Prob. 1 The temperature of the tungsten filament of a particular incandescent light bulb is 3200 K. Assuming that the filament acts like a blackbody emitter, what is the wavelength at which the spectral emission I(λ) is a maximum. Also, what is the corresponding frequency?

$\lambda_{max} T = 2.90 \cdot 10^{-3}\ m \cdot K$

$\lambda_{max} = \frac{2.9 \cdot 10^{-3}\ m \cdot K}{3200\ K} = 9.06 \cdot 10^{-7}\ m = \boxed{906\ nm}$

$\nu_{max} = \frac{3 \cdot 10^{9}\ m/s}{9.06 \cdot 10^{-7}\ m} = \boxed{3.3 \cdot 10^{14}\ Hz}$

Prob. 2 An incandescent light bulb has a filament in the form of a wire of diameter 0.080 mm and length 5.0 cm, at a temperature of 3200 K. What is the power radiated by the filament if it acts like (a)a blackbody, or (b)a graybody with emissivity of 0.3

surface area is

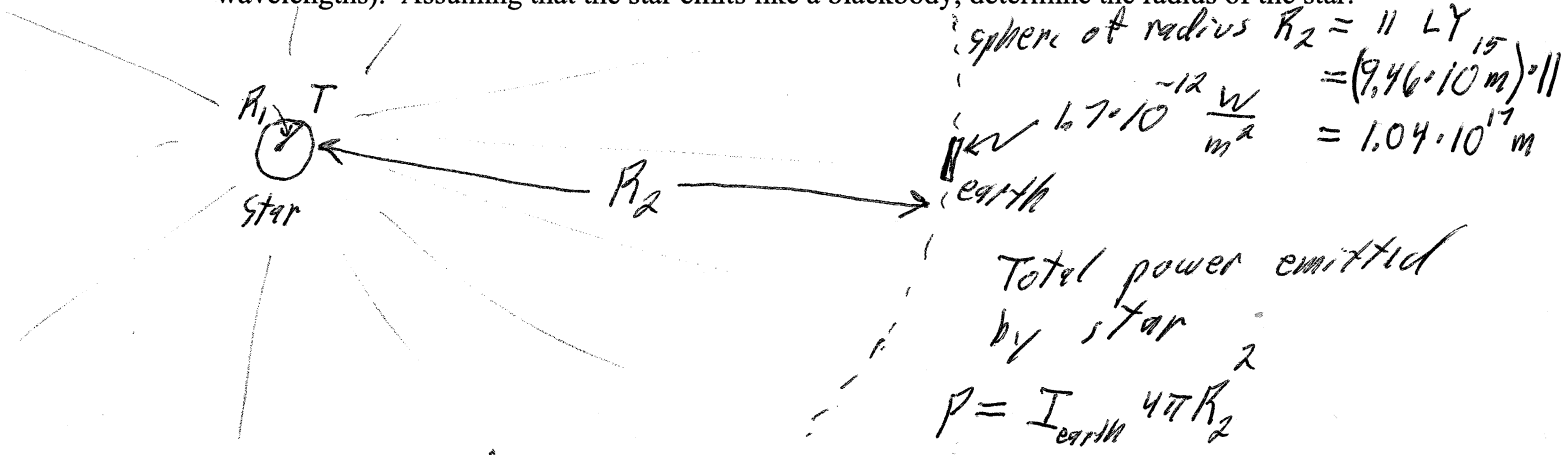
$A = L(2\pi R) = (0.05\ m)\, 2\pi (4 \cdot 10^{-5}\ m) = 1.256 \cdot 10^{-5}\ m^2$

a) $P = \sigma T^4 A = (5.67 \cdot 10^{-8})(3200)^4 (1.256 \cdot 10^{-5})$

$P = \boxed{74.7\ W}$

b) $P = (0.3)(74.7) = \boxed{22.4\ W}$

Prob. 3 A star is known to be 11 light-years from the earth, and its surface temperature is 6600 K. The light that we receive from this star has intensity 1.7×10^{-12} W/m^2 (integrated over all wavelengths). Assuming that the star emits like a blackbody, determine the radius of the star.



sphere of radius $R_2 = 11\ LY = (9.46 \cdot 10^{15}\ m) \cdot 11 = 1.04 \cdot 10^{17}\ m$

$I_{earth} = 1.7 \cdot 10^{-12}\ \frac{W}{m^2}$

Total power emitted by star

$P = I_{earth}\, 4\pi R_2^2$

At star's surface,

$P = \sigma T^4 (4\pi R_1^2)$

so

$\sigma T^4 4\pi R_1^2 = I\, 4\pi R_2^2$

$\therefore R_1 = R_2 \frac{1}{T^2}\sqrt{\frac{I}{\sigma}} = (1.04 \cdot 10^{17})\frac{1}{(6600)^2}\sqrt{\frac{1.7 \cdot 10^{-12}}{5.67 \cdot 10^{-8}}} = \boxed{1.3 \cdot 10^{7}\ m}$