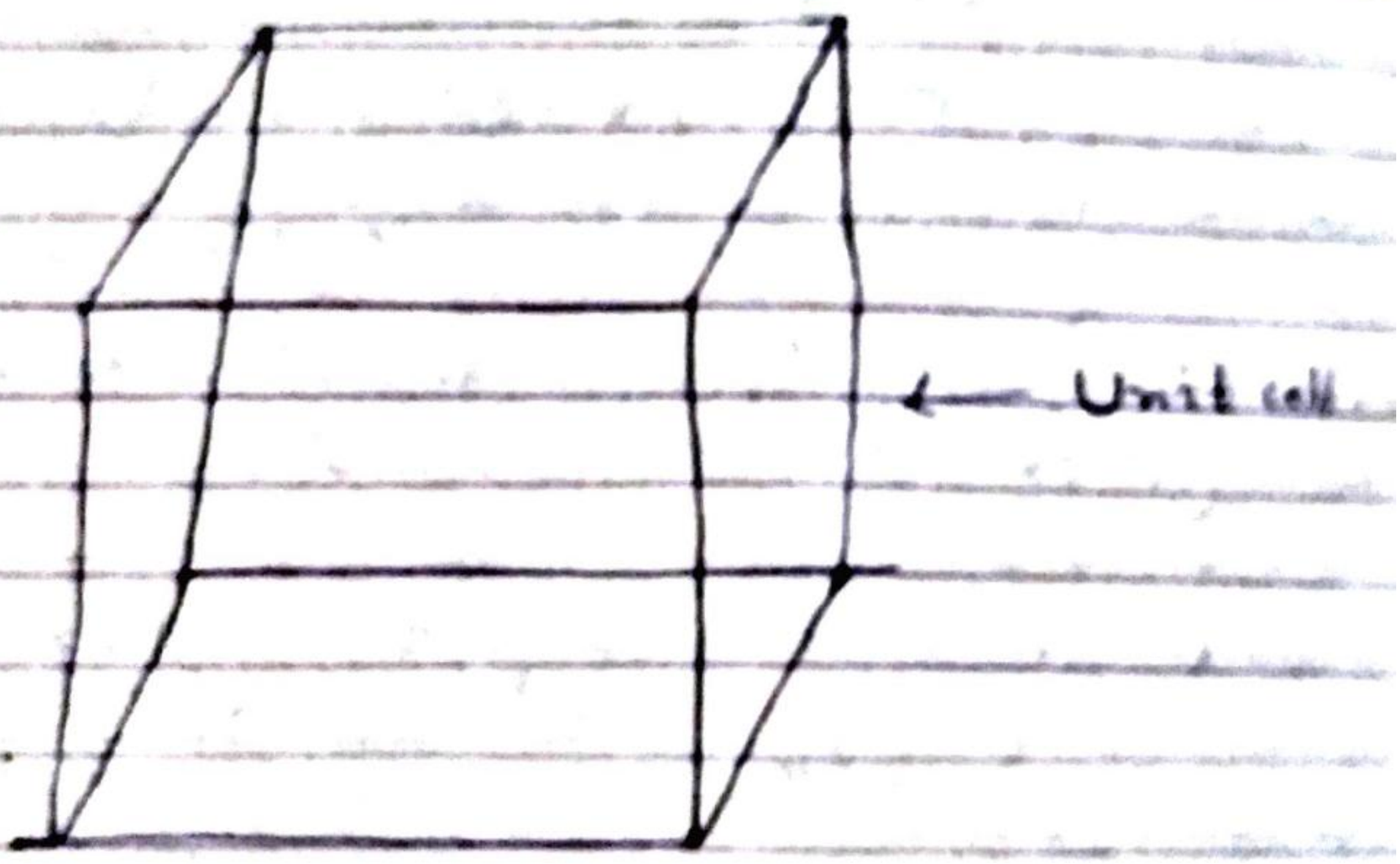
T. D. C. Part I ! Chem (Hons)
Paper II
Gp. A (Org Chem)

Unit 3.

<UNIT CELL>

Unit cell → A unit is smallest part of the space lattice and acts the pattern of the full space lattice is generated by repeating the unit cell along 3 dimension atoms or ions or molecules occupy certain point of the unit cell. The point occupied are called lattice points and the particles occupying the lattice points are called units.

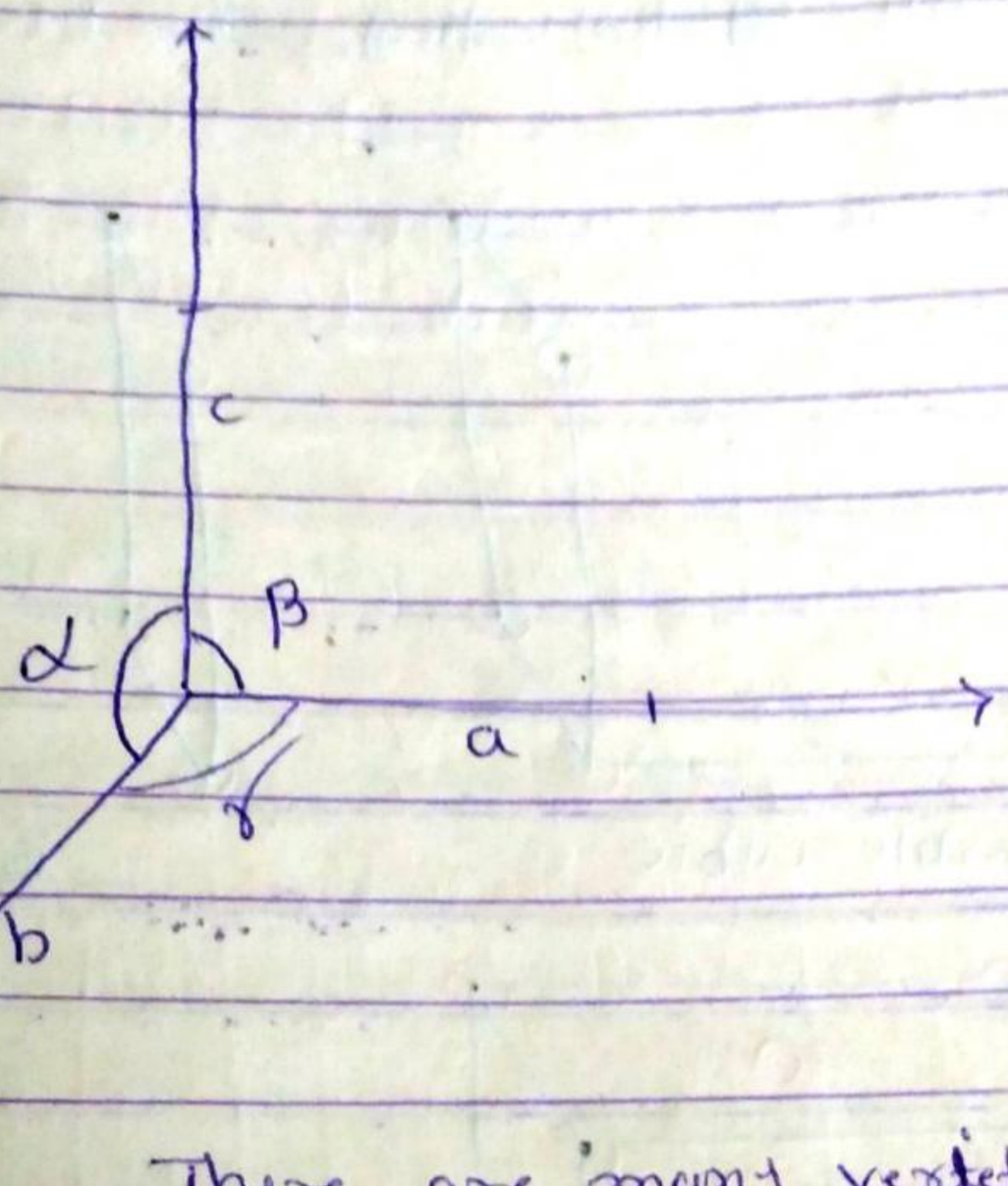


The distance between two adjacent lattice points are called unit length. Unit length along x-direction is called termed a, that along y direction b and that along z-direction termed c. As a, b, c and angles between the axes. α, β, γ vary different type of unit cell are formed. Each type is called a crystal system.

Crystal System

Crystal System :→

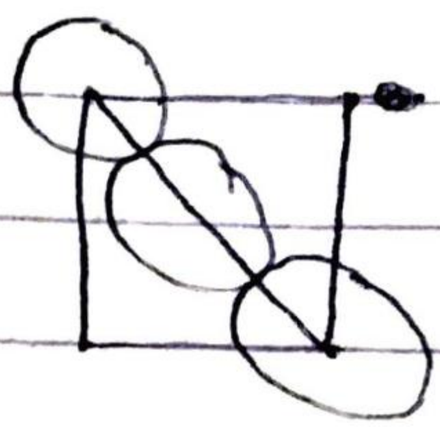
An unit cell is defined by unit lengths a, b, c along the axes and angles, α, β, γ between the axes



There are many varieties in lattice and unit cells. Each variation is a crystal system. There are seven broad classes of crystal systems. The cubic system is one of them. It is simplest and occurs in ordinary substances.

crystal	sides	angles	examples
① cubic	$a=b=c$	$\alpha=\beta=\gamma=90^\circ$	NaCl, Cu
⑫ Tetragonal	$a=b, c$	$\alpha=\beta=\gamma=90^\circ$	SnO_2, α-Sn
⑭ orthorhombic	a, b, c	$\alpha=\beta=\gamma=90^\circ$	α-sulphur
⑤ Rhombohedral	$a=b=c$	$\alpha=\beta\neq\gamma \cdot 90^\circ$	calcite, Bi
⑦ Triclinic	a, b, c	$\alpha\neq\beta\neq\gamma$	$K_2Cr_2O_7$, Cu
⑬ monoclinic	a, b, c	$\alpha=\gamma=90^\circ$ $\beta\neq 90^\circ$	β-sulphur, $K_2Cr_2O_7$
⑥ Hexagonal	$a=c, b$	$\alpha=\gamma=90^\circ$ $\beta=120$	graphite, Quartz

(iii) ● Face centred cubic :→ units occupy the corners and face centres such that 3 units touch each other along the face diagonal and $4r = a\sqrt{2}$.



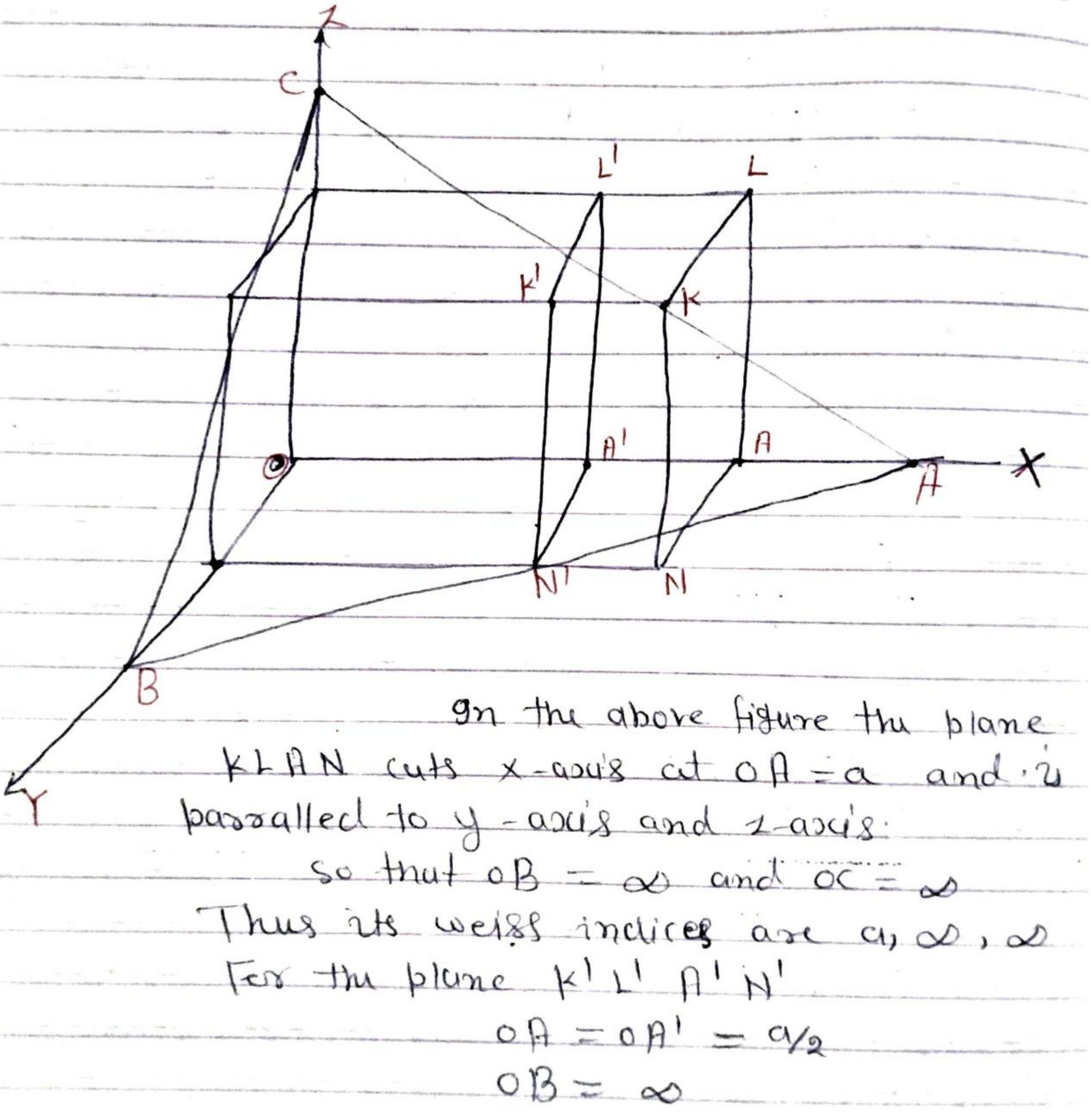
$4r = a\sqrt{2}$.

Units occupying F.C.C lattice points are the smallest and those occupying simple cube are the largest of the three.

There are in all 14 Bravais lattice in 7 crystal structure.

WEISS INDICES

Weiss Indices :→ It describes the plane in terms of intercepts OA, OB, OC mainly by the plane along the co-ordinate axes X, Y & Z, respectively of the crystal system. The intercepts are measured in terms of unit length a, b, c respectively.



In the above figure the plane KLAN cuts x-axis at OA = a and is parallel to y-axis & z-axis.

So that OB = ∞ and OC = ∞

Thus its weiss indices are a, ∞, ∞

For the plane K' L' A' N'

$$OA = OA' = a/2$$

$$OB = \infty$$

$$OC = \infty$$

It's weiss indices are $a/2, \infty, \infty$.

Miller Indices :→

It is more convenient to designate a given type of a plane with Miller indices. These are smallest set of integers are denoted by h, k, l.

Miller indices are reciprocal of co-efficient of Weiss indices and cleared of fractions i.e they are reciprocals of the intercepts of a plane on the axes in terms of unit length.

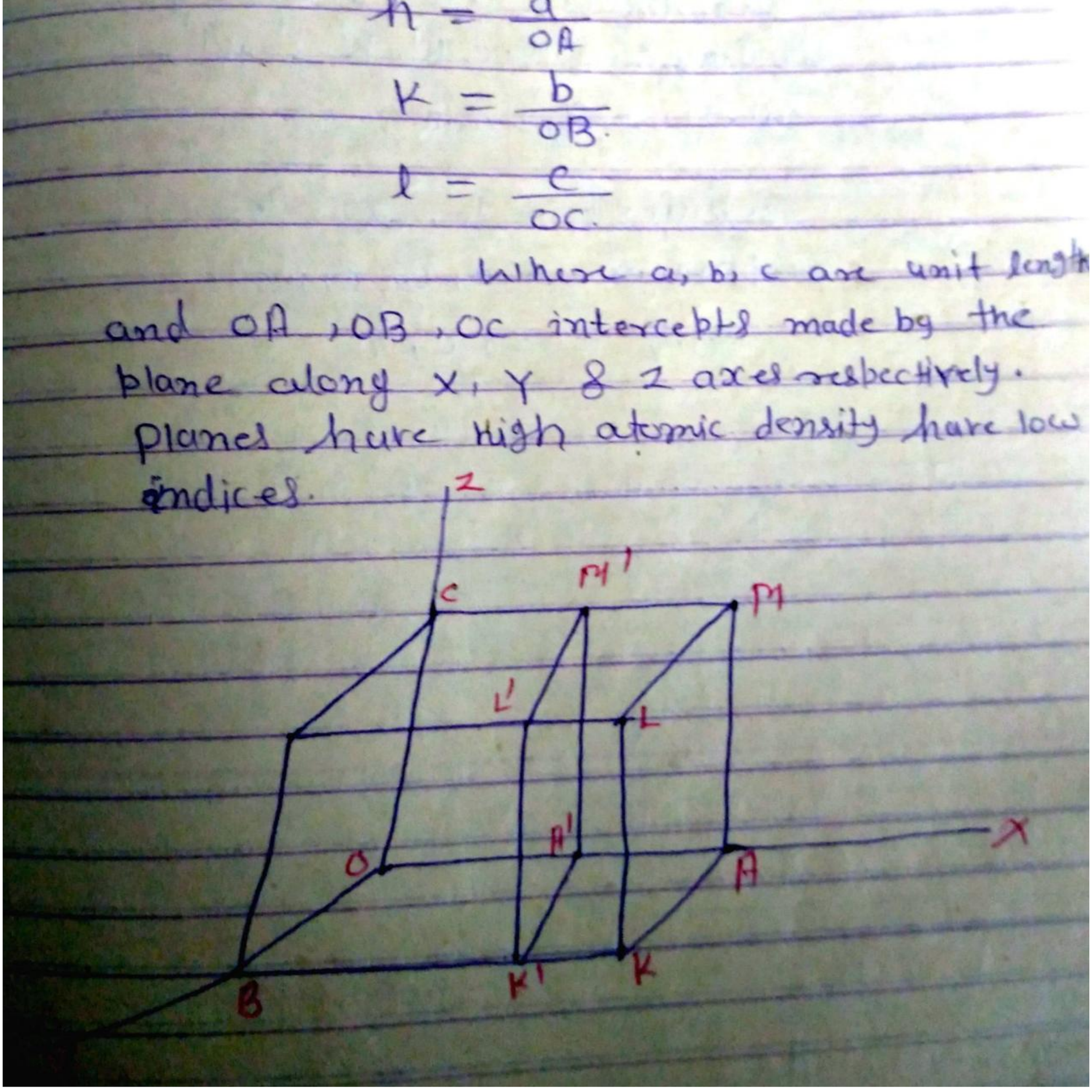
Expressed mathematically as :—

$$h = \frac{a}{OA}$$

$$K = \frac{b}{OB}.$$

$$l = \frac{c}{OC}.$$

Where a, b, c are unit length and OA, OB, OC intercepts made by the plane along x, y & z axes respectively. Planes have high atomic density have low indices.



for the plane ABLM intercepts are

OA = a , OB = ∞ , OC = ∞ ∴ M.I = 1, ∞, ∞

coefficient = 1, ∞, ∞. Reciprocal = 1, 0, 0

Miller indices are 1, 0, 0 since

- $h = \frac{a}{OA} = \frac{a}{a} = 1$
- $k = \frac{b}{OB} = \frac{b}{\infty} = 0$
- $l = \frac{c}{OC} = \frac{c}{\infty} = 0$.

Miller Indices are 1, 0, 0

Similar to plane A', K', L', M'

M.I = 2, ∞, ∞.

coefficient = 1, ∞, ∞.

reciprocal = 1, 0, 0

M.I 1, 0, 0