Chemical Formulas: - Types of Atoms
# of atoms

I. Chemical Analysis

A. Qualitative

Benzene
C_6H_6

Acetylene
C_2H_2

B. Quantitative

Can be represented in 3 ways

1. Empirical Formula:
Simplest whole number ratio of the atoms or ions in a compound

Benzene
C:H

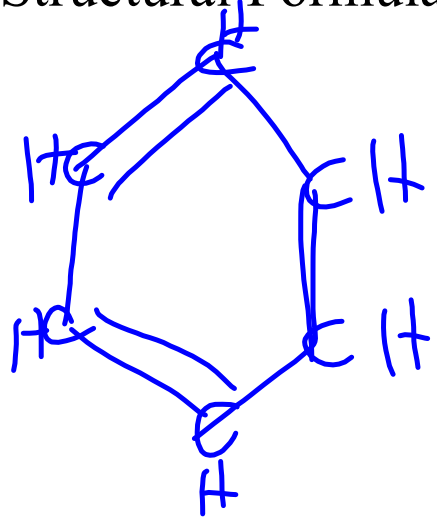
Acetylene
C:H

2. Molecular Formula:
Actual # of atoms in a molecule

C_6H_6

C_2H_2

3. Structural Formula $\Rightarrow$ 2-D representation



H-C≡C-H

Use the formula based on whether a compound is molecular or ionic

What is a molecule?

1 or more atoms that combine to form a single element or compound.

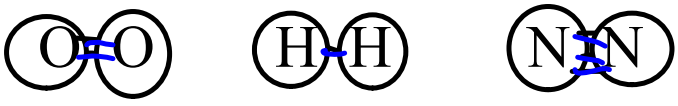
Monatomic Elements:

Ne He Ar

Ne He Ar

Diatomic Elements:

O_2, H_2, N_2 Cl_2 I_2 Br_2



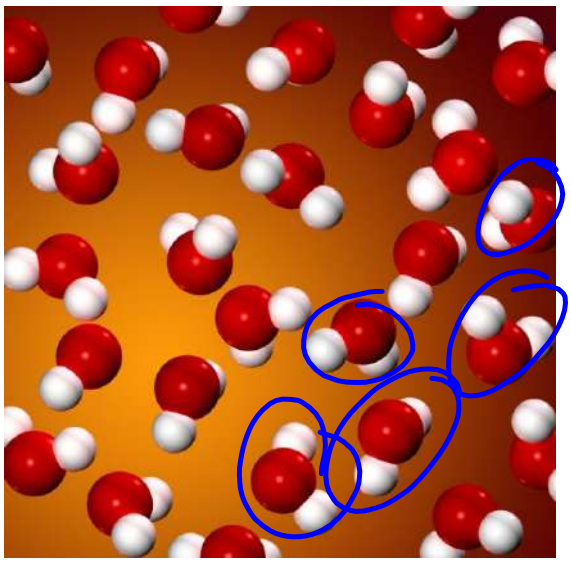
Others: O_3, P_4, S_8

Compounds:
H_2O, CO, CO_2, H_2O_2, NH_3

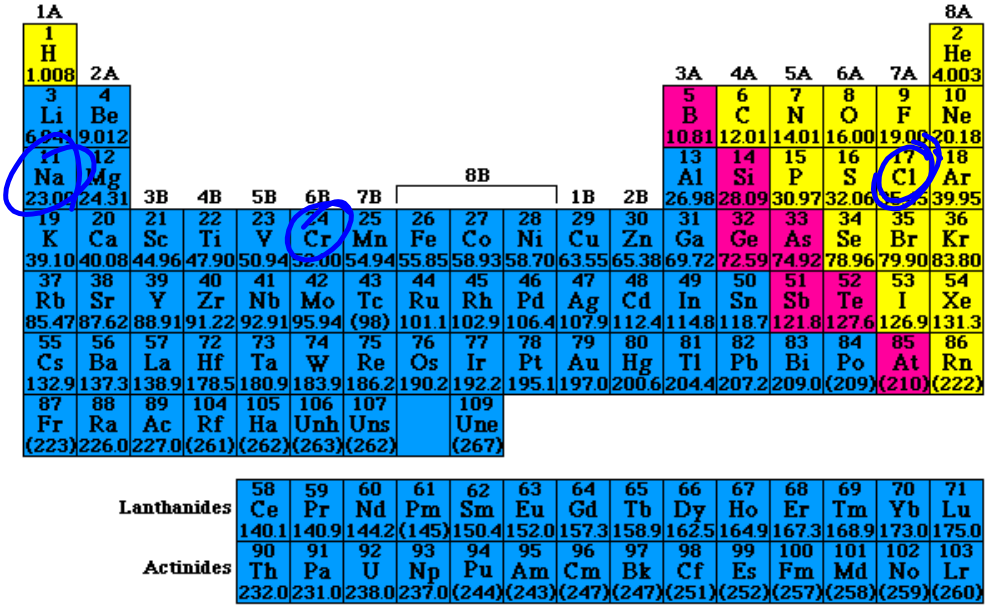
Molecular compounds are consist of 2 or more non-metals -use moleculear formulas, usually

1A												3A	4A	5A	6A	7A	8A
1 H 1.008	2A																2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 23.00	12 Mg 24.31	3B	4B	5B	6B	7B	8B			1B	2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Rf (261)	105 Ha (262)	106 Unh (263)	107 Uns (262)		109 Une (267)									

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)



Ionic compounds: (Salts)
consist of a metal and a non-metal and are made up of ions



Ions:

- Electrically charge atom
- How do they form?

When some atoms react with others, they gain or lose e-

The atom that gains e- becomes negative (anion)

neutral Cl: $17^{+} + 17^{-} = 0$

ionized Cl: $17^{+} + 18^{-} = -1,\ Cl^{-1}$

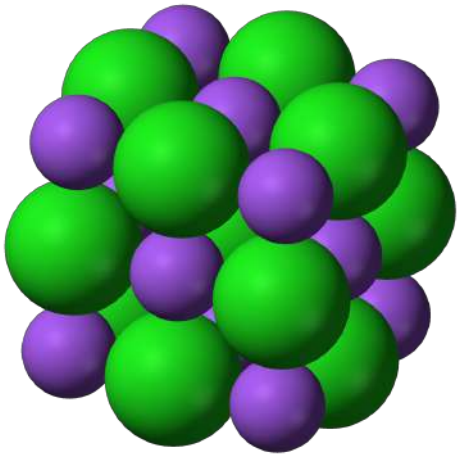
The atom that loses e- becomes positive (cation)

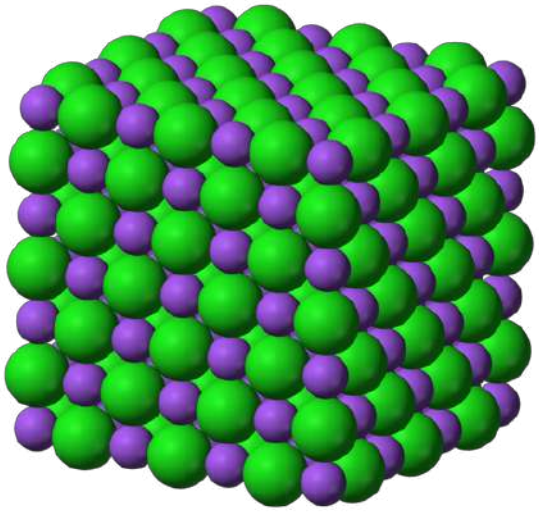
neutral Na: $11^{+} + 11^{-} = 0$

ionized Na: $11^{+} + 10^{-} = +1,\ Na^{+1}$

The compound that is formed by the joining on Na^+ and Cl^- is not made up of single molecules, but varying amounts of individual ions, ∴ their formulas are empirical

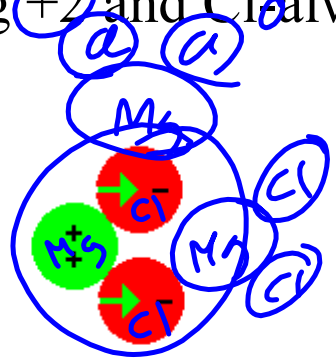
No matter how many ions are present in the sample of NaCl, the Na^+ and Cl^- ions always exist in a ratio of 1:1





formula unit

- $MgCl_2$: Mg +2 and Cl -always exist in a ratio of 2:1



Magnesium Chloride

- Note Total charge of an ionic compound is neutral!
- NaCl, $MgCl_2$- called a formula unit
- one can write the formula for any ionic compound if you know the charge on the ions:

Practice:

cation always first

a) Mg^{+2}, S^{-2} MgS Magnesium sulfide

b) Mg^{+2}, F^{-1} MgF_2 Magnesium fluoride

c) Mg^{+2}, N^{-3} Mg_3N_2 Magnesium Nitride

d) Na^{+1}, *$(NO_3)^{-1}$

e) H^{+1}, *$(CO_3)^{-2}$

f) Al^{+3}, *$(SO_4)^{-2}$

*Polyatomic ion: a group of atoms containing more than 1 element, that act as a single group!