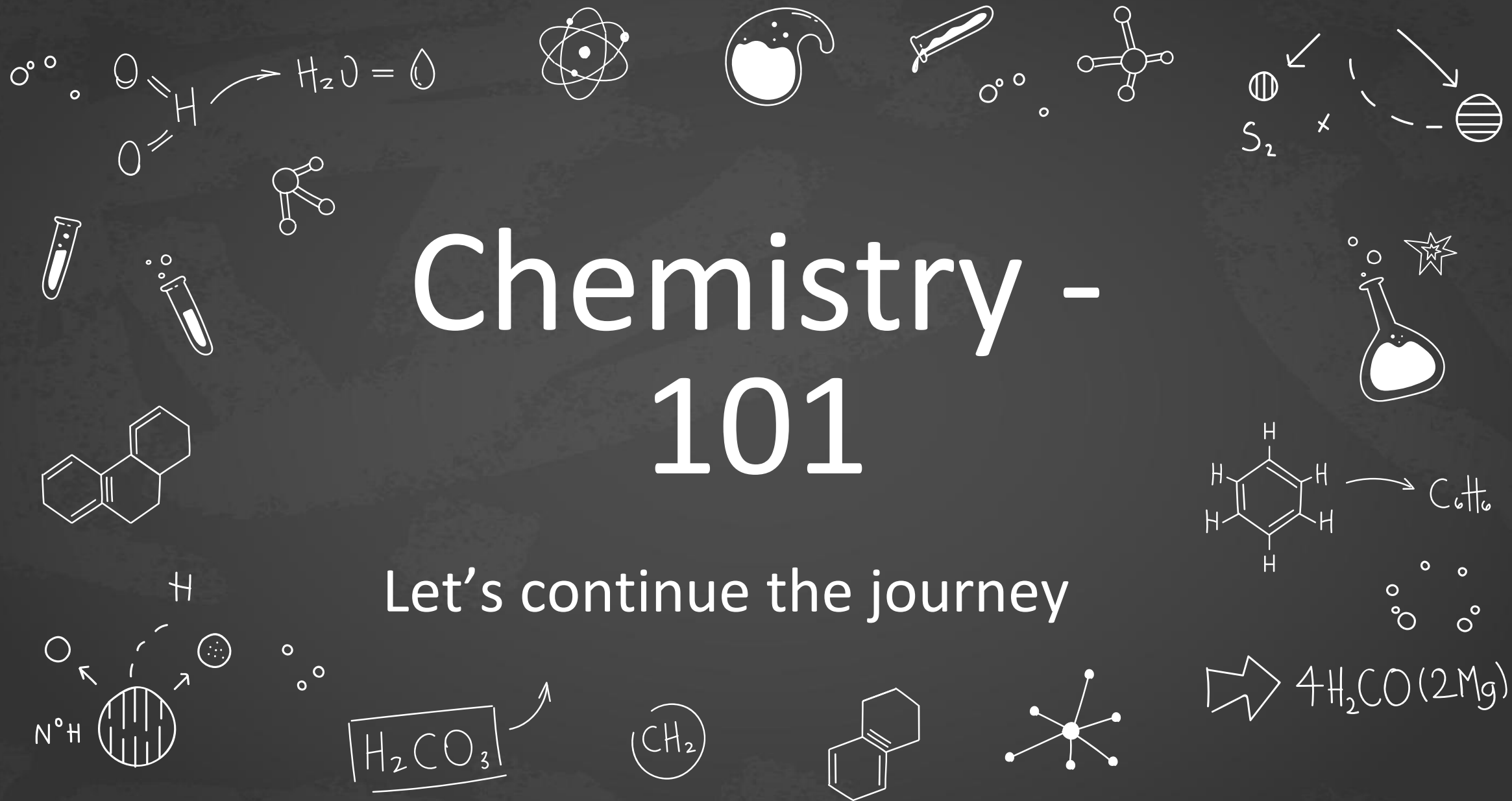


Chemistry - 101

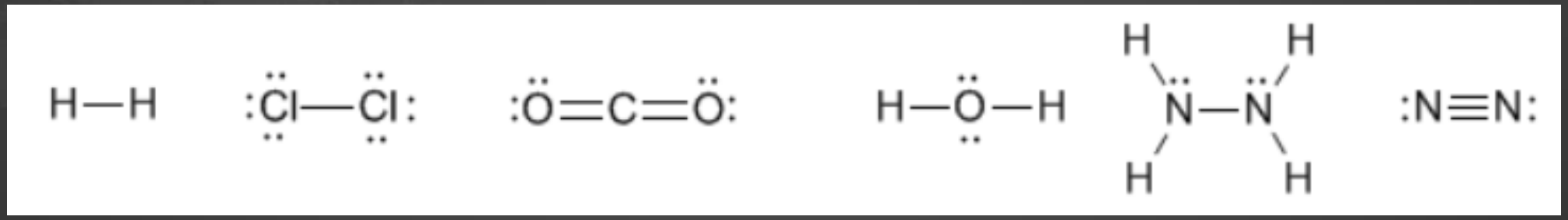
Let’s continue the journey

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



Building chemical formulas using valences

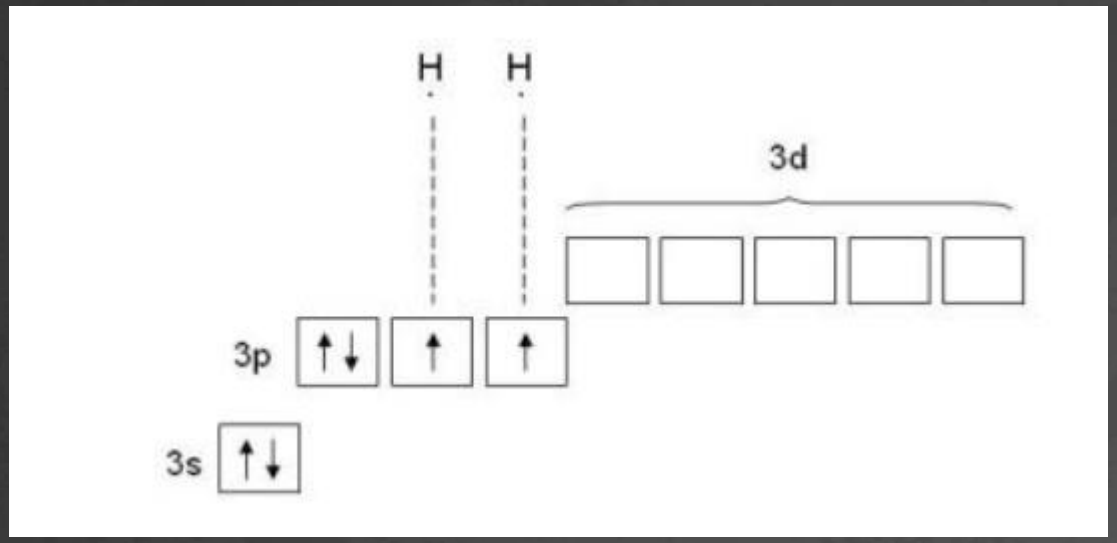
Element	Electron configuration						Valence	Compound with hydrogen
	1s	2s	2p			3s		
$_{1}H$	↑						1	H_2
$_{2}He$	↑↓						0	-
$_{3}Li$	↑↓	↑					1	LiH
$_{4}Be$	↑↓	↑↓					0 (2)	BeH_2
$_{5}B$	↑↓	↑↓	↑				1 (3)	BH_3 (B_2H_6)
$_{6}C$	↑↓	↑↓	↑	↑			2 (4)	CH_4
$_{7}N$	↑↓	↑↓	↑	↑	↑		3	NH_3
$_{8}O$	↑↓	↑↓	↑↓	↑	↑		2	H_2O
$_{9}F$	↑↓	↑↓	↑↓	↑	↑		1	HF
$_{10}Ne$	↑↓	↑↓	↑↓	↑↓	↑↓		0	-
$_{11}Na$	↑↓	↑↓	↑↓	↑↓	↑↓	↑	1	NaH

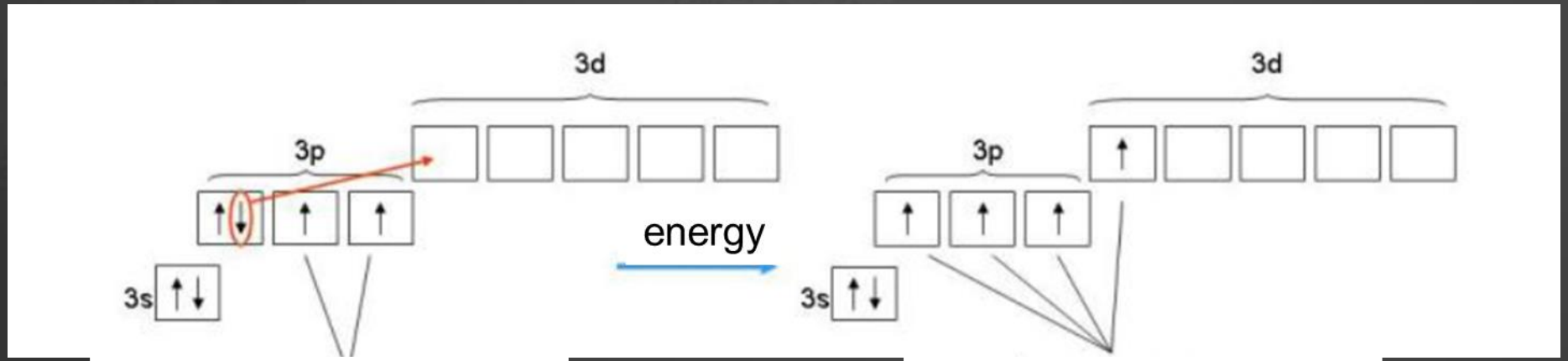
Let’s consider $_{16}S$

$2H + S = H_2S$

$2O + S = SO_2$

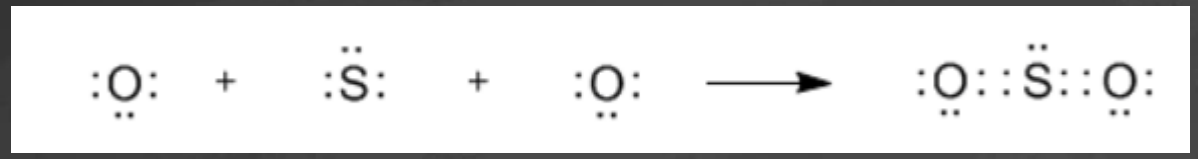
$3O + S = SO_3$

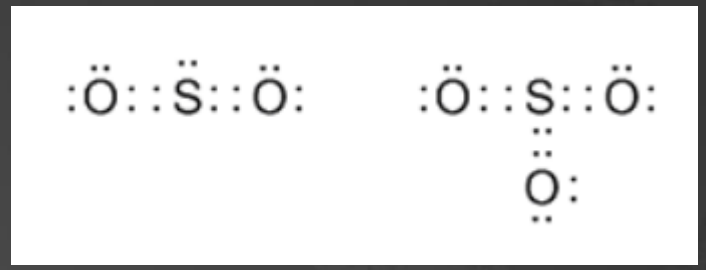


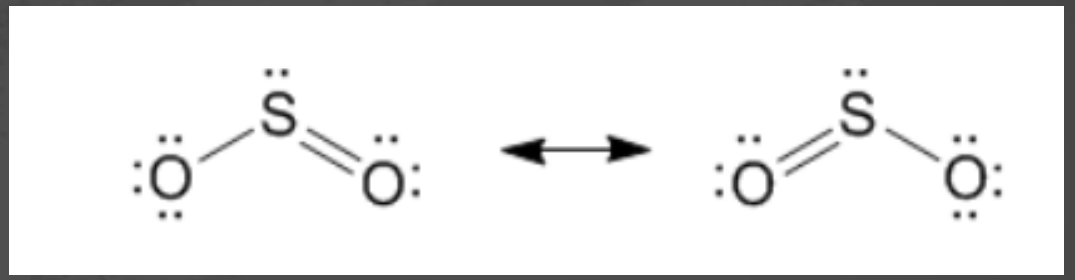


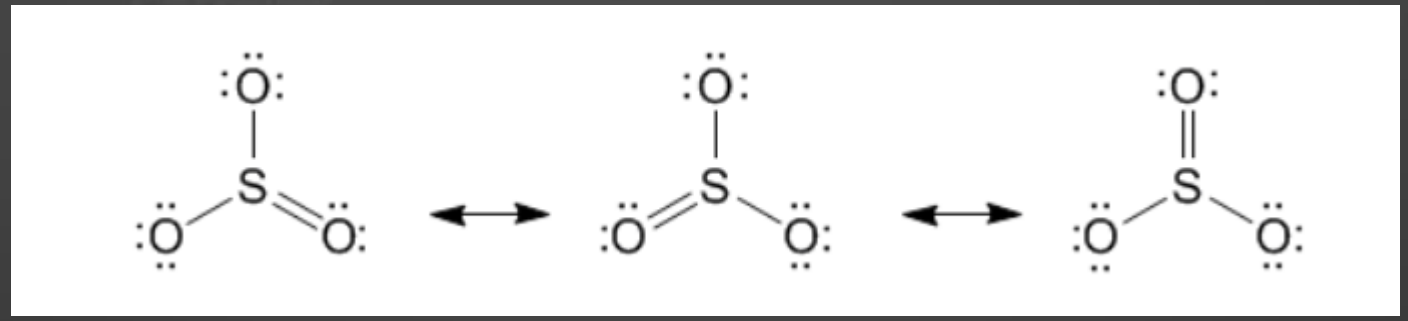
2 unpaired electrons
(valence II)

4 unpaired electrons
(valence IV)

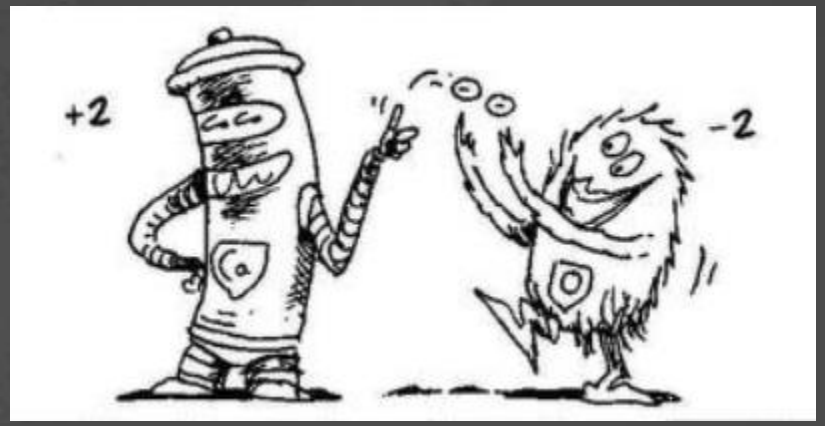








The **oxidation state**, sometimes referred to as **oxidation number**, describes the degree of oxidation (loss of electrons) of an atom in a chemical bond.



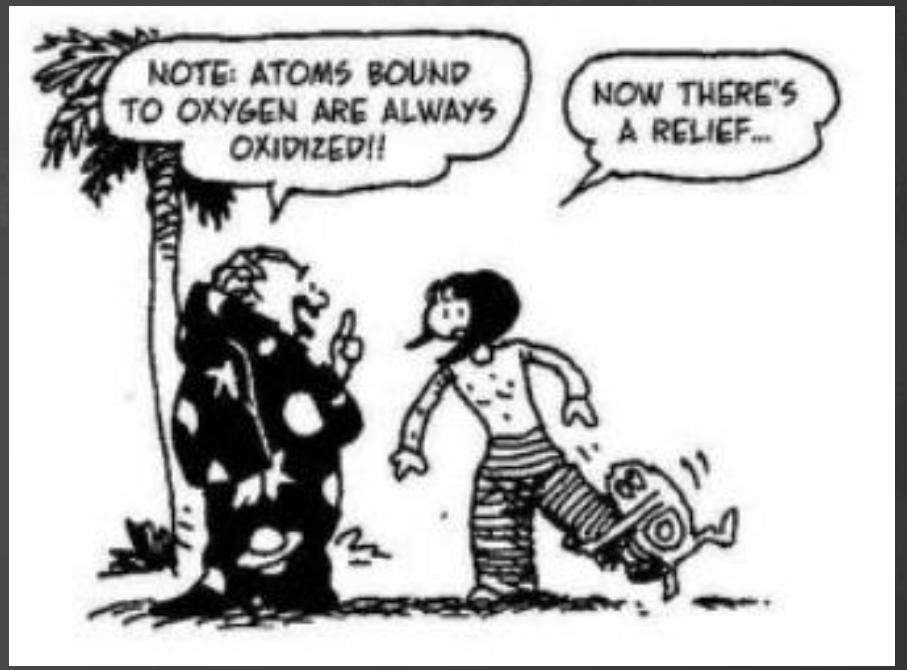
The oxidation state, which may be positive, negative or zero, is the hypothetical charge that an atom would have if all bonds to atoms of different elements were 100% ionic, with no covalent component.

This is never exactly true for real bonds.

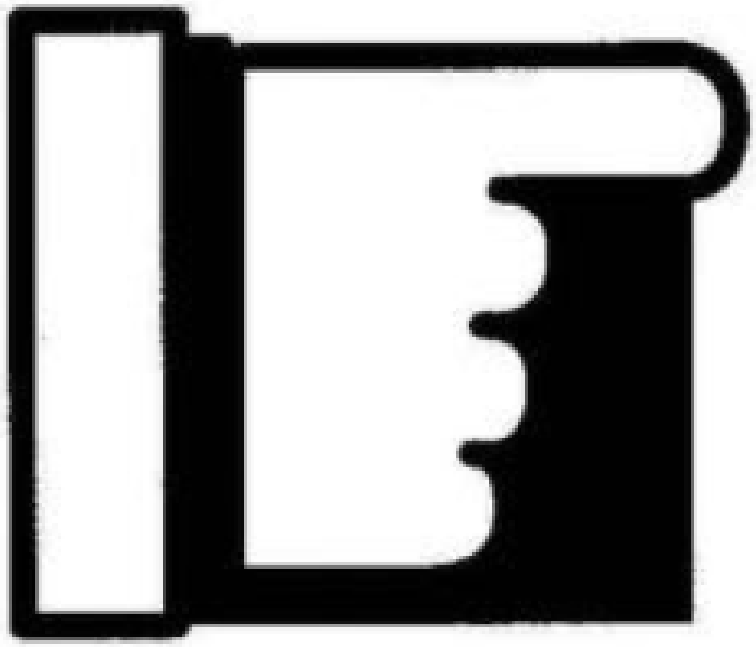
To reach the state of a noble gas, elements transfer their electrons to other elements with stronger electron accepting properties.

$1s^2\ 2s^2\ 2p^6$	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)

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”