Equipartition theorem

- The theorem of equipartition of energy states that for every degree of freedom in a system in thermal equilibrium at temperature T, the average energy of the system is $^1/_2$KT, where k is the boltzmann's constant.

- A monoatomic gas molecule has three degrees of freedom (corresponding to three translatory motions) and possesses average energy of $\frac{3}{2}$ kT .

- Thus to each degree of freedom we can associate $^1/_2$KT energy. This is true for every system.

- A diatomic gas 5 degrees of freedom (three translatory and two rotatory motions) and hence possesses an average kinetic energy of $\frac{5}{2}$ kT.

- Another classic example is one dimensional harmonic oscillator. It has two degrees of freedom one corresponds to kinetic energy ($\frac{P^2}{2m}$) and other one corresponds to potential energy ($^1/_2\, x^2$). Thus a one dimensional harmonic oscillator has a total average energy of $2\frac{1}{2}$ kT = kT.

- Thus solid which consists of atoms which behaves like harmonic oscillators possesses an average energy of KT.