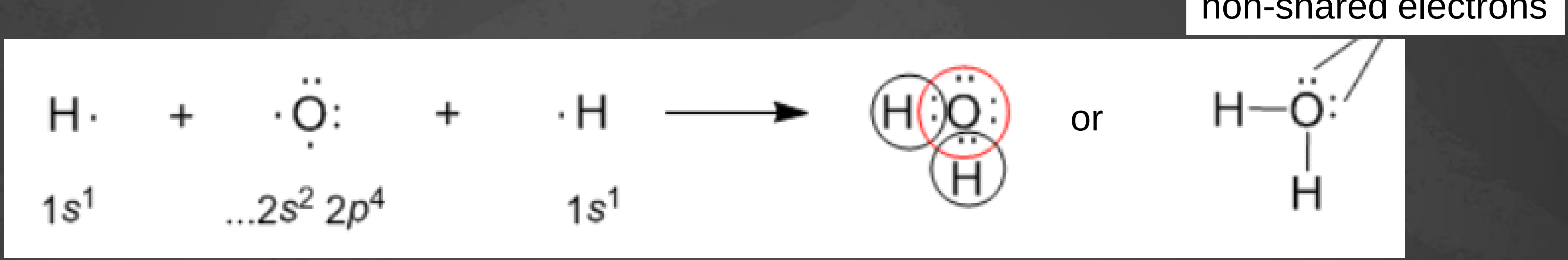
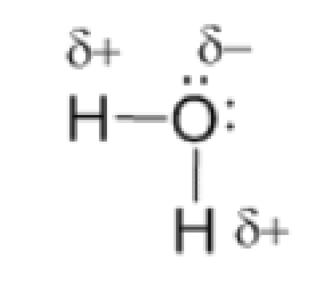
Chemistry - 101

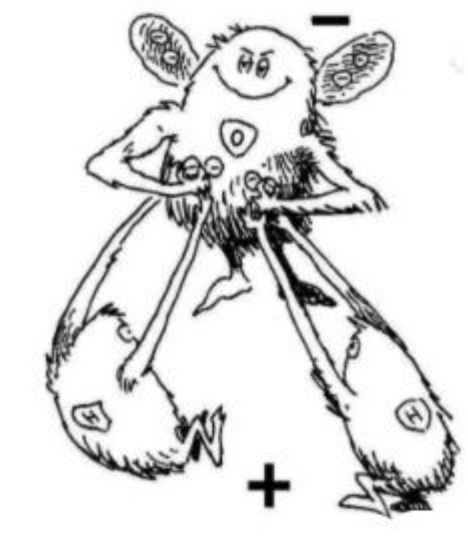
Let’s continue the journey

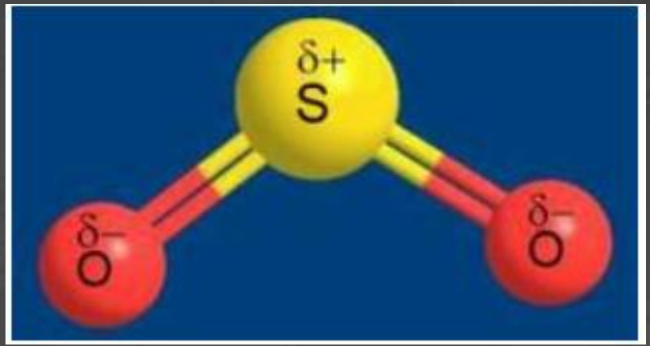
Polar covalent bond

- It is an intermediate between covalent and ionic bonds and like for ionic bond it forms between different atoms









SO_2 molecule with polar covalent bond

Electronegativity is a relative ability of atoms to attract electrons while binding to other atoms. It is an ability to polarize a covalent bond

Bond’s polarity depends on the difference in electronegativity between two atoms. Bigger differences mean more polarity, with a difference of 2 or more being considered ionic

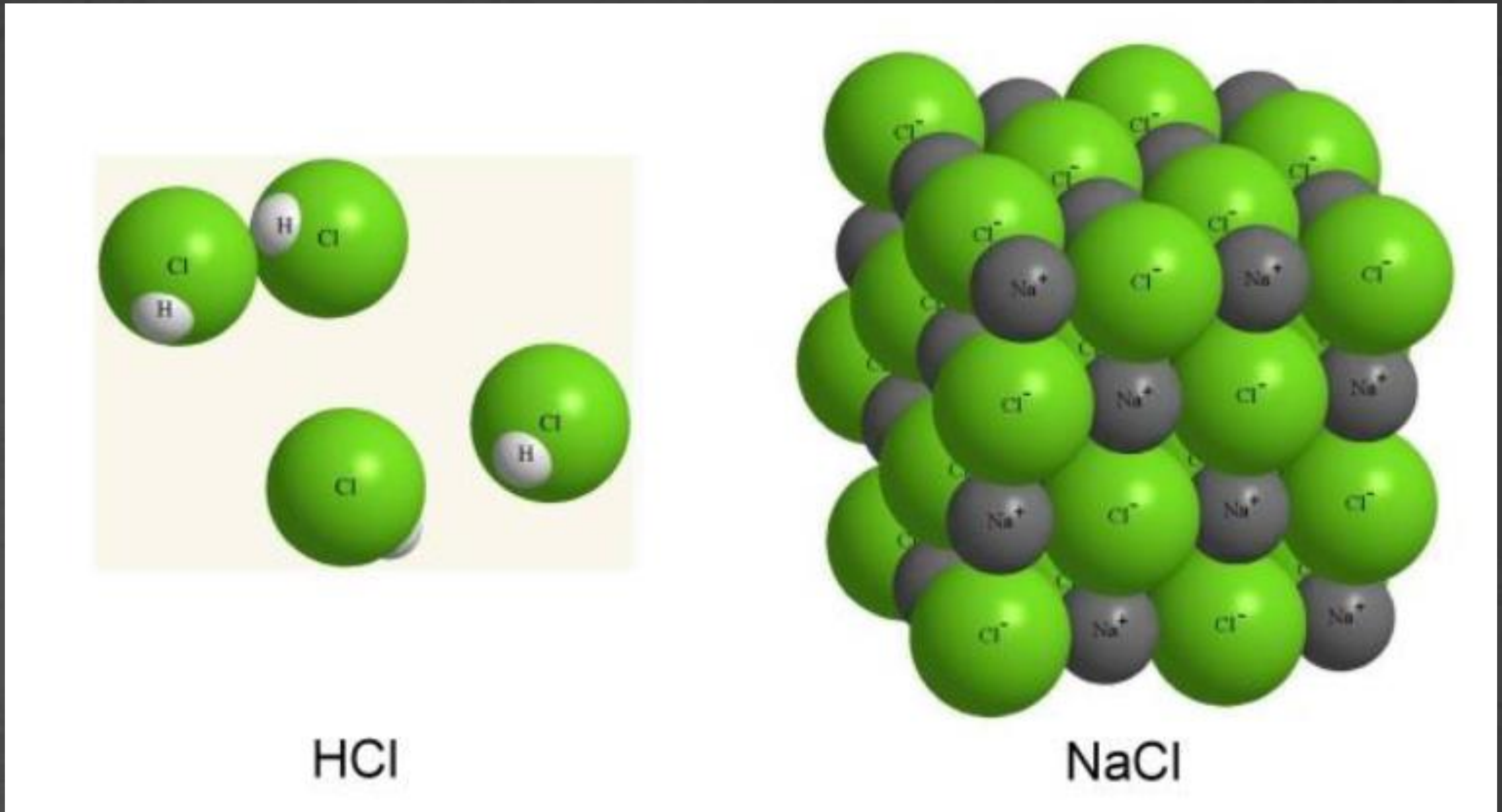
SAMPLE ELECTRONEGATIVITIES			
H	2.1	Na	0.9
Li	1.0	Mg	1.2
C	2.5	S	2.5
N	3.0	Cl	3.0
O	3.5	K	0.8
F	4.0	Ca	1.0

H : H

Cl : Cl

H :Cl

$Na^{+}Cl^{-}$



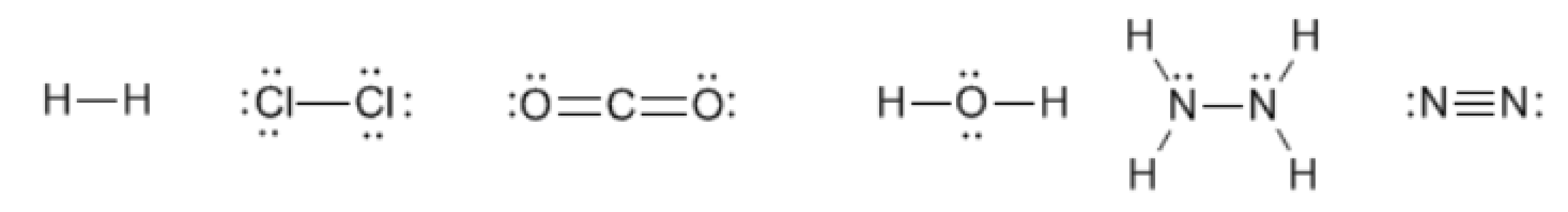
- Increased bond polarity results in different properties of the substance - hydrogen chloride (polar covalent bond) is a gas at room temperature while sodium chloride(ionic bond between the atoms) is a solid crystalline substance

Valence

The valence or valency of an element is a measure of its combining power with other atoms when it forms molecules

Or

The valence is the number of electron pairs that binds the atom with other atoms

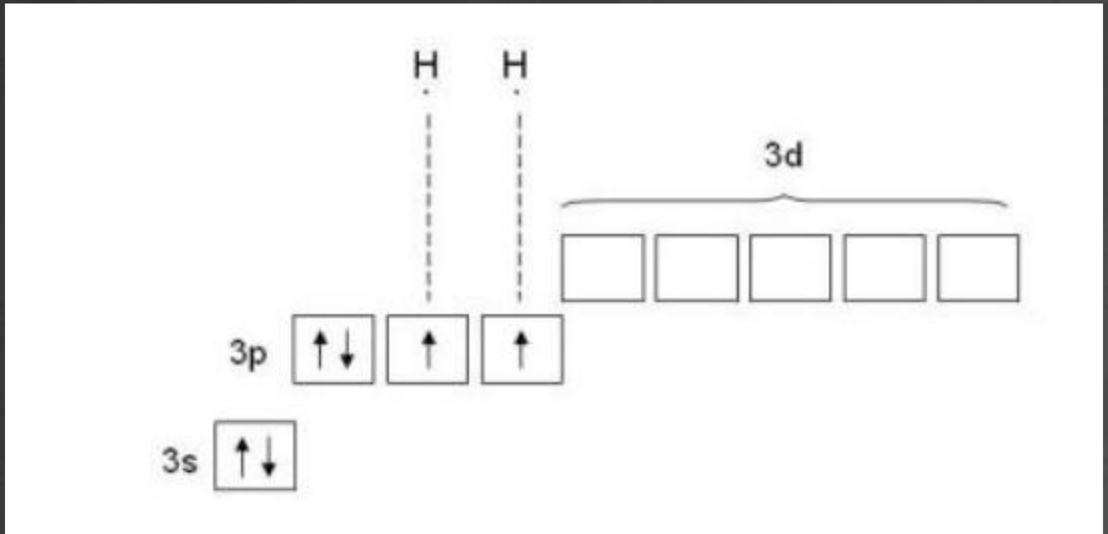


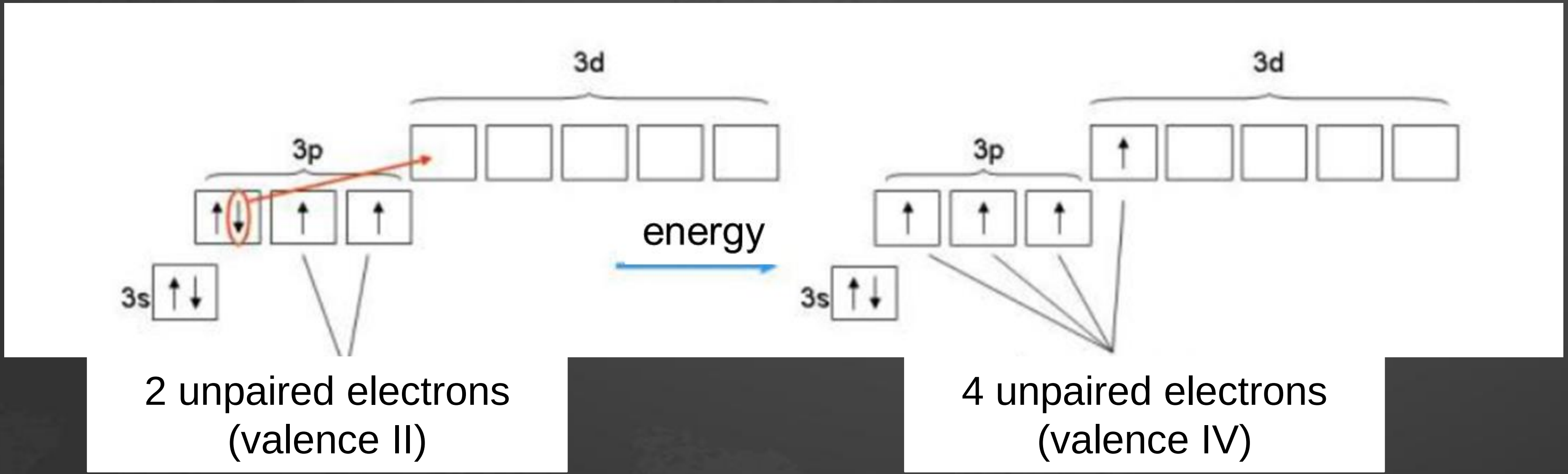
Let's consider $_{16}S$

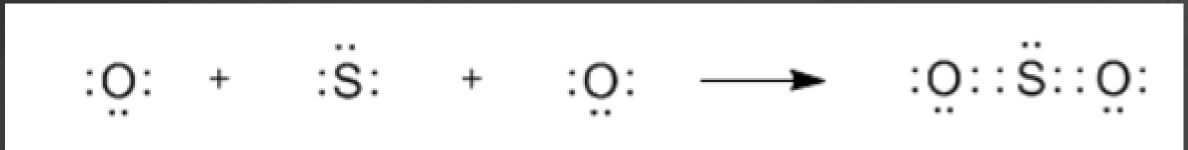
$2H + S = H_2S$

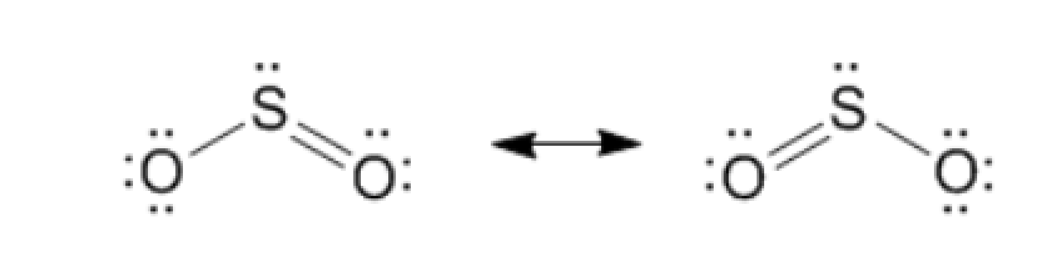
$2O + S = SO_2$

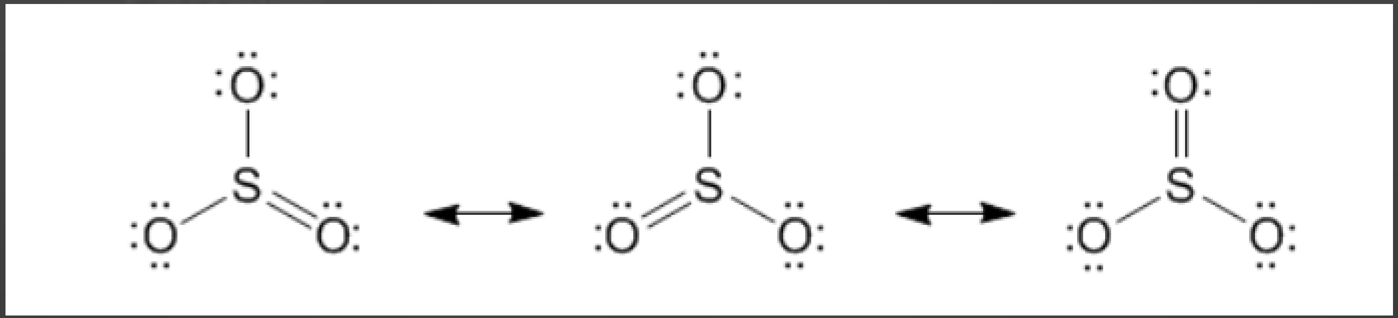
$3O + S = SO_3$



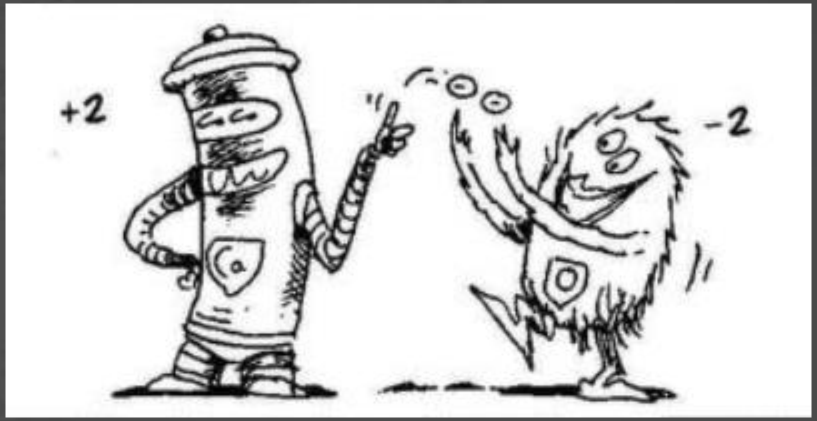








The **oxidation state**, sometimes referred to as **oxidation number**, describes the degree of oxidation (loss of electrons) of an atom in a chemical bond.



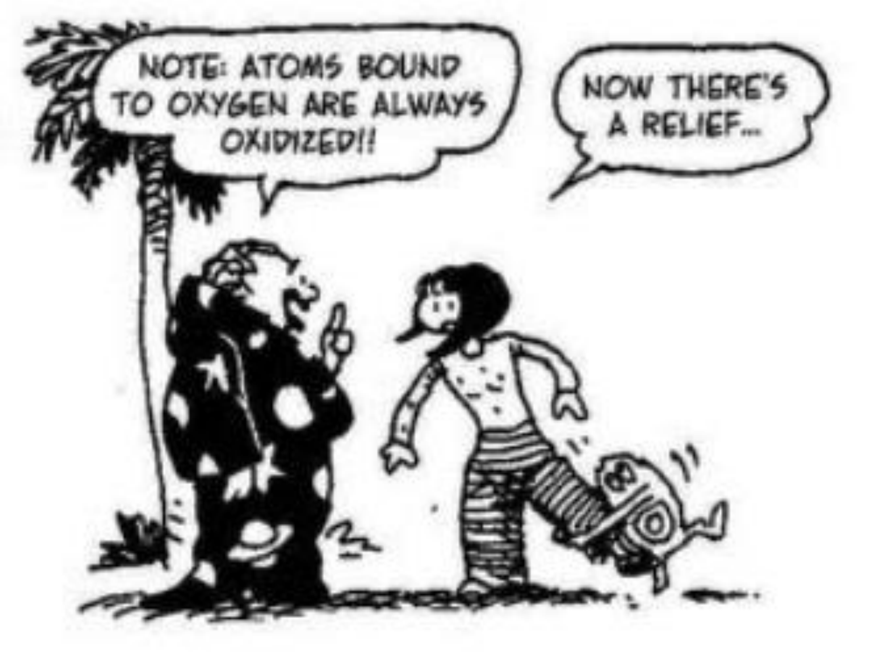
The oxidation state, which may be positive, negative or zero, is the hypothetical charge that an atom would have if all bonds to atoms of different elements were 100% ionic, with no covalent component.

This is never exactly true for real bonds.

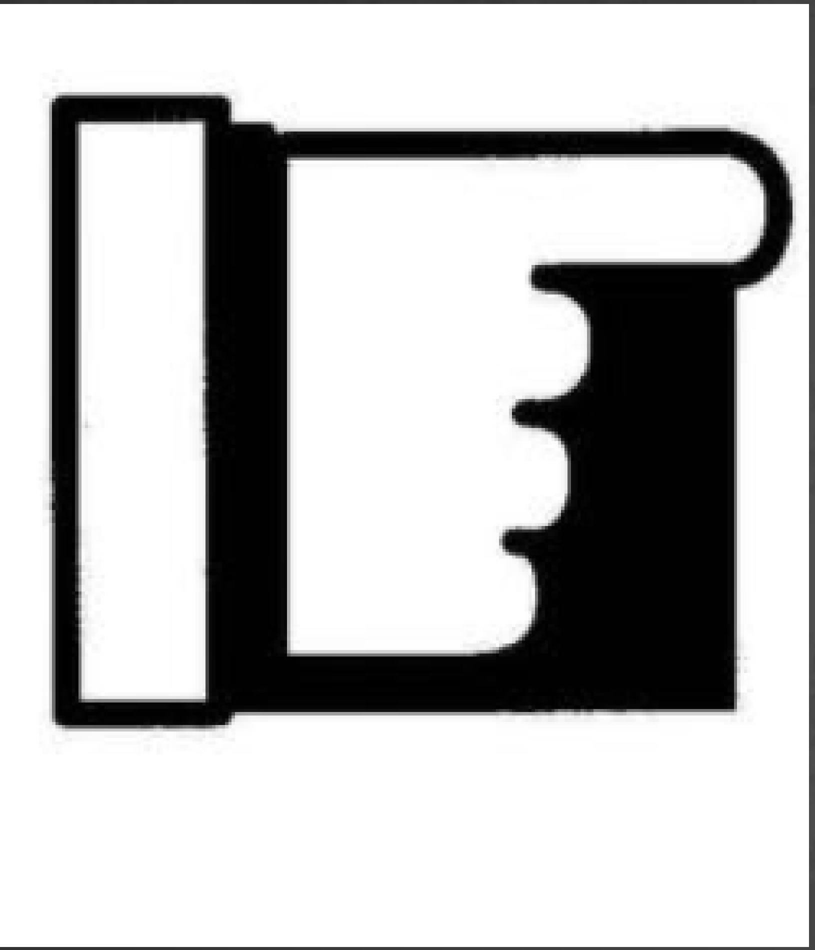
To reach the state of a noble gas, elements transfer their electrons to other elements with stronger electron accepting properties.

$1s^2\ 2s^2\ 2p^6$	Oxidation state
Ne	0
O^{2-}	-2
F^-	-1
Na^+	+1
Mg^{2+}	+2

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	Oxidation state
Ar	0
S^{2-}	-2
Cl^-	-1
K^+	+1
Ca^{2+}	+2



An atoms oxidation number depends on the other atoms around it.
For instance in HCl, chlorine acquires one electron (for an oxidation state of -1) because Cl is more electronegative (~ 3.0) than hydrogen (~2.1).
But in the perchlorate ion, ClO_4^-, chlorine has an oxidation state of +7. All its valence electrons go to oxygen, which is even more electronegative (~3.5) than chlorine.



1) The oxidation state of any free atom is 0
2) The oxidation number of any single atom ion is equal to its charge: H^{+} (+), Fe^{3+} (+3), F^{-} (-), Na^{+} (+); in a polyatomic ion, the oxidation numbers add up to the charge of the ion.
3) Some elements have the same oxidation number in almost all their compounds:

- H: +1 (except in metal hydrides like NaH, where it's -1)
- Fluorine: -1
- Oxygen: almost always -2

4) In a neutral compound, the oxidation numbers add up to zero
5) If the oxidation number of an atom increases in a chemical reaction "it was Oxidized", if it decreases "it was Reduced"

Let's consider H_2SO_3 (sulfurous acid)

Intermolecular forces (Van der Waals forces) – external to the molecule

The weakest: ***London dispersion forces (LDFs)*** – attractive forces that are created by the movement of electrons, which attract to the positive nucleus of another atom. This leads to temporary dipoles that loosely “stick” atoms together.

LDFs are temporary.

LDFs are present in both polar and non-polar molecules.

More electrons means stronger LDFs.

Dipole-Dipole Interactions are the attraction forces that occur between two polar molecules. It is the attraction between the positive end of one polar molecule and the negative end of another polar molecule. (e.g. HCl and H_2O)

The larger the dipole moment (the size of the dipole, which is the distance by which the charges are separated in a molecule) the larger the attractive force.

The strongest: ***Hydrogen bonds*** (not an actual chemical bond) – intermolecular forces between hydrogen (H) and fluorine (F), oxygen (O), or nitrogen (N).

This class uses the materials from the following books:

Larry Gonick and Graig Criddle “The cartoon guide to chemistry”

Manyuilov and Rodionov “Chemistry for children and adults”

Kuzmenko, Eremin, Popkov “Beginnings of chemistry”