**Chapter 34 Problem 41** †

**Given**
$\lambda_{max} = 558\ nm$

**Solution**
a) What is the temperature of the blackbody?

Using Wein's law

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

$$T = \frac{2.898 \times 10^{-3}\ m \cdot K}{\lambda_{peak}} = \frac{2.898 \times 10^{-3}\ m \cdot K}{558 \times 10^{-9}} = 5190\ K$$

b) What is the ratio of radiance at 382 $nm$ compared to 694 $nm$?

The radiance formula for a blackbody radiator is

$$R(\lambda, T) = \frac{2\pi hc^2}{\lambda^5 (e^{hc/\lambda kT} - 1)}$$

The radiance at 382 $nm$ is

$$R(382\ nm, 5190\ K) = \frac{2\pi (6.63 \times 10^{-34}\ J \cdot s)(3.0 \times 10^8\ m/s)^2}{(382 \times 10^{-9}\ m)^5 (e^{(6.63\times10^{-34}\ J\cdot s)(3.0\times10^8\ m/s)/((382\times10^{-9}\ m)(1.38\times10^{-23}\ J/K)(5190\ K))} - 1)}$$

$$R(382\ nm, 5190\ K) = 3.23 \times 10^{13}$$

The radiance at 694 $nm$ is

$$R(694\ nm, 5190\ K) = \frac{2\pi (6.63 \times 10^{-34}\ J \cdot s)(3.0 \times 10^8\ m/s)^2}{(694 \times 10^{-9}\ m)^5 (e^{(6.63\times10^{-34}\ J\cdot s)(3.0\times10^8\ m/s)/((694\times10^{-9}\ m)(1.38\times10^{-23}\ J/K)(5190\ K))} - 1)}$$

$$R(694\ nm, 5190\ K) = 4.35 \times 10^{13}$$

The ratio of the two radiance is then

$$\frac{R(382\ nm, 5190\ K)}{R(694\ nm, 5190\ K)} = \frac{3.23 \times 10^{13}}{4.35 \times 10^{13}} = 0.743$$

† Problem from Essential University Physics, Wolfson