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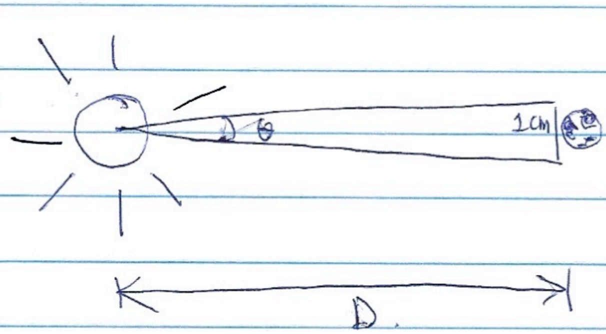
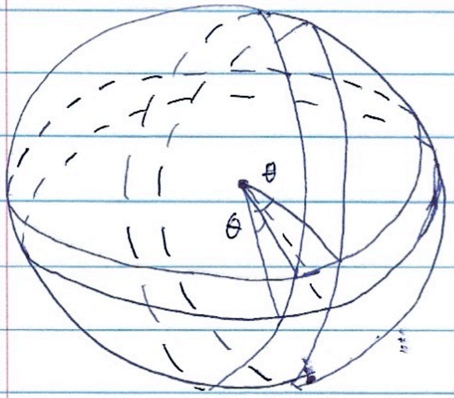
4.2(a)





Fractional surface area = $\left(\frac{2\pi}{\theta}\right)\left(\frac{\pi}{\theta}\right)$

Solar constant = $0.136\ J\,s^{-1}\,cm^{-2}$ gives intensity ~~of fractional~~ per area.

To compute the rate of energy generation, we perform an integral over the sphere bounded by mean distance to earth as radius. Assuming uniform intensity distribution over all angles, we have.

$$[J][s^{-1}] = \frac{2\pi^2}{\theta^2} \times (\text{solar constant})$$

$$= 2\pi^2 \left(\frac{D}{1cm}\right)^2 \times 0.136 \approx \boxed{3.65 \times 10^{26}\ J\,s^{-1}}$$

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1.4.2024.

Kittel TP

4.2(b). We use the energy flux density to approximate the effective blackbody temperature of the sun.

Equating the Energy flux density of the sun with that of a black body:

$$\frac{4\times10^{26}\ J\,s^{-1}}{4\pi\times(7\times10^{10}\ cm)^2} = \sigma_B T^4\ J\,s^{-1}\,cm^{-2}.$$

The units match so we can simply cancel them, doing the algebra:

$$\frac{10^{26}}{\pi\times49\times10^{20}} = 5.67\times10^{-12}\ T^4.$$

$$\frac{10^{26}}{\pi\times49\times10^{20}\times5.67\times10^{-12}} = T^4$$

$$0.11\times10^{16} = T^4.$$

$$\boxed{0.576\times10^4 = T}$$, in Kelvin.

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