

CHM 120 - UNIT 7 SUPPLEMENT

ELECTRON CONFIGURATIONS AND THE PERIODIC TABLE

Objectives for Unit 7:

- Write Electron Configurations
- Investigate Magnetic Spin
- Identify Periodic Properties and Trends
- Explore Properties of Main Group Elements

UNIT 7 QUESTION: How do we represent the location of the electron and how does this location contribute to an atom's properties?

MAGNETIC SPIN QUANTUM NUMBER (m_s): The electron behaves as if it were spinning, (much like the earth spins on its axis). An electron can only spin in two directions, therefore we assign the values for m_s to be: $+1/2$ and $-1/2$. These spinning electrons create a magnetic field, thus causing substances to have certain magnetic properties:

DIAMAGNETIC is a property indicating no attraction for a magnet. The electrons being paired in their spinning cause this.

Example:

PARAMAGNETIC is a property indicating an attraction for a magnet. The electron being unpaired in their spinning causes this.

Example:

FERROMAGNETIC is a property indicating an extremely strong attraction for a magnet. The electrons being unpaired and aligned in a certain direction in their spinning cause this.

Example:

THE ELECTRON CONFIGURATION OF THE ELEMENTS The way electrons are distributed among the orbitals of an atom is its **ELECTRON CONFIGURATION (ELECTRONIC STRUCTURE)**.

PAULI EXCLUSION PRINCIPLE states that no two electrons in any atom can have all four quantum numbers the same (Simpler stated: Only two electron of opposite spin per orbital).

Recall: Orbitals are three dimensional regions with electrons of certain energies.

Example:

Note: The d and s and the f and s overlapping among subshells in $n=3$ and higher.

HUND'S RULE states that electrons entering a subshell containing more than one orbital will be spread over the available orbitals with their spins in the same direction. There are three ways in which we can represent the electrons in their electron configurations:

1. **BOX NOTATION (ORBITAL DIAGRAMS):**
2. **SPECTROSCOPIC NOTATION (ELECTRON CONFIGURATION):**
3. **NOBLE GAS NOTATION:**

Examples:

Note: Look at exceptions: Note: Look at ions, for transition elements with 2+ charge, the electrons come from the ns electrons. Ions with a larger charge, begin to lose electrons in the $(n-1)d$ orbitals.

We can use the periodic table to predict the location of the outermost electrons of an element. Refer to the periodic table for notes.

We say atoms are **ISOELECTRONIC** when, upon forming ions, have the same electron configuration.

Example:

EFFECTIVE NUCLEAR CHARGE: The **NUCLEAR CHARGE (Z)** is the positive charge of the atom's protons in the nucleus. The electrons outside the nucleus are attracted to the protons (the nuclear charge). The outermost electrons (in the outer orbitals) are shielded by the other electrons in lower energy levels. The **NET CHARGE** that is felt by the **OUTER ELECTRONS** is called the **EFFECTIVE NUCLEAR CHARGE (Z*)**. **Example:**

VALENCE ELECTRONS The **VALENCE SHELL** is the outer most energy level for an atom that contains electrons. **VALENCE ELECTRONS** are the electrons in the valence shell. Valence electrons are involved in chemical reactions (because of the size of Z*).

Statement:

Note: Identification on the periodic table.

Example

ATOMIC PROPERTIES AND PERIODIC TRENDS

Note: The behavior of transition and post transition elements for these properties and trends.

EFFECTIVE NUCLEAR CHARGE: Adding a proton to the nucleus results in an increase in Z* and the outer most electrons are held more tightly to the atom.

Trend:

ATOMIC SIZE: Atoms have a diameter of about: **Trend:**

IONIC RADII: Upon the gain or lose of electrons, an atoms size can change greatly. **Generally:**

Trend:

IONIZATION ENERGY: The energy required to remove an electron from an isolated gaseous atom in its ground state.

Example Equation:

Multiple Ionization Energies:

Trend:

ELECTRON AFFINITY: The energy that is released (or absorbed) when an electron is added to a neutral gaseous atom in its ground state.

Example Equation:

Multiple Electron Affinities:

Trend:

CHEMICAL REACTIVITY OF ATOMS GROUP IA: ALKALI METALS:

FACTORS THAT INFLUENCE THE FORMATION OF IONIC COMPOUNDS:

Many atoms combine to form ionic compounds because they undergo changes that bring them to a more stable condition. The driving force for an electron transfer to take place is to have a lower potential energy.

To analyze the factors that contribute to the energy change in this reaction, the reaction takes place in a series of steps: Known as the **BORN-HABER CYCLE**.

Scheme:

Step 1: Step 2: Step 3: Step 4: Step 5:

Step 5 includes the formation of the crystal lattice from gas-phase ions, the energy released during this process is called the **LATTICE ENERGY**.