Astro 130, Fall 2014, Homework covering Chapter 19
Name: _____ Date: _____

1. All stars on the main sequence
   A) are at a late stage of evolution after the red giant stage.
   B) are changing slowly in size by gravitational contraction.
   C) generate energy by hydrogen fusion in their centers.
   D) have approximately the same age to within a few million years.

2. Why does the core of the Sun contain more helium and less hydrogen than the surface material of the Sun?
   A) Thermonuclear reactions have converted much of the original hydrogen in the core into helium.
   B) The hydrogen has been lifted out of the core by the Sun's magnetic field.
   C) Helium is heavier than hydrogen and has sunk toward the center in a process of chemical differentiation.
   D) Helium condensed more easily, so the core became helium-rich when the Sun was first forming. Vast quantities of hydrogen were added only after the core became massive enough.

3. The evolution of a star is controlled mostly by its
   A) initial mass.
   B) location in the galaxy.
   C) surface temperature.
   D) chemical composition.

4. What is the expected main-sequence lifetime of a star with a mass of 15 solar masses? (See Table 19-1, Freedman and Kaufmann, *Universe,* 8th ed.)
   A) 10 billion years
   B) less than 1 million years
   C) 3 million years
   D) 15 million years

5. After a star becomes a red giant, hydrogen fusion
   A) no longer occurs.
   B) occurs in the core.
   C) occurs in a shell around the core.
   D) occurs only during the helium flash.

6. Why does it require higher gas temperatures in the core of a star to produce nuclear fusion of helium compared to that required for hydrogen?
   A) Higher speeds are needed between two He atoms to overcome the shielding effect of the 2 electrons around the nucleus compared to the 1 electron per nucleus of H.
   B) The He nuclei need to be moving faster to avoid the more numerous and faster H nuclei with which they can combine with no energy generation.
   C) Higher collision speeds are needed to overcome the extra electrostatic repulsion between doubly charged He nuclei.
   D) Higher atomic speeds are required to strip off 2 electrons per helium atom rather than 1 electron per atom for hydrogen before fusion can take place.

7. What are the products of helium burning in a star?
   A) magnesium and silicon
   B) nitrogen and oxygen
   C) hydrogen and lithium
   D) carbon and oxygen

8. Under what conditions does electron degeneracy occur?
   A) when electrons become crowded too closely together
   B) when thermonuclear reactions release more electrons than protons
   C) when electrons and positrons annihilate, releasing energy
   D) when ultraviolet light from hot, young O and B stars ionizes the interstellar medium

9. What is the "safety valve" that prevents normal (nondegenerate) stars from self-destructing?
   A) If the pressure rises, the volume occupied by the matter will decrease, reducing the nuclear reaction rate.
   B) If a part of a star is heated, it expands and cools.
   C) If thermonuclear reactions proceed too quickly, the star will run out of fuel before anything drastic happens.
   D) If the temperature rises, the thermonuclear reaction rate will increase.

10. Horizontal-branch stars, which have a range of temperatures with luminosities between 50 and 100 times that of the Sun, are in what stage of their lives?
   A) hydrogen shell burning, with a degenerate helium core
   B) core helium burning
   C) gravitational contraction before the start of core hydrogen burning
   D) core hydrogen burning

11. What are the main general features that make clusters of stars useful to astronomers?
    A) The stars are at the same distance from Earth, were formed at approximately the same time, and were made from same chemical mix.
    B) The stars are all at the same distance from Earth, have the same surface temperature, and joined the cluster at various times.
    C) The stars all have the same apparent magnitude, the same surface temperatures, and the same sizes.
    D) The stars all have the same intrinsic brightness but differ in size and surface temperature.

12. What would you expect to be the overall color of a globular cluster of stars?
    A) blue, because of the contribution from young and very hot stars in the cluster
    B) red, because of the emission of light by the hydrogen gas surrounding the stars in the cluster
    C) blue, because of the scattering of starlight from the dust surrounding the stars in the cluster
    D) red, because of the older population of stars in the cluster

13. The age of a cluster of stars can be judged by the
    A) total number of stars within the cluster.
    B) amount of radioactive elements detected on star surfaces.
    C) turnoff point on the main sequence of its Hertzsprung-Russell diagram.
    D) number of novae per year occurring within the cluster.

14. In describing a star, what does the adjective “metal-poor” mean?
    A) The star has a low abundance of all elements in its spectrum.
    B) The star has a low abundance of all elements heavier than hydrogen in its spectrum.
    C) The star may or may not have a low abundance of carbon in its spectrum, but it is definitely weak in iron.
    D) The star has a low abundance of all elements heavier than hydrogen and helium in its spectrum.

15. Which of the following stars would you classify as a population II star?
    A) a star with approximately the same abundance of heavy elements as the Sun
    B) any member of an open star cluster
    C) a star with very low abundance of heavy elements
    D) a star with a much higher abundance of heavy elements than the Sun

16. A Cepheid variable is a
    A) type of eclipsing binary star.
    B) low-mass red giant that varies in size and brightness in an irregular way.
    C) high-mass giant or supergiant star that pulsates regularly in size and brightness.
    D) variable-emission nebula near a T Tauri star.

17. What scientific method is used to observe the pulsation in size of a Cepheid variable star?
    A) This behavior has only been predicted theoretically; it has never been detected.
    B) observation of the increase and decrease in the size of the star's image
    C) observation of perturbations in the orbits of planets around these stars
    D) Doppler shift of absorption lines in its spectrum

18. In some binary star systems, such as Algol, the less massive star is a red giant and the more massive star is on the main sequence. This is evidence that
    A) mass transfer has occurred from one star to another.
    B) the more massive star formed later, from a disk of gas surrounding the less massive star.
    C) the more massive star captured the other one into orbit some time after the two stars had formed.
    D) stars evolve differently in binary star systems, with less massive stars evolving faster than more massive stars.