CHEM 1515.001 – 1515.006
Exam I
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February 8, 2001

Name ______________________

TA's Name ______________________

Lab Section _______

INSTRUCTIONS:

1. This examination consists of a total of 8 different pages. The last three pages include a periodic table, a table of vapor pressures for water, and a solubility table. All work should be done in this booklet.
2. PRINT your name, TA's name and your lab section number now in the space at the top of this sheet. DO NOT SEPARATE THESE PAGES.
3. Answer all questions that you can and whenever called for show your work clearly. Your method of solving problems should pattern the approach used in lecture. You do not have to show your work for the multiple choice or short answer questions.
4. No credit will be awarded if your work is not shown in problems 4c and 7.
5. Point values are shown next to the problem number.
6. Budget your time for each of the questions. Some problems may have a low point value yet be very challenging. If you do not recognize the solution to a question quickly, skip it, and return to the question after completing the easier problems.
7. Look through the exam before beginning; plan your work; then begin.
8. Relax and do well.

	Page 2	Page 3	Page 4	Page 5	Page 6	TOTAL
SCORES	____ (24)	____ (16)	____ (24)	____ (18)	____ (18)	____ (100)

(9) 1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous. Soluble ionic compounds should be written in the form of their component ions.

a) $HNO_{3}\mathit{(aq)}$ + $Ba(OH)_{2}\mathit{(aq)}$ →

b) $Na_{2}S\mathit{(aq)}$ + $Fe(NO_{3})_{3}\mathit{(aq)}$ →

c) $C_{3}H_{6}\mathit{(g)}$ + $O_{2}\mathit{(g)}$ →

(4) 2. Write the ionic and net ionic chemical equations for 1a) or 1b).

1a)

Ionic equation:

Net Ionic equation:

(11) 3. Identify the intermolecular attractive force(s) present in the following substances. If more than one intermolecular force, indicate which is the most important.

a) N_{2}(l)

b) SO_{2}(l)

c) $CH_{3}NH_{2}$(l)

d) $CH_{2}Cl_{2}$(l)

(16)4a. Define the term equilibrium vapor pressure.

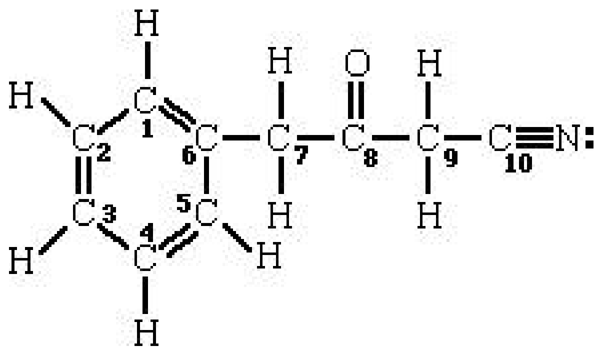
b) What is the equilibrium vapor pressure for water at 90 ˚C?

c) A 1.80 g sample of pure water is injected into a 4.00 L evacuated vessel at 95.0 ˚C. Calculate the pressure exerted by the sample of water assuming it is completely vaporized.

d) Is the assumption the sample water is completely vaporized at 95.0 ˚C in this 4.00 L vessel reasonable? Explain.

e) If the sample in the vessel is cooled to 90.0 ˚C, indicate the phase(s) present and the pressure exerted by water in the vapor phase.

(24)5a. What is the hybridization on each of the designated *central atoms* in the molecule shown below.



C_1 __________ C_8 __________

C_2 __________ C_9 __________

C_3 __________ C_{10} __________

C_7 __________

b) What is the bond angle for each of the following combination of atoms?

C_1–C_6–C_7 __________

H–C_7–C_8 __________

C_9–C_{10}–N __________

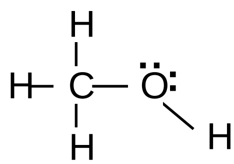
C_9–C_8–O __________

c) Determine the number of sigma and pi-bonds in the structure.

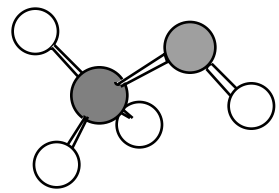
d) Clearly identify the portion(s) of the molecule where delocalized electrons are located.

e) Identify the types of atomic or hybrid orbitals needed to explain the bonding in the CN functional group on this molecule and between C_6 and C_7.

(18)6a. Below is the Lewis structure and a ball-and-stick model of methyl alcohol. Indicate the molecular geometry about both the carbon and the oxygen atom.



Lewis structure



ball-and-stick model

b) What is the most important intermolecular attractive force that occurs in liquid methyl alcohol?

c) Draw several methyl alcohol molecules and clearly indicate how adjacent molecules interact. In your sketch label the most important intermolecular attractive force between adjacent methyl alcohol molecules.

d) Methyl alcohol has a normal boiling point of 64.5 ˚C, Monofluoromethane, CH_3F, has a normal boiling point of –78.4 ˚C. Both of these compounds have approximately the same molar mass, explain the large difference in boiling points.

(18)7a. Isopropyl alcohol, C_3H_8O, has a vapor pressure of 219.0 mmHg at 24.0 ˚C. If the $\Delta H^\circ_{vaporization}$ is $19.3 \frac{kJ}{mol}$, calculate the vapor pressure of isopropyl alcohol at 39.5 ˚C.

b) What is the normal boiling point for isopropyl alcohol?

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008																	2 **He** 4.00
2	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
3	11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	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** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
5	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** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
6	55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
7	87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

Lanthanides	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.2	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinides	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.0	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)	103 **Lr** (260)

Useful Information

$PV = nRT$

$R = 0.0821 \frac{L \cdot atm}{mol \cdot K} = 8.314 \frac{J}{mol \cdot K}$

$\ln\left(\frac{vp_2}{vp_1}\right) = -\frac{\Delta H^\circ_{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

density of H_2O = $1.00 \frac{g}{cm^3}$

density of H_2O = $1.00 \frac{g}{cm^3}$

$q = \text{mass} \cdot \text{Specific heat} \cdot \Delta T$

Temperature (°C)	Vapor Pressure(mmHg)	Temperature (°C)	Vapor Pressure(mmHg)
-5	3.2	50	92.5
0	4.6	55	118.0
5	6.52	60	149.4
10	9.20	65	187.5
15	12.8	70	233.7
20	17.5	75	289.1
25	23.8	80	355.1
30	31.8	85	433.6
35	42.1	90	525.8
40	55.3	95	633.9
45	71.9	100	760

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
^-OH	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble