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Chapter no. 2 Atomic Structure & interactions & Bondings.

BONDING FORCES & ENERGIES:-

At large distances interactions are negligable. because there is no influence of atoms on eachother. however at small separation they exert forces like

↙ ↘

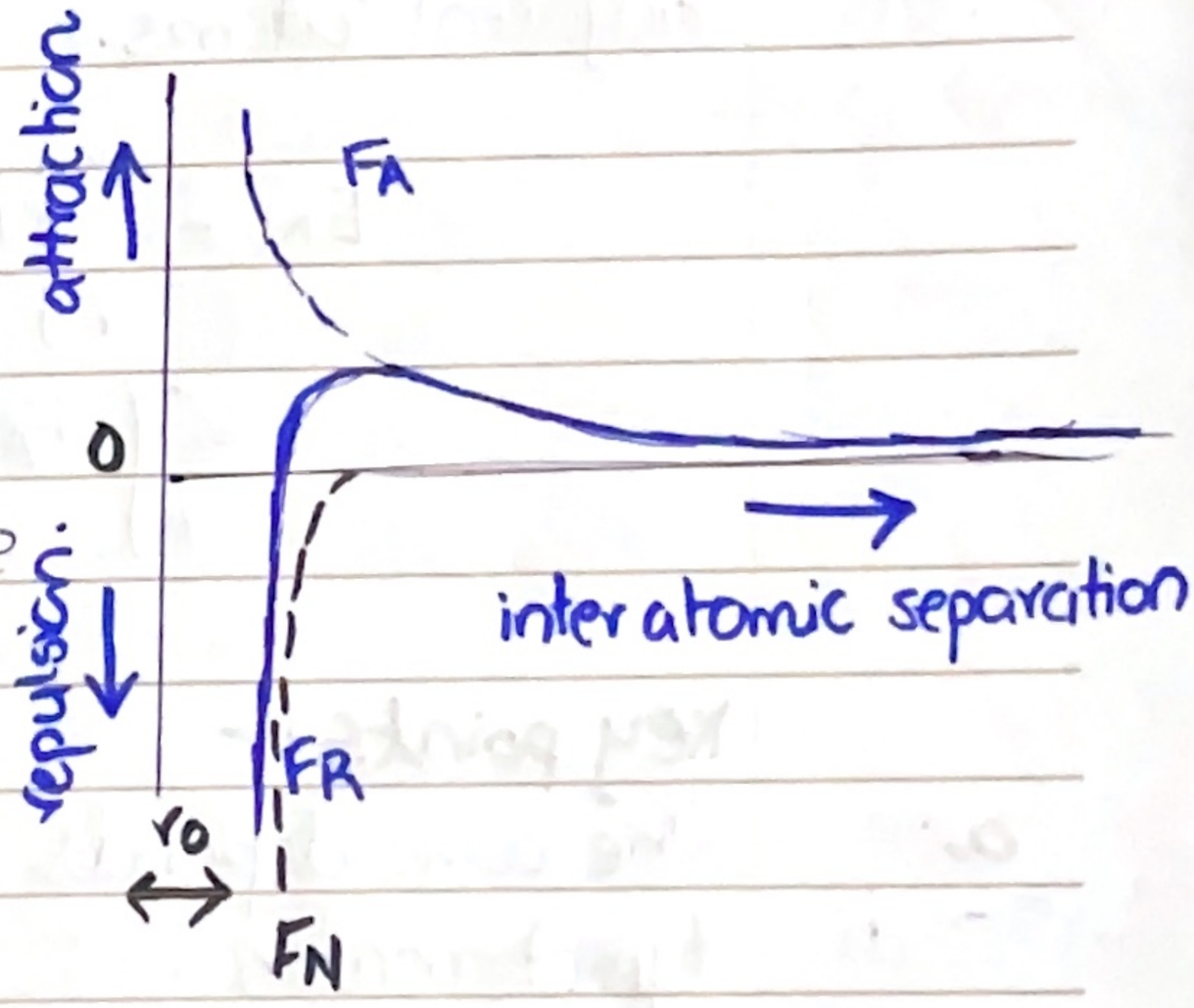
Forces of attraction (F_A) Forces of repulsion (F_B)

and their magnitude depend upon

(i) atomic sizes
(ii) intermolecular distances.

Fig(a)

A plot of F_A & F_R versus r. The origin of the attractive force F_A depends upon the particular type of bonding that exisit between two atoms. Repulsively forces arise from interaction of $-\bar{e}$ clouds



Net force $F_N \Rightarrow F_A + F_R$

If $F_A = F_R$ $[F_N = 0]$ This is the state of equilibrium The centres of the two atoms separated by r_0 (equilibrium spacing)

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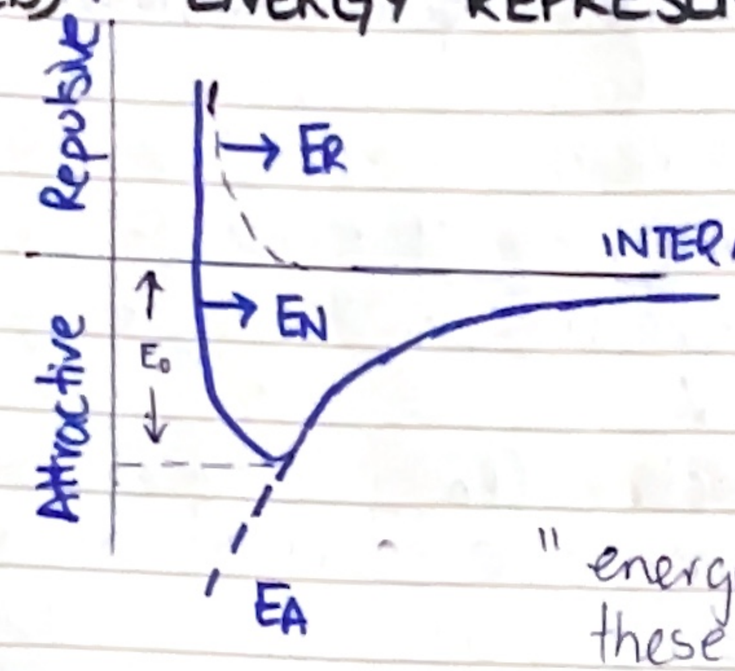
* Usually (r_0) for atoms = 0.3nm.

FIG (b). ENERGY REPRESENTATION.



E_0 = bonding Energy.
" energy required to separate these two atoms to ∞. r)

Another convinent method of representing with potiential energies, in which E_N, E_A & E_R are energies of respective two isolated and adjacent atoms.

$$E_N = \int_r^\infty F_N dr$$

$$= \int_r^\infty F_A dr + \int_r^\infty F_B dr$$

$$= E_A + E_B.$$

key points:-

a. The curve depends upon;
   (i) typeof materials
   (ii) type of bonding.

b. Two atoms attracting eachother, at a certain point would also experience repulsion due to collision of e^-s

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c. Measure of F_A & F_R is used to figure out
   → atomic no. / size
   → energy etc.

(iii) METALLIC BOND:- Sharing of delocalized e^-s across the lattice of metal atoms.

PRIMARY INTERACTION BONDS:-
→ (between metallic & non-metallic bonds)

(i) IONIC BONDING:- $E_A = -A/r$

(ii) COVALENT BONDING:-
(between atoms of low electronegativity difference)

SECONDARY BONDING.

(iii) VANDER WAAL FORCES:-
(i) Also known as the secondary bond.
(ii) It is absent when primary bond is present.
(iii) These bonds occur when coulombic attraction between positive and negative electric dipoles occurs which may be either
   a. induced dipoles.
   b. polar molecules (permanent dipoles).

(iv) H-Bonding :- (H_2O, HN, DNA)
The type of intermolecular bonding that occurs when H atom is covalently bonded to a highly electro-negative atom in a nearby molecule (i.e N, O, F), experiences a strong attraction to another electronegative molecule nearby.
* special type of dipole-dipole interactions.

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(v) **Partial Covalent bonds:-** (H_2O, HF, HCl)
Also known as polar covalent bonds, arise when 2x atoms with different electronegativities share electrons in a covalent bond. In such bond the es are not equally shared b/w atoms but spend more time with ↑ΔE atom.

(vi) **Dispersion forces:-** (helium, neon etc).
Also known as London dispersion/ vander waals forces exisit b/w all as intermolecular forces.

Formed due to temperary electron fluctuation creating dipoles.

* Check example from slide for identification.

Q. Describe the usual physical states of material with certain attractive forces.
Correlation b/w bonding type & material type.
Polymers → covalent
Ceramics → ionic/mixed ionic-covalent
Metals → metallic
Molecular solids → vander waals
Semimetals → mixed-covalent-metallic
Intermetallics → mixed-metallic.
ionic

Q. What is the influence of temp & pressure on certain attractive / bonding forces.

Effects of temperature:-

① Metallic Bonds } higher temps can weaken the bond.
② Ionic Bonds }
③ Partial covalent B & Covalent bonds; higher temps can make/break bonds.
④ H-bonds; higher temps weaken the bonds.
⑤ dispersion forces; higher temps can increase their strength but only to a certain limit.

Effects of Pressure:
▷ Metal bonds: Not effected by ΔP.
① Dispersion forces:- ↑P can cause higher densities of molecules enhancing D. forces
② Partial C.B & Covalent Bonds :- Pressure changing V & D like compression changes molecular structure.
③ H-bonds :- Pressure typically has minimal effect.
④ Ionic bond:- Pressure can effect to a certain extent however less than metallic

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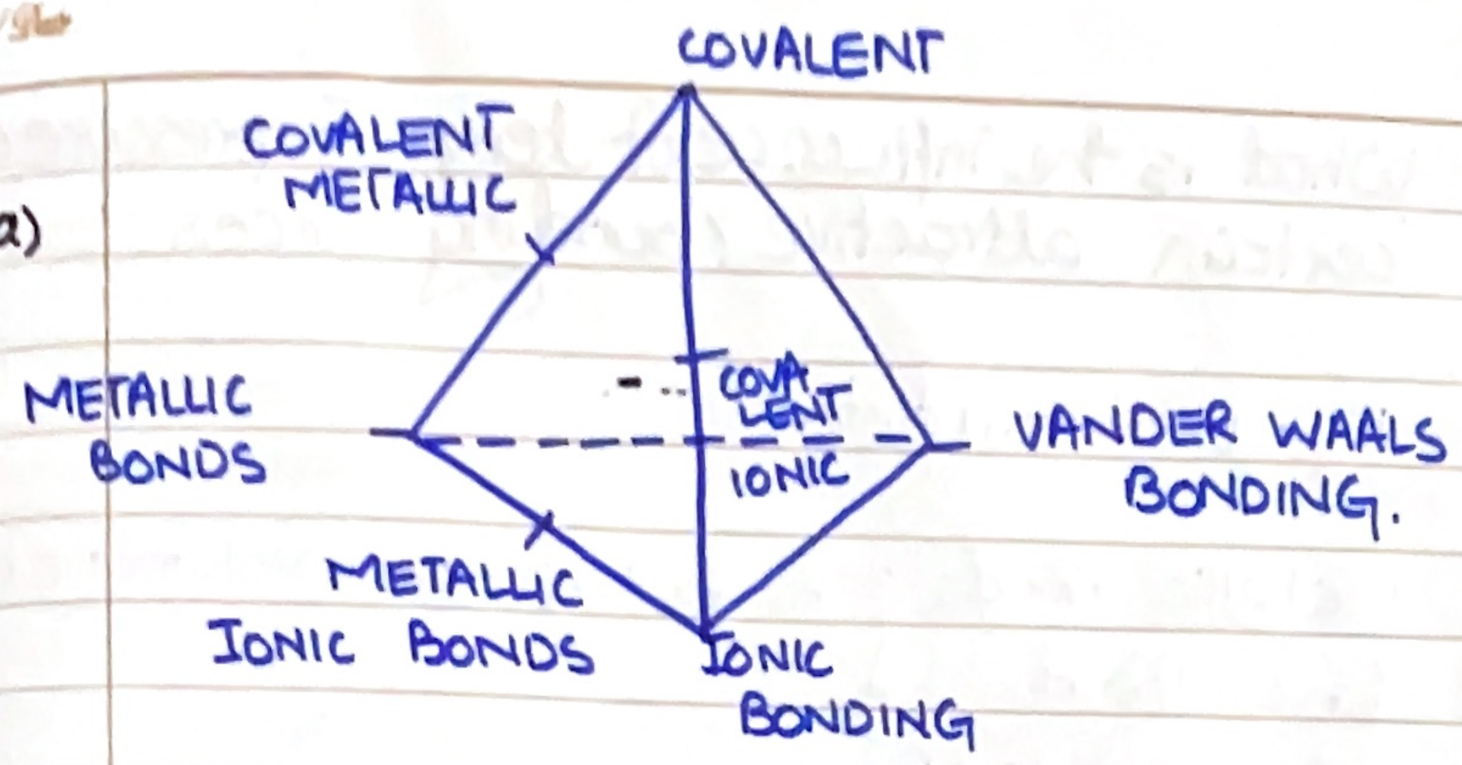
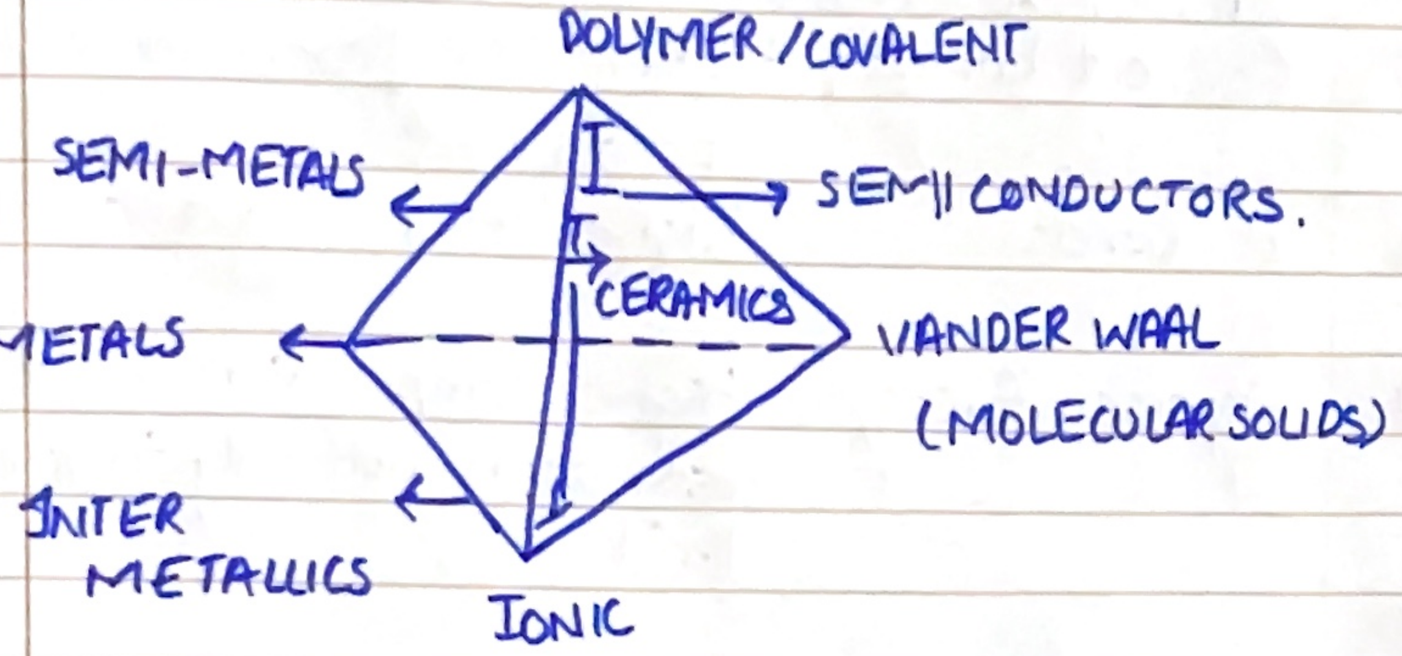
(a)



(b)



Q. Describe Molecules.

① Many molecules are composed of strong covalent bonds adjoining many atoms. Example: Elemental diatomic molecules (F_2, Cl_2, O_2 etc) other compounds like H_2O, CO_2, HNO_3 etc.

② In the condensed liquid and solid states bonds are weak secondary ones.

③ Molecular materials have law M.P & B.P.

④ Most materials that have small molecules composed of a few atoms are gases at ordinary.

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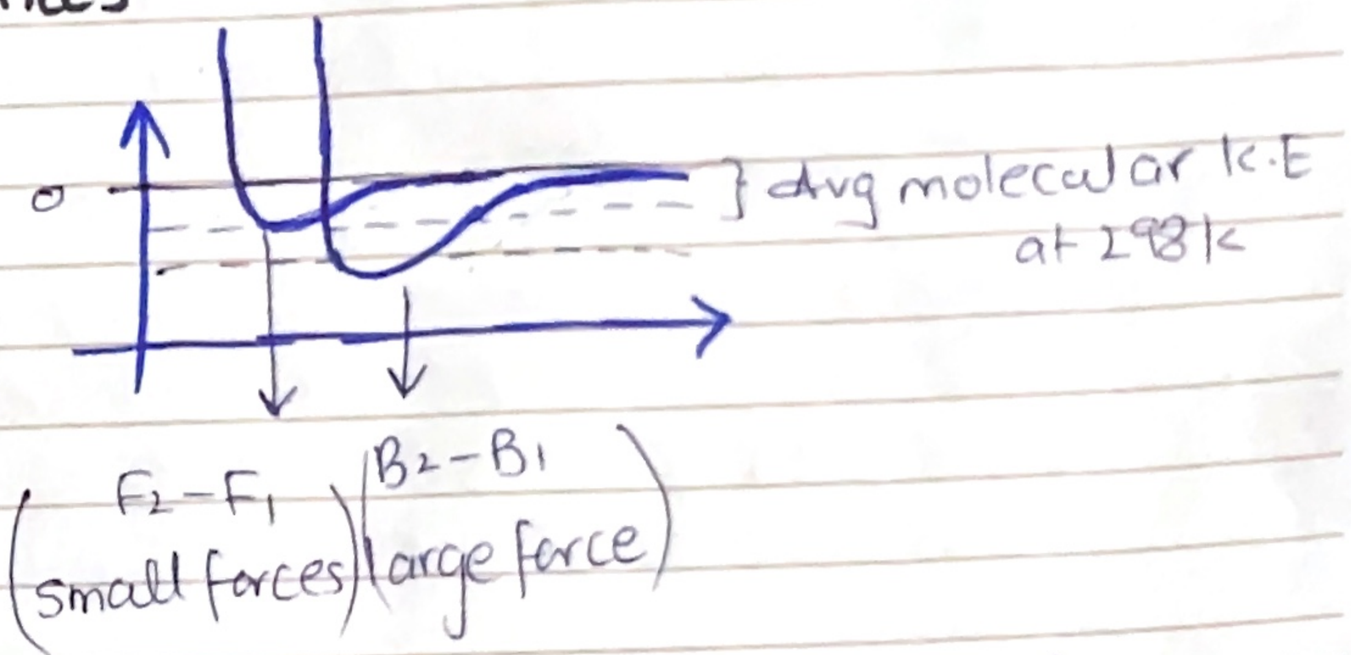
⑤ Modern polymers of extremely large molecules, exisit as solids, some of their properties are strongly dependant on the pressure of vander waals & hydrogen secondary bonds.

Q. Intermolecular forces of attract/repulsion in relation with atomic size / intermolecular distances.



Therefore large atomic size require greater energy to withhold the structure.