Chemistry Assignment Sheet Ch. 7 Atomic Structure and Periodicity

___________ In class: Notes for Asst. #52

___________ Due: **Asst. #52 Ch. 7 Problems: A1, A2, A3, A5, A7, A8.**
In class: Notes for Asst. #53

___________ Due: **Asst. #53 Ch. 7 Problems: A4, A6, A9, A12a, B1ab, B3ab.**
In class: Notes for Asst. #54

___________ Due: **Asst. #54 Ch. 7 Problems: A12b, B5a, B6a, D4.**
In class: Notes for Asst. #55

___________ Due: **Asst. #55 Ch. 7 Problems: D6, D8fgh.**
In class: Notes for Asst. #56

___________ Due: **Asst. #56 Ch. 7 Problems: D10, E1, E3, E5c.**
In class: Notes for Asst. #57

___________ Due: **Asst. #57 Ch. 7 Problems: E2, E4, E6e, E7, E8, E13, E14,**
Ch. 8 Problems: A1, B1abc.
In class: discuss Spectra Lab

___________ In class**: Spectra Lab**

___________ Due: **Spectra Lab Report**
In class: Periodic Worksheet in lab groups.

___________ **Review Asst. #58**
Ch. 7 Problems: A4, A7, A11, B5b, B6b, D11abcd, E10,
Ch. 8 Problems: A2ab.
In class: Sample Problems for Test

___________ Due: **Review Asst. #59**
Ch. 7 Problems: A8, A10, B5c, B6c, D11efgh, E11, E3ab.
In class: Sample Problems for Test

___________ Due: **Study Sheet (or Flash Cards) & 10 or more Practice Problems**
In class: **Test Chapter 7**
**Standards are due the day after the test!

Chemistry Ch. 7 Atomic Structure & Periodicity

A. Light and Matter

A1) The laser in an audio compact disk player uses light with a wavelength of 7.80 $X10^2$ nm. Calculate the frequency of this light.

A2) An FM radio station broadcasts at 99.5 MHz. Calculate the wavelength of the corresponding radio waves.

A3) Microwave radiation has a wavelength on the order of 1.0 cm. Calculate the frequency and the energy of a single photon of this radiation. Calculate the energy of an Avogadro's number (mol) of photons (called an *Einstein*,) of this radiation.

A4) A photon of ultraviolet (UV) light possesses enough energy to mutate a strand of human DNA. What is the energy of a single UV photon and a mol of UV photons, having a wavelength of 25 nm?

A5) The work function of an element is the energy required to remove an electron from the surface of the solid element. The work function for lithium is 279.7 kj/mol (that is, it takes 279.9 kj/mol of energy to remove one mole of electrons from one mole of Li atoms on the surface of Li metal {Einstein's Photoelectric Effect}. What is the maximum wavelength of light that can remove an electron from an atom on the surface of lithium metal?

A6) It takes 208.4 kj of energy to remove 1 mole of electrons from an atom on the surface of rubidium metal. How much energy does it take to remove a single electron from an atom on the surface of solid rubidium? What is the maximum wavelength of light capable of doing this?

A7) It takes 7.21 $X10^{-19}$ j of energy to remove an electron form an iron atom. What is the maximum wavelength of light that can do this?

A8) The ionization energy of gold is 890.1 kj/mol. Is light with a wavelength of 225 nm capable of ionizing a gold atom (removing an electron) in the gas phase.

A9) Calculate the de Broglie wavelength for each of the following:

a) a proton with a velocity 90.% the speed of light

b) a 150. g ball with a velocity of 10. m/s

A10) Neutron diffraction is used in determining the structures of molecules.

a) Calculate the wavelength of a neutron moving at 1.00% of the speed of light.

b) Calculate the velocity of a neutron with a wavelength of 75 pm (1 pm = 1 $X10^{-12}$ m).

A11) Calculate the wavelength of an electron moving with a velocity that is 1.0 $X10^{-3}$ times the speed of light.

A12) Calculate the velocity of an electron with a wavelength of:

a) 1.0 $X10^2$ nm

b) 1.0 nm

B. The Bohr Model for Hydrogen

B1) Calculate the <u>energy</u> of light emitted when each of the following transitions occur in the hydrogen atom.

a) $n = 3 \rightarrow n = 2$

b) $n = 4 \rightarrow n = 2$

c) $n = 2 \rightarrow n = 1$

B2) Calculate the <u>wavelength</u> of light emitted when each of the following transitions occur in the hydrogen atom.

a) $n = 3 \rightarrow n = 2$

b) $n = 4 \rightarrow n = 2$

c) $n = 2 \rightarrow n = 1$

B3) Draw the transition of the electrons in problem **B1**.

B4) Calculate the <u>energy</u> of light emitted when each of the following transitions occur in the hydrogen atom.

a) $n = 4 \rightarrow n = 3$

b) $n = 5 \rightarrow n = 4$

c) $n = 5 \rightarrow n = 3$

B5) Calculate the <u>wavelength</u> of light emitted when each of the following transitions occur in the hydrogen atom.

a) $n = 4 \rightarrow n = 3$

b) $n = 5 \rightarrow n = 4$

c) $n = 5 \rightarrow n = 3$

B6) Draw the transition of the electrons in problem **B4**.

B7) Does a photon of visible light ($\lambda \approx 400$ nm) have sufficient energy to excite an electron in a hydrogen atom?
a) from the n = 1 to n = 5 energy state?
b) from the n = 2 to n = 6 energy state?

B8) An excited hydrogen atom emits light with a frequency of 1.141×10^{14} Hz to reach the energy level for which n = 4. In what principal quantum level did the electron begin?

C. Quantum Mechanics & Quantum Numbers

C1) From the Heisenberg uncertainty principle, calculate Δx for an electron with $\Delta v = 0.100$ m/s. How does Δx compare to the size of a hydrogen atom (1×10^{-10} m)?

C2) From the Heisenberg uncertainty principle, calculate Δx for a base ball (mass = 145 g) with $\Delta v = 0.100$ m/s. How does Δx compare to the size of a base ball (5×10^{-2} m)?

C3) Which of the following sets of quantum numbers are not allowed in the hydrogen atom? For the sets of quantum numbers that are incorrect, state what is wrong in each set.
a) $n = 2, \ell = 1, m_\ell = -1$
b) $n = 1, \ell = 1, m_\ell = 0$
c) $n = 8, \ell = 7, m_\ell = -6$
d) $n = 1, \ell = 0, m_\ell = 2$

C4) Which of the following sets of quantum numbers are not allowed in the hydrogen atom? For the sets of quantum numbers that are incorrect, state what is wrong in each set.
a) $n = 3, \ell = 2, m_\ell = 2$
b) $n = 4, \ell = 3, m_\ell = 4$
c) $n = 0, \ell = 0, m_\ell = 0$
d) $n = 2, \ell = -1, m_\ell = 1$

D. Polyelectronic Atoms

D1) Give the maximum number of electrons in an atom that can have these quantum numbers:
a) $n = 4$
b) $n = 5, m_\ell = 1$
c) $n = 5, m_s = ½$
d) $n = 3, \ell = 2$
e) $n = 2, \ell = 1$

D2) Give the maximum number of electrons in an atom that can have these quantum numbers:
a) $n = 0, \ell = 0, m_\ell = 0$
b) $n = 2, \ell = 1, m_\ell = -1, m_s = -½$
c) $n = 3$
d) $n = 2, \ell = 2$
e) $n = 1, \ell = 0, m_\ell = 0$

D3) The following elements are all found in high-temperature ceramic superconductors. Write the expected <u>electron configuration</u> (long form) for each of the following atoms.
a) Cu b) O c) La d) Y e) Ba f) Tl (#81) g) Bi

D4) Write the expected <u>electron configuration</u> (long form) for each of the following atoms.
a) Sc b) Fe c) P d) Cs e) Xe f) Br

D5) Write the expected <u>electron configuration</u> (long form) for each of the following atoms.
a) Cl b) As c) Sr d) W e) Pb f) Cf g) Eu h) Pt

D6) The following elements are all found in high-temperature ceramic superconductors. Write the expected <u>electron configuration</u> (long form) **and** the <u>orbital diagram</u> (short form).
a) Cu b) O c) La d) Y e) Ba f) Tl (#81) g) Bi

D7) Write the expected <u>electron configuration</u> (long form) **and** the <u>orbital diagram</u> (short form).
a) Sc b) Fe c) P d) Cs e) Xe f) Br

D8) Write the expected <u>orbital diagram</u> (short form).
a) Cl b) As c) Sr d) W e) Pb f) Cf g) Eu h) Pt

D9) Which of the following electron configurations corresponds to an excited state? Identify the atoms and write the correct ground state electron configuration where appropriate.
a) $1s^2\ 2s^2\ 3p^1$ b) $1s^2\ 2s^2\ 2p^6$
c) $1s^2\ 2s^2\ 2p^4\ 3s^1$ d) $[Ar]\ 4s^2\ 3d^5\ 4p^1$

D10) Write the expected <u>orbital diagram</u> (short form).
a) Mo b) Cr c) Ni d) Ag e) Ho f) Am g) Au

Chemistry Ch. 7 Atomic Structure

D11) Write the expected electron configuration **and** orbital diagram.

a) Se b) Cu c) Pb d) Fm e) Cr f) Rh g) Os h) Tm

E. Periodicity

E1) Arrange the following groups of atoms in order of increasing size.

a) Be, Mg, Ca b) Te, I, Xe c) Ga, Ge, In

E2) Arrange the following groups of atoms in order of increasing size.

a) Rb, Na, Be b) Sr, Se, Ne c) Fe, P, O

E3) Arrange the following groups of atoms in order of increasing first ionization energy.

a) Be, Mg, Ca b) Te, I, Xe c) Ga, Ge, In

E4) Arrange the following groups of atoms in order of increasing first ionization energy.

a) Rb, Na, Be b) Sr, Se, Ne c) Fe, P, O

E5) Arrange the following groups of atoms/ions in order of increasing size.

a) Li, Na, K b) P, As c) O^{+1}, O, O^{-1}
d) S, Cl, Kr e) Pd, Ni Cu

E6) Arrange the following groups of atoms/ions in order of increasing ionization energy.

a) Cs, Ba, La b) Zn, Ga, Ge c) In, P, Ar
d) Tl, Sn, As e) O, O^{-1}, O^{2-}

E7) The first ionization energies of As and Se are 0.947 and 0.941 Mj/mol, respectively. Rationalize these values in terms of electron configurations. Hint: Look at the periodic trend in ionization energies. Do these agree? Why or why not? Explain.

E8) The electron affinities of the elements from aluminum to chlorine are -44, -120, -74, -200.4 and -384.7 kj/mol, respectively. Rationalize these values in terms of electron configurations. Hint: Look at the periodic trend in electron affinities. Do these agree? Why or why not? Explain.

E9) For carbon (C) and oxygen (O), pick the atom with the

a) larger atomic size.
b) more favorable (exothermic) electron affinity (largest).
c) higher ionization energy.

E10) For tellurium (Te) and bromine (Br), pick the atom with the

a) larger atomic size.
b) more favorable (exothermic) electron affinity.
c) higher ionization energy.

E11) For magnesium (Mg) and potassium (K), pick the atom with the

a) larger atomic size.
b) more favorable (exothermic) electron affinity.
c) higher ionization energy.

E12) For fluorine (F) and oxygen (O), pick the atom with the

a) larger atomic size.
b) more favorable (exothermic) electron affinity.
c) higher ionization energy.

E13) Order the atoms in each of the following sets from the least exothermic electron affinity (lowest) to the most exothermic electron affinity (highest).

a) S, Se b) F, Cl, Br, I

E14) Order the atoms in each of the following sets from the least exothermic electron affinity (lowest) to the most exothermic electron affinity (highest).

a) N, O, F b) Al, Si, S

Chemistry Ch. 8 Chemical Bonds

A. Electronegativity

A1) Arrange each set of elements in order of increasing electronegativity.

a) N, O, F b) S, Se, Cl
c) Si, Ge, Sn d) Tl, S, Ge

A2) Arrange each set of elements in order of increasing electronegativity.

a) Na, K, Rb b) B, O, Ga
c) F, Cl, Br d) S, O, F

B. Ions and Ionic Compounds

B1) For each of the following groups, place the atoms and/or ions in order of decreasing atomic size.

a) Cu, Cu^{+1}, Cu^{2+} b) Ni^{2+}, Pd^{2+}, Pt^{2+}

c) O, O^{-1}, O^{2-} d) La^{3+}, Eu^{3+}, Gd^{3+}, Yb^{3+}

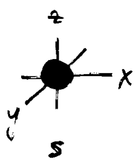
e) Te^{2-}, I^{-1}, Cs^{+1}, Ba^{2+}, La^{3+}

**From this we know where the electron is, but not it's path.

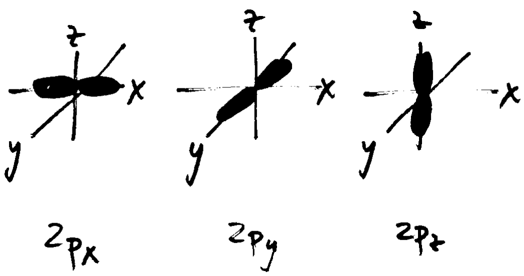
A) Electron Orbitals

By using the square of the wave function, a probability map can be drawn to show where the electrons are located at specific times. see (p. 312-313)

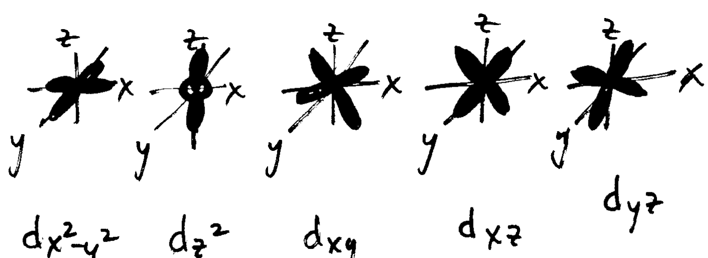
I. s – orbitals (1 type)



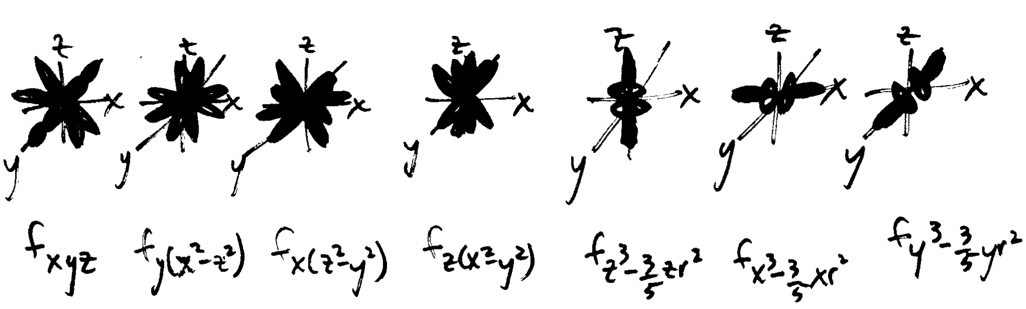
II. p – orbitals (3 types)



III. d – orbitals (5 types)



IV. f – orbitals (7 types)



Chemical Spectra & Flame Lab

The emission spectrum of each element is unique. For this lab the emission spectra of various elements will be determined after looking at various gas lights using a spectroscope. The spectroscope separates light into its various colors and wavelengths. As the light goes through a refractory lense (diffraction grating), the different colors are bent. Some colors are bent more than others and the light is separated. By using the spectra you observe and by using a spectrum chart, the elements will be determined. Also, the overall emission color will be determined for various compounds as they are burned.

Procedure:

1) Go around to each of the four lights and note their emission spectrums. **Write down the unknown letter. On your chart write down each color you see and the number of lines as well as the overall emission color**.
2) After going to all of the lights, repeat to make sure of your results.
3) After the overhead room lights are on, find the overall emission color for the five compounds. Dip a wooden splint into one of the five compound solutions (LiCl, $CaCl_2$, $Sr(NO_3)_2$, $Cu(NO_3)_2$, or KNO_3). ** No double dipping.** **Burn the splint to note the color of the burning cation** (Li^{+1}, Ca^{+2}, Sr^{+2}, Cu^{+2}, or K^{+1}). Break off the end of the splint and repeat for each solution. ** Avoid breathing the fumes.** Please don't leave any wood in the sinks.

Prelab Calculations:

1) Fill in the spectrums, for the gases: Ar, H, He, Ne, in the following chart by looking at the Emission Spectra Chart hanging in the room.

(Record the number of lines, for each color found, in each gas's spectrum.)

Gases	760-700 nm Red	700-640 nm Orange	640-575 nm Yellow	575-510 nm Green	510-455 nm Blue	455-380 nm Purple/Violet		Overall Emission Color of the Lights
Ar								
H	1				1 blue/green	2		
He								
Ne								

2) Make a large chart like the one above, but with Gases: A, B, C, D to record your data for the lights during lab. After the lab you will have to match Ar, H, He, & Ne to lights A, B, C, & D.

3) Hydrogen produces 4 spectral lines: Orange (656 nm, but appears **Red), Blue (486 nm, but appears **Bluish-Green**), Violet (434 nm) and Violet (410 nm). These lines are produced from electrons jumping from n= 6 → 2, n= 5 → 2, n= 4 → 2, n= 3 → 2. **Use any two of these electron transitions and the Bohr equation to find ΔE for the two transitions. Then find the frequencies (ν) and then the wavelengths (λ). Match these wavelengths to the color of light produced by the Hydrogen atom. (4pts)**

Calculations:

1) Match up the four lights with the four gases (Ar, H, He, Ne). State the unknown letter and what gas it is. (Remember: The gas lights may have impurities, which would add extra lines. But if it is let's say Ar, it should have all of the Ar lines, plus any lines made by the impurities.) (4pts)
2) List the five cations (from the five compounds) and what overall emission color is given off. (3pts)
3) Clearly explain why the lights and flames are producing/giving off color. (2pts) (Hint: electrons)

Conclusion: State the four unknown gases and what each is. List the five cations and their colors. What did you learn? Errors? (2pts)