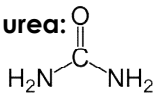
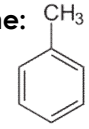
Chemistry 201 –Exam Four Name_____

Part One: Multiple Choice (45 points - 3 points each)
Select the best answer to each question. There is only one correct answer.

Molecules: **urea:**  **toluene:**  MM=92.14 g/mol

chloroform: $CHCl_3$
ethyl alcohol: C_2H_5OH
ethylene glycol: $C_2H_6O_2$
glucose: $C_6H_{12}O_6$
methanol: CH_3OH

1. What is the mole fraction of urea in a solution that contains 2.0 mol of urea and 3.0 mol of water?
   a. 0.25 b. 0.40 c. 0.50 d. 0.60 e. 0.80

2. If 0.100 mol chloroform is dissolved in 400.0 g toluene the molality is:
   a. 0.250 b. 0.500 c. 0.750 d. 1.00 e. 2.00

3. What is the mole fraction of urea in an aqueous solution that is 46% urea by mass?
   a. 0.20 b. 0.25 c. 0.30 d. 0.40 e. 0.80

4. What is the molality of ethyl alcohol in an aqueous solution that is 50.% by mass ethyl alcohol?
   a. 11 b. 15 c. 18 d. 22 e. 33

5. What is the molarity of an HCl solution that is 20.2 % by mass HCL and has a density of 1.096 g/ml?
   a. 0.220 b. 5.54 c. 6.07 d. 6.93 e. 14.1

6. Determine the freezing point of a 0.25 m solution of glucose in water (K_f = 1.86 °C/m).
   a. 0.93 ° C b. -0.93 ° C c. 0.46 ° C d. -0.46 ° C e. 0.23 ° C

7. What is the osmotic pressure for 0.10 M sodium phosphate at 20.0°C? (Note: the solute is ionic!)
   a. 2.4 atm b. 4.8 atm c. 7.2 atm 9.6 atm e. none of these

8. A 12.0% sucrose solution has a density of 1.05 g/cm^3. The number that gives the best value for the mass of sugar in 55mL of this solution is:
   a. 6.6 g b. 6.60 g c. 13.8 g d. 6.93 g e. 58 g

9. What is the freezing point of an aqueous 0.750 molal NH_4I solution? (K_f = 1.86°C/m))?
   a. -1.40 °C b. +1.40 °C c. -1.86 °C d. +1.86 °C e. -2.80 °C

10. Which of the following molecules exhibits hydrogen bonding?
    a. HNF_2 b. H_2S c.B_2H_6 d. HBr e. CaH_2

11. The strongest intermolecular forces between molecules of PH_3 are:
    a. ionic bonds b. hydrogen bonds c. dipole-dipole d. London forces

12. How many grams of a 5.000 % (w/w) glucose solution provide 80.00 g of glucose?
    a. 400. g b. 1200. g c. 100.0 g d. 1600. g e. none of these

13. A semi-permeable membrane separates a 2% (w/w) solution of starch from an 8% (w/w) solution of starch. Which statement is correct:
    a. Initially water will flow from the 2% solution to the 8% solution
    b. Initially water will flow from the 8% solution to the 2% solution
    c. Starch will flow through the membrane until the concentrations are equal
    d. nothing will happen

14. Which of the following, when 10.0 g are dissolved in 1 liter of water, will result in the lowest freezing point for the solution?
    a. C_2H_5OH b. NaCl c. $CaCl_2$ d. CH_3CO_2H e. they will freeze at the same temperature

15. Which substance is most likely to exist as a solid at room temperature?
    a. NH_3 b. PH_3 c. AlH_3 d. CH_4 e, SiH_4

Part Two: Short Answer (20 points - 4 points each)
Write your answer in the space provided

1. What is a super critical fluid? (You may refer to the phase diagrams on the last page.)

2. Xenon boils at 165.05 K. Helium boils at 4.22 K. Why is the boiling point of helium so much lower that than of xenon? Explain this in terms of intermolecular forces.

3. What has to exist for hydrogen bonding to occur? Give an example of hydrogen bonding.

4. Why does the vapor pressure of a liquid increase with increasing temperature?

5. Which solvent, water or carbon tetrachloride, would you chose to dissolve HF? Why?

Part Three: Problem Solving Show your work to receive credit.

1. If the human eye has an osmotic pressure of 8.00 atm at 25°C, what molarity of solute particles in water will provide an isotonic eye drop solution (a solution with equal osmotic pressure)? (**5 points**)

2. An aqueous solution of sodium chloride has a density of 1.01 g/mL. The freezing point of this solution is -1.28°C. What is the percent composition of sodium chloride by mass? (K_f for H_2O is 1.86°C/m) (**5 points**)

3. What volume of ethylene glycol, a nonelectrolyte, must be added to 15.0 L of water to produce an antifreeze solution with a freezing point of -25.0°C? The density of ethylene glycol is 1.11 g/mL and the density of water is 1.00 g/mL (**5 points**)

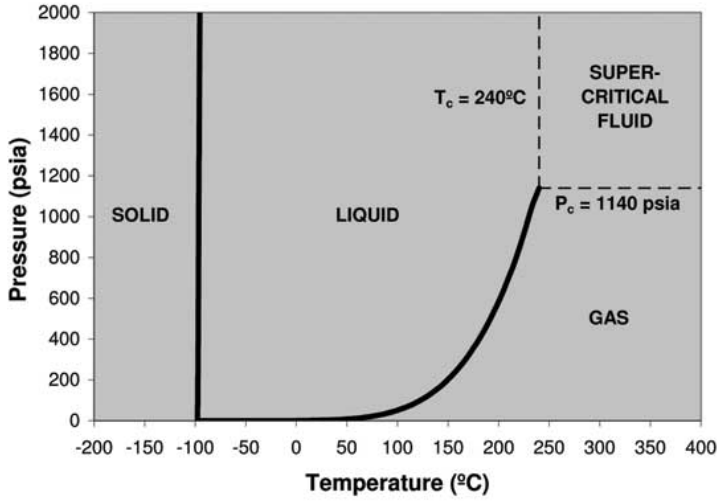
4. Answer these questions using the phase diagrams of methanol and carbon dioxide provided on the next page (**20 points**):

    a. At what temperature will CO_2 sublime at atmospheric pressure?

    b. What is the boiling point of methanol at 200 psia?

    c. At approximately what temperature does methanol freeze?

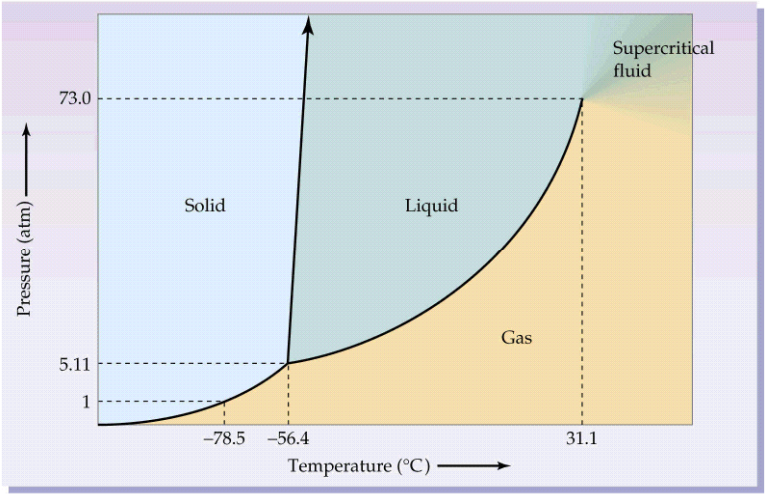
    d. At what temperature and pressure are gas, liquid and solid phases in equilibrium for CO_2?



Phase Diagram of Methanol

14.7 psia = 1.00 atm

(pounds per square inch absolute)



Phase Diagram of Carbon Dioxide