**CAPT CHEMISTRY BIG IDEAS**

* An **atom** is the smallest particle of an element that has the properties of the element.
* At its center is the **nucleus** which contains almost all of the atom’s mass and is positively charged. The electrons are located very far away from the nucleus in discrete energy levels.
* The atom contains subatomic particles called **protons, neutrons, and electrons.**

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| --- | --- | --- | --- |
| **Subatomic Particle** | **Location** | **Charge** | **Mass** |
| **Proton** | **Nucleus** | **+1** | **Approx. 1 amu** |
| **Neutron** | **Nucleus** | **0** | **Approx. 1 amu** |
| **Electron** | **Energy Levels** | **-1** | **Approx. 0 amu** |

* **Isotopes:** Different forms of the same element. The isotopes of a given element contain the same number of protons **(Atomic Number)** but vary in the number of neutrons and in mass. **Mass Number** for a given isotope = mass of protons + mass of neutrons. To find the number of neutrons in a given isotope, subtract the **atomic number from the mass number.**
* **Valence electrons:** Electrons in the outermost energy level (**valence shell)** that are gained, lost or shared when compounds are formed.
* The **Periodic Table** arranges the elements according to their atomic structure.
* **Periodic Law:** *Physical and chemical properties of the elements are periodic functions of their atomic numbers.* .
* **Periodic Table:** *An arrangement of elements in order of increasing atomic number so that elements with similar properties fall into the same column or group.*
* **Families (vertical columns)** contain elements with the same number and arrangement of valence electrons and therefore chemically behave in a similar fashion. Each family has a characteristic **valence number (charge)** that results when the elements in the family lose or gain electrons.
* **Periods (horizontal rows)** contain elements that cycle from exhibiting **metallic reactivity** at the **left** to **nonmetallic reactivity** at the **right**  and end with a **noble gas** that is **nonreactive** because its valence shell is **full (or closed).**
* **Metallic** elements are located on the **left** side of the periodic table. They **lose** electrons and become **positively** charged ions (**cations)**
* **Nonmetallic** elements are located on the **right** side of the periodic table. They **gain** electrons and become **negatively** charged ions (**anions).**
* A **Compound** is made up of atoms of 2 or more different elements; is held together by chemical bonds.
* **Ionic bonds** form when electrons are **transferred**. As a result of the transfer, a **cation** and an **anion** are formed. An ionic bond results from the electrical attraction between the two oppositely charged ions.
* **Covalent bonds** form when a pair of electrons is **shared.** If the sharing is **equal,** a **nonpolar covalent bond** forms. If the sharing is **unequal,** a **polar covalent bond** forms.

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| --- | --- | --- | --- | --- | --- |
| T**ype of Bond** | **Structure** | **Type of Elements** | **Solubility** | **Melting Point Boiling Point** | **State at Room Temp** |
| **Ionic** | Ionic Crystal | Metal & Nonmetal | Dissolve in water | Both are high | Hard crystalline solid |
| **Covalent** | Molecule | Two nonmetals | Dissolve in organic solvents | Both are low | Usually a gas or liquid ; if solid, has low m.p. |

* **Unique structure of carbon** results in the formation of many useful **organic compounds,** such as **polymers**
* Carbon contains **four valence electrons** and typically forms **covalent bonds** resulting in molecular structures. Carbon atoms are able to bond to each other, and this creates molecules comprised of **long chains of carbon atoms.**
* Carbon’s ability to form long chains of carbon atoms results in **polymers.** These are large molecules that consist of many repeating small structural units. The small structural units from which polymers are made are called **monomers.** **Polyethylene** is an example of a widely used polymer. Its **monomer** is **ethylene.**

The **double bond** in the ethylene monomer (shown below) breaks apart. This makes it possible for many ethylene monomers to bond together in a long chain and form polyethylene.

H H H H **H** **H** H H

| | | | | | | |

C = C - C – C – **C** **–** **C** – C – C -

| | | | | | | |

H H H H **H** **H** H H

**Ethylene Polyethylene**

* **Uses for Polyethylene:** plastic bags, plastic wrap, food containers, children’s toys, bottles
* **Properties of Polyethylene:** Tensile strength, Abrasion Resistance, Puncture Resistance
* **Acids** and **Bases**
* **Acids:** Formula starts with **“H”.** Acids donate protons.
* **Bases:** Formula ends with **“OH”.** Bases accept protons.
* **Neutralization Reaction:** Acid + Base🡪 Salt + Water
* **pH:** Is a measurement of the hydrogen ion concentration in a water solution.

**0------------------------------------7--------------------------------------14**

**Most Acidic Neutral Most Basic**

**pH = - log[H+];** [H+] has units of moles H+/liter sol’n;

**Ex: pH of a 1 x 10-3 M H+ solution = 3**

* **Acid Rain** is created when coal and oil are burned and the sulfur contained in the coal/oil is converted to sulfur dioxide (SO2). The SO2 is released in the atmosphere and combines with oxygen in the air to form sulfur trioxide (SO3). The SO3 reacts with water in the air to form sulfuric acid (H2SO4): **SO3(g) + H2O(l) 🡪 H2SO4 (aq)**
* **Effects of Acid Rain:**

Increases acidity of soil which results in the removal essential nutrients – this affects resistance of trees/plants to disease, insects, and bad weather.

Increases acidity of streams, rivers, lakes and can kill aquatic life.

Damages the surfaces of outdoor structures.