Oct. 13th '11

Bonding

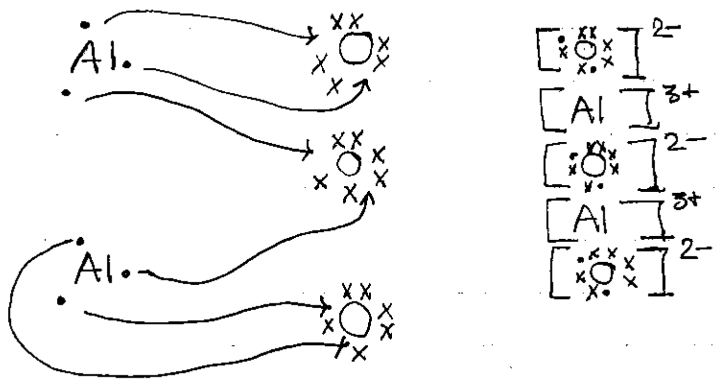
* Three types:
  - ionic bonding (metal loser / non-metal gainer)
  - covalent bonding (non-metal sharer)
  - metallic bonding (metals only - weird)

CH_4 - covalent
$LiCl$ - ionic
Na_2O - ionic
Au - metallic
N_2 - covalent
CO_2 - covalent

* Ionic Bonding:
  - metallic element with lower I.E. (ionization energy) loses electrons
  - non-metallic element with higher E.N. (electro-negativity) gains electrons
  - therefore a transfer of electrons occurs (metal → non-metal)
    - ↳ transfer must satisfy the octet rule
    - ↳ creates cations (positive) and anions (negative)
    - ↳ the ionic bond is a result of positive/negative attraction
  - EX: sodium with chlorine

NaCl

- aluminum with oxygen



Al_2O_3

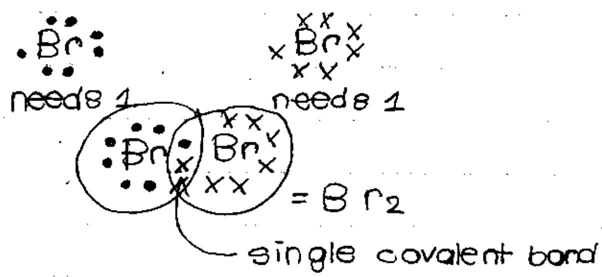
- strong electrostatic forces of attraction create the ionic bond
- multiple ions spontaneously arrange themselves into a crystal lattice structure

Oct-17th '11

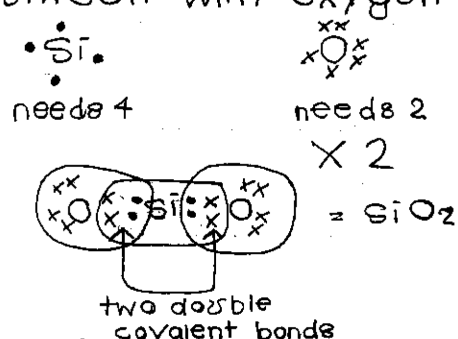
Bonding (cont'd)

* Covalent Bonding:

- this will occur with non-metallic elements only
- octet rule will be satisfied through sharing
  - ↳ sharing can be even = non-polar covalent bond
  - ↳ sharing can be skewed = polar covalent bond
- sharing is always in pairs
  - ↳ $2e^-$ / one pair = single covalent bond
  - ↳ $4e^-$ / two pair = double covalent bond
  - ↳ $6e^-$ / three pair = triple covalent bond
- EX: bromine with bromine

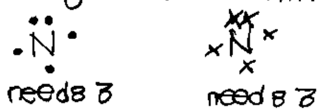


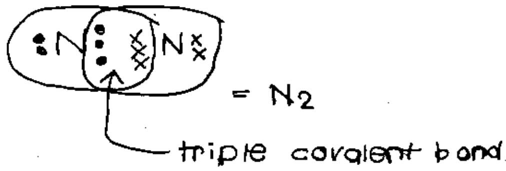
- EX: silicon with oxygen



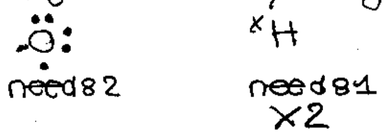
- Valence Shell Electron Pair Repulsion Theory } valence electron pairs repel each other and will locate as far as possible from each other

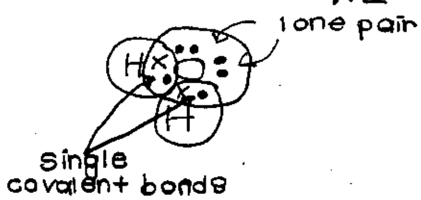
- EX: nitrogen with nitrogen





- EX: oxygen with hydrogen



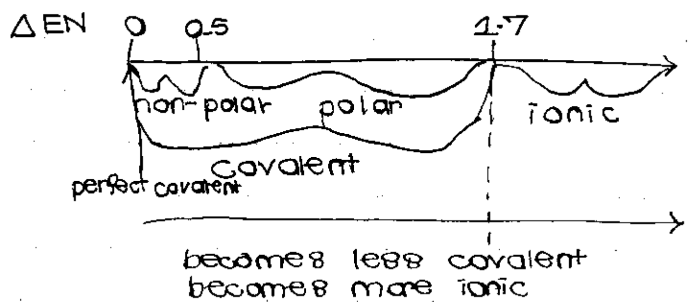


- mutual electrostatic force of attraction between atomic nuclei and bonding electrons creates the covalent bond
- very strong bonds; they are "true bonds"
- only type of bonding that can create small molecules (discrete covalent molecule)
- molecules can be very complex

Oct. 24th, '11

Ionic vs. Covalent Bonding and Molecular Polarizations

- easy rule: metal + non-metal → ionic
  non-metal + non-metal → covalent
- difficult rule: ΔEN (difference in electronegativity

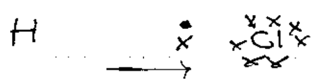


- EX1: Li 0.98, F 3.98 — $\Delta EN = 3.98 - 0.98 = 3.00$ ∴ ionic

- EX2: H 2.20, O 3.44 — $\Delta EN = 3.44 - 2.20 = 1.24$ ∴ polar covalent

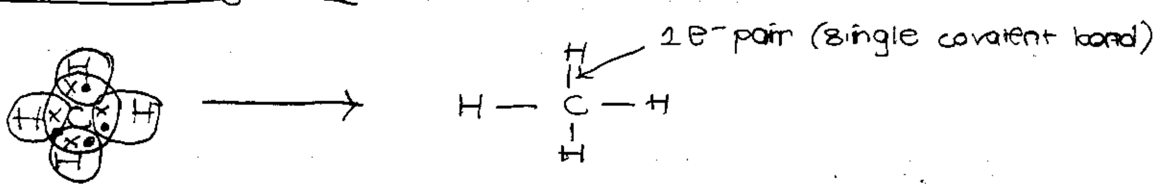
- EX3: H 2.20, C 2.55 — $\Delta EN = 2.55 - 2.20 = 0.35$ ∴ non-polar covalent

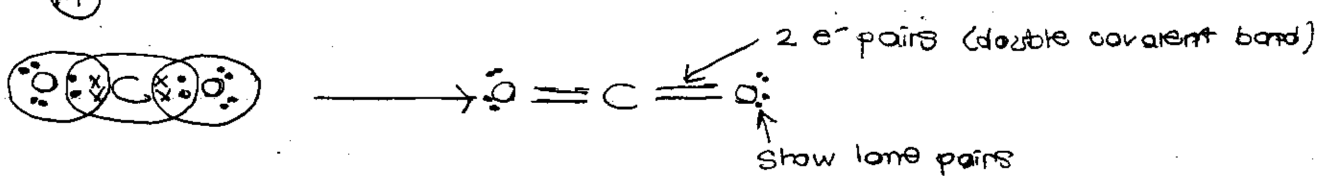
- EX4: HCl — $\Delta EN = 3.16 - 2.20 = 0.96$ ∴ polar covalent



e⁻ pair shifts towards the more electronegative Cl — CORRECT DIAGRAM

* Stick Diagram:





- sample bonds:

C — C non-polar
2-55 2-55

C ⟶ O polar (towards oxygen)
2-55 3.44

↑ shows polarization (e^- shift) towards oxygen

O ⟵ H polar (towards oxygen)
3.44 2-20

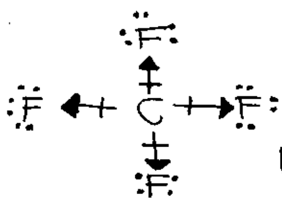
H — C non-polar
2-20 2-55

C ⟹ O

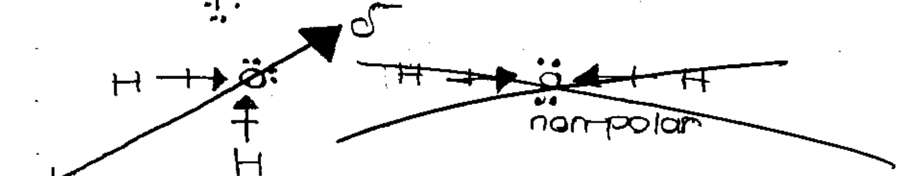
δ^+ H ⟶ Cl δ^- polar molecular
net molecular polarization

δ^+ - partial positive charge (partial 1^+)
δ^- - partial negative charge (partial 1^-)

the partial charges are a result of the shift in e^- due to ΔEN



non-polar molecule
no net molecular polarization
bond polarizations are balanced



net molecular polarization