Chemistry 22
Spring 2010
Exam 2
100 points
Dr. Greg Sanchez

Name: Key

Instructions: You have 1 hour and 20 minutes to complete this exam. For ALL calculations **SHOW YOUR WORK**. Significant figures are required for full credit. You may use the attached periodic table as your reference. Only use the recommended calculator per the syllabus. **There is zero tolerance for cheating.**

1. In which set do all the elements tend to form anions in binary ionic compounds?
   a. C, S, Pb
   b. K, Fe, Br
   c. Li, Na, K
   d. N, O, I

2. How many electrons are in the ion, CO_3^{2-}
   a. 16
   b. 28
   c. 30
   d. 32

   24 e

3. Which one of the following compounds contains ionic bonds?
   a. CaO
   b. HF
   c. NI_3
   d. SiO_2

4. When dissolved in water, of $HClO_4$, $Ca(OH)_2$, KOH, HI, which are acids?
   a. $Ca(OH)_2$ and KOH
   b. Only HI
   c. Only KOH
   d. $HClO_4$ and HI

5. Name the following compounds or provide the chemical formula, where appropriate:

   a. Lead (II) phosphate $Pb_3(PO_4)_2$

   b. Li_2S Lithium sulfide

   c. Stontium hydroxide $Sr(OH)_2$

   d. Zinc hydride ZnH_2

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e. HI hydrogen iodide

f. Dinitrogen trioxide N_2O_3

g. Sulfite ion SO_3^{-2}

h. Potassium peroxide ~~KOH~~ K_2O_2

i. AgCl silver chloride

j. Ferric sulfate $Fe_2(SO_4)_3$

1 each

6. Using the compounds listed in problem #5 (a-j), provide two examples of a soluble salt and two examples of an insoluble salt.

(Soluble) $Sr(OH)_2$

(Soluble) $Fe_2(SO_4)_3$

(Insoluble) $AgCl$

(Insoluble) $Pb_3(PO_4)_2$

1 each

7. Balance the following equation and provide the states (s, aq, l, or g):

(4) a. $3\ Na_2S_{(aq)} + 2\ FeCl_{3(aq)} \rightarrow 1\ Fe_2S_{3(s)} + 6\ NaCl_{(aq)}$

(1) b. Classify the reaction in **7a** double displacement

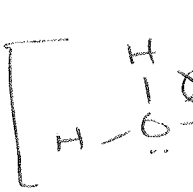
c. Calculate the molecular weight of Fe_2S_3?

(4) Fe: $2 \times 55.85 = 111.70$
S: $3 \times 32.06 = 96.18$
$\rightarrow$ 207.89 g/mol

8. Provide the Lewis dot structure and the molecular geometry for the following atoms:

2 each

a. OF_2  bent

b. H_3O^+  trigonal ~~planar~~ pyramidal

c. PH_3  trigonal ~~planar~~ pyramidal

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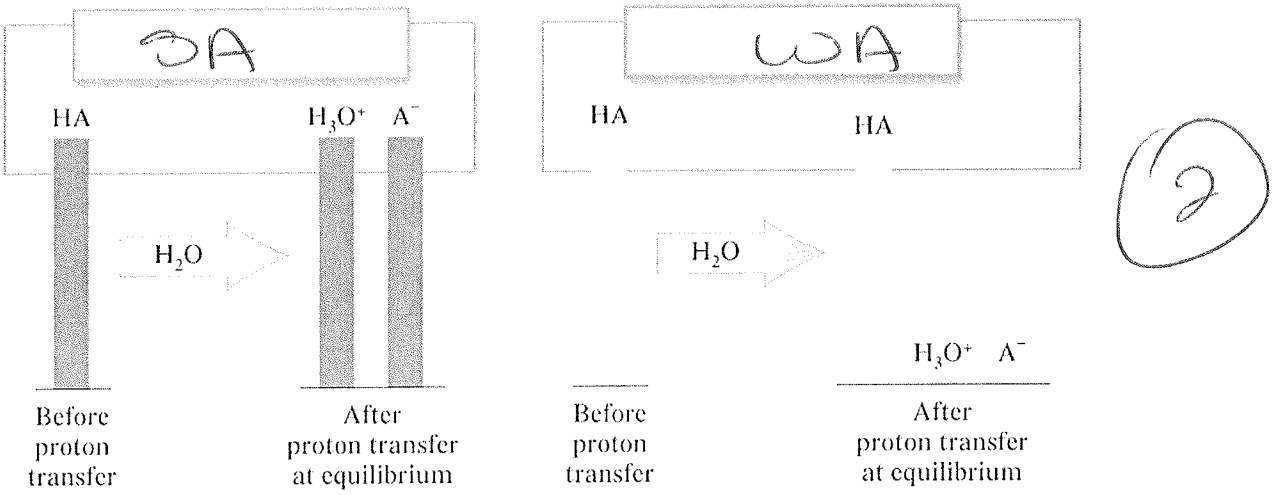
9. Fill in the titles for the graphical representation of acid dissociation below.



2

10. Balance the following equations:

a. 1 CS_2 (g) + 3 Cl_2 (g) → 1 CCl_4 (l) + 1 S_2Cl_2 (l) (4)

b. Classify the reaction in **10a** single displacement (1)

c. What is the mass percent of carbon in 24.3 g of carbon tetrachloride?

$$24.3\,g\,CCl_4 \times \frac{1\,mol\,CCl_4}{153.81\,g} \times \frac{1\,mol\,C}{1\,mol\,CCl_4} \times \frac{12.01\,g\,C}{1\,mol\,C} = 1.90\,g\,C$$ (4)

$$\frac{1.90\,g\,C}{24.3\,g\,CCl_4} \times 100 = 7.82\%$$ mass % of C.

11. True or False

a. F Avogadro's number is 6.022×10^{-23}.

b. F Ionic compounds share electron to form very strong bonds.

c. F Bonds between atoms are formed by sharing or donating electrons from the valence shell, which is the shell closest to the nucleus.

d. F The seven elements that are diatomic are: hydrogen, oxygen, carbon, fluorine, chlorine, bromine, and iodine.

e. F There is no difference between the molecular geometry and electronic geometry.

1 each

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f. T The concepts of electronegativity and polarity are related.

g. T An electrolyte is made up of a soluble salt.

] 1 each

12. Balance the following equation and classify the reaction:

1 $C_6H_{12}O_6$ + 6 O_2 → 6 CO_2 + 6 H_2O (2)

13. Write the chemical formulas for the reactants and product and balance the overall chemical equation:

a. Aqueous phosphoric acid is mixed with aqueous barium hydroxide to produce...

(4) $2\,H_3PO_4(aq) + 3\,Ba(OH)_2(aq) \rightarrow Ba_3(PO_4)_2(s) + 6\,H_2O(l)$

b. Aluminum solid is mixed with aqueous copper (II) nitrate to produce...

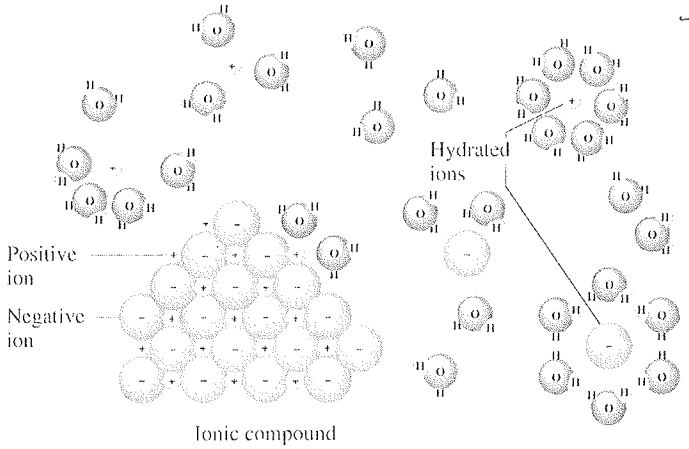
(4) $2\,Al(s) + 3\,Cu(NO_3)_2(aq) \rightarrow 2\,Al(NO_3)_3(aq) + 3\,Cu(s)$

c. Calcium solid and liquid water react to form aqueous calcium hydroxide and gaseous hydrogen.

(4) $Ca(s) + 2\,H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$

14. In less then 2 sentences, describe what is occurring in this picture.

(2)



The process is called solvation. It is what happens when one dissolves a soluble salt in H_2O.

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(4)

$Pb^{+2} + 2NaCl \rightarrow PbCl_2 + 2Na^+$

15. A solution contains 0.133 g of dissolved lead. How many moles of sodium chloride must be added to the solution to completely precipitate all of the dissolved lead as lead chloride? What mass of sodium chloride must be added? (Molar mass of sodium chloride: 58.44 g/mole; Lead: 207.2 g/mole; Lead chloride: 242.7g/mole)

$$0.133\text{g } Pb^{+2} \times \frac{1\text{mol } Pb^{+2}}{207.2\text{ g}} \times \frac{1\text{mol } PbCl_2}{1\text{mol } Pb^{+2}} \times \frac{2\text{mol Cl}}{1\text{mol } PbCl_2} \times \frac{1\text{mol NaCl}}{1\text{mol Cl}}$$

$= 0.0013$ moles NaCl

$$0.0013\text{mol NaCl} \times \frac{58.44\text{ g}}{1\text{mol NaCl}}$$

$= 0.0760$g

10

16. How many acetone (C_3H_6O) molecules are in a bottle of acetone with a volume 325 mL? (density of acetone = 0.788 g/mL)

$$325\text{ml} \times \frac{0.788\text{ g } C_3H_6O}{1\text{ml}} \times \frac{1\text{mol } C_3H_6O}{58.09\text{g}} \times \frac{6.022\times10^{23}\text{ molecules}}{1\text{mol } C_3H_6O}$$

$\rightarrow 2.65\times10^{24}$ molecules of C_3H_6O

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17. Calculate the simplest formula of a compound containing 4.875 g of potassium, 2.429 g of arsenic, and 2.498 g of oxygen.

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$$4.875\text{g K} \times \frac{1\text{mol K}}{39.10\text{g}} = 0.1247\text{ mol K}$$

$$2.429\text{g As} \times \frac{1\text{mol As}}{74.92\text{g}} = 0.0324\text{mol As}$$

$$2.498\text{g O} \times \frac{1\text{mol O}}{16.00\text{g}} = 0.1561\text{ mol O}$$

$$K\ \frac{0.1247}{0.0324}\quad As\ \frac{0.0324}{0.0324}\quad O\ \frac{0.1561}{0.0324}$$

$= 3.9$ $\quad = 1$ $\quad = 4.8$

$= K_4As_1O_5$

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(6)

18) If hydrogen were obtained from water, how much hydrogen in grams could be obtained from 1.0 L of water? (density of water = 1.0 g/mL)

$$1.0\,L\,H_2O \times \frac{1000\,mL\,H_2O}{1\,L} \times \frac{1.0\,g\,H_2O}{mL} \times \frac{1\,mol\,H_2O}{18.02\,g} \times \frac{2\,mol\,H}{1\,mol\,H_2O} \times \frac{1.01\,g\,H}{1\,mol\,H}$$

$$= 112.10\,g\,H$$

$$\hookrightarrow 1.1 \times 10^2\,g\,H$$

or

$$110\,g\,H$$

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(6)