General and Organic Chemistry

Lecture 2

Ch 2: Atoms, Molecules and Ions

20/10/2024

✱ General & organic Chemistry: Chapter 2: Atoms, Molecules and Ions

L2

The Atom

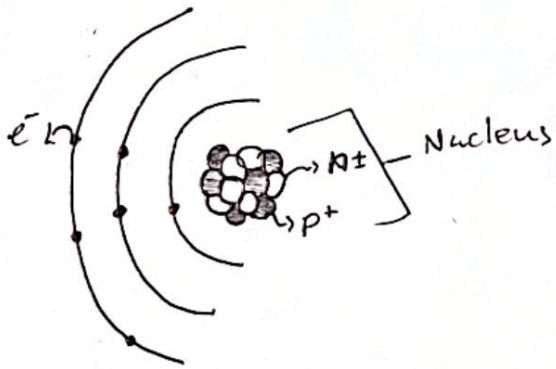
Contains

Electrons: (e^-)
- Found outside the nucleus
- Has a (-) charge

Protons: (P^+)
- Found in the nucleus
- Has a (+) charge

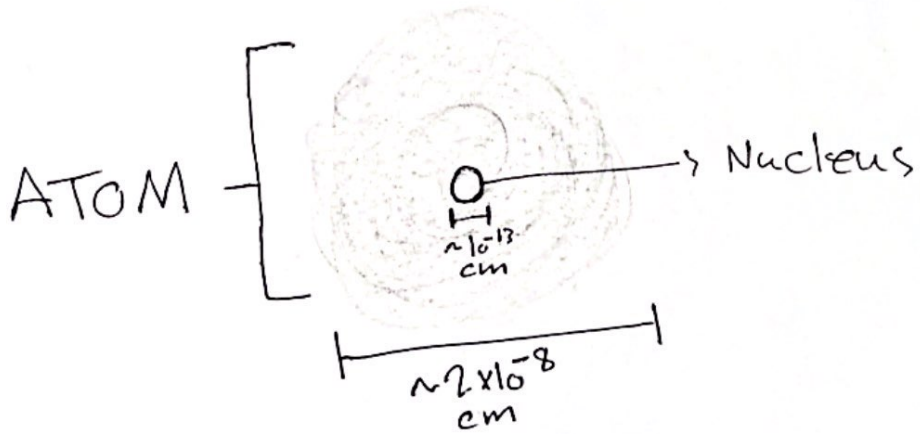
Neutrons ($n^\pm$)
- Found in the nucleus
- Has NO charge
- Has the same mass as the Proton (virtually)

The Positive charge is equal in magnitude to the negative charge



✱ The nucleus is small compared with the size of the atom, but it is Extremely Dense

- It accounts for almost the whole mass of the atom



* Isotopes: Atoms with the same number of Protons but different numbers of Neutrons

- They show almos identical chemicl Properties, because the chemistry of the atom is due to its electrons
- In nature, most elements Contain Mixtures of isotopes

For an Element:

* The number of $P^+ = e^-$
* To get how many neutrons:

$A - Z = n$

A ~ Mass number [No. of $P^+ + n\pm$]

X

Z ~ Atomic Number [No. of P^+]

For isotopes:

ex:

$n = A - Z$

$n = 23 - 11$

$n = 12$

← 23 Na 11

24 Na 11 → $n = A - Z$

$n = 24 - 11$

$n = 13$

Same # of Protons and electrons

they have different # of neutrons even though its the same element

✯ Chemical Bonds :

we are gonna study about

- Ionic الروابط الأيونية Bonds
- Covalent الروابط التساهمية Bonds

★ Covalent Bonds :

- Between non-metals [non-metal and a non-metal]
- They are bonds between atoms that form by :
  Sharing Electrons (e^-)
- Resulting collection of atoms are called a Molecule

ex: H—F

There are :

- Polar Covalent bonds : ex: $H \overset{+\delta}{\longrightarrow} F \overset{-\delta}{:}$ [There is a difference in Electro negativity, thats why its Polar]
- Non-Polar Covalent bonds : ex: H—H [There is no difference in Electronegativity, thats why it isn't Polar]
  Two identical atoms

ex:

H—H ↓ Non-Polar (No difference) in E.N

H—C ↓ Least Polar (Least difference) in E.N

H—N N—O

H—F ↓ most Polar (most difference) in Electro Negetivity

* Ionic Bonds:

- Between Metal and Non-Metal
- Bonds form due to force of attraction between oppositly charged ions

An atom or group of atoms that has a net (+) or (-) charge
ex: Na^+, Cl^-

- Cation: A Positive ion (lost an e^-)
- ~~Anion~~ Anion: A Negative ion (gained an e^-)

Ex: [redacted] , [redacted]

$$Na \cdot \ddot{F}: = Na^+F^-$$

* Here, bonds are made by Completely losing or gaining e^-, is unlike covalent bonds where you share e^-'s and have Partial (-) or (+)

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* The Concept Check:

Dalton's atomic theory has some statements that are still true, which ones are they:

1. Elements are made of tiny particles called atoms ✓ [This is true]
2. All atoms of a given element are identical ✗ [They have different mass]
3. A given compound always has the same relative numbers and types of atoms ✓ [This is true]
4. Atoms are indestructible ✗ [They are destructible, we can use fusion and fission to do that or create some]

✱ The Periodic table :

Groups or Families : Elements in the same vertical columns ↕
- have similar chemical Properties

Periods : Horizontal rows of elements ↔

- The common charges when creating ionic compounds :

Group	Charge
Alkali metals (1A)	+1
Alkaline Earth Metals (2A)	+2
Halogens (7A)	-1
Noble Gasses (8A)	0

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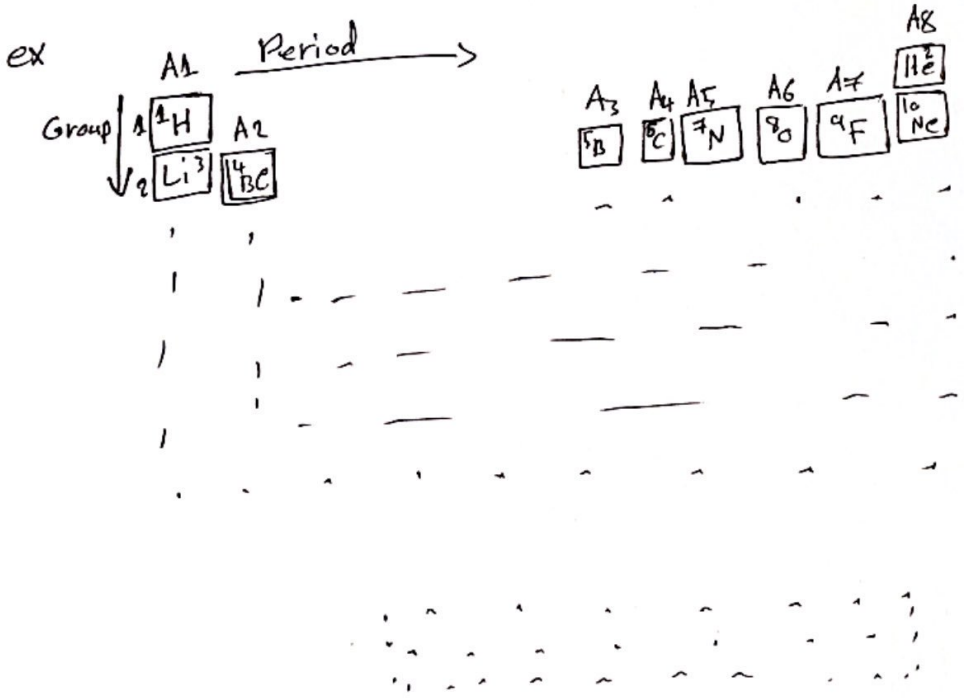
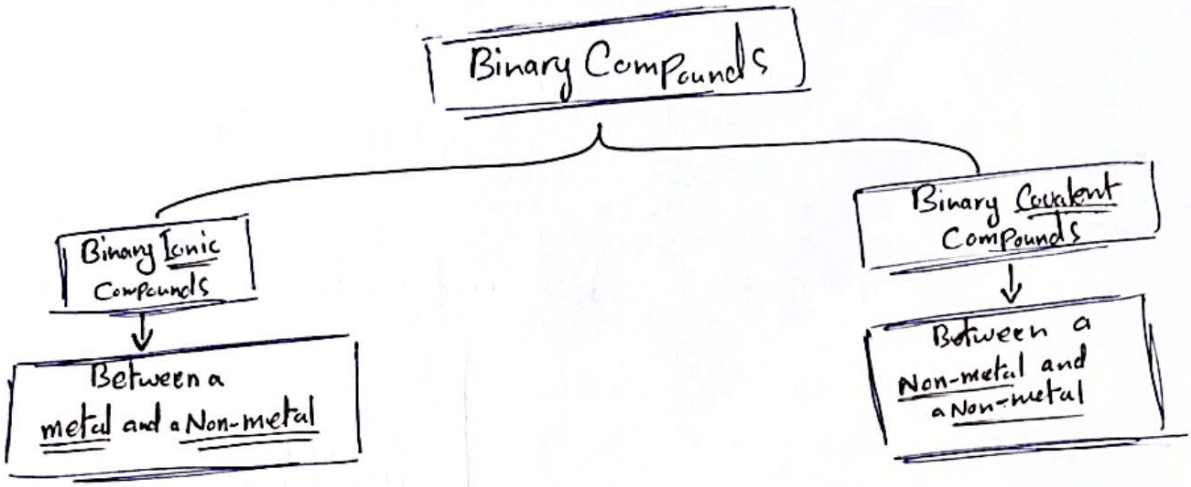
ex



★ Naming Compounds:

- Binary Compounds: Composed of two elements
- Ionic and Covalent Compounds included



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① Binary Ionic Compounds [Type 1]:
↳ Metal & Non-metal

- The Cation (↳ the (+) ion) is named first then the anion (↳ the (-) ion)
- A Monoatomic (↳ ion with only 1 atom) Cation (+) takes its name from the name of the Parent element
- A monatomic anion (-) is named by taking the root of the element name and adding [-ide]

ex:

KCl → Potassium (+) Cloride (-)
↳ K^+ Cl^-
cation ↳ anion

$MgBr_2$ → Magnesium bromide

★ The elements involved are the metals from Group 1 & 2 + Aluminum
bc they have only 1 form! ex: Na → can be only Na^+ → can't be ~~Na^{2+} Na^{3+}~~

② Binary Ionic Compounds [Type II]

↳ Metal & Non-metal

- Metals in these compounds form more than one type of positive ions [can be found in transition metals]
- The charge on the metal ion must be specified using Roman numerals. ex: [I, II, III, IV, V, VI ...]
  1 2 3 4 5 6
- Transition metals cations (+) usually require a Roman numeral
- Elements that form only one type of cations do NOT need a roman numeral ... we use type 1 Going back

ex: Cu can form: Cu^+ and Cu^{2+}

So:

CuBr → Copper(I) Bromide

$CuBr_2$ → Copper(II) Bromide

PbO_2 → Lead(IV) oxide

★ Polyatomic ions: ions that have multiple atoms

Hint: less O → ~ite, more O's → ~ate

Must be memorized:

★ NO_2^-	Nitrite	★ OH^-	Hydroxyde	★ ClO^- or OCl^-	Hypochlorite
NO_3^-	Nitrate	★ CN^-	Cyanide	ClO_2^-	Chlorite
★ SO_3^{2-}	Sulfite	★ PO_4^{3-}	Phosphate	ClO_3^-	Chlorate
★ SO_4^{2-}	Sulfate	★ CO_3^{2-}	Carbonate	ClO_4^-	Perchlorate
		★ $C_2H_3O_2^-$	Acetate	★ CrO_4^{2-}	Chromate
				$Cr_2O_4^{2-}$	Dichromate

✱③ Binary Covalent Compounds [Type III] 3

Non-Metal & Non-Metal

- Formed between two Non-metals
- The first element in the formula is named first using its full name
- The second element is named as if it were an anion
  - Is take root + -ide
- Use Prefixes to denote the number of atoms present but the Prefix ✱mono- should Never be used to name the first element

Prefixes:

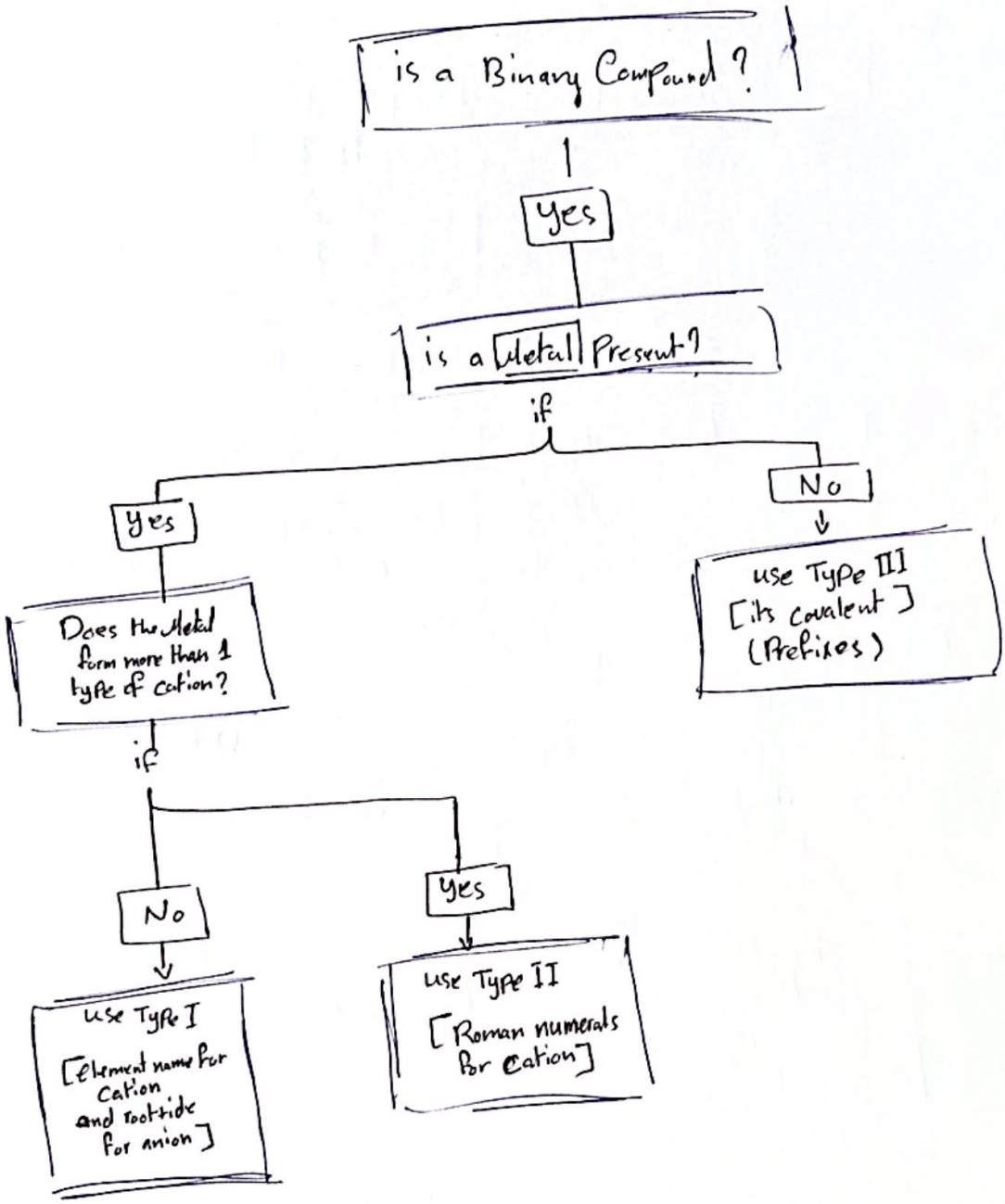
mono-	1
di-	2
tri-	3
tetra-	4
Penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10

ex: CO_2
↓
Carbon dioxide

SF_6
↓
sulfur hexafluoride

N_2O_4
↓
dinitrogen tetraoxide

* Flowchart for naming Binary Compounds :



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* For the second Flow chart :

- if there is Polyatomic ions present we name the compound using similar methods to naming binary ionic compounds

✱ Naming Acids :

Acid : Molecule with one or more H^+ ions attached to an anion

- you can recognize an acid by the Hydrogen that appears first in the formula ex: HCl

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① if the anion (−) doesn't contain oxygen then.

the acid is named with the prefix [hydro−] + suffix [-ic] with the anion : so- hydro(anion root name)ic acid

ex :

HCl → Hydro Chloric acid

HCN → Hydro Cyanic acid

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② if the anion contains oxygen :

- if the anion name ends with [-ate] we add [-ic] to the root name

ex: HNO_3 → Nitric acid

Nitrate ↩

H_2SO_4 → sulfuric acid

sulfurate ↩

- if the anion name ends with [-ite] we add [-ous] to the root name

ex :

HNO_2 → Nitrous acid

Nitrite ↩

H_2SO_3 → Sulfurous acid

*Flow chart for naming acids &