Astronomy 1 fall 2009
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Assignment # 5
Due Friday October 30, 2009

Instructions

On this and future assignments, please write your name on all pages and staple all pages together. Write very clearly!

Please be sure to explain your answer to all word problems briefly but carefully, and to show all your work on the calculations. The grade on each problem will reflect more the verbal explanations and the calculations shown rather than the final answers given in the back. (In fact, the answers to most of the quantitative questions from the book are given in the back and I'll give you the answers to most of my quantitative questions right on the assignments).

You may work with others on the homework problems, but you must write them up yourself, using your own words and calculations. If you hand in a paper nearly identical to someone else's, neither of you will get any credit because we won't know whether or not you actually did the work.

Also, the solutions will be shown on our class website very soon after the due date: http://www.ucsb.physics.edu/~astro1/fall2009. Partly for this reason, we **cannot accept late homework! (Only exception: if you have an emergency and tell me before the due date).**

We will only grade a few problems in detail for 10 points and check to see if you've made a reasonable attempt on the others for the remaining 5 points.

SHOW ALL WORK

1. a) When an electron in a Hydrogen atom drops from the third orbital to the second, emitting a photon, what is the frequency of that photon? It helps to refer to Fig 5-24; you do not have to look at any material, which was not assigned in order to do it. (Answer: 4.6 x 10^14 waves/sec, or Hz).

b) Please do the same for a drop from the second orbital to the first. (Answer: 2.5 x 10^15 Hz)

c) Now calculate the frequency of the photon produced in a single drop all the way from the third to the first orbital. You must do it using the frequencies you just calculated. (Answer: 3.0 x 10^15 Hz)

What is the wavelength? (Answer: 1.0 x 10^2 nm)

What is the energy of this photon? (Answer: 2.0 x 10^-18 J)

Into what part of the electromagnetic spectrum does this photon fall?

2. Consider the formation of the solar system. What are the two reasons that the outer proto-planetary cores (those of Jupiter, Saturn, Uranus, and Neptune) were able to attract and gravitationally bind vast quantities of Hydrogen and Helium, giving these planets very large masses and low densities relative to the terrestrial planets Mercury, Venus, Earth, and Mars? Hint: this involves the concepts of the superabundant light gases H and He, the ices such as water and carbon dioxide, and the rocky and metallic elements like Iron, Manganese, etc.

3. a) How many degrees warmer is the earth's surface due to the (natural) greenhouse effect compared to what it would be if we had no atmosphere? No calculation required, just look in the book.
b) Explain this higher temp in terms of the transparency of our atmosphere in a particular wavelength range.
c) Why is Venus so extremely hot? That is, why is the greenhouse effect so strong on that planet?

4. a) Does Mars have plate tectonics like Earth does?
b) Chains of volcanoes such as Hawaii (and the submerged island extending across the Western Pacific), the Aleutian Islands, the Philippines, etc. are characteristic on Earth. Do Mars or Venus have these features? Why or why not?

5. How does the naturally occurring stratospheric ozone layer protect organisms on Earth? Explain in terms of the transparency of Earth's atmosphere at a particular wavelength range.

6. Find out about these international treaties, and what global environmental problems they attempt to address. Explain each one briefly but quantitatively, that is, summarize the reductions or limitations on the release of damaging environmental contaminants from industrial chemicals. Give the year of each agreement.
a) Kyoto Protocol. Did the US agree to take these steps? When does this agreement expire? Is there a new agreement that takes place after the period covered by Kyoto?
b) Montreal Protocol. Please answer the same question as for a).

7. Can you stand on Jupiter (assuming you bring air to breath and suitable clothing)? Can you row a boat on Jupiter? What is Jupiter made of, mostly? Describe Jupiter's four big "Galilean Moons" (three excellent sentences each would do it).

8. Describe Saturn's rings, noting the size compared with the thickness. The rings are made of small bodies, each independently orbiting Saturn. What are these little chunks made of? Do we know the sizes of the chunks? Explain. How does the thickness (ring thickness divide by diameter) compare with the thickness of a sheet of paper?