

Planck's Quantum theory, or
Quantum theory of Radiation.

Max Planck — 1901

The wave theory successfully explains many properties of electromagnetic radiations such as reflection, refraction, diffraction, interference, polarisation, etc., but fails to explain some phenomenon like black body radiation, Photo-electric effect, etc.

For black body radiation and Photo-electric effect, Max Planck in 1901 present a new theory which is known as Quantum theory of radiation.

Acc to this theory: →

- (i) A hot body emits radiant energy not continuously but discontinuously in the form of small packets of energy called Quantum (in plural quanta) -
- (ii) The energy associated with each quantum of a given radiation is proportional to the frequency of the emitted radiation.

$$E \propto \nu$$

or $E = h\nu$ where, $h = \text{const}$ or Planck's const.

Numerical value of $h = 6.624 \times 10^{-27} \text{ erg. sec}$
 $h = 6.624 \times 10^{-34} \text{ Js}$
 $h = 6.624 \times 10^{-37} \text{ KJs}$

- (iii) The total amount of energy transmitted -

from one body to another will be some integral multiple of energy of a quantum.

$$E = nh\nu$$

where, $n = 1, 2, 3, 4, \dots$

$$E = nh\nu = \frac{nhc}{\lambda} = nhc\bar{\nu}$$

⇒ German-born Physicist Albert Einstein: →

* In 1905, Einstein pointed out that light can be supposed to consist of a stream of particles, called Photons.

* The energy of each photon of light depends on the frequency of the light, i.e. $E = h\nu$.

* Energy is also related according to Einstein, as $E = mc^2$, where, $m = \text{mass of photon}$. (body)
 $c = \text{speed of light}$

Thus, it was pointed out that light has wave as well as particle characteristics (dual nature).

⇒ Black body Radiation: →

An ideal body which emits and absorbs radiations of all wavelengths or frequency is called Black body and the radiation emitted by this body is called Black body radiation.

⇒ Thus an ideal black body is also defined as a perfect absorber and a perfect emitter of radiation.

⇒ Photoelectric effect: →

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