Chapter 8: Electron Configuration and Chemical Periodicity

* The direction of e^- spin is Represented by m_s [either $+\frac{1}{2}$, $-\frac{1}{2}$]
  (Property of Electron)

→ Pauli's exclusion principle: no two electrons in the same atom can have the same four Quantum number

* Energy of atomic orbitals are affected by :-
  1 - nuclear Charge (Z)
  2 - Shielding by other electrons

مهم:
• كلما زادت شحنة النواة تزيد قدرتها على جذب الالكترونات وتقلل طاقة المدارات الخارجية

Revise slide 7

* Zeff : effective nuclear charge
  اقل من شحنة النواة الحقيقية لسبب حجب الالكترونات الداخلية

→ Electrons in the same energy level shield eachother

→ Electrons in the inner energy level shield the outer electrons very effectively

* Penetration: - increases attraction
  - decreases shielding

> n: orbital size (energy)
> l: orbital shape
> m_l: orbital orientation
> m_s: Direction of e^- spin
>
> * an orbital can hold a maximum of two electrons

→ Energy :- $s < p < d < f$

Electron Configuration :- $n\,l$ *
(l → s, p, d, f)

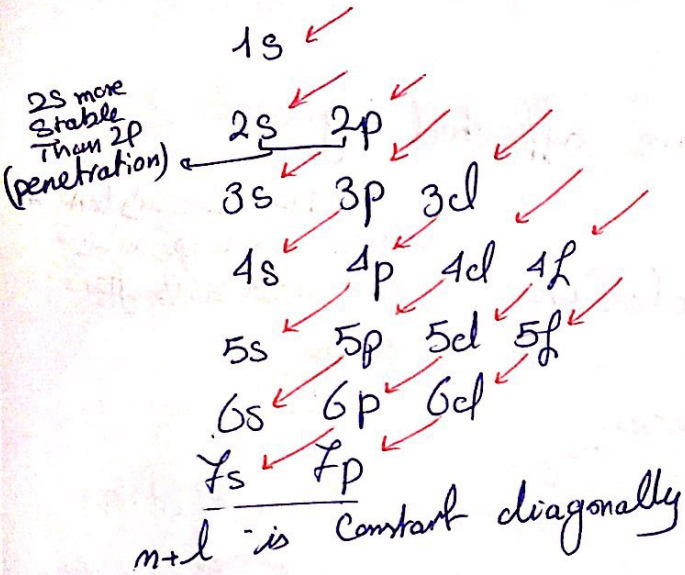
* aufbau principle → e^- placed in the lowest energy sublevel

* Hund's Rule → orbitals of equal energy
  The lowest energy electron Configuration has the max. num of unpaired electrons

- A partial orbital diagram :- shows only the highest en... sublevels is being filled

* Electron Configurations and Group :-

Same Group → Same outer electron Configuration
→ Same chemical behavior



* Noble gas		* what Comes after
2	He	2s
10	Ne	3s
18	Ar	4s
36	Kr	5s
54	Xe	6s
86	Rn	7s

* Categories of Electrons

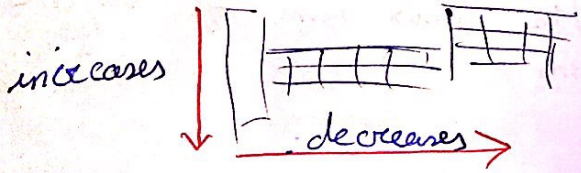
Inner electrons (core)
↳ The Common electrons between atom and previous noble gas + filled orbitals

Outer electrons
- has highest Energy

Valence Electrons
- involved in forming Compounds
  - for main group → ↳ outer electrons
  - transition elements → ↳ outer electrons + e^- at any (n-1)d
    So ns + (n-1)d electrons

* Trends in Atomic size :

1. Atomic size ↑ ← n↑
2. Z_{eff} ↑ — Atomic size ↓

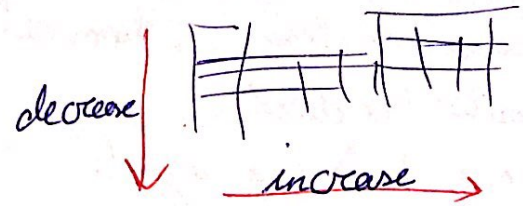


Anions has lower Z_{eff} Than Cations and ~~lower~~ higher Atomic Size

* Trends in ionization Energy (Always positive)

↳ energy required for the Complete removal of 1 mol of electrons from 1 mol of gaseous atoms or ions

→ High IE: anions
→ low IE: Cations



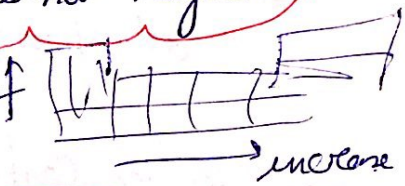
* Trends in Electron Affinity

EA_1 is negative
EA_2 is always positive

↳ Energy change that occurs when 1 mol of electrons is added to 1 mol of gaseous atoms or ions

→ low EA : Cations
→ High EA : anions

Change is not Regular



* Behavior patterns for IE and EA

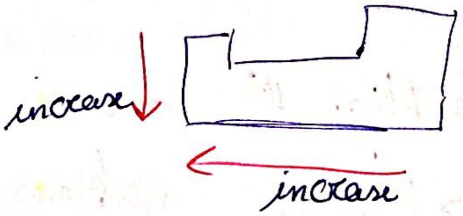
Reactive nonmetals ← Groups 6A, 7A
- high IE
- highly negative EAs
- form negative ions

Reactive metals ← Groups 1A 2A
- low IE
- negative EAs (slightly)
- form positive ions

Noble gases ← Groups 8A
- very high IEs
- slightly positive EAs
- Don't lose or gain electrons

Metallic Behavior

- Shiny Solids
- moderate → high melting points
- good conductors → heat, electricity
- can easily be shaped
- loses electrons → form cations
- * easily oxidized
- Main group → Strong reducing agents
- form ionic oxides → basic in aqueous solution



→ Acid_Base Behavior of oxides

* Main-group Nonmetals form → covalent oxides → * acidic in aqueous solution

* ~ ~ metals → ionic oxides

* Some metals and metalloids form amphoteric oxides Ex: Al_2O_3 with HCl and NaOH

→ Electron Configurations of Main-Group ions :-

Def: Isoelectronic: an atom that has a noble gas electron configuration

Ex: Na^+ $[He]2s^2 2p^2$ = [Ne] isoelectronic with Ne

Pseudo- noble gas Configuration :-

عنما نفقد البعض الكتروناته من المدارات الأعلى طاقة :-

مثل :-

① Sn $[Kr]\,5s^2\,4d^{10}\,5p^2$

↳ Sn $[Kr]\,4d^{10} + 4e^-$

Empty ns, np sublevels and a filled (n-1) d

② or filled ns and (n-1) d sublevels → $2e^- + Sn^{+2}$ $([Kr]\,5s^2\,4d^{10})$

Sn is stable?

Sn^{4+} or Sn^{2+} لأنه عكسية لن يكون نوعاه من الأيونات

* Magnetic properties of Transition Metal Ions

→ If the atom has an unpaired electron
It is attracted by a magnetic field (para magnetism)

→ By contrast, an atom with no paired electrons
is not attracted by a magnetic field (diamagnet-)

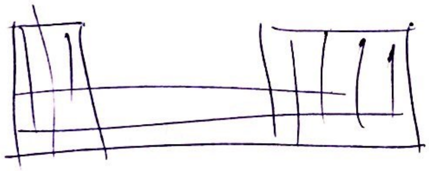
Ionic Size vs Atomic Size

anion / cation

larger ← atom → smaller

+

Ionic Radius increases ↓



* Note: Cation size **decreases** as charge **increases**

If you have an isoelectronic series: (Same electron Configuration)

↳ The size decreases with increasing nuclear charge.

$3^- > 2^- > 1^- > 1^+ > 2^+ > 3^+$

Notes:

* Energy state is affected by: ① n value and ② electron-ele Repulsion

* for the number of orbitals $= n^2$
  ~ ~ max number of electrons $= 2n^2$

* lanthanicls → 4f orbitals are filled, Period 6
* actinicles → 5f ~ ~ ~, Period 7

} inner transition

---

* Atomic size for Transition elements:
  - Period 5 > Period 1
  - Period 5 ≈ Period 6
  - Increases a bit down a Column
  - left to right : decrease

---

* Elements on the left of periodic table forms cations
* ~ ~ ~ right ~ ~ ~ ~ anions
* ~ ~ ~ Top ~ ~ ~ ~ anions
* ~ ~ ~ bottom ~ ~ ~ ~ Cations