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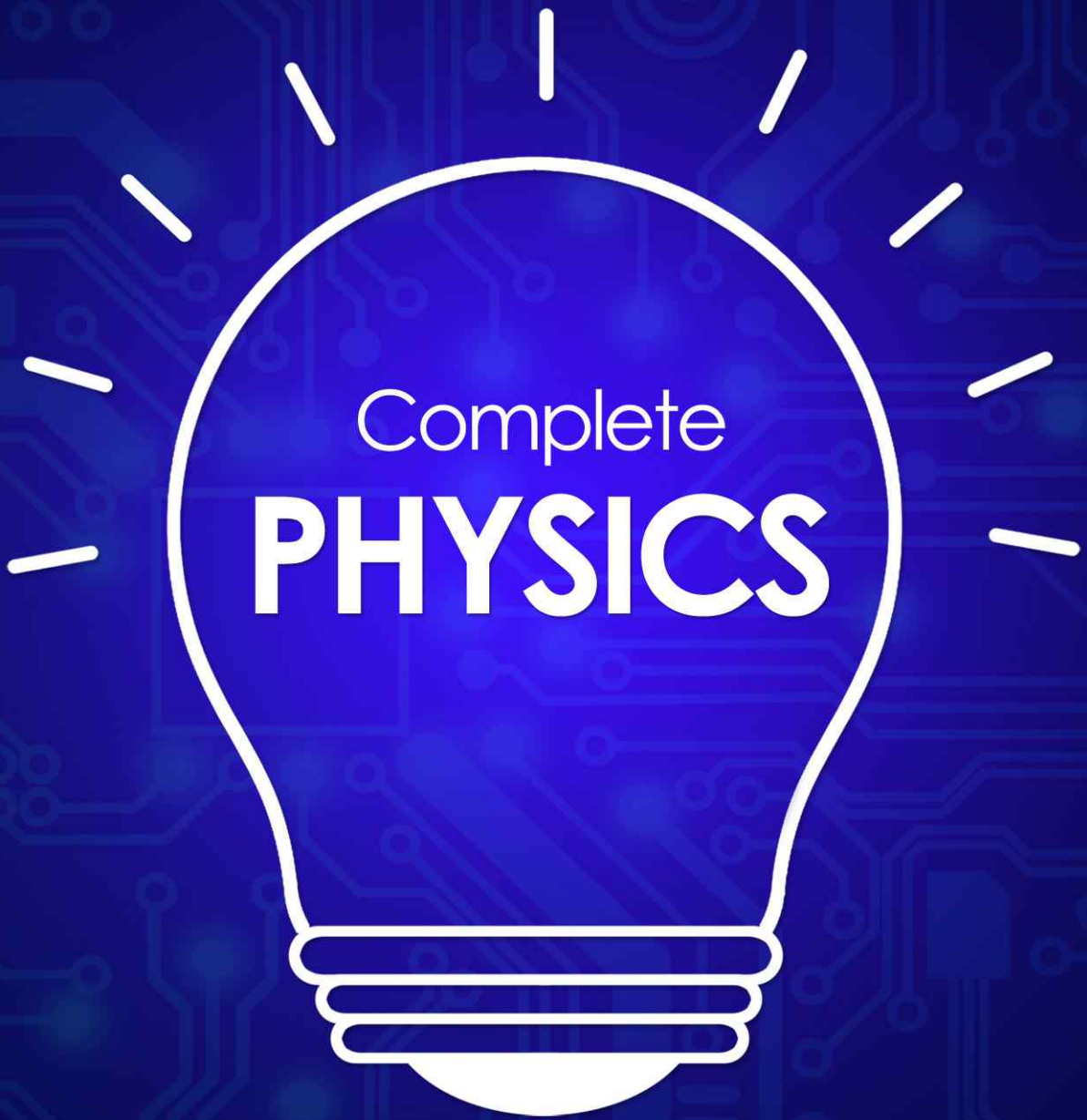

Complete PHYSICS

IIT-JEE · NEET · CBSE eBOOKS

CLASS 11&12th

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CLASS 11th

Thermal Properties of Matter

01. Heat

Heat is a form of energy which produces in us the sensation of warmth.

02. Temperature

The degree of hotness of a body is called its temperature.

03. Thermal Expansion

Almost all solids are found to expand with the rise in temperature. The thermal expansion of solids is of three types namely ***linear expansion, superficial expansion*** *and* ***cubical expansion.*** In each type of expansion, the increase in dimension is observed to be proportional to the original dimension and the rise in temperature. Solids are made up of atoms and molecules. As a given temperature, the atoms and molecules are located at some equilibrium distance. When heat is added to a solid, the amplitude of the vibrations of its atoms and molecules increases. Due to this, the effective interatomic separation increases, which results in the expansion of solids.

(i) **Linear expansion**

Suppose that a solid in the form of a rod of length l is heated, till its temperature rises through $\triangle T$. If the length of the rod becomes l', then it is found that increase in length $(l'-l)$ is

(a) *directly proportional to its original length i.e.*

$$(l'-l) \propto l \qquad \text{...(i)}$$

(b) *directly proportional to rise in temperature of the rod i.e.*

$$(l'-l) \propto \triangle T \qquad \text{...(ii)}$$

From the equations (i) and (ii), we have

$$(l'-l) \propto l \triangle T$$

or $$(l'-l) = \alpha l \triangle T$$

or $$l' = l(1+\alpha \triangle T)$$

Here, the constant of proportionality α is called the ***coefficient of linear expansion.*** Its value depends upon the nature of the material.

The coefficient of linear expansion of the material of a solid is defined as the increase in its length per unit length per unit rise in its temperature.

(ii) **Superficial expansion**

Let S be the intial surface area of a solid and S' be its surface area, when the temperature increases by $\triangle T$. Then, it is found that

$$(S'-S) \propto S$$

$$\propto \triangle T$$

or $$(S'-S) = \beta S \triangle T$$

or $$S' = S(1+\beta \triangle T)$$

Here, β is called the ***coefficient of superficial expansion.***