Name: _____ Date: _____

Elements, Ions, & Molecules

An **element** is a fundamental type of **matter** that has a unique set of properties and cannot be broken down into simpler substances by chemical means.

1. *Use your **Periodic Table of Elements** to identify the following:*

As		**Pb**	
Br		**Li**	
Ca		**Hg**	
C		**N**	
Cu		**P**	
Cl		**Na**	
F		**S**	
Au		**U**	
H		**O**	

The most basic building block of matter is an **atom**, the smallest unit of matter into which an element can be divided and still have its distinctive chemical properties.

If you could view atoms with a super microscope, you would find that each different type of atom contains a certain number of three types of **subatomic particles**:

2. *Identify the **subatomic particles** below:*

Within the Nucleus	Within the Nucleus	Outside the Nucleus
(n)	**(p)**	**(e)**
No Electrical Charge	Positive Electrical Charge	Negative Electrical Charge

A **molecule** is a combination of two or more atoms of the same or different elements held together by forces called chemical bonds.

3. *Identify the common name of the following **molecules**:*

O_2		Cl_2	
H_2		N_2	
O_3		H_2O	
CO		CO_2	

A **compound** are combinations of two or more different elements held together in fixed proportions.

4. *Identify the common name of the following **compounds**:*

H_2O		$NaCl$	
CO		$C_6H_{12}O_6$	
CO_2		CH_4	
H_2S		NH_3	
SO_2		H_2SO_4	
NO		$CaCO_3$	
HNO_3		N_2O	
NO_2		$NaOH$	

*When discussing molecules and compounds, all compounds are molecules but not all molecules are compounds.
An **ion** is an atom or group of atoms with one or more net positive or negative electrical charges. Chemists use a superscript after the symbol of an ion to indicate how many positive or negative electrical charges it has.

5. *Identify the **number** and **charge** of the ions listed below:*

H^+		Cl^-	
Na^+		OH^-	
Ca^{2+}		NO_3^-	
Al^{3+}		CO_3^{2-}	
NH_4^+		SO_4^{2-}	

Matter can undergo a **physical change**, which results in no chance in its chemical composition.

When a **chemical change**, or **chemical reaction**, takes place, there is a change in the chemical composition of the substances involved.

Matter can undergo both physical and chemical changes, as well as nuclear change, or change in the nuclei of its atoms. There are 3 types of nuclear changes:

Radioactive decay occurs when the nuclei of unstable isotopes spontaneously emit fast-moving chunks of matter, high-energy radiation, or both at a fixed rate.

Nuclear fusion occurs when two nuclei of lighter elements, such as hydrogen, are forced together at extremely high temperatures until they fuse to form a heavier nucleus and release a tremendous amount of energy.

Nuclear fission occurs when the nuclei of certain isotopes with large mass numbers, such as uranium-235, are split apart into lighter nuclei when struck by a neutron and release energy. Each fission releases neutrons which can cause more nuclei to fission.

This cascade of fissions can result in a chain reaction that releases an enormous amount of energy in a short time.

6. *Identify the type of **nuclear change** below:*

Solar Energy **H + H → He + n**	
Nuclear Energy Uranium-235 **U + n → Kr + Ba + n + n + n**	
Radiocarbon Dating Carbon-14 **C → N + e**	

The **Law of Conservation of Matter** states whenever matter undergoes a physical or chemical change, no atoms are created or destroyed. All we can do is rearrange the atoms, ions, or molecules into different spatial patterns (physical changes), or chemical combinations (chemical changes). Nuclear change is a chemical change, within the nuclei the molecules.

The **Law of Conservation of Energy**, which is the **First Law of Thermodynamics**, states that whenever energy is converted from one form to another in a physical or chemical change, no energy is created or destroyed.

The Second Law of Thermodynamics states that as energy is converted from one form to another in a physical or chemical change, it always goes from a more useful form to a less useful form.

The usable energy is always less than what was available at the start of the change because the low-quality energy usually takes the form of heat that flows into outward into the surrounding environment.