Warm-Up | Types of Chemical Bonds

Lesson Objectives

By the end of this lesson, you should be able to:

- Compare and contrast _____, metallic, and covalent bonds.
- Relate electronegativity and ionization energy to _____ formation.

Science Practice: Create a chart to compare and contrast ionic, metallic, and covalent bonds.

Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

_____	chemical bond	A. a bond resulting from the attraction between oppositely charged ions
_____	ionic bond	B. a bond resulting from a sharing of electrons between two atoms
_____	covalent bond	C. a strong connection between atoms
_____	metallic bond	D. a collection of atoms connected by covalent bonds; the smallest unit of a covalent compound
_____	formula unit	E. a bond resulting from the sharing of valence electrons among many atoms
_____	molecule	F. an electrically neutral group of ions joined by ionic bonds; the smallest unit of an ionic compound

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Lesson Question

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Types of Bonds

Chemical bond: a strong connection between [ ]

- Three types of bonds:
  - Ionic
  - Covalent
  - Metallic
- Type of bond affects properties of a compound:
  - Melting point, conductivity, malleability

Type of Bond	Typical Properties
Ionic	Brittle, high melting point, conducts [ ] when molten or dissolved in water
Covalent	Brittle, low melting point, does not conduct electricity in any form
Metallic	Malleable and ductile, relatively high melting point, conducts electricity in [ ] and molten forms

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Bonds Represent Low Energy States

Low energy = more [ ]

As opposite charges approach:

- potential [ ] decreases.
- electrostatic force [ ].

As like charges approach:

- potential energy increases.
- electrostatic [ ] pushes.

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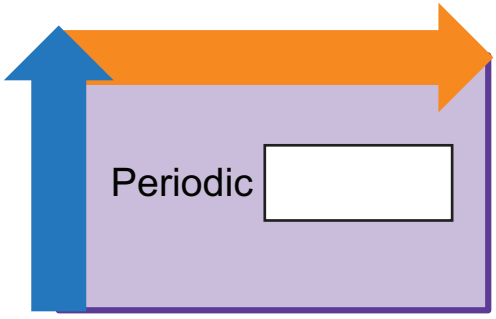
Reactivity and Bond Formation

Electronegativity:

- Attraction of an atom for an [ ]
- Higher values = more reactive
- Difference in electronegativity affects type of [ ] that forms

Ionization [ ]:

- Ease of [ ] of an electron
- Lower values = more [ ]



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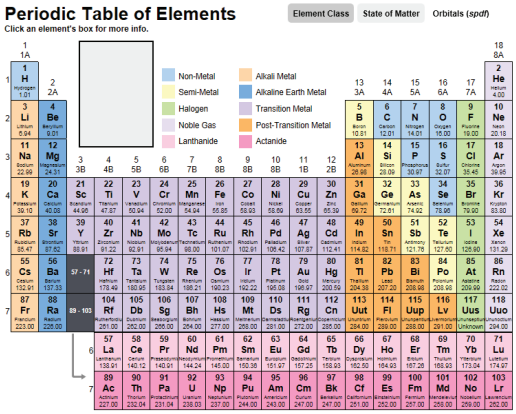
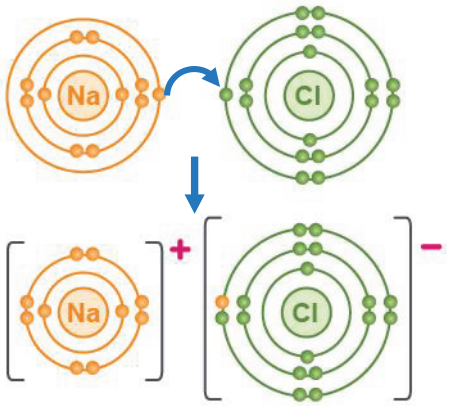
Ionic Bonds

Ionic bond: bond resulting from the attraction between oppositely charged ions

- Bond primarily between _____ and nonmetals
- Smallest unit: **formula unit**
  - An electrically neutral group of _____ joined by ionic bonds; the smallest unit of an ionic compound



- Valence electron "attracted" by more electronegative _____
- Electron "given up" by atom with lower ionization _____
- Resulting positive and _____ atoms (ions) strongly attract
- Electronegativity difference _____ 1.5



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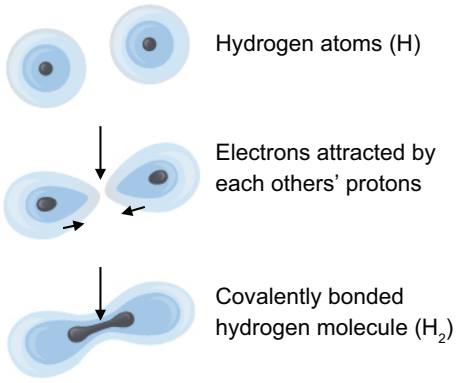
Covalent Bonds

Covalent bond: bond resulting from a sharing of electrons between two atoms

- [ ] have similar electronegativities
- Neither can extract [ ] from the other
- Electronegativity difference < 1.5
- Between [ ] (typically)

Water; H_2O	Methane; CH_4
H: 2.1	H: 2.1
O: 3.44	C: 2.55

- Technically, all bonds both covalent and ionic
- Bonds between atoms of [ ] element are, by definition, 100% covalent
- Smallest unit: **molecule**
  - A collection of atoms connected by covalent bonds; the smallest unit of a [ ] compound



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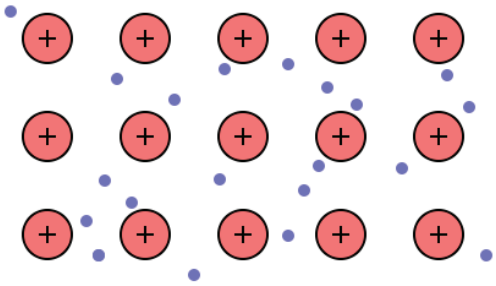
Metallic Bonds

Metallic bond: bond resulting from the sharing of [ ] electrons among many atoms

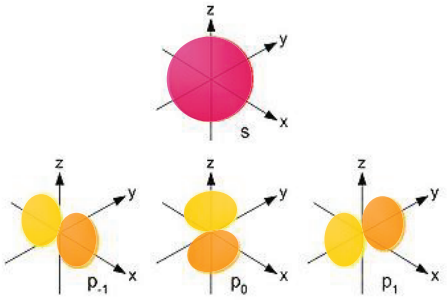
- "Electron sea" model of [ ]
- Valence electrons shared among all metal nuclei
- Bonds not [ ] (malleable)
- Electrons move freely (conductive)



Orbital Shape and Bond Types

Electron [ ] must overlap to share electrons.

- *s*-Orbitals
  - Spherical
  - [ ] in all directions
- *p*-Orbitals
  - [ ]-shaped on an axis
  - Overlap in one direction



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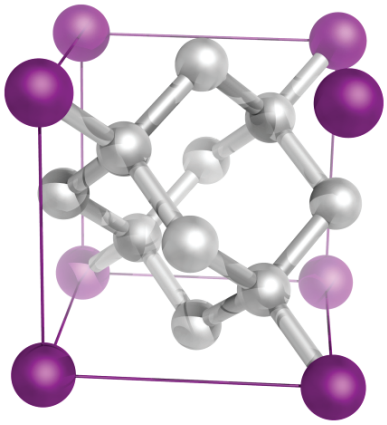
Valence Electrons: Nonmetals vs. Metals

Valence electrons in nonmetals occupy directional [ ]-orbitals.

- Hardest substances known
- Brittle, given enough [ ]

Metal valence electrons spread out into [ ] *s*-orbitals.

- Bonds do not “shatter”
- Easily deformed ([ ])



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Ionic Bonds and Physical Properties

- Crystal lattice
- Melt at high [ ]
- Brittle
- Dissolve in water to form [ ]
- Conduct electricity in liquid or [ ] form

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Covalent Bonds and Physical Properties

- Smaller molecules
- [ ] melting points
- Nonconductive

Metallic Bonds and Physical Properties

- [ ] conductors
- Malleable

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Summary | Types of Chemical Bonds

Lesson Question

What are the three main ways that elements can come together to form bonds?

Answer

Slide 2

Ionic Bonds

- Ionic bonds form between atoms with large differences in electronegativity.
  - Typically [ ] and nonmetals
  - Electronegativity difference > 1.5
- Ionic bonds form between two atoms when one atom loses an electron to an atom with a stronger electron affinity. This produces oppositely charged ions, which are attracted to each other to form an ionic bond.
- Ionic compounds tend to be [ ], have a high melting point, and conduct electricity when melted or dissolved in water.

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Covalent Bonds

- Covalent bonds form between atoms with small differences in electronegativity.
    - Typically nonmetals
    - Electronegativity difference < 1.5
- Covalent bonds form between two atoms when the atoms share electrons. The sharing may be equal (as between two atoms of the same element) or unequal (as between atoms of [ ] elements).
- Covalent substances tend to be brittle, have a low melting point, and are unable to [ ] electricity.

Metallic Bonds

- Metallic bonds form between atoms of metals.
- Metallic bonds form when [ ] move easily between atoms.
- Metallic substances tend to be malleable and [ ], have a relatively high melting point, and conduct electricity well as a solid or liquid.

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Use this space to write any questions or thoughts about this lesson.

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