HW11, 2024

1. Electronegativity is the relative ability of an atom to attract electrons when it forms a bond with another atom. In other words, it reflects an atom's ability to polarize a covalent bond.

The difference in electronegativity between two atoms helps determine the type of bond they form. Generally: electronegativity difference in Nonpolar covalent bond < 0.4, in Polar covalent bond the difference is between 0.4 and 2.0, Ionic bond > 2.0

The table below lists electronegativities for various elements. One reliable source for electronegativity values is *ptable.com*.

Examples:

The bond in an **O=O** molecule is nonpolar covalent: 3.44 – 3.44 = 0

The bond in an **H–F** molecule is polar covalent: 3.98 – 2.20 = 1.78

The bond between **K and O** in K_2O is ionic: 3.44 – 0.82 = 2.62

Electronegativity table:

Element	Electronegativity	Element	Electronegativity
Cs	0.79	H	2.20
K	0.82	C	2.55
Na	0.93	S	2.58
Li	0.98	I	2.66
Ca	1.00	Br	2.96
Mg	1.31	N	3.04
Be	1.57	Cl	3.16
Si	1.90	O	3.44
B	2.04	F	3.98
P	2.19		

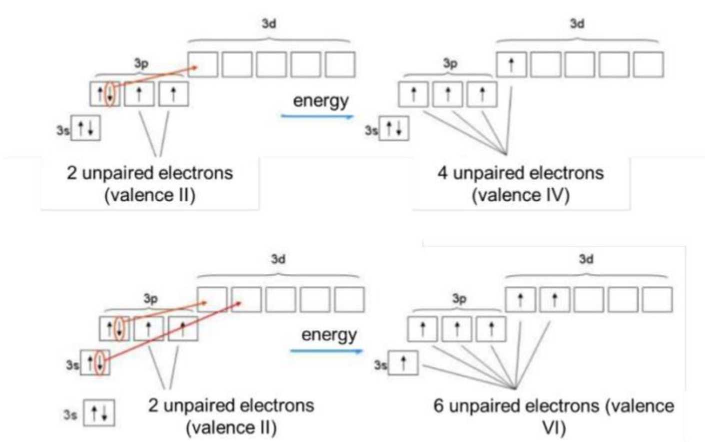
2. The valence is the number of electron pairs (bonds) that binds the atom with other atoms. For some common elements it may be useful to remember their valences. The table below gives valences of some common elements. (The numbers in parentheses show possible valences for elements that may exhibit more than a single valence.)

Valences of some common elements

Element	Valence	Element	Valence
H	I	Ba	II
Na	I	O	II
K	I	Zn	II
Ag	I	Sn	II (IV)
F	I	Pb	II (IV)
Cl	I (III, V, VII)	Fe	II, III
Br	I (III, V, VII)	Cr	III, VI
I	I (III, V, VII)	S	II, IV, VI
Hg	I, II	Al	III
Cu	I, II	N	III (IV)
Be	II	P	III, V
Mg	II	C	IV
Ca	II	Si	IV (II)

Valence can be used to determine chemical formulas. For example, to write the formula of an Fe(III) compound with oxygen (iron oxide), we can write the element symbols with their valences above them, then swap the valences and use them as subscripts for the opposite elements:

If given an additional energy an atom can get into an excited state from the ground state where the energy is at its minimum. In the excited state electrons can unpair and move to different orbitals within the same shell increasing the valency of the atom. For example, sulfur ($_{16}S$) can have valences II, IV, and VI by transferring one or two electrons to 3d orbitals:



The energy necessary to unpair electrons and increase the valence may be compensated by formation of more molecular bonds with the excited atom.

Example of the chemical formula, potassium chloride we write as KCl, and structural formula we write as K – Cl.

Questions

1. Determine the nature of the bond and put the compounds below into one of the following three groups: a) with covalent bonds; b) with polar covalent bonds; c) with ionic bonds

PH_3, CaO, Br_2, $BeCl_2$, CsBr, S_8, BF_3, H_2, Li_2O

2. Using valences of elements write down chemical formulas of a) calcium with fluorine, b) magnesium with oxygen, c) aluminum with oxygen.
3. Determine the valence of each atom in a) HCl, b) $BeCl_2$, c) $AlBr_3$, d) PH_3.
4. Predict if Se element can have one or multiple valences using its outer shell configuration.