

## 2.7: Stefan's Law (The Stefan-Boltzmann Law)

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The total exitance integrated over all wavelengths or frequencies can be found by integrating Equations 2.6.1 - 2.6.4. Integration of 2.6.1 over wavelengths or of 2.6.3 over frequencies each, of course, gives the same result:

$$M = \sigma T^4 \quad (2.7.1)$$

where

$$\sigma = \frac{2\pi^5 k^4}{15h^3 c^2} = 5.6705 \times 10^{-8} \text{ W m}^{-2} \text{K}^4 \quad (2.7.2)$$

Equation 2.7.1 is Stefan's Law, or the Stefan-Boltzmann law, and  $\sigma$  is *Stefan's constant*.

Integration of Equation 2.6.2 over wavelengths or of 2.6.4 over frequencies each, of course, gives the same result:

$$N = \rho T^3 \quad (2.7.3)$$

where

$$\rho = \frac{4\pi\zeta(3)k^3}{h^3 c^2} = 1.5205 \times 10^{-8} \text{ ph s}^{-1} \text{m}^{-2} \text{K}^{-3} \quad (2.7.4)$$

Here  $\zeta(3)$  is the Riemann zeta-function:

$$\zeta(3) = 1 + \left(\frac{1}{2}\right)^3 + \left(\frac{1}{3}\right)^3 + \left(\frac{1}{4}\right)^3 + \dots = 1.202057 \quad (2.7.5)$$

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