NAME: HONORS CHEMISTRY

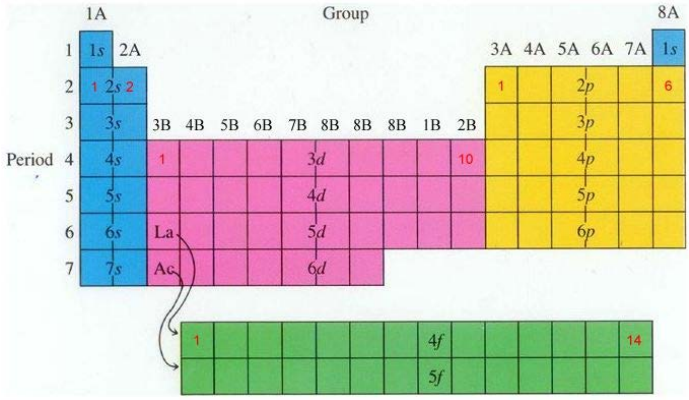
SECTION: Putting It All Together III

Organizing Chemistry
Atomic Structure, Periodic Properties, and Bonding Patterns

Part I: Basic Structure of the Atom (Refer to pp. 75-80, pp. 82-101, and pp. 323-346 in your textbook)

A. "Most of what I needed to know about the atom I learned from John Dalton"
B. Getting Inside the Atom (See your notes for the important experiments)
   1. Cathode Ray Tube—How did Thomson prove the existence of electrons?
   2. α scattering—How did Rutherford prove the existence of the nucleus?
   3. Neutrons—What are they and where are they? How do they relate to isotopes?
   4. Oil Drop Experiment—Millikan measured the charge of the electron.
   5. Energy Levels within the atoms—Who suggested them, and what evidence is there to support them? Be sure to review the electromagnetic spectrum.
   6. Quantum Mechanics—Make the leap to a statistical model of the atom.
      a) Energy Levels: n = 1 through 7 (effectively)
      b) Energy Sublevels: sets of orbitals within each energy level
         s, p, d, f

   Use the periodic table to remember it all!



C. Practice

1. Using arrows and boxes, give the complete electron configuration of : (Refer to pp. 338-345)
   a) Iron

   b) Tellurium

   c) Why do some elements exhibit exceptional electron configurations? (Refer to your notes)

2. Give the outermost electron of:

a. Na _____	d. Mg _____	g. I _____
b. Nd _____	e. P _____	h. Hg _____
c. Cr _____	f. Kr _____	i. Sb _____

3. Explain how the electron configurations of families 1, 2, 17, and 18 predict the charges of those families. (Remember stable octets? Refer to p. 101)

4. What is the average atomic mass of hafnium if, out of every 100 atoms, 5 have mass 176 amu, 19 have mass 177 amu, 27 have mass 178 amu, 14 have mass 179 amu, and 35 have mass 180. amu?

5. Describe what each of the following quantum numbers represents. (Refer to your notes)
   n

   l

   m

   s

6. For n = 3, list the allowed values of l, m, and s.

7. What do these equations mean? $E = h\nu$ $c = \lambda\nu$ ($h = 6.626 \times 10^{-34}$ J/sec $c = 3.00 \times 10^{8}$ m/s)

8. When sodium is heated, a yellow spectroscopic line whose energy is 3.37×10^{-19} J is produced. What is the frequency of this light? What is its wavelength?

Electron configurations of the elements are the key to bonding behavior of the elements. We have already reviewed formulas for ionic compounds. Let's look at covalent bonding and molecular geometry. Refer to pp. 370-391 in your textbook.

9. Using the Period 2 elements, predict the formulas and shapes of covalent compounds formed by the representative elements. (You should recognize this!)

Family:	1	2	13	14	15	16	17
Element	Li	Be	B	C	N	O	F
electron config							
Lewis diagram for H cpd							
Shape							
Polar or nonpolar?							

10. Now, draw the Lewis electron dot structures of the following compounds. For each molecule, describe its shape and indicate whether or not it is polar.
    a. CH_3OH b. NF_3 c. CCl_4 d. BF_3 e. BeH_2 f. H_2S

11. A molecule has a trigonal planar shape. What hybridization would you expect to find on its central atom? (Refer to your notes)

12. Draw a structural diagram for a propyne molecule, C_3H_4. Label each sigma bond and each pi bond. How many electron domains surround each carbon atom? Give the hybridization of each carbon atom. (See pp. 656-657 for naming hydrocarbons.)

13. Which elements can form multiple bonds? Draw Lewis structures of each, and describe its shape.
    a. CO_2 b. C_2H_4 c. C_2H_2 d. HCN

14. What is a resonance structure?

15. Draw resonance structures for the polyatomic ion carbonate, CO_3^{2-}. Each oxygen is attached to the carbon. Assign formal charges to each atom.

16. Compare the properties of ionic compounds with covalent compounds. (Refer to pp. 359-369)
    Ionic: Covalent:

Part II: Periodicity

Another look at the periodic table!

Overall, the periodic table is organized by_____.

What do the elements in *columns* of the table have in common, and how does this affect their behavior?

A. Reviewing the Periodic Trends

For each of the following properties, tell *what* trend is exhibited, and *explain* that trend, both as you go from left to right across a row and as you go down a column. Refer to pp. 342-351 and pp. 361-362 in your textbook.

1. atomic radius (size)

2. ionization energy

3. electronegativity

4. electron affinity

B. Applying the Periodic Trends

1. Sodium and potassium will both undergo a single displacement reaction with water, producing hydrogen gas and a basic solution. (That's why the group I elements are referred to as the alkali metals!) Write a balanced equation for each reaction and explain why potassium reacts so much more easily than sodium.

2. Given the elements Na Si Cl
   a) Which has the highest first ionization energy?

   b) Which has the smallest radius?

   c) Which is most metallic in character?

3. Why is the 3rd ionization energy for beryllium so much larger than the second ionization energy?

4. Calcium will undergo a single displacement reaction with water, but magnesium will not. Explain.

5. Gold and silver are sometimes referred to as “noble metals”—neither reacts very easily. Calcium and strontium, however, are quite reactive. Explain.

6. The nonmetallic elements can form covalent bonds with each other, but the metallic elements do not bond with each other. Explain.

7. Cl_2 will displace bromine from a solution of NaBr, but I_2 will not. Explain.