AST 301-Fall 2006 Scalo
Review sheet for EXAM 5

Because we have got a little behind, the 5th exam. Friday Nov. 10, will cover chapters 19 (which would have been on the previous exam), 20, and 21. We will postpone Ch. 22 (Black holes) until the next exam). A brief description of the chapters and any material to exclude are given here, along with some questions for you to think about.

Chapter 19.

Most of this material will have been covered in class and will appear on the exam. Notice that sec.19.6 (the last section, on Star Clusters) is closely related to the next chapter, especially the technique for obtaining their ages. This is extremely important in astronomy because it is one of the only ways that we can determine the ages of stars.. Probably the most important part to feel comfortable with is sec. 19.2, because it is similar to what you'll be reading in the next chapter, using the H-R diagram to describe the evolution of stars. However you DON'T have to memorize the "stages" that the authors describe, not by number—i.e. I won't ask you "In what stage does X occur?" I don't care about the numbers, just that you understand something about the evolution, how a cloud becomes a protostar which becomes a main sequence star. Try to draw an evolutionary track for a protostar approaching the main sequence.

Chapter 20

The evolution of low-mass stars is the subject here. You should be able to describe (e.g. how is its size, mass, luminosity, ... changing?) and explain the different phases of evolution that these stars go through, and what fuel they are burning and where.

What is the main sequence, and why do stars spend so much time there? Explain how stars try to rejuvenate themselves as red giants. Why do they eventually fail? How do they die? What is a planetary nebula--what do you expect to see at the center of it?

Why can't stars below a certain critical mass become a star?

Although I urge you to read the sections describing the phenomena that can occur when stars evolve in binary systems (20.6, 21.1), you will not be tested on this material; you will need to understand some of it in order to read later sections (e.g. 22.3). Also remember that the section on star clusters at the end of chapter 20 (20.5) is closely related to the material from section 19.6 on the same subject.

Chapter 21

This chapter is about the very different late evolution and death of stars above a certain mass. There is a crucial phase at which the massive stars and low-mass stars (of Ch. 20) rapidly begin to evolve very differently. What happens? Why are the subsequent events of crucial importance in the formation of many of the chemical elements heavier than carbon? How do the other elements get produced? These massive stars end their lives as supernovae, amazingly powerful explosions in which most of the star is expelled into space; what will this expelled gas look like? What happens to material that doesn't get expelled? Try to explain the difference between a core-collapse supernova and a carbon detonation supernova, explaining the sequence of events that occur in each case.

I strongly recommend that you try all the Review and Discussion, and True-False/Multiple Choice questions at the end of each chapter (except those having to do with binary stars); they are nearly all good ones, at the level that will be typical on the exam. In fact I will, as usual, take a few of the exam questions from the end-of-chapter and online questions. However I do *not* recommend that you spend most of your study time trying to find the answers to these questions: they should be attempted after you have studied, as a self-test, although a quick look at them might be good to give you an idea of how much you understand.

A good way to review is to try to "tell the story" of the evolution of stars of different masses, starting with the main sequence phase, making sure you can explain all the stages of evolution and the differences between the evolution of low-mass and high-mass stars. Each time you use some new terminology, e.g. "degenerate core," try to explain what you mean, as if you were explaining this to someone with no background.

1. What distinguishes a protostar from its earlier stage as a collapsing interstellar cloud?
a) Hydrogen begins to fuse. b) It stops emitting infrared radiation and produces visible light.
c) Its central region becomes opaque and begins to heat up. d) It is at that point near the main sequence.

2. What event must occur in order for a protostar to become a full-fledged star?
a) The onset of hydrogen fusion b) The formation of a photosphere
c) The cessation of gravitational collapse
d) Movement out of the dark cloud from which it was formed, so that it can be observed.

3. What characteristic of a star cluster is used to determine its age?
a. The number of red giants. b. The number of main sequence stars.
c. The faintest stars seen in the cluster. d. The extent of the main sequence in the H-R diagram.

4. Why do the cores of massive stars evolve into iron, but not heavier elements?
a. The attempt of the star to fuse iron disrupts the stability of the core by requiring energy.
b. The temperature never gets high enough to allow the fusion of heavier elements.
c. The star goes supernova before the core has a chance to make heavier elements.
d. Iron does not become degenerate.

5. What produces a carbon detonation (Type I) supernova?
a. The collapse of the core of a massive star.
b. A nova
c. The radioactive decay of cobalt into iron.
d. Mass transfer to a white dwarf in a binary where the Chandrasekhar mass is exceeded.

6. How was the chemical composition of the sun different 3 billion years ago from what it is now?
a. more hydrogen now b. more helium now
c. more heavy elements now d. it won't change until the sun becomes a red giant

7. When a star evolves from the main sequence to the red giant phase
a. the core gets hotter and the luminosity increases.
b. the core gets cooler and the surface gets hotter.
c. the core gets hotter and the luminosity decreases.
d. the core and the surface both get cooler.

8. Roughly how long does it take a stellar iron core to collapse?
a) One second. b) One year. c) A few million years. d) Forever.

9. If the fusion of lighter elements with iron to form still heavier elements does not occur in a star, how is it that stars are able to synthesize many elements heavier than iron?
a. neutron capture in the s-process b. helium capture
c. photodisintegration d. neutronization