

Name _____

Do not forget to write your name and fill in the bubbles with your student number, and fill in test form A on the answer sheet. Write your name above as well. You have 50 minutes. For each question, mark the best answer. The formulas you may want are:

$$d = \frac{3.26 \text{ ly}}{p} \quad \frac{L}{L_{\odot}} = \left(\frac{T}{T_{\odot}} \right)^4 \left(\frac{R}{R_{\odot}} \right)^2 \quad L = 4\pi d^2 B$$

- Which outer layer of the Sun has the highest temperature?
A) Photosphere B) Corona C) Chromosphere D) Exosphere E) Thermosphere
- Which of the following would, by itself, indicate that a star is a nearby star?
A) The star is bright; easily seen by the naked eye
B) The star is an O star and yet difficult to detect
C) The star seems to wobble back and forth every year by a large amount compared to background stars
D) The star seems to wobble back and forth every year by a small amount compared to background stars
E) None of the above
- What fundamental property makes a plasma different from an ordinary gas?
A) It is made primarily of hydrogen rather than some other gas
B) It is so hot that the electrons have become detached from the atoms
C) It is hot enough for nuclear fusion to occur
D) It is hot enough that it glows in visible light
E) It has magnetic fields
- What is the second most common element in a typical star, such as the Sun?
A) Carbon B) Iron C) Oxygen D) Hydrogen E) Helium
- A massive star supernova is most likely to occur in a region where
A) All the stars are very luminous
B) All the stars are very dim
C) There are a lot of new stars being born
D) All the stars are very old
E) None of the above
- Which of the following is the primary way that we know what the Sun is made of?

- A) The overall color of the Sun
 B) Sample return missions that have dived into the corona of the Sun
 C) The wavelengths of the dark lines in the spectrum of the Sun
 D) The measurement of the rates of fusion in the Sun
 E) Stellar models that balance the pressure versus gravity for the Sun
7. Why does the edge of the Sun look less bright than when we look at the center of the Sun?
 A) The hottest part of the Sun is the part pointed towards us
 B) The fusion rate is fastest on the side of the Sun facing Earth
 C) When we look at the center of the Sun, we see not only the Sun's light, but also the reflection of the Earth shining back at us
 D) We see deeper into the layers of the Sun when we look straight down, where the Sun is hotter
 E) The Sun is closer to the Earth at the central point, making it look brighter
8. Just before a high mass star starts to undergo a massive star supernova, the core is made primarily of
 A) Helium B) Carbon/Oxygen C) Silicon D) Iron E) Neon
9. Suppose a star was 4 times the surface temperature of the Sun, but had the same radius. How many times more luminous than the Sun would it be?
 A) 2 B) 4 C) 16 D) 64 E) 256
10. Which of the letters at right corresponds roughly to where one would find a red giant star on the Hertzsprung-Russell diagram?
- | | | |
|---|---|---|
| | A | |
| | | E |
| | | C |
| B | | D |
11. What would be the best method for estimating the age of a cluster of stars?
 A) Measure the fraction of helium in the spectrum of a typical star
 B) Measure the relative fraction of main sequence stars to dead stars, such as white dwarfs
 C) Make a Hertzsprung-Russell diagram for the cluster, and see where it “turns off” from the main sequence
 D) Measure the velocity of the stars and see how much the cluster has spread over time
 E) Measure the mass of the most massive star that is still living in the cluster
12. Heat is transported out of the Sun by
 A) Convection throughout the Sun
 B) Radiation throughout the Sun
 C) Conduction throughout the Sun
 D) Radiation in the outer layers of the Sun, and convection in the interior
 E) Convection on the outer layers of the Sun, and radiation in the interior
13. In what way does the life history of a two solar mass star differ from a one solar mass star?
 A) The two solar mass star ends its life as a neutron star

- B) The two solar mass star ends its life as a black hole
 C) The two solar mass star eventually burns carbon and oxygen to heavier elements
 D) The two solar mass star does the same thing as a one solar mass star, but does it faster
 E) The two solar mass star does the same thing as a one solar mass star, but does it slower
14. Which particles are found in the nucleus of an atom?
 A) Protons (only)
 B) Neutrons (only)
 C) Protons and neutrons, but not electrons
 D) Protons, neutrons, and electrons, but not neutrinos
 E) Protons, neutrons, electrons, and neutrinos
15. Why is the helium burning stage of a star so much shorter than the hydrogen burning stage?
 A) Because the star is more luminous and the burning produces less energy per fusion
 B) Because the star is less luminous and the burning produces less energy per fusion
 C) Because the star is more luminous and the burning produces more energy per fusion
 D) Because the star is less luminous and the burning produces more energy per fusion
 E) None of the above
16. Which of the following events is believed can cause intense bursts of gamma rays?
 [1] Collapse of very high mass star
 [2] Merger of two white dwarfs
 [3] Merger of two neutron stars
 A) [1] only B) [2] only C) [3] only D) [1] and [2] E) [1] and [3]
17. What particles coming from the Sun confirm that it is currently undergoing nuclear fusion?
 A) Helium B) Photons C) Electrons D) Neutrinos E) Neutrons
18. Pulsars probably have at their heart what sort of star?
 A) Red giant B) White dwarf C) Black hole D) Planetary nebula E) Neutron star
19. Which of the following is not true of a typical globular cluster of stars?
 A) It contains thousands of or up to a million stars
 B) The stars are usually quite young
 C) It would probably contain lots of white dwarfs and red giant stars
 D) They are usually found in the halo of a galaxy, not the disk
 E) Actually, these are all generally properties of globular clusters
20. In which of the following stages does hydrogen burning occur anywhere in a star?
 A) Double shell burning (only)
 B) Protostar (only)

- C) Main sequence (only)
 - D) White dwarf (only)
 - E) Main sequence and double shell burning
21. What event is responsible for the ultimate death of the Sun?
- A) All the hydrogen runs out
 - B) All the helium runs out
 - C) The outer layers of the Sun are blown away by strong winds
 - D) The Sun burns all the way to iron, which cannot burn any more
 - E) The core of the Sun collapses under its immense gravity
22. Which of the following does not convey approximately the same information as the rest?
- A) Color
 - B) Surface temperature
 - C) Spectral class
 - D) Luminosity
 - E) Actually, all of these do approximately correspond to each other
23. The hottest stars in the HR diagram can be found in what part of the diagram?
- A) Left
 - B) Right
 - C) Top
 - D) Bottom
 - E) Middle
24. What happens to a star during the white dwarf stage?
- A) It gradually gets cooler and shrinks
 - B) It gradually gets cooler and grows
 - C) It gradually gets cooler and stays the same size
 - D) It gradually gets hotter and grows
 - E) It gradually gets hotter and shrinks
25. What sign would indicate that a particular star is moving away from us?
- A) If its overall color were slightly bluer than expected
 - B) If its overall color were slightly redder than expected
 - C) If its spectral lines are shifted towards the blue end of the spectrum
 - D) If its spectral lines are shifted towards the red end of the spectrum
 - E) If the luminosity were slightly less than expected
26. A white dwarf with the same mass as the Sun is about the size of
- A) The Earth
 - B) The Sun
 - C) Jupiter
 - D) A city
 - E) A pinhead
27. Suppose we know the brightness of a star. What additional information would allow us to determine the distance to the star?
- A) Luminosity
 - B) Temperature
 - C) Radius
 - D) Mass
 - E) Color
28. For a low mass star like the Sun, what is going on in the center of the star when it reaches its largest stage?
- A) It consists of inert helium
 - B) It consists of inert carbon and oxygen

- C) It has hydrogen burning to helium
 - D) It has helium burning to carbon and oxygen
 - E) It has carbon and oxygen burning to heavier elements
29. How does the number of sunspots change over time?
- A) It rises and falls in an approximate eleven year cycle
 - B) It rises and falls about every month at the rate the Sun rotates
 - C) It has been steadily increasing over time
 - D) It has been steadily decreasing over time
 - E) It is on the average steady from month to month and year to year
30. If a star is a main sequence star of spectral class B2, then we can conclude that it is probably also
- A) A low mass star
 - B) A high mass star
 - C) A non-luminous star
 - D) An old star
 - E) A star in a binary system
31. What sort of system can produce a supernova that completely destroys one of the stars?
- A) White dwarf plus black hole
 - B) White dwarf plus giant star
 - C) White dwarf plus neutron star
 - D) Black hole plus giant star
 - E) Neutron star plus giant star
32. How does the Sun rotate?
- A) The equator goes around in less time than the rest, but in the same direction
 - B) The equator goes around in more time than the rest, but in the same direction
 - C) The entire Sun rotates at the same rate, like a solid object
 - D) The equator goes around one direction while the rest goes around the opposite direction
 - E) It is impossible to know, since the Sun has no surface features that can be used to measure rotation
33. The spectrum from a planetary nebula is a
- A) Dark line spectrum
 - B) Bright line spectrum
 - C) Continuous spectrum
 - D) Bright line spectrum for low mass stars; dark line spectrum for high mass stars
 - E) Dark line spectrum for low mass stars; bright line spectrum for high mass stars