AY1 Homework for Quiz 2: Spring 2017

Erg=CGS unit of energy=gram·cm^2/second^2; $E=mc^2$ in units of ergs if "m" is in grams and "c"=3x10^{10} cm/sec;

1. **Star A has twice the trigonometric parallax and twice the luminosity of Star B (assume no dust toward either star).**

   a) What is the relative distance of the two stars?

   b) What is the relative brightness of the two stars?

2. **The Sun will eventually go through which of the following phases?**

___ planetary nebula

___ red-giant branch

___ SNII

___ white dwarf

3. **In the fusion of four protons into helium, 4.7×10^{-26} grams of material is converted into energy. How much energy does this amount of matter produce?**

4. **Which of the following are True (T), which False (F)?**

___ The fraction of the Sun composed of helium is larger than it was 1 billion years ago.

___ The Sun is losing mass every day

___ The fraction of the Sun composed of Fe is larger than it was 1 billion years ago

___ The luminosity of the Sun decreases a small amount every day as it uses up its hydrogen fuel

5. **Given that hydrogen fusion to helium produces 10^{18} ergs of energy per gram of hydrogen:**

   A. How much energy can the Sun produce via this mechanism with the 2×10^{32} grams of hydrogen in the core where the temperature is hot enough for fusion to occur?

   B. How long could the Sun produce energy via his hydrogen fusion at its luminosity of 4×10^{33} ergs/second?

6. **In a SN I outburst, the initial burst of light is due to the energy released in fusion reactions. What keeps the SN glowing after the first 15 days?} (select one)**

   ___ A. Neutrino heating
   ___ B. Photo-disintegration of Iron nuclei
   ___ C. Radioactive decay or Nickel and Cobalt formed during the explosion
   ___ D. Radioactive decay of Hydrogen and Helium

7. **Which of the following are used in measuring stellar masses (check any that are)?**

   ___ A. Proper motion measurements of nearby stars
   ___ B. Radial velocity measurements of stars in binary systems
   ___ C. Red Giants that are within 100pc of the Sun
   ___ D. Newton's Laws of gravity

8. **The Solar luminosity at the Earth is 3.9×10^{33} ergs/sec. What is it at the distance of Jupiter (5 AU or 5 times the distance from the Sun compared to Earth)?**

   ____ A. 3.9×10^{33} ergs/sec
   ____ B. $(3.9 \times 10^{33})/5$ ergs/sec
   ____ C. $(3.9 \times 10^{33})/5^2$ ergs/sec
   ____ D. $(3.9 \times 10^{33}) \times 5^2$ ergs/sec

9. **"Hydrostatic" models for the Sun or other stars are based on (check any that are correct):**
   ____ A. Gas pressure compressing stars to the point just before they become liquid
   ____ B. Balancing the force of gravity and gas (thermal) pressure at every radius
   ____ C. The laws of physics governing the fusion of the elements
   ____ D. Static electricity providing support against gravitational collapse

10. **The principle behind determining stellar radius or surface area is best described by (select one):**

   ____ A. Using stellar luminosity combined with Wien's Law for the peak radiation as a function of temperature
   ____ B. Using the distance determined from parallax and the apparent size of a star
   ____ C. Using stellar luminosity, stellar surface temperature and Stephan's Law that related temperature and radiated energy for a surface
   ____ D. Using binary stars and radial velocity measurements

11. **Which of the following statements are True (T), which (F) regarding the Main Sequence in the Hertzsprung-Russell Diagram:**
   ____ A. It is a mass sequence with the lower-mass stars at the low-temperature/low-luminosity corner and the higher-mass stars at the high-T/high-L corner
   ____ B. It is the sequence of stars that are in equilibrium fusing hydrogen to helium in their cores
   ____ C. Stars start their lives in the cool-T/low-L corner and evolve along the Main Sequence as they age and get hotter
   ____ D. Once a star is on the Main Sequence, it stays there for at least 10 billion years

12. **High temperature is required for hydrogen fusion because (check one):**
   ____ A. Only at high temperatures do the protons approach close enough for the nuclear force to overcome the electrical force
   ____ B. Only at high temperatures can gravity be balanced
   ____ C. Hydrogen can not be fused unless oxygen is present and that only occurs at "burning" temperatures

13. **Why does hydrogen fusion only occur at the center of the Sun?**

14. **How much energy is released by the reactions in the core of the Sun each second?**

15. For two stars on the Main Sequence of the H-R Diagram, compare the luminosity of Star F and Star G if Star G has a higher surface temperature and is at twice the distance of Star F.

16. Four stars occupy the four corners of the H-R diagram (UL, LL, UR, LR):

_____ A. In which corner(s) is (are) the largest star(s)?
_____ B. In which corner(s) is (are) the most luminous star(s)
_____ C. In which corner(s) is (are) the hottest star(s)
_____ D. In which corner(s) is (are) the lowest-mass star(s)

17. Which of the following are true (T), which false (F) about the white dwarf the Sun will eventually become?

___ A. It will have become slightly more massive than the Sun is now because lightweight hydrogen has been converted into heavier Helium
___ B. It will be enriched in helium compared to the Sun
___ C. It will initially have a much higher surface temperature than the Sun
___ D. It will be supported against gravity by electron degeneracy forces

18. Which of the following support the theory of SN II: core-collapse supernovae?

___ A. SN II are always seen near regions of star formation
___ B. The supernova remnants in the Galaxy show evidence of heavy element enhancements
___ C. There are pulsars (rotating neutron stars) at the centers of some SN II remnants
___ D. They have luminosities similar to red giant stars

19. Which of the following are predicted properties of the neutron star left behind by a SNII?

____ A. They will initially have very high surface temperatures
____ B. They will be spinning very rapidly
____ C. They will have much higher densities that main sequence stars or white dwarfs
____ D. They will be supported by gravity by neutron degeneracy

20. Which of the following are part of the story that explains a SN I explosion?

___ A. Core collapse of the iron core of a massive star
___ B. Mass transfer in a close binary onto a white dwarf
___ C. Violent stellar collisions in star clusters that force objects over the Chandrasekar Limit
___ D. Explosive nucleosynthesis that produces radioactive nickel and cobalt

21. Why do we expect a freshly-formed neutron star to be rapidly rotating.

22. The lowest-luminosity white dwarfs in the Galaxy have about 10^{-5} the luminosity of the Sun. Why are there no whites dwarfs at lower luminosities than this?

23. How long will a star with 10 times the mass of the Sun and 10,000 times the luminosity of the Sun spend on the Main Sequence of the H-R Diagram?

24. Why don't White Dwarfs collapse to smaller radius due to gravity? (check any that are correct).

___ A. They are supported by hydrogen fusion
___ B. All white dwarfs are in the process of slowly collapsing till they become neutron stars
___ C. They are supported by electron degeneracy
___ D. They are already a super density fluid and fluids can not be compressed