Astronomy 2110 Homework #4

Spring 2024 Due Thursday, Feb 15 in class.

For full credit you must write your solutions neatly and include all work. Do not forget the units.

1) A cellular phone is actually a radio transmitter and receiver. You receive an incoming call in the form of a radio wave at 880.65 MHz. What is the wavelength (in meters) of this wave?

2) The bright star Bellatrix in the constellation Orion has a surface temperature of 21,500 K. What is its wavelength of maximum emission in nanometers (nm)? What color would this star appear to your eye?

3) To emit the same amount of light energy per second, which must emit more photons/sec: a source of red light, or a source of blue light? Explain your answer.

4) (a) Describe the spectrum of hydrogen at visible wavelengths. (b) Explain how Bohr's model of the hydrogen atom accounts for the Balmer lines.

5) If you see a blue star, what does its color tell you about how the star is moving through space? Explain your answer.

6) What wavelength of electromagnetic radiation is emitted with the greatest intensity by this book? To what region of the electromagnetic spectrum does this wavelength correspond?

7) Use the value of the solar constant of 1370 W/m^2 (see also Box 5-2) and the distance from the Sun to the Earth to calculate the luminosity of the Sun in Watts. Compare this to the value given in the Appendix of the book.

8) The bright star Sirius in the constellation of Canis Major (the big dog) has a radius of 1.67 solar radii, and a luminosity of 25 solar luminosities. (a) Use this information to calculate the energy flux at the surface of Sirius. (b) Use your answer from part (a) to calculate the surface temperature of Sirius. How does your answer compare to the value given in Box 5-2 (or Wikipedia)?

9) Instruments on board balloons and spacecraft detect 511 keV photons coming from the direction of the Galactic center. What is the wavelength of these photons? To what region of the electromagnetic spectrum does this wavelength correspond?

10) You are given a traffic ticket for going through a red light (wavelength 700 nm). You tell the police officer that because you were approaching the light, the Doppler effect caused a blue-shift that made the light appear green (wavelength 500 nm). How fast would you have to have been going for this to be true? Would the speeding ticket be justified?