Chapter 2, #25, 26, 29, 30 March 26, 2021

repeat with 2.45 GHz microwave radiation

25. $f\lambda = c$ $\lambda = \frac{c}{f}$

$\lambda = \frac{3\times10^8 \frac{m}{s}}{95\times10^6 \ Hz}$ $Hz = \frac{1}{s}$

so seconds cancel

$= \frac{3}{95} \times 10^2 \ m \approx 3m$ (3.16m if you want more exactness)

Repeat for 2.45 GHz radiation (microwaves)

$\lambda = \frac{3\times10^8 \frac{m}{s}}{2.45\times10^9 \ Hz} = \frac{3}{2.45}\times10^{-1} \ Hz$

$= 0.122 \ m$ or about 12 cm

26. $E = hf$ h is Planck's constant

(a) 10x the frequency $\Rightarrow$ 10x the photon energy

(b) Put in $f = \frac{c}{\lambda}$

$E = \frac{hc}{\lambda}$

2x the wavelength $\Rightarrow \frac{1}{2}$ the photon energy

29. $$\underset{\text{luminosity}}{L} = \underbrace{4\pi \overset{\text{radius}}{R^2}}_{\text{surface area}} \sigma \overset{\text{Temperature}}{T^4}$$

σ = Stefan–Boltzmann constant

All of the above is from Figure It Out Box 2.3

(a) If we keep everything the same but triple T_{sun}, we get $(3T_{sun})^4$ in the formula, which is $81\,T_{sun}^4$. So the formula is 81x more than $L_{sun} = 4\pi R_{sun}^2 \sigma T_{sun}^4$

(b) We get $(2R_{sun})^2$ where we had R_{sun} so another factor of 4. $4 \times 81 = 324$x more luminosity than the sun.

30. $L_{\text{other star}} = 2\,L_{sun}$

$R_{\text{other star}} = R_{sun}$

What is $T_{\text{other star}}$ compared to T_{sun}

$T_{\text{other star}} = \sqrt[4]{2}\;T_{sun}$