

Ay 1 Self-calibration Midterm Exam

DUE May 8th

35 questions. Open notes, closed book; can use calculator if necessary

NOTE: YOU SHOULD BE ABLE TO DO THIS WITHOUT YOUR NOTES OR BOOK, BUT AFTER GOING THROUGH IT ONCE W/O NOTES, FEEL FREE TO CHECK YOUR NOTES. This exam will not count on your final grade unless it is needed to help a poor final exam grade.

April 29, 2009

1. Which of the following constellations is ALWAYS visible at night in the sky above Pasadena?
(A) Crux (Southern Cross, declination = -60 degrees)
(B) Cassiopeia (dec = 60 deg.)
(C) Orion (dec = 5 deg.)
(D) Pisces (dec = 15 deg.)
2. The bright star Vega is 8.1 pc away. We observe another star that, based on our measure of its surface temperature, seems to be nearly identical to Vega. If this second star appears 2500 times dimmer than Vega, how far away is it likely to be?
(A) 128 pc (B) 0.51 pc (C) 2025 pc (D) 405 pc
3. What is the Main Sequence?
(A) A strip on the diagram of star effective temperature versus luminosity that contains most 'normal' stars. (B) A schematic description of how the Sun will evolve from its current state, into a red giant, through a planetary nebula phase, and ending up as a white dwarf. (C) A country line dance popular at Texas A&M. (D) A description of the phases of a supernova explosion.
4. What is the force that keeps Sun-like stars from collapsing under their own weight?
(A) electrostatic force (B) gas pressure (C) gas pressure gradients (D) electron degeneracy (E) gravitational energy
5. What is the source of energy that allows the Sun to release so much radiation (10^{27} watts), continuously over a lifetime of 10 billion years?
(A) chemical reactions (B) nuclear fission (C) energy release due to gravitational contraction (D) nuclear fusion of 4 Hydrogen atoms into one Helium atom
6. At what point will the Sun will become a red giant?
(A) never (B) it has already been one (C) after it has converted most of the hydrogen in its core to helium (D) as metals accumulate, it turns red and gets larger

7. How do we determine the masses of stars?

(A) from the color of the star. (B) from the stellar luminosity. (C) by studying the orbits of extrasolar planets around stars. (D) by examining the orbits of binary stars

8. There are two high tides per day on Earth because:

(A) there is one from the Sun and one from the Moon (B) there are two major oceans on Earth (C) the Moon orbits the Earth twice per day (D) the Moon induces tides on both sides of the Earth at once

9. Which elements are formed only in supernovae?

(A) hydrogen and helium (B) carbon and oxygen (C) silicon and iron (D) uranium and lead

10. What advantages does the Hubble Space Telescope have over ground-based telescopes?

(A) less atmospheric distortion (B) room for larger mirrors (C) less gravitational distortion (D) longer useful lifetime

11. Which of the following is true?

(A) the stars in a constellation are usually the same age (B) all constellations lie on the ecliptic (C) the placement of stars in constellations changes in time (D) the zodiac is the set of constellations in the plane of the galaxy

12. A sidereal day is:

(A) 4 min shorter than a solar day (B) 4 min longer than a solar day (C) sometimes longer and sometimes shorter than a solar day (D) the same as a solar day (E) depends on terrestrial location

13. Why are star clusters good laboratories for studying stellar evolution?

I. The stars are all approximately the same age.

II. The stars are all roughly the same mass.

III. The stars are all at about the same distance.

(A) I and II (B) II and III (C) I and III (D) I only

14. The temperature required to overcome the Coulomb barrier and fuse hydrogen is roughly 10^{10} K, yet the core of the Sun is roughly 10^7 K. Why can the Sun fuse hydrogen?

(A) temperature can be defined as the average kinetic energy of the atoms so some atoms are traveling fast enough to fuse together (B) quantum tunneling allows fusion without crossing over the barrier. (C) chemical interactions provide the additional energy necessary to fuse the atoms. (D) neutrinos collide with the atomic nuclei and induce fusion. (E) alpha particle decays interact with atomic nuclei and induce fusion.

15. The 14-inch telescope on the roof of Robinson building has a large mirror in the bottom, and a secondary mirror near the top. Light bounces off the mirror in the bottom, up to the secondary, and back down through a hole in the center of the bottom mirror. What kind of focus is this?

(A) Prime focus (B) Newtonian focus (C) Cassegrain focus (D) Coude focus

16. The largest telescopes operate in which wavelength region?
 (A) radio (B) infrared (C) visible (D) x-ray (E) gamma ray
17. By some freak accident, you are born on the north pole of the planet Uranus. Uranus orbits the Sun once every 84 years and rotates once on its axis every 17.2 hours. If you are born at Sunrise, how old will you be at Sunset?
 (A) 8 hours old (B) 8.5 hours old (C) 3 days old (D) 42 years old (E) 84 years old
18. You are outside at midnight and observe the planet Venus directly overhead. Which of the following is most likely?
 (A) You are at the Earth's equator (B) You are at the Earth's north pole
 (C) It is the Vernal Equinox (D) You are hallucinating
19. For nearby stars, stellar distances are measured by examining the apparent motion of stars as the Earth revolves around the Sun. Given that a star appearing to move 1" on the sky is defined to be at a distance of 1 parsec (pc) from the Sun, what is the distance to an object which moved 0.08"?"
 (A) 80 pc (B) 12.5 pc (C) 8 pc (D) .08 pc (E) 1000 pc
20. What is the main evidence that gamma-ray bursts occur outside our galaxy?
 (A) Their distribution is isotropic (B) Their duration is so short (C) There aren't enough collapsars in our galaxy (D) We don't have any such evidence
21. Betelgeuse has a radius 300 times that of the Sun, and an effective temperature about half that of the Sun. What is the luminosity of Betelgeuse in solar luminosities?
 (A) 0.25 (B) 75 (C) 9000 (D) 5600
22. What is the primary factor that determines whether a star ends up as a planetary nebula, a neutron star, or a black hole?
 (A) Its composition (B) Its mass (C) Its rotation rate (D) The surrounding environment
23. A spectrum of the Sun's light shows continuous radiation with black lines (or bands) superimposed. This is explained as:
 (A) radiation from a hot blackbody with emission lines from gas closer to the star's surface (B) radiation from a hot blackbody with absorption lines from gas closer to the star's surface (C) black body radiation from the Sun and from dust in the solar wind between Earth and Sun
24. Black body radiation is one of the most important and basic forms of radiation understood by astronomers. Planck explained it, but before that Wien related the wavelength of peak intensity to the temperature of the black body. What is this relation (known as Wien's Law)?
 (A) $\lambda \propto 1/T^2$ (B) $\lambda \propto 1/T$ (C) $\lambda \propto T$ (D) $\lambda \propto T^4$
25. Why do astronomers study stellar spectra?
 (A) to determine the composition of stellar atmospheres (B) to learn about the temperature of stellar atmospheres (C) to detect planets orbiting stars (D) none of the above (E) all of the above

26. What causes seasons on the Earth?

(A) The Earth's orbit is an ellipse, and the Earth is hottest when it is close to the Sun (B) The Moon's gravity causes the Earth to move towards and away from the Sun (C) The Earth's axis is tilted with respect to the ecliptic pole (D) We don't have seasons, this is California!

27. The Moon takes 27.3 days to revolve around the Earth. However, the Moon takes 29.5 days to go through a full cycle of phases. Why are these numbers different?

(A) The Moon is on an elliptical orbit (B) The Moon only rotates once every 29.5 days (C) The numbers are in terms of lunar days and Earth days (D) The Earth orbits the Sun at the same time that the moon orbit the earth

28. When does the first quarter moon (after new) rise?

(A) at Sunrise (B) at noon (C) at Sunset (D) at midnight

29. Which are the basis principles for understanding normal stellar structure?

(A) energy conservation (B) elemental nucleosynthesis (C) hydrostatic equilibrium (D) thermal equilibrium (E) C & D (F) A & B

30. Why is it difficult to observe in the infrared from Earth?

(A) There are too many warm, living objects near the telescope (B) It is difficult to build telescopes large enough to achieve good resolution in the infrared (C) The atmosphere is very opaque at these wavelengths (D) It is no more difficult than observing in the optical

31. The ultimate angular resolution of a 10 meter optical telescope compared to a 100 m radio telescope is:

(A) 1000 times better (B) similar (C) million times better (D) the same

32. The Very Large Array (VLA) is a radio interferometer composed of 27 radio telescopes, each 25m in diameter, spread over an area about 36 km across. Which of the following are true about the VLA? I. It has the angular resolution of a single radio telescope with a diameter of about 36 km. II. In a given amount of time, it can see objects as faint as a single radio telescope with a diameter of 36 km. III. The VLA has better angular resolution at shorter radio wavelengths than at longer wavelengths.

(A) I only (B) II only (C) I and III (D) II and III

Short Answer:

33). Why isn't there a solar eclipse every month?
(write your answer w/ figure if helpful)

34). Why are the Balmer lines of hydrogen stronger in the spectra of stars of intermediate temperature (A-type stars) than in hotter (O-type) or cooler (F,G, K-type) stars?

Essay question: Discuss and compare the techniques astronomers use to observe the sky at various wavelengths. For instance, how do radio telescopes compare with optical telescopes? What are the limitations that astronomers must overcome to observe in different wavelength bands?