CHM 1046 Spring, 2016

Test 1

Name (print)_____

Show all your work for complete (and partial) credit. Use units where appropriate and report your answers to the correct number of significant figures. All equations should balance; indicate phases.

Useful information: . $\Delta T_f = K_f m$ $\qquad$ $P_A = X_A P^o_A$ $\qquad$ $P_A = X_A P_{tot}$

1. Draw a picture of a phase diagram.
   Label the axis and the phases.

2. Draw a plot of the vapor pressure
   of water vs. temperature. Label
   both axis with enough specificity
   to show the normal boiling point
   of water (100ºC).

3. Please explain why vapor pressure
   is dependent on the strength of
   intermolecular forces. Why would
   two liquids with different
   intermolecular forces have
   different vapor pressures?

4. Indicate the types of intermolecular forces that the following molecules would exhibit.
   Check all that apply

Compound	dipole/dipole	London/dispersive	H-bonding
CH_2Cl_2			
CH_3OH			
$CH_3CH_2CH_2CH_2CH_3$			
NH_3			

5. Draw a picture of any two molecules except water hydrogen bonding. You may use two of the same type of molecule. Use Lewis dot structures for the molecules and a dashed line for the hydrogen bond.

6. Why is the melting point for $H_2O(s)$ (0°C) so much lower than the melting point for $NaCl(s)$ (801°C)? Please give a molecular-level explanation instead of citing macroscopic trends.

Compound	m.w.	$\Delta H°_{fus}$	$\Delta H°_{vap}$ at 100°	Specific heat of liquid/ solid
$H_2O(l)$	18.015g/mol	6.009kJ/mol	40.7kJ/mol	4.184Jg^{-1}°C^{-1}/2.03 Jg^{-1}°C^{-1}

7. a) How much energy would it take to heat a block of ice weighing 100.g from -15.0°C to 0.0°C

   b) How much heat would it take to melt 100.g of ice at 0°C?

8. The density of silver (Ag, element #47, 107.87g/mol) is 10.50g/cm^3. The volume of a unit cell of silver is 6.82x10^{-29}m^3 (edge length of the cubic cell is 408.6pm). What type of cubic unit cell is silver composed of? You must show calculations. N_A=6.022x10^{23}mol^{-1}. Partial credit: what should you calculate to solve this problem?

9. In a solution, the major component is called the _____, and a minor component is called a/an _____.

10. Compared to the pure solvent, a solution will have a higher/lower (choose one) vapor pressure and a higher/lower (choose one) melting point.

11. a) A compound that does not dissolve in water is probably _____.

   b) Increasing _____ increases the solubility of solids in liquids but decreases the solubility of gases in liquids.

12. A solution of benzene and toluene has $X_{benzene} = X_{toluene} = 0.50$. The vapor pressures of pure benzene and toluene are 38 and 11 mm Hg, respectively, at 25°C. What would be the mole fraction of toluene in the vapor in equilibrium with the mixture?

13. What mass of a solution that is 7.65% NaCl by mass would contain 15.0g of NaCl (58.44g/mol)?

14. A solution of vinegar is 0.763M acetic acid, $HC_2H_3O_2$ (60.05g/mol). The density of the solution is 1.004g/mL. What is the molal concentration of acetic acid?

Diphenyl ether melts at 26.84°C. A 0.1000m solution of pyrene (an organic compound) in diphenyl ether melts at 26.04°C. (Next 2 questions)
15. What is the molal freezing point depression constant for diphenyl ether? If you do not have enough information to calculate an answer, what additional information do you require?

16. What would be the melting point of a 0.2000m solution of anthracene (another organic compound) in diphenyl ether? If you do not have enough information to calculate an answer, what additional information do you require?

5 points extra credit? What is a supercritical fluid? Under what conditions do supercritical fluids exist? Give a couple of properties of supercritical fluids.