Chemistry 104 Exam 1 October 8, 1996

1. List the types of intermolecular forces that exist between molecules of:
   (a) I_2 and H_2O (b) CH_3OH (c) N_2 (d) KI and CCl_4
   (e) LiF and H_2O

2. Arrange the following in order of increasing surface tension (no explanation is necessary):
   CF_4, RbF, F_2, HF, IF

3. Arrange the following in order of decreasing solubility in water (no explanation is necessary): KCl, ICl, I_2, NH_3

4. Classify solids of the following as amorphous or crystalline. If crystalline, classify them as ionic, molecular, covalent, or metallic crystals.

   (a) FrCl (b) H_2O (c) acrylic (d) C (e) I_2

5. How much energy does it take to make 125 g of ice cubes at -10.0 °C from water at 40.0 °C?

6. The vapor pressure of ethyl ether is 0.414 atm at 10.0 °C. The ΔH_{vap} for ethyl ether is 26.0 kJ/mol. What is the vapor pressure of ethyl ether at 34.0 °C?

7. You are given a sample of crystalline nickel. First-order Bragg diffraction was observed at an angle of $\theta = 5.798°$ when the crystal was exposed to X rays of $\lambda = 0.712$ Å. Calculate the spacing between planes in this crystal.

8. The distance between planes in crystalline nickel as determined by x-ray diffraction is equal to the cell edge length. This metal crystallizes in a face-centered cubic unit cell. What is the density of nickel?

9. On the phase diagram below, label the solid, liquid, and gas phases, the triple and critical points, and the normal boiling and melting points.

10. A commonly used commercial solution of aqueous ammonia (NH_3) is 28% by mass and has a density of 0.90 g/cm^3. Calculate (a) the molality and (b) the molarity of this solution.

Data and equations:

$q = ms\Delta t$ $q = m\ (1/M.W.)\ \Delta H$ $\ln (P_1/P_2) = (\Delta H_{vap}/R)(1/T_2 - 1/T_1)$

$2d\sin\theta = n\lambda$

Specific heat of ice: 2.03 J/g °C
Specific heat of water: 4.184 J/g °C
Specific heat of steam: 1.99 J/g °C
$\Delta H_{fus(H2O)} = 6.01$ kJ/mol
$\Delta H_{vap(H2O)} = 40.79$ kJ/mol

For cubic cells:
scc: $a = 2r$ bcc: $a = 4r/\sqrt{3}$ fcc: $a = \sqrt{8}r$