

ASTRONOMY 0089: EXAM 2
Class Meets M,W,F, 1:00 PM
Mar 22, 1996

INSTRUCTIONS: First fill in your name and social security number (both by printing and by darkening the correct circles). Sign your answer sheet using your normal signature. Now answer all 45 questions. Students should choose the best answer of those given. There is only one correct answer for each question. Please remember to answer questions 44 and 45 as these identify which version of the exam you've taken. Read all questions carefully before answering.

1. The solar wind and magnetic activity (e.g., flares) on the Sun can interfere with radio communications on Earth.
 - a. True
 - b. False

2. Star A has a temperature of 10000 K and a radius of $1 R_{\odot}$. Star B has a temperature of 5000 K and a radius of $4 R_{\odot}$. Which of the following statements is true?
 - a. Star A and B both have the same luminosity.
 - b. Star A has luminosity 4 times that of Star B.
 - c. Star A has luminosity 2 times that of Star B.
 - d. Star A has luminosity 16 times that of Star B.
 - e. Star B has luminosity 4 times that of Star A.

3. Which of the following statements is INCORRECT?
 - a. Normal gas pressure increases as the density increases.
 - b. Normal gas pressure increases as the temperature increases.
 - c. Electron degeneracy pressure increases as the density increases.
 - d. Electron degeneracy pressure increases as the temperature increases.
 - e. Normal gas pressure provides the support against gravitational contraction for stars on the Main Sequence.

4. Which statement about binary star systems is INCORRECT?
 - a. In an eclipsing binary system, the light from one star is periodically occulted by the other star.
 - b. Binary star systems are rare.
 - c. Some binary systems may be used to determine stellar masses.
 - d. Some binary systems may be used to determine stellar radii.
 - e. In a spectroscopic binary, the absorption lines are seen to shift in wavelength periodically.

5. The granulation pattern on the surface of the Sun arises from
 - a. heating of the photosphere by solar flares.
 - b. the differential rotation of the Sun.
 - c. thermonuclear fusion in the photosphere.
 - d. convective motion of gases in and under the Sun's photosphere.
 - e. the dissipation of large sunspot groups.

6. Electron degeneracy occurs when
 - a. thermonuclear reactions halt the collapse of a protostar.
 - b. electrons resist being pushed together. It occurs in the core of a low mass star just before the onset of He burning.
 - c. electrons resist being pushed together. It occurs in the core of a low mass star during its life on the Main Sequence.
 - d. the protostar is approaching the main sequence.
 - e. electron particles in the solar wind ionize the Earth's atmosphere.

7. A small piece of stone has a volume of 10 cubic centimeters, and a mass of 40 gm. Its average density is
 - a. 4 gm/cm^3
 - b. 0.4 gm/cm^3
 - c. 0.25 gm/cm^3
 - d. 400 gm/cm^3
 - e. Indeterminate as you need to know the stone's composition.

8. Which statement regarding nuclear fusion is INCORRECT?
 - a. The temperature required to fuse He into C is higher than the temperature required to fuse H into He because higher collisional speeds are needed to overcome the extra electrostatic repulsion between the double charged He nuclei.
 - b. In the Sun, the fusion of H into He occurs via the proton-proton chain.
 - c. The fusion of C into heavier elements such as Neon and Magnesium, and eventually Silicon, Iron etc, only occurs in massive stars.
 - d. The fusion of He into C occurs via the triple alpha process.
 - e. It supplies the energy of White Dwarf stars.

9. In the Sun, energy is generated by which process?
 - a. The fusion of H into He.
 - b. The fusion of He into C.
 - c. The release of stored thermal energy.
 - d. The release of gravitational energy as the Sun slowly contracts.
 - e. Nuclear fission.

10. A light curve refers to the which of the following?
- A curve drawn with feather-weight ink.
 - A plot of the variation in brightness of a star against time.
 - An evolutionary track on the H-R diagram.
 - It is another name for the main sequence.
 - A plot of a binary star's orbital motion around its companion.
11. Two stars are seen to have identical spectra. One star is very close, and hence its distance is known. To determine the distance of the second star, which is extremely far away, we could use
- trigonometric parallax.
 - nucleosynthesis.
 - spectroscopic parallax.
 - Wien's Law.
 - the Stefan-Boltzmann Law
12. When the Sun uses all the Hydrogen in its central region its core will begin to contract and heat. Because of this, the outer layers of the Sun will
- expand and heat.
 - do nothing.
 - expand and cool.
 - contract and heat, similar to the core.
 - pulsate violently creating a planetary nebulae.
13. Sunspots are black because
- they contain 10 times as much iron as the surrounding regions.
 - the gas in them is so hot that all the electromagnetic radiation is emitted in the X-ray region.
 - clouds in the chromosphere block our view of the hot photosphere.
 - nuclear reactions occur in them more slowly than in the surrounding gas.
 - they are cool relative to the surrounding gas.
14. A star lies at a distance of 1 kpc (i.e., 1000 parsecs) from the Earth. If the star were moved to a distance of 3 kpc its apparent brightness would
- increase by a factor of 3.
 - increase by a factor of 9
 - decrease by a factor of 3
 - decrease by a factor of 9
 - increase by a factor of 81.

15. The average density of the Earth is
- very similar to water.
 - about twice that of water.
 - similar to the density of Jupiter.
 - about 5.5 times that of water.
 - about 20.5 times that of water.
16. Which of the following provides the most accurate description of the initial composition (by mass) of the Sun?
- 20% Hydrogen, 60% Helium, 20% Carbon, Nitrogen and Oxygen
 - Since it was formed from the Solar nebula, its composition is similar to that of the Earth.
 - 70% Hydrogen, 28% Helium, 2% Carbon, Nitrogen and Oxygen
 - 30% Hydrogen, 20% Helium, 50% Carbon, Nitrogen and Oxygen
 - 20% Hydrogen, 20% Helium, 30% Carbon, Nitrogen and Oxygen, 30% Iron and other elements.
17. The Sun, in about 5 billion years from now, will evolve into a red giant. Which statement about the resulting red giant is true?
- Its luminosity will be similar to that of the Sun since it will have the same mass.
 - Its temperature will be approximately 10000 K.
 - Its luminosity will greatly exceed (e.g., by a factor of 100) the present luminosity of the Sun.
 - Its energy will be generated via the fusion of He into C in its inner core.
 - It will have a surface temperature of around 3500 K and hence, from the Stefan Boltzmann law, it follows that its Luminosity will be lower than the present Luminosity of the Sun.
18. In the H-R diagram, low mass main sequence stars reside
- at the lower left.
 - at the upper right.
 - at the upper left
 - at the lower right.
 - in the same region as White Dwarf stars.
19. The layer of the Sun from which visible light is emitted (and escapes to the Earth) is called the
- photosphere.
 - corona.
 - chromosphere.
 - convective zone.
 - plage.

20. To which region of the Sun does the following refer? It is an inhomogeneous and tenuous region with a temperature of more than 10^6 K (1 million K). At visible wavelengths it is best studied during a Solar eclipse.
- the chromosphere.
 - the core
 - the photosphere
 - the convective zone.
 - the corona.
21. Because of obscuration by dust it is best to observe protostars using
- optical or visible light.
 - UV light.
 - neutrinos.
 - infrared radiation.
 - X-rays.
22. A star has a parallax of 0.1 arcseconds. Its distance from the Earth is
- 0.1 parsecs.
 - 10 parsecs.
 - 100 parsecs.
 - Cannot be determined unless we know the star's luminosity.
 - approximately 3.3 parsecs.
23. A high mass star will explode in a spectacular supernovae explosion leaving behind a neutron star or black hole as the remnant.
- True
 - False
24. A star with an apparent magnitude of 6 has an apparent brightness 2.5 times larger than a star with an apparent magnitude of 5.
- True
 - False
25. In the convective zone of the Sun hot gas rises upwards (i.e. toward the surface) while cool gas sinks. This process is important as
- it generates the neutrinos with which we can study the Sun's core.
 - it transports energy from the interior to the outer layers.
 - it ensures that the Sun has uniform composition throughout.
 - it facilitates nuclear fusion by ramming the gas together.
 - all of the above.

26. Neutrinos are important as they provide a means of probing the convective zone of the Sun.
- True
 - False
27. To measure transverse motions, astronomers use the Doppler effect.
- True
 - False
28. Magnetic fields are associated with most of the activity seen on the Sun's surface.
- True
 - False
29. The approximate age of our solar system is
- 4.5×10^6 years.
 - 4.5×10^{11} years.
 - 4.5×10^{12} years.
 - 4.5×10^9 years.
 - 4.5×10^7 years.
30. In a young cluster of stars, now devoid of gas and dust, there are many massive and luminous O stars. Suppose we were to look at the same cluster in 100 million years (10^8 years). Which of the following statements would be true?
- The cluster would look much the same as it does today.
 - The cluster would be devoid of M stars — they would have evolved off the main sequence and ended their life in a supernovae explosion.
 - Stars of mass similar to that of the Sun will have evolved into red giants.
 - The cluster will now contain many white dwarfs — the final products of low mass stellar evolution.
 - The cluster would be devoid of O stars — they would have evolved off the main sequence and ended their lives in supernova explosions.
31. Photometry is the technique of measuring a star's apparent brightness through one or more filters.
- True
 - False
32. Consider two objects of the same composition and the same mass. Of these 2 objects, the object with the smallest surface area will cool the fastest.
- True
 - False

33. The solar system is flat (i.e. most of the planet orbits lie in the same plane) because the original material from which the Sun formed was rotating. This rotation impeded the collapse in directions perpendicular to the rotation axis.
- True
 - False
34. Helioseismology is the study of vibrations in the Sun to place constraints on the Sun's internal structure.
- True
 - False
35. Which star, with the following Main Sequence spectral type, has the longest lifetime?
- O
 - F
 - B
 - A
 - K
36. T Tauri stars
- are evolved low-mass stars burning He in their core.
 - are stars of extremely low mass whose central temperature never gets high enough to initiate the fusion of H into He.
 - are extremely young objects approaching the Main Sequence.
 - are a form of pulsating star useful for determining stellar distances.
 - are the final evolutionary products of low-mass stellar evolution.
37. Why does the core of the Sun contain more helium and less hydrogen than does the surface of the Sun?
- Helium is heavier and has sunk toward the center.
 - Helium condenses more easily. Thus the protosun initially formed a core of Helium before accreting a Hydrogen rich envelope.
 - Hydrogen has been converted to Carbon and heavier elements as the Sun has evolved while the amount of Helium has remained constant.
 - Motion due to convection has moved the Hydrogen to the outer layers.
 - Thermonuclear reactions have converted some of the original Hydrogen into Helium.
38. The luminosity of a star depends on the distance of the star from Earth.
- True
 - False

39. The surface temperature of the Sun is approximately
- 5800 K
 - 4200 K
 - 14000 K
 - 15×10^6 K
 - 1200 K
40. Auroras
- are regions of intense magnetic activity on the Sun's surface.
 - are regions of the Sun which are slightly warmer than the surrounding photosphere.
 - are produced when energetic particles emitted by the Sun collide with Oxygen and Nitrogen molecules in the Earth's atmosphere.
 - are dense molecular clouds undergoing rapid star formation.
 - are the extended halos which surround comets when they are near the Sun.
41. Assuming that the stars are on the Main Sequence, which of the following spectral types has the largest Luminosity?
- K
 - F
 - G
 - A
 - B
42. Gravitational energy release is an important source of energy for which type(s) of stars?
- Protostars.
 - White Dwarf stars.
 - Main Sequence stars.
 - All of the above.
 - None of the above.
43. Spectral absorption lines due to molecules are most prevalent in which stellar spectral class?
- B
 - F
 - M
 - G
 - O

44. Condensation refers to which of the following?
- a. Molecules combining to form liquid or solid particles in a gas which is cooling.
 - b. The collapse of an interstellar gas cloud.
 - c. The collapse of the central core of a red giant.
 - d. The merging of planetesimals to form protoplanets.
 - e. The merging of protoplanets to form regular planets.
45. Mark the appropriate box.
- a. If the color of your exam is white, mark answer (a)
 - b. If the color of your exam is green, mark answer (b)
 - c. If the color of your exam is pink, mark answer (c)
 - d. If the color of your exam is orange, mark answer (d)
46. Mark answer (a)

Answers:

1(a) 2(a) 3(d) 4(b) 5(d) 6(b) 7(a) 8(e) 9(a) 10(b)
11(c) 12(c) 13(e) 14(d) 15(d) 16(c) 17(c) 18(d) 19(a) 20(e)
21(d) 22(b) 23(a) 24(b) 25(b) 26(b) 27(b) 28(a) 29(d) 30(e)
31(a) 32(b) 33(a) 34(a) 35(e) 36(c) 37(e) 38(b) 39(a) 40(c)
41(e) 42(a) 43(c) 44(a) 45(a) 46(a)