B.Sc Phy. Part-I Paper-II Gr-'B'

Write short Notes on:

Stefan - Boltzmann Law

According to stefan - Boltzmann law, the radiant energy (heat) lost per second per unit area by a black body at absolute temp T, surrounded by an enclosure at temp T_0, is given by

$$E = \sigma (T^4 - T_0^4).$$

Let us suppose that T is greater than T_0 by only a small amount x. Then we can put $T = (T_0 + x)$. Then

$$E = \sigma [(T_0 + x)^4 - T_0^4]$$

$$= \sigma [4T_0^3 x + 6T_0^2 x^2 + 4T_0 x^3 + x^4].$$

Now x is small say 30° whereas T_0 is 300 K for a room temp. of 27°c (say). Therefore, the terms $6T_0^2 x^2$, $4T_0 x^3$, and x^4 can all be neglected compared with $4T_0^3 x$. Thus, the last expression reduces to

$$E = 4\sigma T_0^3 x$$

$$= 4\sigma T_0^3 (T - T_0)$$

or $E \propto (T - T_0)$.

Thus, when the temp of a body is only

slightly higher than the temperature of its surroundings, the heat lost per second by the body is proportional to the difference in temperature of the body and that of the surroundings. This is Newton's Law of Cooling.

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