CHEM 1215
Exam II
John II. Gelder
October 7, 1998

Name _____

TA's Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 5 different pages. The last page includes a periodic table 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. You will receive 2 points for knowing your TA's name AND laboratory section number in which you are officially enrolled.

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 (if any) or short answer questions.

4. Point values are shown next to the problem number.

5. 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.

6. Look through the exam before beginning; plan your work; then begin.

7. Relax and do well.

	Page 2	Page 3	Page 4	TOTAL
SCORES	_____	_____	_____	_____
	(36)	(48)	(16)	(100)

(16) 1. Complete the following table by inserting the name of a compound or a formula.

Compound Name	Formula
hydrosulfuric acid	**H_2S**
iron(III) oxide	**Fe_2O_3**
iodine heptafluoride	IF_7
lithium sulfite	Li_2SO_3
barium hydroxide	**$Ba(OH)_2$**
lead acetate or lead(II) acetate	$Pb(C_2H_3O_2)_2$
potassium cyanide	**KCN**
sodium nitrite	$NaNO_2$

(8) 2. When gaseous hydrogen fluoride is used to etch solid glass, $CaSiO_3$, at room temperature, gaseous silicon tetrafluoride, liquid water and aqueous calcium fluoride are formed. Write the balanced chemical equation for the following description. Be sure to include the phase for each substance.

$$\mathbf{CaSiO_{3}}\textit{(s)} + \mathbf{6HF}\textit{(g)} \rightarrow \mathbf{SiF_{4}}\textit{(g)} + \mathbf{3H_2O}\textit{(l)} + \mathbf{CaF_{2}}\textit{(aq)}$$

(12) 3. Predict the solubility of the following compounds in water. For those compounds that are soluble write the formula for the cation and anion that exists in aqueous solution.

a) $PbSO_4$
insoluble

b) $Mg(ClO_4)_3$
soluble **Mg^{2+} and ClO_4^-**

c) HCl
soluble **H^+ and Cl^-**

d) $(NH_4)_3PO_4$
soluble **NH_4^+ and PO_4^{3-}**

(36) 4. 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.

a) $Fe(s) + \mathbf{2}HCl(aq) \rightarrow \mathbf{FeCl_2}_{(aq)} + \mathbf{H_2}_{(g)}$ **or** $\mathbf{2FeCl_3}_{(aq)} + \mathbf{3H_2}_{(g)}$

b) $MgSO_4(aq) + \mathbf{2}AgNO_3(aq) \rightarrow \mathbf{Mg(NO_3)_2}_{(aq)} + \mathbf{Ag_2SO_4}_{(s)}$

c) $\mathbf{2}H_3PO_{4(aq)} + \mathbf{3}Ba(OH)_{2(aq)} \rightarrow \mathbf{Ba_3(PO_4)_2}_{(s)} + \mathbf{6H_2O}_{(l)}$

d) $Pb(NO_3)_2(aq) + K_2CrO_4(aq) \rightarrow \mathbf{PbCrO_4}_{(s)} + \mathbf{2KNO_3}_{(aq)}$

e) $H_2SO_4(aq) + \mathbf{2}KOH(aq) \rightarrow \mathbf{K_2SO_4}_{(aq)} + \mathbf{2H_2O}_{(l)}$

f) $\mathbf{2}C_6H_{14}(l) + \mathbf{19}O_2(g) \rightarrow \mathbf{12CO_2}_{(g)} + \mathbf{14H_2O}_{(l)}$

g) $S_8(s) + \mathbf{8}O_2(g) \rightarrow \mathbf{8SO_2}_{(g)}$

h) $\mathbf{2}Cs(s) + Br_2(l) \rightarrow \mathbf{2CsBr}_{(s)}$

h) $\mathbf{2}C_4H_{10}O_2(l) + \mathbf{11}O_2(l) \rightarrow \mathbf{8CO_2}_{(g)} + \mathbf{10H_2O}_{(l)}$

(12) 5. Write the balanced ionic and balanced net ionic chemical equations for 1d) and one other choosing from 1a, 1b or 1c. (Remember to include the correct charges on all ions and the phase of each species.)

1d)

Ionic equation:

$$\mathbf{Pb^{2+}(aq) + 2NO_3^-(aq) + CrO_4^-(aq) + 2K^+(aq) \rightarrow 2K^+(aq) + 2NO_3^-(aq) + PbCrO_4(s)}$$

Net Ionic equation:

$$\mathbf{Pb^{2+}(aq) + CrO_4^-(aq) \rightarrow PbCrO_4(s)}$$

1a, 1b or 1c)

Ionic equation:

$$\mathbf{Fe(s) + 2H^+(aq) + 2Cl^-(aq) \rightarrow Fe^{2+}(aq) + 2Cl^-_{(aq)} + H_2}_{(g)}$$

Net Ionic equation:

$$\mathbf{Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2}_{(g)}$$

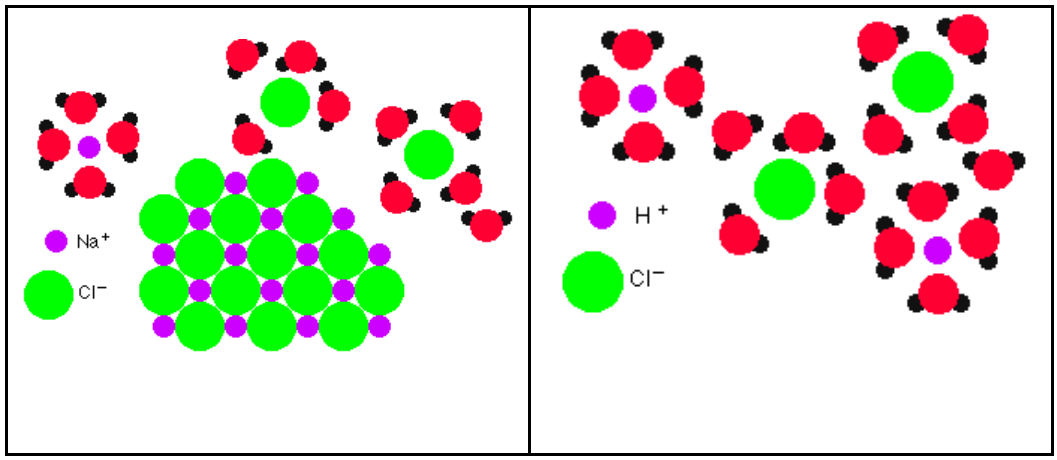
(8) 6a. Solubility is defined as the maximum amount of a solute that will dissolve in a given amount of solvent at a given temperature. Provide a brief explanation of the meaning of solute and solvent when discussing solubility.

The solute is the component in the solution present in the smallest amount. The solvent is the component in the largest amount, or the component whose phase is the same as the phase of the solution, or water.

b) What does it mean when it is stated that the solubility of a substance depends on temperature?

The amount of solute which will dissolve in a given amount of solvent depends on the temperature. The amount of solute which will dissolve in a given amount of solvent may increase or decrease with an increase or decrease of temperature.

(8) 7. Describe what happens, at the atomic level, when a soluble ionic compound dissolves in water. You may use a diagram with your explanation if you want.



When an ionic solute, such as NaCl, dissolves in water the compound is separated into its component ions (cation and anion) and each ion is surrounded by water molecules. For cations the oxygen atom of the water molecule orients itself so it is closest to the cation. For anions the hydrogen atoms of water orient themselves so they are closest to the anion. Since the ionis are now free to move in the solution this explains why solutions of soluble ionic compounds are good conductors of electricity.

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	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)

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	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^+
CrO_4^{2-}	insoluble	except Group IA, IIA 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