Chapter 9: Models of chemical Bonding

- **Types of Bonding:-**

Groups 1A and 2A ↙ ↙ Groups 6A, 7A

1- **Ionic bonding:** - metal + nonmetal
- transfer of electrons

Prop	Metal	Nonmetal
At. size	larger	smaller
Z_{eff}	lower	Higher
IE	lower	Higher
EA	less negat.	More negative

2- **Covalent bonding:** - nonmetal + nonmetal
- sharing of electrons

Note: The chemical formula of Covalent Compound is the molecular formula

3- **Metallic bonding:** - electric pooling
metal + metal
sharing valence electrons

Lewis Electron Dewis Symbols

- Number of Dots = Valence Electrons = Group of the element

→ • **for a metal:** total number of dots = number of electrons That should be lass to form a Cation

→ • **for a non metal:** number of unpaired dots = number of electrons that atom gains to form a anion or # of electrons It shares to form Covalent bond.

* **octet rule:** لازم يكون حولين الذر 8 الكترونات ←
او 2 في حالة He, Li

The ionic Bonding Model :-

of electrons gained = # of electrons lost

Periodic Trends in lattice Energy :-

$\Delta H^\circ_{lattice}$ = lattice Energy : energy required to separate 1 mol of ionic solid into gaseous ions

→ Electrostatic energy $\propto$ $\Delta H^\circ_{lattice}$ $\frac{(+) \times (-)}{\text{radius of (cation + anion}}$

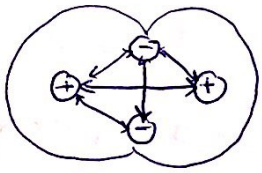
$\Delta H^\circ_{lattice}$ affected by : Ionic size and ionic charge

↑ ΔH ↓ ↑ ΔH ↑

Properties of ionic compounds

1- hard
2- Rigid
3- brittle
4- high melting points and boiling point
5- Do not Conduct electricity when in a solid state but Conducts it when melted or dissolved

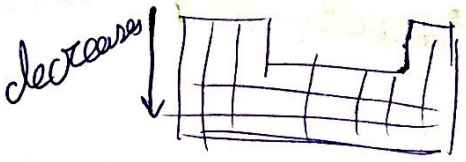
Distribution of electron density in H_2



Bond length

Note:

Electrostatic energy :-



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Bonding Pairs and lone Pairs :-

• ازواج الالكترونات المشاركة في الرابطة

(unshared Pairs) ازواج الالكترونات غير المشاركة في الرابطة

Note,
Bond Breaking: endothermic process
Bond formation: exothermic process

Properties of a Covalent Bond

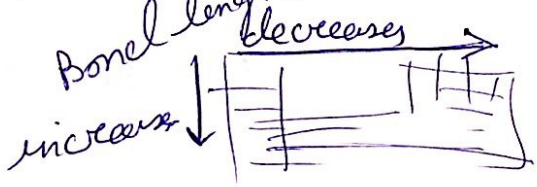
- **Bond Order** = number of Pairs in the bond single or double or Triple
- **Bond Energy** = energy needed to overcome the attraction between the nuclei and the shared electrons. (strength / enthalpy) — Always positive

stronger bond higher bond energy

- **Bond length** :- distance between the nuclei of the two bonded atoms

Bond order $\propto$ Bond energy $\propto \frac{1}{\text{Bond length}}$

↳ Shorter Bond means stronger Bond



ΔH°_{rxn} :- forming a bond → heat is released (exothermic Reaction, <0)
breaking a bond → " " absorbed (endothermic Reaction, >0)

$$\Delta H^\circ_{rxn} = \Sigma \Delta H^\circ_{\text{reactant bonds broken}} + \Sigma \Delta H^\circ_{\text{product bonds formed}}$$

Electronegativity and Bond Polarity

Polar covalent Bond: زوج الالكترونات مشارك بالتفاوت واقرب الى احد الـ atoms

قدرة الـ atom على جذب زوج الالكترونات

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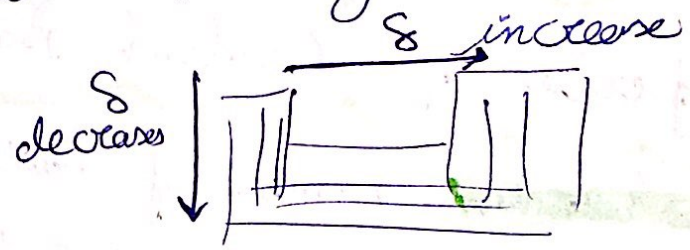
* الـ atom الأقل electroneg- يكون سالب جزئياً والأكثر electroneg... يكون موجب جزئياً في الرابطة

* يكون اتجاه السهم باتجاه الـ atom الأكثر electronegativity

Notes:-

The most electronegative element is fluorine

* Non metals are more electronegative than metals



ملاحظة: العنصر الأكثر electronegal- يكون على الـ shared atoms والأقل يكون على أي الأماكن

Oxidation Number:-

O.N = # of valence e^- − (# of shared e^- + # of unshared e^-)

ΔEN:

- ΔEN = 0 → Nonpolar covalent-
- 0 < ΔEN < 0.4 → covalent
- 0.4 < ΔEN < 1.7 → Polar covalent
- 1.7 < ΔEN < 3.3 → Mostly ionic

ΔEN ↓ ⇒ melting point and electrical Conductivity ↑

Because the bond type changes from ionic → polar covalent → nonpolar covalent

Note: Nonpolar covalent bond: atoms are identical

Ex : H−H , F−F

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