15.3.2012 MATERIAL SCIENCE

ATOMIC BONDING IN SOLIDS

F_A ⟶ Attractive force between two atoms & depends on the particular bonding that exists between the two atoms. Magnitude varies with distance

F_R ⟶ Repulsive force between two atoms ⇒ repulsion between electron clouds of two atoms.

F_N ⟶ Net force between two atoms

$= F_A + F_R$

$F_N = 0$, if $F_A = F_R$

r_0 ⟶ Distance of separation (spacing between two atoms)

$= 0.3\ nm\ (3A) = 0.3 \times 10^{-9} m$

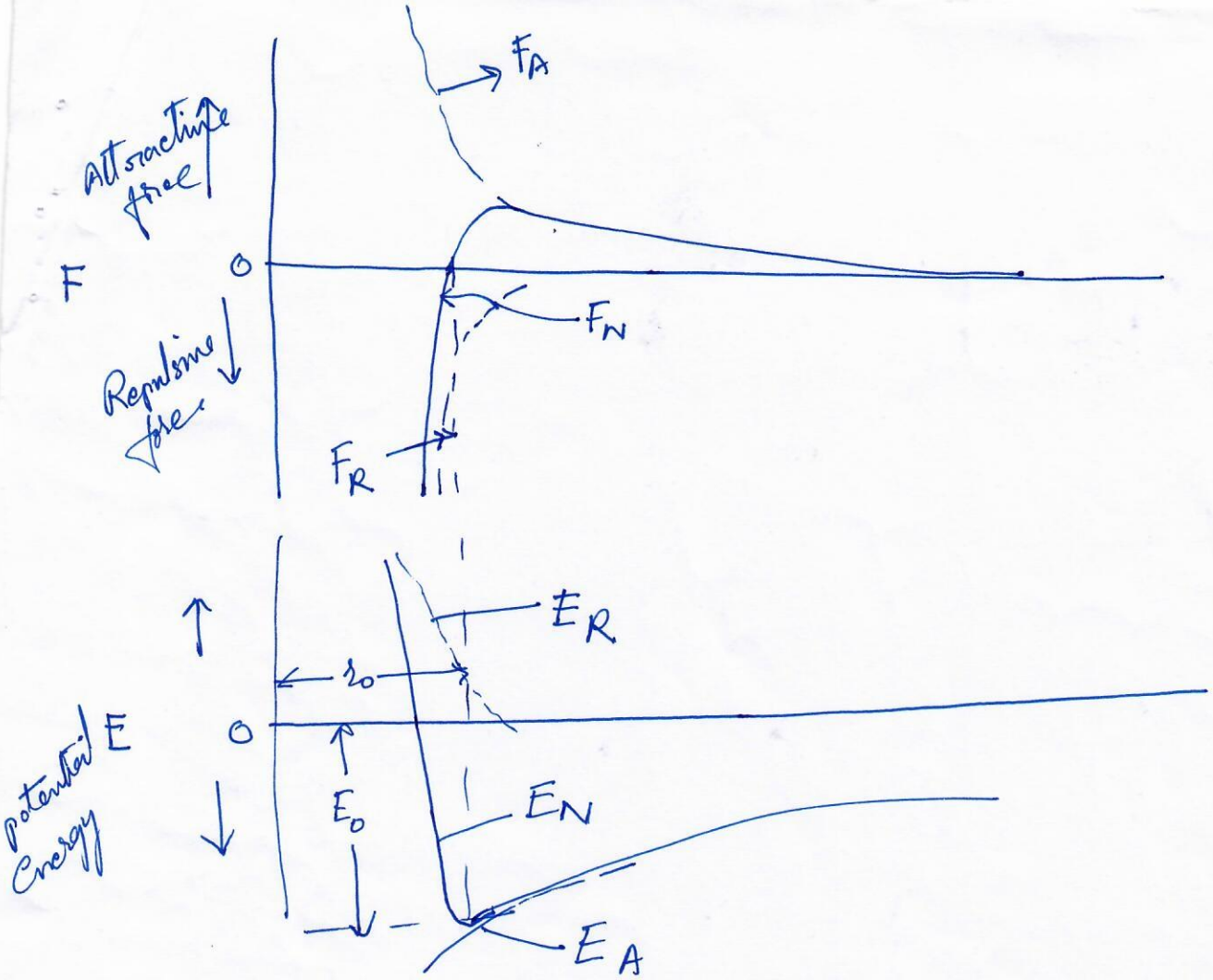
$= 3 \times 10^{-10} m = 3A^0$.

= In this position, two atoms counteract any external push or pull.

E ⟶ Potential energy due to interatomic forces

$= \int F dr \quad F \rightarrow F_R$ or F_A.

E_N ⟶ net



Interatomic Bonding

Ionic Bond

$$E_A = -\frac{A}{r} \quad \text{where } A = \frac{1}{4\pi\epsilon_0}(Z_1 e)(Z_2 e)$$

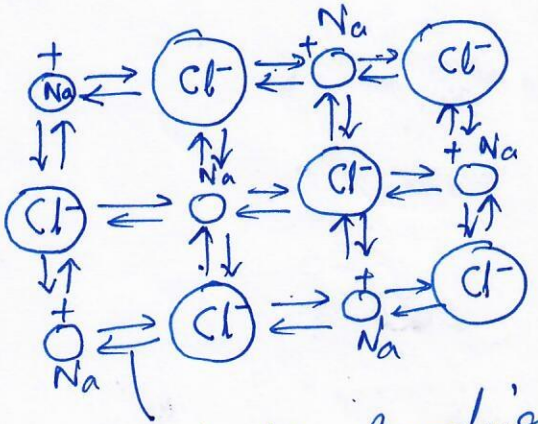
$$E_R = \frac{B}{r_0^n}$$

$\epsilon_0 = 8.85 \times 10^{-12}$ F/m permittivity of vacuum

Z_1 & Z_2 are valencies

$e \rightarrow 1.602 \times 10^{-19}$ C

& 1.602×10^{-19} J = 1 eV.



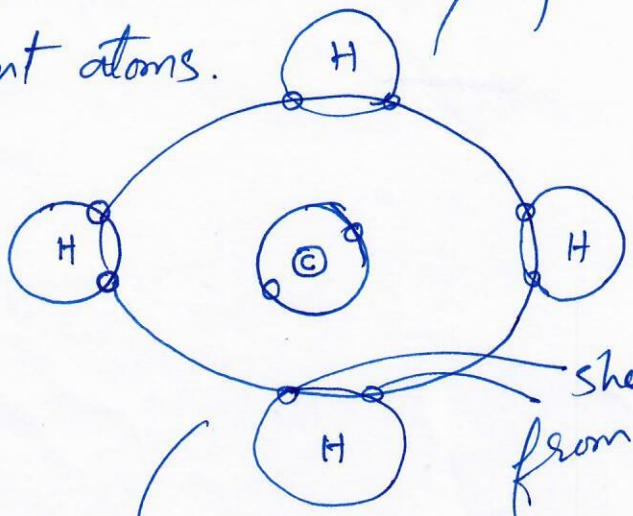
Coulombic Bonding force NaCl.

Bonding Energy = 640 kJ/mol.

$n = 8$

COVALENT BONDING

Bonding due to sharing of electrons by adjacent atoms.

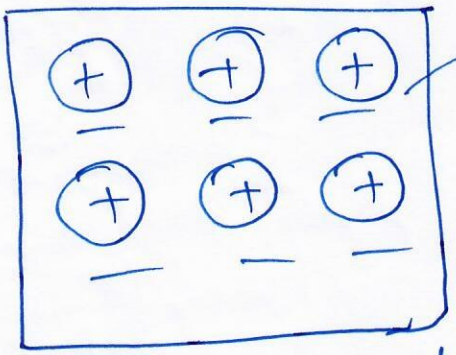


Diamond has covalent bonding] Bonding energy = 713 kJ/mol

Melting temp — 3550°C

Bismuth — 270°C] weak bonding.

METALLIC BONDING



assumed to be one nucleus (+ve) and an electron cloud.

Energy of bonding = 68 kJ/mol

Wander Walls Bonding

weak bonding of energy = 10 kJ/mol

THE SPACE LATTICE & UNIT CELLS

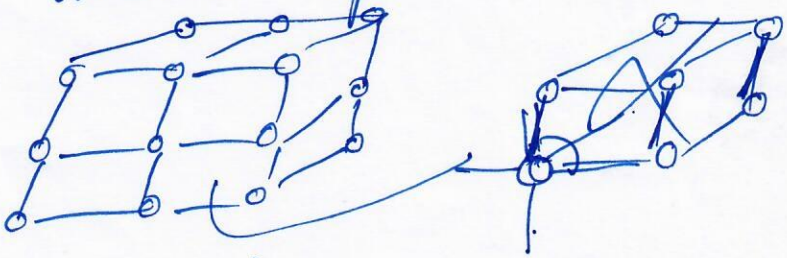
Solids ⟶ CRYSTALLINE Solids
(Orderly structure of their atoms, molecules ions posses well-defined shapes)
example metals)
shapes ⟶ crystals or grains.

Amosphous Solids
(No well defined structures)
of atoms, molecules or ions

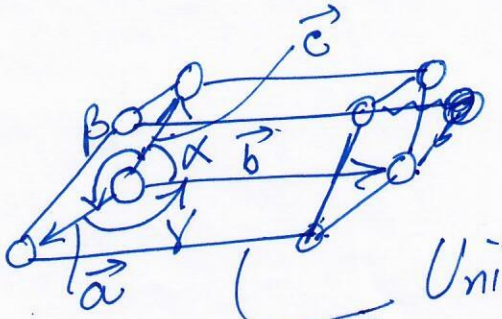
LRO ⟶ long range order

SRO ⟶ short range order

Space lattice ⟶ Atomic arrangement network is called space lattic



Nomenclature



Unit cell

$\vec{a}, \vec{b}, \vec{c}$ lattic vectors

α, β, γ → inter axial angles

Space lattic is formed by Repeated unit cell.

Crystal → Grouping of lattice points

Unit Cell → 14-types called Bravais lattices and are 4-basic types.

4-Basic Unit Cells

1. Simple 2. Body Centred
3. Face Centred 4. Base Centered

Wander Walls binding exists between induced dipoles and permanent dipoles of a material. These are of the order of 10KJ/mol.