> Deduction of wein's displacement law from Planck's law:—

Plank's radiation law is

$$E_\lambda d\lambda = \frac{8\pi hc}{\lambda^5} \frac{d\lambda}{(e^{hc/\lambda KT} - 1)}$$

When this equation is differentiated with respect to λ and equated to zero, the wien's displacement law ~~witch~~ which ($\lambda T = \text{constant}$) is obtained for wavelength corresponds to maximum energy emission for a given value of T. that is

$$\frac{dE_\lambda}{d\lambda} = \frac{1}{(e^{hc/\lambda KT} - 1)} \times \frac{-5(8\pi hc)}{\lambda^6} + \frac{8\pi hc}{\lambda^5} \times \frac{\frac{hc}{\lambda^2 KT} e^{hc/\lambda KT}}{(e^{hc/\lambda KT} - 1)^2}$$

$$= \frac{1}{(e^{hc/\lambda KT} - 1)} \times \frac{-40\pi hc}{\lambda^6} + \frac{8\pi hc}{\lambda^5} \times \frac{hc}{\lambda^2 KT} \times \frac{e^{hc/\lambda KT}}{(e^{hc/\lambda KT} - 1)^2}$$

For E_λ maximum the value of its first derivative should be zero

So

$$\frac{8\pi hc}{(e^{hc/\lambda KT} - 1)\lambda^6} \left[-5 + \frac{hc}{\lambda KT} \times \frac{e^{hc/\lambda KT}}{(e^{hc/\lambda KT} - 1)} \right] = 0$$

$$= \left[-5 + \frac{hc}{\lambda KT} \frac{e^{hc/\lambda KT}}{(e^{hc/\lambda KT} - 1)} \right] = 0$$

Let $\frac{hc}{\lambda KT} = y$

Then $-5 + \frac{hc}{\lambda KT} \frac{e^{hc/\lambda KT}}{(e^{hc/\lambda KT} - 1)}$ becomes

$$\left[-5 + y \frac{e^y}{(e^y - 1)}\right] = 0$$

solving this for y then we get

$$y = 4.965 = \frac{hc}{\lambda KT}$$

$$\frac{hc}{\lambda KT} = 4.965$$

$$\lambda_m T = \left(\frac{hc}{4.965 K}\right) \Rightarrow \text{constant}$$

$$\boxed{\lambda_m T = b} \quad \text{where } b = \frac{hc}{(4.965 K)}$$

This is Wien's displacement law.