Stars, Galaxies & the Universe (29:50)
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Exam #2 - Fall 2010
Wednesday, October 20th

FORM A - SOLUTIONS

1. The variations in brightness of a Red Giant star are due to what physical process?
   (a) expansion and contraction of the star due to instabilities between gravity and pressure
   (b) accretion and subsequent explosion of mass onto an unseen, compact companion
   (c) changes in the Earth's atmosphere which ``blur'' the image of such a bright star
   (d) shockwaves from violent iron fusion occurring in the core of this type of star
   (e) the periodic eclipsing of its surface by a cooler companion star

2. Which of the following is the right timescale for the brightness variations in Red Giants?
   (a) 1-10 minutes
   (b) 1 millisecond
   (c) 1-100 years
   (d) 1-100 days
   (e) 1-100 million years

3. Which of the following is the best description of solar rotation?
   (a) The Sun rotates like a solid body, with a period of 26 days at all latitudes
   (b) The Sun rotates fastest at the poles and slowest at the equator
   (c) The Sun rotates fastest at the equator and slowest at the poles
   (d) The Sun's rotation varies from 20 days at the S pole to 40 days at the N pole
   (e) The Sun's rotation varies from 25 to 35 days depending on solar cycle

4. In the Sun's ***radiative*** layers,
   (a) hot gas rises and cooler gas sinks.
   (b) photons pass instantly through because they interact with nothing in this layer.
   (c) photons get trapped by interacting and giving energy to atoms in this layer.
   (d) nuclear fusion occurs.
   (e) helium is converted into iron.

5. Which of the following is **NOT** true for white dwarfs (WD)?
   (a) a 1.2 solar mass WD is smaller in radius than a 1.0 solar mass WD
   (b) WDs are supported by electron degeneracy pressure
   (c) a WD is found at the center of a supernova remnant
   (d) the Sun will become a WD

(e) a WD can not be more massive than 1.4 solar masses

6. What is the best explanation of the bending of a beam of light (a photon) as it passes close to a massive object like the Sun using Einstein's view of gravity?
(a) The gravitational field interacts with the electromagnetic field of the photon to bend its path.
(b) The gravitational field of the massive object changes the refractive index of the nearby space, which causes the path of the photon to be bent.
(c) The photon travels across and must follow the curved spacetime surrounding the massive object.
(d) The photon follows the magnetic field lines of the Sun, and therefore is bent.
(e) The photon is pulled in gravitationally to the massive object.

7. Which of the following statements is ***correct*** concerning the Sun?
(a) It is a post-main sequence star
(b) It is converting helium to hydrogen in the core
(c) The interior transports energy only by convection
(d) The photosphere is cooler than the chromosphere
(e) Solar neutrinos are produced in the Sun's envelope

8. The "Crab" Nebula is an example of a
(a) planetary nebula
(b) dark nebula
(c) pulsar
(d) supernova remnant
(e) nearby galaxy

9. Protostars are known to be bright objects in the infrared part of the spectrum. What is the source of energy in the protostar as it collapses?
(a) hydrogen to helium fusion
(b) helium to carbon fusion
(c) combustion
(d) release of gravitational energy
(e) convection

10. Where on an H-R diagram would a protostar be located?
(a) below and to left of the main sequence
(b) above and to the right of the main sequence
(c) in the upper left corner, along the main sequence
(d) in the right corner, below the main sequence
(e) at the position of the Sun

11. Which of the following is evidence that ***convection*** occurs on the solar surface?
(a) the presence of sunspots on the photosphere
(b) the Van Allen Radiation Belts
(c) the Corona has a temperature of 2 million K
(d) the Sun has limb brightening at the edge of the photosphere
(e) the presence of granulation on the solar photosphere

12. The *planets* in our solar system formed out of
(a) the gas, rock and ice "debris" in the protostar's disk
(b) a supermassive black hole
(c) the gas in a giant molecular cloud
(d) a planetary nebula
(e) a brown dwarf star

13. Which of the following lists the sizes (i.e., radius) of the three stellar corpses in order of ***decreasing size***?
(a) black hole, neutron star, white dwarf
(b) black hole, white dwarf, neutron star
(c) red giant, white dwarf, brown dwarf
(d) white dwarf, neutron star, black hole
(e) neutron star, black hole, white dwarf

For questions 14-18, use the choices to best match the statements below.
Note: choices (a) – (c) may be used more than once and/or not at all.

14. Star that has the longest main sequence lifetime. **(c)**
15. Star that has the shortest main sequence lifetime. **(a)**
16. Star that has a surface temperature of ~6000 K. **(b)**
17. The coolest main sequence star. **(c)**
18. The star that will become a neutron star. **(a)**

(a) 10 solar mass star
(b) 1 solar mass star
(c) 0.5 solar mass star

19. Why do sunspots on the solar surface appear dark?
(a) it is an optical illusion – they are really the same brightness as the solar surface
(b) they are hotter regions than the surrounding bright solar surface
(c) they are located deeper within the Sun than the bright solar surface
(d) they are cooler regions than the surrounding bright solar surface
(e) they are highly magnetized and therefore appear dark

20. *Approximately* how much **longer** is the Sun expected to burn hydrogen into helium?
(a) another 5 years
(b) another 50,000 years
(c) another 5 billion years
(d) another 10 billion years
(e) there is not enough information to figure this out

21. What "radiates" in the Van Allen Radiation Belts?
(a) photons from the solar wind that are trapped
(b) charged particles (cosmic rays) from the solar wind that are trapped
(c) the Earth's atmosphere
(d) vibrating molecules that are trapped by these belts
(e) iron atoms

22. When an object becomes a black hole
(a) it sucks all matter toward it.
(b) it collapses to such a small size that no light can escape from it.
(c) it fuses hydrogen into helium until it has used up all matter.
(d) all matter is destroyed.
(e) it becomes theoretical.

23. On an H-R diagram, stars in the upper left hand corner are
(a) hot and dim
(b) cool and luminous
(c) hot and luminous
(d) cool and dim
(e) protostars

24. Which telescope would you use to detect the pulsed signature of a pulsar?
(a) Chandra X-ray Observatory
(b) Spitzer Infrared Space Observatory
(c) The Arecibo Radio Telescope in Puerto Rico
(d) Keck Optical Observatory in Hawaii
(e) University of Iowa's Rigel Robotic Telescope

25. The Main Sequence is an astronomical term for
(a) the phase of a star's life before it begins to produce its own energy
(b) a sequence of events that happen to a star after it has exhausted its nuclear fuel
(c) a region in the upper right hand part of the H-R diagram
(d) the phase in a star's life when it fuses hydrogen to helium in its core
(e) the physical relationship between the flux of a star and its luminosity