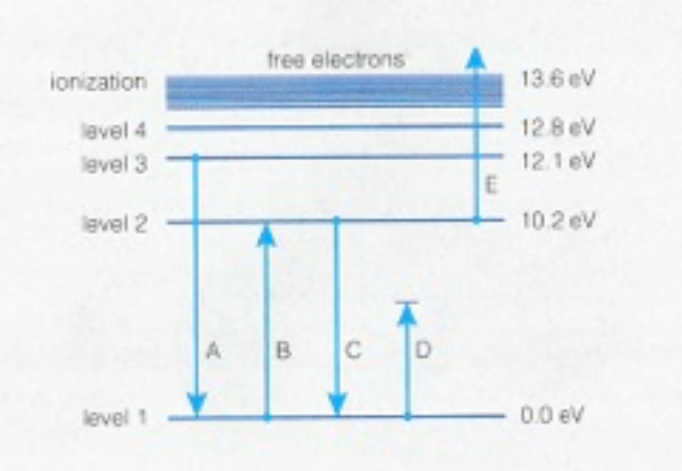
Problem Set #2

Due Monday, March 2 by 5pm to Dickinson 104

1. Suppose the surface temperature of the Sun were about 12000K, rather than 6000K.
    a. By what numerical factor would the amount of thermal radiation (energy) the Sun emits increase?
    b. What would happen to the Sun's wavelength of peak emission (*be specific and quantitative*)?
2. A traditional incandescent light bulb uses a hot tungsten coil to produce a thermal radiation spectrum. The temperature of this coil is typically about 3000K.
    a. What is the wavelength of the maximum intensity for this light bulb? Compare to the 500 nm wavelength of maximum intensity for the Sun.
    b. Overall, do you expect the light from this bulb to be the same as, redder than, or bluer than light from the Sun? Why? Use your answer to explain why professional photographers must adjust their cameras for indoor photography vs. outdoor photography.
    c. Do incandescent light bulbs emit all their energy as visible light? Use your answer to explain why these light bulbs are usually hot to the touch.
3. When a food containing sodium spills into an open flame on a stove, a characteristic orange color is produced (specifically, $\lambda = 589.6$ nm). Calculate the *difference* in energy between the two levels in a sodium atom responsible for the emission of this light.
4. Astronomers claim that objects throughout the universe are made of the same chemical elements that exist here on Earth. Given that most of these objects are so far away that we can never hope to visit them, why are astronomers so confident that these objects are made from the same set of chemical elements, rather than some completely different type of materials?
5. The following labeled transitions represent an electron moving between energy levels in a hydrogen atom. Using the figure on the next page, answer each of the following questions and *explain your answers*.
    a. Which transition could represent an atom that *absorbs* a photon with 10.2eV of energy? Explain.
    b. Which transition could represent an atom that *emits* a photon with 10.2eV of energy? Explain.
    c. Which transition represents an electron that is breaking from of an atom? Explain.
    d. Which transition, as shown, is *not possible*? Explain.

e. Would transition A represent emission or absorption of light? How would the wavelength of the emitted/absorbed photon compare to that of the photon involved in transition C? Explain.



6. In class today (Tuesday, February 24), we spent time talking about one kind of non-thermal emission – emission line radiation from atomic transitions. Do some reading (in the book, online, etc) and write a short (~a couple paragraphs) description of another kind of non-thermal emission. Possibilities include florescence/phosphorescence, LEDs, Lasers, etc. (Chapter 7 in your book is a good resource). Your description should include, to the best of your ability, a description of the *physical processes* in these systems that result in the creation of light. If you have questions about whether a kind of emission would be appropriate, please ask.