**Section 6.1 Notes – Ionic Bonding**

Read Pages 158-164 in order to complete the reading guide and answer the questions.

Argon’s name is a reminder of its inactivity. It comes from the Greek word *argos*, which means “idle” or “inert.” Why is argon very inactive yet oxygen is highly reactive? Chemical properties, such as reactivity, depend on an element’s electron configuration.

**Stable Electron Configuration**

The highest occupied energy level of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ is filled. When the highest occupied energy level of an atom is filled with electrons, the atom is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and not likely to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The noble gases have stable electron configurations with \_\_\_\_\_\_\_\_\_\_\_\_\_\_ valence electrons (or \_\_\_\_\_\_\_\_ in the case of helium).

The chemical properties of an element depend on the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons. Therefore, it is useful to have a model of atoms that focuses only on valence electrons. An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ diagram is a model of an atom in which each dot represents a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The symbol in the center represents the nucleus and all the other electrons in the atom.

* **Which group of elements have full valence shells?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **What does an atom need in order to be stable?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **What model is used to show valence electrons?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Ionic Bonds**

Elements that do not have complete sets of valence electrons tend to \_\_\_\_\_\_\_\_\_\_\_. By reacting, they achieve electron configurations similar to those of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_. Some elements achieve stable electron configurations through the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of electrons between atoms.

***Transfer of Electrons.*** A chlorine atom has one electron fewer than an argon atom, If the chlorine atom were to \_\_\_\_\_\_\_\_\_\_\_ a valence electron, it would have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electron arrangement as argon. A sodium atom has one more electron than a neon atom. If a sodium atom were to \_\_\_\_\_\_\_\_\_\_\_\_ this electron, its highest occupied energy level would have eight electrons. It would then have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electron arrangement as neon.

What happens at the atomic level when sodium reacts with chlorine? An electron is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from each sodium atom to a chlorine atom. Each atom ends up with a more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electron arrangement than it had before the transfer.



***Formation of Ions.*** When an atom gains or loses an electron, the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is no longer equal to the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The charge on the atom is not balanced and the atom is not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. An atom that has a net positive or negative electric charge is called an \_\_\_\_\_\_\_\_\_\_\_. The charge on an ion is represented by a \_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ sign.

The ion that forms when a chlorine atom \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an electron has 17 protons and 18 electrons. This ion has a charge of 1- because it has one extra \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. An ion with a negative charge is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Anions like the Cl- ion are named by using part of the element name plus the suffix –*ide*. Thus, Cl- is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion.

A sodium ion has 11 protons and 10 electrons. Because it has one \_\_\_\_\_\_\_\_\_\_\_\_\_ proton, the sodium ion has a charge of 1+. An ion with a positive charge is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Naming a cation is easy. You just use the element \_\_\_\_\_\_\_\_\_\_\_\_\_, as in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion.

* **When you lose an electron, an atom becomes (positive or negative)?\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **When you gain an electron, an atom becomes (positive or negative)?\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **What is a positive ion called?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **What is a negative ion called?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Formation of Ionic Bonds.*** Remember that a particle with a negative charge will attract a particle with a positive charge. When an anion and a cation are close together, a chemical \_\_\_\_\_\_\_\_ forms between them. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ is the force that holds atoms or ions together as a unit. An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond is the force that holds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ together. An ionic bond forms when electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one atom to another.

**Ionic Compounds**

Compounds that contain ionic bonds are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ compounds, which can be represented by chemical formulas. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a notation that shows what elements a compound contains and the \_\_\_\_\_\_\_\_\_\_\_ of the atoms or ions of these elements in the compound. The chemical formula for sodium chloride is NaCl. From the formula, you can tell that there is \_\_\_\_\_\_\_ sodium ion for each \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion in sodium chloride.

A magnesium ion cannot reach a stable electron configuration by reacting with just one chlorine atom. It must transfer electrons to \_\_\_\_\_\_\_\_\_ chlorine atoms. After the transfer, the charge on the magnesium ion is 2+ and its symbol is Mg2+. The formula for the compound is MgCl2. The 2 written to the right and slightly below the symbol for chlorine is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Subscripts are used to show the relative numbers of \_\_\_\_\_\_\_\_\_\_\_\_\_ of the element present. If there is only one atom of an element in the formula, no \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is needed.



Mg2+

Mg

***Crystal Lattices.*** A chemical formula for an ionic compound tells you the ratio of the ions in the compound. But it does not tell you how the atoms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the compound. If you looked at a sample of sodium chloride with a hand lens or microscope, you would be able to see that the pieces of salt are shaped like \_\_\_\_\_\_\_\_\_\_\_\_\_\_. This shape is a clue to how the sodium and chloride ions are arranged in the compound.

Each chloride ion is surrounded by six sodium ions and each sodium ion is surrounded by six chloride ions. Each ion is attracted to all the neighboring ions with an opposite charge. This set of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ keeps the ions in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ positions in a rigid framework, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Solids whose particles are arranged in a lattice structure are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The shape of an ionic crystal depends on the arrangement of \_\_\_\_\_\_\_\_\_\_\_\_\_ in its lattice. In turn, the arrangement of ions depends on the \_\_\_\_\_\_\_\_\_\_ of ions and their relative sizes. Crystals are classified into groups based on the shape of their crystals.

***Properties of Ionic Compounds.*** The properties of sodium chloride are typical of an ionic compound. It has a high melting point. In its solid state, sodium chloride is a poor conductor of electric current. But when melted, it is a good conductor of electric current. Sodium chloride crystal shatter when struck with a hammer. The properties of an ionic compound can be explained by the strong \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ among ions within a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Recall that the arrangement of particles in a substance is the result of two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factors. The first factor is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ among particles in a substance. The second factor is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the particles. The stronger the attractions among the particles, the more kinetic energy the particles must have before they can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

For an electric current to flow, charged particles must be able to \_\_\_\_\_\_\_\_\_\_ from one location to another. The ions in a solid crystal lattice have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ positions. However, when the solid melts, the lattice breaks apart and the ions are free to \_\_\_\_\_\_\_\_\_\_\_\_.

***Comprehension Questions***

1. When is an atom least likely to react?

2. Describe one way an element can achieve a stable electron configuration?

3. What characteristic of ionic bonds can be used to explain the properties of ionic compounds?

4. Draw the electron dot diagram for Nitrogen

5. Show the transfer of electrons between Lithium and Fluorine (use page 159 as an example)

6. Show the transfer of electrons between Calcium and Chlorine (use page 161 as an example)

Matching

7. \_\_\_\_\_\_electron dot diagram A) an atom with a net electrical charge

8. \_\_\_\_\_\_ion B) notation shows what elements a compound has

9. \_\_\_\_\_\_anion C) solid with particles arranged in a lattice structure

10.\_\_\_\_\_\_cation D) force that holds atoms or ions together as a unit

11.\_\_\_\_\_\_chemical bond E) an ion with a negative charge

12.\_\_\_\_\_\_ionic bond F) model of an atom showing valence electrons

13.\_\_\_\_\_\_chemical formula G) an ion with a positive charge

14.\_\_\_\_\_\_crystals H) force that holds cations and anions together