

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 55 minutes. For each question, mark the best answer. The formulas you may want are:

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

- How does a plasma differ from an ordinary gas?
 - The atoms are generally in molecules in a plasma, but single atoms in a gas
 - A plasma does not satisfy the ideal gas law, $P = knT$, unlike a gas
 - A plasma maintains its shape, unlike a gas, which can change shape
 - A plasma has fixed volume, unlike a gas, which changes volume based on pressure
 - A plasma is so hot that the electrons have come loose from their atoms
- How does the number of sunspots differ from time to time on the surface of the Sun?
 - It rises and falls roughly with a period of a couple days
 - It rises and falls roughly with a period of about 11 days
 - It rises and falls roughly with a period of about 11 months
 - It rises and falls roughly with a period of about 11 years
 - It stays pretty constant over time
- Which would be a clue that a cluster of stars I am examining is probably very old?
 - It has a reddish color to it
 - It has a blueish color to it
 - It is exceptionally bright
 - It is exceptionally dim
 - It is collecting social security
- How is heat transported from the interior of the Sun to the exterior in the outer layers of the Sun?
 - Radiation: by light
 - Magnetic induction: by magnetic fields
 - Convection: by flowing plasma
 - Conduction: by direct physical contact
 - Neutrinos: brought out from the interior
- What does a star look like just before a massive star supernova?

- A) It is made almost entirely of hydrogen, with just a bit of helium at the center
 - B) It is made of almost entirely helium, with just a bit of carbon and oxygen at the center
 - C) It is made of almost entirely silicon, with a bit of iron at the center
 - D) It is very complex, with multiple layers made of different things burning to different things
 - E) It is a mixture of many elements, but uniformly mixed throughout
6. In the Doppler method, how do we detect the presence of extrasolar planets?
- A) The light from the planet is alternately red shifted and blue shifted by its motion around the star
 - B) The light from the star is alternately red shifted and blue shifted by the gravitational influence of the planet
 - C) The planet is observed to move slightly to one side and back as it orbits its star
 - D) The star is observed to move slightly to one side and back under the influence of the planet
 - E) Light from a distant star is gravitationally lensed by the planet
7. How does the corona of the Sun compare with the photosphere?
- A) It is much higher temperature and much lower density
 - B) It is much higher temperature and much higher density
 - C) It is much lower temperature and much higher density
 - D) It is much lower temperature and much lower density
 - E) It is comparable in both temperature and density
8. After a massive star supernova, in addition to the supernova remnant, there is also
- A) A neutron star or black hole
 - B) A white dwarf
 - C) A protostar
 - D) A planetary nebula
 - E) Nothing
9. When gas moves from one star to another in a binary system, what is the nature of how the gas is usually transferred?
- A) It comes into the second star uniformly from all sides
 - B) It comes in primarily at the north and south geographic poles
 - C) It comes in straight at the equator, but falling straight into the star
 - D) It forms an accretion disk that orbits the star before falling in
 - E) It forms an ablation sphere that surrounds the star, then slowly flows in
10. What force holds the protons and neutrons together inside a helium nucleus?
- A) Gravity

- B) Electric forces
 - C) Magnetic forces
 - D) The strong force, or strong nuclear force
 - E) The weak force, or weak nuclear force
11. The second most common element in most stars, including the Sun, is
- A) Hydrogen
 - B) Oxygen
 - C) Carbon
 - D) Iron
 - E) Helium
12. Suppose the Sun suddenly doubled its radius, but its surface temperature remained the same. How would its luminosity change?
- A) It would get 16 times more luminous
 - B) It would get 4 times more luminous
 - C) It would get 2 times as luminous
 - D) It would stay the same
 - E) It would get $\frac{1}{2}$ as luminous
13. The spectrum from the Sun is a
- A) Dark line (absorption) spectrum
 - B) Bright line (emission) spectrum
 - C) Continuous (thermal) spectrum
 - D) White noise (random) spectrum
 - E) None of the above
14. Which of the following is the primary determining factor in how long a star lives?
- A) Composition: Those with high levels of helium die fast
 - B) Composition: Those with low levels of helium die fast
 - C) Planets: Those with the most planets die fast
 - D) Mass: Those with the lowest mass die fast
 - E) Mass: Those with high mass die fast
15. When we look at the “surface” of the Sun, the layer we are actually seeing is the
- A) Radiative zone
 - B) Photosphere
 - C) Corona
 - D) Chromosphere
 - E) Core
16. A star that is very luminous but very cool would appear where on the Hertzsprung-Russell diagram?
- A) Upper right
 - B) Lower right
 - C) Upper left
 - D) Lower left
 - E) Such a star is impossible
17. During which stage of a star like the Sun’s life is it the largest in size?
- A) Protostar
 - B) Double shell burning

- C) Main sequence
- D) White dwarf
- E) Core helium burning

18. Which of the following is true of some extrasolar planet systems?
- A) There are planets much larger than Jupiter (only)
 - B) There are gas giants close to their star (only)
 - C) There are planets in very eccentric orbits, or even going around backwards (only)
 - D) All of the above
 - E) None of the above
19. What sorts of stars will end their life as white dwarfs?
- A) Any star in the main sequence stage
 - B) Any star in the protostar stage
 - C) Low mass stars lighter than 8 times the Sun's mass
 - D) High mass stars heavier than 8 times the Sun's mass
 - E) Stars with a high proportion of helium in their initial composition
20. What is missing from the following net nuclear reaction:
- $$4 \text{ Hydrogen} + 2 \text{ electrons} \rightarrow 1 \text{ Helium} + \text{energy}$$
- A) There should be some neutrinos absorbed by the process
 - B) There should be some neutrinos produced by the process
 - C) There should be carbon interacting as well
 - D) There should be oxygen interacting as well
 - E) Actually, there is nothing missing from this process
21. Suppose that Star A is observed to apparently move from side to side over the course of a year, with a parallax of 0.05 arc-seconds. What is the distance to star A?
- A) 0.0153 ly B) 0.163 ly C) 6.13 ly D) 65.2 ky E) Insufficient information
22. Which of the following is not true about high mass stars?
- A) They produce many heavy elements by fusion late in their life, like neon, silicon, and iron
 - B) They end their life as a supernova
 - C) During the main sequence they are much brighter than low mass stars
 - D) During the main sequence they have hotter surface temperatures than low mass stars
 - E) After they die, they always end as a neutron star
23. The Sun is currently in which stage of stellar evolution?
- A) Protostar
 - B) White dwarf
 - C) Main sequence

- D) Double-shell burning
 - E) Core helium burning
24. A planetary nebula is
- A) The cloud of gas from which a star forms
 - B) The cloud of gas from which planets form
 - C) The cloud of gas which has been expelled from a star and is illuminated as the star is dying
 - D) A cloud of gas that is left over after a star explodes
 - E) A cloud of gas the is left over after a star evaporates its planets
25. Which of the following observations would be a sign that a star is moving away from us?
- A) The star is gradually getting dimmer over time
 - B) The star is gradually getting more red over time
 - C) The angular size of the star is getting smaller over time
 - D) The spectral lines of the star is shifted towards the blue end of the spectrum
 - E) The spectral lines of the star is shifted towards the red end of the spectrum
26. Between the main sequence and the core helium-burning stage of a star can be found which stage?
- A) Protostar
 - B) Planetary nebula
 - C) White dwarf
 - D) Red giant
 - E) Double shell burning
27. What distinguishes between the protostar stage and the main sequence?
- A) The protostar stage is not yet fusing hydrogen to helium
 - B) The protostar stage is not hot enough to glow
 - C) The protostar stage is already burning helium to carbon and oxygen
 - D) The protostar stage has used up all the hydrogen in its core
 - E) The protostar stage is done with fusion
28. Suppose I have measured the brightness of a star. Which additional piece of information would allow me to determine the luminosity of the star?
- A) Mass B) Temperature C) Distance D) Radius E) Composition
29. When the Sun has finished its complete life, what elements will have been produced by fusion in its interior?
- A) Helium (only)
 - B) Carbon (only)
 - C) Oxygen (only)

- D) Helium and carbon, but not oxygen
 - E) Helium, carbon, and oxygen
30. A typical white dwarf star is about the same size as
- A) A city
 - B) Jupiter
 - C) Earth
 - D) The Sun
 - E) The Solar System
31. A binary system that produces a supernova has what type of star on which gas is accreting?
- A) A black hole
 - B) A main sequence star
 - C) A neutron star
 - D) A molecular cloud
 - E) A white dwarf
32. The Sun is a G2 star. The star α Centauri A is also a G2 star. What additional piece of information would allow you to conclude that they are probably about the same luminosity?
- A) They are both main sequence stars
 - B) They are both about one solar mass
 - C) They are at about the same distance from the Earth
 - D) They are about the same brightness
 - E) None of the above would allow us to conclude that they have similar luminosities
33. Why are main sequence stars the most common type of star?
- A) The star masses that lead to main sequence stars are very common
 - B) The main sequence lasts the longest
 - C) Stars in our neighborhood are all the same age, and hence all in this stage
 - D) The composition of stars leading to the main sequence is the most common
 - E) Actually, they are relatively rare, but being the brightest stars, we notice them the most