Subatomic Particles

A. Protons – Protons carry a single positive charge that have a mass of one approximately one atomic mass unit. The atomic number is equal to the number of protons found in an atom.
B. Neutrons – Neutrons carry no charge and have a slightly larger mass than protons. Isotopes of an element have different number of neutrons but the same number of protons. The mass number is equal to the number of protons plus number of neutrons.
C. Electrons – Electrons carry a charge equal but opposite to that of protons. An electron is very small, about $1/1{,}837^{th}$ the mass of a proton.

Atomic Weights

Atomic mass of an atom is expressed in atomic mass units (amu) which is approximately 1.66×10^{-24} grams.

A more conventional way of expressing mass of an atom is **Atomic Weight.** Atomic weight is the weight in grams of one **mole** of an element, expressed as g/mol. A mole a unit of counting, much like a "dozen", where a mole is represented by **Avogadro's number** (6.02×10^{23}). One mole of an element is equal to its atomic mass number but in grams instead of amu.

Bohr's Model

A. In 1913, Niels Bohr created an atomic model based on the work of Ernest Rutheford and Max Planck. This model was of the structure of the hydrogen atom, where the nucleus consisted of a central proton around which an electron traveled in a circular orbit. The electrons are only capable of having discrete energies called **quanta**.
B. Atomic Emission Spectra - At room temperature, most atoms are at a ground state. Electrons can be excited to higher energy levels by hear or other energy, resulting in an excited state of the atoms. Electrons, when excited, will quickly return to the ground state, preferring low energy. When returning to ground state, the energy lost will be released as photons, who's energy can be calculated:

$$E=hc/\_$$

E is energy, h is Planck's constant (6.626×10^{-34} Js), c is the velocity of light (3.00×10^{8} m/s) and _ is the wavelength of the radiation.

Each element can have its electrons excited to different distinct energy levels, giving each element a unique atomic emission spectrum (like a fingerprint).

Quantum Numbers

Bohr's model assumed that electrons follow a circular orbit at a fixed distance from the nucleus. However, Bohr's model did not take into consideration of the repulsion between multiple electrons. Using the **quantum model**, electrons are described as being in regions in space called **orbitals**, rather than circular orbits. Orbitals show the probability of finding an electron in the atom. The reason why we now use probability is because pinpointing the exact location of an electron is almost impossible as described in **Heisenberg uncertainty principle**.

A. Principal Quantum Number (n)– Also known as the principal energy level, this number can theoretically take on any positive integer value. The larger the value of n, the higher the energy and the radius of the electron's path. The maximum number of electrons in energy level n is $2n^2$.
B. Azimuthal Quantum Number (l) – Also known as the angular momentum, refers to the **subshells** or **sublevels** that occur in the principal energy level. For any given energy level n, it can have n-1 sublevels, values being from 0 to n-1. The first four subshells l= 0, 1, 2, and 3 are known as the s, p, d andf subshells. The maximum number of electrons in each subshell is 4l+2.
C. Magnetic Quantum Number (m_l)– an **orbital** is a specific region within a subshell that contain no more than two electrons. Each subshell can contain multiple orbitals, but the magnetic quantum number specifies which orbital an electron is likely to be found. M_l can be integers between l and –l, including 0. Thus, in subshell s, there is only one orbital (value 0), where subshell p has 3 orbitals (-1, 0, +1)
D. Spin Quantum Number (m_s) – Since each orbital can only have 2 electrons, electrons in each orbital have **spin orientations** either –1/2 or +1/2. Electrons in the same orbital must have opposite spins. Electrons in different orbitals with the same spin are said to have **parallel spins**.