

Homework Problem #2

$$C_1 := 0.59544 \times 10^8$$

$$\pi := 3.1415927$$

$$C_2 := 14388$$

$$\sigma := 5.669 \cdot 10^{-8}$$

A. Maximum emission

$$C_3 := 2897.8$$

for sun,

$$T_{\text{sun}} := 6000$$

$$\lambda_{\text{sun}} := \frac{C_3}{T_{\text{sun}}}$$

$$\lambda_{\text{sun}} = 0.483 \quad \text{microns}$$

for earth

$$T_{\text{earth}} := 290$$

$$\lambda_{\text{earth}} := \frac{C_3}{T_{\text{earth}}}$$

$$\text{suntot} := \sigma \cdot T_{\text{sun}}^4$$

$$\lambda_{\text{earth}} = 9.992 \quad \text{microns}$$

$$\text{earthtot} := \sigma \cdot T_{\text{earth}}^4$$

B. Visible emission

$$e_{\text{sun}} := \int_{.4}^{.7} \frac{2 \cdot \pi \cdot C_1}{\lambda^5 \cdot \left(e^{\frac{C_2}{\lambda \cdot T_{\text{sun}}}} - 1 \right)} d\lambda$$

$$e_{\text{sun}} = 2.761 \times 10^7 \quad \text{watts per sq m}$$

$$\text{percent} := \frac{e_{\text{sun}} \cdot 100}{\text{suntot}} \quad \text{percent} = 37.575$$

$$e_{\text{earth}} := \int_{.4}^{.7} \frac{2 \cdot \pi \cdot C_1 \cdot 10^{20}}{\lambda^5 \cdot \left(e^{\frac{C_2}{\lambda \cdot T_{\text{earth}}}} - 1 \right)} d\lambda$$

$$\text{percent} := \frac{e_{\text{earth}} \cdot 100}{\text{earthtot} \cdot 10^{20}} \quad \text{percent} = 0$$

$$e_{\text{earth}} = 3.795 \times 10^{-4} \quad \text{times } 10^{-20} \text{ watts per sq. m}$$

C. Infrared emission

$$e_{\text{sun}} := \int_2^{25} \frac{2 \cdot \pi \cdot C_1}{\lambda^5 \cdot \left(e^{\frac{C_2}{\lambda \cdot T_{\text{sun}}}} - 1 \right)} d\lambda$$

$$e_{\text{sun}} = 4.034 \times 10^6 \quad \text{watts per sq m}$$

$$\text{percent} := \frac{e_{\text{sun}} \cdot 100}{\text{suntot}} \quad \text{percent} = 5.491$$

$$e_{\text{earth}} := \int_2^{25} \frac{2 \cdot \pi \cdot C_1}{\lambda^5 \cdot \left(e^{\frac{C_2}{\lambda \cdot T_{\text{earth}}}} - 1 \right)} d\lambda$$

$$e_{\text{earth}} = 329.531 \quad \text{watts per sq. m} \quad \text{percent} := \frac{e_{\text{earth}} \cdot 100}{\text{earthtot}} \quad \text{percent} = 82.186$$