

Bonding

Everything around us is composed of a complex mixture of atoms or ions, all of which are bonded together in different ways. Why do atoms and ions bond to one another?

The manner in which atoms and ions bind together has a profound effect on both the physical and chemical properties of the compounds that are formed.

Ionic Bonds

Ionic compounds are formed by the TRANSFER of electrons from a _____ (_____) to a _____ (_____).

A _____ is the simplest collection of ions from which an ionic compound's formula can be established and is analogous to a molecule in a covalent compound.

In an ionic compound, the ions minimize their potential energy by combining in orderly arrangement called a _____.

Each of the ions in the crystal is called a _____.

Crystals have different 3-D shapes depending on the ratio of cations to anions in the compound and on the _____ of the cations and anions.

_____ are representations that show how the atoms or ions in a molecule or formula unit are bonded to each other. Lewis Structures only show the _____ electrons in a formula unit or molecule.

How to Draw Lewis Structures for Ionic Compounds

Example 1: Draw the Lewis structure for the compound formed from potassium and chlorine.

Example 2: Draw the Lewis structure for the compound formed from magnesium and fluorine.

Example 3: Draw the Lewis structure for the compound formed from aluminum and oxygen.

Covalent Bonds

Covalent bonds are formed when two or more nonmetals _____ electrons.

The smallest piece of a covalent compound is a _____.

Atoms can share 2 electrons - _____

4 electrons - _____

6 electrons - _____

Single bonds are the longest and strongest. Triple bonds are the shortest and strongest.

Each atom in a covalent compound shares electrons to achieve an _____ (Octet Rule).

When every atom has an octet (full s and p orbitals), the molecule is stable and low in energy.

Aspects of covalent bonds:

- **Bond axis** –

- **Bond angle** –

- **Bond length** –

- **Bond energy** –

How to Draw Lewis Structures and Structural Formulas for Some Simple Molecules

Molecular Formula	Bond Type	Lewis Structure	Structural Formula

Determining the Lewis Structure of More Complex Covalent Compounds

We are going to call this helpful tool form drawing Lewis Structures – Needs, Available, Shared, Not Shared

Some important guidelines to keep in mind:

1. If carbon is present, it is the central atom.
2. Hydrogen can only bond once, so it does not need an octet, but is stable with 2 valence electrons.
3. The LEAST electronegative atom is in the center (when no carbon is present).
4. If electrons are not shared, they are placed around the atoms in pairs (called lone pairs) so that each atom has an octet!

Here's how it works:

NASU	Lewis Structure	Structural Formula	Shape of Molecule
I Br			

NASU	Lewis Structure	Structural Formula	Shape of Molecule
H_2O			
NH_3			
C_2HCl			
CO_2			

NASU	Lewis Structure	Structural Formula	Shape of Molecule
SiCl ₄			
HCN			

Resonance – refers to bonding in molecules that cannot be correctly represented by a single Lewis structure. The actual structure of the molecule is an average of all possible structures of that molecule.

Example 1: Ozone, O₃

Example 2: Sulfur trioxide, SO_3

Polyatomic ions - a group of covalently bonded atoms that has a charge. An electron (or electrons) has been gained by the group or lost by the group. Polyatomic ions form bonds with oppositely charged ions.

Example 1: Ammonium ion, NH_4^+

Example 2: Nitrate ion, NO_3^-

Example 3: Sodium sulfate