

Covalent Bonds

1. Compare and contrast an ionic versus covalent bond. You may use columns and bullet points or complete sentences.

IONIC

Forms between a metal and a nonmetal

Forms ions

Metal has *complete e^- transfer* to nonmetal

Held together by electrostatic attraction

Bond length of each atomic radius added

COVALENT

Forms between all nonmetals

No ion formation

Electrons are *shared*

Bond length shorter since orbital overlap

Goal is the same! 8 electrons

2. What is a metallic bond?

A metallic bond is a bond between pure metals resulting from the electrostatic attraction between metal cations and delocalized electrons that are free to roam and form a “sea of electrons”.

3. Identify the following as ionic (I), covalent (C), or metallic (M) bonds.

a. Br_2 C

g. SO_3 C

b. MgCl_2 I

h. H_2SO_4 C

c. HCl C

i. Br_2 C

d. Na (s) M

j. Cu (s) M

e. Ca_3N_2 I

k. CO_2 C

f. KBr I

l. MgCl_2 I

4. Describe the attractive forces and repulsive forces that exist between two atoms forming a covalent bond as their orbitals overlap.

The positive nucleus of each atom is attracted to the electrons of the incoming atom. At the same time, the two positive nuclei repel each other as do the electron clouds. Thus, there is an optimum bond length for each covalent bond where energy is minimized by balancing attractive and repulsive forces.

5. Explain the energy change when a bond is formed versus when a bond is broken.

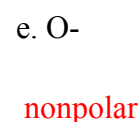
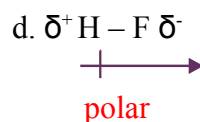
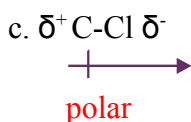
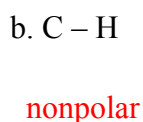
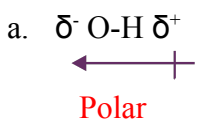
Energy is required to break bonds. Energy is released when bonds are formed. If a reaction is endothermic, it takes more energy to break the bonds of the reactants than is released when the bonds of the products are formed.

6. What is a polar bond? A nonpolar bond?

A polar bond is formed when the electrons shared between two different atoms is shared unequally. This occurs because one atom is more electronegative than the other and the atoms play “tug-o-war” for the bonded electrons. The more EN atom wins. If the atoms are the same

(with a few exceptions of different atoms with close EN), the electrons are shared equally and form a nonpolar bond.

7. Label each of the following as polar bond or nonpolar bond. If it is polar, draw delta notation and an electronegativity arrow.



8. What types of covalent bonds are there and how many electrons are involved with each type of bond?

Covalent bonds can be a single bond (2 e⁻), a double bond (4 e⁻), or a triple bond (6 e⁻).

9. Which type of covalent bond is the strongest? Which type is the shortest? Which has the most range of motion? Explain.

Single bonds are the longest and weakest bonds with the most range of motion. Atoms can rotate at the end of the bond, move rotationally and translationally. Double bonds are shorter and stronger with less motion. Triple bonds are the strongest and shortest of all bonds with little to no range of motion.