

SCHOOL OF STUDIES IN PHYSICS

VIKRAM UNIVERSITY UJJAIN



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LATTICE VIBRATION

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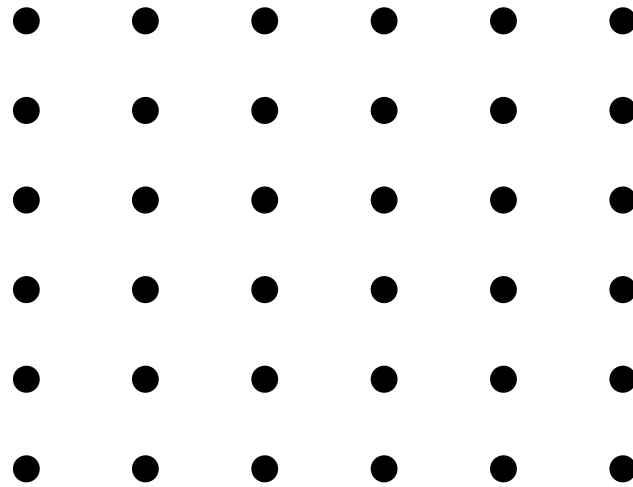
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INTRODUCTION :-

Lattice is an array of points in space in which the environment of any two point is identical.

According to Bravais, the structure of a crystal is represented by a lattice. Thus, lattice is an array of points used to represent the structure of a crystal geometrically.

These points are called the lattice points



LATTICE

Figure shows the two dimensional array of point. It is clear from the figure that the arrangement of points around each point is same. That is the geometrical arrangement of point in space.

LATTICE VIBRATION

Each solid is made up of atoms. In a solid, the atoms vibrate about their equilibrium positions, such vibrations are called the lattice vibrations.

These vibrations occur at all temperatures, even at absolute zero and they are mainly responsible for the thermal properties like specific heat, thermal conductivity, thermal expansion etc, of a solid. There is some assumptions for consider to lattice vibrations

ASSUMPTIONS

- 1) All atoms in a solid are arranged in straight line with a constant inter – atomic spacing “ a ”.
- (2) All atoms are identical, each of mass “ m ”
- (3) Each atom is considered to be a sphere, thus solid contents a large number of spheres.
- (4) Each atoms connected with its neighbouring atom by an ideal spring of force constants “ β ”.
- (5) Each atoms experiences the force of interaction only with its nearest neighbouring atoms.
- (6) The force between the atoms obey the Hook’s law. According to this law the force on the atom is depends linearly on the extension and contraction of its nearest neighboring distances. In other words .The force on the atoms linear restoring force under which it execute the simple harmonic motion on either side of its equilibrium position

SIMPLE HARMONIC OSCILLATOR

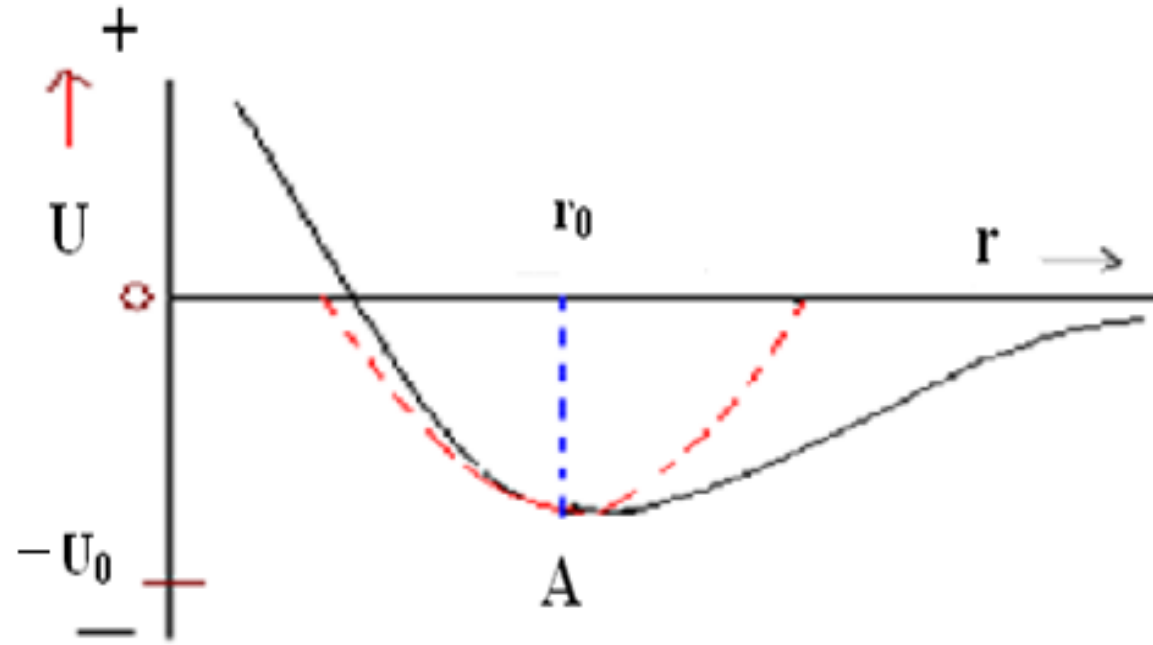
The potential energy between a pair of atoms in solid is given by,

$$U = -\alpha/r^6 + \beta/r^{12} \quad (1)$$

where,

r = is the distance between the nuclei of two atoms.

α and β = are the constants which are characteristics of the solid.



**Potential energy
curve**

VIBRATION OF ONE DIMENSIONAL MONOATOMIC CHAIN

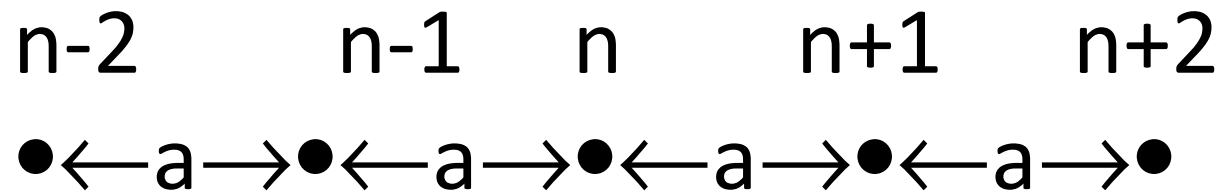


Fig. (a) in state of rest

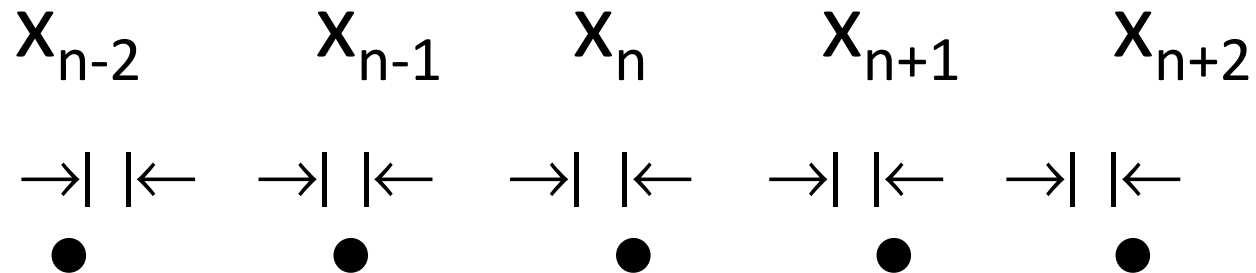


Fig (b) in state of vibration

- Fig. shows one dimensional lattice of atoms. Let the mass of each atoms be “ m ” and the inter- atomic separation be “ a ”.
- In the fig. the atoms are equidistant in the position of equilibrium. When the longitudinal wave propagates in the lattice, the atom execute simple harmonic motion in either side of their equilibrium positions.

REFERENCES:-

- LATTICE DEFECTS :S. BHATTACHERJEE
- LATTICE DEFECTS :G.D. NIGAM
- UNIFIED PHYSICS :R.P. GOYAL

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THANK YOU