

Exam 1
Friday, Feb 26, 2016
100 pts

1. (16 pt total) Justify all parts of the following true statements. Choose your language and reasoning carefully and support your arguments with diagrams, equations, or calculations. (8 pt each)
- a. All quantum levels above $n=1$ have 1 s orbital and 3 p orbitals. These orbitals are filled using the Aufbau principle and Hund's rule (make sure it is clear what each of these terms mean!).
- b. The wavelength emitted when an electron in a H atom moves from $n=5$ to $n=3$ is 1282 nm.
2. (8 pt) Draw a picture of a p_z orbital and a d_{xz} orbital. Label the node(s), if any and specify what kind of node(s) they have.

3. (23 pt) Write and **balance** the following equations, **give states of matter**, and say what **type** of reaction they each represent. (6 pt each)

- a. A complex ion of 1 Fe(III) ion with 1 thiocyanate ion reacts with sodium fluoride to form a complex of 1 Fe(III) with 6 fluorides.

Reaction:

Type:

- b. A solution of copper (II) nitrate reacts with potassium hydroxide to form copper (II) hydroxide

Reaction:

Type:

- c. Acetic acid reactions with sodium hydroxide (need to predict the products!).

Reaction:

Type:

- d. On the appropriate reaction above, label the (2 pt each)

i. Bronsted base

ii. Conjugate acid

- e. For reaction c, give the net ionic equation (3 pt)

4. (10 pt total) For the compounds below, circle the ones that are ionic. Underline the ones that form extended 3D structures (rather than discrete molecules).



Pick an example of an extended structure and a discrete structure and draw a diagram of what a microscopic view of those solids would look like.

Extended

Discrete

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

- i. potassium iodide
- ii. oxalic acid
- iii. stannic fluoride
- iv. sulfur hexafluoride
- v. molybdenum (IV) phosphate

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

- i. $\text{Li}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
- ii. K_3N
- iii. PBr_5
- iv. H_2SO_4
- v. NO_2^-

6. Using your periodic table and other relevant information from this course, identify the following (3 pt each, 18 pt total):

- a. _____ The symbol for the halogen in the 3rd period
- b. _____ The electron configuration of W (Z=74)
- c. _____ The symbol for a diamagnetic metal
- d. _____ The **name** of element with the electron configuration [Ar]4s²3d⁸
- e. _____ The n and l quantum numbers for the 5f orbital
- f. _____ A transition metal with one of its common charges

7. (9 pt) Circle the appropriate answers below

a. Non metal(s)

Ge N Li Gd Se Pb

b. Lewis bases

NH₃ Cu²⁺ Rh³⁺ Cl⁻ SCN⁻

c. **Allowed** quantum number combinations

n=1 l= 1 m_l = -1 n=6 l= 1 m_l = -1 n=3 l= 2 m_l = -1 n=5 l= 3 m_l = -3

8. (6 pt) WGRE operates at a frequency of 91.5 MHz. Calculate the energy of these radiowaves (a low energy type of electromagnetic radiation) in kJ/mol.

Potentially useful information:

$$E = h\nu$$

$$c = \lambda\nu$$

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

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

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

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

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

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

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

TABLE 8.3 Solubility Rules for Ionic Compounds
All compounds containing the following ions are soluble in water: <ul style="list-style-type: none">• Cations: group 1 ions (alkali metals) and NH_4^+• Anions: NO_3^- and CH_3COO^- (acetate)
Compounds containing the following anions are soluble except as noted: <ul style="list-style-type: none">• Group 17 ions (halides), except the halides of Ag^+, Cu^+, Hg_2^{2+}, and Pb^{2+}• SO_4^{2-}, except the sulfates of Ba^{2+}, Ca^{2+}, Hg_2^{2+}, Pb^{2+}, and Sr^{2+}
Compounds that are only slightly soluble include these: <ul style="list-style-type: none">• All hydroxides except those of group 1 cations^a• All sulfides except those of group 1 cations and NH_4^+• All carbonates except those of group 1 cations and NH_4^+• All phosphates except those of group 1 cations and NH_4^+
^a The solubilities of the group 2 hydroxides and sulfides increase with increasing atomic number. MgS decomposes in water, forming H_2S and Mg(OH)_2 .