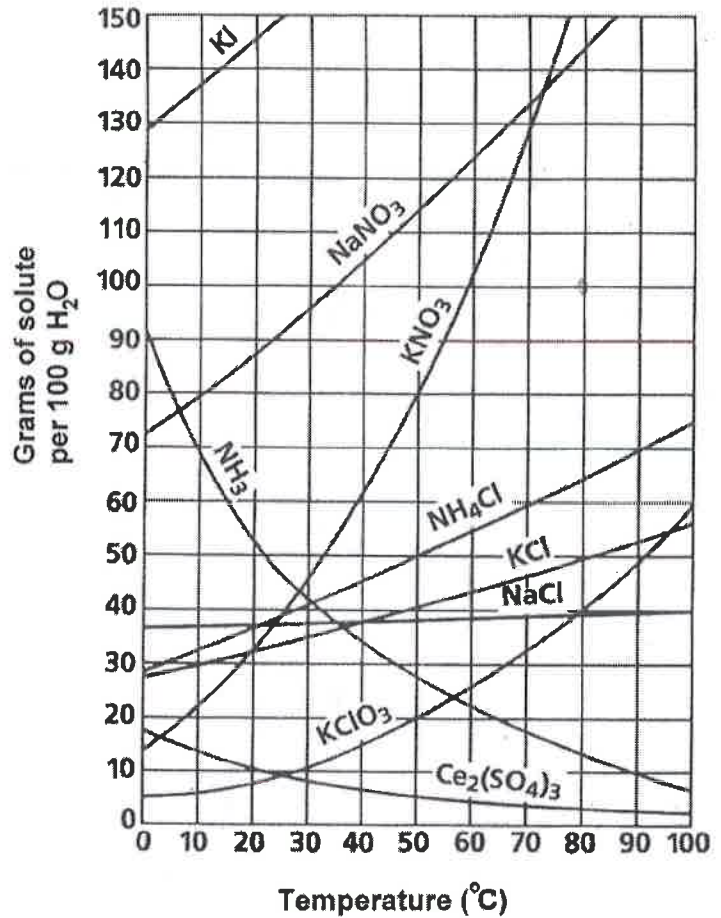
- 1.) What is the molarity of solution containing 0.3 moles of solute in 250 mL of solution?
- 2.) How many moles of solute are there in 600 mL of a 0.1 M solution?
- 3.) What is the molarity of a 125 mL solution containing 26.8 grams of calcium chloride ( $\text{CaCl}_2$ )?
- 4.) How many mL of a 6.0 M solution would you need to make 500 mL of a 0.2 M solution?
- 5.) What volume of a 1.0 M solution would you need to make 350 mL of a 0.5 M solution?
- 6.) Indicate how many particles are formed when the following solutes dissolve.

SOLUTE	# OF PARTICLES	SOLUTE	# OF PARTICLES
sucrose ( $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ )	1	aluminum chloride ( $\text{AlCl}_3$ )	4
sodium sulfate ( $\text{Na}_2\text{SO}_4$ )	3	methanol ( $\text{CH}_3\text{OH}$ )	1

- 7.) Which compound in the table above would have the greatest effect on the freezing and boiling point?
- 8.) When 5.0 g of  $\text{C}_6\text{H}_{12}\text{O}_6$  dissolves in 50.0 g of water, what is the boiling point elevation of the solution? ( $K_b$  Water =  $0.512^\circ\text{C}/m$ )
- 9.) Find the boiling point elevation of a solution containing 6.0 g benzene,  $\text{C}_6\text{H}_6$ , in 35 g of naphthalene. ( $K_b$  of naphthalene =  $5.65^\circ\text{C}/m$ )
- 10.) What is the molality of a solution when you have 42.4 g of NaCl dissolved in 145.3 g of water?
- 11.) What is the molality of a solution when you have 1.2 mol of solute dissolved in 152 kg of solvent?
- 12.) What is the molality of a 1023-gram aqueous solution which contains 345.3 grams of  $\text{CaCl}_2$ ?
- 13.) What is the molality of a 0.23 L solution containing 51.2 grams of NaCl? (The density of the solution is  $1.34\text{ g/mL}$ )
- 14.) Which salt, NaCl or  $\text{CaCl}_2$ , has a greater effect on freezing point? Explain.

### Part 3: Solubility Curve

- What mass of solute will dissolve in **100mL** of water at the following temperatures?
  - $\text{KNO}_3$  at  $70^\circ\text{C}$  130g
  - $\text{NaCl}$  at  $100^\circ\text{C}$  40g
  - $\text{NH}_4\text{Cl}$  at  $90^\circ\text{C}$  70g
  - Which of the **above** three substances is most soluble in water at  $15^\circ\text{C}$ .  $\text{NaCl}$
- At  $90^\circ\text{C}$ , you dissolved 10 g of  $\text{KCl}$  in 100. g of water. Is this solution saturated, unsaturated or supersaturated?
- A mass of 100 g of  $\text{NaNO}_3$  is dissolved in 100 g of water at  $80^\circ\text{C}$ .
  - Is the solution saturated or unsaturated?
  - As the solution is cooled, at what temperature should solid first appear in the solution? Explain.  $35^\circ\text{C}$
- Which compound is **most** soluble at  $20^\circ\text{C}$ ?  $\text{KI}$
- Which is the **least** soluble at  $40^\circ\text{C}$ ?  $\text{Ce}_2(\text{SO}_4)_3$
- Which substance on the graph is **least** soluble at  $10^\circ\text{C}$ ?  $\text{KClO}_3$



## chp. 16 Review Honors Key

$$1. M = \frac{0.3 \text{ mol}}{.250 \text{ L}} = 1.2 \text{ M}$$

$$2. 0.1 \text{ M} = \frac{x \text{ mol}}{.6 \text{ L}} = 0.06 \text{ mol}$$

$$3. \frac{26.8 \text{ g CaCl}_2}{1} \times \frac{1 \text{ mol CaCl}_2}{111.1 \text{ g CaCl}_2} = 0.241 \text{ mol}$$

$$M = \frac{0.241 \text{ mol}}{.125 \text{ L}} = 1.93 \text{ M}$$

$$4. M_1 V_1 = M_2 V_2$$
$$(6.0 \text{ M})(x \text{ mL}) = (0.2 \text{ M})(500 \text{ mL})$$
$$x = 16.67 \text{ mL}$$

$$5. (1.0 \text{ M})(x \text{ mL}) = (0.5 \text{ M})(350 \text{ mL})$$
$$x = 175 \text{ mL}$$

7.  $\text{AlCl}_3$

$$8. \frac{5.0 \text{ g C}_6\text{H}_{12}\text{O}_6}{1} \times \frac{1 \text{ mol}}{180 \text{ g}} = 0.0278 \text{ mol} \quad m = \frac{0.0278 \text{ mol}}{0.05 \text{ kg}}$$

$$\Delta T_b = (0.512^\circ\text{C/m})(0.556 \text{ m})$$

$$\Delta T_b = 0.285^\circ\text{C}$$

$$9. \frac{6.0 \text{ g C}_6\text{H}_6}{1} \times \frac{1 \text{ mol}}{78 \text{ g C}_6\text{H}_6} = 0.0769 \text{ mol} \quad m = \frac{0.0769 \text{ mol}}{.035 \text{ kg}}$$

$$\Delta T_b = (5.65^\circ\text{C/m})(2.1978 \text{ m})$$

$$\Delta T_b = 12.418^\circ\text{C}$$

$$10. \frac{42.4 \text{ g NaCl}}{1} \times \frac{1 \text{ mol}}{58.5 \text{ g NaCl}} = 0.725 \text{ mol NaCl}$$

$$m = \frac{0.725 \text{ mol}}{.1453 \text{ kg}} = 4.988 \text{ m}$$

$$11. m = \frac{1.2 \text{ mol}}{152 \text{ kg}} = 0.00789 \text{ m}$$

$$12. \text{ mass solvent} = 1023\text{g} - 345.3\text{g} = 677.7\text{g} = .6777\text{kg}$$

$$\frac{345.3\text{g CaCl}_2 \times 1\text{mol CaCl}_2}{111.1\text{g CaCl}_2} = 3.108\text{mol}$$

$$m = \frac{3.108\text{mol}}{.6777\text{kg}} = 4.586\text{m}$$

$$13. 0.23\text{L} = 230\text{ml}$$

$$D = \frac{m}{v} \quad 1.34\text{g/ml} = \frac{x\text{g}}{230\text{ml}} \quad x = 308.2\text{g solution}$$

$$308.2\text{g} - 51.2\text{g NaCl} = 257\text{g} = .257\text{kg}$$

$$\frac{51.2\text{g NaCl} \times 1\text{mol NaCl}}{58.5\text{g NaCl}} = 0.875\text{mol}$$

$$m = \frac{0.875\text{mol}}{0.257\text{kg}} = 3.41\text{m}$$

14.  $\text{CaCl}_2$