CHEM 1314.02 and 1314.03
Final Exam
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December 11, 2000

Name _____

TA's Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 8 different pages. The last page include a periodic table and some useful equations. 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.
4. No credit will be awarded if your work is not shown in problems 3, 4, 5 and 6c
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	TOTAL
SCORES	_____ (25)	_____ (20)	_____ (22)	_____ (33)	_____ (100)

(9) 1. Write the chemical formula(s) of the product(s) and balance all of the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous

a) $C_3H_{8(s)} + O_{2(g)} \rightarrow$

b) $K_{(s)} + Cl_{2(g)} \rightarrow$

c) $Na_2CO_{3(s)} + HClO_{4(aq)} \rightarrow$

(4) 2. Write the ionic and net ionic chemical equations for 1c).

Ionic equation:

Net Ionic equation:

(12) 3. Given the following reaction

$$3NaOH_{(s)} + H_3X_{(s)} \rightarrow Na_3X_{(aq))} + 3H_2O_{(l)}$$

18.55 mLs of 0.453 M NaOH are required to react with a given amount of H_3X.

a) Calculate the mol of H_3X that reacted.

b) Calculate the mass of water formed

c) If the mass of the sample of H_3X that reacted above is 0.397 g, calculate the molar mass of X.

(4) 4a. Given the following double displacement reaction

$$2Na_3PO_{4(s)} + 3Pb(NO_3)_{2(aq)} \rightarrow 2Pb_3(PO_4)_{2(s)} + 6NaNO_{3(aq)}$$

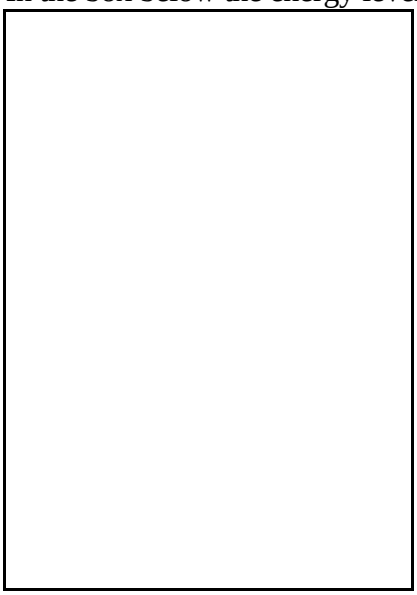
What is the maximum number of grams of lead phosphate that can be obtained when 12.3 g of sodium phosphate is reacted with 33.1 g of lead nitrate?

b) Calculate the mass of sodium nitrate formed in the reaction.

c) If all the sodium nitrate formed in the reaction is dissolved in enough water to make 355 mLs of solution, calculate the concentration (molarity) of sodium nitrate in the solution.

(10) 5. A coffee-cup calorimeter holds 200. grams of water at 22.5 ˚C. When 8.00 grams of NH_4NO_3 are completely dissolved in the water in the calorimeter the temperature falls to 19.56 ˚C. Calculate the heat of the solution for in NH_4NO_3 kJ mol^{-1}. Assume the solid NH_4NO_3 is at the same temperature as the water initially, that the specific heat of the solution is the same as that of water, and the heat capacity of the calorimeter is 8.65 J $˚C^{-1}$.

(12) 6a. In the box below the energy level diagram for a hydrogen atom showing the first four energy levels.



b) On the diagram in Part a) draw the transition for an electron moving from the ground state (n = 1) level to the third energy level.

c) Calculate the frequency of the photon of light required to excite the electron between these two energy levels.

Short Answer.

(9) 7a. Complete the following table

Name of Compound	Formula of Compound	Ionic or Covalent
Iron(II) nitrate		
	H_2SO_4	

(8) b) Report the results of the following calculation to the correct number of significant figures.

$$\frac{8.7142 + (3.450 \cdot 0.871)}{1.1717} =$$

c) Diagram the following system as viewed at the atomic level in the space provided. Be sure to clearly label each substance in your diagram.

A homogeneous mixture of helium and nitrogen at 0 ˚C.

d) Dilute nitric acid, $HNO_3(aq)$, is 32.0% by weight HNO_3. A volume of 125 mL of the dilute nitric acid solution contains 101 g of water. Calculate the density of this solution.

e) The mass of $Cu(CN)_4^{2-}$ that contains 16 N atoms.

f) Write the ground state electron configuration and indicate the number of unpaired electrons for Sn.

g) Draw the orbital diagram for the valence electrons in bromine.

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** (266)	107 **Bh** (264)	108 **Hs** (269)	109 **Mt** (268)	110 (271)	111 (272)	112 (277)		114 (285)		116 (289)		

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

$E_n = -2.18 \times 10^{-18}\ J\left(\frac{1}{n^2}\right)$ $r_n = 0.529 \times 10^{-8}\ n^2\ cm$ $h = 6.626 \times 10^{-34}\ J\cdot s$

$\Delta E = -2.18 \times 10^{-18}\ J\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ $\lambda = \frac{c}{\nu}$ $E = h\nu$ $c = 3.00 \times 10^8\ \frac{m}{s}$

$U = \frac{kQ_1Q_2}{d}$

Avogadro's number = 6.02×10^{23}

density of water = $1.00\ \frac{g}{mL}$

Activity Series

Metal	Half-Reaction Reaction
Gold	$Au^{3+} + 3e^- \rightarrow Au$
Platinum	$Pt^{2+} + 2e^- \rightarrow Pt$
Mercury	$Hg^{2+} + 2e^- \rightarrow Hg$
Silver	$Ag^{+} + e^- \rightarrow Ag$
Copper	$Cu^{2+} + 2e^- \rightarrow Cu$
Hydrogen	$2H^{+} + 2e^- \rightarrow H_2$
Lead	$Pb^{2+} + 2e^- \rightarrow Pb$
Tin	$Sn^{2+} + 2e^- \rightarrow Sn$
Nickel	$Ni^{2+} + 2e^- \rightarrow Ni$
Cobalt	$Co^{2+} + 2e^- \rightarrow Co$
Iron	$Fe^{2+} + 2e^- \rightarrow Fe$
Chromium	$Cr^{3+} + 3e^- \rightarrow Cr$
Zinc	$Zn^{2+} + 2e^- \rightarrow Zn$
Manganese	$Mn^{2+} + 2e^- \rightarrow Mn$
Aluminum	$Al^{3+} + 3e^- \rightarrow Al$
Magnesium	$Mg^{2+} + 2e^- \rightarrow Mg$
Sodium	$Na^{+} + e^- \rightarrow Na$
Calcium	$Ca^{2+} + 2e^- \rightarrow Ca$
Barium	$Ba^{2+} + 2e^- \rightarrow Ba$
Potassium	$K^{+} + e^- \rightarrow K$
Lithium	$Li^{+} + e^- \rightarrow Li$

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