Dr. Madhukarrao Wasnik P.W.S. College Of Arts, Commerce & Science, Nagpur

Subject : Chemistry

Class : B.Sc. 2nd Year Semester IV

Paper II : PHYSICAL CHEMISTRY

Unit I

TOPIC : Law of Crystallography

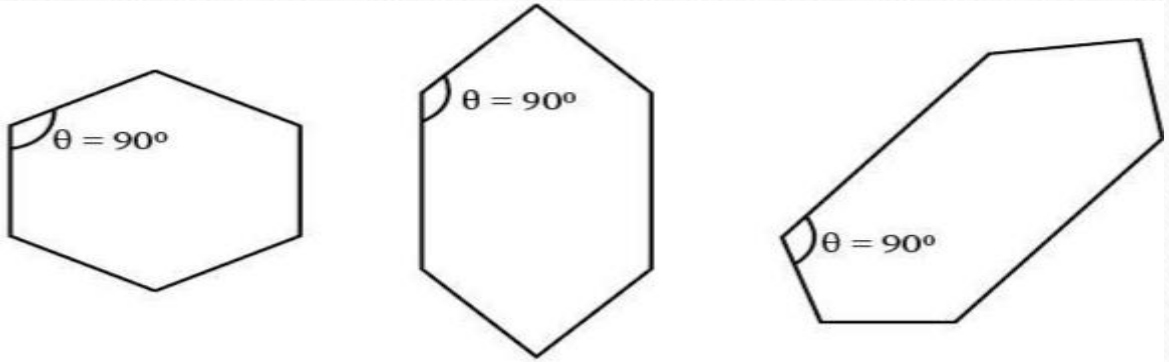
Crystallography

- It is a branch of science which deals with geometrical properties and structure of Crystal and crystalline substances.
- Crystalography is based on three fundamental laws. They are-

1. Law of constancy of interfacial angle
2. Law of rationality of indices
3. Law of symmetry

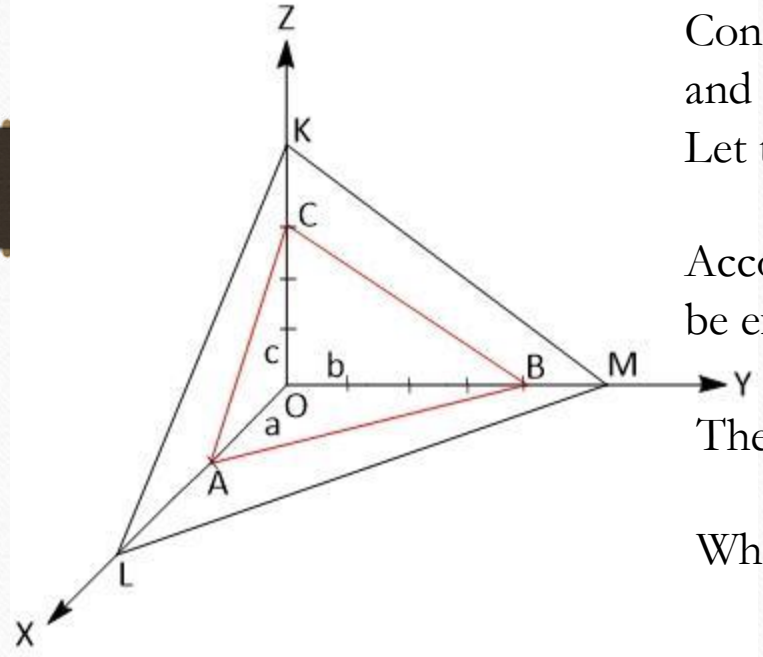
Law of constancy of interfacial angle

- These law was given by steno.
- *"The crystals of same substance may have different shapes depending upon sizes of faces but the angles between the corresponding faces remain constant".*
- It can be well understood from the diagrams as given below



Law of rationality of indices

- These law was given by **Hauy**.
- *"All the phases of a crystal lattice cut the given Axis atom different positions which are the integral multiples of unit plane."*



Consider a 3D coordinate system with x, y, & z axes. A plane ABC is unit plane and KLM is any face parallel to ABC plane.
Let the distances are d(*OA*) = *a* d(*OB*) = *b* d(*OC*) = *c*

According to law of rationality of indices the intercepts made by plane KLM can be expressed as-

$d(OL) = la$ $d(OM) = mb$ $d(OK) = nc$

The ratios are given by-

$d(OP) / d(OA) = l$ $d(OM) / d(OB) = m$ $d(OK) / d(OC) = n$

Where, *l, m, n* are simple integral wholes numbers or fractions of whole numbers.

Law of symmetry

- *"All the crystals of same substance possess same elements of symmetry".*
- It can be well understood from the elements of symmetry

- **Elements of Symmetry:** The crystal has 3 types of elements of symmetry.

1. **Plane of symmetry:** It is defined as "An imaginary plane by which, if a crystal is divided into two parts one becomes the mirror image of each other".

In cubic crystal system, it have total **9** planes of symmetry as shown in diagram

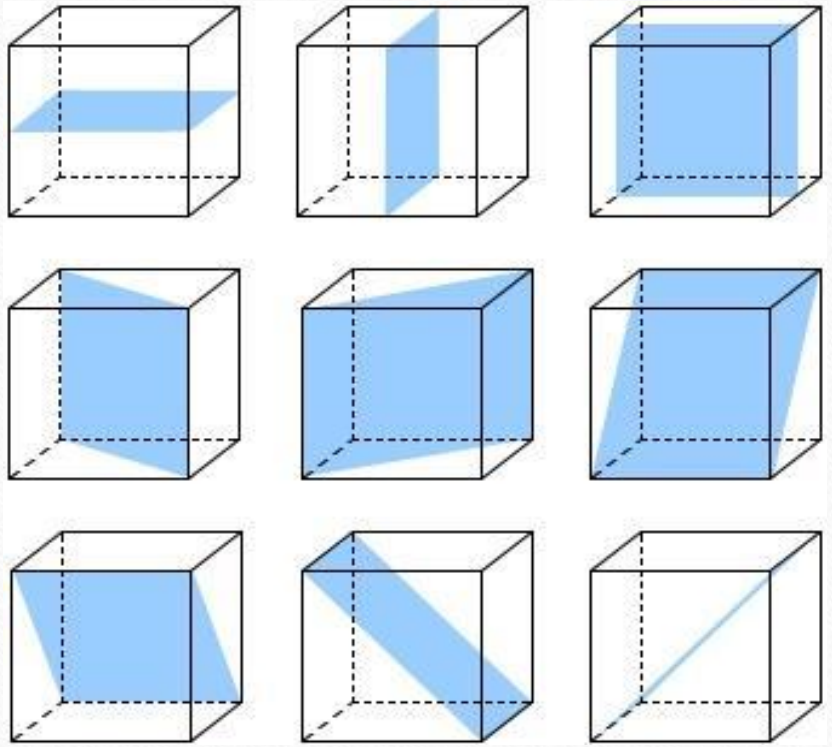


Fig. Plane of symmetry in cube

2. **Axis of symmetry:** It is defined as, "An imaginary line through the Crystal about which is the Crystal is rotted through 360° it present the same appearance more than once during the course of complete rotation".

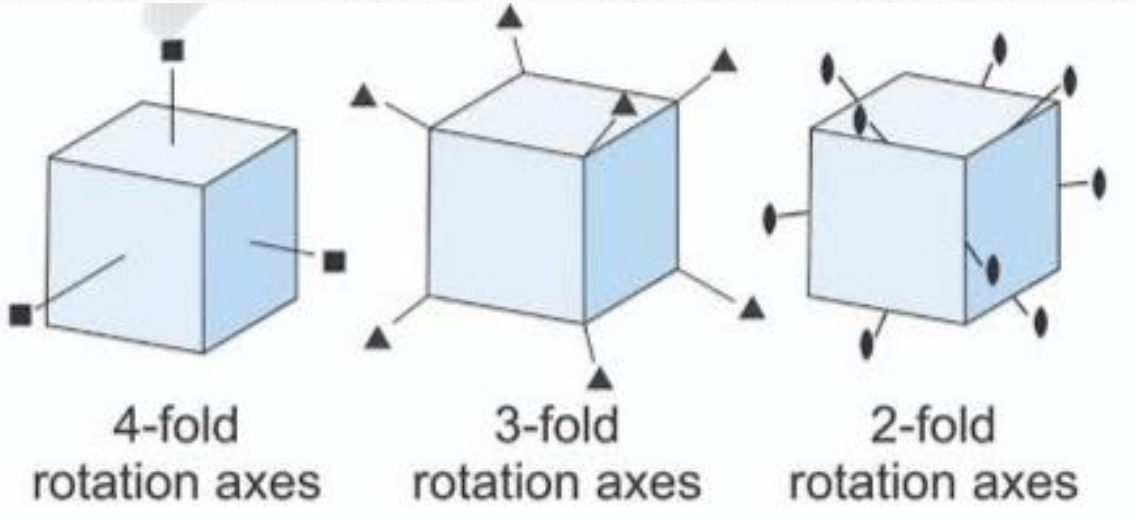
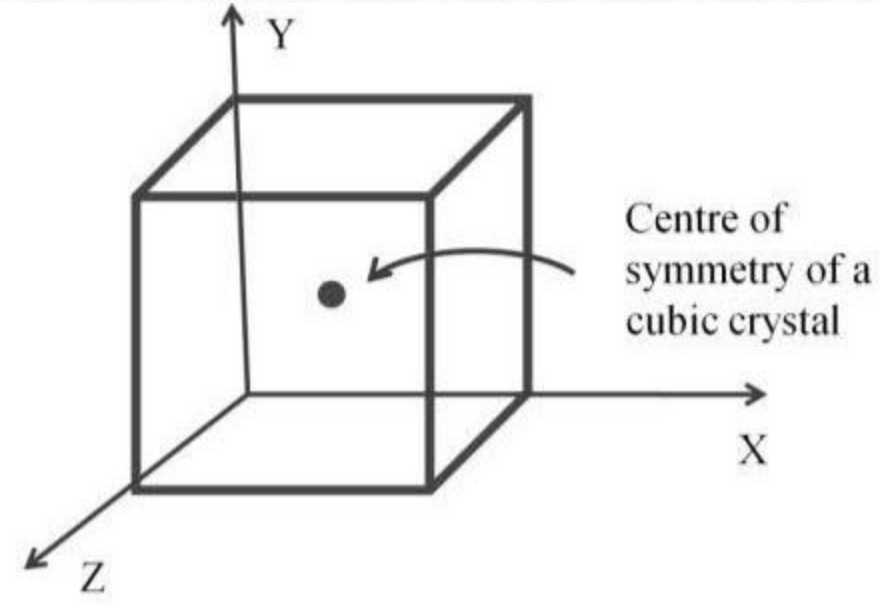


Fig. Axis of symmetry in cube

In cubic crystal system, it shows total **13** planes of symmetry as shown in figure.

3. Centre of symmetry: it is defined as "Centre or point of symmetry of a crystal is point within the Crystal such that any line drawn through it will intersect the surface of the Crystal at equal distance in both direction.



I. In cubic t system it has **1** center of symmetry.
II. Sum of all the number of a planes access and points of symmetry are called as **element of symmetry.**
III. For cubic crystal system the there are total **23** elements of symmetry.

Definition

- **Space lattice:** Regular arrangement of the constituent particles of a crystalline solid in three dimensional space is called as space lattice.
- **Lattice point:** Corresponding to each particle, there is a point in the space lattice which is called as lattice point.
- **Unit cell:** The smallest repeating unit in space lattice which when repeated over and over produces the complete space lattice is called as unit cell.