Solids

Characteristic propery → Definite shape
→ Definite volume
→ Rigidity
→ High density
→ Low compressibility.

Constituent particles (atom/molecules OR ions) are closely packed and held together by strong forces.

Form of solids / Type of solids

Crystalline Solid	Amorphous solid
1) Definite and regular arrangement of constituent particles in space	1) Donot have any regular arrangement of constituent particles
2) True solids	2) pseudo solids
3) Long order arrangement of particles	3) Short order arrangement of particles. (Here particles are not in regular arrangement and posses only short range order) Here particles are arranged ~~regular manner~~ upto a small region).

4)

In crystalline solid, the particles (ion, molecule or atoms) are arranged in definite geometric pattern in 3Dim network. This is known as long range order. This arrangement repeat's periodically over the entire crystal. ~~Due to this~~

long range order → regular arrangement of particle keeps reppeating itself over and over for a huge number of particles

4) Sharp Mpt

5). These are Anisotropic in nature ie their physical properties are different in different directions.

* conductance, mechanical strength.

6) They give clean surface after cleaving it $\bar{c}$ a knife.

4) they melt over a certain range of temp.

5) These are isotropic in nature ie their physical properties are same in all the direction

6) Donot give a clean surface after cleavage $\bar{c}$ knif They undergo irregular breakage.

7) Not true solids.

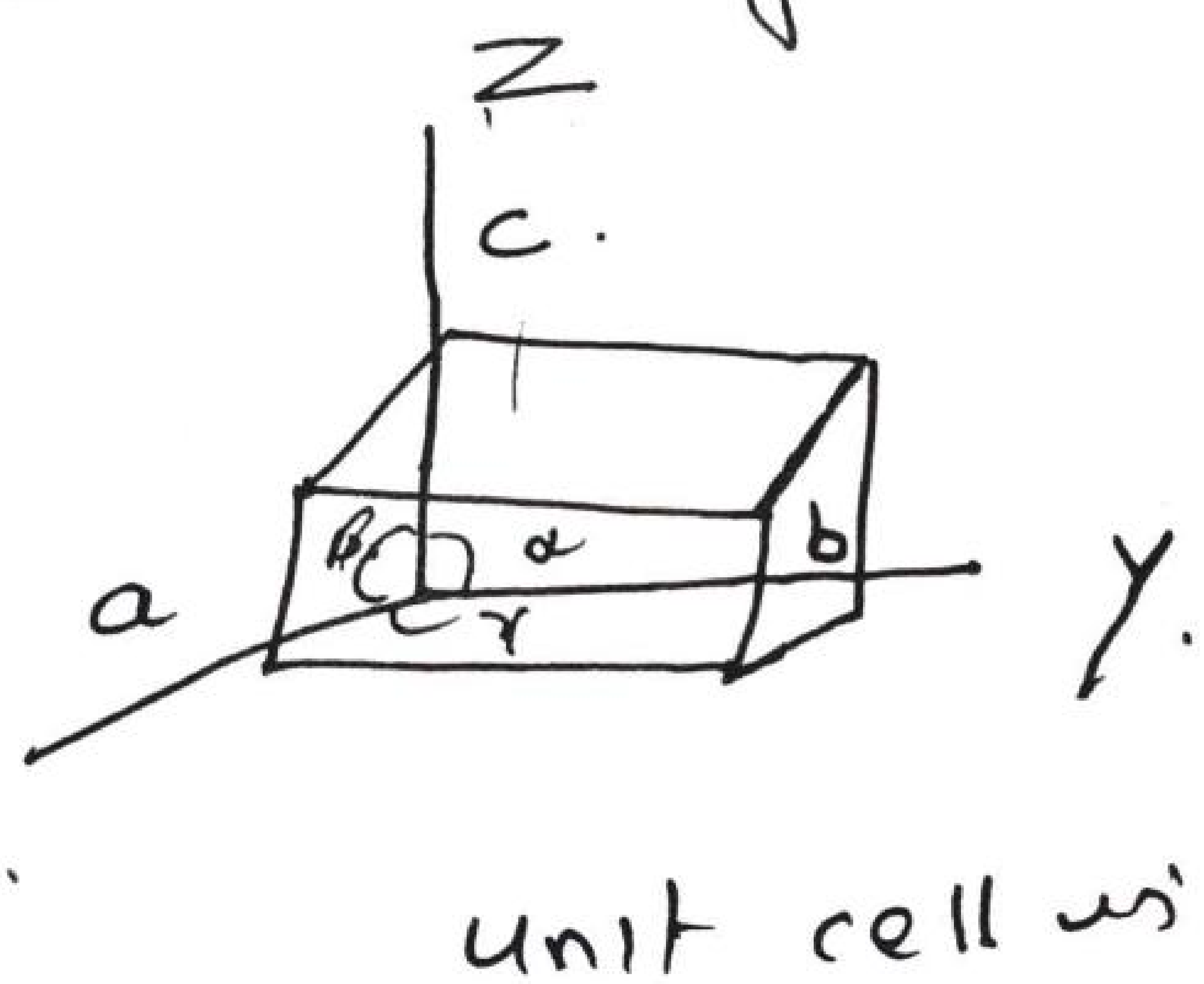
cz Due to short range order, small part of amorphous solid may be crystalline and rest may be non crystalline.

Scanned by TapScanner

space lattice OR crystal lattice ⇒ It may be defined as regular 3-Dim arrangement of identical points in space.

The positions which are occupied by atoms ions OR molecules in the crystal lattice are called lattice points OR lattice sites.

Unit cell ! A space lattice can be sub-divided into a no. of small cells known as unit cells. It can be defined as the smallest block from ~~unit~~ which entire crystal can be built up by its repetition in 3 Dim.



unit cell is characterised by a, b & c along three edges of unit cell. and angle α, β, γ b/w the pair of edges.

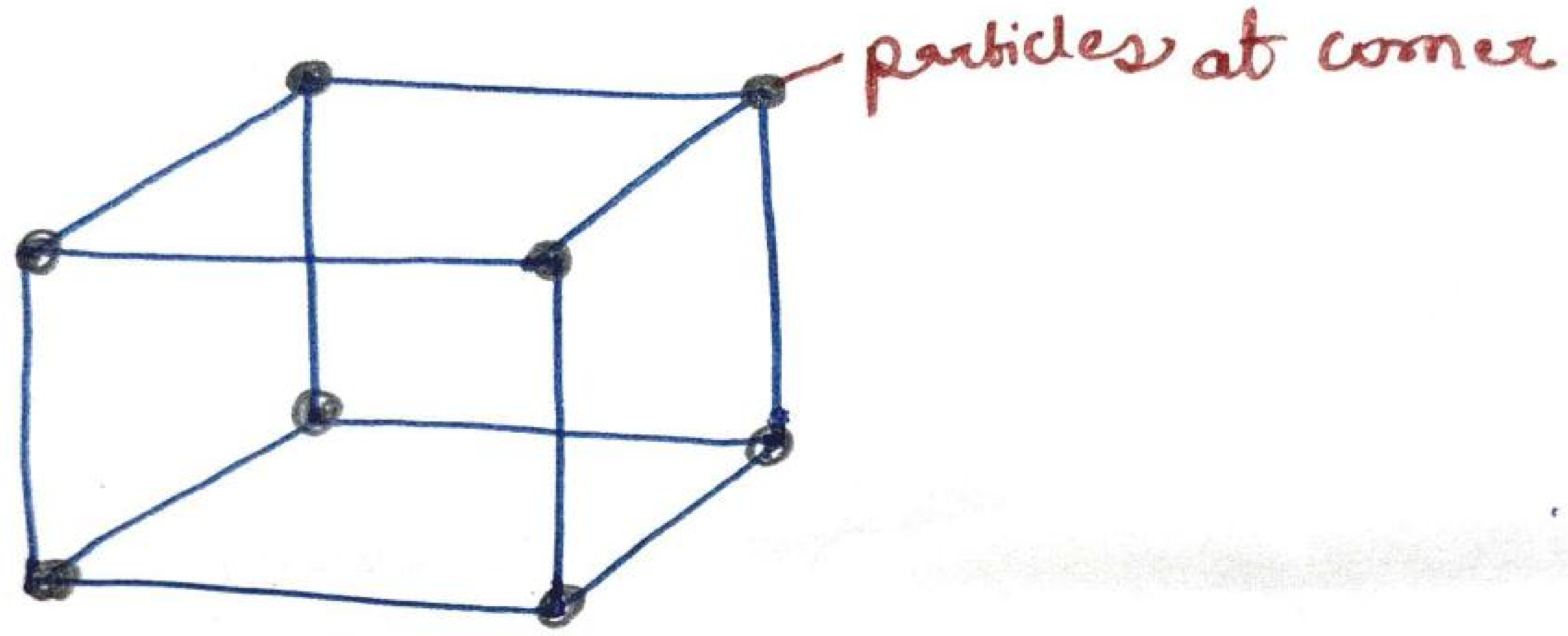
crystal → homogeneous solid, which is formed by 3-D repeating unit (pattern of ions, atoms, molecule) with fixed distance

Crystal lattice ⇒

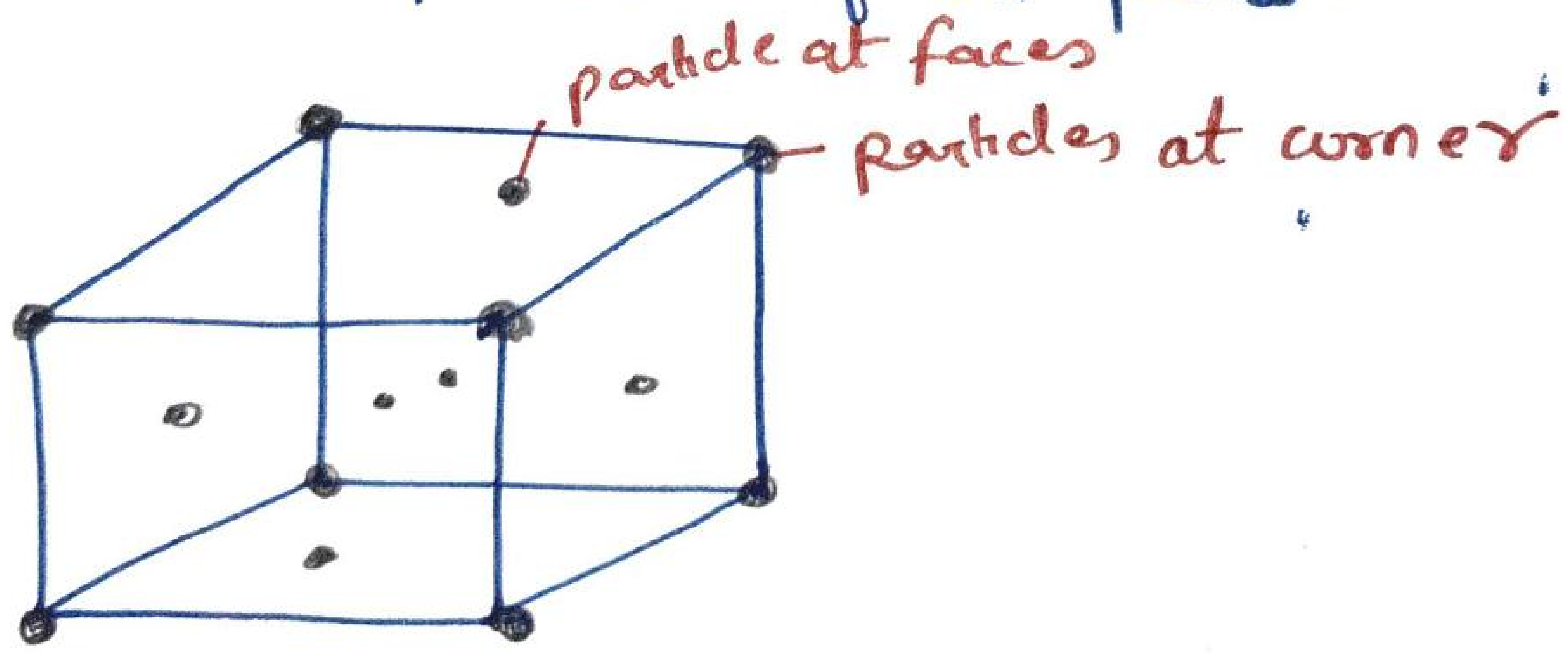
Smallest portion of crystal lattice → is called unit cell. It can be used as repetitive unit to ~~build~~ build up the whole crystal.

Types of unit cell ⇒

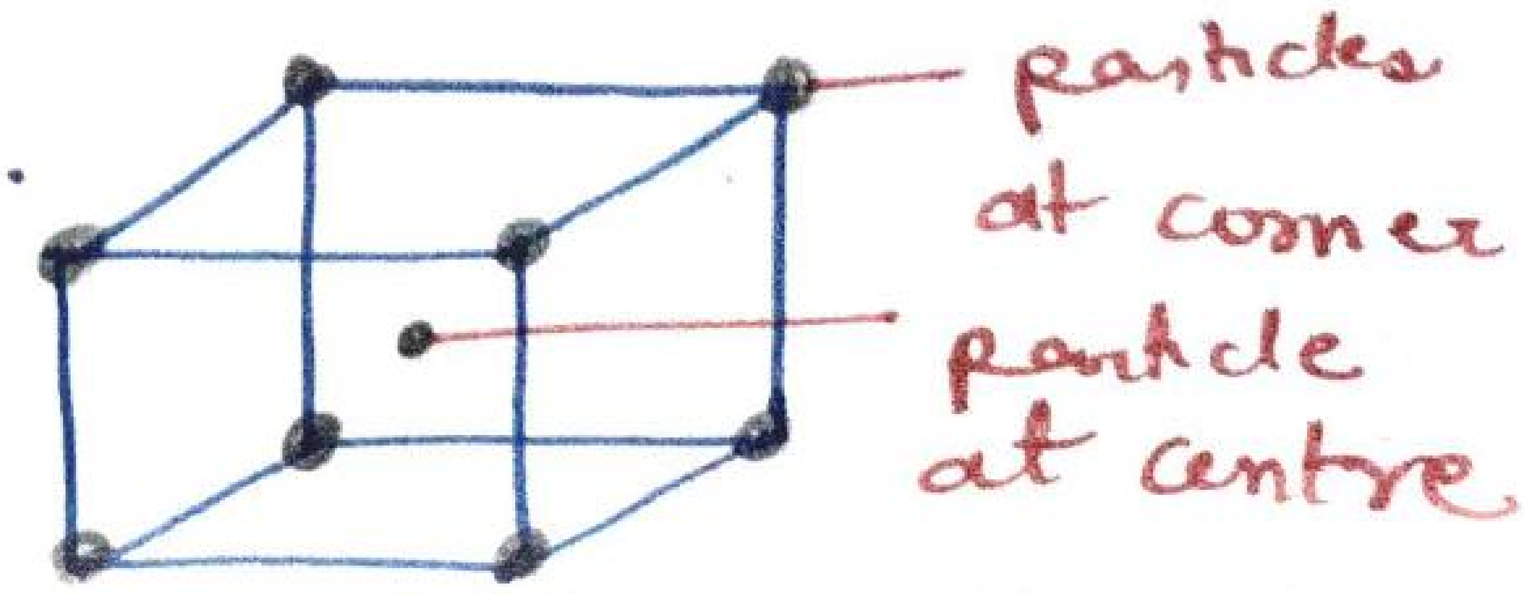
(i) Simple / primitive unit cell → particles are present at the corners only.



(ii) Face centred unit cell → particles are present at the corners as well as at the centre of each of six faces.



(iii) Body centred unit cell → particles are present at the corners as well as at the centre of the unit cell.



Unit cell	No. of particles and their contribution			
	Corner	Face	Centre	Total
Simple cubic	$8 \times \frac{1}{8}$	—	—	1
Face centred	$8 \times \frac{1}{8}$	$6 \times \frac{1}{2}$	—	4
Body centred	$8 \times \frac{1}{8}$	—	1	2

[To calculate no. of atoms combined within Simple, body, Fcc.

Calculation :-

(i). Simple cubic unit cell consists of one atom at each of the 8 corners. Each atom is thus shared by 8 unit cell Hence $n = 8 \times \frac{1}{8}$

(2) bcc ⇒ consists of 8 atoms at the 8 corners and one at centre.

At each corner only $1/8$ th of atom is within the unit cell. Thus contribution of 8 corner is $8 \times 1/8 = 1$. while that of body centred atom is 1 $\therefore n = 1+1 = 2$.

3) Fcc = 8 atoms at corner contribute $8 \times (1/8) = 1$. There is one atom at each of 6 faces which is shared by 2 unit cells each.

$\therefore$ contribution of 6 faced centred atoms $= 6 \times \left(\frac{1}{2}\right) = 3$ $n = 1+3 = 4$.

Bravais lattices

on the basis of interfacial angle & axes ← 230 crystal forms → on the basis of their symmetry

based on repeating units

grouped into

14 types of space lattices (Bravais lattices)

7 different crystal systems.

crystal system	Parameters of the unit cell	
	Intercept/axes	Angles.
1 Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90°$.
2. Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90°$
3. Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90°$
4. orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90°$
5. Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = 90°, \beta \neq 90°$
6. Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90°$.
7. Hexagonal	$a = b \neq c$	$\alpha = \beta = 90°, \gamma = 120°$

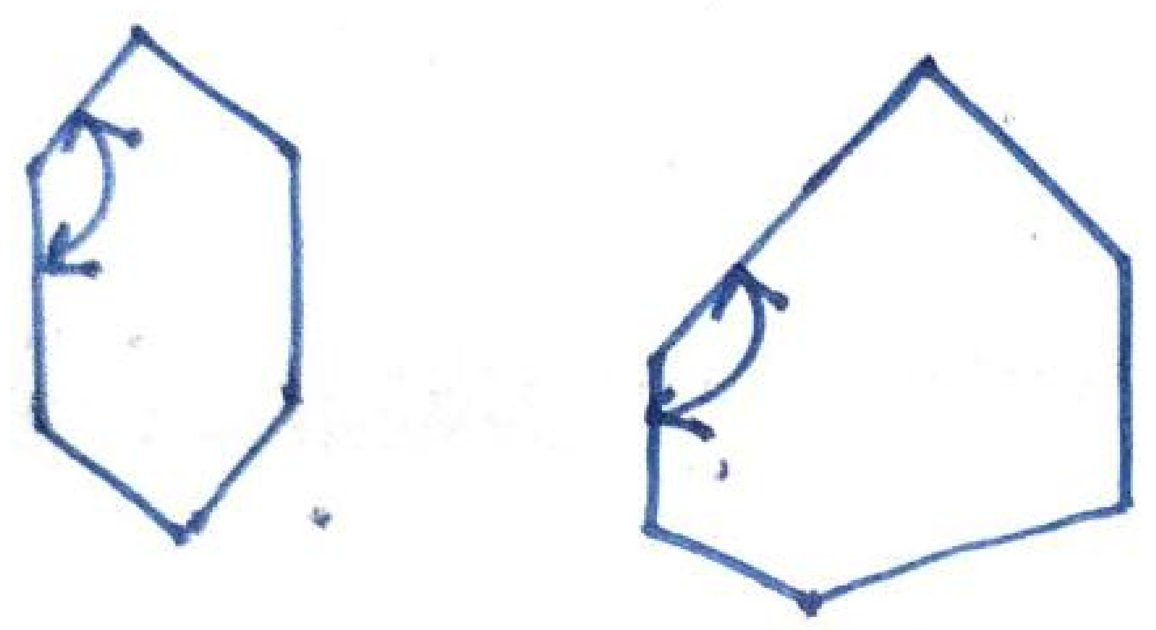
Symmetry elements

Two important property of a crystal.

(i) Interfacial angle

(ii) Symmetry.

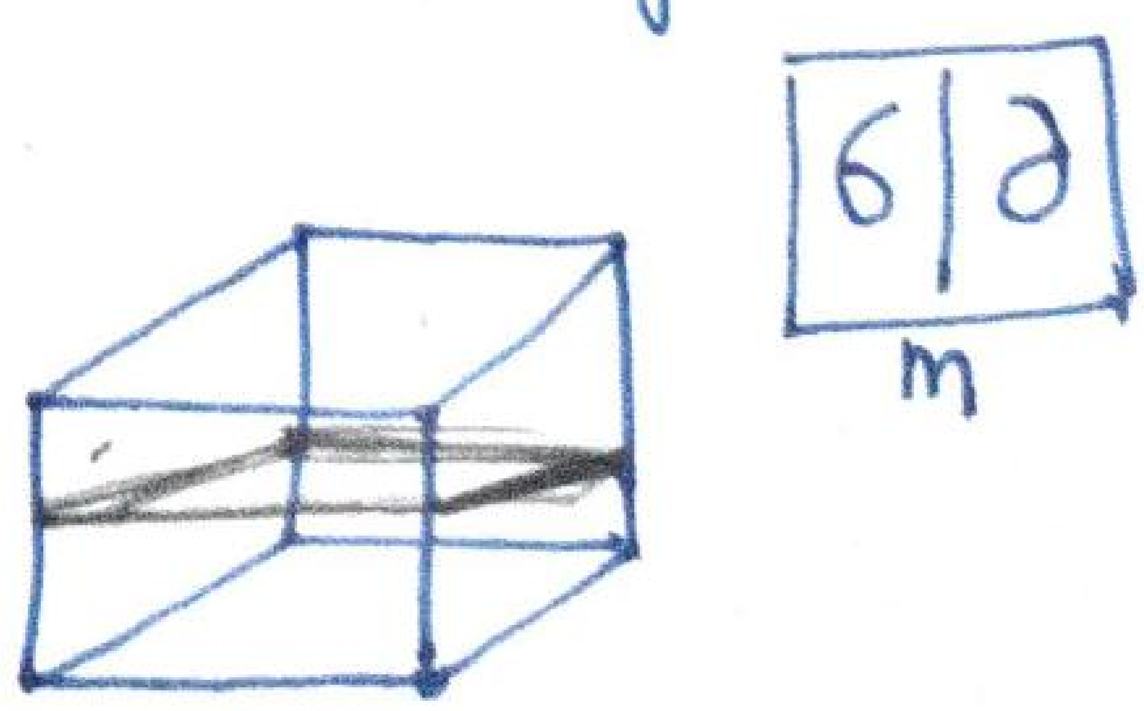
Crystals are bound by surfaces/ ~~to~~ which are usually planar. These surfaces are called faces. The angle b/w any two faces is called interfacial angle.



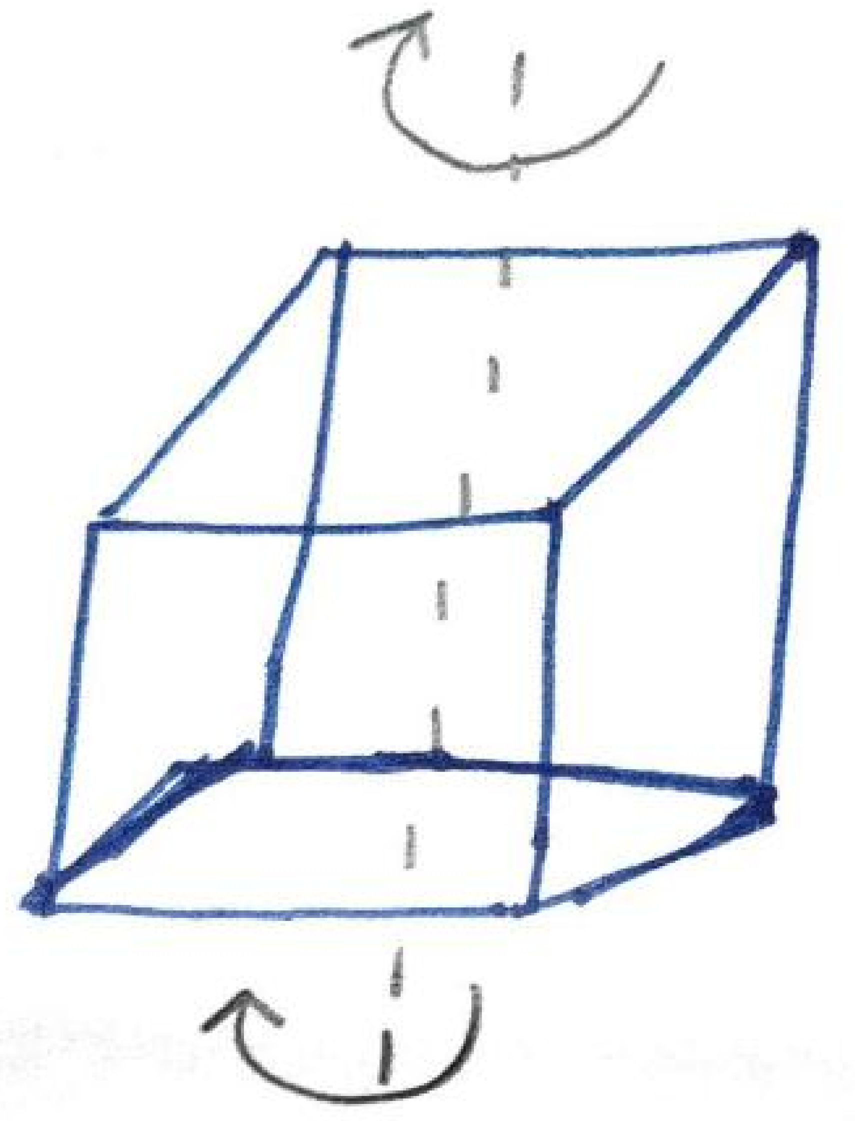
Symmetry → plane of symmetry
→ Axis of symmetry
→ Centre of symmetry.

Crystallography ↓ branch of science that deals $\bar{c}$ the study of structures, geometry and properties of crystals

Plane of symmetry → It is an imaginary plane which passes through the centre of a crystal & can divide ~~it~~ it into two equal portions which are exactly the mirror images ~~to~~ of each other



Axis of symmetry → It is an imaginary line, passing through the crystal such that when the crystal is rotated about this line, it present the same appearence more than once during the complete revolution ie in a rotation through 360°C.

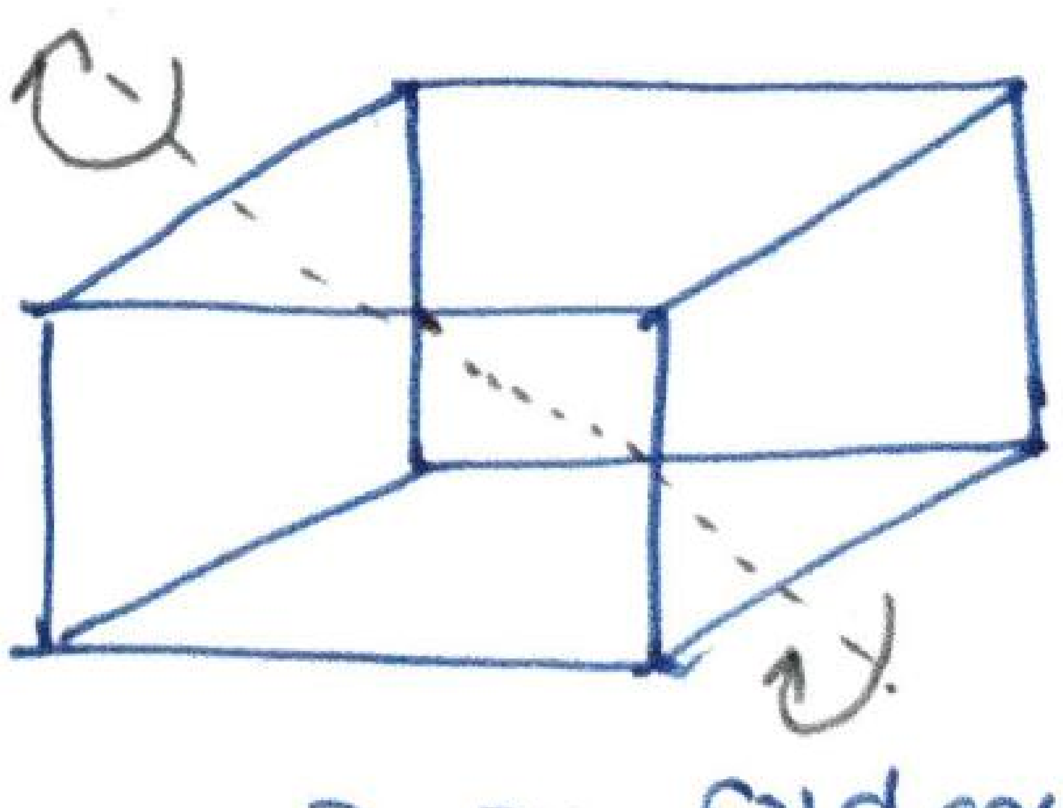


Axis of four fold symmetry.

$$\frac{360}{4} = (90^\circ)$$

Here the angle through which crystal to be rotated to get the same appearence will be 90°

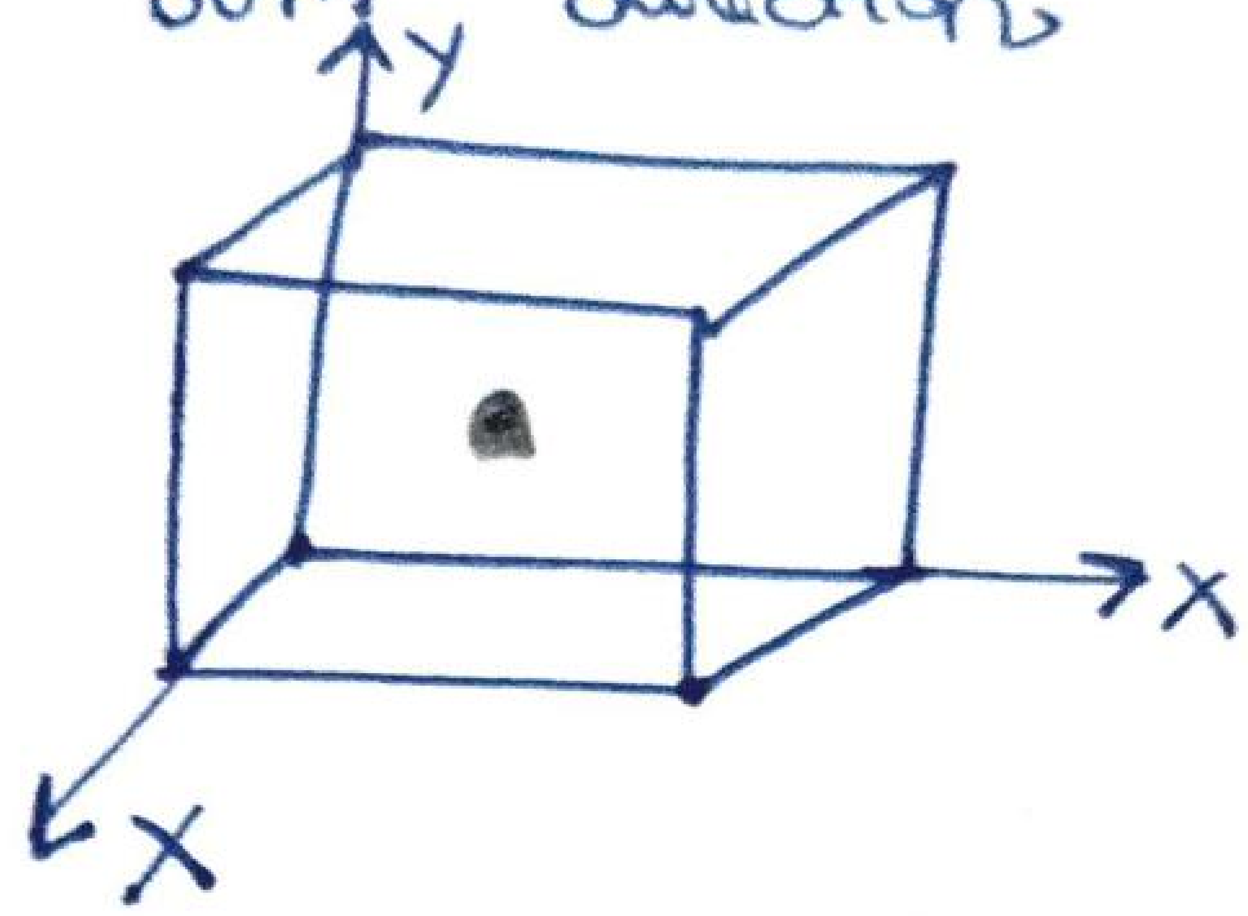
~~If~~ the similar appearance of crystal is repeated on a rotation through an angle of $360/n$ around an imaginary axis, ~~the~~ the axis is called an n fold axis where n is known as order of axis.



2 ~~fro~~ fold axis

same appearance ~~at~~ after an 180° angle of $\frac{360}{2}$

Centre of symmetry → It is an imaginary point in the crystal that any line drawn through it intersects the surface of crystal at equal distance in both direction.

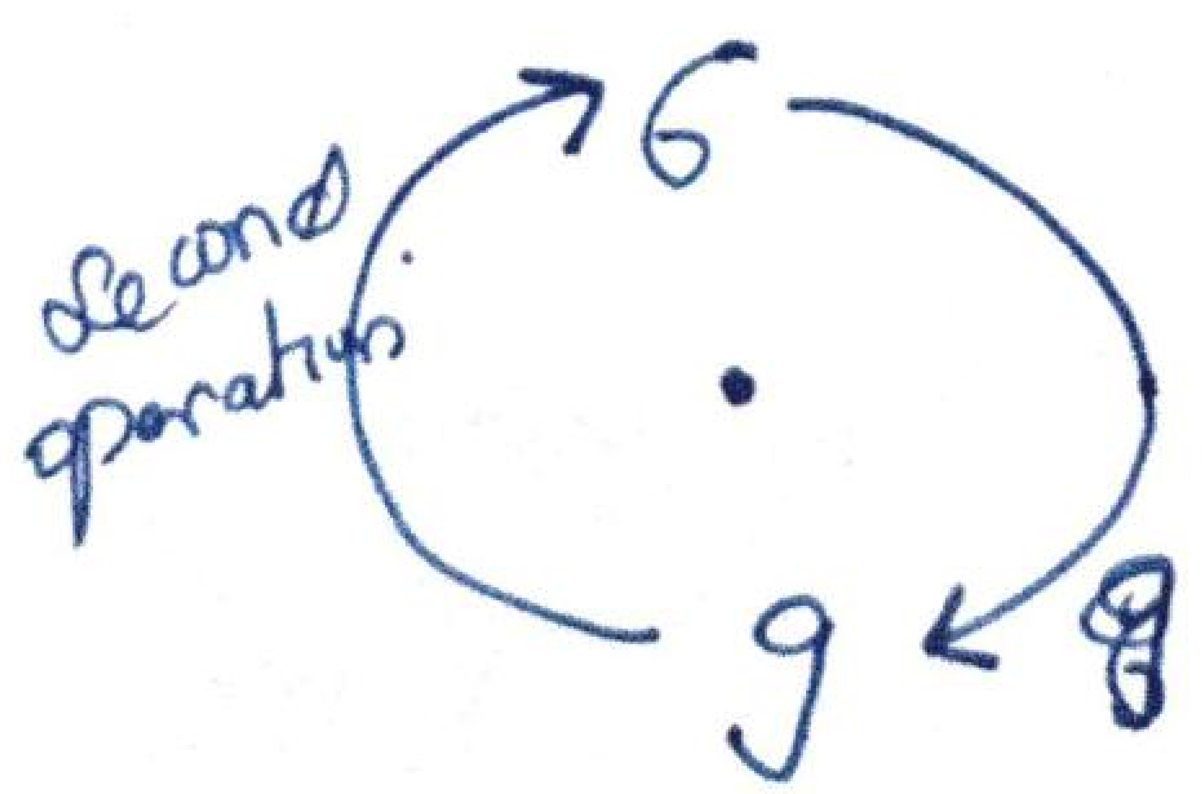


only simple cubic system have one centre of symmetry.
Other systems do not have centre of symmetry.

The total no. of planes, axis and centre of symmetrys possessed by a crystal is called elements of symmetry of the crystal.

If during the rotation of a crystal around an axis, one of the faces repeats itself two or more times, the crystal is said to have an axis of symmetry. Symmetry axis may be two fold if a face is repeated twice every 360°, three fold if it is repeated three times....

eg.



ie Two fold rotation $= 360°/2$.
operation