CHEM 1215
Exam II
John II. Gelder
March 1, 2000

Name _____

TA's Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 6 different pages. The last two pages includes a periodic table, Useful Information 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 (if any) or short answer questions.

4. No credit will be awarded if your work is not shown in problems 5, 6 and 8.

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	TOTAL
SCORES	_____ (36)	_____ (41)	_____ (23)	_____ (100)

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

Compound Name	Formula
Ammonium bromide	**NH_4Br**
Silver oxide or silver(I) oxide	Ag_2O
Nitric acid	$HNO_{3(aq)}$
Barium peroxide	**BaO_2**
Tetraphosphorus heptasulfide	**P_4S_7**
Nickel(II) carbonate	$NiCO_3$
Sodium sulfate	Na_2SO_4
Magnesium phosphate	**$Mg_3(PO_4)_2$**
Nitrogen trichloride	NCl_3

(7) 2. When sulfur dioxide is bubbled into an aqueous solution of sodium carbonate and sodium sulfide a compound called sodium thiosulfate is formed along with carbon dioxide. Thiosulfate is a polyatomic anion with the formula $S_2O_3^{2-}$. Write a balanced chemical equation from this description. Be sure to include the phase for each substance.

$4SO_2(g) + Na_2CO_3(aq) + 2Na_2S(aq) \rightarrow CO_2(g) + 3Na_2S_2O_3(aq)$

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

Compound	Soluble/Insoluble	Ions
CaS	**Soluble**	**Ca^{2+}, S^{-2}**
$ZnSO_4$	**Soluble**	**Zn^{2+}, SO_4^{-2}**
HCl	**Soluble**	**H^+, Cl^-**
$BaCO_3$	**InSoluble**	
$NH_4C_2H_3O_2$	**Soluble**	**NH_4^+, $C_2H_3O_2^-$**

(27) 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) $\mathbf{2}Fe(OH)_3(aq) + \mathbf{3}H_2SO_4(aq) \rightarrow \mathbf{Fe_2(SO_4)_3(aq) + 6H_2O(l)}$

b) $\mathbf{3}Be(s) + N_2(g) \rightarrow \mathbf{Be_3N_2(s)}$

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

d) $NiCl_2(aq) + \mathbf{2}KOH(aq) \rightarrow \mathbf{Ni(OH)_2(s) + 2KCl(aq)}$

e) $S_8(s) + \mathbf{8}H_2(g) \rightarrow \mathbf{8H_2S(g)}$

f) $Mg(s) + \mathbf{2}HCl(aq) \rightarrow \mathbf{MgCl_2(aq) + H_2(g)}$

g) $BaCl_2(aq) + (NH_4)_2SO_4(aq) \rightarrow \mathbf{BaSO_4(s) + 2NH_4Cl(aq)}$

h) $C_2H_5OH(l) + \mathbf{3}O_2(g) \rightarrow \mathbf{2CO_2(g) + 3H_2O(l)}$

i) $Sr(s) + \mathbf{2}H_2O(l) \rightarrow \mathbf{Sr(OH)_2(aq) + H_2(g)}$

(6) 5. How much heat is required to heat a 75.0 g sample of water from 30.0 ˚C to 95.5 ˚C?

$$\textbf{Heat} = \mathbf{4.184}\ \frac{\mathbf{J}}{\mathbf{g \cdot ^\circ C}}\ \mathbf{\cdot\ 75.\ g\ \cdot\ (95.5\ ^\circ C - 30.0\ ^\circ C) = 2.06 \times 10^4\ J}$$

(8) 6. A 60.0 g sample of aluminum metal, initially at 23.5 ˚C is carefully added to a 100. g sample of water at 55.0 ˚C. Calculate the final temperature of the mixture. Note: the specific heat of aluminum is 0.900 $\frac{J}{g\ ^\circ C}$.

q(heat gained by the H_2O) = – q(lost by the Al)

$(S.H. \cdot mass \cdot \Delta T)_{water} = -(S.H. \cdot mass \cdot \Delta T)_{Al}$

$$\mathbf{4.184}\ \frac{\mathbf{J}}{\mathbf{g \cdot ^\circ C}}\ \mathbf{\cdot\ 100.\ g\ \cdot\ (T_f - 55.5\ ^\circ C) = -\ 0.900}\ \frac{\mathbf{J}}{\mathbf{g \cdot ^\circ C}}\ \mathbf{\cdot\ 60.0\ g\ \cdot\ (T_f\ ^\circ C - 23.5\ ^\circ C)}$$

$$\mathbf{418.4}\ \frac{\mathbf{J}}{\mathbf{^\circ C}}\ \mathbf{\cdot\ (T_f - 55.5\ ^\circ C) = -\ 54}\ \frac{\mathbf{J}}{\mathbf{^\circ C}}\ \mathbf{\cdot\ (T_f\ ^\circ C - 23.5\ ^\circ C)}$$

$$\mathbf{418.4\ J\ T_f - 23{,}012 = -\ 54\ J\ T_f + 1269}$$

$$\mathbf{472.4\ J\ T_f = 24{,}281}$$

$$\mathbf{T_f = 51.4\ ^\circ C}$$

(15) 7. Distinguish precisely and in scientific terms the difference among items in the following groups;

a) atomic number and mass number

Atomic number of an element is equal to the number of protons in the element. The mass number is the sum of the protons and the neutrons.

b) electron, proton and neutron

The electron is negatively charged and is located around the nucleus.
The proton is positively charged, much heavier than the electron and along with the neutron comprise the nucleus.
The neutron has no charge, and is about the same mass as the proton.

c) an atom, an anion and a cation

An atom is the smallest unit of matter, and has the same number of protons and electrons, therefore it is neutral. An anion has more electrons than protons and a cation has fewer electrons than protons.
Ions can be monoatomic or polyatomic.

(8) 8. Two isotopes of copper exist in nature. 30.80% of copper is ^{65}Cu with a mass of 64.9278 u. What is the mass of the other isotope of copper?

average atomic mass = Σ(isotopic mass · fractional abundance)
average atomic mass = ^{65}Cu · fractional abundance + $^{??}$Cu · fractional abundance
63.55 u = 64.9278 u · 0.3080 + unknown · 0.6920
63.55 u = 19.9978 + unknown · 0.6920
43.55 u = unknown · 0.6920
unknown = 62.94

Periodic Table of the Elements

	IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008	IIA																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	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	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

Specific Heat (capacity) for $H_2O = 4.184 \frac{J}{g\ ^\circ C}$

q (heat) = S.H. · mass · ΔT

average atomic mass = Σ(isotopic mass · fractional abundance)

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