Exam 1
Monday, Feb 27, 2017
100 pts

1. a. Write the formula for the following compounds. (5 pt)

    i. dinitrogen trioxide

    ii. magnesium nitrate hexahydrate

    iii. titanium (IV) oxide

    iv. stannous fluoride

    v. chloric acid

   b. Write the name for the following compounds. (5 pt)

    i. HBr

    ii. $(NH_4)_2C_2O_4$

    iii. $Fe(ClO_4)_2 \bullet 3H_2O$

    iv. SeF_4

    v. KO_2

2. Using your periodic table and other relevant information from this course, identify the following (3 pt each, 15 pt total):

    a. The name for an area of an atomic orbital where there is 0% probability of finding the electron

    b. The oxidation states of **all** of the elements in $Cd(ClO_4)_2$

    c. The electron configuration of Gd

    d. The **name** of the halogen in the 4^{th} period

    e. The symbol of a main group element with a common charge of +3

3. (16 pt total) Justify all parts of the following true statements. Some will be based on the Bohr model or quantum theory. **Be sure to state clearly which model you are using.** Choose your language and reasoning carefully and support your arguments with diagrams, tables, or calculations! (8 pt each)

   a. The Z_{eff} of an atom increases as you go across the periodic table but it stays approximately the same as you go down the periodic table.

   b. There are 5 different d-orbitals in the 4^{th} principal quantum level and each one can hold 2 e^-. There is only 1 s-orbital in the 4^{th} principal quantum level but it can also hold 2 e^-.

4. (10 pt total)
   a. Draw a sketch of a $4d_{xz}$ orbital, labeling the axes clearly. Label all angular and radial nodes. (6 pt)

   b. Draw a radial probability diagram for a $4d_{xz}$ orbital next to your orbital above with axes and any nodes appropriately labeled. (4 pt)

5. (17 pt total) a. Turn the following description into a series of **(unbalanced)** chemical equations including states of matter: Iron metal is added to a solution of hydrochloric acid. It reacts to form hydrogen gas and aqueous iron (III). When an excess of the sodium hydroxide is added, iron (III) hydroxide precipitates from solution. When a solution of potassium thiocyanate is added to this mixture, a blood red complex ion consisting of one thiocyanate with one iron (III) ion is formed. (6 pt)

   b. Classify each of the 3 reactions above according to the 4 types we used. (3 pt)

   c. For one of the reactions above (clearly indicate which one!) balance and write the net ionic equation. (4 pt)

   (1 pt each) Identify a substance in the reactions above that is a:
   d. Base
   e. Complex ion
   f. Oxidizing agent

6. (12 pt) Circle the correct answer(s) below.

   a. Circle elements that are metals:

   antimony platinum strontium beryllium mercury

   b. Circle the terms for a proton acceptor and an electron pair acceptor, respectively.

   Lewis acid, Base Acid, Lewis Acid Base, Lewis Base Acid, Lewis base Base, Lewis Acid

   c. Circle the elements that have unpaired electrons

   Na Se Ne Fe Ca

   d. Circle the salts that are insoluble

   $MgCl_2$ $Ca_3(PO_4)_2$ $Hg(NO_3)_2$ Na_2CO_3

7. (11 pt total) a. If an electron moves from the n=3 level of a H atom to the ground state (n=1), is the sign of the energy change positive or negative? (2 pt)

b. What is the frequency of the light associated with that transition in GHz (give it in other units if you are not sure how to convert!)? (6 pt)

c. Calculate the energy of that transition for 1 mol of electrons in units of kJ/mol. (3 pt)

8. When you put electrons into orbitals in multi-electron atoms, you populate the orbitals using three different rules: Hund's rule, the Aufbau principle, and the Pauli Exclusion Principle. Explain two of these rules and why you follow them! (4 pt)

Potentially useful information:

$E = h\nu$

$c = \lambda\nu$

1 J = 1 (kg m^2)/ s^2

h= 6.626 x 10^{-34} J•s

Avogadro's number: 6.022 x 10^{23}

c= 3.00 x 10^8 m/s

$E_n = -2.18 \times 10^{-18}$ J $(1/n^2)$

$$\lambda = \frac{hm}{u}$$

$$\Delta x * m \Delta u \geq \frac{h}{4\pi}$$

Soluble Compounds
G. **IA** cations (Li^+, Na^+, K^+, Rb^+, Cs^+), and ammonium cation NH_4^+ (all soluble no exception)
Nitrate (NO_3^-), perchlorate (ClO_4^-), acetate (CH_3COO^-) (all soluble no exception)
Halide (F^-, Cl^-,Br^-,I^-) all soluble except Ag^+, Hg_2^{2+}, Pb^{2+}
Sulfate (SO_4^{2-}) all soluble except Sr^{2+}, Ba^{2+}, Hg_2^{2+}, Pb^{2+}

Insoluble Compounds
Carbonate (CO_3^{2-}) all insoluble except G. **IA** cations and ammonium.
Sulfide (S^{2-}) all insoluble except G. **IA** cations and ammonium, Ca^{2+}, Ba^{2+}, Sr^{2+}
Hydroxide (OH^-) all insoluble except G. **IA** cations and ammonium, Ca^{2+}, Ba^{2+}, Sr^{2+}
Phosphate (PO_4^{3-}) all insoluble except G. **IA** cations and ammonium.