Exam 1
Chem 1142
Fall 2008

Show all work to receive credit!

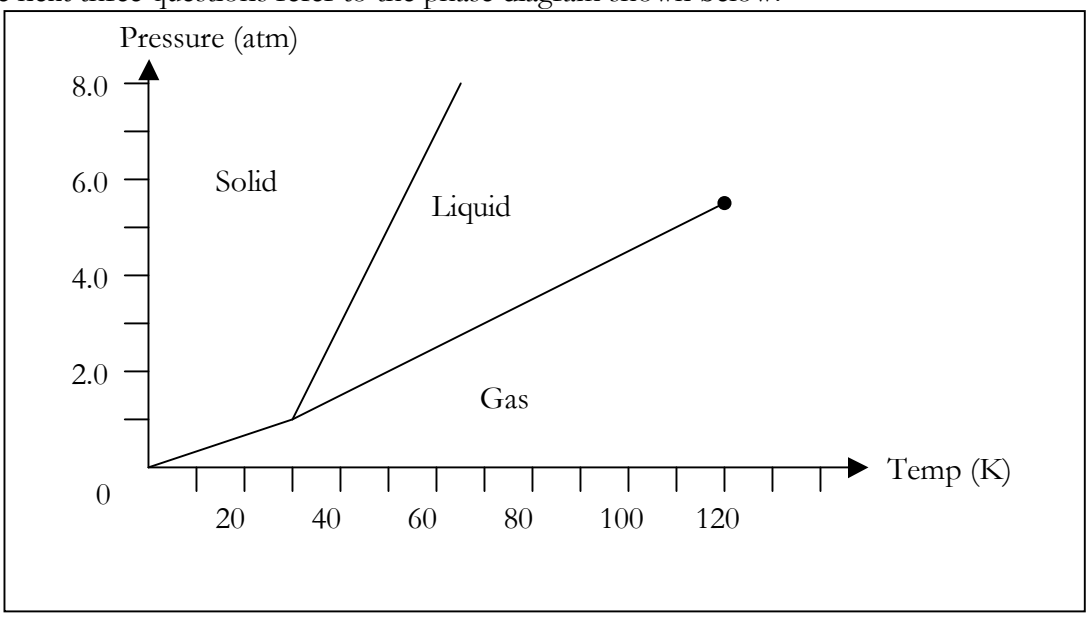
Name:_____

Q1. List the intermolecular forces that exist between molecules of: (10 pts.)
a) CO_2 b) CH_3CH_2OH

Q2. Iron crystallizes in a body-centered cubic unit. The edge of this cell is 287 pm. Calculate the density of iron. (10 pts.)

Q3. Name the following processes: (12 pts.)
a) Solid → Liquid
b) Liquid → Gas
c) Gas → Solid
d) Solid → Gas
e) Gas → Liquid
f) Liquid → Solid

The next three questions refer to the phase diagram shown below.



Q4. What phase will the substance be in at 60 K and 1.0 atm? (3 pts.)
a) Solid b) Liquid c) Gas d) Supercritical-fluid e) Triple-point

Q5. What is the freezing point at 0.25 atm? (3 pts.)
a) 10 K b) 20 K c) 30 K d) 40 K e) No freezing point exists

Q6. What is the boiling point at 3.0 atm? (3 pts.)
a) 70 K b) 20 K c) 120 K d) 0.05 K e) 35 K

Q7. What's the definition of a saturated solution? (4 pts.)

Q8. How many grams of solute are present in 125 g of a 4.5% (w/w) solution? (8 pts.)

Q9. A 4.53 M solution of CsBr(aq) has a density of 1.38 g/mL. Calculate its molal concentration. (10 pts.)

Q10. Calculate the van't Hoff factor, *i*, for a 2.45 m aqueous solution of NaBr if the boiling point of the solution is 102.34 °C at 1 atm. Comment on the value you obtain. Explain why it deviates from the ideal value. (k_b = 0.512 °C/m) (10 pts.)

Q11. Calculate the osmotic pressure of a 0.050 M solution of $Na_2SO_4(aq)$ at 23 ºC. Comment on any assumptions you are making. (8 pts.)

Q12. Which of the following compounds will have the highest vapor pressure. Explain why. (6 pts.)

a) CH_3Br b) CH_3Cl c) CH_3OH d) CH_3F

Q13. Acetic acid is a polar molecule and can form hydrogen bonds with water molecules. Therefore, it has a high solubility in water. Yet acetic acid is also soluble in benzene (C_6H_6), a non-polar solvent that lacks the ability to form hydrogen bonds. A solution of 3.8 g of CH_3COOH in 80. g C_6H_6has a freezing point of 3.5 ºC. Calculate the molar mass of the solute and explain your result. (13 pts.)

$fp(C_6H_6)$ = 5.5 ºC. k_f (C_6H_6) = 5.12 ºC/m.

Useful information

Periodic Table of the Elements

IA	*IIA*											*IIIA*	*IVA*	*VA*	*VIA*	*VIIA*	*VIIIA*
1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973762	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90447	54 Xe 131.29
55 Cs 132.90545	56 Ba* 137.327	71 Lu 174.967	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po [210]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

*	57 La 138.9055	58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04
**	89 Ac [227]	90 Th 232.0381	91 Pa 231.03588	92 U 238.0289	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]

$\Delta T_b = ik_b m$ $\Delta T_f = ik_f m$ $\Pi = iMRT$

$R = 8.3145\ \text{J/mol·K} = 0.08206\ \text{(L·atm)/(mol·K)}$

$N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$