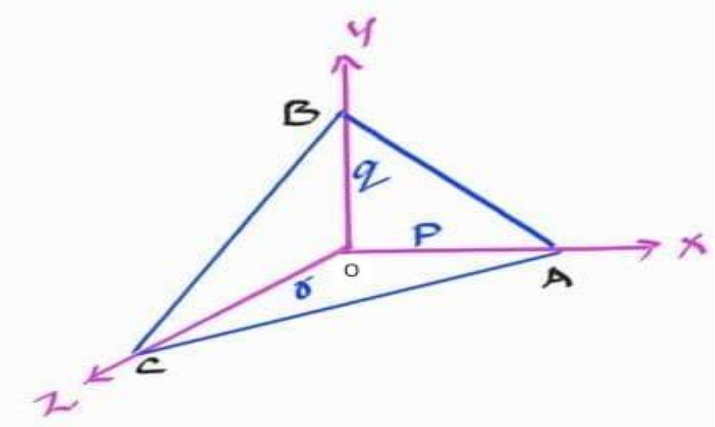
MILLER INDICES

- **Introduction:**
- Miller indices were introduced in 1839 by the British mineralogist William Hallowes Miller.
- The method of representing orientation of crystal planes was historically known as the Mellerian system and the indices as Mellarian.
- The planes passing through the lattice points are called Lattice planes.
- **Definition:**
- Miller evolved a method to designate a set of parallel planes in a crystal by 3 numbers (h k l) known as Miller indices. (or)
- The reciprocal of the intercepts made by the plane on the crystallographic axes (when reduced to smallest numbers) are known as Miller indices.
- Miller indices are represented by a set of numbers (h k l), used to identify the plane or surface in a crystal.
- **Steps in the determination of Miller indices (or) procedure for finding Miller indices:**



- **Step 1:** Choose the System of three coordinate axes (Crystallographic axes) x, y, & z.
- **Step 2:** Determine the intercepts P, Q, & R of the required plane ABC on these axes
  i.e., OA = p, OB = q and OC = r.
- **Step 3:** Take ratio of reciprocals of the intercepts, i.e., 1/p : 1/q : 1/r
- **Step 4:** Convert these reciprocals into integers by multiplying each one of them with their LCM pqr
  i.e., 1/p x pqr 1/p x pqr 1/p x pqr (LCM=pqr)
- **Step 5:** Reduce to lowest terms & enclose these integers in small parentheses.
  i.e. Miller indices (h k l) of the crystal →(qr pr pq) = (hkl)

Example 1:

- **To obtain Miller indices for the intercepts a, b/2, 3c in a cubic crystal.**
- Step1: A plane makes intercepts: a, b/2, 3c
- Step 2: Intercepts: 1, 1/2, 3 (since lowest ratio's when a=b=c)
- Step 3: Reciprocals 1/1, 2/1, 1/3
- Step 4: Multiplying with their LCM 3
- 1 x 3, 2 x 3, 1/3 x 3 → 3, 6, 1
- Step 5: Miller indices of the given crystal

  (hkl) = (361).

Example 2:

- **To obtain Miller indices for the intercepts 2, 3, & 4 in a cubic crystal.**
- Step 1: A plane makes intercepts as 2, 3, & 4 along x, y & z axes
- Step 2: Intercepts → 2, 3, 4 (since lowest ratio's when a= b=c)
- Step 3: Reciprocals → 1/2, 1/3, 1/4
- Step 4: Multiplying with their LCM 12)

  1/2 x 12, 1/3 x 12, 1/4 x 12 → 6, 4, 3
- Step 5: Miller indices of the chosen crystal

  (hkl) = (643)

Important salient features of Miller Indices

- Miller indices give the orientation of the crystal plane.
- A plane parallel to one of the coordinate axes has an intercept of infinity.
- If the miller indices of two planes have the same ratio [i.e., (844) & (422) or (211)], then the planes are parallel to each other.
- All parallel planes have the same miller indices.
- Plane passing through origin is defined in terms of Parallel planes having non-zero intercepts.
- If (hkl) are the miller indices then a/h, b/k & c/l are the intercepts for corresponding lattice parameters a, b & c.
- If (hkl) are the Miller indices of the plane, then the plane cuts the axes into h, k, l equal segments respectively.