~~Different types of crystals lattice~~

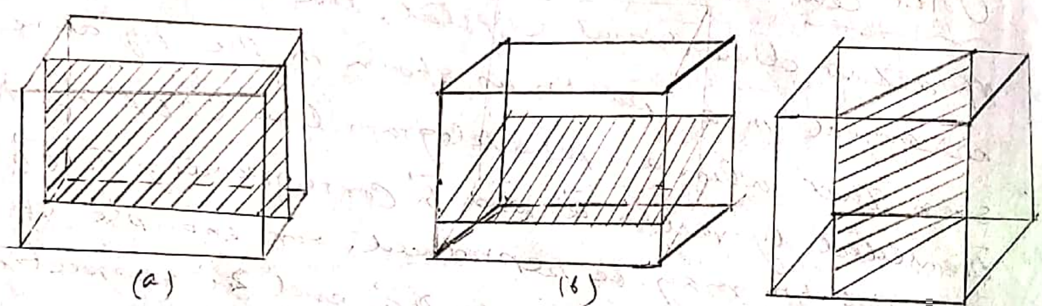
Symmetry in a crystalline solid.

If a certain operation leaves a space lattice unchanged (i.e. bring it into same position), a symmetry of special kind may exist. For example a candle is symmetric about vertical axis since it can be rotated about that axis without changing in appearance.

There are different types of symmetries in a crystal. If the symmetry operations are performed about a point or line, then such symmetry operations are known as point group symmetry. The point group symmetry ~~operations~~ element associated with a crystal are (1) plane of symmetry (2) Axis of symmetry (3) centre of symmetry.

1. **plane of symmetry**: If the crystal is divided by an imaginary plane into two halves, such that one is the mirror image of the other, then such a plane is called plane of symmetry.

The three planes of symmetry parallel to the faces of the cube are shown in fig below. We can say that the crystal is divided into two equal ~~half~~ halves by each plane. In a cubic crystal there are six diagonals

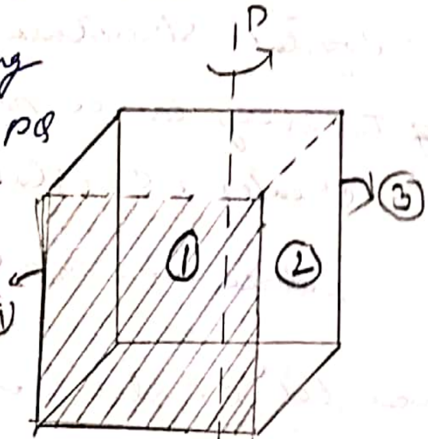


(a) (b) (c)

plane of symmetry. By joining a pair of opposite parallel edges we can obtain a diagonal plane of symmetry. Because in a cube there are twelve edges, so six pair of opposite edges are formed. Hence the six diagonal plane of symmetry are obtained. In this way there are nine plane of symmetry in a cubic crystal.

2. Axis of Symmetry :- This is an ~~axis~~ axis passing through the crystal such that if the crystal is rotated about this axis, the crystal remains invariant.

Suppose a cube is rotating anticlockwise about an axis PQ which is passing through the centres of opposite faces and is perpendicular to the plane of the cube given in the fig.



When the cube is rotated through $\pi/2$ from the position indicated, the face number (4) will occupy the same position as the face number (1). Thus each rotation of $\pi/2$ brings the cube into self coincidence or in a congruent position. Hence the axis PQ is called the axis of symmetry. Because there are four congruent positions in one complete rotation so it is called a four-fold axis of symmetry. The axis is called n-fold if the crystal is rotated through an angle $\frac{2\pi}{n}$ radians or $\frac{360}{n}$ degree.

If $n=4$, the crystal is brought into position of self-coincidence by a rotation through 90° and the axis is called tetrad.

If $n=6$, the crystal is brought into position of self-coincidence by rotation through 60° and the axis is termed as hexad.

If $n=3$, the crystal is brought into position of self-coincidence by rotation through 180°, the axis is called diad.

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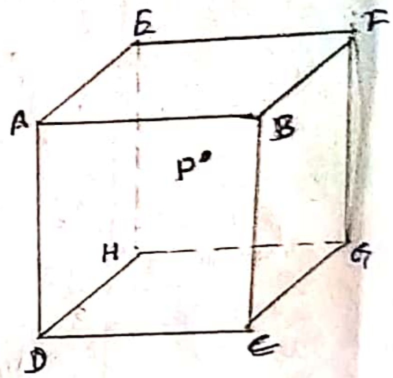
3. ~~It is a point in~~

3. Centre of Symmetry :- It is a point in a crystal such ~~so~~ that any line passing through it will meet the surface of the crystal at equal distances on either side.



Let us assume a unit cell of cubic structure as shown in the fig. The point P at the centre of body shows the centre of symmetry. Thus when a line is drawn from A and it is crossing from P, then this line will touch the point G in such a way that AP = GP. A similar statement can be given for points B and H as well as D and F.