Dr. Bolaños **CHEM 110 - Exam 4A** **Fall 2015**

Name:_____ Date: _____

There are 8 questions totaling 103 points (6 pages + 1 Reference Sheet). PLEASE look over the entire examination BEFORE you begin to ensure your packet is complete. REMEMBER: ***The best place to start your exam may not be at the beginning!*** You have 2.75 hours to complete this examination and may only use a basic scientific calculator and the periodic table provided. All work must be shown for credit AND all answers must be expressed with the proper amount of significant figures. For problems involving dimensional analysis, all work must be shown in proper format to receive any credit. Please sign the honor code below. Please KEEP YOUR WORK COVERED with your Periodic Table or scratch paper. If you need further clarification, please speak with the instructor.

*** I certify that the work presented in this examination is my own; no help was given or received during this examination.

Signature _____

1. For the following, A-V, please fill-in, circle, or provide the appropriate response for EACH question. *(41 pts. total, 1 pt each blank for most)*

   a) An x-ray emits a lower frequency than gamma radiation. True ***or*** False?

   b) The number of valence electrons the element with 120 protons possesses is _____.

   c) Sodium emission spectrum yields bright lines at 589.0 nm and 589.6 nm. The line at 589.0 nm has twice the intensity of the line at 589.6 nm. The wavelength emitting more photons overall is_____nm and the energy of one photon of the 589.0 nm is _____ J.

   d) The excitation of an electron in an hydrogen atom is an endothermic *or* exothermic **(circle one)** process. If a red light is observed upon emission, a *Lyman or Paschen or Balmer* **(circle one)** series transition occurs resulting in an electron moving from n=_____ to n= _____ **(be careful here!).**

   e) The energy value associated with energy level six in atom is _____ J.

   f) Most transitions metals tend to have this charge as an ion: _____.

   g) Which transition emits a longer wavelength? *n = 6 to n = 5* ***or*** *n=4 to n=3* (circle one set)

   h) The maximum number of electrons in a 4f orbital is _____ and the maximum number of electrons on n=5 is _____; the maximum number of orbitals in a 5d sub-level is _____.

   i) The total # of electrons found in l=7 is _____ while the maximum # of electrons found in n = 4, l = 3, m_l = -3 is _____. The maximum # of electrons in an atom that can have n=3, m_s = 1/2 is _____.

   j) Propose an electronic transition in a hydrogen atom that results in a emission of an UV photon.

   $n_{initial}$ =_____ to n_{final} = _____

   k) Provide a set of four quantum numbers to describe the last electron in Br atom . **(4 pts total)**

   n = _____ l = _____ m_l = _____ m_s = _____

l) Propose a set of quantum numbers for the last electron in Zn^{2+} ion. ***Be careful!*** **(4 pts total, 1 pt each blank)**

n = _____ l =_____ m_l=_____ m_s =_____

m) Which is lower in energy: ___3p ***or*** 3s__? **(circle one) .**

n) The atom has the higher $Z_{effective}$: __Br ***or*** Se___ ? **(circle one) .**

o) Which substance is easier to ionize in each set:

i. __Ca ***or*** Ba ? **(circle one)** ii. ___P ***or*** S___ ? **(circle one)**

p) Which has the smaller atom: __S ***or*** Cl ***or*** Se__ **(circle one)**?

q) The two most probable ions of cobalt are: _____.**(2 pts total)**

r) Which are diamagnetic substances? ***Circle all.*** Rb Ti^{3+} P^{3-} Cd^{2+} **(2 pts total)**

s) Cations have a *smaller* ***or*** *larger* **(circle one)** radius compared to its neutral atom.

t) Which is the more metallic element: __Pb ***or*** Ba__ **(circle one)** ?

u) Which substance is likely to have the higher affinity for an electron: __Se ***or*** O__?

v) Place the following four substances in order of increasing radius: Te^{2-} Cs^{+} I^{-} Ba^{2+}

_____ < _____< _____< _____ **(2 pts total)**

w) If the 1st Electron Affinity (EA) for Cl is -349 kJ/mol, the likely 2nd EA for Cl could be _____ kJ/mol. ***Hypothesize here, please.***

x) **True** or **False**? *Circle one.* The second ionization energy of an atom is always greater than the first ionization energy of the same atom.

y) Consider the boron atom. Which electron removal (provide #) will result in the **greatest** increase in ionization energy (IE) from the previous IE value. _____ ***Possible answers:*** first, second, third, fourth, fifth, etc. **(2 pts)**

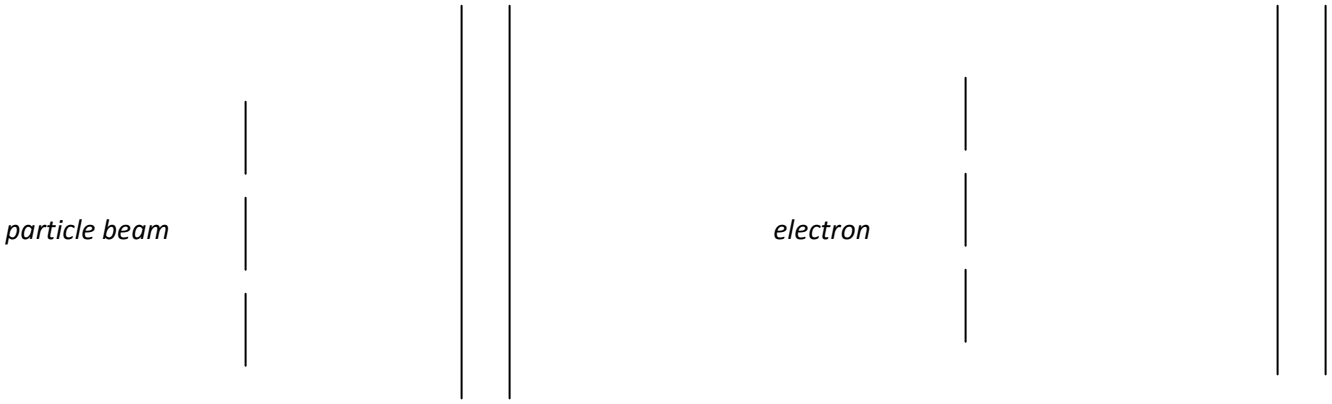
2. *Consider the electron configuration for the following species and answer each question.* **(8 pts total, 4 pts ea)**

Substance	***Electron Configuration***
V	***Full Electron Configuration:***
Sg *(Atomic # 106)*	***Abbreviated Electron Configuration***

3. Rank the EMR is order of increasing wavelength ***(feel free to abbreviate in blanks)*** **(4 pts total)**
yellow light, ultraviolet radiation, radio waves, infrared radiation, indigo light

_____ < _____< _____< _____< _____

4. *A particle beam and an electron beam are separately focused through a double slit system.* **(10 pts total)**
a. Please draw in the resulting image on the screen behind slits (draw between the long double lines which represent screen). **(4 pts)**



b. What is the significance of the double slit experiments relative to an electron? Be specific and SHOW another double slit experiment to directly support the significance. **(6 pts)**

5. Please provide the appropriate chemical reaction for the following (**8 pts total):**
   a. The chemical reaction showing the second ionization energy (IE_2) for Al (g). (**4 pts)**

   b. The chemical reaction showing the first electron affinity (EA_1) for S (g). (**4 pts)**

6. An X-ray photon of wavelength 0.989 nm strikes a surface. The emitted electron has a kinetic energy of 951 eV. What is the binding energy of the electron in kJ/mol? [KE = ½ mv^2; 1 electron volt (eV) = 1.602 x 10^{-19} J]. **SHOW ALL WORK FOR CREDIT. (8 pts total)**

7. An electron in the n= 8 level of the hydrogen atom relaxes to a lower energy level, emitting light of 7.71 $x10^{14}$ Hz. What is the value for of n for the level to which the electron relaxed? **SHOW ALL WORK FOR CREDIT. (8 pts total)**

8. Imagine a universe in which the value of m_s can be +1/2, 0 -1/2. Assuming that all the other quantum numbers can take only the value possible in our world, determine each of the following (SHOW ALL WORK FOR CREDIT; (**12 pts total; 4 pt each)**

    a. The new electronic configuration of Al.

    b. the atomic number of the element with a completed n=3 shell.

    c. the number of unpaired electrons in Ne.

Reference Sheet

$c = \lambda\nu$

$E = h\nu$

$c = 3.0 \times 10^{8}$ m/s

$\lambda = h/m\nu$

$\Delta x * m\Delta v > h/4\pi$

$E_n = - hcR (1/n^2)$

Φ= (Binding Energy)

$KE_{(ejected\ electron)} = E_{photon} - \Phi$

$\Delta E = -hcR_H (1/n_f^2 - 1/ n_i^2)$

$1/\lambda = 1.097 \times 10^{7}\ m^{-1} (1/n_f^2 - 1/ n_i^2)$

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

$R = 1.097 \times 10^{7}\ m^{-1}$

1 J = kg $*m^2/s^2$

$hcR = 2.18 \times 10^{-18}$ J

1 Watt = 1 J / sec

Mass of $e^- = 9.10938 \times 10^{-31}$ kg

Charge of $e^- = 1.609 \times 10^{-19}$ C

1 kWh = 3.60×10^{6} J

1 Å = 1.0×10^{-10} m