

Homework Assignment #1 due in class Thu. 9/15

1.
 - a) The human eye's daylight sensitivity (photopic vision) peaks at about 5550 \AA (555 nm). What frequency does this correspond to? At what color do we perceive this wavelength?
 - b) Nighttime (scotopic) vision peaks at about 5070 \AA (507 nm); what frequency does this correspond to? At what color do we perceive this wavelength?
 - c) In general, photopic vision is full-color, while scotopic vision is more monochrome, though one can still get a vague impression of color in low light. Based on your answers to a) and b), and your own experience, describe your perception of a scene in full daylight compared with moonlight or other low-light environment.
2. Dental x-rays have a wavelength of about 0.5 \AA (0.05 nm). How many times more energy does one of these photons carry than a visible-light photon of 5500 \AA (550 nm)? *Hint:* Try solving this problem using scaling arguments, rather than performing full calculations for both cases. Scaling is a very useful technique that saves time and reduces the possibility for calculation errors.
3. The highest-energy gamma rays that have been detected to date come from as-yet unidentified sources inside globular star clusters. These gamma rays have energies exceeding 10 TeV (1 TeV= 10^{12} eV). How fast (in m/sec) would a 0.1 mg fruit fly have to be crawling for its kinetic energy to equal a 10 TeV gamma ray? At this rate, how many times could it crawl around a 1-cm diameter grape in one second?
4.
 - a) Derive an expression for $\Delta\lambda$, the change in the peak wavelength of the Planck function (λ_{max}) for a blackbody of temperature T, corresponding to a small shift in temperature, ΔT . (This is problem 2.14 in the text).
 - b) Calculate λ_{max} for T=5800K. Using your result from part a), estimate λ_{max} (in nm) for T=5900K. How far off is this approximation from the value you get if you use Wien's Law to directly calculate λ_{max} for T=5900K?

Plus from Ch 2 in Kutner:
Questions 2.4, 2.11
Problems 2.13, 2.18