

Astronomy 3 Midterm Examination

October 24 2000

Name: _____

Total Sections Attended: _____ (this will not affect your grade, but will be used for statistical purposes)

Instructions: READ ALL INSTRUCTIONS BEFORE BEGINNING!!!

- You have one hour and fortyfive minutes to complete the exam.
- Before starting, check to make sure that you have all 10 pages (including this cover sheet).
- You are required to answer all the questions
- You may not use any books/notes etc. or calculators. All potential difficult math questions have equations and arithmetic on this page
- Any form of cheating, including any communication with other students, copying answers (with or without the other student's knowledge), using notes/books, etc., is strictly prohibited and will have serious consequences.
- If you have questions understanding a particular problem, ask a TA for assistance. We'll help you the best that we can.

Potentially Useful Equations and Numbers:

$$\left(\frac{P}{1 \text{ year}}\right)^2 = \left(\frac{a}{1 \text{ au}}\right)^3$$

$$F = m a$$

$$F_{\text{gravity}} = \frac{GMm}{d^2}$$

$$v_{\text{escape}} = \sqrt{\frac{2GM}{R}}$$

Inverse Square Law \rightarrow *brightness* = I_o/d^2

$$\left(\frac{d}{1 \text{ parsec}}\right) = \left(\frac{1 \text{ arcsecond}}{\text{parallax angle}}\right)$$

$$\text{Luminosity} = \text{constant} \times R^2 \times T^4$$

$$8^{1/3} = 2$$

$$216^{1/3} = 6$$

Score: Section A-_____ / 15 Section B-_____/35 Section C-_____/ 30 Section D-_____/ 20

Total Score _____ / 100

Section A Definitions (15 points total)

1. Name 6 types of photons (i.e. Radio Waves) and rank them from smallest wavelength to largest wavelength. [3 points]
2. State Kepler's 3 laws of planetary motion. [6 points]
3. State (but do not describe) 3 different processes in which heat can be transferred [3 points]
4. Name the three objects which a star could end up as at the end of its lifetime (i.e. after all forms of energy generation have ceased). [3 points]

Section B Short Answer (35 points total) [5 points each]

1. Solar atmosphere:

What is the name of the region below which we can no longer directly see most of the visual photons from the interior of the Sun? [2 pts]

Why do sunspots appear dark? [2 pts]

How long is the Solar Cycle? (i.e. the time it takes for the number of sunspots to go from maximum to minimum to maximum again, as well as for their polarities to reverse) [1 pt]

2. Venus:

The temperature on the surface of Venus is hotter than that of Mercury, even though Mercury is closer to the Sun. Describe the effect which may have caused this phenomenon. [3 pts]

Why is it necessary to use radar to map the surface of Venus? [2 pts]

3. Mars:

- Give two pieces of evidence which support the idea that Mars once had a substantial amount of liquid water on its surface. [2 pts]

From those 2 pieces of data, how can we infer Mars once had a substantial atmosphere? [3 pts]

4. Spectra

How do transitions between energy levels relate to how atoms emit or absorb photons? [4 pts]

Why will a hot gas produce an emission line spectrum? [1 pt]

5. Solar Structure

1. Name an effective method astronomers use to probe the structure of the interior of the Sun. [1 pt]

1. Name the two zones of the Solar interior. (The core of the Sun is NOT considered a zone) [2 pts]

1. What effect prevents the Sun from collapsing in on itself despite the Sun's enormous gravity? [2 pts]

6. Energy Generation in the Sun

1. Through what process does the Sun produce most of its energy? [2 pts]

1. At what location in the Sun does this process take place? [1 pt]

1. Why is most of the energy generated at this location? [2 pts]

7. The Moon:

Describe two scenarios for the formation of the Moon. State a piece of evidence supporting each scenario. [5 pts]

Multiple Choice (30 points total) [3 points each]

- Two** planets, Adam and Mike, are recently found around the nearby sun-like star LINO07. Each planet orbits around the star with periods of 8 yrs and 216 yrs, respectively. The distance of planet Adam and planet Mike's circular orbits around LIN 007 are thus, respectively:
 - 8 and 216 AU
 - 1/8 and 1/216 AU
 - 2 and 6 AU
 - 4 and 36 AU
- If the distance between LIN 007 and planet Adam is half of that between LINO07 and planet Mike, then the brightness of LINO07 on planet Adam would be
 - four times stronger than on planet Mike
 - two times stronger than on planet Mike
 - four times weaker than on planet Mike
 - two times weaker than on planet Mike
- If planet Adam has twice the radius and eight times the mass of planet Mike, an astronaut would weigh:
 - 2** times more on planet Adam than on planet Mike
 - 8 times more on planet Adam than on planet Mike
 - 4 times more on planet Adam than on planet Mike
 - half as much on planet Adam than on planet Mike
- A catastrophic collision causes planet Mike to speed away from the host star LINO07 at half the speed of the light while planet Adam continues to orbit LINO07. The spectrum of planet Adam's atmosphere observed by an astronomer on planet Mike immediately after the collision appears to be
 - red shifted
 - blue shifted
 - remained the same
 - no longer observable
- When planet Mike is at a distance of 4 parsecs, its parallax observed by an astronomer on planet Adam is 1 arc second. Some years later when planet Mike reaches a distance of 8 parsecs, its parallax observed by the same astronomer will be
 - 2 arc second
 - 1 arc second
 - 0.5 arc second
 - 0 arc second
- Dr Evil made a copy of the Earth, with exactly the same orbit and spin orientation, and named it Minime. He was so proud of his achievement he decided to relocate the cities of Alexandria and Syne from Earth to Minime along with astronomer Eratosthenes. At the astronomer's insistence, Dr Evil made the compromise of maintaining the exact north-south distance between the two cities. On the day when the Sun was overhead in Syne, Eratosthenes noticed that the Sun cast a 14 degree shadow on Alexandria instead of the 7 degree shadow he used to see on Earth. Based on this observation, he concludes the size of Minime is
 - twice that of the Earth
 - same as that of the Earth
 - half that of the Earth
 - quarter that of the Earth

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7. The star Regulus is 81 times more luminous than the Sun. Its surface temperature is also 3 times hotter. The radius of Regulus is
- (a) same as that of the Sun
 - (b) one third that of the Sun
 - (c) three times larger than that of the Sun
 - (d) nine times larger than that of the Sun
8. Bart Simpson accidentally swallowed a 1 gram lump of radioactive ^{14}C Carbon which has a half life of 5740 years. When his body was eventually discovered by a group of archaeologists 11480 years later, they found the mass of the lump of radioactive carbon to now be:
- (a) completely converted into ^{14}N Nitrogen
 - (b) 0.5 gram
 - (c) 0.25 gram
 - (d) 1 gram
9. The most common isotope of oxygen has atomic number 8 and atomic weight 16. Another isotope of oxygen has two extra neutrons, its atomic number and atomic weight are
- (a) 10 and 18
 - (b) 10 and 16
 - (c) 8 and **16**
 - (d) 8 and 18
10. Water ice may be found near the Moon's south pole because
- (a) this region is covered by vast ice sheets just like the Earth's south pole.
 - (b) some areas are always in the shadow of the Sun light and remain cool
 - (c) there are several underground natural springs
 - (d) it is supplied from the annual rain fall during the lunar winter
11. The Italian physicist Galileo provided proof for the heliocentric model of the solar system by
- (a) showing Voyager II space craft images of planetary orbits
 - (b) traveling to the Sun and back
 - (c) computing the orbit of the Earth with a PC computer
 - (d) comparing the phases of Venus at various positions relative to the Sun

Long Answer Comparative Planetology (20 points total)

1. Name 3 differences between terrestrial and Jovian planets in the Solar System [3 points]

2. The Moon

• Name two independent methods of measuring the age of Lunar surface. [2 points]

• What do these investigations tell us about the age of the Highlands and Maria on the Moon? [2 points]

• What process may have caused this age difference? [2 points]

3. Ages of Planetary Surfaces

State the relative ages of the surfaces of Mercury, Venus, and Mars [3 points]

Give one reason which may be attributed as the most likely cause of this difference. [3 points]

4. Why are there hardly any small craters on Venus? [3 points]