

Chem 106 Exam 3. January 21, 2005.

Name _____

You must show all work for credit!

Useful Information: $\ln \frac{P_1}{P_2} = \frac{\Delta H}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$, $q = s \times m \times \Delta T$, $R = 8.314 \text{ J/mol}\cdot\text{K}$, $1 \text{ atm} = 760$

mm Hg

(1)(6 points) Which of the following molecules has a permanent dipole moment? Draw a three dimensional figure of each molecule and indicate the direction of the dipole moment (if it has one).

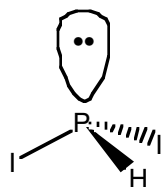
(a) OF₂

(b) AlCl₃

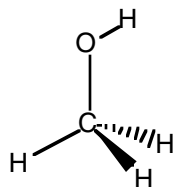
(c) NH₃

(2)(4 points) List all intermolecular forces that are important for each of the following molecules.

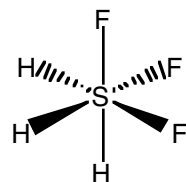
(a)



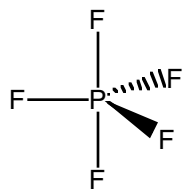
(b)



(c)



(d)



(3) (7 points) Complete the table

Type of Solid	Metal	ionic	molecular	network covalent
solid conducts electricity			no	
liquid conducts electricity			no	
particles are connected by		ionic bonds		
soluble in nonpolar solvents	no			
soluble in polar solvents	no		polar ones are	

(4)(2 points) Place the following in order of increasing boiling point.

- (a) Ne
- (b) CH₄
- (c) SF₆
- (d) SI₆

(5)(8 points) Iron has a melting point of 1535 °C. Its $\Delta H_{\text{fus}} = 13.13 \text{ kJ/mol}$. If the heat capacity for solid iron is 25.1 J/mol•K, how much energy is required to heat a 1.00 kg piece of iron from 25 °C until it has all melted at 1535 °C?

(6)(6 points) Sketch a phase diagram for hydrazine. The triple point of hydrazine is at $2.0\text{ }^{\circ}\text{C}$ and 0.004 atm , the critical point is at $380\text{ }^{\circ}\text{C}$ and 145 atm , and the normal boiling point is at $113\text{ }^{\circ}\text{C}$. Label the regions for all four phases, the triple point, and the critical point. Solid hydrazine is more denser than liquid hydrazine.

(7) (3 points) Using the phase diagram from problem 6, tell if any phase changes occur when the conditions are changed as follows

(a) The temperature is raised from $-50\text{ }^{\circ}\text{C}$ to $400\text{ }^{\circ}\text{C}$ at 1 atm of pressure

(b) The pressure is raised from 1 atm to 20 atm at $420\text{ }^{\circ}\text{C}$

(c) The temperature is raised from $50\text{ }^{\circ}\text{C}$ to $400\text{ }^{\circ}\text{C}$ at 0.5 atm of pressure.

(8)(6 points) Chloroform, CHCl_3 was once used as an anesthetic. Chloroform has a ΔH_{vap} of 31.4 kJ/mol and a normal boiling point of 61.7 °C. What is its P_{vap} at normal body temperature, 37 °C?

(9)(4 points) Which of the following compounds do you expect to be soluble in water? in toluene (C_7H_8)?

(a) HF

(b) PF_5

(c) Na_2CO_3

(d) I_2