AST 301 Scalo
Review for Exam 3

This exam covers only chapters 6 and 15, the solar system and theories of planetary formation, and extrasolar planet detection, NOT chapter 16 (the Sun), which we don't have time to cover in class and so will postpone. Suggested end-of-chapter and online questions were sent to you by email and are available at the class website, but I will copy them again in this document so that you have everything in one place. There are also a sample of 10 somewhat more difficult multiple choice questions at the end of this review sheet.

Remember, in case you have not yet read the material (shame!), Chapters 6 and 15 are NOT in your textbook, but are available to read (or print) online because there is a link to the ebook version of your textbook at the course web site. I think you need an access code that came with your textbook. Page numbers below maybe be off by a small amount compared to the ebook When I copy in the end of chapter and textbook web site suggested questions, below, this is what the notation means:

"RD"="review and discuss" questions and TF="true/false" questions refer to end of chapter questions (this time in the ebook, since these chapters are not in your textbook).

"TWS" = Textbook website extra questions that are MC1, MC2 (multiple choice sets 1 and 2) or T/F (true/false).

<u>Chapter 6</u>: 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's sec. 6.6. Read the "More Precisely 6-1", but such numerical examples will not be on the exam. Also read the "More Precisely 6-2" in order to understand the concept. You don't have to memorize any of the information in Table 6.1, although it might help to look at it awhile. However Table 6.2 IS important to learn.

This chapter ends (sec. 6.7) with a brief version of the first half of chapter 15, concerning theories about the origin of planetary systems, but concentrating on our solar system in chapter 6.

Suggested questions:

eBook. After "chapter summary" in table of contents, just go to the next page for the review questions at the "end of chapter."

RD: 1, 3-8, 10, 11, 17-20; TF: 1-3, 5-8, 11, 13, 14, 16, 19, 20.

TWS: MC1: 2, 4, 5, 7, 10, 12, 14, 15. MC2: 4, 7, 8, 9 T/F: 2, 5, 8,12, 20

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 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. I will NOT test you on the method of gravitational lensing, but read about it if interested. Make sure you understand that there are several techniques that can be used to detect extrasolar planets (name them, explain them), but basically only one of them has been successful, so far, in detecting large numbers of extrasolar planets. Can you explain why that is? What do you learn from this technique? What could you learn about a planet from other techniques?

Notice that of the two methods that use the "wobble" of the parent star, we only discussed the radial velocity (Doppler) technique in class, not the astrometric technique, which you should read about yourself.

Of the numerous extrasolar planets that have been discovered, what are some of the surprising results? They are nearly all massive (e.g. like Jupiter or larger)—was this a surprise? Explain. More lower-mass planets with larger periods have been discovered as more time has elapsed since the first discovery in 1995—can you explain why? 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?

The "Discovery 15-1" on [p. 390] is for your interest only, but will not be on the exam.

Suggested questions:

RD: All; TF: All.

TWS: MC1: 1, 3, 6, 7, 9, 10, 14, 15.

MC2: 2, 4, 7, 10, 12, 14, 15. T/F: 1, 3, 5, 10, 12-15, 20.

When you have read chapter 15 on extrasolar planets, see if you can easily answer these:

What is the name of the major tool in the search for extrasolar planets that was just launched last year? What technique will it use for detecting planets? What unique kind of planet should it be able to find if it exists?

Explain in your own words why planet detection by the radial velocity method has yielded by far the most discoveries.

In case that the end of chapter and online questions are not enough material for you to use for review, sample questions similar to those that will appear on the exam are given here. (The questions in parenthesese are just other ways for you to see whether you understand the question or not.)

Sample questions.

1. Which of the following has a mostly icy composition? (Why? Why not the others?)
   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? (Explain how this age was obtained.)
a. about a hundred million years b. 5 billion years c. 5000 years
d. 500,000 years e. greater than 10 billion years

3. Which of the following is NOT a way in which the terrestrial and jovian planets differ? (Be able to list the ways in which they DO differ.)
a) The terrestrial worlds are small, while the jovian worlds are large.
b) The terrestrial worlds have few or no moons, while the jovian worlds have many moons.
c) The orbits of the terrestrial worlds are relatively close together, while the orbits of the jovian worlds are farther apart.
d) The jovian planets have orbits that are highly inclined to the average plane of the solar system, the terrestrial planets do not.

4. Early phases of the formation of the terrestrial planets in the protosolar nebula were probably dominated by (I am purposely not using the textbook terms “condensation” and “accretion” to see if you understand what processes, not memorize the words)
a. the breaking apart of very large objects into very small planets, or “planetesimals”.
b. collapse of the gas under the force of gravity.
c. collapse of the dust under the force of rotation.
d. growth of hot gas clouds.
e. gradual accumulation of smaller objects into larger ones by collisions.

5. What is the main role played by the strong protosolar wind in the development of the solar system?
a. It determined the shape of the protosolar nebula.
b. It cleared out the remaining gas and dust from the protosolar nebula, effectively ending the era of planet formation.
c. It controlled which elements could condense into solids and become incorporated into planets.
d. It pushed the smaller planetesimals into very elliptical orbits, where they remain today.
e. It caused the differentiation in chemical makeups of the different planets.

6. Extrasolar gas giant planets are found awfully close to their parent stars. This probably means
a. gas giants form by gravitational instability, not core-accretion.
b. planetary migration does not occur as predicted.
c. gas giants sometimes form closer to their stars than terrestrial-mass planets in these systems, unlike our own solar system.
d. they must have had very high temperatures when formed.
e. the protostellar disk often survives long enough for severe migration to occur.

7. 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.

8. Which of the following techniques can be used to estimate the density of an extrasolar planet?

a. radial velocity method   b. astrometric method c. transit method

9. What is the major physical process that should cause the material around young stars to form a disk, rather than, say, a sphere? (We spent considerable lecture time on this.)

a. powerful winds from the newly formed star   b. gravity

c. collisions between particles   d. rotation

10. 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.