

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:

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

- Which of the following is consistently found occurring at sunspots?
 - Magnetic fields (only)
 - Cooler temperatures (only)
 - Nuclear fusion (only)
 - Magnetic fields and cooler temperatures, but not fusion
 - Magnetic fields, cooler temperatures, and fusion
- If I had two stars, which quantity tells me which star is actually producing more total power?
 - Brightness
 - Luminosity
 - Temperature
 - Distance
 - Mass
- Suppose that during the planetary nebula stage of a star, a star stayed the same luminosity, while its size got 9 times smaller. How must its temperature have changed?
 - It got 3 times colder
 - It got 9 times colder
 - It got 3 times hotter
 - It got 9 times hotter
 - Insufficient information
- A typical visible light image of the entire Sun's surface shows
 - A perfectly uniform disk
 - A disk which is dimmer near the edge, and has some dark spots called sunspots
 - A disk which is dimmer near the edge, but otherwise uniform
 - A disk which has some dark spots called sunspots, but is otherwise uniform
 - A disk which is brighter near the edge, but otherwise uniform
- When we look close up at the Sun's surface, it shows "granulation", caused by
 - Convection of the hot gasses rising to the surface and cooler gases falling back down
 - Solar prominences and other phenomena creating small shadows
 - Dark regions where carbon has accumulated, making parts slightly darker
 - Regions with slightly different hydrogen/helium ratios caused by fusion
 - Regions where the solar wind is leaving/not leaving

6. How does the luminosity of an O main sequence star differ from the luminosity of an M main sequence star?
 - A) Since they are both main sequence, they are about the same
 - B) The M star is a little (2-3 times) more luminous
 - C) The M star is a lot (1000 or more times) more luminous
 - D) The O star is a little (2-3 times) more luminous
 - E) The O star is a lot (1000 or more times) more luminous
7. What is the name of the particle that comes directly from the center of the Sun, passing through it without colliding with anything?
 - A) Neutrino
 - B) Photon
 - C) Proton
 - D) Neutron
 - E) Electron
8. In a planetary nebula, the gas ejected from a dying star begins to glow. What is powering this glow?
 - A) Nuclear fusion occurring in the nebula
 - B) Ultraviolet light coming from the star's hot surface
 - C) Stellar wind slamming into the interstellar medium
 - D) Stellar wind slamming into previously lost stellar wind
 - E) Neutrinos from the powerful fusion in the dying star
9. The Sun is a G2 star. Which of the two stars F2 and G7 is it hotter than?
 - A) G7 only
 - B) F2 only
 - C) Both
 - D) Neither
 - E) Insufficient information
10. The type of material that composes essentially all stars is
 - A) Solid
 - B) Ordinary gas (made of atoms or molecules)
 - C) Liquid
 - D) Plasma (gas with the electrons not attached to the atoms)
 - E) None of the above
11. How does the number of flares, prominences, coronal mass ejections, and other types of solar activity vary with time?
 - A) It occurs at about the same rate at all times
 - B) It occurs at rates that rise and fall, but there is no apparent pattern to it
 - C) It occurs at rates that rise and fall with a period of about eleven days
 - D) It occurs at rates that rise and fall with a period of about eleven months
 - E) It occurs at rates that rise and fall with a period of about eleven years
12. Not all white dwarfs are the same size. What determines their size?
 - A) Temperature: hotter is larger
 - B) Temperature: hotter is smaller
 - C) Mass: lighter is smaller
 - D) Mass: lighter is larger
 - E) Composition: The more oxygen, the smaller
13. Spectroscopic parallax is a technique that only works for

- A) Binary stars
 - B) Main sequence stars
 - C) White dwarfs
 - D) The nearest stars
 - E) The Solar System
14. Which quantity is hard to measure for most stars, but easier for binary stars?
- A) Brightness
 - B) Luminosity
 - C) Temperature
 - D) Distance
 - E) Mass
15. We have a pretty good idea of what stars are made of by studying
- A) Samples of the stellar winds coming from them
 - B) Their typical color
 - C) The peak of their spectra
 - D) The wavelengths of the bright lines in their spectra
 - E) The wavelengths of the dark lines in their spectra
16. Pulsars produce very regular repeating signals. What object is believed to be responsible for pulsars?
- A) Black hole
 - B) Neutron star
 - C) White dwarf
 - D) Protostar
 - E) Planetary nebula
17. How many hydrogen nuclei are used up per helium nucleus created in the Sun's interior?
- A) 2
 - B) 3
 - C) 4
 - D) 6
 - E) more than 6
18. How is heat transported from the center of the Sun to the surface?
- A) It moves by radiation everywhere
 - B) It moves by convection everywhere
 - C) It moves by radiation near the center, and by convection near the surface
 - D) It moves by convection near the center, and by radiation near the surface
 - E) Little Sun Elves run back and forth carrying boxes of light
19. If a star's spectral lines match those of hydrogen, except they are shifted slightly to the red end of the spectrum, this is telling you the star is
- A) Not made of hydrogen
 - B) Made of a non-standard isotope of hydrogen
 - C) Made of hydrogen, but moving towards you
 - D) Made of hydrogen, but moving away from you
 - E) None of the above
20. Protostars are in a sense not real stars because they
- A) Have never won an Academy Award (Oscar)

- B) Are not hot enough to glow
 - C) Have not yet formed a spherical shape
 - D) Have not yet begun nuclear fusion
 - E) Have already finished nuclear fusion
21. Low mass stars like the Sun end their life as
- A) Neutron stars (only)
 - B) Black holes (only)
 - C) White dwarfs (only)
 - D) Neutron stars or black holes, but not white dwarfs
 - E) Neutron stars, black holes, or white dwarfs
22. The hottest layer of the exterior of the Sun is the
- A) Photosphere
 - B) Chromosphere
 - C) Corona
 - D) Exosphere
 - F) Thermosphere
23. Three stars have masses of 0.1, 1, and 10 times the Sun's mass. If they are born at the same time, in what order will they probably die?
- A) 0.1 first, then 1, then 10
 - B) 10, then 1, then 0.1
 - C) The 10 and the 1 at about the same time, and much later, the 0.1
 - D) Since they were all born at the same time, they will all die at about the same time
 - E) Insufficient information
24. Parallax is the distance method where you deduce the distance to the star from
- A) The change in angle as viewed by two points in Earth's orbit
 - B) The angular size and actual size of the star
 - C) The color (spectral class) and brightness of the star
 - D) The mass and brightness of the star
 - E) The time between when you send a radar signal out, and when it returns
25. What is the second most common element in a typical star?
- A) Carbon
 - B) Helium
 - C) Hydrogen
 - D) Iron
 - E) Oxygen
26. A star in the upper right part of the Hertzsprung-Russell diagram will be
- A) Cool and luminous
 - B) Hot and luminous
 - C) Cool and dim
 - D) Hot and dim
 - E) Insufficient information
27. What do we call the stage of a star where the core consists of pure helium, but it is not yet fusing the helium to heavier elements?
- A) Main sequence
 - B) Double shell burning

- C) Red giant
- D) Core helium burning
- E) Planetary nebula

28. Which category of stars are the most luminous?

- A) Main sequence
- B) White dwarf
- C) Neutron stars
- D) Giants
- E) Supergiants

29. Which particles can be found in the nucleus of an atom?

- A) Proton (only)
- B) Neutron (only)
- C) Electron (only)
- D) Proton and neutron, but not electron
- E) Proton and electron, but not neutron

30. X-rays can be produced from close binaries where one star is a giant star and the other is a

- A) Neutron star (only)
- B) White dwarf (only)
- C) Black hole (only)
- D) Neutron star or white dwarf
- E) Neutron star or black hole

31. Which of the following objects has the highest average density?

- A) Main sequence star
- B) Double shell burning star
- C) White dwarf
- D) Neutron star
- E) Protostar

32. In the late stages of the Sun, which of the following elements is produced?

- A) Neon B) Silicon C) Iron D) Hydrogen E) Carbon

33. Just before a high mass star undergoes a supernova explosion, the core is composed (primarily) of

- A) Iron B) Silicon C) Neon D) Oxygen E) Carbon