

# Chemical Bonding : Ionic vs. Covalent vs. Metallic

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*Directions:: Read sections 6.1, 6.3 & 6.4 in your textbook. Be sure to note the similarities and differences between ionic, covalent and metallic bonding. In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.*

C 1. Atoms seldom exist as independent particles in nature because

- a. as single particles, most atoms have low potential energy.
- b. their electronegativity is much lower when they combine with other atoms.
- c. atoms are more stable when they combine with other atoms.
- d. neutral particles are rare.

C 2. The electrons involved in the formation of a chemical bond are called \_\_\_\_\_ electrons.

- a. ionic
- b. covalent
- c. valence
- d. inner

A 3. A chemical bond between atoms results from the attraction between the valence electrons and \_\_\_\_\_ of different atoms.

- a. nuclei
- b. isotopes
- c. inner electrons
- d. Lewis structures

A 4. When an atom completely loses its valence electrons to another atom, they form a bond that is considered to be

- a. ionic.
- b. covalent.
- c. polar-covalent.
- d. nonpolar-covalent.

B 5. Atoms that are bonded with an electronegativity difference of 0 to 0.3 are generally to be

- a. negatively charged compounds.
- b. nonpolar-covalent compounds.
- c. polar-covalent compounds.
- d. ionic compounds.

B 6. When a bond forms between two or more nonmetals the bond that is considered to be

- a. ionic.
- b. covalent.
- c. bipolar.
- d. electrostatic

C 7. A covalent bond consists of

- a. a shared electron.
- b. two different ions.
- c. a shared electron pair.
- d. an octet of electrons

C 8. A covalent bond in which there is an unequal attraction for the shared electrons is

- a. nonpolar.
- b. ionic.
- c. polar.
- d. dipolar.

A 9. The greater the electronegativity difference between two bonded atoms, the greater the bond's percentage of

- a. ionic character.
- b. metallic character.
- c. nonpolar character.
- d. electron sharing.

A 10. A chemical bond that results from the electrostatic attraction between positive and negative ions is called a(n)

- a. ionic.
- b. covalent.
- c. polar-covalent.
- d. nonpolar-covalent.

C 11. The compound HCl is a(n) \_\_\_\_\_ compound.

- a. ionic
- b. metallic
- c. polar covalent
- d. nonpolar covalent

D 12. The compound  $H_2$  is a(n) \_\_\_\_\_ compound.  
a. ionic                      b. metallic                      c. polar covalent                      d. nonpolar covalent

C 13. The salts  $NaCl(s)$  and  $CaCl_2(s)$   
a. are good conductors of electricity.                      c. are held together by ionic bonds.  
b. are positively charged.                      d. Both (a) and (b)

A 14. Compared with solid ionic compounds, solid molecular compounds generally  
a. have lower melting points.                      c. are harder.  
b. are more brittle.                      d. conduct electricity as liquids.

D 15. Because strong attractive forces hold the layers in an ionic crystal in relatively fixed positions, ionic compounds  
a. are hard.                      c. are not electrical conductors as solids.  
b. are brittle.                      d. All of the above

A 16. Some ionic compounds do not dissolve in water because  
a. the attractions between the water molecules and the ions are not as strong as the attractions between the ions.  
b. they are less dense than water and float on the surface.  
c. water is a covalent compound and covalent compounds cannot dissolve ionic compounds.  
d. water molecules cannot fit in the spaces between the ions in the crystal lattice.

A 17. The compound  $NaCl$  is a(n) \_\_\_\_\_ compound.  
a. ionic                      b. metallic                      c. polar covalent                      d. nonpolar covalent

D 18. Chemical bonding in metals is  
a. the same as ionic bonding.                      c. a combination of ionic and covalent bonding.  
b. the same as covalent bonding.                      d. different from ionic or covalent bonding.

B 19. Choose the pair of elements that will have the least ionic character  
a. Na and Cl                      b. O and Cl                      c. H and O                      d. Na and O

A 20. Metals are malleable because when struck, one plane of metal atoms  
a. can slide past another plane without breaking bonds.  
b. cannot easily move out of the way.  
c. moves in a way that maximizes the repulsive forces within the metal.  
d. bonds to the plane directly beneath it.

C 21. Which of these is responsible for the good electrical conductivity of metals?  
a. the arrangement of metal atoms in separate layers  
b. the high density of metals atoms in the crystal lattice  
c. the ability of electrons to move freely about the crystal structure  
d. the fact that metal atoms contain many orbitals separated by very small energy

B 22. The arrangement of valence electrons in a metallic bond is best described as  
a. fixed positions in a lattice.                      c. concentrated electron density around specific atoms.  
b. a sea of free-moving electrons.                      d. electron pairs existing in multiple bonds.

B 23. What type of energy best represents the strength of an ionic bond?  
a. thermal energy.                      c. ionization energy.  
b. lattice energy.                      d. radiant energy.

D 24. In a crystal of an ionic compound, each cation is surrounded by a number of  
a. molecules. c. dipoles.  
b. positive ions. d. negative ions.

B 25. The lattice energy of compound A is greater than that of compound B. What can be concluded from this fact?  
a. Compound A is not an ionic compound.  
b. It will be more difficult to break the bonds in compound A than those in compound B.  
c. Compound B has larger crystals than compound A.  
d. Compound A has larger crystals than compound B.

B 26. The forces of attraction between molecules in a molecular compound are generally  
a. stronger than the attractive forces among formula units in ionic bonding.  
b. weaker than the attractive forces among formula units in ionic bonding.  
c. approximately equal to the attractive forces among formula units in ionic bonding.  
d. equal to zero.

B 27. In metals, the valence electrons are considered to be  
a. attached to particular positive ions. c. immobile.  
b. shared by all surrounding atoms. d. involved in covalent bonds.

D 28. Mobile electrons in the metallic bond are responsible for  
a. luster. c. electrical conductivity.  
b. thermal conductivity. d. All of the above.

C 29. If electrons involved in bonding spend most of the time closer to one atom rather than the other, the bond is  
a. ionic. b. dipolar. c. polar-covalent. d. nonpolar-covalent.

A 30. What property of the two atoms in a covalent bond determines whether or not the bond will be polar?  
a. electronegativity b. electron affinity c. polarization d. ionization

**Table 13.2 Electronegativity Values for Atoms of Selected Elements**

H						
2.1						
Li	Be	B	C	N	O	F
1.0	1.5	2.0	2.5	3.0	3.5	4.0
Na	Mg	Al	Si	P	S	Cl
0.9	1.2	1.5	1.8	2.1	2.5	3.0
K	Ca	Ga	Ge	As	Se	Br
0.8	1.0	1.6	1.8	2.0	2.4	2.8

Directions: Answer the following questions in the space provided.

31. How does the behavior of electrons in metals contribute to the metal's ability to conduct electricity and heat?

2 The electrons are "free-flowing" so they easily transfer heat and electricity.

32. How can electronegativity be used to distinguish between an ionic bond and a covalent bond?

2 big differences in E.N. means ionic  
Small differences in E.N. means covalent

33. Describe how the electrons are distributed in a polar covalent bond.

2 Shared unequally  
electrons hang out more by the more E.N. atom.

34. Compare how ions are held together in an ionic bond to how atoms are held together in a covalent bond.

2 ions are held together strongly by opposite charges  
atoms are held together by sharing electrons in a covalent bond weaker.

35. Complete the following table.

	Metals	Ionic Compounds	Covalent Compounds
Composed of	2 or more metals	metal + nonmetal	mostly nonmetals
Overall charge	no charge	no charge	no charge
Conductive	yes	in liquid state	no
Melting point	high	very high	low
Hardness	yes - varies	<del>no</del> yes	no
Malleable	yes	no	no
Ductile	yes	no	no