

ChemQuest 26

Electronegativity

Name: _____

Date: _____

Hour: _____

Information: Definition of Electronegativity

Electronegativity is a measure of how much an atom attracts an electron. The higher the electronegativity, the greater the atom's attraction for electrons. Atoms that become negative ions have a much greater electronegativity than atoms that become positive ions. Below is a table of the electronegativities of many elements from the periodic table.

1 H 2.20						2 He —	
3 Li 0.97	4 Be 1.47	5 B 2.01	6 C 2.50	7 N 3.07	8 O 3.50	9 F 4.10	10 Ne —
11 Na 1.01	12 Mg 1.23	13 Al 1.47	14 Si 1.74	15 P 2.06	16 S 2.44	17 Cl 2.83	18 Ar —
19 K 0.91	20 Ca 1.04	31 Ga 1.82	32 Ge 2.02	33 As 2.20	34 Se 2.48	35 Br 2.74	36 Kr —

Critical Thinking Questions

1. Why do you think there are no values for the noble gases?
2. In terms of electrons, what is the difference between a covalent bond and an ionic bond?
3. What type of bond (covalent or ionic) would you expect to form between an atom with a high electronegativity and an atom of low electronegativity. Explain and give an example.
4. What type of bond (covalent or ionic) would you expect to form between two atoms of somewhat high electronegativity? Explain and give an example.
5. Consider the ionic compound, sodium chloride (NaCl). Which atom has a greater attraction for electrons—sodium or chlorine? Which atom forms the negative ion?

6. In an ionic bond, the atom with the highest electronegativity will always form a _____ ion.
(positive or negative)
7. Consider the covalent compound, carbon monoxide (CO).
- Draw the Lewis dot structure for carbon monoxide.
 - In the Lewis structure you drew, you should see that there is a triple bond between carbon and oxygen. The carbon and oxygen share 6 electrons. All 6 electrons are not shared equally, however, because carbon and oxygen don't have equal attraction for electrons. The 6 electrons spend a little more time near one of the atoms—predict which one and explain.
8. Why are the electrons in a nitrogen-phosphorus covalent bond NOT shared equally? Which atom do the electrons spend more time around? Explain.
9. True or false: In an ionic bond, the difference in electronegativities between the two bonding atoms is greater than the difference in a covalent bond.
10. In terms of electronegativity, explain why this statement is true: “Carbon monoxide is more ‘ionic’ than carbon monosulfide”.
11. Which bond is more like an ionic bond—a nitrogen-oxygen bond or a carbon-oxygen bond? Explain.
12. Which compound is more like an ionic compound— NH_3 or PH_3 ? Explain.

Information: “Polar” Bonds

In critical thinking questions 10, 11, and 12 we used the term “ionic” when describing covalent bonds. This can get confusing and so instead of the term “ionic” we will use the term “**polar**”. A **polar covalent bond** then is a covalent bond in which the electrons are not shared equally by the two atoms involved in the bond. For example, in carbon monoxide the electrons spend more time near oxygen than carbon because oxygen has a greater electronegativity. Because of oxygen's greater electronegativity, it attracts the electrons more than carbon.

Critical Thinking Questions

13. Which bond is more polar—a phosphorus-chlorine bond or a phosphorus-fluorine bond? Explain why.
14. Consider a carbon-fluorine bond. One atom in the bond is “partially negative” and the other atom is “partially positive”. Which atom is which? Explain how you know.
15. In your own words explain what you think the term “partially negative” means and explain why an atom might be partially negative when it bonds covalently. (I.e. What makes it partially negative?)
16. In your own words explain what you think the term “partially positive” means and explain why an atom might be partially positive when it bonds covalently. (What makes it partially positive?)

Information: Polar vs. Nonpolar

Not all covalent compounds are categorized as polar. For example, a carbon-hydrogen bond is made up of two atoms that have very similar electronegativities. Because of this, carbon and hydrogen share the electrons just about equally and we say that a carbon-hydrogen bond is “nonpolar”. As a general measure, if the difference in electronegativity between two bonding atoms is less than about 0.5, then the bond is nonpolar.

Critical Thinking Questions

17. For the following bonds, indicate whether they are ionic (I), polar covalent (P), or nonpolar covalent (NP).
- _____ a) C—P _____ b) S—O _____ c) Fe—O _____ d) N—H
18. What are the three most electronegative atoms on the periodic table?