Chem 1515
Problem Set #1
Fall 2001

Name_____

TA Name _____

Lab Section #_____

ALL work must be shown to receive full credit. **Due at the beginning of lecture on Wednesday, August 29, 2001.**

PS1.1. Using the Pre-Lecture Exploration (http://intro.chem.okstate.edu/PLE182201/PLMPhase.html) #1 discussed in class as a source, explain why a gas condenses to a liquid as the temperature is lowered. Base your explanation in terms of the submicroscopic level.

PS1.2. In the boxes below diagram the specified system as viewed at the atomic level in the space provided. Be sure to clearly label each of the substances in your diagram.

A sample of nitrogen at 25 ˚C	A sample of H_2O at 25 ˚C	A sample of iron at 25 ˚C

Label Area:

PS1.3. Explain what the terms heat of fusion and heat of vaporization mean. Provide a chemical equation describing the fusion and vaporization process. Also explain how you could calculate the heat of fusion or heat of vaporization using the table of data in Appendix B on page A-5.

PS1.4. a) How much heat is produced when 57.0 g of steam at 115 ˚C is converted to water at 15.0 ˚C?

b) How much heat is required to convert 128.0 g of ice at -10.0 ˚C to liquid at 95.0 ˚C?

PS1.5. Ethyl alcohol melts at -114 ˚C and boils at 78 ˚C. The enthalpy of vaporization for ethyl alcohol at 78 ˚C is $870\,\frac{J}{g}$ and the enthalpy of fusion is $109\,\frac{J}{g}$. If the specific heat of solid ethyl alcohol is taken to be $0.97\,\frac{J}{g\cdot{}^{\circ}C}$, and that for the liquid $2.3\,\frac{J}{g\cdot{}^{\circ}C}$, how much heat is required to convert 10.0 g of ethyl alcohol at -120 ˚C to the vapor phase at 78 ˚C?

PS1.6. Define the term equilibrium vapor pressure.

b) Use a vapor-pressure table (check the Database link on the class web site) to look up the equilibrium vapor pressure of a sample of water at 90 ˚C and at 80 ˚C.

c) Consider two closed containers each partially filled with liquid water one at 95 ˚C and the other at 80 ˚C. Can the pressure of water vapor in the gas phase in either container ever exceed the equilibrium vapor pressure at the particular temperature? Explain why or why not.

PS1.7. A sample of water in the vapor phase (no liquid present) in a flask of constant volume exerts a pressure of 508 mm Hg at 100 ˚C. The flask is slowly cooled.

a) Assuming no condensation, use the Ideal Gas Law to calculate the pressure of the vapor at 90 ˚C; at 80 ˚C.

b) Will condensation occur at 90 ˚C; 80 ˚C?

c) On the basis of your answers in a) and b), predict the pressure exerted by the water vapor at 90 ˚C; at 80 ˚C.

PS1.8. Consider the following data for the white phosphorus (P_4):

T(˚C)	vapor pressure (mmHg)
215	162
227	222
239	300
245	346
257	459
263	525
280	759

a) Use graphing software (Microsoft Excel) to plot ln (P_v) vs. $\frac{1}{T}$ for white phosphorus and use your graph to determine the slope of the best line through the data. The heat of vaporization of a liquid can be obtained from such a plot. The relationship is given as,

$$\text{slope} = -\frac{\Delta H^\circ_{vap}}{8.314\ \frac{J}{mol \cdot K}}$$

Calculate the heat of vaporization for white phosphorus. (Note: Be sure to clearly label the graph.)

b) Using the graph, determine the temperature of a sample of white phosphorus when the vapor pressure is 324 mmHg.

c) Using the graph, determine the vapor pressure of a sample of white phosphorus at 270. ˚C.

PS1.9. The normal boiling point of acetone, $(CH_3)_2CO$ is 56.2 ˚C and its ΔH°_{vap} = 32.0 $\frac{kJ}{mol}$. Draw a Lewis structure for acetone and calculate the temperature at which acetone has a vapor pressure of 415. mmHg.

b) Using data in part a of this problem, calculate the vapor pressure of acetone when the temperature is 25.0 ˚C.