AST 301—Review for Exam 3

Consult "Guide to Reading and Study" (available at the course website) for details of reading and suggested end-of-chapter and online questions.

Chapter 6: There are a few basic things like being able to name the planets in order of distance from the Sun, listing (in clear language) the regularities concerning planetary orbits and rotations, as well as the exceptions. I think a good preparation would be to pretend you are giving some friends a verbal tour of the solar system. Tell them as much as you can about the two classes of planets (be specific—e.g. what properties are different? And explain any "technical" terms!). Tell whatever you know about each planet, the nature of asteroids, comets, meteors,… and how they probably got to be where they are (e.g. did you remember to tell your visitor that most comets spend most of their time very far from the sun? Make sure you imagine being asked why this is so and how we know it—can you give a reasonable answer? Did you mention the "Oort cloud?")

Remember that you don't have to know anything about the various space missions discussed in this chapter.

Chapter 15: This chapter is continuous with Chapter 6 because it is concerned with developing a theoretical model that can explain most of the features of our solar system that we read about in Chapter 6. I suggest you try testing your understanding of the material by telling a friend (imaginary or not) a narrative that begins with the collapse of a big gas cloud under its own gravity and ends up with the solar system as it is today, filling in all the intermediate steps and the explaining the physical processes that are thought to be responsible for these steps. Why was temperature so important? Why was rotation so important? Why was the small fraction of material in the original cloud that was in the form of microscopic dust grains probably crucial to the formation of the planets? What are "planetesimals" and how did they form? Can you name a few lines of evidence that they once did exist? Explain clearly why the terrestrial and jovian planets have such different properties in terms of the theory described in this chapter.

The final section on the discovery of extrasolar planets is one of the most exciting and evolving areas in astronomy at this time, so I want to make sure you study that well. Make sure you understand that there are several techniques that *could* be used to detect extrasolar planets, but that basically only one has been so far successful (with a few recent detections using another technique). Can you explain why that is? (We also went over this in class.) Of the numerous extrasolar planets that have been discovered, what are some of the surprising results? They are all massive (e.g. like Jupiter or larger)—was this a surprise? Explain. Why do these discoveries point to the importance of the protostellar wind (observed to be blowing hard and fast from most young stars) during the later stages of evolution of planetary systems?

Chapter 16: We move on to our first star, the Sun, before studying stars in general. In this chapter, remember that you don't have to study the (interesting!) section 16.5 on "The Active Sun,"although I hope you will look through it—it is our only chance to observe a star's complexity close-up. The way I suggest you review this material is to take the approach I followed in the lecture version: Begin at the center of the Sun and describe in as much detail as possible what is going on at each depth as you work your way out, concentrating on how energy is generated in the center, finding its way to the surface (through the radiative and convective zones—what do these words mean? Try to explain to someone), and eventually being emitted at the photosphere? What is the photosphere anyway? Look at Discovery 16-1 on p. 415—it is referring to sec. 16.3, not 16.2 as stated (typo) on p. 415. What is helioseismology and what has been learned from it?

Concerning the proton-proton cycle, the specific way in which the sun uses nuclear fusion, I *don't* expect you to memorize the steps in the reaction sequence, but I do expect you to know what's going on. For example: Explain why helium gets produced. Does the new helium have a different mass than the particles that went into making it? If so, where did this mass go? Read “More Precisely 16-1” on p. 412 for your own information, but I won’t test you on it; however it might come in handy at the end of the course when we discuss the (unimaginably) early universe.

Be able to describe briefly why the solar neutrino experiments are such an important test of our understanding of the sun. Is there any other way to “look” into the sun’s interior?

Some sample questions are included below. Also try the questions at the end of the chapters and on the textbook web site—some will be on the exam. And don’t forget the two “homework questions” that were given in the outline to the lectures. Finally: bring a #2 pencil and a blank piece of paper. Good luck.

1. Which of the following has a mostly icy composition?
a) asteroid b) Venus c) comet d) Jupiter

2. What is the approximate age of the solar system, according to the best available scientific evidence?
a. about a hundred million years b. 4.6 billion years c. 5000 years
d. 500,000 years e.10 billion years

3. Most of the extrasolar planets that have been discovered orbiting stars besides the sun are
a. on nearly circular orbits, not what was expected.
b. large jovian-like planets with distances from their star more like the terrestrial planets of our solar system.
c. orbiting very far from their parent star.
d. rare compared to what was expected.

4. What is the major physical process that should cause the material around young stars to form a disk, rather than, say, a sphere?
a. powerful winds from the newly formed star b. gravity
c. collisions between particles d. rotation

5. What has been a major surprise from recent searches for extrasolar planets?
a. Most solar-type stars don’t have planets.
b. Terrestrial-sized planets have not been found.
c. Many of the planets discovered have very eccentric orbits.

6. The pressure at the center of the sun is determined by
a. nuclear reactions.
b. the rate at which photons can diffuse through the overlying layers.
c. the fact that pressure balances the weight (due to gravity) of all the material outside the center.
d. the temperature and pressure in the photosphere.

7. What is a way of investigating the interior of the sun without using any exotic particles, just light?
a. Gamma rays from the sun’s core.
b. Analyze spectral lines from the photosphere to estimate the relative abundances of different elements.
c. Interpret the complex vibrations of the sun.
d. There is no other way.