Atoms, Ions, and Compounds

Atoms:

An atom is a single entity. The element iron (Fe) can be separated into individual atoms. Atoms do not have a charge; they are neutral.

Molecules:

Atoms combine to form molecules. The element nitrogen exists naturally as a diatomic molecule, N_2.

When a molecule consists of atoms of different elements, it is called a compound. When nitrogen and hydrogen combine, they may form the compound ammonia, NH_3.

Ions:

When atoms gain or lose electrons, they are ions. Ions are charged. Cations have a positive charge, while anions have a negative charge.

Elements that are metals tend to lose electrons and become cations. Examples are K^{+}, Ba^{+2}, and Al^{+3}.

Elements that are nonmetals tend to gain electrons and become anions. Examples are Cl^{-}, O^{-2}, and P^{-3}.

Elements that become ions are called monoatomic ions. When a compound such as NaCl is dissolved in water, it breaks apart into Na^{+} and Cl^{-}, which are monoatomic cations and monoatomic anions, respectively.

There are also polyatomic ions (consisting of more than one atom). Examples are listed below:

Polyatomic cation: NH_4^{+1}
Polyatomic anions: OH^{-}, MnO_4^{-}, NO_3^{-}, SO_3^{-2}, SO_4^{-2}, $Cr_2O_7^{-2}$, PO_4^{-3}, AsO_4^{-3}, BO_3^{-3}

Compounds:

Compounds do not have a charge. There are different types of compounds: ionic (a metal bonded with at least one nonmetal) and molecular (two or more nonmetals bonded together).

Ionic compounds:
Binary ionic: $NaCl$, KBr, CaS, MgO, BaF_2, Al_2O_3, $CuCl_2$
Ternary ionic: $MgSO_4$, $Ba(NO_3)_2$, $Ca_3(PO_4)_2$, $LiOH$

Molecular compounds:
Binary: CO_2, Br_2O_7, CH_4
Ternary: $C_6H_{12}O_6$

Acids:
Binary: HCl, HI
Ternary oxyacids: $HOCl$ (monoprotic), H_2SO_4 (diprotic), H_3PO_4 (triprotic)