

PROBLEM SET 2
Physics 1022

1. What is the frequency of electromagnetic radiation that has a wavelength of 0.1 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^{16} Hz? In what part of the spectrum does this radiation occur?
3. Gamma rays travel faster than the Sun does in 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 98.6° F. What kind of radiation do you predominantly emit? At what wavelength (or over the 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 has an average surface wind speed of 100 m/s. How does the temperature of Jupiter compare with that of the Sun? (a) What is the wavelength of maximum emission for the surface of the atmosphere? In what part of the electromagnetic spectrum is this? (b) The average temperature of Jupiter's surface is 130° C. Compared with each square meter of surface at this temperature, how much more energy is emitted per second from each square meter of Jupiter's surface?
9. The brightest star in the constellation of Cassiopeia (the L-shape) has a radius of 1.6×10^8 m, and a temperature of 21,000 K. What is the star's surface temperature? (Note: The symbol σ is the Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}$ W/m²·K⁴.)
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_{α} , 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_{α} , 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?