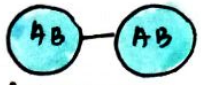
Chemical bonding

DEFINITION

- electrostatic forces of attraction that bind particles together to form matter
  -

    interatomic bonds
  - 

    intermolecular forces

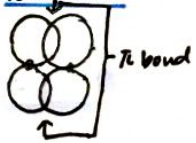
IONIC BONDING

- electrostatic force of attraction between oppositely charged ions, due to transfer of e^- from a metal to non metal.
- eg. $[Na]^+ \left[\cdot\underset{\times\times}{\overset{\times\times}{F}}\cdot \right]^-$
- Ionic bond strength depends on :
  - charge of ions - charge ↑ strength ↑ (stronger forces of attraction)
  - ionic radius - radius ↓ strength ↑ (short bonds)
- electrostatic attraction constitutes ionic bond.
- Sometimes called electrovalent bond.
- Evidence of ions :
  - Electrolysis
  - Electron density map (by x-ray) (produces contour map)

Electron density map

- Properties of ionic compounds
  - melting temp ↑
  - brittle
    - when force applied, similarly charged ions become next to each other ∴ repel & break.
  - electrical conductivity
  - solubility
    - solute-solvent bond > solvent-solvent, solute-solute
    - only in polar solvents (eg. H_2O)

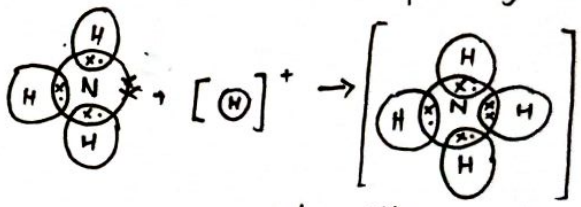
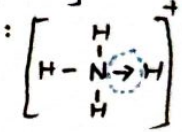
COVALENT BONDING

- sharing e^-
- atoms held together by electrostatic force of attraction between +ve charges of their nuclei & -ve charge on shared e^-.
- σ-bond
  -
    σ bond
- π-bond
  - 

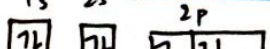
    (in p-orbitals only)!
- Double bonds are shorter & stronger than single bond.
  - double bonds = higher electron density.
    = greater force of attraction between nuclei & electrons.

DATIVE COVALENT BONDING

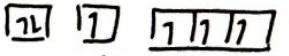
(co-ordinate bonding)

- when one atom provides both e^- for a covalent bond
  - lone pair
  - electron-deficient compound } must have
- 
  also written as : 
- min number of covalent bonds = number of single electrons in orbitals in ground state.
  - in excited state, electrons can be promoted into empty orbital of another subshell in same quantum shell

C (ground) 1s 2s 2p



(excited)



jump into subshell of same shell

METALLIC BONDING

- strong electrostatic force of attraction between a lattice of positive metal ions and the sea of delocalised electrons
- depends on → size of atom
  → charge
  → no of delocalised e^- per atom

size ↓, bond strength ↑
charge ↑, " ↑
more e^- ↑ " ↑

(AKA Al^{3+})

(Ionic bond continued)

- Not all ionic compounds have high m.p. & soluble in H_2O
  - due to polarisation of an ionic bond

anion distorted

- small cation has high charge density
- attract & distort electron cloud of anion
- → some degree of electron sharing
- → some degree of covalency.

(+) → small size, high charge ⇒ highly polarising (Group 2, 3) (Al^{3+}, Mg^{2+})

(−) → large size, high charge ⇒ highly polarisable 被吸,所以要大 (P^{3-}) (Group 5, 6, 7 below NOF)

* O^{2-} = ionic except Al_2O_3

atomic size ↑ ↓

AlF_3	ionic
$AlCl_3$	covalent
$AlBr_3$	covalent
AlI_3	covalent