**Ch 9 Periodic Properties of the Elements Name:**

*9.1 Nerve Signal Transmission*

How do the pumps and channels in cells differentiate between sodium and potassium ions?

9*.2 The Development of the Periodic Table*

Dӧbereiner groups elements into \_\_\_\_\_\_\_\_\_\_ by similar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Newlands use \_\_\_\_\_\_\_\_\_\_\_\_s.

The modern periodic table is credited primarily to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and also \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

How did he organize his table?

What did the table allow him to do and what difficulty did he encounter?

What did the table not explain?

*9.3 Electron Configurations: How Electrons Occupy Orbitals*

What is an electron configuration?

Note the configurations and orbital diagrams for H and He. The box (we will use lines in class) represents the

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the arrows represent the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. For He the \_\_\_\_\_\_\_\_\_\_\_ exclusion principle

shows that the electrons must have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ spins so that no 2 electrons in an atom can

have the same 4 \_\_\_\_\_\_\_\_\_\_\_\_ numbers. *CC9.1 \_\_\_\_*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ law describes the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles.

Energy of attraction/repulsion is directly proportional to the charges (q1 and q2) and inversely proportional to the distance between them. E = *k* q1q2/r (*k is a constant)* The formula can also be written as F(force) = *k* q1q2/r2.

Shielding shows how the inner electrons “shield” outer electrons from the full charge of the nucleus. Penetration shows how the energy “ordering” of the sublevels s < p< d is determined *Figure 9.4* and 9.5.

*CC9.2 \_\_\_\_*

What does Aufbau’s principle and Hund’s rule state about electrons filling orbitals?

Examine the configurations and diagrams on pg 354. Note the example of using a noble gas such as [Ne] to represent inner electrons and “shorten” the configuration. Read the bullet points at the bottom of the page – this will be related to the organization of the periodic table.

*Practice 9.1*

*Practice 9.2 CC9.3 \_\_\_\_*

*9.4 Electron Configurations, Valence Electrons, and the Periodic Table*

*Figure 9.6* shows we can make the connection between an element’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and its electron

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Notice how the sublevel orbitals fill in order as you move across each row until a \_\_\_\_\_\_\_\_\_

gas is reached at the end of the period. As you move down a \_\_\_\_\_\_\_\_\_\_\_ (group or family) the number of electrons

in the outermost \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ level remains the \_\_\_\_\_\_\_\_. These outermost electrons called

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons are important in \_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonding and determine an element’s properties. These

electrons are distinguished from the rest of the electrons in an atom called the \_\_\_\_\_\_\_ electrons. These first 18

elements are referred to as the REPRESENTATIVE or Main-Group elements. Notice the “historical” designation at

the top of each column as groups 1A-8A. *Practice 9.3*

*CC9.4 \_\_\_\_*

*Figure 9.7* shows how the period table is arranged by \_\_\_\_\_\_\_\_\_\_\_\_ blocks. The number of \_\_\_\_\_\_\_\_\_\_\_\_s in a

block corresponds to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ number of \_\_\_\_\_\_\_\_\_\_\_\_\_ that can occupy the \_\_\_\_level of that block.

*s* block = \_\_\_ (\_\_\_ orbital), *p* block = \_\_\_ (\_\_\_ orbitals), *d* block = \_\_\_ (\_\_\_ orbitals), and *f* block = \_\_\_(\_\_\_orbitals)

The number of \_\_\_\_\_\_\_\_\_\_\_\_ electrons for any main-group elements is equal to the lettered \_\_\_\_\_\_\_\_\_ number

(Except He which is a \_\_\_\_\_\_\_\_\_ gas. Some periodic tables place He next to H in 2A.) Note that for the main-group

elements the row *(period) number* is *equal* to the highest \_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy level.

The example on pg 363-4 shows how the Noble gas short-hand electron configuration can be written for Cl. *(AP expects that you can write complete configurations for about the first 30 elements but the short-hand configs are often required.) Practice 9.4 & More Practice 9.4 (you may use the Noble gas short-hand)*

In the *d* block (\_\_\_\_\_\_\_tion elements) the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ quantum number of the *d* orbitals is equal to the row

number \_\_\_\_\_\_\_\_\_\_ one. In the 4th row the \_\_*s* orbital is generally \_\_\_\_\_\_\_\_\_\_ in energy than the ­­\_\_*d*. Keep in

mind the 4*s* and 3*d* orbitals are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ close in \_\_\_\_\_\_\_\_\_\_ which causes \_\_\_\_\_\_\_\_\_\_\_\_\_\_ behavior in the

order of fill. ­In the *f* block (\_\_\_\_\_\_\_\_ transition elements) the principle quantum number of the *f* orbitals is equal to

the row number \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_. (Again close energy spacing causes exceptions to the order of fill.)

*9.5 The Explanatory Power of the Quantum-Mechanical Model*

Why are the chemical properties of elements in the periodic table “periodic”?

Why are Noble gases unreactive?

Why do the alkali metals, alkaline earth metals, and halogens tend to be reactive? *CC9.5 \_\_\_\_*

*Figure 9.8* shows that Groups 1A, 2A, 6A, 7A, and a few other elements form ions with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charges.

*9.6 Periodic Trends in the Size of Atoms and Effective Nuclear Charge*

It is very difficult to measure the size of an atom due to the quantum nature of orbitals. The atomic radius of an atom

is an average of \_\_\_\_\_\_\_\_\_\_\_\_\_ radii determined from measurements for a large number of elements and compounds.

What general trends for atomic radii do *Figure 9.9 & 9.10* show?

Why does atomic radius increase down a group?

Atomic radius tends to decrease as you move across a row in the periodic table because according to \_\_\_\_\_\_\_\_\_\_\_\_

law the attraction between a nucleus and an electron increase with increasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge. Effective

nuclear charge depends on \_\_\_\_\_\_\_\_\_ing by the inner \_\_\_\_\_\_\_\_\_\_\_\_s, but in general as you move right across a

row in the pd table the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ nuclear charge experienced by the valence electrons increases causing the

radius of the atom to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. What can be said about the radii of the transition elements? *(why?)*

*Practice 9.5 and More Practice 9.5 (briefly state your reasoning) CC9.6 \_\_\_\_*

9*.7 Ions: Electron Configurations, Magnetic Properties, Ionic Radii, and Ionization Energy*

We remove electrons in the \_\_\_\_\_\_\_\_\_\_\_\_\_ n-value orbitals \_\_\_\_\_\_\_\_. (The explanation on this page is technically not correct. I will talk about the reasons during class.)

Evidence for certain e-configs can be found using magnetic fields. Silver is \_\_\_\_\_\_magnetic (\_\_\_\_\_\_\_\_\_\_\_\_ to an

external magnetic field) because it has an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electron in the 5*s* orbital. Zinc is \_\_\_\_magnetic (slightly

repelled by the external field) because all valence electrons are paired. Zn2+ ions are also diamagnetic which shows

that the 2 electrons are lost from the \_\_\_\_ orbital not the \_\_\_ orbital.,

Cations are much \_\_\_\_\_\_\_\_\_\_\_\_ than their corresponding (parent) atoms since the outermost electrons (farthest from

the nucleus have been lost). Anions are much \_\_\_\_\_\_\_\_\_\_\_\_\_ than their corresponding atoms since there is increased

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s among the outermost electrons. Ions having the same # of electrons are \_\_\_electronic. *NOTE the data for the isoelectronic series S2−, Cl−, K+, Ca2+ and the explanation given for the change is ion size*.

*Practice 9.7 & More Practice 9.7*

*CC 9.7 \_\_\_\_ (explain your choice)*

Define ionization energy:

Write an equation for IE3 = 6912 of sodium:

*Figures 9.14&15* shows that in general as you move across a row in the pd table 1st ionization energy \_\_\_\_\_\_\_\_\_\_\_\_\_s

because valence electrons experience a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ effective nuclear charge while as you move down a column

1st IE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s because the valence electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ away from the nucleus and are held

less \_\_\_\_\_\_\_\_\_\_\_\_\_. (COULOMB’S LAW) *Practice 9.8 & More Practice 9.8*

*Exceptions:* B has a \_\_\_\_\_\_\_\_\_\_\_\_\_ IE than Be because the 2­­­\_\_ orbital penetrates into the nuclear region less than the

2\_\_orbital and the 1*s* electrons can shield the electrons in the 2*p* slightly more than the 2\_\_. (Result” 2*p* orbitals share

\_\_\_\_\_\_\_\_\_\_\_ in energy and an electron is \_\_\_\_\_\_\_\_\_\_\_\_ to remove(lower IE). O has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_IE than N

which is caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between electrons when they \_\_\_\_\_\_\_\_\_\_\_\_\_ the same orbital. N is 2*p3* and O

is 2*p­­\_\_* so the 4th electron must \_\_\_\_\_ making it \_\_\_\_\_\_\_\_\_\_\_\_ remove .

*Table9.1* shows trends in \_\_\_\_\_\_\_\_\_ive IEs. Notice that the separation line between the pink and blue areas show that

it is much easier to remove successive valence electrons and as you reach \_\_\_\_\_\_ electrons the IE has a LARGE jump

in value. This helps to explain for example why Mg forms a 2+ ion. *CC9.8 \_\_\_\_*

What would be the most likely charge for an aluminum atom?

*9.9 Electron Affinities and Metallic Character CC9.9 \_\_\_\_*

Define electron affinity (Why is it usually negative?):

Write an equation to represent the EA of oxygen.

*Figure 9.16* In general EA becomes more \_\_\_\_\_\_\_\_\_\_\_ down a group and more \_\_\_\_\_\_\_\_\_\_\_\_across a period.

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (group 7A) have most \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ EAs.

Note: Exceptions for Group 2A and 5A do occur. Why does it make sense that the Noble gases have EAs >0?

Summarize the trends for metallic character.

What do the trends explain about the pd table?

*Practice 9.9 & More Practice 8.9*

*9.9 Periodic Trends Summary*

Table 9.2 is a nice summary of the 4 major Periodic Properties and the trends across and down the periodic table. Notice that changes in distance to valence electrons and effective nuclear charge are reasons for the trends. (COULOMB’S LAW!!!)

*Exercises* (pgs 387-389) #39a, 41a, 43d, 44(a,c), 50(a,d), 51, 55, 61, 65(a,b), 69, 88, 95