Chapter 2: Atoms, molecules and ions

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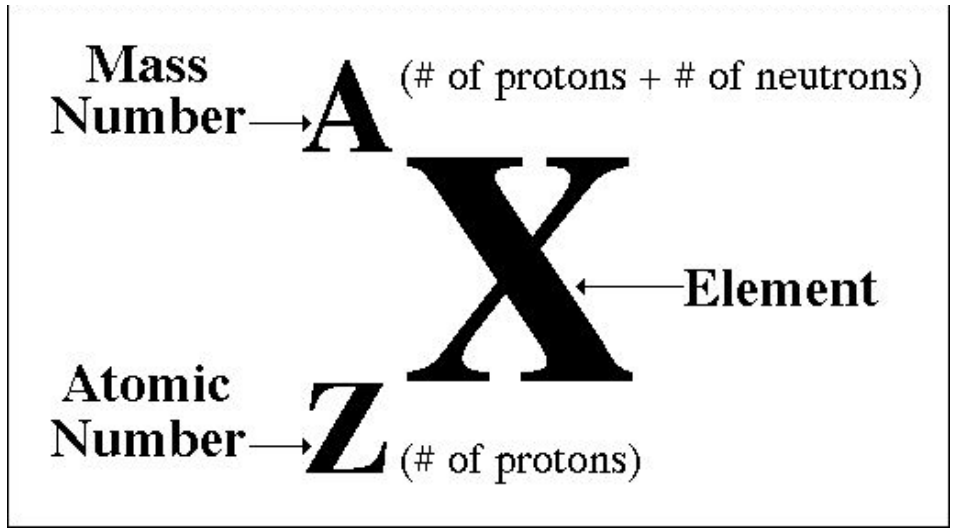
Atomic number and Mass number



$^{59}_{27}Co$

Atomic number 27

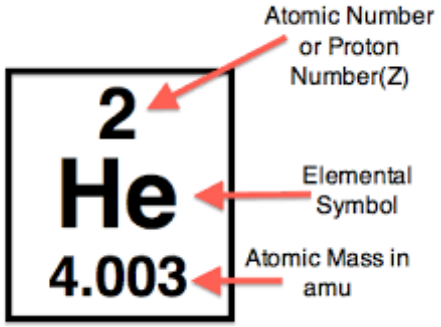
Mass number 59

Number of P 27

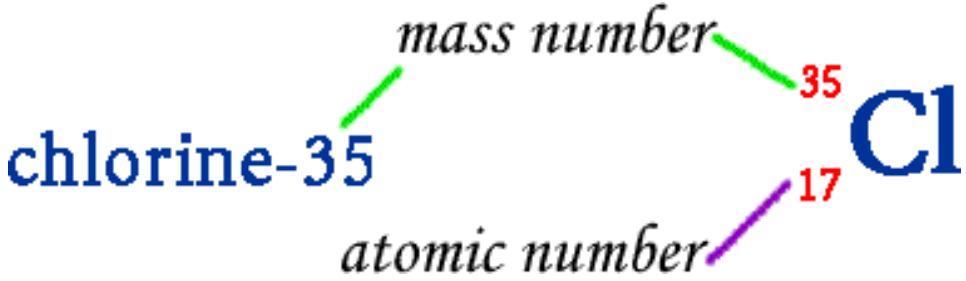
Number of e 27

Number of n (59 -27)=32

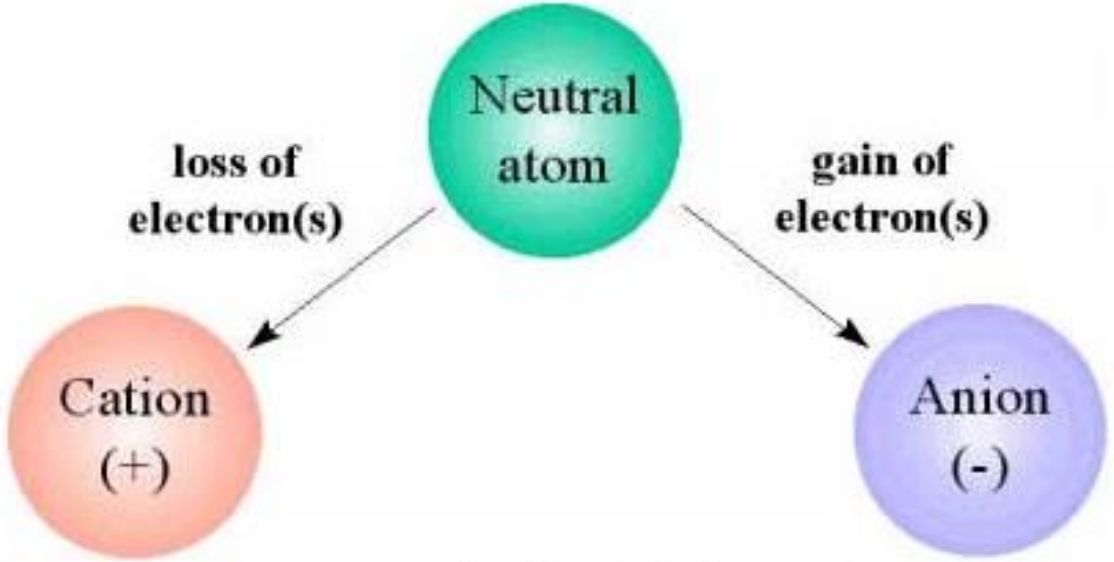
Atomic number can also be found in the periodic table



Mass number can also be found in the name of isotope



number of e = number of p



number of e < number of p
number of e = number of p - charges

number of e > number of p
number of e = number of p + charges

How many proton, neutron and electron are there in

	#proton	#neutron	#electron	Type of species
$^{56}_{26}Fe$	26	56-26=30	26	atom
$^{56}_{26}Fe^{+3}$	26	56-26=30	26-3=23	cation
$^{32}_{16}S$	16	32-16=16	16	atom
$^{32}_{16}S^{-2}$	16	32-16=16	16+2=18	anion

What is the name of an isotope with 19 protons and 17 neutrons?

Element? **Potassium**

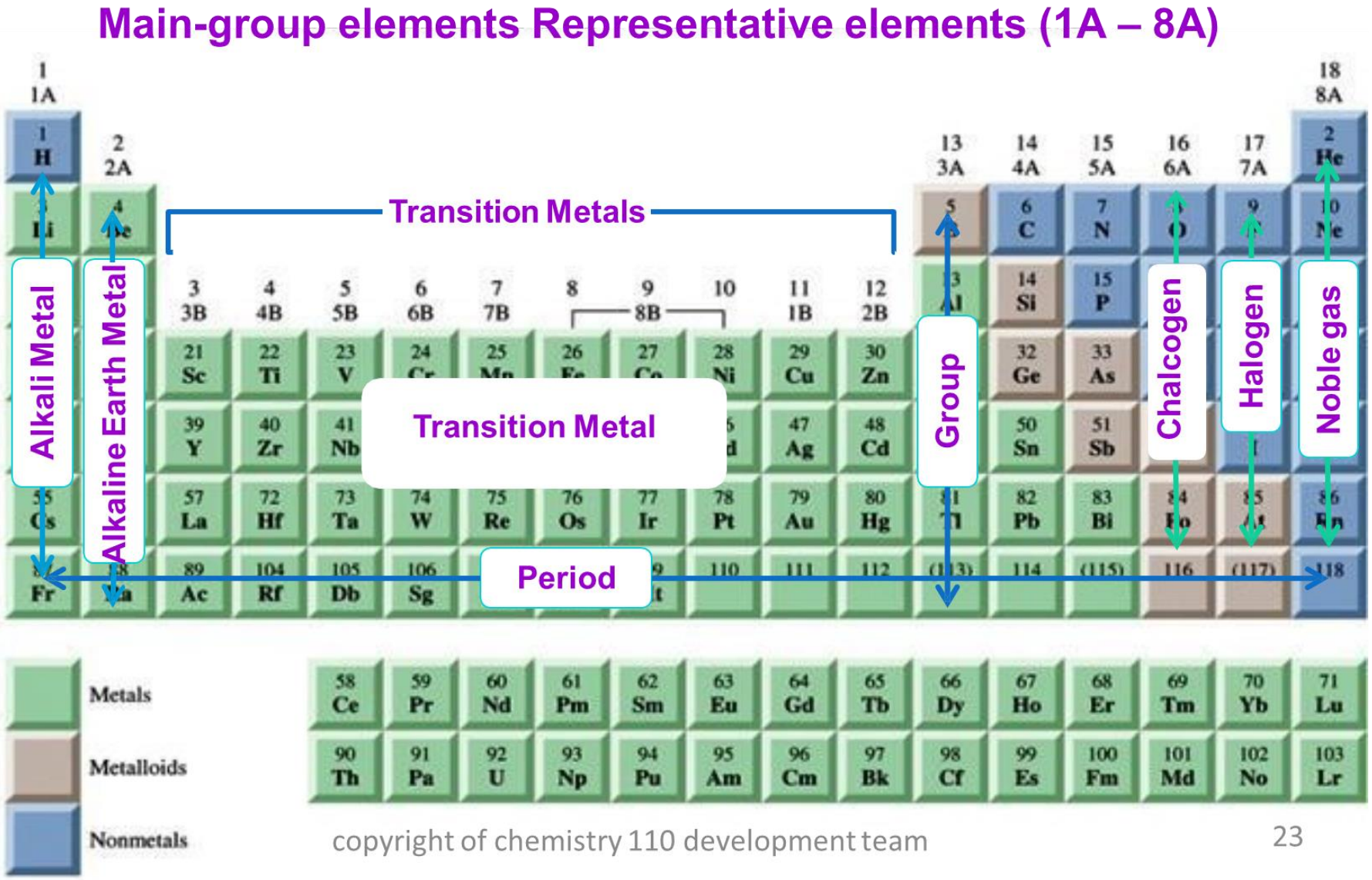
Mass Number? **19 + 17 = 36**

Potassium-36

An atom of the isotope sodium-24 consists of how many protons, neutrons, and electrons? (p = proton, n = neutron, e = electron)

Number of protons = atomic No. (Z)= 11
Number of electrons = Number of protons = 11
Number of neutrons = mass No. (A)- atomic No. (Z) = 24- 11 = 13

Periodic Table



What is the symbol of the element in Group 4A(14) and Period 2?

C

Si

Ge

Sn

Which element is in group 3 and period 2 ?

B

Al

Ca

Y

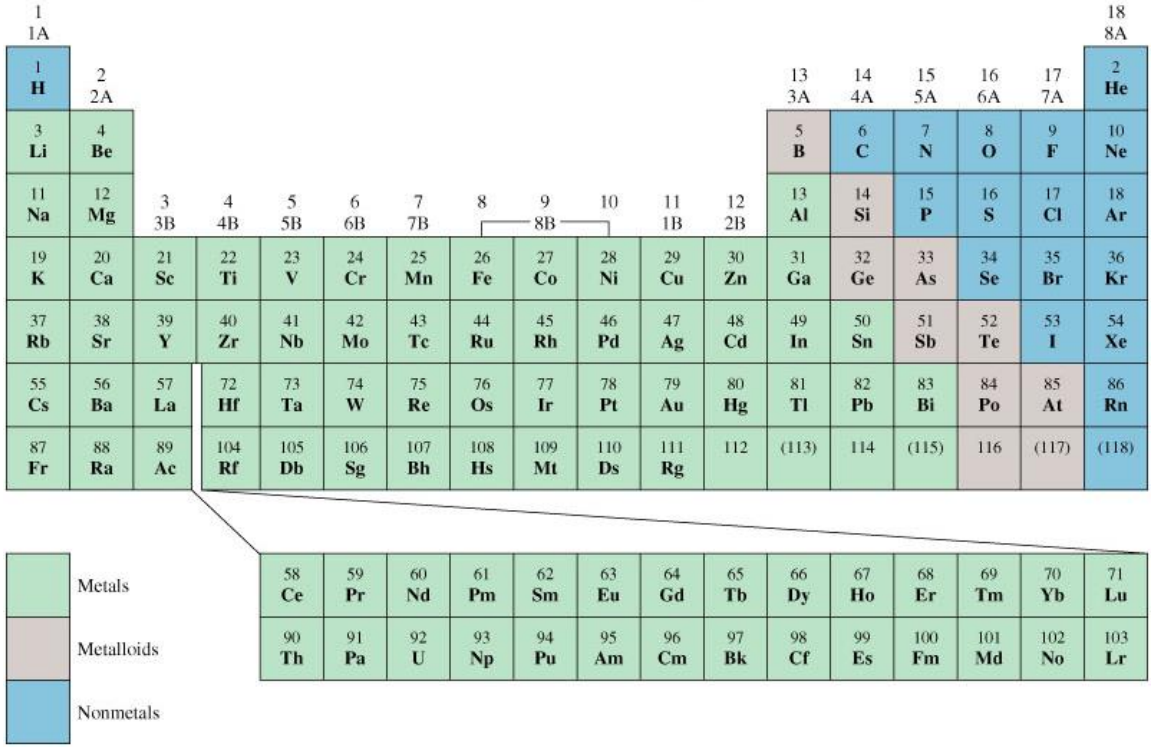
Which element consider as moderate conductor for electricity and heat?

Ti

Si

P

Be



Chemical formulas

Empirical or molecular ?

$C_6H_{12}O_2$ (molecular) $C_6H_{12}O_2 \xrightarrow{/2} C_3H_6O$

$C_6H_{12}O$ (empirical)

$C_5H_{11}O$ (empirical)

H_2S (empirical)

Writing compound formula

Firstly, Decide if the compound Ionic or Molecular compound

How !! look to the **first element**,

if it is **metal** or NH_4 → **ionic**

if it is **metallod or nonmetal** →**molecular**

In case of ionic compound:

- write the ion symbol of each part with its oxidation number
- put the oxidation number of each part as subscript for the other part (قاعدة تبادل التكافؤات)
- simplify the formula if you can

In case of molecular compound:

- write the elements symbol as they appear in the compound name
- the subscript will be the prefixes of each element
- don't simplify the formula

Write the chemical formula :

dichlorine octoxide ⟶ (molecular) Cl_2O_8

DON'T simplify ~~ClO_4~~

Ionic formulas

What is the formula for the ionic compound formed by magnesium and Chloride?

Magnesium	Chloride
Mg^{+2}	Cl^{-}

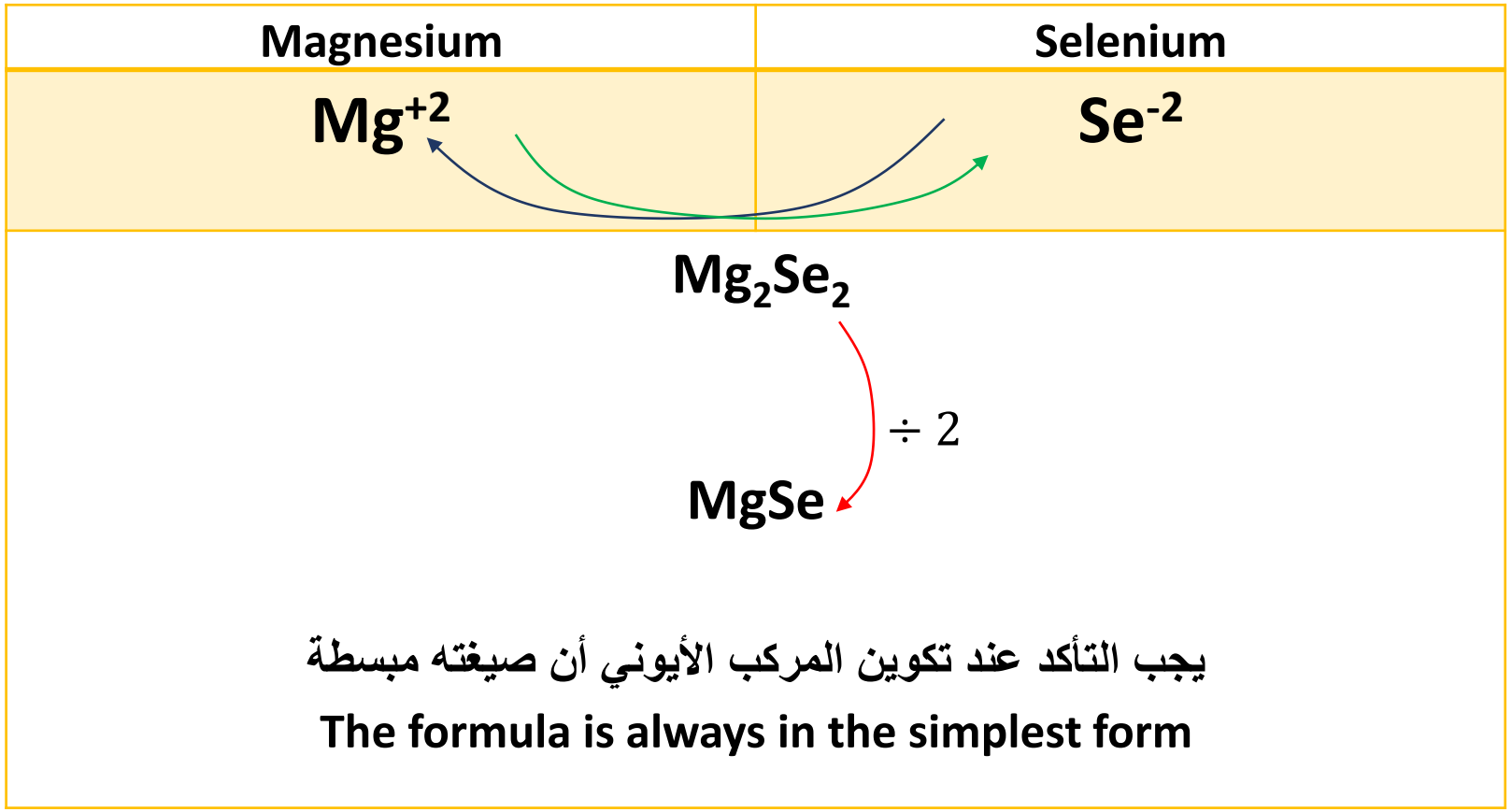
$MgCl_2$

يجب التأكد عند تكوين المركب الأيوني أن صيغته مبسطة

The formula is always in the simplest form

Ionic formulas

What is the formula for the ionic compound formed by magnesium and selenium?



Ionic formulas

What is the formula for the ionic compound formed by Tin(IV) and Oxygen?

Tin (IV)	Oxide
Sn^{+4}	O^{-2}

Sn_2O_4

÷ 2

SnO_2

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The formula is always in the simplest form

Ionic formulas

What is the formula for the ionic compound formed by calcium and phosphate?

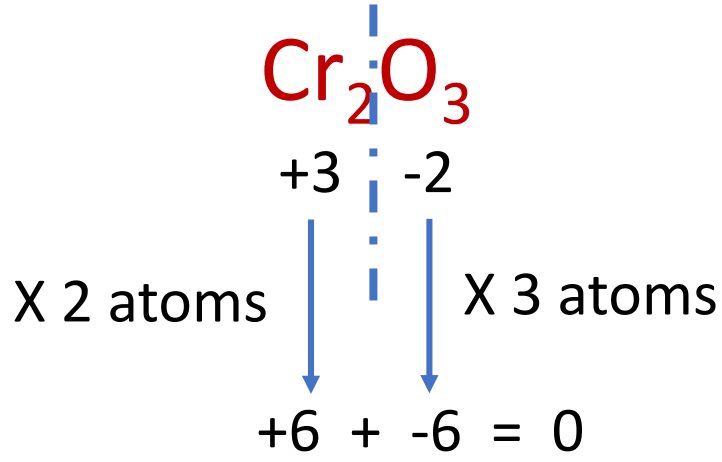
calcium	phosphate
Ca^{+2}	$(PO_4)^{-3}$

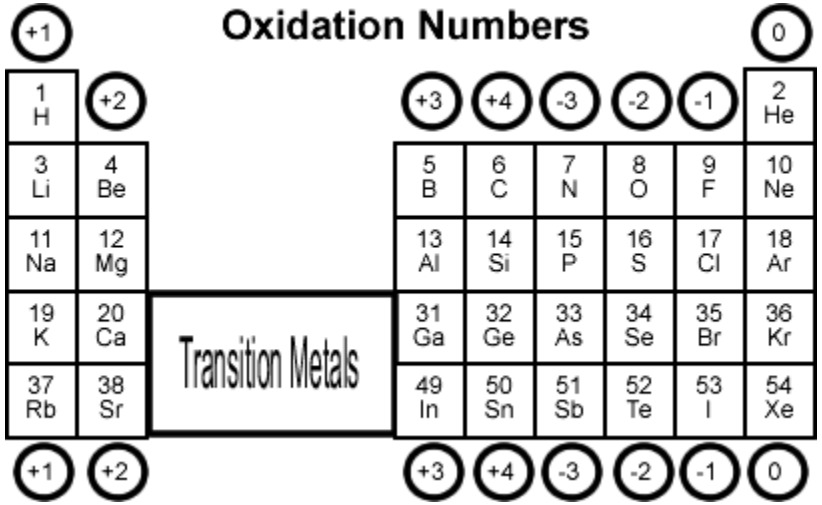
$Ca_3(PO_4)_2$

يجب التأكد عند تكوين المركب الأيوني أن صيغته مبسطة

The formula is always in the simplest form

What is the valency (oxidation number) of oxygen in Cr_2O_3

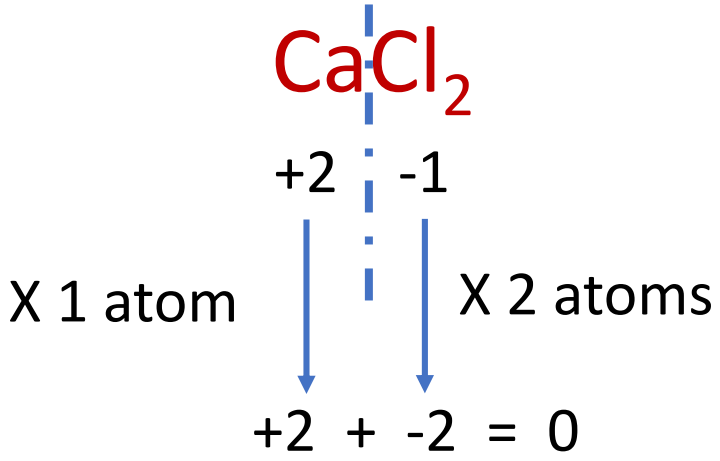




oxidation number for oxygen = -2

oxidation number for chromium = +3

What is the valency (oxidation number) of element in $CaCl_2$



oxidation number for calcium = +2

oxidation number for chloride = +1

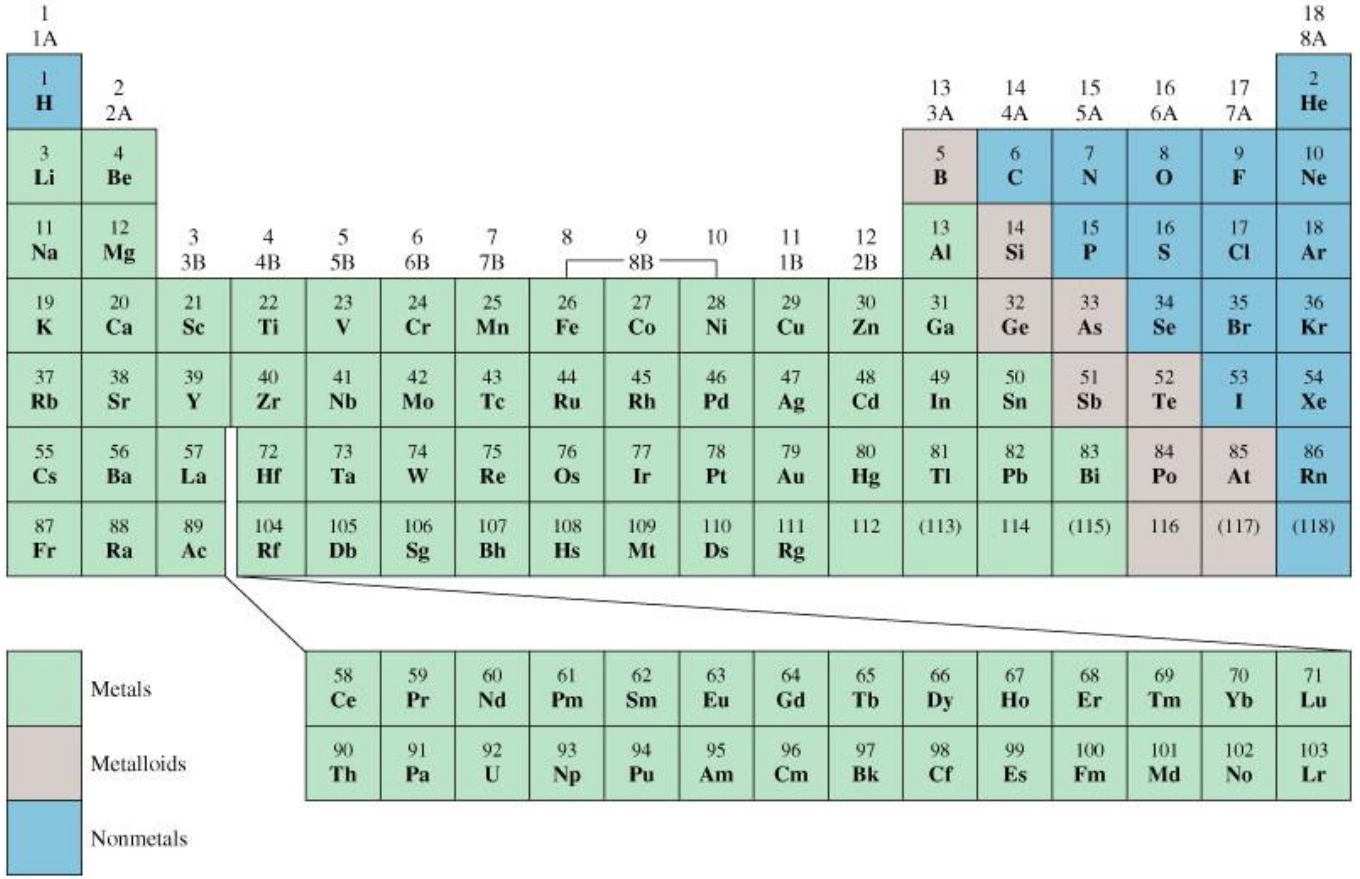
Naming compound

Firstly, Decide if the compound Ionic or Molecular compound

How !! look to the **first element**,

if it is **metal** or NH_4 → **ionic**

if it is **metallod or nonmetal** →**molecular**



Naming compound

Firstly, Decide if the compound Ionic or Molecular compound

How !! look to the **first element**,

if it is **metal** or NH_4 → **ionic**
if it is **metallod or nonmetal** →**molecular**

Ionic Compounds

Metal cation + Nonmetal anion

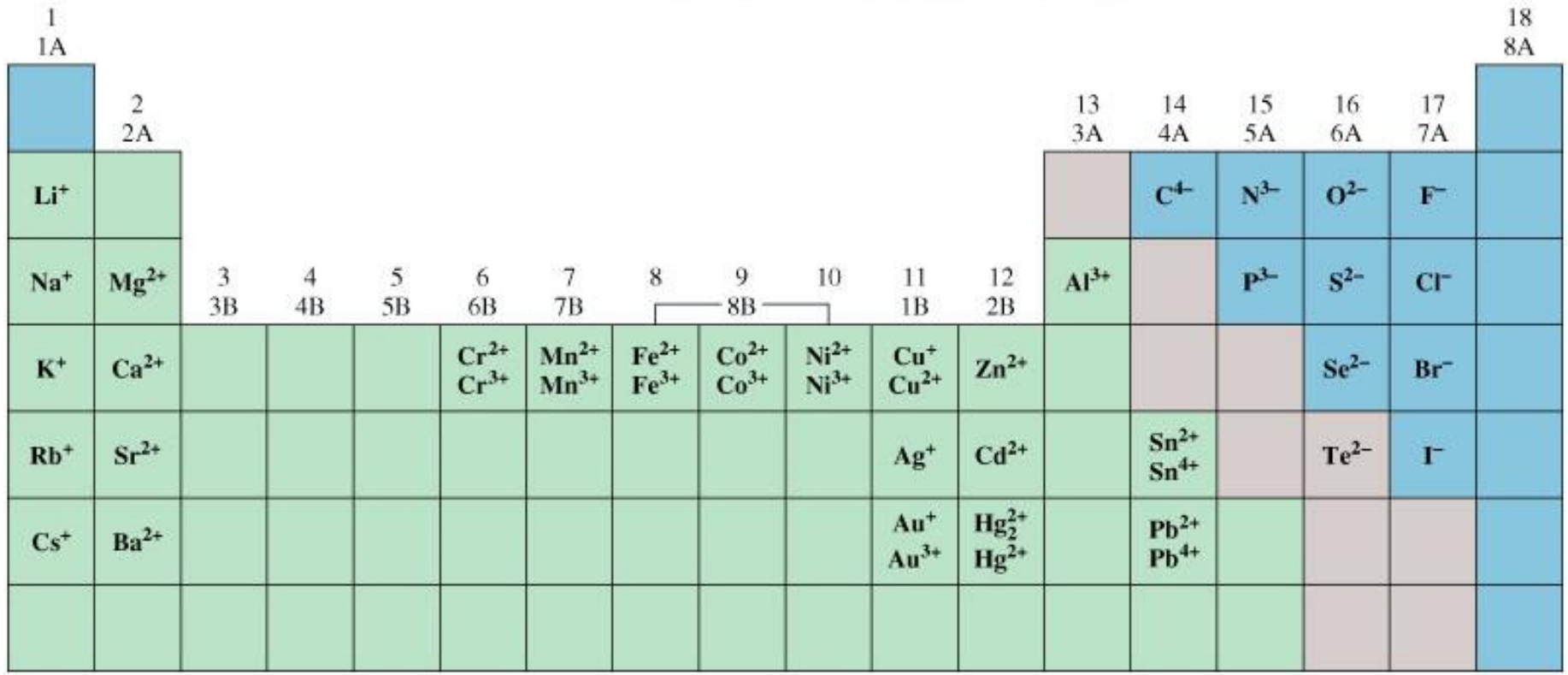
Metal Cation: takes their names from the element

Nonmetal Anion: Take the first part of the element name and add -ide

Metals form only one type of cation:
Just put the name

Metals form more than one type of cation (10 metals) use stock system, i.e show the oxidation number of metal by adding roman number after the metal name

Note : for the common cation or anion , just put the name as it


1
1A
18
8A
2
2A
13
3A
14
4A
15
5A
16
6A
17
7A
Li+
C4–
N3–
O2–
F–
Na+
Mg2+
3
3B
4
4B
5
5B
6
6B
7
7B
8
9
10
8B
11
1B
12
2B
Al3+
P3–
S2–
Cl–
K+
Ca2+
Cr2+
Cr3+
Mn2+
Mn3+
Fe2+
Fe3+
Co2+
Co3+
Ni2+
Ni3+
Cu+
Cu2+
Zn2+
Se2–
Br–
Rb+
Sr2+
Ag+
Cd2+
Sn2+
Sn4+
Te2–
I–
Cs+
Ba2+
Au+
Au3+
Hg22+
Hg2+
Pb2+
Pb4+

Molecular Compounds

Place the name of the first element in the formula first, and the second element is named by adding –ide at the last of the name.

Rules to name molecular compounds:

Rule 1: use Greek prefixes to denote the number of atoms of each element

Rule 2: Drop mono for the first element

Rule 3: Drop all prefixes if the first element is H

Rule 4: Drop the second o in mono prior to a vowel (monoxide)

Rule 5: Drop the a in prefixes ending in a prior to a vowel (tetroxide)

HCl
Hydrogen Chloride

H					
*hydr*ogen					
	B	C	N	O	F
	*bor*on	*carb*on	*nitr*ogen	*ox*ygen	*fluor*ine
		Si	P	S	Cl
		*silic*on	*phosph*orus	*sulf*ur	*chlor*ine
			As	Se	Br
			*arsen*ic	*selen*ium	*brom*ine
				Te	I
				*tellur*ium	*iod*ine

Common names

H_2O water

NH_3 ammonia

CH_4 methane

H_2S hydrogen sulfide

SiH_4 silane

B_2H_6 diborane

TABLE 2.4

Greek Prefixes Used in Naming Molecular Compounds

Prefix	Meaning
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10

Molecular Formula	Number of Atoms of First Element	Number of Atoms of Second Element	Name of Compound
ClF	1	1	Chlorine monofluoride
ClF_5	1	5	Chlorine pentafluoride
CO	1	1	Carbon monoxide
CO_2	1	2	Carbon dioxide
Cl_2O	2	1	Dichlorine monoxide
PCl_5	1	5	Phosphorus pentachlroride
N_2O_5	2	5	Dinitrogen pentoxide

Molecular Formula	Name of Compound
BCl_3	Boron trichloride
SF_6	Sulfur hexafluoride
NI_3	Nitrogen triiodide
N2O4	Dinitrogen tetroxide
Cl_2O	Dichlorine monoxide
B5H9	Pentaboron nonahydride
Br3O8	Tribromine octoxide
ClF	Chlorine monofluoride

Chemical Formula	Type of Compound	Compound Name
MgF_2	Ionic	Magnesium fluoride
CuF_2	Ionic	Copper(II) fluoride
SF_2	Molecular (covalent)	Sulfur difluoride
NaBr	Ionic	Sodium bromide
AuBr	Ionic	Gold(I) bromide
IBr	Molecular (covalent)	Iodine monobromide

Chemical Formula	Type of Compound	Compound Name
MgF_2	Ionic	Magnesium fluoride
CuF_2	Ionic	Copper(II) fluoride
SF_2	Molecular (covalent)	Sulfur difluoride
NaBr	Ionic	Sodium bromide
AuBr	Ionic	Gold(I) bromide
IBr	Molecular (covalent)	Iodine monobromide

Name the following compound $Pb(SO_4)_2$

lead (IV) sulfate

lead (II) sulfate

lead (IV) sulfide

lead sulfate

Name the following compound NH_4Cl

ammonium chloride

ammonium monochloride

ammonium chlorine

amine chloride

Name the following compound $Al(CN)_3$

aluminum cyanide

aluminum (III) cyanide

aluminum (III) cyano

aluminum carbide

Thank you