VIVEKANANDA COLLEGE
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KOLKATA-700063

NAAC ACCREDITED 'A' GRADE

Topic: physics of crystalline solids

Course Title: Applied Physics

Paper: CC-3

Unit:

Semester: 2

Name of the Teacher: Romela Dutta

Name of the Department: Electronics

CC-3

Solid state physics

Bravais lattice, primitive vectors & unit cell

- A collection of pts in which the neighbourhood of each point is the same as the neighbourhood of every other pt under some translation is called Bravais lattice.

- The primitive unit cell is the parallel piped (in 3D) formed by primitive lattice vectors

Bravais lattice refers to the 14 different 3D configurations into which atoms can be arranged in crystals. The smallest group of symmetrically aligned atoms which can be repeated in an array to make up the crystal is called unit cell.

Bravais lattice is an array of discrete points with an arrangement & orientation that look exactly the same from any of the discrete points, that is lattice pts are indistinguishable from one another.

Sunday 15

14 types of Bravais lattice

Out of 14 types of Bravais lattices some 7 types of Bravais lattices in 3D space are listed here. a, b & c have been used to denote the dimensions of the unit cells whereas α, β & γ denote corresponding angles in unit cells.

16 MONDAY

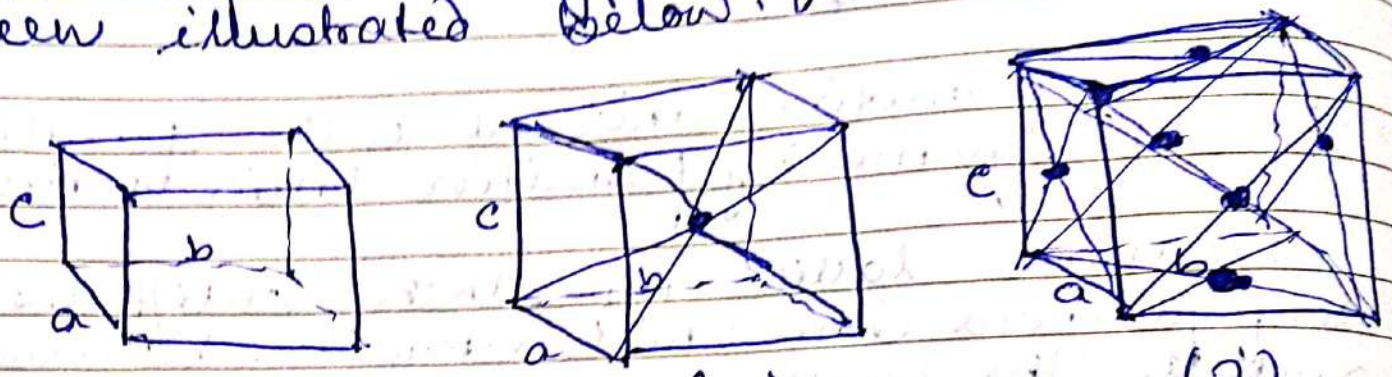
Wk. 016-349

(1) Cubic systems

In Bravais lattices with cubic systems, the following relationships can be observed,

$$a = b = c, \quad \alpha = \beta = \gamma = 90^\circ$$

The 3 possible types of cubic cells have been illustrated below.



(x) (y) (z)

(x) → Simple cubic cell

(y) → Body Centred cubic cell (BCC)

(z) → face centred cubic cell (FCC)

(2) Orthorhombic Systems

$$a \neq b \neq c,$$

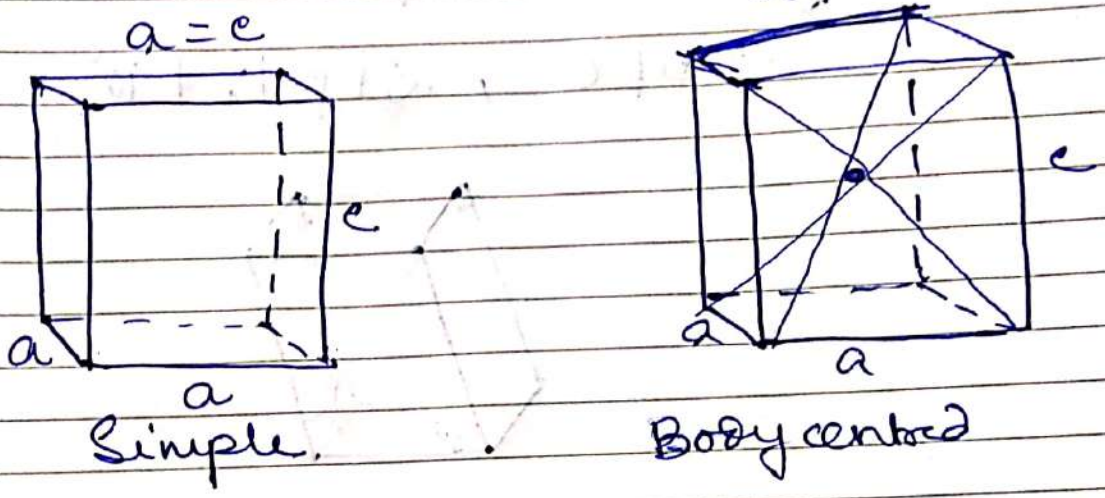
$$\alpha = \beta = \gamma = 90$$

The four types of orthorhombic systems are simple, base centred, face centred and body centred.

(3) Tetragonal systems

$a = b \neq c$; $\alpha = \beta = \gamma = 90°$

The two types of tetragonal systems are simple tetragonal cells and body centred tetragonal cells.

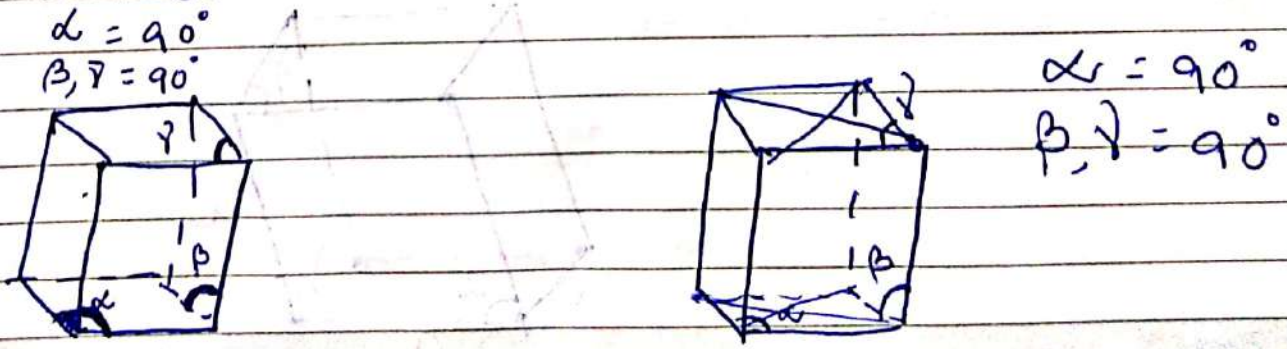


ex — Stannic oxide & Titanium oxide.

(4) Monoclinic systems

$a \neq b \neq c$; $\beta = \gamma = 90°$ & $\alpha \neq 90°$

The two possible types of monoclinic systems are primitive and base centred monoclinic cells

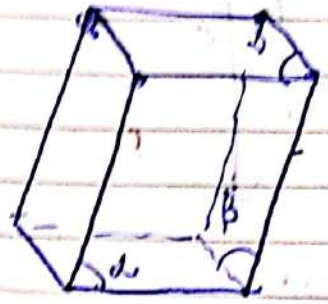


eg - Monoclinic sulphur and Sodium Sulphate decahydrate.

(5) Triclinic System

There exists only one type of triclinic Bravais lattice which is a primitive cell. It obeys the following relationship.

$a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90^\circ$

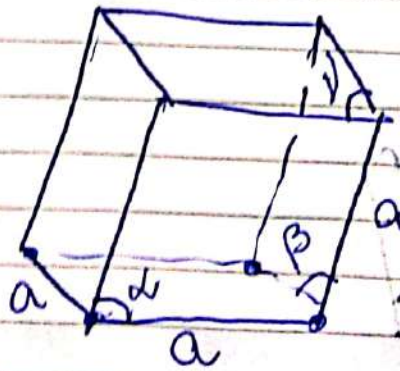


eg - Potassium dichromate ($K_2Cr_2O_7$)

(6) Rhombohedral System

$a = b = c$; $\alpha = \beta = \gamma \neq 90^\circ$

$\alpha = \beta = \gamma \neq 90^\circ$

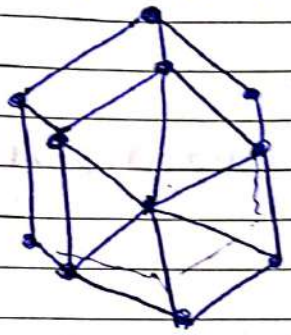


ex - Calcite and Sodium nitrate

(7) Hexagonal system

The only type of hexagonal Bravais lattice is the simple hexagonal cell.

$a = b \neq c$; $\alpha = \beta = 90^\circ$ & $\gamma = 120^\circ$



ex - Zinc oxide and beryllium oxide

Thus it can be noted that all 14 possible Bravais lattices differ in their cell length and angle relationships.