

Covalent Bonding

Molecule

A neutral group of atoms held together by covalent bonds. A single molecule is an individual unit that can exist on its own.

Molecular Compound

A chemical compound whose simplest units are molecules

8

Covalent Compound Properties

Covalent compounds...

- 1) generally have much lower melting and boiling points than ionic compounds.
- 2) are soft and squishy (compared to metals and ionic compounds).
- 3) tend to be more flammable than ionic compounds.
- 4) do not conduct electricity in water.
- 5) are not usually very soluble in water.

9

Diatomic Molecule

A molecule containing only two atoms

There are 7 diatomic elements.

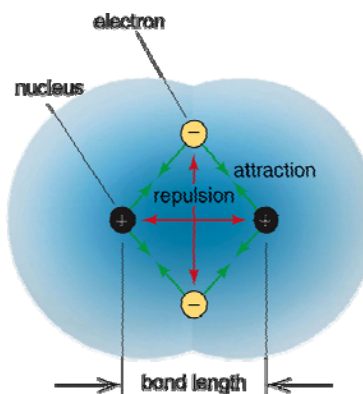
$H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2$ (Ignore At_2)

Other diatomic Molecule examples:

CO, NO, HBr, HCl

10

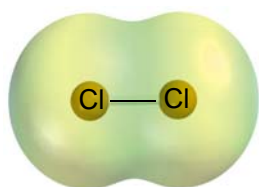
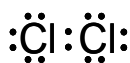
Attractive and Repulsive Forces



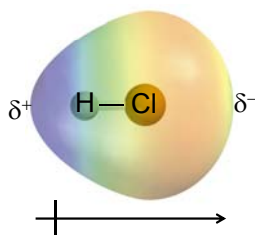
11

Covalent Bond Types

Nonpolar Covalent



Polar Covalent



12

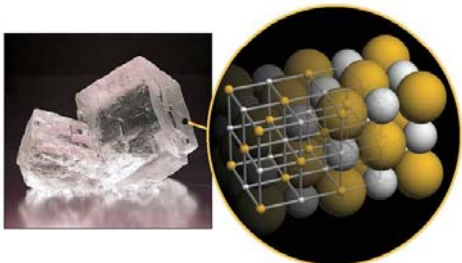
Exceptions to the Octet Rule

- Hydrogen forms bonds where it is surrounded by 2 electrons
- Boron can form bonds where it is surrounded by 6 electrons

13

Ionic Compound

Composed of positive and negative ions that are combined so that the numbers of positive and negative charges are equal

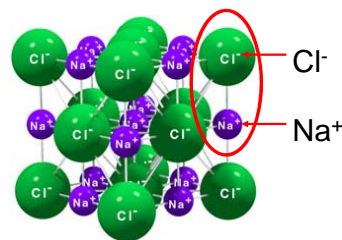


20

Formula Unit

The simplest collection of atoms from which an ionic compound's formula can be established

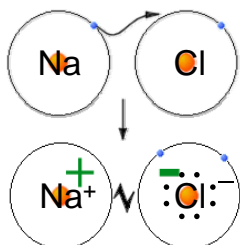
- A formula unit is based on ion charges
- Ex. Sodium chloride is NaCl. One Na⁺ to one Cl⁻



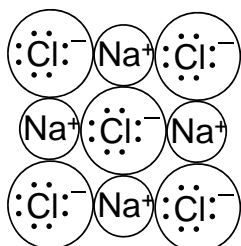
21

Formation of an Ionic Bond

Electron Transfer

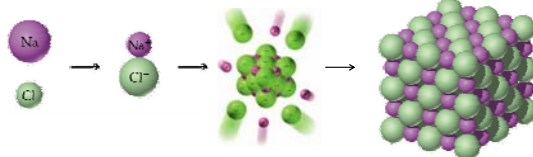


Electrical Attraction



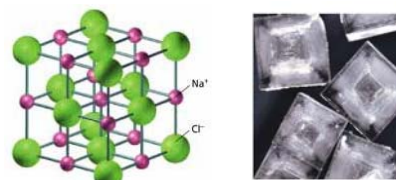
22

Crystal Structure of Sodium Chloride



Crystal Lattice

The orderly arrangement of ions in an ionic crystal.



23

Ionic Compound Properties

Ionic compound properties are based on the attraction between the cations and anions.

Ionic compounds...

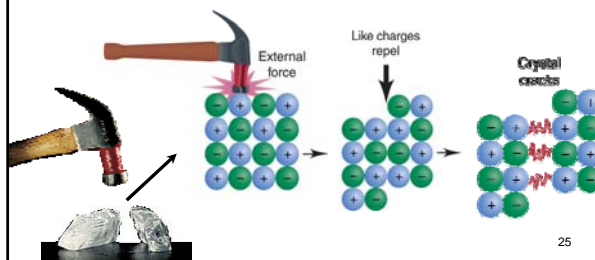
- tend to have very high melting and boiling points
- tend to be very hard but brittle
- do not burn
- do not conduct electricity as a solid

24

Cracking of an Ionic Compound

Ionic compounds tend to be very hard but very brittle.

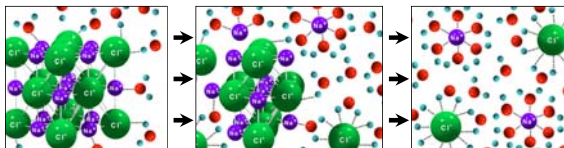
- Enough force breaks the ionic bonds
- The crystal shifts and like charges repel
- An entire row splits apart.



25

Ionic Compound Properties

- Many ionic compounds dissolve in water
 - Ions separate and are surrounded by water
 - Attraction of water must overcome attraction between ions



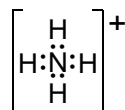
- Ionic compounds dissolved in water will allow ions to move freely and conduct electricity
- Molten ionic compounds have ions moving freely and can carry an electrical current

26

Polyatomic Ion

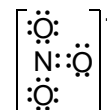
A charged group of covalently bonded atoms. The charge is due an excess or shortage of electrons.

Ammonium ion (NH_4^+)



9 Protons (+)
- 8 Electrons (-)
+1 Charge

Nitrate ion (NO_3^-)



23 Protons (+)
- 24 Electrons (-)
-1 Charge

27

Metallic Bonding

Chemical bonding that results from the attraction between metal atoms and the surrounding sea of electrons

Delocalized

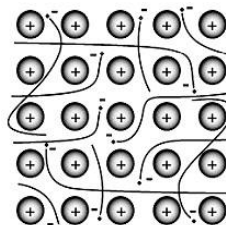
Electrons do not belong to any one atom and move freely throughout the metal's network of empty orbitals.

Electrons Delocalize because metals have very few valence electrons and have more room to move around.

28

Structure of Metallic Bonding

Metals have a crystal structure surrounded by a sea of electrons. The atoms are fixed while the valence electrons are free to move around.



29

Metallic Properties

Malleability - Ability to be hammered into thin sheets

Ductility - Ability to be drawn into a wire

Conductivity- Ability to conduct heat and electricity.

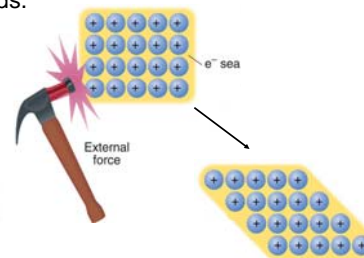
Luster – A shiny appearance



30

Deformation of Metal – Malleability and Ductility

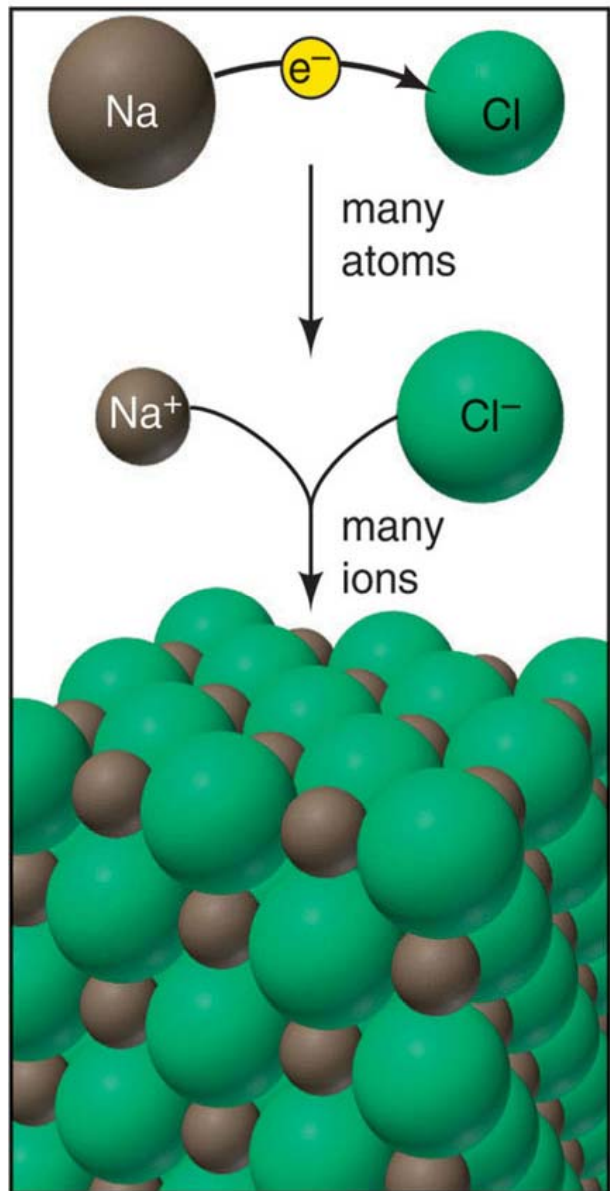
- Metallic bonds are the same in every direction.
- A plane of atoms can slide past another without breaking bonds.



31

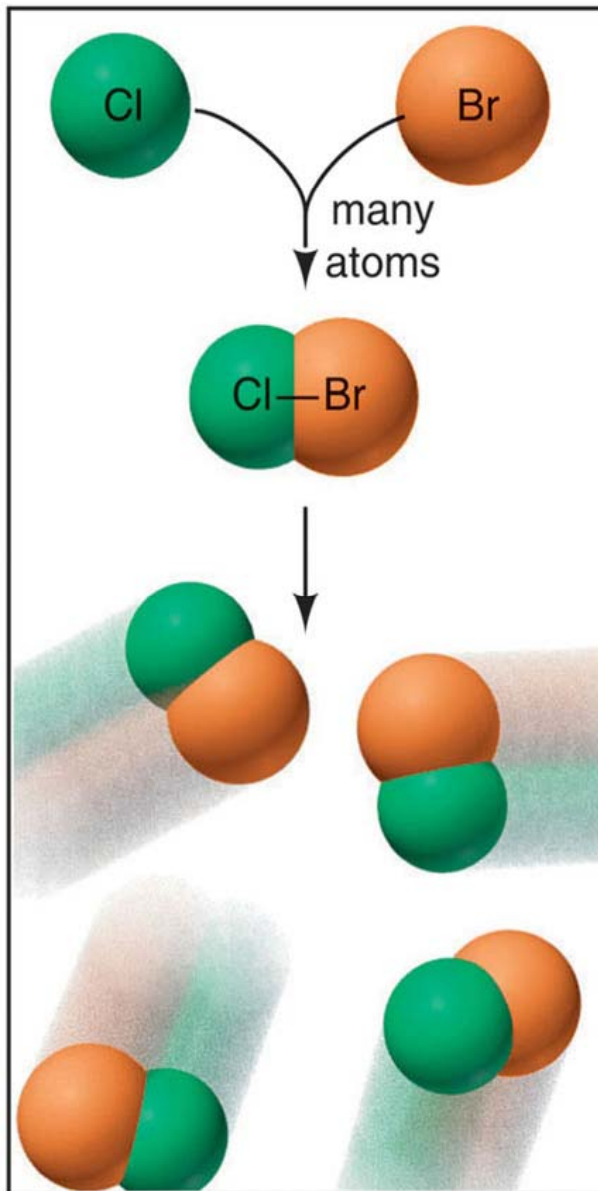
The three models of chemical bonding

Ionic Bonding



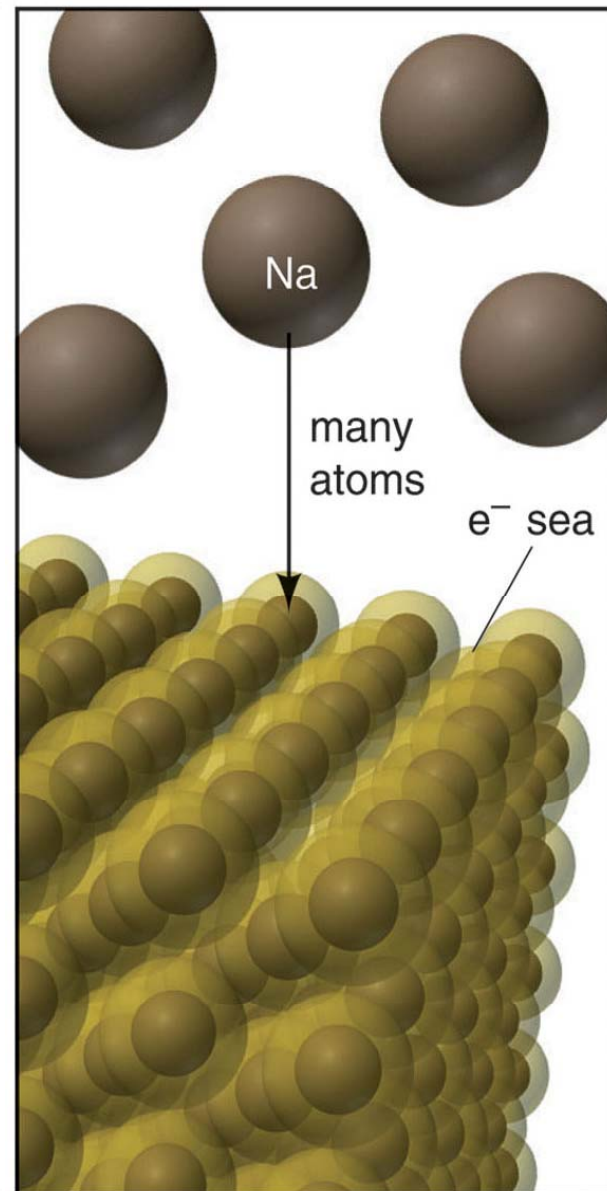
Metal/Nonmetal
Electron Transfer

Covalent Bonding



Nonmetal/Nonmetal
Electron Sharing

Metallic Bonding



Metal/Metal
Electron Delocalization⁷