PROBLEM SET 2
Physics 2013

1. What is the frequency of electromagnetic radiation that has a wavelength of 0.4 nm? In what part of the spectrum does this radiation occur?

2. What is the wavelength of electromagnetic radiation that has a frequency of 3×10^{20} Hz? In what part of the spectrum does this radiation occur?

3. Saturn is two times farther from the Sun than is the Earth. How does the flux of solar energy on Saturn compare with that on the Earth?

4. How close to the Sun would a space craft have to go to reach the distance at which the flux of solar energy is 10 times as large as the solar energy flux at the Earth?

5. Your normal body temperature is 98.6° F. What kind of radiation do you predominantly emit? At what wavelength (in nm) do you emit the most radiation?

6. What is the temperature of the Sun's surface in degrees Kelvin?

7. The star Alpha Lyrae (the brightest star in the constellation Lyrae, the Violin) has a surface temperature of 11,000 K. How many times more energy is emitted each second from each square meter of the surface of Alpha Lyr than from each square meter of the Sun's surface? (Assume the two stars have equal radii.)

8. Jupiter is known to have an active volcano named Pele whose temperature can be as high as 2300° C. (a) What is the wavelength of maximum emission for the volcano at this temperature? In what part of the electromagnetic spectrum is that? (b) The average temperature of Io's surface is -130° C. Compared with a square meter of surface at that temperature, how much more energy is emitted per second from each square meter of Pele's surface?

9. The bright star Sirius in the constellation of Canus Major (the Large Dog) has a radius of $1.67 R_\odot$ and a luminosity of $23 L_\odot$. What is the star's surface temperature? (Note: The symbol $\odot$ in the line "Sun, so $1 \text{ of } R_\odot = 1 \text{ of}$" means the radius of the Sun.)

10. Planet A has twice the frequency of Planet B. How do the energies of the two photons compare?

11. (a) Calculate the wavelength of Ly_δ, the fourth wavelength in the Paschen series. (b) Draw a schematic diagram of the hydrogen atom and indicate the electron transition that gives rise to this spectral line. (c) In what part of the electromagnetic spectrum does this wavelength lie?

12. (a) Calculate the wavelength of H_α, the spectral line for an electronic transition between the $n = 3$ and $n = 2$ orbits of hydrogen. (b) In what part of the electromagnetic spectrum does this wavelength lie?