Exam 1A
Chem 1142
Spring 2013

Name:_____

MULTIPLE CHOICE. [4 pts ea.] Choose the best response on the scantron sheet. [**48 pts total.**]

Q1. What angle do the sp^2 hybrid orbitals make with respect to each other?
    a) 90°   b) 109.5°   c) 120°   d) 180°   e) 90° and 120°

Q2. How many σ and π bonds are there in a molecule of acetylene: H–C≡C–H?
    a) 3 σ, 1 π b) 3σ, 2 π c) 2 σ, 3 π d) 2 σ, 2 π e) 0 σ, 3 π

Q3. Which one of the following substances would exhibit dipole-dipole intermolecular forces?
    a) CCl_4 b) Cl_2 c) N_2 d) NCl_3 e) CH_4

Q4. At room temperature, which of the following compounds has the strongest intermolecular forces?
    a) CO_2 b) H_2O c) $NaCl$ d) CH_3CH_3 e) CH_3Cl

Q5. The boiling points of NH_3, PH_3, AsH_3, and SbH_3 follow a periodic trend except for
    a) NH_3 which has an unexpectedly high boiling point
    b) NH_3 which has an unexpectedly low boiling point
    c) SbH_3 which has an unexpectedly high boiling point
    d) SbH_3 which has an unexpectedly low boiling point
    e) AsH_3 which has an unexpectedly high boiling point

Q6. What fraction of an atom occupying a face position of a cubic lattice is part of the unit cell?
    a) 1   b) ½   c) ¼   d) 1/6   e) 1/8

Q7. For a pure substance, ΔH_{fus} is known to be +15.0 kJ/mol. Which of the following is most probably the ΔH_{vap} for this substance?
    a) –15.0 kJ/mol   b) –45.0 kJ/mol   c) 0.0 kJ/mol
    d) +15.0 kJ/mol   e) +45.0 kJ/mol

Q8. A substance at a temperature greater than its critical temperature is called
    a) a solid   b) a vapor   c) a rheostatic liquid
    d) a supercritical fluid   e) an hydraulic fluid

Q9. Which of the following is an example of a covalent network solid?
    a) C(graphite)   b) MgO c) P_4 d) $NaCl$ e) I_2

Q10. If the pressure of a gas over a liquid increases, the amount of gas dissolved in the liquid will
    a) increase   b) decrease   c) remain the same
    d) have a higher vapor pressure   e) depend on the polarity of the gas

Q11. Which of the following would have the **lowest** boiling point?
    a) pure H_2O b) 1 m $C_6H_{12}O_6$(aq)   c) 1 m KCl(aq)
    d) 1 m $(NH_4)_2SO_4$(aq)   e) 1 m Na_2SO_4(aq)

Q12. Which concentration will change as the temperature of a solution is increased?

        a) %(w/w)   b) molality   c) molarity   d) morality   e) mole-fraction

Short Response.

Show ALL work to receive credit.

Q13. [13 pts.] Describe the geometries of these cubic cells: simple cubic, body-centered cubic, and face-centered cubic. Which of these would give the highest density for the same type of atoms? Explain.

Q14. [14 pts.] The normal boiling point and normal freezing point of sulfur dioxide are –10 °C and –72.7 °C respectively. The triple point is –75.5 °C and 1.65×10^{-3} atm, and its critical point is at 157 °C and 78 atm. On the basis of this information, draw a rough sketch of the phase diagram of SO_2. Be sure to carefully label your diagram.

Q15. [15 pts.] A quantity of 7.480 g of an organic compound is dissolved in water to make 300.0 mL of solution. The solution has an osmotic pressure of 1.43 atm at 27 °C. The analysis of this compound shows it to contain 41.8 % C, 4.7 % H, 37.3 % O, and 16.3 % N. Calculate the molecular formula of the organic compound.

Q16. [10 pts.] Calculate the van't Hoff factor of Na_3PO_4 in a 0.40 *m* aqueous solution whose boiling point is 100.78 °C.

$\mathcal{U}$seful Information

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1																	18
1 H 1.01	2											13	14	15	16	17	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba* 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	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 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
**	89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	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]

1 atm = 101,325 Pa = 760 mmHg = 760 torr

$R = 0.08206 \text{ L} \cdot \text{atm/mol} \cdot \text{K}$ $R = 8.314 \text{ J/mol} \cdot \text{K}$

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

$c = kP$