Exam Two **CHM 203 (Dr. Mattson)** **12 October 2011**	***Print your name:*** ***Signature:***	***Circle your section:*** ***8:30 9:30***

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in box and then attach the periodic table. BOX YOUR ANSWERS! Write legibly.

1. (5 pts) Strong/Weak/Non-electrolyte? All of the following substances form aqueous solutions. Classify each of these solutions as a strong (S), weak (W), or non-electrolyte (N).

$CuCl_2(aq)$	S	W	N
$HC_2H_3O_2(aq)$	S	W	N
$C_2H_3OH(aq)$	S	W	N
$C_{12}H_{22}O_{11}(aq)$	S	W	N
$HClO_4(aq)$	S	W	N

2. (2 pts) Ammonia, NH_3, forms an aqueous solution that is described by the equation shown below. Note the arrows.

$NH_3(aq) + H_2O(l) \rightleftharpoons OH^-(aq) + NH_4^+(aq)$

(a) What sort of electrolytic solution does ammonia form? Circle: Strong Weak Non-electrolyte

(b) Is the solution mostly $NH_3(aq)$, with very little $OH^-(aq)$ and $NH_4^+(aq)$? Circle: Yes No

3. (3 pts) What would happen if 1.0 g AgCl(s) were dumped into a beaker containing 200 mL distilled water and stirred? Circle all that are true.

(a) The AgCl(s) would dissolve, forming AgCl(aq).

(b) The conductivity light would light up.

(c) The solution would be acidic.

(d) An oxidation-reduction reaction would occur.

(e) The AgCl(s) would settle on the bottom.

4. (7 pts) Which of these ionic substances are expected to be water-soluble?

$NiSO_4$	NH_4NO_3	$Bi(ClO_4)_3$	$PbCl_2$
CdS	$Fe(OH)_3$	$Ca(C_2H_3O_2)_2$	$BaSO_4$

5. (4 pts) HCl(aq) reacts with KOH(aq).

(a) Write and balance the overall equation, including states of matter such as (aq), (l), etc.

(b) Write and balance the net ionic equation.

6. (3 pts) Suppose a solution contains a mixture of $Hg_2(NO_3)_2(aq)$ and $Hg(NO_3)_2(aq)$. How might one separate the mercurous ion for the mercuric ion? Circle all that are true.

(a) Add $Cl^-(aq)$ to precipitate the Hg_2^{+2}, but not the $Hg^{+2}(aq)$.

(b) Add $Cl^-(aq)$ to precipitate the Hg^{+2}, but not the $Hg_2^{+2}(aq)$.

(c) Add $S^{-2}(aq)$ to precipitate the Hg_2^{+2}, but not the $Hg^{+2}(aq)$.

7. (10 pts) Nomenclature. Complete the table. *(Skip this question if you are nomenclature certified.)*

Formula:	**Name:**
N_2O_4	
$Mg(HCO_3)_2$	
$FeBr_3$	
H_2SO_3	
$HC_2H_3O_2$	
	perchloric acid
	phosphoric acid
	potassium sulfide
	copper(II) chloride
	bromine pentafluoride

8. In an experiment similar to the one you saw in class, 17.00 g aluminum foil was added to 475 mL of a 0.428 M solution of green $Ni^{+2}(aq)$. The green color of the solution faded to clear with time. It was determined that elemental nickel, Ni, and $Al^{+3}(aq)$ were the products of the reaction.

(a) (2 pts) Write the ***balanced*** net ionic equation for this reaction. Include the states of matter, (s) or (aq).

(b) (1 pt) What was oxidized? Circle one:

Ni(s) $Ni^{+2}(aq)$ Al(s) $Al^{+3}(aq)$

Continued…

(c) (1 pt) What was reduced? Circle one:

$Ni(s)$ $Ni^{+2}(aq)$ $Al(s)$ $Al^{+3}(aq)$

(d) (1 pt) What was the oxidizing agent? Circle one:

$Ni(s)$ $Ni^{+2}(aq)$ $Al(s)$ $Al^{+3}(aq)$

(e) (3 pt) What was the limiting reagent? Show work!

Circle one: $Ni(s)$ $Ni^{+2}(aq)$ $Al(s)$ $Al^{+3}(aq)$

9. (4 pts) What volume (in mL) of 0.45 M KOH(aq) is required to react completely with 50.00 mL 0.2227 M $H_2SO_4(aq)$? Hint: Balance the equation first!

10. (4 pts) What volume of 0.204 M $K_2Cr_2O_7(aq)$ (in mL) is required to react completely with 1.12 g $Fe(NO_3)_2(s)$ (MM = 179.9 g/mol) according to:

$Cr_2O_7^{-2}(aq) + 6\ Fe^{+2}(aq) + 14\ H^+(aq) \rightarrow$

$2\ Cr^{+3}(aq) + 6\ Fe^{+3}(aq) + 7\ H_2O(aq)$

11. (5 pts) A certain electron transition emits a photon with a wavelength of 610 nm. What is the corresponding energy in kJ/mol?

12. (4 pts) Which member of each pair represents the larger energy? Circle your choice for each pair.

(a) Electromagnetic waves: λ = 400 nm or 600 nm

(b) Electron transition: n = 4 → n = 3 or n = 5 → n=3

(c) Frequency: $\upsilon = 5 \times 10^{14}\ s^{-1}$ or $7 \times 10^{14}\ s^{-1}$

(d) Orbitals: 4p or 5s

13. (5 pts) What are the allowed values of the quantum number in question, given the value of another quantum number? Provide a **range** of values as per the example in (a). Answer should be based on what is possible according to the theory, not what exists with the known elements.

	If…	**…then**	**Range:**
(a)	If l = 4	then n =	**5 to** ∞
(b)	If n = 6	then l =	
(c)	If l = 3	then m_l =	
(d)	If m_l = 2	then l =	
(e)	If n = 17	then l =	
(f)	If m_l = 3	then n =	

14. (8 pts) According to the Aufbau principle, which orbital is filled immediately before and after each of the following in a multi-electron atom?

	Filled before:		Filled after:
(a)		4s	
(b)		4d	
(c)		3p	
(d)		4f	

15. (8 pts) Write the electron configurations using core notation and indicate the number of unpaired electrons present in each of the following ground-state atoms.

	Electron configuration	Unpaired e^-
(a) N		
(b) S		
(c) Fe		
(d) Te		

Print your name here:

For DocM to complete:
Subtotal from exam: _____

Homework: (20 max) _____

Total: _____

Determine your grade:

A+ ≥ 95; A ≥ 90; B+ ≥ 85; B ≥ 80; C+ ≥ 75; C ≥ 70; D ≥ 60

$c = \lambda\upsilon$ $\quad \Delta E_{per\ photon} = hc/\lambda$ $\quad \Delta E_{per\ mol\ photon} = \Delta E_{per\ photon} \times N_A$

$E = -2.178 \times 10^{-18} J(1/n^2)$ $\quad \Delta E = E_f - E_i = -2.178 \times 10^{-18} J(1/n_f^2 - 1/n_i^2)$

$1/\lambda = 1.097 \times 10^{-2}\ nm^{-1}(1/n_f^2 - 1/n_i^2)$

$h = 6.626 \times 10^{-34}\ J\ s$ $\quad c = 3 \times 10^8\ m/s$ $\quad N_A = 6.023 \times 10^{23}\ mol^{-1}$

Answers

1. S, W, N, N, S
2. (a) Weak; (b) Yes
3. e
4. $NiSO_4$ $\quad NH_4NO_3$ $\quad Bi(ClO_4)_3$ $\quad Ca(C_2H_3O_2)_2$
5. (a) $HCl(aq) + KOH(aq) \rightarrow H_2O(l) + KCl(aq)$

   (b) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
6. a
7.

Formula:	Name:
N_2O_4	dinitrogen tetraoxide
$Mg(HCO_3)_2$	magnesium bicarbonate or magnesium hydrogen carbonate
$FeBr_3$	iron(III) bromide or ferric bromide
H_2SO_3	sulfurous acid
$HC_2H_3O_2$	acetic acid
$HClO_4$	perchloric acid
H_3PO_4	phosphoric acid
K_2S	potassium sulfide
$CuCl_2$	copper(II) chloride
BrF_5	bromine pentafluoride

8. (a) $3\ Ni^{+2}(aq) + 2\ Al(s) \rightarrow 3\ Ni(s) + 2\ Al^{+3}(aq)$

   (b) Al(s)

   (c) $Ni^{+2}(aq)$

   (d) $Ni^{+2}(aq)$

   (e) $Ni^{+2}(aq)$ (Go moles!: 0.630 mol Al and 0.203 mol $Ni^{+2}(aq)$; dividing each mole amount by the coefficients gives 0.315 for Al and 0.0678 for $Ni^{+2}(aq)$.)

9. 49.5 mL KOH(aq)

10. 5.10 mL

11. 196 kJ/mol

12. (a) λ = 400 nm; (b) n = 5 → n=3; (c) 7 x 10^{14} s^{-1}; (d) 5s

13.

	If…	**…then**	**Range:**
(a)	If l = 4	then n =	**5 to** ∞
(b)	If n = 6	then l =	0 to 5
(c)	If l = 3	then m_l =	-3 to +3
(d)	If m_l = 2	then l =	2 to ∞
(e)	If n = 17	then l =	0 to 16
(f)	If m_l = 3	then n =	4 to ∞

14.

	Filled before:		Filled after:
(a)	3p	4s	3d
(b)	5s	4d	5p
(c)	3s	3p	4s
(d)	6s	4f	5d

15.

	Electron configuration	Unpaired e^-
(a) N	$1s^2\ 2s^2\ 2p^3$	3
(b) S	[Ne] $3s^2\ 3p^4$	2
(c) Fe	[Ar] $4s^2\ 3d^6$	4
(d) Te	[Kr] $5s^2\ 4d^{10}\ 5p^4$	2