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87.202 - PRINCIPLES OF EARTH & ENVIRONMENTAL SYSTEMS II
STUDY QUESTIONS AND PROBLEMS I

1. Radio waves, like light, normally travel in straight lines. In view of the curvature of the earth's surface, why can radio signals be received at great distances from the place where they are emitted?

2. The earth is continually receiving radiation from the sun. Why doesn't its temperature increase?

3. What are the consequences of decreasing the amount of ozone in the stratosphere?

4. Why is the diurnal variation of temperature over land larger than over the ocean?

5. Discuss what happens to solar radiation in passing through the atmosphere, from the "top" of the atmosphere to the ground.

6. Calculate the temperature of a red-hot iron bar that has its energy wavelength maximum at 0.65μm. Calculate the rate of emission of energy from the iron bar. (a = 2900 μm K and $\sigma = 5.670373 \times 10^{-8}$ J s^{-1} m^{-2} K^{-4}. (ans: T = 4,462 K; E = 2.248×10^{7} J s^{-1} m^{-2})

7. The following equation relates the distance from a perfect radiator to the intensity of the radiation at that distance.

$$E_2/E_1 = d_1^2/d_2^2$$

where E_1 is the energy flux at distance d_1 and E_2 is the energy flux at distance d_2.

The solar constant is 1.3608×10^{3} J s^{-1} m^{-2}. The radius of the surface of the sun is 6.95×10^{5} km and the mean distance from the sun to the earth is 149.6×10^{6} km.

a. Calculate the energy emitted per unit surface area from the sun's surface. (ans: 6.305×10^{7} J s^{-1} m^{-2})

b. Calculate the surface temperature of the sun. (ans: 5,775 K)

8. a. Compute the temperature the earth would have in the absence of the atmosphere in order to emit exactly the amount of radiation received on average from the sun. Use 1.3608×10^3 J s^{-1} m^{-2} for the solar constant and 6370 km for the radius (R) of the earth. Remember that the radiation received is that intercepted by the cross section of the earth, πR^2, but the radiation emitted comes from the earth's entire surface, $4\pi R^2$. (ans: 278.3 K)

b. If the albedo were exactly what the average planetary albedo is at present, namely 0.30, but the atmosphere was absent, calculate the temperature the earth would have to have in order for the energy emitted by the earth to be exactly equal to the amount absorbed at the surface? (ans: 254.6 K)