AST 112: Tue - Thu 10:30 to 11:45

STUDY GUIDE FOR EXAM 2

Be Familiar with the first part of the material from Study Guide 1

CELL PHONES and LAPTOPS are Forbidden

Chapter 8. The Sun

Know the data on Page 143

1. What is the photosphere, the chromosphere, the corona?
2. What is granulation? What is it telling us about heat flow from the interior? How long does a granule last?
3. What is convection? Conduction? Radiation? (Discussed in class)
4. What is supergranulation? Spicules are found at the edges of supergranules. How long do they live?
5. How does the temperature of the Sun's visible layers vary with height above the photosphere? (Figure 8-3)
6. How far does the Corona extend into space? How hot is the corona? What is the Solar wind?
7. Helioseismology is the study of the interior of the Sun using the Sun's oscillations in radius. We can study the interior of the sun just as ringing a bell tells us how the bell is made. (Figure 8-7)
8. What are Sunspots? (Look carefully at Figure 8-8: Never stare or point a telescope at the Sun)
9. What is the 11 year Sunspot cycle? The 22 year magnetic cycle? (Page 152-153)
10. What are flares, prominences, filaments? (Page 158-159)
11. What is the butterfly diagram (P. 152-153)? What does it tell us about the Sunspots during the cycle?
12. What is the Maunder minimum in the numbers of Sunspots?
13. Where does the energy from the sun come from? Why do we know that it must be nuclear energy?
14. Binding energy is the energy that keeps the protons and neutrons in the nucleus from flying apart.
15. Nuclear Fusion requires high temperatures and high densities to overcome the Coulomb barrier. (Because like charges repel)
16. What is the proton-proton chain? (See Figure 8-14)
17. What is a neutrino? How is energy released in the proton-proton chain? Deuterium is an isotope of hydrogen.
18. How does the energy flow from the center to the surface? Where is convection important? Radiation?
19. What is the difference between nuclear fusion and nuclear fission. Which is most important in current nuclear power plants like Palo Verde?
20. What does the solar neutrino experiment tell us? What are the most recent results:

Discussed in class.

21. Who is the astronomer who built the Homestake Mine experiment and was awarded the Nobel Prize?

<u>Chapter 9: The Family of Stars</u>

1. The distances to nearby stars are determined by the use of the parallax method. What is the parallax of a star ? (Remember the relationship between distance and parallax is an inverse relationship.)
2. How is stellar parallax measured? (position of stars measured 6 months apart- see Figure 2)
3. What is a parsec? How is it defined? What is the abbreviation (pc)? How many light years in a parsec?
4. What is the distance limit of the parallax method? (about 100 pc)
5. What is the proper motion of a star? How is it measured? (Position of stars over years of time)
6. Why do we need both distance and proper motion to determine the speed of a star in space?
7. What is meant by the apparent magnitude of a star? It was defined in chapter 2 on pages 15 and 16.
8. What is the absolute magnitude of a star? (It is the apparent magnitude a star would have at 10 pc)
9. The inverse square law of light is used in this section. It is defined on page 83. It is important and I spent some time on it in class. Remember that it means that the brightness of a star decreases as the distance squared of a star increases.
10. Skip the equations on Page 172 (unless you like logarithms but they won't be needed on the exam)
11. What is meant by the luminosity and surface temperature of a star? (Remember that I use ergs not joules): Look at the first part of Section 9-3 and know stellar spectra types (O,B,A,F,G,K,M...)
12. What is the relationship between luminosity, radius, and temperature of a star? How is it obtained?
13. Make sure that you understand and are familiar with the examples on page 178. We can use the equation on this page to determine the radius of a star. (I did these examples in class)
14. The Hertzprung-Russell (HR) Diagram: Why is it important? What do we learn from it? Why do we use it to study stellar clusters? I used clusters as a reason for the existence of the HR Diagram. My analogy had to do with comparing classrooms. Not cars.
15. What is the Main Sequence? Where is the Sun located in this diagram? What is actually being plotted against what? (Temperature against brightness but radius is also useful)
16. Where do most of the stars fall in this diagram? What is the physical significance of the Main Sequence? (Region where stars are fusing H to He in their cores.)
17. Where do the red giants and white dwarfs fall in the diagram? WHY? (Some stars are much bigger than the Sun and some stars are much smaller than the Sun - we get to this in

the next two chapters)

18. What is the Luminosity Classification of the Sun? Why do we need a Luminosity Classification?
19. Skip interferometric Observations.
20. How do we get the masses of binary stars? Be able to use the equation on Page 184 (I worked examples in class - it is based on material on pages 67-69 and 88 which I went through briefly).
21. What are the different types of binaries? What are eclipsing binaries used for? (Stellar radius - sizes of stars)
22. What is a light curve? (The brightness of a star as a function of time: Figure 9-23)
23. What physical principle is being used to study a spectroscopic binary. It was also used to discover planets around other stars. (Doppler shift which is introduced on pages 135 to 139)
24. Be familiar with Figure 9-23 (Page 188)
25. Remember that more massive stars are more luminous which means that they are using up their hydrogen fuel very fast as compared to the Sun. (Look at the material on pages 192 and 193)

<u>Chapter 10: The Interstellar Medium</u> (This material overlaps with Star Formation in the next chapter)

1. The evidence that there is gas between the stars: Emission nebulae, sharp absorption lines in hot stars, forbidden lines, ionized hydrogen regions. What is a forbidden line? (An emission line that occurs only in a very low density gas. Much less dense than the best vacuum obtained on the Earth)
2. The evidence that there is dust between the stars: extinction, reddening, reflection nebulae, dark clouds, Barnard nebulae.
3. Know the Three Kinds of Nebulae on pages 199-200. Look carefully at the material on pages 199-200.
4. Remember that absorption lines from cool gas clouds are much narrower than absorption lines in stars. (Figure 10-5)
5. Why is the Sky Blue during the day? For the same reasons that reflection nebulae are blue and light from distant stars is reddened and dimmed (extinction). Figure 2a - page 200.
6. HI clouds contain neutral gas and they are cold.
7. What are some of the molecules that are found in space? I showed a table in class which is not in the book. There is a large amount of ethyl alcohol in space (Should we care?).
8. We observe the presence of hydrogen gas using the 21-cm radio line. 21-cm is the wavelength, the frequency is 1420 MHZ. It is emitted when the electron in the hydrogen atom flips the direction of its spin.
9. We can see through the entire Galaxy at 21 cm and so we have mapped the galaxy in hydrogen.
10. Important components of the ISM are the Giant Molecular Clouds which contain a lot of material. These are related to star formation. The nearest GMC is the Orion Nebula.
11. Other components are Cool Clouds, The Intercloud Medium, Molecular Clouds, Coronal

Gas (see Table 10-1)

12. We also observe the presence of dust because it glows in the infrared.
13. The ISM consists of gas and dust which have been expelled from previous generations of stars and will then go to form new stars. (Know the Gas-Stars-Gas Cycle)

Chapter 11: Star Formation and the Structure of Stars:

1. Note that some of the material in the last part of this chapter overlaps with the material in Chapter 12. Which is NOT on this test.
2. Stars are born in Giant Molecular Clouds like the Orion Nebula.
3. Figure 11-2 on page 219 suggests how nearby stars can cause clouds to collapse into new stars. Figure 11-3 shows a newly formed young cluster inside a Giant Molecular Cloud.
4. Free-fall contraction is the star obtaining energy from its collapse - or contraction - under its own gravity. This happens right at the beginning of a cloud collapsing into stars.
5. What is a protostar? Pre-main sequence star? What is meant by the cocoon stage? As the protostar collapses, it is rotating which causes it to flatten into a disk with a bulge at the center called a protostellar disk. (see Figure 11-4 page 221)
6. Section 11-2 discusses how star formation is going on in the Orion Nebula. See also page 224 and 225.
7. What is meant by the birth line? (Figure 3 on page 228 and Figure 11-8 on page 230)
8. How long did it take the Sun to contract to the main sequence? How long for a 15 solar mass star? Look at figure 11-8.

7\. What is a T-Tauri star and where is it found? What is a T-association? An O Association? A Herbig-Haro object? Look at the material on pages 228-229.

8\. A bi-polar flow is gas ejected from both the north and south rotation poles of the protostar. (Figure 11-10)

9\. What is HH 34? What is 30 Doradus? (Read the figure captions in this chapter carefully.)

10\. How do we know that NGC 2264 is a young cluster?

18\. The Orion Nebula is the closest Giant Molecular Cloud. Where is the Orion Nebula located in the sky?

19\. Where are the Trapezium Stars? (Look at Figure 3 on page 225)

Sections 11-4 and 11-5 will be on the next test.