Chemistry 141
Dr. Cary Willard
Exam 1b

Name ___________________________

February 22, 2011

Multiple Choice	____________	(30 points)
Page 5	____________	(14 points)
Page 6	____________	(14 points)
Page 7	____________	(10 points)
Page 8	____________	(14 points)
Page 9	____________	(15 points)
Page 10	____________	(15 points)
Total	____________	(112 points)
Percent	____________	(100 %)

All work must be shown to receive credit. Give all answers to the correct number of significant figures

Avogadros number = 6.022×10^{23} /mol
4 quarts = 1 gallon
36 in = 1 yard

Solubility Rules

- Alkali metals and NH_4^+ compounds are soluble.
- Nitrates(NO_3^-), acetates ($CH_3CO_2^-$), chlorates (ClO_3^-), perchlorates(ClO_4^-), and sulfates(SO_4^{-2}) are generally soluble (except for Sr^{+2}, Ca^{+2}, Ba^{+2}, Pb^{+2}, and Hg_2^{+2} sulfates).
- Chlorides(Cl^-), bromides(Br^-), iodides(I^-), are soluble (except for Silver(Ag^+),mercury(I)(Hg_2^{+2}), and lead(II)(Pb^{+2}) halides).
- Most compounds not included above are not soluble.
  - i.e. Sulfides(S^{-2}), carbonates(CO_3^{-2}), phosphates(PO_4^{-3}), chromates(CrO_4^{-2}), Oxides (O^{-2}), and Hydroxides(OH^-)
    - ($Ca(OH)_2$, CaO, $Sr(OH)_2$, SrO, $Ba(OH)_2$ and BaO are slightly soluble.)

Grossmont College
Periodic Table

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	NOBLE GASES
1 **H** 1.008																1 **H** 1.008	2 **He** 4.002
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.00	12 **Mg** 24.30											13 **Al** 27.00	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.70	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
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** (99)	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
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	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)
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)	110 **??** (269)								

Lanthanide series	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (147)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	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
Actinide series	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	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)

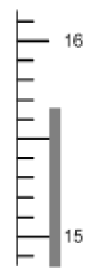
Multiple Choice (30 points) – Give the best answer for each of the following questions.

1. A consistent explanation of known observations is called
   a. an experiment.
   b. a prediction.
   c. a theory.
   d. a hypothesis.

2. Which of the following statements does not describe a **chemical** property of oxygen?
   a. When coal is burned in oxygen, the process is called combustion.
   b. Iron will rust in the presence of oxygen.
   c. Oxygen combines with carbon to form carbon dioxide gas.
   d. The pressure is caused by collision of oxygen molecules with the sides of a container.

3. A student measured the diameter of a sphere and determined the average value. His measurements are 6.17cm, 6.16cm, 6.16cm and 6.17cm If the true diameter is 6.18 cm, what can be said about the student's results?
   a. It is accurate and precise.
   b. It is precise but not accurate.
   c. It is accurate but not precise.
   d. It is neither precise nor accurate.

4. To the correct number of significant figures, what is the temperature reading on the following Celsius thermometer?
   a. 15 ^{o}C
   b. 16 ^{o}C
   c. 15.67 ^{o}C
   d. 15.6 ^{o}C



5. Which of the following is **not** explained by Dalton's atomic theory?
   a. the law of multiple proportions
   b. conservation of mass during a chemical reaction
   c. the existence of more than one isotope of an element
   d. the law of definite proportions

6. How many protons (p) and neutrons (n) are in an atom of calcium-46?
   a. 20 p, 26 n
   b. 26 p, 20 n
   c. 46 p, 60 n
   d. 20 p, 46 n

7. In which set do all elements tend to form cations in binary ionic compounds?
   a. Li, B, O
   b. O, F, Cl
   c. N, As, Bi
   d. Mg, Cr, Pb

8. The solid compound, Na_2CO_3, contains
   a. Na^+ ions and CO_3^{2-} ions.
   b. Na^+, C^{4+}, and O^{2-} ions.
   c. Na_2CO_3 molecules.
   d. Na_2^+ and CO_3^{2-} ions.

9. How many H^+ ions can the acid, H_2CO_3, donate per molecule?
   a. 0
   b. 1
   c. 2
   d. 3

10. Which one of the following statements about balanced equations is **false**? In a balanced reaction
    a. mass must be conserved.
    b. molecules must be balanced on both sides of the reaction arrow.
    c. net charge must be balanced on both sides of the reaction arrow.
    d. atoms must be balanced on both sides of the reaction arrow.

11. Which statement about diluted solutions is **false**? When a solution is diluted
    a. the concentration of the solution decreases.
    b. the number of moles of solvent remains unchanged.
    c. the number of moles of solute remains unchanged.
    d. the molarity of the solution decreases.

12. HBr, HCl, $HClO_4$, KBr, and NaCl are all classified as
    a. weak electrolytes.
    b. acids.
    c. strong electrolytes.
    d. nonelectrolytes.

13. What reagent could be used to separate Br^- from NO_3^- when added to an aqueous solution containing both?
    a. NaI *(aq)*
    b. $Ba(OH)_2$ *(aq)*
    c. $AgNO_3$ *(aq)*

    d. $CuSO_4$ *(aq)*

14. What is the oxidation number of the oxygen atom in H_2O_2?
    a. +2
    b. +1
    c. -1
    d. -2

15. Which species functions as the oxidizing agent in the following reduction-oxidation reaction:

$$5\,Fe^{+2}(aq) + MnO_4^{-1}(aq) + 8\,H^{+1}(aq) \rightarrow Mn^{+2}(aq) + 5\,Fe^{+3}(aq) + 4\,H_2O(aq)$$

    a. Mn^{2+}*(aq)*
    b. MnO_4^-*(aq)*
    c. H^+*(aq)*
    d. Fe^{2+}*(aq)*

Problems

1. (5 points) Give the IUPAC name for the following compounds

   a. $MgCl_2$ ______magnesium chloride______________

   b. $AlPO_3$ ______aluminum phosphite _____________

   c. Cl_2O_7 ______dichorine heptoxide______________

   d. $KBrO_2$ ______potassium bromite________________

   e. $V(NO_2)_5$ ______vanadium(V) nitrite______________

2. (5 points) Write the correct formula for each of the following compounds

   a. Ammonium hypochlorite ______NH_4ClO__________________

   b. Zinc iodide ______ZnI_2________________

   c. Ferric sulfate ______$Fe_2(SO_4)_3$___________

   d. Mercury(I) carbonate ______Hg_2CO_3____________

   e. Sulfur trioxide ______SO_3________________

3. (4 points) Perform the following calculation and report your answer with the correct number of significant figures.

$$\frac{6.34 + (90.3)(0.05442) + 943.8642}{(85.3992 - 86.00)} = \frac{6.34 + 4.91 + 943.8642}{85.3992 - 86.00} = \frac{955.12}{-0.60} = -1600$$

4. (8 points) Copper can be drawn into thin wires. How many meters of 34 gauge wire (diameter = 6.304×10^{-3} in) can be produced from the 5.01 lb of covallite, an ore of copper that is 66.0% copper by mass (Hint: Treat the wire as a cylinder: the density of copper is 8.95 g/cm^3, figure out the mass of copper wire per unit length.)

$$Volume\ of\ 1\ in\ wire = (\pi r^2)l = \left(\frac{\pi d^2}{4}\right)l = \left(\frac{\pi(6.304 \times 10^{-3} in)^2}{4}\right)1in = 3.121 \times 10^{-5} in^3$$

$$\frac{g\ Cu}{in} = \frac{3.121 \times 10^{-5} in^3}{in\ wire} \times \left(\frac{2.54\ cm}{1\ in}\right)^3 \times \frac{8.95\ g}{1\ cm^3} = \frac{4.58 \times 10^{-3} g\ Cu}{in\ wire}$$

$$?\,m\ wire = 5.01\ lb\ ore \times \frac{454\ g\ ore}{1\ lb\ ore} \times \frac{66.0\ g\ Cu}{100\ g\ ore} \times \frac{1\ in\ wire}{4.58 \times 10^{-3} g\ Cu} \times \frac{2.54\ cm\ wire}{1\ in\ wire} \times \frac{1\ m\ wire}{100\ cm\ wire} \times \frac{1\ km\ wire}{1000\ m\ wire} = 8.33\ km\ wire$$

5. (6 points) An element X forms both a dichloride (XCl_2) and a tetrachloride (XCl_4). Treatment of 10.00 g XCl_2 with excess chlorine forms 12.55 g XCl_4. Calculate the atomic mass of X. Predict its identity.

$$12.55\ g\ xCl_2 - 10.00\ g\ XCl_4 = 2.55\ g\ Cl\ added$$

$$2.55\ g\ Cl \times \frac{1\ mol\ Cl}{35.45\ g\ Cl} \times \frac{1\ mol\ XCl_2}{2\ mol\ Cl} = 0.0360\ mol\ XCl_2$$

$$molar\ mass\ XCl_2 = \frac{10.00\ g\ \ XCl_2}{0.0360\ mol\ XCl_2} = 278\ gXCl_2/mol$$

$$molar\ mass = 278amu = 1\,x(?\ \ amu/X) + 2\ Cl(35.45\ amu/Cl)$$

$$X = 207.1\ \ probably\ lead$$

6. (6 points) Complete the following double displacement reaction with balanced molecular, total ionic, and net ionic equations.

$$Fe(NO_3)_{2(aq)} \quad + \quad H_3PO_{4(aq)} \rightarrow$$

$$3\ Fe(NO_3)_{2(aq)} \quad + \quad 2\ H_3PO_{4(aq)} \rightarrow Fe_3(PO_4)_{2(s)} \quad + 6\ HNO_{3(aq)}$$

Balanced total ionic equation

$$3\ Fe^{+2}{}_{(aq)} + 6\ NO_3^{-1}{}_{(aq)} + 2\ H_3PO_{4(aq)} \rightarrow Fe_3(PO_4)_{2(s)} + 6\ H^{+1}{}_{(aq)} + 6\ NO_3^{-1}{}_{(aq)}$$

Balanced net ionic equation

$$3\ Fe^{+2}{}_{(aq)} + 2\ H_3PO_{4(aq)} \rightarrow Fe_3(PO_4)_{2(s)} + 6\ H^{+1}{}_{(aq)}$$

7. (4 points) Balance the following redox half reaction that occurs in basic solution

$$SO_2Cl_2 \quad + H_2O \ + \ 2\ e^{-1} \rightarrow \quad SO_3^{-2} \quad + \quad 2 \quad Cl^{-1} + 2\ H^{+1}$$

$$2\ H^{+1} + 2\ OH^{-1} \rightarrow 2\ H_2O$$

$$SO_2Cl_2 + 2\ OH^{-1} + 2\ e^{-1} \rightarrow SO_3^{-2} \ + \ 2\ Cl^{-1} + H_2O$$

Is this an oxidation or a reduction?

reduction

8. (6 points) Balance the following redox reaction in acidic solution

$$S_2O_3^{-2} + OCl^{-1} \rightarrow Cl^{-1} + S_4O_6^{-2}$$

1st half reaction

$$2\ S_2O_3^{-2} \rightarrow S_4O_6^{-2} + 2\ e^{-1}$$

2nd half reaction

$$OCl^{-1} + 2\ H^{+1} + 2\ e^{-1} \rightarrow Cl^{-1} + H_2O$$

overall reaction in acid

$$2\ S_2O_3^{-2} + OCl^{-1} + 2\ H^{+1} \rightarrow S_4O_6^{-2} + Cl^{-1} + H_2O$$

9. (8 points) When 6.853 mg of a sex hormone containing C, H, and O was burned in a combustion analysis, 19.73 mg of CO_2 and 6.391 mg of H_2O were obtained. What is the empirical formula of the compound?

$?\,mg\ C = 19.73\ mg\ CO_2 \times \frac{1\ mmol\ CO_2}{44.01\ mgCO_2} \times \frac{1\ mmol\ C}{1\ mmol\ CO_2} = 0.4483\ mmol\ C \times \frac{12.01\ mg\ C}{1\ mmol\ C} =$ $5.384\ mg\ C$ $(78.56\%\ C)$ (

$?\,mg\ H = 6.391\ mg\ H_2O \times \frac{1\ mmol\ H_2O}{18.02\ mg\ H_2O} \times \frac{2\ mmol\ H}{1\ mmol\ H_2O} = 0.7093\ mmol\ H \times \frac{1.008\ mg\ H}{1\ mmol\ H} =$ $0.7150\ mg\ H$ (10.43% H)

$?\,mg\ O = \left(6.853\ mg - (5.384\ mg\ C + 0.7150\ mgH)\right) = 6.853mg - 6.099mg$
$= 0.754\ mg\ O$ $(11.00\%\ O)$

$$?\,mmol\ O = 0.754\ mg\ O \times \frac{1\ mmol\ O}{16.00\ mg\ O} = 0.0471\ mmol\ O$$

$$C_{\frac{0.4483}{0.0471}}H_{\frac{0.7093}{0.0471}}O_{\frac{0.0471}{0.0471}}$$

$$C_{9.51}H_{15}O_1 \rightarrow C_{19}H_{30}O_2$$

10. (5 points) How many grams of copper are in 50.0 mL of a 28.7% solution of copper (II) chloride with a density of 1.284 g/mL?

$$?\,g\ Cu = 50.0\ mL\ soln \times \frac{1.284\ g\ soln}{1\ mL\ soln} \times \frac{28.7\ g\ Cu}{100\ g\ soln} = 18.4\ g\ Cu$$

11. (10 points) Phencyclidine or angle dust has a molecular formula $C_{17}H_{25}N$. Answer the following questions regarding phencyclidine.

a. Calculate the molar mass of phencyclidine.

$$molar\ mass = 17\ C(12.01\ amu/C) + 25\ H(1.008\ amu/H) + 1\ N(14.01\ amu/N)$$
$$= 204.2amu + 25.20amu + 14.01amu = 243.4amu$$

b. Calculate the number of moles of carbon in 6.83 moles of phencyclidine.

$$?\,mol\ C = 6.83\ mol\ phe \times \frac{17\ mol\ C}{1\ mol\ phe} = 116\ mol\ C$$

c. Calculate the number of molecules of phencyclidine that contains 325 atoms of hydrogen.

$$?\,molec\ phe = 325\ atom\ H \times \frac{1\ molec\ phe}{25\ atom\ H} = 13\ molec\ phe$$

d. Calculate the mass of phencyclidine that contains 6.836 x 10^{24} atoms of carbon.

$$?\,g = 6.836 \times 10^{24} atom\ C \times \frac{1\ mol\ C}{6.022 \times 10^{23} atom\ C} \times \frac{1\ mol\ phe}{17\ mol\ C} \times \frac{243.4\ g\ phe}{1\ mol\ phe} = 162.5\ g\ phe$$

e. Calculate the mass in grams of one molecule of phencyclidine.

$$?\,g\ phe = 1\ molec\ phe \times \frac{1\ mol\ phe}{6.022 \times 10^{23} molec\ phe} \times \frac{243.4\ g\ phe}{1\ mol\ phe} = 4.042 \times 10^{-22} g\ phe$$

12. (15 points) You mix 527.0 mL of 0.2754 M sodium carbonate with 250.0 mL of 0.6684 M chromium(III) chloride. Write the reaction and determine the number of grams of chromium(III) carbonate produced, and the final concentration of all ions in the solution.

Balanced chemical equation (Check with me before you go on to be sure this is correct.)

$$3\ Na_2CO_{3(aq)} + 2\ CrCl_{3(aq)} \rightarrow 6\ NaCl_{(aq)} + Cr_2(CO_3)_{3(s)}$$

$$?\,mol\ Na_2CO_3 = 527.0\ mL \times \frac{0.2754\ mol\ Na_2CO_3}{1000\ mL} = 0.1451\ mol\ Na_2CO_3$$

$$?\,mol\ CrCl_3 = 250.0\ mL \times \frac{0.6684\ mol\ CrCl_3}{1000\ mL} = 0.1671\ mol\ CrCl_3$$

	X = 0.0484 mol		X=0.0836mol				
	3 Na_2CO_4(aq)	+	2 $CrCl_3$(aq)	→	6 NaCl(aq)	+	$Cr_2(CO_3)_3$(s)
I	0.1451 mol		0.1671 mol		0 mol		0 mol
Δ	-3x		-2x		+6x		+ x
E	0.1451 – 3x		0.1671-2x		6x		1x
	=0.1451-3(.0484) =0 mol		=0.1671-2(.0484) =0.0703mol		=6(0.0484) =0.2904 mol		=0.0484 mol

$$0.0484\ mol\ Cr_2(CO_3)_3 \times \frac{284.0\ g\ Cr_2(CO_3)_3}{1\ mol\ Cr_2(CO_3)_3} = \boxed{13.7\ g\ Cr_2(CO_3)_3}$$

$$[Na^{+1}] = \frac{0.2904\ mol\ Na^{+1}}{0.7770\ L\ solution} = \boxed{0.3737\ M\ Na^{+1}}$$

$$[CO_3^{\ -2}] = \frac{0\ mol\ CO_3^{\ -2}}{0.7770\ L\ solution} = \boxed{0\ M\ CO_3^{\ -2}}$$

$$[Cr^{+3}] = \frac{0.0703\ mol\ Cr^{+3}}{0.7770\ L\ solution} = \boxed{0.0905\ M\ Cr^{+3}}$$

$$[Cl^{-1}] = \frac{3(0.0703\ mol\ Cl^{-1}) + 0.2904\ mol\ Cl^{-1}}{0.7770\ L\ solution} = \frac{0.5013\ mol\ Cl^{-1}}{0.7770\ L\ solution} = \boxed{0.6452\ M\ Cl^{-1}}$$

Moles $Cr_2(CO_3)_3$ produced __0.0484 mol___ Mass $Cr_2(CO_3)_3$ produced___13.7 g_______

Moles Na^{+1} =________0.2904 mol__________ $[Na^{+1}]$ = _____0.3737M___________

Moles CO_3^{-2} = _______0 mol_______________ $[CO_3^{-2}]$ = _____0 M_______________

Moles Cr^{+3} = ________0.0703 mol__________ $[Cr^{+3}]$ = _____0.0905 M__________

Moles Cl^{-1} = _________0.5013 mol__________ $[Cl^{-1}]$ = ______0.6452 M__________