Name: __________________________

Astronomy - Chapter 7 - The Sun

1. Does the Sun have a solid surface?
   A. Yes, it does: the solid surface is hidden below the visible "surface," where the pressure is higher.
   B. No, it does not: the Sun is entirely a gas, from its surface right to its center.
   C. Yes, it does: we are looking at a solid surface when we study the Sun in visible light.

2. We see more deeply into the Sun at its center than at its limb because of interaction between the light and atoms of the gas. What conclusion can be reached therefore if the Sun appears less bright at its limb than at the center?
   A. Temperature decreases with increasing height in the solar photosphere.
   B. Light from the limbs is reddened by solar rotation and appears cooler and therefore less intense.
   C. Temperature increases with increasing height in the solar photosphere.

3. The photosphere of the Sun is the:
   A. visible surface of the Sun, where granules and sunspots are found.
   B. high-temperature part of the Sun's atmosphere from which the solar wind is ejected into space.
   C. layer above the visible surface, where spicules carry gas upward.

4. Where will spicules be found on the Sun?
   A. uniformly all over the Sun, over the dark regions of the granular structure in the photosphere
   B. only over sunspots, held in place by magnetic fields
   C. mostly along the edges of supergranular cells in the chromosphere

5. One interesting and somewhat unexpected characteristic of the solar corona is its:
   A. spectrum, consisting of line emissions from hydrogen, dominated by the red Balmer line.
   B. very low temperature, less than the Earth’s surface temperature. This is surprising, in view of its proximity to a hot radiating body, the Sun.
   C. extremely high temperature, greater than 1,000,000 K.

6. The number of sunspots on the Sun:
   A. varies with a precise period of 11.1 years, being governed by predictable physical processes.
   B. varies with a cycle of approximately 11 years.
   C. does not vary much from year to year, the Sun being a very stable star.
7. The continuous spectrum (i.e., the blackbody portion of the spectrum) of a sunspot, compared to that of the quiet solar surface, appears:

- exactly the same, since it is originating from the same solar material, mostly hydrogen.
- somewhat more blue.
- somewhat redder.

8. If the material at the Sun's equator is seen to rotate about the Sun's axis with a period of 25 days, what is the equivalent period of rotation for the solar polar regions?

- about 18 days, since this surface is closer to the solar spin axis
- about 35 days, much longer than that of the equator
C

9. If the magnetic polarity of the northern region of the Sun was north in A.D. 2000, in which of the following years would it be south?

- A. any time, because the polarity of the Sun's overall magnetic field is always changing
- B. A.D. 2011
- C. A.D. 2022

10. Which of the following statements is a CORRECT description of sunspots on the Sun?

- A. Their number varies over a period of about 11 years, but there can be periods of several decades at a time during which no or almost no sunspots are seen on the Sun.
- B. Sunspots generally form closer to the Sun's equator early in a solar cycle, then farther from the equator as the cycle progresses.
- C. Sunspots near the Sun's equator take longer to rotate about the Sun's rotation axis than do sunspots farther from the equator.

11. Although the interior of the Sun cannot be viewed directly by visible radiation, astronomers are able to explore this region by studying:

- A. neutrons that are produced in nuclear reactions in the deep interior and are able to escape from the solar plasma because they are electrically neutral.
- B. surface oscillations that are generated by sound waves passing through the solar interior.
- C. highly penetrating γ (gamma) rays that are emitted by nuclei in the deep solar interior.
12. The one physical parameter that transforms a region of quiet solar surface into an active and violent region is an increase in:
   A. the temperature of the gas.
   B. the intensity of the magnetic field.
   C. violent turbulence or convection.

13. A giant loop of gas arching out from the visible edge of the Sun is called a:
   A. spicule.
   B. prominence.
   C. coronal hole.

14. The solar wind appears to originate primarily:
   A. in coronal holes, which are low-density, low-temperature regions on the high atmosphere of the Sun.
   B. in the bright, dense, and high-temperature streamers of the corona.
   C. over active regions in which sunspots are embedded.

15. Which of the following is NOT a consequence of coronal mass ejections and other surges of high-energy particles from the Sun striking the Earth?
   A. disruption of power grids
   B. damage to satellites
   C. major tropical storms such as hurricanes and cyclones

16. The energy (such as light and heat) released by the Sun is produced by nuclear reactions in the core of the Sun, which convert hydrogen into helium. According to Einstein’s equation $E = mc^2$, the mass of one helium nucleus should be:
   A. equal to the mass of four hydrogen nuclei, since mass is always conserved in nature.
   B. less than the mass of four hydrogen nuclei.
   C. greater than the mass of four hydrogen nuclei, the extra mass being produced from the energy of the reaction.

17. If radiation normally travels at the speed of light, why does it take longer than 100,000 years for energy from thermonuclear reactions in the solar core to reach the surface of the Sun?
   A. The photons undergo innumerable collisions and interactions as they travel from atom to atom.
   B. Photons bounce back and forth within the Sun, continually reflecting from the underside of the photosphere.
   C. The extremely high density of the gas in the core slows down the light, much as glass or water slows light.
18. Which of the following three modes of thermal-energy transport is NOT effective in the solar interior?
   A. radiation  
   B. convection  
   C. conduction

19. What is a neutrino?
   A. an uncharged subatomic particle with no or almost no mass, and with the ability to pass right through the Sun and the Earth without stopping  
   B. a positively charged subatomic particle with the same mass as an electron  
   C. an uncharged subatomic particle with approximately the same mass as a proton, and often found along with protons in atomic nuclei

20. When the number of neutrinos reaching the Earth from the Sun was first measured, it was only about a third of the number predicted theoretically. How has this discrepancy been resolved?
   A. The solar interior is cooler than originally predicted, so fewer neutrinos are produced.  
   B. Most neutrinos are absorbed in the solar interior before they leave the Sun.  
   C. Neutrinos can change "flavor" as they travel from the Sun to the Earth.