Astronomy 101 Midterm 1 Question Pool 4/25/2008

Greetings exam takers! Below is the set of "big questions" from which I will draw the two questions that you will be required to answer on exam day, Friday, May 2nd. Each is readily discussed at a "science-lite" level within a paragraph or two, but the industrious students of this class are advised to be as **complete** and **thorough** as possible, particularly in presenting **evidence** and **physical examples**. An exhaustive answer to these questions might take volumes – however, you are encouraged to keep it to less than three standard pages (5-6 pages in your blue book) per question. You should draw your arguments and evidence from the text, your lecture notes, and where appropriate from outside readings and personal knowledge.

I and the TAs are available to address any of your comments, questions, or concerns on these questions up until 10:00am on the day of the exam (though I will guarantee written responses to questions only up until 5pm the day **before** the exam – Thursday, May 1st). I strongly suggest that you take advantage of this opportunity and prepare meaningful answers to each well in advance of the exam; your preparation will pay off in a much easier and more successful experience!

Good luck!

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1. As a science, astronomy confronts nature on a dizzying range of physical scales. This means keeping an eye on the big picture – and keeping track of the relevant players and their places on the stage – is always important! Beginning at the level of small asteroids and comets (a few kilometers across), and continuing through planets, stars, galaxies, and superclusters (millions of light-years across!), discuss in detail the range of important spatial scales in the universe. Describe in detail the dimensions of objects that dominate each of these size scales, the relative amounts of "empty space" between them, and their relationships to the larger structures within which they reside.

2. We have learned in this class that even while sitting perfectly still in the deepest, quietest meditation, each of us is hurtling across the universe at speeds that are, quite frankly, astronomical (How far did you move while reading that sentence? Over 100,000 kilometers!!). Beginning at the level of the rotation of the Earth, describe in detail the various motions in which humans participate, up through the very largest scales of the universe. How has the difficulty of detecting this motion affected our understanding of astronomy through history? Does the constant state of change we experience in both time and in our physical surroundings imply anything about the distinct natures of 'space' and 'time'?

3. While there are many obvious aspects of the sky which change regularly, the rapidly changing Moon is amongst the most noticeable and significant – and fortunately, amongst the most straightforward to understand. As clearly as you can, and using well-labeled sketches if necessary to assist, describe and explain using physical examples both (a) the cycle of lunar phases, and (b) the common eclipses of the Sun and Moon, all as viewed from the Earth.

4. Evidence from early human civilizations suggests that from its very beginnings, mankind has made careful observations of the sky and attempted to predict and explain the patterns of motion seen there – particularly those of the Sun and planets. Trace the history of attempts to predict the movement of the planets, from human pre-history to the revolutionary developments of Galileo and Newton. In doing so, show how our current firm grasp on the how and why of planetary motions evolved from earlier efforts to explain these "wandering stars".

5. Most comprehensive descriptions of the planets in our solar system begin by dividing those worlds into two broad categories – "terrestrial" and "jovian" worlds. Justify in detail this apparently natural division by presenting the observed and theoretical differences between the compositions, structures, and physical conditions of specific Solar System worlds in each of these two categories. What processes in their formation led these worlds down such different evolutionary paths? How have jovian planets influenced the terrestrial planets over time?

6. No general astronomy class could possibly be complete without addressing that most basic -- but most complicated! -- of questions: how did the Sun, the Earth and the other planets form and come to be in the arrangement that we observe today in our Solar System. Present, explain, and justify the currently accepted model of the formation of our Solar System (in particular), as well as other planetary systems in general. How does that model address the variety of patterns in the Solar System observed by astronomers? What insights into this model have we gained from looking at other stars and their planetary systems?

7. The Sun is in more ways than one the "star" of our solar system. Its enormous mass dictates the movements of all of the other bodies in our solar system, and its luminosity is far and away the primary source of energy available to those bodies. Describe very briefly the history of mankind's attempts to explain the source of the Sun's energy, and then provide a detailed description of the fusion-centered model of the Sun that appears to have successfully described the inner workings of our star. How does this model account for the relatively stable size and luminosity of the Sun over the last few billion years?

8. Astronomy has always been driven by observations of the heavens, and the telescope has been at the vanguard of this work, from Galileo's sketches of the moons of Jupiter, to modern views from the Hubble Space Telescope. At a physical level, why is it the case that "bigger is better" is generally the rule in the construction of telescopes? Is it always so? Address these questions and state the scientific, engineering, and economic cases for and against large telescope construction. What advantages do space-based telescopes uniquely provide? What limitations do they suffer?

9. The Sun is frequently referred to in the popular scientific press as an 'average' star, or 'typical' of most of the stars in our galaxy. Do you agree with this sentiment? Compare and contrast the important physical characteristics of the Sun (temperature, luminosity, origin, etc.) with the most common types of stars in our galactic environment. In what ways is the Sun in fact similar to most other stars? In what ways does the Sun stand out as unusual?