Periodic Trends in Electronegativity

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CONCEPT 1

Periodic Trends in Electronegativity

Lesson Objectives

The student will:

- define electronegativity.
- describe the trends that exist in the periodic table for electronegativity.
- use the general trends to predict the relative electronegativities of atoms.

Vocabulary

electronegativity
the ability of an atom in a molecule to attract shared electrons

Introduction

Around 1935, the American chemist Linus Pauling developed a scale to describe the attraction an element has for electrons in a chemical bond. In this lesson, we will gain an understanding of this concept and recognize its trend on the periodic table.

Electronegativity Defined

In a molecule, some electrons are shared between the atoms making up the molecule. The ability of an atom in a molecule to attract shared electrons is called **electronegativity**. The higher the electronegativity of an atom, the greater its ability to attract shared electrons. The electronegativity of atoms has been defined in several ways. One method that is widely accepted is that developed by Linus Pauling.

On the Pauling scale, shown below, fluorine is the most electronegative element with an electronegativity of close to 4.0, and cesium and francium are the least electronegative with electronegativities of around 0.7.

Pauling Electronegativity Values

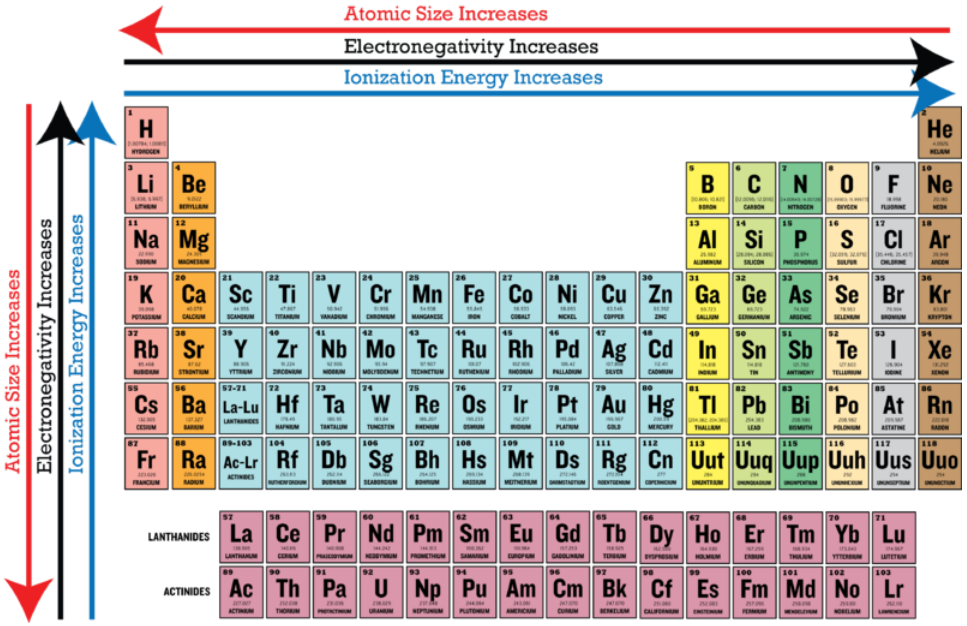
1 H 2.20																
3 Li 0.98	4 Be 1.57											5 B 2.04	6 C 2.55	7 N 3.04	8 O 3.44	9 F 3.98
11 Na 0.93	12 Mg 1.31											13 Al 1.61	14 Si 1.90	15 P 2.19	16 S 2.58	17 Cl 3.16
19 K 0.82	20 Ca 1.00	21 Sc 1.36	22 Ti 1.54	23 V 1.63	24 Cr 1.66	25 Mn 1.55	26 Fe 1.83	27 Co 1.88	28 Ni 1.91	29 Cu 1.90	30 Zn 1.65	31 Ga 1.81	32 Ge 2.01	33 As 2.18	34 Se 2.55	35 Br 2.96
37 Rb 0.82	38 Sr 0.95	39 Y 1.22	40 Zr 1.33	41 Nb 1.6	42 Mo 2.16	43 Tc 1.9	44 Ru 2.2	45 Rh 2.28	46 Pd 2.20	47 Ag 1.93	48 Cd 1.69	49 In 1.78	50 Sn 1.96	51 Sb 2.05	52 Te 2.1	53 I 2.66
55 Cs 0.79	56 Ba 0.89	57 La 1.1	72 Hf 1.3	73 Ta 1.5	74 W 2.36	75 Re 1.9	76 Os 2.2	77 Ir 2.20	78 Pt 2.28	79 Au 2.54	80 Hg 2.00	81 Ti 1.62	82 Pb 2.33	83 Bi 2.02	84 Po 2.0	85 At 2.2
87 Fr 0.7	88 Ra 0.9															

Group and Period Trends in Electronegativity

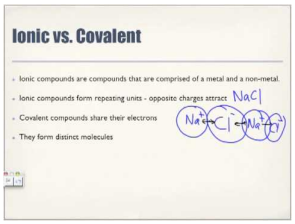
The electronegativity of atoms increases as you move from left to right across a period in the periodic table. This is because as you go from left to right across a period, the nuclear charge is increasing faster than the electron shielding, so the attraction that the atoms have for the valence electrons increases.

The electronegativity of atoms decreases as you move from top to bottom down a group in the periodic table. This is because as you go from top to bottom down a group, the atoms of each element have an increasing number of energy levels. The electrons in a bond are thus farther away from the nucleus and are held less tightly.

Atoms with low ionization energies have low electronegativities because their nuclei do not have a strong attraction for electrons. Atoms with high ionization energies have high electronegativities because the nucleus has a strong attraction for electrons.



Here is another video that describes ionization energy trends in the periodic table **(1c)**: http://www.youtube.com/watch?v=q3AiM1BYX-c (9:39).



MEDIA

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Lesson Summary

- American chemist Linus Pauling developed the electronegativity scale to describe the attraction an element has for electrons in a chemical bond.
- The higher the electronegativity of an atom, the greater its ability to attract shared electrons.
- The electronegativity of atoms increases as you move from left to right across a period in the periodic table.
- The electronegativity of atoms decreases as you move from top to bottom down a group in the periodic table.

Further Reading / Supplemental Links

A series of selectable videos that show the properties and discuss the bonding of various elements.

- http://www.periodicvideos.com/#

Review Questions

1. Define electronegativity.
2. Choose the element in each pair that has the lower electronegativity.
    a. Li or N
    b. Cl or Na
    c. Ca or K
    d. Mg or F
3. Which of the following will have the largest electronegativity?
    a. Se
    b. F
    c. Ne
    d. Br
4. Which of the following will have the smallest electronegativity?
    a. Na
    b. Ne
    c. Al
    d. Rb
5. Describe the general trend for electronegativity in period 2.