Astronomy 101: Final Exam Guide
San Diego State University, Prof. Leonard

→ Note: The only changes made to this Final Exam Guide, compared to the Guide that is in your Course Reader (pages 289 - 295) occur on page 4 (page 292 of the Course Reader), under the section “Where Can I go for Help?”. While that section has changed considerably, all else has remained the same!

As stated in the Course Syllabus, the final examination in this course will take place at the following times and locations:

Section 6 (11 AM class): Tuesday, December 15, 10:30 AM → 12:30 PM, Room PA-216 (normal lecture room).

Section 8 (2 PM class): Tuesday, December 15, 1:00 PM → 3:00 PM, Room NE-060 (normal lecture room).

Details about the content of the final exam are spelled out in this document, but here are some highlights:

1. The final exam will consist of:
   - 75 multiple choice questions (worth 75% of the exam grade).
   - 1 essay question (worth 25% of the exam grade).

   On the last page of this document you will find four potential final exam essay questions. One of the four questions will appear, in the exact form that it is written in this document, on your final exam.

2. The final exam must be taken at the scheduled time, and no makeup (or early) exams will be given under any circumstances.

3. The final examination is cumulative, and will cover the entire course’s content with roughly equal emphasis.

4. You will have the full 2 hours to work on the exam.

5. As with the midterm exams, you will again be permitted to bring an official “cheat sheet” to the final exam (to be detached from the last pages of the course Reader).

Exam Day

The exam procedure for the final is the same as it was for all of the midterm exams. Namely, when you arrive to class on the exam day, please do not take a seat until told to do so. Copies of the exam, with individual names on them, will be placed on all desks before you may sit down. Thus, before the room is set up, please wait outside the lecture room. Everything should be ready by the nominal start time for the exam.

Please bring the following to the exam:

1. A ParSCORE FORM No. F-289-PAR-L scantron form. These may be purchased at the campus bookstore and are pink in color. To save exam time, you may fill out parts of the form ahead of time. This includes:
   - Top of form: The ‘Name’ (Last, First, Middle), ‘Subject’ (Astro 101), Date (December 15, 2009) and ‘Hour/Day’ (T/Th 11:00 AM or T/Th 2:00 PM).
   - Right hand column of form: Write and bubble in your RED-ID number in the spaces for ‘I.D. Number’. Leave the ‘Test Form’ and ‘Exam Number’ sections blank. Do not write anything on Side 2 of the form.
2. A number 2 pencil and a good eraser! (Note that you may answer the essay question using a pen, if you prefer; the multiple choice questions must be answered in pencil, as usual.)

3. Your official “Exam cheat-sheet” (to be detached from the last pages of the course Reader), with your name at the top, and all the information you want handwritten inside the box.

Note that no calculators will be permitted during the exam, and you do not need to bring any extra paper on which to write your essay response (paper will be provided for you).

About this Guide

This guide is intended to assist you with your preparation for the exam. It provides suggestions that I hope you will find useful.

→Disclaimer: This guide is not all-inclusive, and in no way should serve as a substitute for your own, self-directed preparation for the exam.

What Should I Study?

Everyone has their own best method for preparing for an exam. Here is my suggestion for a useful way to prepare for this particular test.

1. Gather together all of the weekly reading assignments, course handouts, and on-line reading quizzes that have been distributed or taken throughout the course. This includes:

   (a) Weekly reading assignments 1 → 15.
   (b) On-line reading quizzes #1 →#10, with solutions.

If you are missing any of the weekly reading assignments, handouts, or reading quiz solutions, they are all available for download from the course website:

http://sciences.sdsu.edu/~leonard/astro101

Once you are at the course web-site, simply click on the links for “Weekly Assignments”, “Class Handouts”, or “On-Line Reading Quiz Solutions”, to download and print out the material that you need.

2. Review the Selected Powerpoint Slides in the Course Reader. Since you may not have time to completely reread the textbook for all of the sections covered during the semester, I would start your review by carefully reviewing the “Selected Powerpoint Slides” that are included in the Course Reader (see Table of Contents for page number).

   In general, these slides contain a substantial amount of writing (as opposed to pictures), and often provide a quick listing of the major points/ideas/people/terms that are important to have mastered in that particular subject area. While these slides do not encompass “everything” for which you are responsible, they do tend to emphasize the most important items that you want to be sure to understand. Look these over carefully, and make a note of particular areas in which you feel additional study is needed.

   → Note that if you have limited study time available, reviewing the Powerpoint slides is probably your most efficient way to get a quick review the course material.

3. Look over the “Key Concepts, Terms, People and Ideas” list, from the course syllabus. The last pages of the course syllabus (reprinted in your Course Reader) provide a list of key items covered during the whole course, and covered during the lectures and reading. Being able to define/describe each of these terms is a useful way to be sure you have covered all of the major points of the chapters. As was true with the Powerpoint slides handouts, note down any words with which you are unfamiliar.

4. Review the textbook and Course Reader readings. Here are the sections of the text, and readings from the Course Reader, that we have covered during this course, and for which you are explicitly responsible:
(a) **Textbook:**
- Prologue: Entire Prologue.
- Chapter 1: Entire chapter.
- Chapter 2: Entire chapter.
- Chapter 3: Section 3.7 only.
- Chapter 4: Entire chapter.
- Chapter 6: Section 6.1.1, 6.1.2 (partial – see Week 8 handout).
- Chapter 7: Sections 7.1, 7.2, 7.3.1 → 7.3.3, 7.4.2.
- Chapter 8: Sections 8.1.1, 8.4.3 and 8.4.4.
- Chapter 9: Sections 9.2.1, 9.2.2 and 9.4.4.
- Chapter 10: Sections 10.1, 10.2 and 10.3.1.
- Chapter 12: Sections 12.4.1 and 12.4.2.
- Chapter 13: Sections 13.4.3, 13.4.4, 13.5.1 and 13.5.3.
- Chapter 14: Sections 14.1.1 → 14.1.4, 14.2, 14.3.1, 14.4 and 14.5.
- Chapter 15: Entire chapter.
- Chapter 16: Sections 16.3, 16.4.
- Chapter 17: Sections 17.1, 17.2, 17.3.1, 17.4.1, 17.4.2, 17.5
- Chapter 18: Section 18.3.1.
- Chapter 19: Section 19.3.1.
- Appendix 4
- Appendix 5

(b) **Course Reader: All Required Readings**

- Mathematical Toolkit
- Reading Graphs
- A Few Mathematical Skills
- Angular Size
- Kepler & Newton
- Other Worlds: An Introduction to the Solar System
- Light Waves
- Nuclear Interactions
- The Birth and Life of Stars
- An Expanding Universe
- Measuring the Expected Deceleration
- The Future of the Universe

Given time constraints, it may not be possible to completely reread all sections of the textbook and Course Reader that were assigned (although this is, of course, recommended!). If this is the case, you should focus your efforts on those particular topics that you previously identified as being in need of review.

5. **Prepare for the essay question.** As stated earlier, there will be one essay question on your final exam, and it will be one of the four essay choices that is given on the last page of this document. Thus, you know the possibilities for the exact essay question that will appear on your final. Spend some time now organizing your thoughts for each of the potential essay questions. The key to doing well on the essay is to write your response as though you are teaching the reader about the subject. In other words, do not write as though it is your astronomy professor who will be reading your answer. Rather, take the approach in your response that you are explaining your answer to another student who has not had the benefit of Astronomy 101. So, answer the questions carefully, with as much detail as you feel is necessary to thoroughly explain your answer.

6. **Review/retake the on-line reading quizzes.** Now that you have completed your review of the material, test yourself by retaking the old on-line reading quizzes. Questions that you get wrong should be
investigated to make certain you understand *why* you incorrectly answered it – make use of those solutions!

7. **Take the sample exam multiple choice questions.** A sample of 5 questions is included in this *Final Exam Guide*, and are indicative of the difficulty and content of the actual exam. While 5 questions can not encompass the full scope of the test, they should give you a sense of the types and level of difficulty of the questions that will be asked.

**Where Can I go for Help?**

Help is available before the exam through:

- **My office hours:** *Wednesday*, December 9, 1:30 – 3:00 PM, Rm. 238 physics building. (Note that my usual Friday, 12:00 - 2:00 office hours have been replaced with these hours on Wednesday.) Note that these office hours are the last chance to review your two midterm exams *with me*. You may also review the midterms with any of the TAs during the TA help room hours given below.

- **TA help room hours** *(Rm. 215, physics-astronomy building, unless otherwise noted):*

A Teaching Associate will be available in the TA help room at the following days and times before your exam:

- Tuesday, December 8: 5 – 6 PM
- Wednesday, December 9: 12 – 2 PM; 5 – 6 PM
- Thursday, December 10: 2 – 6 PM
- Friday, December 11: 9 – 10 AM; 12 – 2 PM
- Monday, December 14: 10 – 11 AM; 2 – 3 PM; 6 – 7 PM in room PA-215; 6 – 8 PM in Rm. 256 of the physical sciences building
- Tuesday, December 15: 10 – 11 AM

Please note that the TA Help Room hours for Monday, Dec. 14 and Tuesday, Dec. 15 are different from what they were for those days of the week during the semester.

→ Meeting with *any* of the teaching associates will be helpful. Note, though, that the teaching associates who are specifically associated with my sections of Astronomy 101 are in the Astronomy Help Room at the following times:

- Shimonee Kadakia: Tuesday, Dec. 8, 5 – 6 PM; Friday, Dec. 11, 9 – 10 AM; and Monday, Dec. 14, 6 – 8 PM *(in Rm. 256 of the physical sciences building for these two hours only)*
- Alex Burke: Friday, Dec. 11, 1 – 2 PM
- David Krogsrud: *Wednesday*, Dec. 9, 1 – 2 PM and 5 – 6 PM; Monday, Dec. 14, 6 – 7 PM

Since Shimonee, Alex, and David are part of your course, they may be able to provide more specific guidance than other TAs about things related to this particular section, but you are of course encouraged to go to the Help Room whenever it is convenient for you – most of the other TAs have also been TAs for my sections in the past!

- **Last-minute question-and-answer session.** On Monday, December 14, (i.e., the day before the final exam), an optional extra help session will be held in Rm. 216 of the physics-astronomy building from 1:30 – 3:00 PM. I will be there to answer any questions that you may have; note that this is NOT a formal “review session”; no additional information about the exam or its contents will be given at this session. Rather, it is provided solely as last-minute help to answer any questions that may have cropped up during your studying.

— Exam cover sheet, practice multiple choice questions, and essay question possibilities are given on the next three pages —
[YOUR NAME HERE]

Astronomy 101: Final Exam
December 15, 2009
Professor Douglas Leonard

CLOSED BOOK, NO CALCULATORS

• Print your name and ID number on the SCAN-TRON FORM No. F-289-P AR-L.
• Mark all answers on SCAN-TRON FORM No. F-289-P AR-L. Use a #2 pencil. Completely fill in the appropriate bubble. Be sure to thoroughly erase all altered answers and stray marks! If the SCAN-TRON machine rejects your form for any (valid) reason, you will lose one point (of the 100 that are possible) from your test score.
• For true-false questions: mark bubble A if the statement is true, and bubble B if false.
• For multiple choice questions: mark the bubble corresponding to the single best answer.
• For the essay question, write your response directly in your exam booklet, on the pages provided.
• There is no penalty for guessing. Be sure to answer all questions! (Note that the SCAN-TRON machine will reject a form for which an answer is not recorded for every question.)
• Time limit: 2 hours – budget your time appropriately! Don’t spend too much time agonizing over a tough question. Make a note of it on your exam (you may write in your exam booklet) and return to it after you have finished the others.
• Do not remove this exam booklet from the classroom. Failure to leave your test booklet on your desk will result in receiving a 0% grade for the exam.
• So: No stray marks, one answer per question, answer all questions, and leave the exam booklet on your desk when finished!

DO NOT OPEN THIS EXAM UNTIL TOLD TO DO SO!!

When you are finished, simply place the following THREE things in a stack on your desk:

• Test booklet (TOP of stack)
• Cheat-Sheet (MIDDLE of stack)
• SCAN-TRON (BOTTOM of stack)

GOOD LUCK!!!
Astronomy 101 – Sample Final Examination Questions (answers at bottom)

Multiple Choice/True-False (75 points – 1 point each)

Select the best answer for each of the following questions, and indicate your choice by filling in the appropriate bubble on your SCAN-TRON form. Be sure to read all answers before making a selection. For true-false questions, mark bubble A if the statement is true, and bubble B if it is false.

1. T or F. The average distance from the Earth to the Sun is less than one light year.
2. San Diego has a latitude of about 33° N. Which of the following statements is TRUE for an observer located in San Diego?
   (a) The south celestial pole is always visible right on the southern horizon.
   (b) All stars rise over the Eastern horizon and set below the Western horizon during the course of 24 hours.
   (c) The north celestial pole is always located about 33° above the northern horizon.
   (d) The north circumpolar zone includes all stars located within 57° of the north celestial pole.
   (e) Stars do not rise or set but, rather, all circle in a counter-clockwise direction around the zenith.
3. A star that is 10 lightyears away from Earth would, if moved to a distance of 40 lightyears, appear to be
   (a) 4 times brighter than before.
   (b) 4 times fainter than before.
   (c) 8 times fainter than before.
   (d) 16 times fainter than before.
   (e) 16 times brighter than before.
4. The “Hubble Deep Field”
   (a) is a very deep and detailed image of a small patch of sky taken by the Hubble Space Telescope.
   (b) is a marshy swamp located in Hubble, WI.
   (c) is an image of the Andromeda galaxy taken by Edwin Hubble in 1929.
   (d) is a quick “snapshot” of the Milky Way Galaxy taken with the Keck telescope in 2004.
   (e) is the name given to a mysterious force that is causing the universe to accelerate in its expansion.
5. Recent observations indicate that the universe is expanding faster today than it was a few billion years ago (i.e., the expansion of the universe is accelerating.) What kind of observations has led astronomers to this surprising conclusion?
   (a) Observations of Cepheid variables in nearby galaxies.
   (b) The measurement of extragalactic distances using Type Ia supernovae as “Standard Candles”.
   (c) The discovery of large amounts of dark matter in the halo of the Milky Way.
   (d) The discovery of many black holes in the Milky Way.
   (e) The fact that galaxies today are getting a lot more speeding tickets than they used to.

(Answers – 1: A (True); 2: C; 3: D; 4: A; 5: B.)
Essay (25 points)

As discussed earlier in this Final Exam Guide, your final exam will consist of 75 multiple choice questions (worth 75% of the exam grade) and one essay question (worth 25% of the exam grade). Here you are given a list of four possible essay questions, one of which will appear on your final exam.

Possible Essay Questions on Final Exam

Please carefully answer the following question in your own words and with as much detail as you feel is necessary to thoroughly explain your answer.

1. A college friend, who has not had the benefit of taking Astronomy 101, comes up to you and says: “I just heard that our Sun will one day ‘run out of fuel’ and die. Is this true? And what happens after it dies?”

Write an essay that gives your complete response to your friend. While you are free to choose the specific content and order of topics for your essay, it should, at bare minimum, include some discussion of the following items: how stars generate the energy by which they shine; how stars evolve; nature and properties of the object that is expected to remain after the Sun dies. Remember, you are teaching your friend about our Sun’s evolution with your response, not supplying a list of terms and definitions to your astronomy professor! The more complete and well-explained your answer, the better.

2. A college friend, who has not had the benefit of taking Astronomy 101, asks you: “How do we learn about all of the stars that I can see in the night sky? That is, how do we know what they’re made out of, how (or if) they are moving, and how hot they are?”

Write an essay that gives your complete response to your friend. While you are free to choose the specific content and order of topics for your essay, it should, at bare minimum, include some discussion of the following items: The science of spectroscopy and Kirchoff’s Laws; Doppler shift; proper motion. Remember, you are teaching your friend about how we learn about the stars, not supplying a list of terms and definitions to your astronomy professor! The more complete and well-explained your answer, the better.

3. A college friend, who has not had the benefit of taking Astronomy 101, comes up to you and says: “I just heard that our Universe is ‘expanding’. How did we discover this? And, what exactly does it mean that our Universe is ‘expanding’?”

Write an essay that gives your complete response to your friend. While you are free to choose the specific content and order of topics for your essay, it should, at bare minimum, include some discussion of the following items: The Hubble/Humason discovery – when and how it was made, and how it has been interpreted; Big Bang cosmology. Remember, you are teaching your friend about the expanding universe with your response, not supplying a list of terms and definitions to your astronomy professor! The more complete and well-explained your answer, the better.

4. A college friend, who has not had the benefit of taking Astronomy 101, comes up to you and says: “It seems obvious to me that the Earth is at rest at the center of the Universe, since I see everything – the Sun, planets, and stars – rise up in the East and set in the West each day, and have no sense that the Earth itself is moving at all. Is this belief of mine correct?”

Write an essay that gives your complete response to your friend. While you are free to choose the specific content and order of topics for your essay, it should, at bare minimum, include some discussion of the following items: Broad, historical development of the geocentric and heliocentric cosmologies; Galileo’s principle of equivalence and Newton’s Law of Inertia; location of Earth and Sun relative to the rest of the Universe. Remember, you are teaching your friend about our location in the physical universe with your response, not supplying a list of terms and definitions to your astronomy professor! The more complete and well-explained your answer, the better.