Matter and Motion Fall 2015

Chemistry Workshop 2

The workshop is intended to be a low-pressure setting where we get to practice problems, ask any questions, and discuss concepts and problem solving methods. Have fun! Work together on whiteboards or scratch paper and then neatly write your solutions in the notebook where you keep chemistry class notes. Your workshop solutions will be included in your portfolio. Starting this week, workshop solutions will be posted on the class website for you to use while studying.

1. Use the orbital box notation to give the full electronic configuration for the ground state of iron metal. What are acceptable quantum numbers for its highest energy electrons? Discuss how Hund's rule and the Pauli Exclusion Principle apply here.

2. How many electrons may be placed in:

a) the 3d sublevel of an atom b) the 2s sublevel of an atom c) the 3^{rd} energy level (n=3)

3. Write the electron configuration using the noble gas notation for:

a) Sn b) V

4. How many valence electrons are each of the following?

a) boron b)iodine c) titanium d) carbon e) barium

5. It is claimed that subshells half-filled with electrons are particularly stable. Discuss the physical basis for this claim.

6. Magnetism is a commonly observed quantum mechanical property of matter. Atoms with unpaired electrons are attracted by magnetic fields and thus said to exhibit *paramagnetism*. The degree to which this effect is observed is related to the number of unpaired electrons present in the atom. Consider the ground-state electron configurations for Li, N, Ni, Te, Ba, and Hg. Which of these atoms would be expected to be paramagnetic, and how many unpaired electrons are present in each paramagnetic atom?

7. Mars is roughly 60 million km from Earth. How long does it take for a radio signal originating from Earth to reach Mars?

8. Look up the values for Planck's constant, the speed of light, and the charge on the electron. From these values, and the equation $E = hc/\lambda$, derive a simple relationship between wavelength in nanometers and energy in electron volts (eV).

9. Assume that we are in another universe with different physical laws. Electrons in this universe are described by four quantum numbers with meanings similar to those we use. We will call these quantum numbers p, q, r, and s. The rules for these quantum numbers are as follows:

P = 1, 2, 3, 4, 5, …

q takes on positive odd integers and $q \leq p$

r takes on all even integer values from –q to +q. (including zero)

s= +1/2 or -1/2

a. Sketch what the first four periods of the periodic table will look like in this universe.

b. What are the atomic numbers of the first four elements you would expect to be least reactive?

c. How many electrons can have p = 4, q = 3?

d. How many electrons can have p = 3, q = 0, r = 0?