AST 111: Tu-Thu 1:30pm - 2:45pm

STUDY GUIDE FOR EXAM 2

CLOSED BOOK OPEN NOTES ONLY

1. **YOU MUST NOT USE YOUR LAPTOP, TABLET,TEXTBOOK, or CELLPHONE**

a. Bring a calculator –(NOT the one on your cellphone) Do Not cheat off your neighbor!

b. Bring a Number 2 Pencil and an eraser.

2. **HINTS ON TAKING "OPEN NOTES" TESTS-- WHEN STUDYING:**

a. Carefully read the Chapter Summary, learn the "New Terms"

b. Try to do the Review Questions, and the Discussion Questions.

c. Work as many problems as you can. Feel free to ask me if you are having problems doing them.

3. **TAKING THE TEST**

a. **Read the test questions carefully!**

b. Go through the test once and answer all the questions that you can. Then go back and do the other questions.

c. You may mark on the test booklet: cross off obviously wrong answers, work the problems, and show your work.

d. Circle the answer on the test booklet - this is the last resort if you have made a mistake on the answer sheet.

e. Carefully darken in the answer on the answer sheet, do not rip, mutilate, fold, or spindle it.

f. Check your answer sheet. Make sure you have answered all 50 questions.

g. MAKE SURE THAT YOUR NAME IS ON THE ANSWER SHEET AND YOU HAVE PUT IN YOUR FULL UNIVERSITY ID NUMBER-LEFT JUSTIFIED. I will subtract points if this is not done.

h. **BRING A PICTURE ID.**

Chapter 7. Starlight and Atoms.

a. Remember the structure of an atom (nucleus with protons and neutrons plus electron(s) orbiting the nucleus)

b. What is meant by neutral, ionized, electron orbits. Remember that all matter consists of atoms. Each atom consists of a nucleus with electron(s) in orbit around the nucleus. (Page 131)

c. The nucleus consists of proton(s) and neutron(s). Know what is meant by atomic number and atomic weight. What is an isotope?

d. The Coulomb force binds the electrons to the nucleus.

e. The various orbits around the nucleus are called energy levels because it takes energy to move away from the nucleus or the atom must give up energy for the electron to jump back toward the nucleus. Remember that only certain energies (distances from the nucleus) are permitted. (Stairway analogy)

f. What is an excited atom? Ground state?

g. The key concept about thermal emitters is that they emit radiation in a pattern that depends only on their temperature not their surfaces. So we ignore reflected light.

h. Peak wavelength, which I use in class, is the same as wavelength of maximum intensity (p. 137).

i. Look at Figure 7-6 in order to understand the three laws of thermal emission. Know the three "laws" as given in class. He leaves out the first one: That a hotter thermal emitter emits more energy at every wavelength than a cooler thermal emitter.

j. What is the Stefan-Boltzmann Law? Wien's Law? How can we use Wien's Law to determine at what wavelength a thermal emitter radiates most strongly.? The value of the constant given in class is 5000 * 6000 because I use Angstroms not nanometers.

k. Know Kirchhoff's Laws as given on page 140-141: (1) A hot solid or dense gas produces a continuous spectrum. (2) A low density excited or hot gas produces a bright, emission line spectrum. (3) Put a low density gas in front of a continuous spectrum and you get a continuous spectrum with dark, absorption lines superimposed.

l. Know emission and absorption lines and where and how they are formed.

m. What is the Doppler Effect or Doppler Shift. How can we use it to tell whether an object is moving toward or away from us? What is meant by a blue shift? A red shift?

n. Review the uses of the Doppler effect that I discussed in class.

o. Skip the Doppler formula on page 143

p. Try to do problems 1 and 2 on page 145

Chapter 8. The Sun

Know the data on Page 148

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? (Figure 8-2)
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 158-159) Where are we in the current Sunspot cycle? (discussed in class)
10. What are flares, prominences, filaments? (Page 162-163)
11. What is the butterfly diagram (P. 158-159)? What does it tell us about the Sunspots during the cycle?
12. What is meant by 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 8-15)
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 person who built the Homestake Mine experiment and was awarded the Nobel Prize? (Page 169)

Chapter 9: Perspective origins:
1. I only covered 9-1: Pages 176- 177
2. Know the material in the numbered paragraphs on Page 177.

Chapter 10. Origin of the Solar System:

1. Remember the difference between rotation and revolution. A planet rotates on its axis and revolves around the Sun.
2. What are the facts that must be explained in order to understand the formation of our own solar system? Know the Solar System characteristics in Table 10-3.
3.What are the major similarities and differences between the inner Terrestrial planets and the outer Jovian planets? (Look at pages 198-199 and read the figure captions)
4. What is the importance of impact craters in determining the evolution of the solar system? The earliest theories for the formation of the solar system assumed that the sun was already present and the planets formed later. This is WRONG! (The Sun and Planets formed at the same time from the same material)
5. Where are the Asteroids found? Comets? The Kuiper belt?
6. How is the age of the solar system determined? What is meant by the half-life of a radioactive element? What are some of the elements that are used to date the Solar System? (Figure 10-5)
7. Radioactive dating is used to determine the age of the solar system. The half-life is the time it takes for half of a parent radioactive isotope to decay into its daughter isotope.
8. We measure the proportion of the original isotope to the daughter isotope to see how much time has passed.
9. Radioactive elements are produced in nova and supernova explosions. Possibly one went off nearby and caused the gas cloud to start collapsing into our Sun and planets.
10. LaPlace was the first to propose the nebular hypothesis in which the solar system formed from a contracting nebula. LaPlace understood gravity a lot better since he had the work of Newton on which to build.
11. What was the Angular Momentum problem? (The Sun rotates slowly - most of the angular momentum in the Solar System is in Jupiter)
12. The atoms in your body (except for hydrogen and helium) were formed by nuclear processes in stars.
13. The Solar Nebula Hypothesis assumes that the sun and planets were formed at the same time out of the same material but the sun formed slightly faster than the planets. This is slightly different from what is said in the textbook but more correct.
14. What is the evidence that the Solar nebula hypothesis is probably correct? (Observations of forming stars.)
15. What is a planetesimal? Protoplanet? Which comes first. What is meant by accretion?
16. What happens during differentiation? Is the Earth differentiated? Look at Figure 10-10.
17. What is meant by the condensation sequence of the gas in the solar nebula? (Table 10-2)

18. The planets formed in the spinning disk around the sun. Small particles condensed to form larger particles which collided to form planetesimals which collected into the proto planets. The planets closest to the sun lost most of their gas, those farther away did not.
19. Large amounts of gas from young stars is blown out into space at high speeds. This gas eventually accumulates with other gas to form new stars.
20. What is meant by differentiation of a planetary interior? The planet must be molten. (Figure 10-10)
21. What is the Jovian Problem?
22. What is meant by outgassing? How is this related to the present atmosphere of our earth? The first atmosphere?
23. What is an Extra-Solar planet? What physical principal is used to find these planets (the Doppler Shift discussed in an earlier chapter and figure 10-16) ? Which planets in our solar system do they resemble? (See section 10-4)
24. What is liquid hydrogen and metallic hydrogen? Where are they found?
25. Why are the 4 largest satellites of Jupiter called the Galilean Satellites?
26. Radiation pressure describes the fact that light exerts a force on gas and small particles.
27. The nebular theory has been confirmed by studying other solar systems and regions of space where stars are forming. (Pages 213-218)
28. The inner planets have higher densities - they are rocks and iron rich material. The outer planets are mostly thick atmosphere gas giants. They may have small rocky cores.
29. Asteroids and comets are the left-overs from the formation of the solar system. (The turkey on the Friday after Thanksgiving).
30. There were enough asteroids and comets around in the young Solar System to fall onto the surfaces of all the planets and cause craters and reheating in some cases. We cannot see the surfaces of the outer planets but their moons (except Io) also show impacts.
31. We are searching, even as you read this, for possible large bodies that might impact the earth.
32. Deimos and Phobos are captured asteroids.
33. Our own Moon was probably caused by numerous impacts of asteroid sized objects with the Earth after differentiation had occurred. That is why the Moon's composition resembles the mantle and crust of the earth.
34. The latest results from the Kepler satellite is that virtually all stars that you see in the night sky have planets.
35. Kepler found planets by staring at a large number of stars and watching for the planet to cross in front of the star. It would then measure the dip in brightness caused by this eclipse.

Chapter 11: Planet Earth

Know the celestial profile for each Planet. The one for Earth is on page 228.

1. What are the 4 stages of planetary evolution: differentiation, cratering, flooding, slow surface evolution? What is comparative planetology? (Figure 11-2)
2. What are the four processes that effect the geology of the earth and the other inner planets: impact craters, volcanism, plate tectonics (or its absence), and erosion.
3. What is seismology? How are pressure or p-waves and shear or s-waves used to determine the internal structure of the Earth? Look at figures 11-3, 11-4, and 11-5. I showed a number of different versions of Figure 11-5 in class.
4. What are the various parts of the interior of the earth and where are they located? The four layers of the Earth are the inner solid core, the liquid core, the mantle, and the crust. Why is the core thought to be iron rich material?
5. What are the heat sources in the Earth's interior? How do we know the ages of the rocks?
6. The Earth has a magnetic field that protects us from particles emitted from the Sun. What are the Van Allen Belts? How is the Earths magnetic field like a bar magnet? What is the evidence that the direction of the magnetic field changes with time:
7. What is the relationship between the Aurorae and the Earth's magnetic field and radiation belts?
8. What is Plate Tectonics? How are the mid ocean rise and mid ocean rift connected?
9. What is a subduction zone (See pages 234-235)? What is basalt rock formed out of? Look at the figure captions on page 234.
10. What mountain range is formed from the collisions of plates? (Himalayas)
11. A rift valley is formed when a crustal plate splits. Where is the crust of the earth thinnest? Thickest?
12. What will the continents look like in about 250 million years ? Plates can slip along each other.
13. What is the evidence for plate tectonics and continental drift? What is a Convection Cell and how does it transfer heat from the interior to the surface? What is Magma?
14. The Hawaiian Islands are caused by a hot spot in a plate which brings magma to the surface and the overlying plate moves with respect to the hot spot. They are shield volcanoes. The types of volcanoes are discussed on pages 272-273 (The chapter on Mars).
15. What is the composition of the Earth's atmosphere? How is it similar to and different from other planetary atmospheres such as Mars and Venus? (Table 11-1)
16. What probably happened to Earth's first atmosphere? What is the source of our current atmosphere?
17. What is the source of the oxygen in the atmosphere?

18. What is the Greenhouse effect? What are the Greenhouse gases? Where else is the Greenhouse effect important in the solar system?
19. Our water probably came from outgassing via volcanoes and maybe the result of cometary impact.
20. Since the Earth did not freeze, the oceans could absorb carbon dioxide and reduce the amount of Greenhouse gases in the atmosphere.
21. Venus was so hot that water vapor escaped and allowed carbon dioxide to increase and produce a runaway Greenhouse effect.
22. What is meant by the Albedo of a planet? (The fraction reflected)
23. What is global warming and how is it related to the amount of carbon dioxide in the atmosphere? Discussed in Class!
24. Where is the Ozone layer located? Why is the Ozone layer important to life?
25. What human effects have changed the ozone layer?
26. How does the depletion of Ozone affect life on the earth? What causes ozone depletion?
27. The best discussion of Volcanoes can be found on pages 272-273.

Chapter 12: The Moon and Mercury: Airless Worlds.

MOON:

1. The key similarity between the Moon and Mercury is their heavily cratered surfaces. Their surfaces provide a history of the early formation of the Solar System.
2. The Moon keeps the same face toward the Earth because of Tidal Coupling.
3. Where is the Terminator (the answer is not: "in California")? What is a Mare (plural is Maria)?
4. Why are the highlands on the Moon thought to be very old? And older than the Maria?
5. Read about impact craters - I went into this in some detail in class. What do the rays from some craters tell us? What and when was the Late Heavy Bombardment? (Pages 246-247)
6. Where and what is Mare Orientale?
7. Is there any evidence that impacts on the Moon blasted off rocks that fell onto the Earth? (Yes)
8. Know about the various missions to the Moon in the 1960's and 1970's. (Table 12-1)
9. All the rocks brought back to the earth are igneous - formed by the solidification of molten rock.
10. What is meant by anorthosites, breccias, regolith, vesicules? (Figure 12-5 on page 251)
11. How did we learn about the internal structure of the moon?
12. How did the Maria form? Figure 12-8. About how long ago? How do we know that they are younger than the highlands?
13. The only currently viable hypothesis for the formation of the Moon is the Large-Impact hypothesis originated by Al Cameron and collaborators. However, recent studies suggest that it must have been multiple smaller impacts (Figure 12-9)

MERCURY:

1. How long is the Mercury Day? How does it compare to the Mercury year (Figure 12-11)?
2. What does the surface of Mercury look like? What kind of craters are found on Mercury?
3. Remember that Mercury is tidally locked to the sun but does not keep the same face to the Sun.
4. What is the Caloris Basin? How did its formation produce the lineated terrain? (Figure 12-14)
5. What caused the dark lava Plains? The Lobate Scarps?
6. Mercury also has smooth plains that date from after the Late Heavy Bombardment (Figure 12-15)
7. What do we know about the internal structure of Mercury? It's origin and evolution?
8. We know less about the interior of Mercury because it does not have a moon. It was only recently that the MESSENGER satellite began orbiting Mercury .
9. One of the Messenger discoveries about Mercury is that at one time it had a large number of volcanoes.