Chapter 34 Problem 19 †

Given
$T = 5800\ K$

Solution
a) Find the wavelength of peak radiance.
The wavelength for maximum radiance is given by Wien's displacement law.

$$\lambda_{\max} T = 2.898 \times 10^{-3}\ m \cdot K$$

Solving for the wavelength gives

$$\lambda_{\max} = \frac{2.898 \times 10^{-3}\ m \cdot K}{T}$$

$$\lambda_{\max} = \frac{2.898 \times 10^{-3}\ m \cdot K}{5800\ K} = 5.00 \times 10^{-7}\ m$$

This wavelength corresponds to bluish-green light.

b) Find the median wavelength (where half the power is radiated above this wavelength and half below).

The equation for median wavelength is

$$\lambda_{median} T = 4.11 \times 10^{-3}\ m \cdot K$$

Solving for wavelength gives

$$\lambda_{mean} = \frac{4.11\ \times 10^{-3}\ m \cdot K}{T}$$

$$\lambda_{mean} = \frac{4.11 \times 10^{-3}\ m \cdot K}{5800} = 7.09 \times 10^{-7}\ m$$

This wavelength corresponds to red light. Therefore, half of the energy from the sun is radiated away as infrared and longer wavelength and the other half is visible, ultra-violet and shorter wavelengths.

†Problem from Essential University Physics, Wolfson