II. Groups and Chemical Reactivity

★ Group # = # of outermost (valence) e^-'s

Group 1A: Alkali Metals

- Tend to lose 1 e^-

eg $K \rightarrow K^+ + e^-$

↑

so typical charge (aka oxidation number or oxidation state) is +1

Group 2A: Alkaline Earth Elements

- Tend to lose 2 e^-'s

eg $Ca \rightarrow Ca^{2+} + 2e^-$

(∴ typical ox. state is +2)

Group 8A: Noble Gases

- Don't do squat (a fact we simply accept!)

* Atoms in chemical reactions seek to have as many e^-'s as (i.e. become isoelectronic with) the nearest noble gas *

DEMO: $Ca_{(s)} + H_2O_{(\ell)} \rightarrow$ ...

DEMO: $K_{(s)} + H_2O_{(\ell)} \longrightarrow \ldots$

Group 7A: Halogens

- Tend to gain or share 1e$^-$

eg $F + e^- \rightarrow F^-$ (↑ -1 ox state)

eg F (7 valence e$^-$'s)

Lewis (Chap. 9) - arrange e$^-$'s in (up to) 4 groups

So :F· (1 short of Ne)

$\Rightarrow F + F \longrightarrow F_2$

i.e. :F· ·F:

or :F–F: (ox. state of zero)

"shared e$^-$ pair" or "covalent bond"

F_2 eg of a molecule: ① finite group of atoms
② fixed composition
③ held together by 1 or more covalent bonds

Group 6A : Chalcogens

- Tend to gain or share 2 e^{-1}'s

eg $O + 2e^- \rightarrow O^{2-}$ (O^{2-}: −2 ox. state)

$O + O \rightarrow O_2$ (O: 0 ox state)

(in Chap 9/10, learn why $\ddot{O}=\ddot{O}$)

Reactivity: F > O, Cl > S, etc. (why in Ch. 8)

III. Compounds and Nomenclature

- contains more than 1 element
- fixed composition

MEMORIZE Silberberg Tables 2.3, 2.4, 2.5, 2.6

A. Binary (contains 2 elements)

* metal + non-metal
  ⇓ e^- transfer
  ionic compound or salt
  ① infinite (in principle) group of atoms
  ② fixed composition
  ③ held together by ionic bonds ($\oplus \leftrightarrow \ominus$)

eg $2Na_{(s)} + Cl_{2(g)} \rightarrow 2\,NaCl_{(s)}$

O and all Group 7A elements are <u>diatomic</u>

How do we know NaCl consists of ions?

DEMO: $NaCl_{(s)} \xrightarrow{H_2O} Na^+_{(aq)} + Cl^-_{(aq)}$

(H_2O solvates the Na^+ and Cl^-, but doesn't react with them chemically)

NOMENCLATURE

① Write cation, then anion
↑ element name ↑ "ide" suffix

② Write charge if more than 1 ox state possible
eg Fe^{2+} iron(II) Fe^{3+} iron(III)

③ Overall charge of a formula must be neutral

④ Use a Greek prefix for # of waters of hydration

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* non-metal + non-metal
⇓ sharing of e^-'s
molecule or covalent compound
eg nitrogen oxides

NOMENCLATURE

① Write 2nd element as if it were an anion
② Use Greek prefixes to indicate the number of each atom (since it can vary!)
③ Leave off an initial "mono"

B. Compounds with More Than 2 Elements

If 1 element is a metal ⇒ ionic compound

If all elements are non-metallic ...

ionic compound

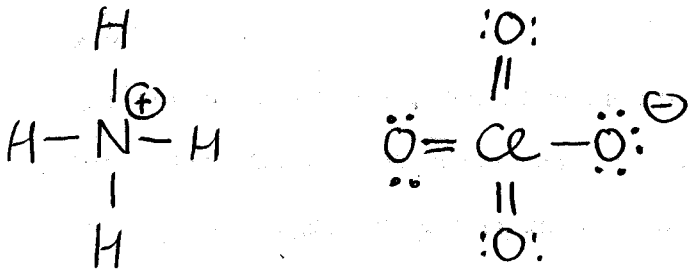
⇒ cation and/or anion is <u>polyatomic</u> (more than 1 atom)

eg NH_4ClO_4 (s)

$\downarrow H_2O$

NH_4^+ (aq) + ClO_4^- (aq)

[H_2O solvation can break ionic bonds <u>btwn</u> ions...]

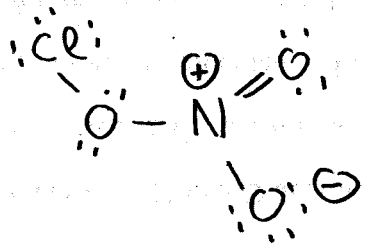


[but H_2O can't break covalent bonds <u>within</u> polyatomic ions!]

∴ in terms of chemistry and nomenclature, treat polyatomic ions as a unit

molecule

eg $ClONO_2$



chlorine nitrate

(names usually are just memorized)