**AST 301 (Scalo, Fall 2010): Review sheet for Exam 1**

The first exam will cover chapters 1 through 3 (*except that we will postpone section 3.5 on the Doppler effect to exam 2*). The material to be emphasized or omitted should by now be clear, both through the content of the lectures, and through the sheet "Guide to Reading and Study" (at class web site). The main topics we have omitted are the phenomena of the night sky and the history of astronomy. Very generally, the main topics you should understand have to do with motion of an object under the influence of a force (especially gravity), and the appearance of the *continuous thermal spectrum* of a body heated to a certain temperature (the radiation laws). The present review is meant to give you a better feel for the kind of understanding you need to have in order to be well prepared for the first exam.

Although the clever publishers of your textbook decided to put the "Glossary" of terms at the textbook website, it will be even more beneficial if you compiled such a list yourself—mostly the words in bold type in the text. The most important suggestion I can give you is to **find whether you can explain most of these terms in everyday language,** and note whether you are repeating something you memorized or are explaining something you understand. It is important that you try to explain in everyday language, and each time you use a term that is specific to astronomy, define it in a way that anyone could understand. If you have the sense that you are simply trying to repeat memorized phrases and terms, you will do poorly.

After you have studied, be sure to try the multiple choice/true false questions at the end of each chapter, and at the textbook web site, as specified in the "Guide to Reading and Study." (At class web site if you haven't already downloaded it)

In class lectures we spent most time on how long it took to develop a description of the motions of planets in the sky, leading to the **heliocentric model**, **Kepler's laws**, and **Newton's laws** (of motion, and of gravity). Besides Kepler's and Newton's laws, one of the most important and useful things to become familiar with are the names and order (in **wavelength, frequency, and energy**) of the different kinds of radiation--radio waves to gamma rays. Figures 3.4 and especially 3.9 provide a convenient visual aid for this. We will only spend one lecture on this (because of Labor Day), but a large portion of the exam will be on this material.

The idea of the **spectrum of light** from a radiating object is fundamental to all that follows. You should be familiar with how the total amount of light, and the relative amounts of light emitted at different wavelengths, are related to the temperature of an object, through the "radiation laws". Later we will use these to estimate properties of stars and galaxies that will give us clues to their evolution. **Wien's Law** and the **Stefan-Boltzmann law** should be more than abstract formulas to you—be able to explain what they say in everyday language, think about how they apply to objects of different temperatures, astronomical or not. Figure 3.11 (and 3.12) is crucial here—if it is clear to you what is being demonstrated, then you are in good shape.

The lectures and reading guide sheet should also have made it clear that very little math will be used on the exam, and the few questions that do use math will be simple.

<u>An example</u>: If the earth were a third as far from the sun as it is now (i.e. 0.33 AU), how much weaker or stronger would the gravitational force from the sun be? This one should seem simple if you understand all the "laws" we have covered. There might be about four questions that make use of simple formulas in this way on the exam.

Don't worry about all the numbers you have encountered in reading. There are only a very few specific numbers that you should know, like the fact that the nearest star is a few light years (or about a parsec) distant (and how that distance was determined!), which is a much greater distance than the size of the solar system (about 40 AU out to Pluto, or $10^{-4}$ pc), but which is a tiny distance compared to the size of our galaxy (about 100,000 light years across—how many parsecs?). I will always tell you in class which numbers I expect you to memorize, and there aren't many this time—no dates, names of specific planets or stars, or even specific people other than the ones who have names associated with "laws." This means that as you read, you should not encounter the numbers in the text as items to be memorized, only as symbols being used to illustrate some point, or to give you a quantitative comparison or example, or as an antidote to the idea that everything can be understood with pretty pictures.

This particular section (and the next one) is extremely important for the rest of the course: Orbital period, how to calculate masses of objects from their motions, various types of light (e.g. infrared), use of the radiation laws to learn the properties of objects, etc. will occur repeatedly. Consequently the material on this exam is the basis for the material in remainder of the course, and so you should be especially diligent and thorough about your preparation for this exam and the next, or you will feel negative effects later.

→ Be sure to bring a number 2 pencil to the exam, and take out a blank piece of paper before the exam begins, so that you can record the letters corresponding to your answers. You will be turning in the exam itself, and recording your answers on a scantron bubble sheet that you will also turn in. Copy the letter answers from the scantron to the blank piece of paper. A few sample questions are on the next page.

*Here are some sample questions, along with a little commentary*. You can consider these as homework questions, some of which will be on the exam, along with some of the end-of-chapter and online questions.

1. Star A has a parallax which is 5 times larger than star B. Which of the following statements is true?
a) Star A is 5 times nearer than B. b) Star A is 5 times more distant than B.
c) Star A is intrinsically brighter than B. d) Star A is intrinsically fainter than B.
e) None of the above.
[There is no calculation required. If you know how parallax and distance are related, you should be able to just say the answer.]

2. For a planet in orbit around some star, how does orbital speed at aphelion (point of greatest distance) compare to the speed at perihelion (point of smallest distance)?
a) same b) higher c) lower
d) depends on the mass of the planet e) depends on the mass of the star
[It is unimportant whether you know what aphelion and perihelion mean—they are defined within the question. I am just finding whether you understand "someone's" $2^{nd}$ law…This question was taken from the interactive questions at the textbook web site, so be sure to try those.]

3. According to Newton's First Law of Motion, if the sun's gravity were suddenly to turn off, the planets would
a) continue to orbit in circular paths. b) continue to orbit in elliptical paths.
c) move in a straight line. d) be unaffected: Newton's First Law does not deal with gravity.
[Notice: for d), it is true that Newton's First law doesn't deal with gravity, but it definitely is not the correct answer.]

4. Kepler's Laws of planetary motion and Newton's Laws of Motion are related in the sense that one may be derived from the other if we also use
a) elliptical orbits instead of circular b) the distances
c) the velocities d) the law of gravity d) the law of inertia
[Try answering this first, then read on. This is a tough one for most people, so here is some assistance: First, you have to know which can be derived from the other. Newton's from Kepler's? No, Newton's are more general. So it is Kepler's laws that can be derived from Newton's laws of motion. But do Newton's laws of motion have anything to do, specifically, with orbits?
If you get the idea now, then you see the question is asking: *What is needed to make Newton's laws of motion be about orbital motion of planets around stars, rather the abstract and general laws that they are otherwise? Can you answer it in this form?]*

5. Which of the following describes how the intensity of radiation emitted from a black body varies with frequency?
a) All the radiation is emitted at one frequency.
b) The intensity peaks at one frequency and falls off above and below that frequency.
c) The intensity has a minimum at one frequency and rises above and below that frequency.
d) The radiation emitted is constant at all frequencies.
e) A black body emits no radiation.
[An important question designed to find if you have any idea what a spectrum is.]

6. A star much hotter than the sun will emit most of its energy as ________ radiation.
a) radio b) ultraviolet c) visible d) infrared
[First, ask what radiation law relates temperature to the wavelength at which most of the radiation is emitted?]

If you understand question six, then try this similar question:
If you wanted to discover a planet orbiting another star, a planet that was just like the Earth, what wavelength region should you try to observe in order to receive the most light? (A hint: The temperature of the Earth is about 300 degrees Kelvin, while that of a star is several thousands degrees.)