Chemistry 104 Exam 1 January 23, 1998

Name_____

Signature_____

ID number_____ Seat number_____

This exam is closed book, closed notes. The only items you are allowed to use for this exam are a calculator and a pen or pencil. A periodic table and data/equations sheets are attached to this exam. Constants and equations not given on the exam will not be supplied by the instructor. Do the problems you think are easier first, then go back and work on the ones you find more difficult. If you require extra space to work, you may use the back of the page you are on, but you must clearly indicate that you have done so to receive credit. Show all work and include units and correct significant figures for full credit.

Grading:

1._____/10

2._____/10

3._____/15

4._____/10

5._____/12

6._____/11

7._____/10

8._____/10

9._____/12

Total:_____/100

1. (10 points) Arrange the following in order of decreasing solubility in Br_2 (no explanation is necessary):

H_2O, CCl_3F, BF_3, I_2, KBr

2. (10 points) Arrange the following in order of increasing vapor pressure (no explanation is necessary):

HF, $SiBr_4$, , AsH_3, I_2, $BaCl_2$

3. (15 points) List the types of intermolecular forces that exist between molecules of:

(a) CH_3OH and PCl_5

(b) CO_2

(c) CI_4 and RbCl

(d) NH_3

(e) $CFCl_3$ and KCl

4. (10 points) Classify solids of the following as amorphous or crystalline. If crystalline, classify them as ionic, molecular, covalent, or metallic crystals.

(a) rayon

(b) B

(c) NaI

(d) Fr

(e) NH_3

5. (12 points) One type of crystalline iron forms a body centered cubic unit cell with a density of 7.86 g/cm^3. What is the radius of an iron atom in pm?

6. (11 points) Calculate the energy released when 1.000 kg of H_2O at 178.0 °C is cooled to form H_2O at 20.0 °C.

7. (10 points) Isopropyl alcohol, used in rubbing alcohol, has a heat of vaporization of 42.09 kJ/mol and a vapor pressure of 31.6 mm Hg at 20.0 °C. What is the vapor pressure of isopropyl alcohol when the temperature is 60.0 °C?

8. (10 points) The normal melting and boiling points of oxygen are -218.4 °C and -183.0 °C, respectively. The triple point occurs at -218.7 °C and 0.0015 atm, and the critical point is at -118.6 °C and 49.8 atm. Sketch the phase diagram for oxygen below. Label all points, including the solid (s), liquid (l), and vapor (g) phases.

9. A solution of carbon dioxide in water is 0.0950 M carbon dioxide and has a density of 0.97 g/cm^3.

(a) (6 points) Calculate the percent by mass of carbon dioxide in the solution.

(b) (6 points) Find the molality of the 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: $a = \sqrt{8}r$