

**PROBLEM SET 2**  
**Physics 1022**

1. What is the frequency of electromagnetic radiation that has a wavelength of 3.0 nm? In what part of the spectrum does this radiation occur?
2. What is the wavelength of electromagnetic radiation that has a frequency of  $3 \times 10^{16}$  Hz? In what part of the spectrum does this radiation occur?
3. Gamma rays travel faster than the Sun than on the Earth. How does the flux of solar energy at Saturn compare with that at the Earth?
4. How close to the Sun would you need to get to match the distance at which the flux of solar energy at Saturn is equal to the solar energy flux at the Earth?
5. Your normal body temperature is 37.0°C. What kind of radiation do you predominantly emit? In what wavelength (or range) do you emit the most radiation?
6. What is the temperature of the Sun's surface in degrees Fahrenheit?
7. The star Alpha Centauri (the brightest star in the constellation Centauri, the Wolf) has a surface temperature of 21,000 K. How many times more energy is emitted each second from each square meter of the surface of Alpha Centauri than from each square meter of the Sun's surface? (Assume the two stars have equal radii.)
8. Jupiter's atmosphere is an active volcano named Io, whose temperature can be as high as 1200°C. (a) What is the wavelength of maximum emission for the surface of the volcano? In what part of the electromagnetic spectrum is this? (b) The average temperature of Io's surface is 120°C. Compared with each square meter of surface at this temperature, how much more energy is emitted per second from each square meter of Io's surface?
9. The brightest star in the constellation of Great Dipper (the Large Dip) has a radius of  $1.61 R_{\odot}$  and a luminosity of  $12.6 L_{\odot}$ . What is the star's surface temperature? (Note: The symbol  $L_{\odot}$  is the luminosity of the Sun, or  $3.828 \times 10^{26}$  watts from the surface of the Sun.)
10. Photon A has twice the frequency of Photon B. How do the energies of the two photons compare?
11. (a) Calculate the wavelength of  $H_{\alpha}$ , the fourth wavelength in the Paschen series. (b) What is the atomic number 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  $H_{\alpha}$ , the spectral line for the electron transition between the  $n = 17$  and  $n = 16$  orbits of hydrogen. (b) In what part of the electromagnetic spectrum does this wavelength lie?