

Problem 1. The most energetic frequency interval and wavelength interval

(a) The energy density can be written

$$u = \int_0^\infty d\omega \frac{du}{d\omega} \quad (1)$$

where $du/d\omega$ is the energy per frequency interval $d\omega$. Using a graphical means show $du/d\omega$ is maximum for $\hbar\omega = 2.82kT$. What is the energy of a photon with this frequency for a black body of 6000K, which is approximately the surface temperature of the sun.

(b) The energy density can be written

$$u = \int_0^\infty d\lambda \frac{du}{d\lambda} \quad (2)$$

where $du/d\lambda$ is the energy per wavelength interval $d\lambda$. Find $du/d\lambda$, and using a graphical method find the wavelength where $du/d\lambda$ is maximum. (You should find $\lambda \simeq 4.9\hbar c/kT$.) What is this wavelength in nm for a black body of 6000K, which is approximately the surface temperature of the sun.

Spectral Density of Energy

