# INTRODUCTION OF MILLER INDICES

MILLER INDICES ARE THE MATHEMATICAL REPRESENTATION OF THE CRYSTAL PLANES. THE CONCEPT OF MILLER INDICES WAS INTRODUCED IN THE EARLY 1839S BY THE BRITISH MINERALOGIST AND PHYSICIST WILLIAM HALLOWES MILLER. THIS METHOD WAS ALSO HISTORICALLY KNOWN AS THE MILLERIAN SYSTEM AND THE INDICES AS MILLERIAN OR THE MILLER INDICES.

DEFINATION

MILLER INTRODUCES A SET OF THREE NUMBERS TO DESIGNATE A PLANE IN A CRYSTAL. THIS SET OF THREE NUMBERS IN KNOWN AS MILLER INDICES OF THE CONCERNED PLANE.

REPRESENTATION OF MILLER INDICES

Representing Crystallographic plane

Cubic
Cell
a=1
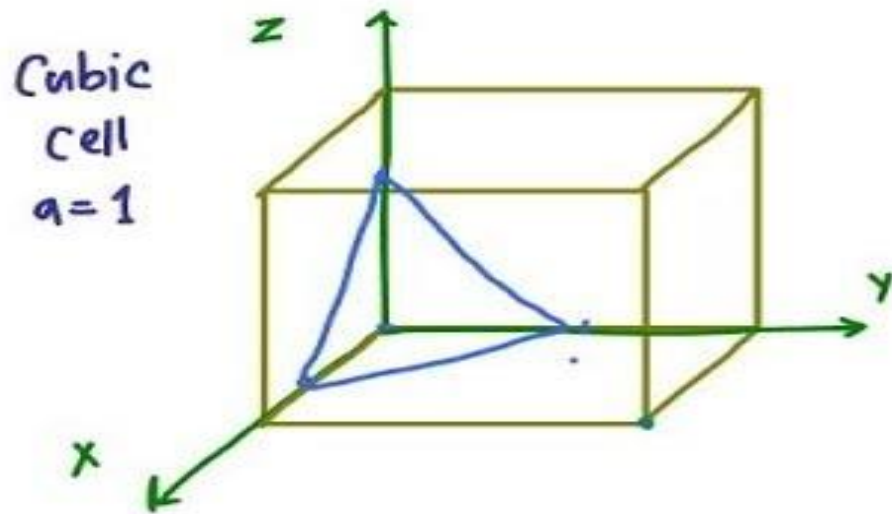
Miller Indices

integers (h, k, ℓ)
having same ratios
with one another
as the reciprocal
of intercepts of
the plane on Axes

StudyYaar

CRYSTAL PLANES AND MILLER INDICES

A CRYSTAL LATTICE MAY BE REGARDED AS THE AGGREGATE OF DIFFERENT SET OF PARALLEL PLANES PASSING THROUGH LATTICE POINTS SUCH AS EACH SET OF PARALLEL PLANE HAS PARTICULAR ORIENTATION AND DIRECTION WITH REFERENCE TO COORDINATOR AXIS.LINES SHOWN IN FIGURE WILL APPEAR AS PLANES WHEN GEOMETRY IS EXTENDED IN 3-D. THE PROBLEM IS HOW TO DESIGNATE THE ORIENTATION AND DIRECTION OF THESE SET OF PARALLEL CRYSTAL PLANES .MILLER EVOLVED METHOD TO DEGINATE ORENTATION & DIRECTION OF PARALLEL SET OF PLANES W.R.T. CO-ORDINATE AXIS BY THAN NUMBER INTEGERS CALLED MILLER INCIDICES.
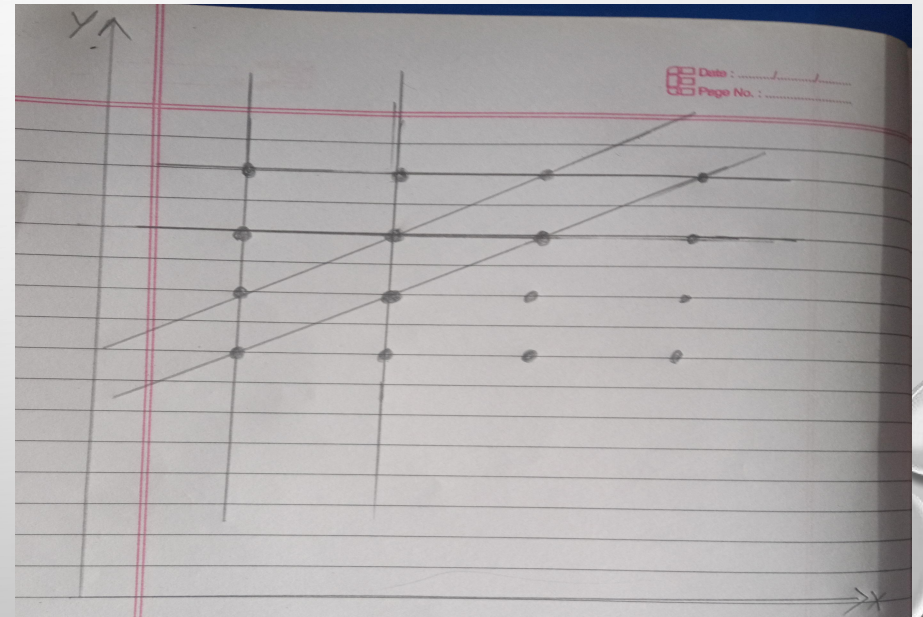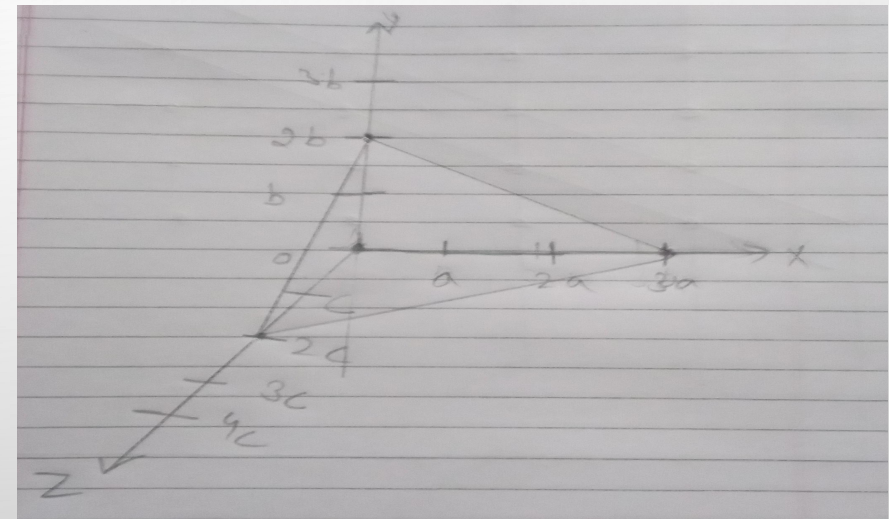
STEPS TO FIND MILLER INDICES

STEP I

TAKE A POINT OR ATOM AS ORIGIN & CONSTRUCT THREE CO- ORDINATE AXIS.FIND THE INTERCEPTS OF THE PLANES ALONG THREE CO-ORDINATE AXIS .

X	Y	Z
3A	2B	3C

STEP II

EXPRESS THE INTERCEPTS AS MULTIPLES OF A,B&C

3	2	2

STEP –III

   TAKE RECIPROCAL OF INTERCEPTS

       1/3   1/2   1/2

STEP –IV

REDUCE RECIPROCALS OF INTERCEPTS INTO SMALLEST SET OF INTEGERS IN THE SAME RATIO BY MULTIPLYING WITH THEIR L.C.M.

       1/3*6 =2   1/2 *6=3   1/2 *6=3

STEP –V

ENCLOSE THE SMALLEST SET OF INTEGERS IN THE PARAMETERS &WE WILL GET MILLER INDICES SO MILLER INDICES ARE (233).

RULES OF MILLER INDICES

1. DETERMINE THE INTERCEPTS (A,B,C) OF THE PLANES ALONG THE CRYSTALLOGRAPHIC AXES, IN TERMS OF UNIT CELL DIMENSIONS.

2. CONSIDER THE RECIPROCAL OF THE INTERCEPTS MEASURED.

3. CLEAR THE FRACTIONS, AND REDUCE THEM TO THE LOWEST TERMS IN THE SAME RATIO BY CONSIDERING THE LCM.

4. IF A HKL PLANE HAS A NEGATIVE INTERCEPT, THE NEGATIVE NUMBER IS DENOTED BY A BAR ($\bar{\ }$) ABOVE THE NUMBER.

5. NEVER ALTER OR CHANGE THE NEGATIVE NUMBERS. FOR EXAMPLE, DO NOT DIVIDE -3,-3, -3 BY -1 TO GET 3,3,3.

6. IF THE CRYSTAL PLANE IS PARALLEL TO AN AXIS, ITS INTERCEPT IS ZERO AND THEY WILL MEET EACH OTHER AT INFINITY.

7. THE THREE INDICES ARE ENCLOSED IN PARENTHESIS, HKL AND KNOWN AS THE HKL INDICES. A FAMILY OF PLANES IS REPRESENTED BY HKL AND THIS IS THE MILLER INDEX NOTATION.

GENERAL PRINCIPLES OF MILLER INDICES

1. IF A MILLER INDEX IS ZERO, THEN IT INDICATES THAT THE GIVEN PLANE IS PARALLEL TO THAT AXIS.

2. THE SMALLER A MILLER INDEX IS, IT WILL BE MORE NEARLY PARALLEL TO THE PLANE OF THE AXIS.

3. THE LARGER A MILLER INDEX, IT WILL BE MORE NEARLY PERPENDICULAR TO THE PLANE OF THAT AXIS.

4. MULTIPLYING OR DIVIDING A MILLER INDEX BY A CONSTANT HAS NO EFFECT ON THE ORIENTATION OF THE PLANE.

5. WHEN THE INTEGERS USED IN THE MILLER INDICES CONTAIN MORE THAN ONE DIGIT, THE INDICES MUST BE SEPARATED BY COMMAS TO AVOID CONFUSIONS. E.G. (3,10,13)

6. BY CHANGING THE SIGNS OF THE INDICES 3 PLANES, WE OBTAIN A PLANE LOCATED AT THE SAME DISTANCE ON THE OTHER SIDE OF THE ORIGIN.

IMPORTANT FEATURES OF MILLER INDICES

1. IN CUBIC CRYSTAL THE DIRECTION PERPENDICULAR TO

(HKL) IS REPRESENTED BY [HKL] IS THE LINE PERPENDICULAR

TO PLANE (HKL).

2. NO COMMAS ARE INTRODUCED IN BETWEEN THE INDICES OF SINGLE

DIGIT EG.(233) ,BUT WHEN MILLER INDICES OF A PLANES ARE DOUBLE

DIGIT, THESE ARE SEPARATED BY COMMAS (10,5,15).

3. THE MILLER INDICES (266),(133) REPRESENTS THE SAME PLANE.