

Chemical Bonds

Objectives

- explain what bonding is
- compare ionic and covalent bonding

Notes

Definition - force of attraction between the atoms of a compound

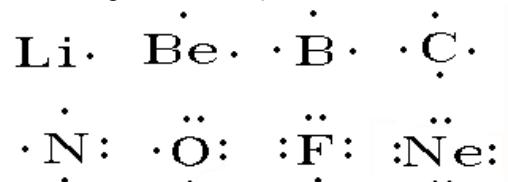
- ★ the electrons of one atom are attracted to the protons of another
- ★ when atoms combine, there is a tug of war over the valence electrons
- ★ the combining atoms either lose, gain, or share electrons in such a way that they complete their outer shells

Types of bonds

- ★ Ionic bond
 - ★ Definition - attraction between oppositely charged ions
 - ★ Formation of ionic bonds
 - ★ Description
 - ★ the electrons of one atom are attracted to the protons of another
 - ★ metals hold onto electrons loosely while nonmetals hold onto electrons tightly
 - ★ metals lose electrons and nonmetals gain electrons in such a way that they complete their outer shells
 - ★ atoms that gain or lose electrons become electrically charged
 - charged atoms are called ions
 - metals become positively charged ions by losing electrons
 - nonmetals become negatively charged ions by gaining electrons
 - ★ metal cations and nonmetal anions become bonded because they are oppositely charged
 - ★ Example
 - ★ changes in the electron configuration of sodium and chlorine when they combine
 $\text{Na } 2\text{-}8\text{-}1 + \text{Cl } 2\text{-}8\text{-}7 \rightarrow \text{Na}^+ 2\text{-}8 + \text{Cl}^- 2\text{-}8\text{-}8$
 - ★ changes in the charges of sodium and chlorine when they combine
 $\text{Na}^0 + \text{Cl}^0 \rightarrow \text{Na}^{+1} + \text{Cl}^{-1}$
 - ★ the charge on the ion is the same as its oxidation state or valence
 - ★ the sodium and chlorine are attracted because they are oppositely charged
 - ★ the charge on the compound is zero
 - ★ covalent bond
 - ★ Definition - bond formed by sharing electrons
 - ★ Formation of covalent bonds
 - ★ Description
 - ★ the electrons of one atom are attracted to the protons of another
 - ★ neither atom pulls strongly enough to remove an electron from the other
 - the electronegativity difference is < 1.7
 - hydrogen behaves like a metal
 - ★ no valence electrons are transferred, rather, they are shared
 - the electronegativity difference is zero
 - the electrons are shared equally
 - the bond is nonpolar
 - the electronegativity difference is > 0
 - the electrons are displaced towards the more electronegative element (nonmetal)
 - the bond is polar
 - ★ unpaired electrons pair up in such a way that the atoms complete their outer shells

Electron Dot Diagrams Showing Unpaired Electrons

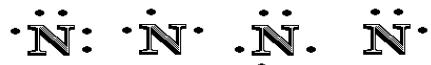
(NOTE: When bonding occurs, molecular orbitals form. As a result, the two electrons that are normally paired in the lowest energy orbital move into separate orbitals)



Answer the questions below by circling the number of the correct response

1. Barium combines by (1) gaining two electrons, (2) losing two electrons, (3) sharing two electrons, (4) sharing 3 electrons.

2. Which of the following is the correct electron dot diagram for nitrogen?



(1) (2) (3) (4)

3. In water, the bond between hydrogen and oxygen is (1) ionic, (2) polar covalent, (3) nonpolar covalent, (4) nonpolar noncovalent.

4. Which of the following occurs during covalent bonding?
(1) Electrons are lost. (2) Electrons are gained. (3) Valence electrons fall from the excited state to the ground state.
(4) Unpaired electrons form pairs.

5. Which of the following is an example of a substance with a nonpolar covalent bond? (1) HCl (2) Cl₂ (3) HClO₂ (4) NaCl

6. The electronegativity of sulfur is (1) 16, (2) 239, (3) 2.6, (4) 32.

7. Which of the following elements has the highest electronegativity?
(1) fluorine (2) chlorine (3) barium (4) hydrogen

8. The formula for magnesium fluoride is MgF₂. The best explanation for this fact is that when they combine (1) each of two magnesium atoms lose an electron and a fluorine atom gains two, (2) a magnesium atom loses two electrons and each of two fluorine atoms gains one, (3) a magnesium atom shares two electrons with two fluorine atoms, (4) each of two magnesium atoms share an electron with a fluorine atom.

9. When calcium combines, it usually (1) loses two electrons, (2) gains six electrons, (3) shares two electrons, (4) shares six electrons.

10. What is the maximum number of atoms carbon can combine with at once? (1) 1 (2) 2 (3) 3 (4) 4