**Chemistry Concepts**  Name:

**Chapter 5:** The Periodic Law

5-1: History of the Periodic Table

**Mendeleev and Chemical Periodicity**

* When elements were arranged in order of increasing atomic mass,
* *Periodic* -

**Moseley and the Periodic Law**

* Moseley arranged elements according to
* - physical and chemical properties of the elements are periodic functions of their atomic numbers.

**The Modern Periodic Table**

* **The Periodic Table** - so that elements with similar properties fall in the same column, or group.

5-2: Electron Configuration and the Periodic Table

**Periods and Blocks of the Periodic Table**

* *–* vertical columns of elements that share similar chemical properties.
* *Periods -*
* **Alkali metals** -group 1 elements

  + In their pure state, all of the alkali metals have a silvery appearance and are soft enough to cut with a knife.
* **Alkaline-earth metals** - group 2 elements
  + beryllium, magnesium, calcium, strontium, barium, and radium
  + Group 2 metals are , but are still too reactive to be found in nature in pure form.

**Sample Problem A**

* a. Without looking at the periodic table, identify the group, period, and block in which the element that has the electron configuration [Xe]6*s*2 is located.
* b. Without looking at the periodic table, write the electron configuration for the Group 1 element in the third period. Is this element likely to be more reactive or less reactive than the element described in (a)?

- *d*-block elements

* The *d* sublevel first appears when *n* = 3.
* The 3*d* sublevel is slightly higher in energy than the 4*s* sublevel, so these are filled in the order 4*s*3*d*.

**Sample Problem B**

* An element has the electron configuration [Kr]4*d*55*s*1. Without looking at the periodic table, identify the period, block, and group in which this element is located. Then, consult the periodic table to identify this element and the others in its group.

**Main-group elements** -

* The *p*-block elements consist of all the elements of Groups 13–18 .
* The properties of elements of the *p* block vary greatly.
* *nonmetals* except
* *metalloids*
* eight *p*-block *metals*.
* - elements of Group 17
* fluorine, chlorine, bromine, iodine, and astatine
* The halogens are the
* They react vigorously with most metals to form examples of the type of compound known as salts.
* The metals of the *p* block are generally harder and denser than the *s*-block alkaline-earth metals,

**Sample Problem C**

* Without looking at the periodic table, write the outer electron configuration for the Group 14 element in the second period. Then, name the element, and identify it as a metal, nonmetal, or metalloid.

**F Block elements:** the *f*-block elements are wedged between Groups 3 and 4 in the sixth and seventh periods.

* *Lanthanides -*
* *Actinides -* are between actinium and rutherfordium. The actinides are all

**Sample Problem D**

* Name the block and group in which each of the following elements is located in the periodic table. Then, use the periodic table to name each element. Identify each element as a metal, nonmetal, or metalloid. Finally, describe whether each element has high reactivity or low reactivity.
* a. [Xe]4*f*145*d*96*s*1 c. [Ne]3*s*23*p*6
* b. [Ne]3*s*23*p*5 d. [Xe]4*f*66*s*2

5-3: Electron Configuration and Periodic Properties

**Atomic Radii**

* Boundaries are fuzzy.
* **Atomic radius** may be defined as
* The trend to smaller atoms across a period is caused by the increasing positive charge of the nucleus,
* The trend to larger atoms down a group is caused by the increasing size of the electron cloud around an atom as the

**Sample Problem E**

* Of the elements magnesium, Mg, chlorine, Cl, sodium, Na, and phosphorus, P, which has the largest atomic radius? Explain your answer in terms of trends of the periodic table.

**Ionization Energy**

* **Ion** –
* **Ionization -** process that results in the formation of an ion.
  + Ex: Sodium Na+
  + **Ionization energy, *IE*** –
* *In general, ionization energies of the main-group elements increase across each period.*
  + A higher charge more strongly
* *Among the main-group elements, ionization energies generally decrease down the groups.*
  + Electrons removed from atoms of each succeeding element in a group are in higher energy levels, farther from the nucleus.
  + The electrons are

**Sample Problem F**

* Consider two main-group elements, A and B. Element A has a first ionization energy of 419 kJ/mol. Element B has a first ionization energy of 1000 kJ/mol. Decide if each element is more likely to be in the *s* block or *p* block. Which element is more likely to form a positive ion?

**Ionic Radii**

* **Cation** –
* The formation of a cation by the loss of one or more electrons always leads to a
* **Anion** -
* Always leads to an increase in atomic radius.

**Valence Electrons**

* Electrons located in the
* Form chemical compounds
  + Valence electrons are often located in
  + example: the electron lost from the 3*s* sublevel of Na to form Na+ is a valence electron.

**Electronegativity**

* Measure of the ability of an atom in a chemical compound
* *Increase across periods*
* *Decrease or*

**Sample Problem G**

* Of the elements gallium, Ga, bromine, Br, and calcium, Ca, which has the highest electronegativity? Explain your answer in terms of periodic trends.