UNIT- I

Crystal Physics

Lattice - Unit cell - Bravais lattice - lattice planes - Miller indices - d spacing in cubic lattice - Calculation of no. of atoms per unit cell - Atomic radius - Coordination number - Packing factor for SC, BCC, FCC & HCP structures - Diamond & graphite structure.

Introduction:

Materials differ from one another in their properties. Some solids are brittle, are malleable, some are strong, some are weak, some are good conductors of heat & electricity, some are non-conductors of heat & electricity. Some are magnetic and so on.

The difference in the properties of the solids are due to their structure.

Classification of solids:

1. Crystalline Materials
2. Non-Crystalline materials (or) Amorphous

1. Crystalline Materials:

The materials in which the atoms are arranged in a regular pattern are known as crystalline materials.

It may be either a single crystal or poly crystal.

In the single crystal, the entire solid consists of only one crystal.

In poly-Crystalline material, a collection of many small Crystals are separated by well-defined boundaries. The Crystalline Solids are made up of either metallic Crystals (eg. copper, silver etc), or non-metallic Crystals eg(carbon, Silicon etc).

Amorphous Materials:

The materials in which atoms are arranged in an irregular pattern are known as Amorphous material.

eg: Glass, rubber etc.

Crystal:

A Crystal is a three-dimensional Solid which consists of a periodic arrangement of atoms.

Crystal Structure:

The arrangement of atoms in a crystal.

Crystallography:

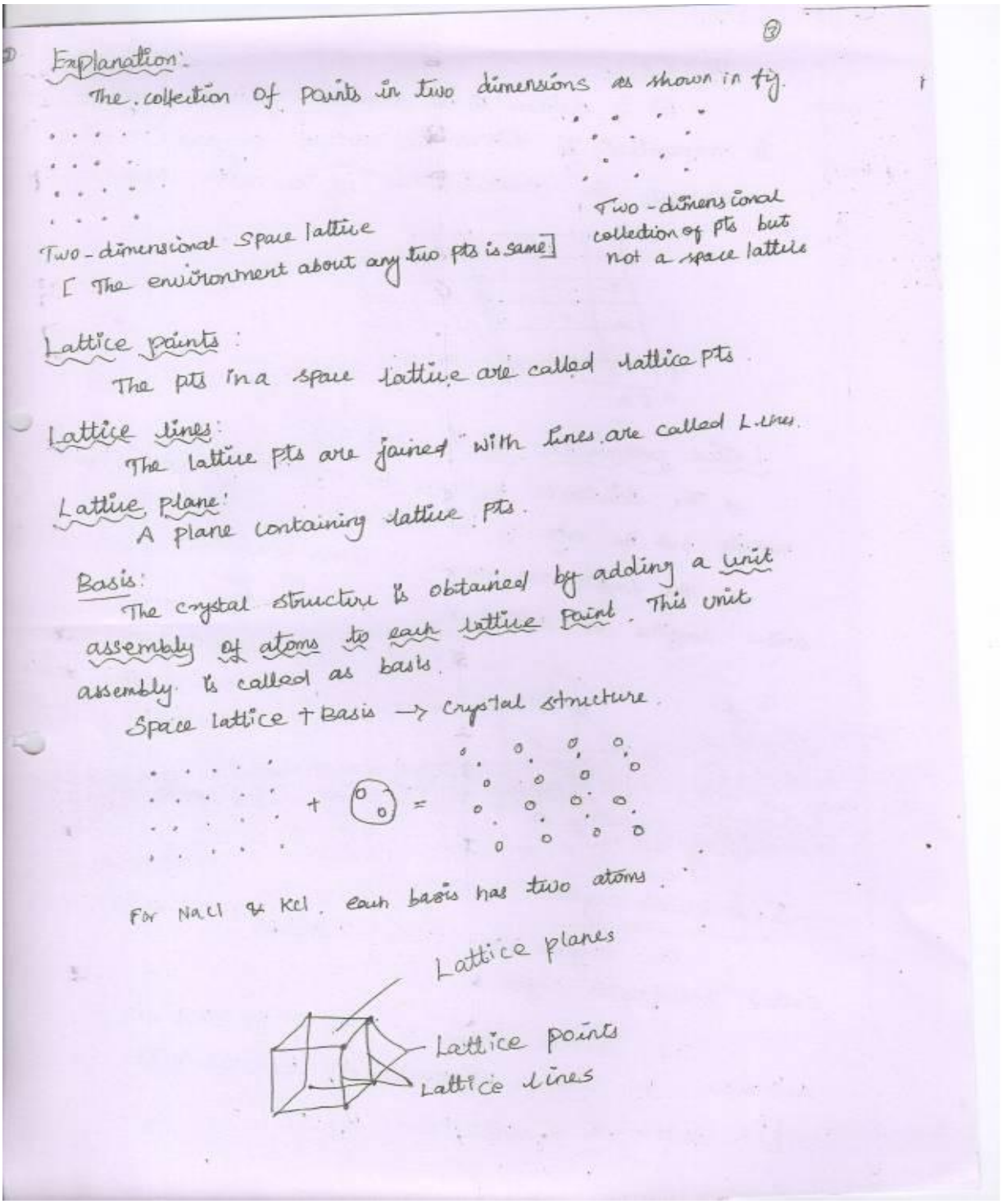
The branch of Physics which deals with internal structure, properties, external or internal symmetries in a crystal is called as crystallography.

Lattice:

The representation of atoms in the crystal as Consider as points in 3-dimensions is called Space lattice or simply lattice.

Defination:

Every point has identical surroundings to that of every other point in the array.



Explanation:

The collection of points in two dimensions as shown in fig.

Two-dimensional Space lattice
[The environment about any two pts is same]

Two-dimensional collection of pts but not a space lattice

Lattice points:

The pts in a space lattice are called lattice pts

Lattice lines:

The lattice pts are joined with lines are called L.ines.

Lattice Plane:

A plane containing lattice pts.

Basis:

The crystal structure is obtained by adding a unit assembly of atoms to each lattice point. This unit assembly is called as basis.

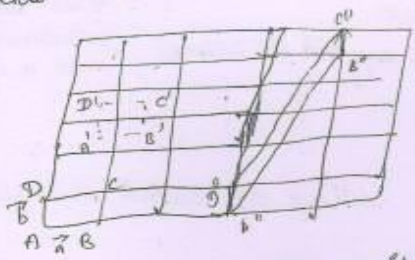
Space lattice + Basis → Crystal structure

For NaCl & KCl, each basis has two atoms.

Lattice planes
Lattice points
Lattice lines

UNIT CELL

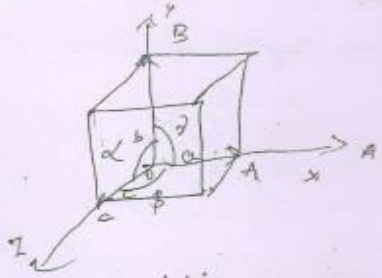
It is defined as the smallest geometric figure which is repeated to derive the actual crystal structure. It represents the characteristics of the entire crystal.



Lattice parameters of the unit cell:

⇒ The distance between two neighbouring lattice points is nothing but the edge of the unit cell.

⇒ The lengths OA, OB, OC in three axes OX, OY, OZ are the axial lengths or intercepts.



The axial lengths $OA = a$, $OB = b$, $OC = c$ are known as Intercepts a, b & c along three axis

Interfacial angles:

The angles b/w three intercepts (α, β, γ) are called Interfacial angles.

The actual shape & size of the unit cell is determine by lattice parameters of the unit cell.

[i.e Intercepts & interfacial angles].