

Name: (Answer Key)

Directions: Listed below are twenty (20) multiple-choice questions based on the material covered by the lectures thus far. Choose the correct response from those listed, **along with at least a one (1) sentence justification for your answer**. Alternate justification techniques include math calculations and labeled sketches. Each question is worth 5 points: 2 for the letter response and 3 for the justification. Collaboration with your peers is permitted, but all justifications must be in your own words. If you are unsure about a question, make an educated guess, and justify your guess (which can include why you can rule out certain choices from the list). If you get stuck, **please seek assistance from your peers, the TA, or the professor**. Note: It may be helpful to place your answers on a separate sheet of paper and staple it to this assignment sheet.

WARNING: Please **DO NOT** copy material word for word from sources such as textbooks, a peer's notes, online references (i.e. Google or Wikipedia), etc in any responses to homework, quiz, or exam questions. Ideas should be expressed in your own words. Not only does this protect you from illegal acts of plagiarism and/or accusations of cheating, but it also aids your future studying by having ideas expressed in a way that you, personally, can best understand. If for some reason you **MUST** quote text from a source in your answer, properly reference your quote.

1. Thermonuclear fusion reactions in the core of the Sun convert four hydrogen nuclei into one helium nucleus. The helium nucleus has
 - A) less mass than the four hydrogen nuclei.
 - B) the same mass as the four hydrogen nuclei.
 - C) an undetermined amount of mass that depends on the temperature at which the reaction occurs.
 - D) more mass than the four hydrogen nuclei.
2. By how much does the mass of the Sun decrease each second because of the energy it radiates (its luminosity)? (See the discussion in Box 18-1 of Freedman and Kaufmann, *Universe*, 7th ed.)
 - A) 4.2×10^9 kg
 - B) 3.9×10^{26} kg
 - C) 2.0×10^7 kg
 - D) 6.0×10^{11} kg
3. Hydrogen "burning" by fusion reactions occurs only in the deep interior of the Sun (and other stars), because this is the only place in the Sun where
 - A) there is sufficient hydrogen.
 - B) the density is sufficiently low for the high temperature atoms to build up enough energy to collide and undergo fusion.
 - C) the temperature is low enough and the density is high enough to allow hydrogen atoms to collide with each other often enough for fusion to occur.
 - D) the requisite conditions of high temperature and high density occur.
4. What happens to the positrons produced by the nuclear reactions in the core of the Sun?
 - A) They collide with electrons, producing energy.
 - B) They collide and stick together to form helium.
 - C) They combine with neutrons to form protons.
 - D) They escape from the Sun into space.

5. The Sun has existed for a very long time without large changes in its size, appearance, or behavior. This means that it must be in hydrostatic equilibrium. Under these conditions, which two parameters must be in exact balance within the Sun?
- A) numbers of hydrogen and helium nuclei
 - B) hydrogen gas pressure and helium gas pressure
 - C) inward force of gravity and outward gas pressure
 - D) magnetic field and force of gravity
6. Which of the three ways by which heat energy can be transmitted from one place to another—radiation, conduction, convection—is important in the solar interior below the surface of the Sun?
- A) radiation and convection
 - B) conduction and radiation
 - C) conduction and convection
 - D) radiation alone, by photons of energy
7. Where is most of the mass of the Sun concentrated?
- A) It is spread uniformly through the Sun.
 - B) in the inner core
 - C) in the photosphere
 - D) in the convective zone
8. What happens to the neutrinos produced by the nuclear reactions in the core of the Sun?
- A) They collide and stick together with protons to form helium nuclei.
 - B) They escape from the Sun into space.
 - C) They combine with protons to form neutrons.
 - D) They collide with electrons, producing energy.
9. What causes the granular appearance of the surface of the Sun?
- A) the regular impact of meteoroids and comets on the solar surface
 - B) differential rotation of the surface layers
 - C) thermonuclear fusion in its interior
 - D) convective motion under the solar surface
10. The centers of the granular cells on the surface of the Sun are brighter than the edges of the cells because
- A) the centers are composed of different gases than the edges.
 - B) the centers are hotter than the edges.
 - C) the centers are denser than the edges.
 - D) the centers are cooler than the edges.
11. What is the solar wind?
- A) the storm of waves and vortices on the Sun's surface generated by a solar flare
 - B) the constant flux of photons from the Sun's visible surface
 - C) the circulation of gases between the equator and the poles of the Sun
 - D) the Sun's outer atmosphere streaming out into space

12. Sunspots are
- A) cooler regions of the Sun's high corona.
 - B) the shadows of cool, dark curtains of matter, hanging above the solar surface.
 - C) cooler, darker regions on the Sun's surface.
 - D) hotter, deeper regions in the Sun's atmosphere.
13. What specific physical effect was used to verify the existence of intense magnetic fields in sunspots?
- A) observation of ionized atoms in the region of the sunspots
 - B) the Zeeman effect, the splitting of spectral absorption lines
 - C) the measurement of relative strengths of spectral absorption lines from various atoms
 - D) Doppler shift of light from sunspots
14. The intensity of sunlight that reaches Jupiter (orbiting at about 5 AU) is approximately what fraction of that at Earth's orbital distance? (See the discussion of the inverse square law in Chapter 19, Freedman and Kaufmann, *Universe*, 7th ed.)
- A) 1/25
 - B) the same
 - C) 1/100
 - D) 1/5
15. As you drive along a road, trees in the middle distance seem to shift in position relative to faraway hills. What name is given to this phenomenon?
- A) Doppler effect
 - B) inverse-square law
 - C) perspective
 - D) parallax
16. If stellar parallax can be measured to a precision of about 0.01 arcsec using telescopes on the Earth to observe stars, to what distance does this correspond in space?
- A) 500 pc
 - B) 200 pc
 - C) 100 pc
 - D) 0.01 pc
17. If a nearby star is 6.52 ly from Earth, what would be its measured parallax? (Hint: Remember to use the proper units.)
- A) 0.15 arcsec
 - B) 0.50 arcsec
 - C) 0.31 arcsec
 - D) 1.00 arcsec
18. The star Procyon has a parallax of 0.287 arcsec and a proper motion (true motion across the sky) of 1.25 arcsec per year. What is the tangential velocity of Procyon? (Use sketches and calculations as needed.)
- A) 68 km/s
 - B) 21 km/s
 - C) 1.7 km/s
 - D) 16 km/s

19. Suppose that two identical stars (having the same total light output or luminosity) are located such that star A is at a distance of 5 pc and star B is at a distance of 25 pc. How will star B appear, compared to star A?
- A) 1/2.2 as bright
 - B) 1/25 as bright
 - C) 1/20 as bright
 - D) 1/5 as bright
20. Two stars in our sky have the same apparent brightness. If neither of them is hidden behind gas or dust clouds, then we know that they
- A) may be at different distances, in which case the nearest one must have the greater luminosity.
 - B) may be at different distances, in which case the farther one must have the greater luminosity.
 - C) must have the same temperature.
 - D) must be at the same distance away from us.

Answer Key

1. A
2. A
3. D
4. A
5. C
6. A
7. B
8. B
9. D
10. B
11. D
12. C
13. B
14. A
15. D
16. C
17. B
18. B
19. B
20. B