Astronomy 7 - Study Guide for Exams

Here is a guide to help you focus on the important aspects of the chapters and class notes on discussions held in class. Use this guide in conjunction with YOUR NOTES (with luck you have put STARS in your notes near the items that were suggested as good exam questions - *these items might not appear below*!) the in-class Quizzes and the Questions, found at both the beginning (Learning Goals) and end (Review Questions) of each chapter. Study the figures (sometimes a picture is worth a thousand words, and is easier to remember). For all mid-term exams, you MAY bring a ***hand-written*** (BOTH sides), **3x5-inch notecard** with you to the exam. Remember, the Final Exam is COMPREHENSIVE (that means it covers the WHOLE SEMESTER!!); ***for that exam only***, your notecard may measure **5x8 inches**.

Astronomy and the Universe

What is the Scientific Method, as we discussed in class? Perhaps YOU could think of YOUR OWN example of how YOU practice doing science this way every day...

We looked at some basic math tools and skills, such as the idea of Scientific Notation. The basic units of measure that we will use include mass, time, and length. Standard measures of Astronomical distances use units of A.U., lightyears, and parsecs. Standard metric prefixes that you should know include kilo-, milli-, mega-, giga-, etc. Many astronomical observations are also done using angular measures (definition of a parsec, for example). Can you think of some pertinent questions on these topics? (if not, see the end of Chap 1!)

Positions, Celestial Sphere, Seasons

There are several ways to pinpoint features of the sky. One way, a "local" way, uses terms like horizon, azimuth, altitude, zenith, nadir, and meridian. (I KNOW you know what these mean...) A more global view is the map of the sky that we call the Celestial Sphere, which is based on Earth's natural spherical coordinates (Equator, poles, period of rotation). What are Right Ascension and declination? The constellations are a tool for remembering the locations of stars, allowing for humans to plan for seasonal changes. Oh, speaking of seasons, why does the Earth have them? Remember that this is a bit complex, and so a simple answer (e.g., "the Earth's axis is tilted") likely will NOT suffice!

Earth has three important motions: Rotation, Revolution, and Precession. Further, some of these pertain to what part of the universe we can see at night, as well as to why we have seasons. Can you explain these different motions, as well as other important events (such as Solstices, Equinoxes) and the extremes on Earth that correspond? What marks the Celestial Sphere's North Pole? Has this always been, and will it always be? Why/why not? What is the **ecliptic**?

Motion of the Moon

We discussed the orbit of the Moon, and the resulting phases. Could you identify the lunar phase (using the proper words, of course!) if you were shown the Earth-Moon-Sun configuration? Could you identify the phase if you were *shown a picture*? What is an eclipse; what kinds are there; and when/why do they occur?

Gravitation and the Waltz of the Planets

We discussed the evolution of thought regarding our perspective on the solar system and universe from two views: the historical progression of observations and ideas. Can you compare/contrast the basic ideas of the Geocentric vs. Heliocentric models? Summarize the relevant contributions of these people: Eratosthenes, Ptolemy, Copernicus, Brahe, Kepler (3 laws!), Galileo, and Newton (4 laws!). [Once these contributions were available, we could build a framework for understanding the origin of the solar system, called the Nebular Hypothesis. We will be addressing this important hypothesis after our exam.] How does Gravity work? (Notice I didn't ask Why - NO ONE KNOWS the answer to that!) What do you know about the difference between a scalar and a vector quantity? Can you give examples?

Explain the cause for the tides in Earth's oceans, and what must happen (and when) for Spring and Neap tides to occur. Include the influences of all players, especially in light of Newton's 3rd Law of Motion!

The Nature of Light

We reviewed some of the properties of light that were once thought to be contradictory: reflection, refraction, diffraction, interference, and the photoelectric effect. Can you describe each of these, and tell whether it indicates light's wave-like or particle-like nature? Light (as we normally use the word) is actually only a small fraction of a much larger continuum of radiation known as the Electromagnetic Spectrum (EMS). The EMS has been subdivided into different regions, such as those with the shortest wavelengths and therefore highest energies (as dictated by Planck's Law), called *gamma rays*, and those with the longest wavelengths and lowest energies, called *Radio waves*. What are the others? What are the colors that make up visible light, and what are their relative energies?

Important Laws to know include Planck's ($E = hc/\lambda$), Wien's, Stefan-Boltzmann, Kirchhoff's. Laws governing blackbody radiation can be "boiled down" to read something like this: 1) All objects emit radiation (from their surfaces). 2) Hot objects emit more energy than cold objects. 3) Hot objects emit higher energy radiation than cold objects. 4) Photons are generated or absorbed when a charged particle, such as an electron, is accelerated. A REALLY important concept in this chapter is that ***the Bohr model of the atom explains the absorption and emission spectra of atoms***. <u>What kinds of substances/conditions produce continuous, absorption, or emission spectra?</u> (We discussed Absorption at length in class.) Can you explain why each case should happen?

Optics and Telescopes

Reflection and refraction are important properties to consider when building optical telescopes. You should be familiar with parts and relationships, such as the objective lens, eyepiece, and focal length, and how these affect light-gathering power, angular resolution, and magnification. You should also be aware of potential problems (spherical and chromatic aberration, weight, temperature, etc.) and how reflectors avoid those problems! For reflecting telescopes, can you tell the differences among the four varieties shown on p. 126 of your text? What are the practical applications of each of these (who would use it, and why)? Astronomers and astrophysicists use a variety of other kinds of telescopes to capture the photons from all other parts of the EMS too. Why are some telescopes useless at Earth's surface - why is it necessary to send them into space?

Comparative Planetology

This section involves getting some basic data regarding the objects in the solar system - data that can constrain how we think the solar system formed and how it has evolved since its formation. The first section (Chap 7) presents some of the broad points that need to be considered; data you should have a handle on should include averages and extremes. For example, what are the three basic categories of materials that we started with? We have classified the planets into Terrestrial (T) and Jovian (J). What are the bases for this classification? One is their size: T are small (how big in diameter? which is biggest/smallest?) while J are huge (again, what is the ballpark for their size, and which is biggest/smallest?) Another is density - which means what? Why is density an important property to consider? It is not merely interesting that ALL the planets (Pluto's not!) orbit in the same plane. (Why do you suppose Mercury is out of the plane by 7 degrees?) They also revolve in the same direction. Do they all revolve in the same direction? What about moons (revolutions and rotations)?

The Nebular Hypothesis for the Origin of the Solar System is a time-tested framework for our understanding of the Solar System. Can you describe the steps (as we did in class) involved, from the formation of the nebula itself (long after the Big Bang - you shouldn't need to discuss the Big Bang anywhere in this class) up to the (relative) present? Where did the particles come from? Why did they hang around for so long with nothing happening? Why might that stability have changed, resulting in the formation of the Solar System as we know it? How did the formation of our star and planets proceed? What forces were involved? (Hint: the Sun is not a force!) More specifically, what is the Solar Wind - where does it come from, what's happening, WHY is it happening, and what does it do? (Hint: T-TAURI STAGE should figure prominently here.) Lastly (kind of!), ***does this model explain the formation of the objects in our solar system***? In other words, what components of the hypothesis satisfy the similarities and differences observed in the planets today?

Earth Features and Processes

Our Principle of Uniformitarianism (what's THAT?) lead us to suspect that we'd better understand the Earth as well as possible before we start making interpretations of the surface features of other planets! So the Earth formed through the processes of accretion along with the other planets and everything. Did it form as it exists today, or was it perhaps originally a homogeneous ball of rock that has undergone changes over the last 4.5 B.y.? More specifically, what is differentiation, and how did it occur in the Earth? Does it still happen today? What are the results (notice that's plural) of igneous differentiation? Explain the existence of plates (of Plate Tectonics fame - hint: the cool temperature at the top of the mantle makes that uppermost mantle brittle and rigid; this layer is the "bread" underlying the "spread" of various kinds of crustal rock) and how Continental Crust differs from Oceanic Crust. How are plate tectonics related (or not!) to volcanism? Can you explain how our atmosphere came to be the way it is today, given what we know about the processes involved in the evolution of our planet?

What are the layers of the atmosphere (layers based on what?). WHY does the temperature change with altitude the way it does? Why is there a Coriolis Effect, what does it do, and what does that tell us about a planet with an atmosphere? What is the Greenhouse Effect, and how (exactly and in detail) does it occur? Please remember the level of detail with which we addressed this in class. What is the extension of that - Global Warming (or Climate Change) - and why is it thought that humans play a role?

Atmosphere allows for the exchange of water among different places, and this exchange allows for weathering and degradation of the surface. Running water shapes the surface, creating drainage patterns. Can you describe (draw) two patterns, and what they imply about the terrain?

Craters are formed by impact. Earth has few visible craters (compared with Luna). Why? What are the resurfacing processes active on Earth?

Luna

Earth's moon was thought long ago to be a giant crystal mirror - a reflection of Earth's surface. Galileo saw through his telescope (what kind did he use, again?) that it has features - Craters, Maria, and Highlands - proving that the Ancients did NOT know everything. Describe how the maria are different from the highlands, in terms of their compositions (rock types), relative elevations, and crater densities. How did the highlands form? (hint: think about ice cream!) As a check on your answer, do the processes you invoke explain the presence of a Peridotite Mantle? How and when did the Maria form, and how do we know this? Why are the maria concentrated on the side where they are? Explain their formation, and their relationship to the history of cratering on the Moon.

How (and when!) did Luna form? (We briefly discussed 3 now-dismissed and one accepted hypotheses...) Remember, Luna's formation is likely to have coincided with the offsetting of the Earth's axis of rotation from its original position that was "normal" to the plane of its orbit. Does Luna have a magnetic field today? Would you expect it to?

(Why/why not? Think about that important value we discussed regarding the Surface Area to Volume Ratio). Why are there different layers within, and how do we know that there are (rather than merely suspect that there are)?

Chap 11: Mercury, Venus and Mars

Check out the Learning Goals found at the beginning of this chapter - these are good! So are Review Questions (starting on p. 292) 1, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 29, 30, 32, 33, 34 and 40; Advanced Questions 50, 53, 54, 61, 62, 65 and 71. Rather than repeat them here, these questions serve as an appropriate study guide!

Chap 12: Jupiter and Saturn

The same is true for Chap 12; see questions starting on p. 325: 1, 2, 3, 4, 8, 10, 11, 12, 15, 18, 19, 20, 21, 24, 26, 30, 31, and 34.

Chap 13: Satellites of Jupiter and Saturn

In addition to the Learning Goals, check out the questions that start on p. 349: 1, 3, 4, 5, 9, 10, 11, 14, 15, 16, 18, 19, 20, 21, 23, 26, 29, 31, 32, 33, 35, and 36; Advanced: 37, 39, 55, and 57.

Chap 14: Uranus, Neptune, and Pluto/Kuiper Belt Objects

In addition to the Learning Goals, check out the questions that start on p. 372: 2, 3, 5, 6, 9, 12, 13, 14, 15, 21, and 25; Advanced: 34, 45, 47, and 49

Chap 15: Vagabonds

In addition to the Learning Goals, check out the questions that start on p. 397: 1, 4, 6, 7, 10, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 26, 28, 29, and 30; Advanced: 38, 41, 42, and 48.

You'll find that a portion of these questions are a bit redundant, which really implies that what they are driving at is of great importance! I hope you will give me feedback as to whether this study guide is helpful, and which style works better. Good luck!