Spring 2007 **Astronomy - Test 3** **Test form A**

Name _____

Do not forget to write your name and fill in the bubbles with your student number, **leaving the last bubble blank**, 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:

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

1. Which of the following describes how sunspots differ from other places on the sun's photosphere?
   A) These spots are much hotter than the rest of the Sun
   B) These spots contain a higher concentration of helium
   C) These spots have stronger magnetic fields
   D) These spots have dark carbon deposits
   E) These spots rotate around the Sun, while the rest of the surface stays put

2. The death of a high mass star normally takes the form of a
   A) Type I supernova (technically, type Ia)
   B) Type II supernova
   C) Nova
   D) Planetary nebula
   E) X-ray burster

3. In X-ray pulsar systems, why is it that the X-rays come in pulses, rather than steadily?
   A) Because the neutron star is rotating, and we alternately see and don't see the hot spot
   B) Because the neutron star is alternately expanding and contracting
   C) Because the gas is being fed to the neutron star in regular pulses
   D) Because the stars collide (or nearly collide) at regularly spaced intervals as they orbit each other
   E) Because X-rays are waves, which have high points and low points, like any wave

4. Which of the following describes the distance method known as spectroscopic parallax?
   A) Radar is sent from Earth and bounced off of distant objects; the spectrum of the returning radar signal tells you the distance
   B) The angle of a star is measured over the course of a year, the difference in angle (parallax) tells you the distance
   C) The spectrum of a Cepheid Variable star is used to determine the parallax of the star
   D) The spectral class and brightness of a main-sequence star is measured, and with the help of the Hertzsprung-Russell diagram, the luminosity is deduced
   E) A really long tape measure is stretched from here to the star in question

5. After a star explodes in a supernova (type I or type II), what <u>usually</u> becomes of the gas that is blown away from the star?
   A) It becomes a large cloud called a supernova remnant
   B) It becomes a disk called a protoplanetary disk
   C) It becomes a roughly spherical shell called a planetary nebula
   D) It recollapses to join the neutron star that is at the core of the supernova
   E) It forms new stars called protostars

6. Suppose a nebula consists of a hot, thin gas. What type of spectrum would we expect to get from this nebula?
   A) A bright line spectrum, consisting of discrete bright lines
   B) A continuous spectrum, consisting of all wavelengths
   C) A red-shifted spectrum, consisting of only longer wavelengths of light
   D) A blue-shifted spectrum, consisting of only shorter wavelengths of light
   E) A dark line spectrum, consisting of all wavelengths except for a few

7. Under what circumstances can you theoretically escape from a black hole?
   A) Only light can escape, from any distance
   B) Material objects, but not light, can escape from any distance
   C) You can escape provided you are inside the event horizon
   D) You can escape provided you are outside the event horizon
   E) You can escape provided you are outside the singularity, the point at the center

8. During which stage is a star most likely to lose a large portion of its mass?
   A) Main sequence
   B) Asymptotic giant
   C) Horizontal branch
   D) White dwarf
   E) Protostar

9. Why are there no stars less than about 0.08 times the Sun's mass?

A) Objects smaller than this are incapable of gravitationally collapsing
B) Such small objects tend to combine with other comparable objects to form bigger stars
C) Nearby supernovae tend to disrupt small mass objects like this
D) Such objects get absorbed by other nearby stars
E) Such objects don't have enough mass to start nuclear "burning" of hydrogen

10. The reason most stars are main sequence is because
    A) That is the stage where they spend the most time
    B) Most stars have the right mass to be in this stage
    C) These stars are the most easily visible
    D) Main sequence stars burn hydrogen, and hydrogen is the most abundant element
    E) Stars near the Sun were born at the same time, and therefore are naturally all in the same stage

11. Which of the following methods is <u>not</u> currently used for detecting planets around other stars?
    A) The planet's gravity distorts the shape of the star; we measure the shape of the star
    B) The planet passes in front of the star, slightly dimming it
    C) The planet's gravity tugs on the star, causing the star to alternately red shift/blue shift as seen from Earth
    D) Images of the stellar system show a dim source (the planet) next to the star
    E) Gravitational lensing of distant stars behind the target star/planet show an increase in the distant star's brightness caused by the star and the planet

12. In which of the following stages is there no nuclear "burning" of fuel going on anywhere?
    A) Main Sequence
    B) Asymptotic Giant
    C) Red Giant
    D) Horizontal Branch
    E) All of these stages have nuclear "burning" of fuel

13. What keeps a white dwarf from collapsing to a point?
    A) Pressure caused by the high temperature from nuclear fusion
    B) The quantum mechanical property that <u>electrons</u> don't like being at the same place at the same time
    C) The quantum mechanical property that <u>neutrons</u> don't like being at the same place at the same time
    D) The electrical repulsion of the electrons from each other
    E) The electrical repulsion of nuclei from each other

14. How does the size of a typical white dwarf star compare with the size of a typical neutron star?
    A) Neutron stars are much (more than twice) bigger than white dwarfs
    B) White dwarfs are much (more than twice) bigger than neutron stars
    C) White dwarfs and neutron stars are about the same size
    D) The one with the larger mass will be bigger
    E) The one with the smaller mass will be bigger

15. Suppose I have two stars, with masses of 1 solar mass (star X) and 5 solar masses (star Y) respectively, that are born at about the same time. If I come back much later, which of the following would be impossible?
    A) Stars X and Y are both main sequence stars
    B) Star X is a main sequence star and star Y is a red giant
    C) Star Y is a main sequence star and star X is a red giant
    D) Star X is a red giant and star Y is a white dwarf
    E) Stars X and Y are both white dwarfs

16. Assuming I could actually make them work, which of the following would be the most efficient way to make my car run (most miles per kilogram of fuel)?
    A) Combine two hydrogen atoms with one oxygen atom to make water (chemical burning)
    B) Combine four hydrogen atoms to make one helium atom (nuclear burning)
    C) Combine three helium atoms to make one carbon atom (nuclear burning)
    D) Combine one carbon and one helium atom to make one oxygen atom (nuclear burning)
    E) Burn gasoline

17. Which of the following is <u>not</u> a stellar corpse; that is, a star that is no longer undergoing fusion?
    A) White dwarf
    B) Black hole
    C) Planetary nebula
    D) Neutron star
    E) All of the above <u>are</u> types of stellar corpses

18. Most of the mass of a neutron star actually comes from
    A) Electrons B) Protons C) Neutrinos D) Neutrons E) Light

19. How does luminosity differ for different stars on the main sequence?
    A) High mass stars are a lot less luminous than low mass stars
    B) High mass stars and low mass stars are about the same luminosity
    C) High mass stars are a lot more luminous than low mass stars
    D) Young stars are a lot brighter than old stars on the main sequence
    E) Old stars are a lot brighter than young stars on the main sequence

20. Hydrogen burns to helium. Helium burns to carbon and oxygen. Are there any types of stars that burn carbon and oxygen to heavier elements?
    A) Yes, horizontal branch stars, but not red giant stars
    B) Yes, red giant stars, but not horizontal branch stars
    C) Yes, in both red giants and horizontal branch stars
    D) Yes, in some supergiant stars
    E) No

21. What is the basic difference between a plasma, like the stars are made from, and an ordinary gas, like our atmosphere?
    A) Our atmosphere is all gas; plasmas are a mixture of gas and liquid
    B) Plasmas are made primarily of hydrogen, while atmospheres are made of nitrogen and oxygen
    C) Plasmas are very low density; atmospheres tend to be much higher density
    D) Plasmas have nuclear processes occurring in them; atmospheres have only chemical processes
    E) Plasmas have ionized (charged) particles in them; gasses consist of neutral atoms

22. Two stars, A and B, appear equally bright. They have the same luminosity. Star A is orange, and star B is white. Which star is farther away?
    A) Star A
    B) Star B
    C) They are equally distant
    D) It is impossible to know without knowing the *spectral type* of the two stars
    E) It is impossible to know without knowing the *mass* of the two stars

23. During the protostar stage, when a star remains the same temperature but its radius shrinks, how does the star move on the Hertzsprung-Russell diagram?
    A) Left B) Right C) Up D) Down E) None of the above

24. How large are the largest prominences on the Sun?
    A) As large as a medium sized city, like Winston-Salem
    B) As large as a state, like North Carolina
    C) As large as a nation, like the USA
    D) As large as the Earth
    E) Much larger than the Earth

25. For a Cepheid variable star, the brightness is measured. What other piece of information would allow you to determine how distant it is?
    A) Its mass
    B) Its spectral class
    C) Its temperature
    D) Its rotation rate
    E) Its pulsation period

26. The most common element in a star like our Sun is hydrogen, and the second most common element is
    A) Oxygen B) Carbon C) Helium D) Silicon E) Iron

27. Which of the following cannot be determined from the spectrum alone of a star?
    A) What the star is made of
    B) How hot the (surface) of the star is
    C) How fast the star is moving towards or away from us
    D) The distance to the star
    E) Actually, all of these can be determined from the spectrum alone

28. What would be the best way to estimate the age of a cluster of stars, presumably all born at the same time?
    A) Check their ID, especially if they are trying to order alcohol
    B) Count the relative number of stars that are main sequence/horizontal branch/giant stages
    C) Find asymptotic giant stars in binary systems and estimate their mass
    D) Measure the quantity of hydrogen left in typical main sequence stars
    E) Plot them on the Hertzsprung-Russell diagram and measure where the distribution "turns off" from the main sequence

29. The following equation, describing the net fusion reaction of the Sun, has something wrong with it. What is it?

    4 hydrogen + 2 electrons + energy → 1 helium + 2 neutrinos

    A) The energy should go on the right; energy is produced, not absorbed
    B) No neutrinos are produces in fusion
    C) Electrons are created, not destroyed, by this process
    D) Carbon should be on the right, not helium
    E) There is nothing wrong with this equation

30. Why is it especially helpful to photograph the Sun during solar eclipses?
    A) This is the only time the Sun is dimmed enough that we can photograph it without burning out our equipment
    B) This is the only time we can see the atmosphere of the Sun from here on Earth
    C) This is the only time the surface of the Sun can be studied
    D) This is the only time the neutrinos from the Sun can be studied
    E) No reason; eclipses are just cool

31. When is one star likely to transfer mass to its companion in a close binary system?

A) When the more massive star dies, but not when the less massive one dies
B) When the less massive one dies, but not when the more massive one dies
C) When the more massive star is in a giant stage, but not when the less massive one is in a giant stage
D) When the less massive star is in a giant stage, but not when the more massive one is in a giant stage
E) When either star is in a giant stage

32. When we say the Sun is a G2 star, what exactly do we mean?
A) This describes the temperature of the Sun
B) This describes the mass of the Sun
C) This describes the radius of the Sun
D) This describes the luminosity of the Sun
E) This tells us the Sun is a main sequence star

33. What causes planetary nebulae to glow?
A) It is reflected light from the star
B) It is radioactive decay of elements produced in a supernova explosion
C) It is chemical reactions among the complex atoms that have been expelled from the star
D) It is electrons that were knocked loose by ultraviolet light from the star recombining with the atoms
E) It is nuclear reactions occurring in the nebula