

Exam 1
Monday, Feb 27, 2017
100 pts

1. (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. There are only 4 different orbitals in the 2nd principal quantum level but 16 in the 4th principal quantum level.
 - b. The wavelength of light emitted from a hydrogen atom when an electron moves from the $n=4$ to the $n=2$ level is 487 nm, and these photons have an energy of 246 kJ/mol.
2. Using your periodic table and other relevant information from this course, identify the following (3 pt each, 15 pt total):
 - a. The term for the species that oxidizes something else in a redox reaction
 - b. Number of radial nodes in a 4p orbital
 - c. The electron configuration for mercury
 - d. The **name** of the alkaline earth metal in the 5th period
 - e. The formula for an insoluble salt of iodide

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

- i. hydrocyanic acid
- ii. potassium carbonate
- iii. manganese (II) acetate tetrahydrate
- iv. dinitrogen trioxide
- v. plumbous chloride

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

- i. $\text{Na}_2\text{S}_2\text{O}_3$
- ii. $\text{Cr}_2(\text{C}_2\text{O}_4)_3$
- iii. H_2SO_3
- iv. AuCl
- v. $\text{Mg}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$

4. (13 pt total)

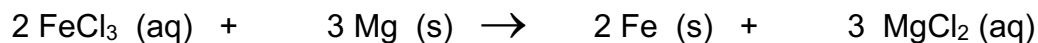
a. Draw a sketch of a $5p_x$ orbital, labeling the axes clearly. Label any angular and radial nodes. (6 pt)

b. Draw a radial probability diagram for a $5p_x$ orbital next to your orbital above with axes and any nodes appropriately labeled. (4 pt)

c. What does the radial probability diagram show you (generally)? (3 pt)

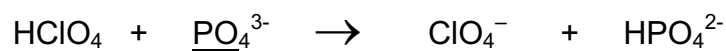
5. (20 pt) For the following chemical reactions, give the requested information:

a. Type of reaction (using the 4 types we discussed in class!) _____ (3 pt)



b. Predict the products, balance, and give the net ionic equation for the reaction of aqueous lead (II) nitrate with a solution of calcium chloride. (6 pt)

c. General term for **the role** of the underlined species in the reaction (3 pt)



d. Write the equation for the formation of a complex ion between aqueous chromium (III) and 6 chloride ions. (4 pt)

e. In equation d above, identify the Lewis acid and Lewis base. (2 pt)

f. What observations in the lab indicate a complexation reaction has happened? (2 pt)

6. (7 pt total) An iridium-rich layer is found at the KT-boundary, the geological dividing line marking the extinction of the dinosaurs. The iridium is believed to be from a comet that struck the earth near the Yucatan peninsula.

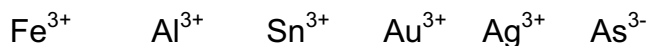
a. Give the electron configuration of the Ir (3 pt):

b. Based on your electron configuration, how many unpaired electrons would you expect Ir to have? (2 pt)

c. Is it paramagnetic or diamagnetic? (2 pt)

7. (12 pt) Circle the correct answer(s) below.

a. Correct common charges for the elements below



b. Circle the statement(s) about quantum theory that are true

- Electrons occupy circular orbits that can have only specific energies
- For a 3p orbital, $l=0,1$
- No two electrons in the same atom can have the same n , l , and m_l
- $(\Psi)^2$ describes the probability of finding an electron at a certain point in space
- Hund's rule is followed because half-filled orbitals are more stable than filled ones

c. Circle the elements that are in group IVA



d. Which classes of compounds typically form discrete (as opposed to extended) structures?



8. (7 pt) Gamma ray astronomy is used to study the origins of the universe.

a. What is the energy of a mole of gamma rays with a frequency of 1×10^{10} GHz?
(4 pt)

b. What is the wavelength of that light in nm? (3 pt)

BONUS: Share one thing you learned that I didn't include on this test.

Potentially useful information:

$$E = h\nu$$

$$c = \lambda\nu$$

$$1 \text{ J} = 1 \text{ (kg m}^2\text{) / s}^2$$

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$\text{Avogadro's number: } 6.022 \times 10^{23}$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

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

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

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

General Solubility Rule

All nitrates are soluble

All acetates are soluble ($\text{AgC}_2\text{H}_3\text{O}_2$ only moderately)

All chlorides, bromides and iodides are soluble except Ag^+ , Pb^+ and Hg_2^{2+} . (PbCl_2 is slightly soluble in cold water and moderately soluble in hot water.)

All sulfates are soluble except those of Ba^{2+} , Pb^{2+} , Ca^{2+} and Sr^{2+}

All carbonates and phosphates are insoluble except those of Na^+ , K^+ and NH_4^+ . (Many acid phosphates are soluble).

All hydroxides are insoluble except those of Na^+ and K^+ . Hydroxides of Ba^{2+} and Ca^{2+} are slightly soluble.

All sulfides are insoluble except those of Na^+ , K^+ , NH_4^+ and those of the alkaline earths: Mg^{2+} , Ca^{2+} , Sr^{2+} and Ba^{2+} . (Sulfides of Al^{3+} and Cr^{3+} hydrolyze and precipitate as the corresponding hydroxides.)

All salts of sodium ion, potassium ion and ammonium ion are soluble except several uncommon ones.