**Atoms and Starlight**

**Multiple Choice**

*Identify the letter of the choice that best completes the statement or answers the question.*

\_\_\_\_ 1. Absolute zero is

|  |  |
| --- | --- |
| a. | zero degrees Celsius. |
| b. | the temperature at which atoms have no remaining energy from which we can extract heat. |
| c. | the temperature at which water freezes. |
| d. | both a and c |
| e. | none of the above |

\_\_\_\_ 2. The neutral hydrogen atom consists of

|  |  |
| --- | --- |
| a. | one proton and one neutron. |
| b. | one proton. |
| c. | one proton, one neutron, and one electron. |
| d. | one proton and one electron. |
| e. | an isotope and an ion. |

\_\_\_\_ 3. The process of removing an electron from a stable nucleus is known as

|  |  |
| --- | --- |
| a. | ionization. |
| b. | Doppler broadening. |
| c. | collisional broadening. |
| d. | a red shift. |
| e. | quantum mechanics. |

\_\_\_\_ 4. The lowest energy level in an atom is

|  |  |
| --- | --- |
| a. | the absolute zero temperature. |
| b. | the ground state. |
| c. | the ionization level. |
| d. | responsible for Doppler shifts. |
| e. | the energy level from which the Paschen Series of hydrogen originates. |

\_\_\_\_ 5. A plot of the continuous spectra of five different stars are shown in the figure below. Based on these spectra, which of the stars is the hottest?



|  |  |
| --- | --- |
| a. | Star A |
| b. | Star B |
| c. | Star C |
| d. | Star D |
| e. | Star E |

\_\_\_\_ 6. An atom that is excited

|  |  |
| --- | --- |
| a. | is also ionized. |
| b. | is an isotope. |
| c. | has had its electron moved to the lowest energy level. |
| d. | can emit a photon when the electron moves to a lower energy level. |
| e. | can emit a photon when the electron moves to a higher energy level. |

\_\_\_\_ 7. The table below lists the color index for each of several stars. Which star in this table would have the lowest temperature?

|  |  |
| --- | --- |
| Star Name | Color Index |
|  Boo | +1.23 |
|  Peg | -0.23 |
|  Leo | +0.08 |
|  Leo | -0.11 |
|  Peg | +1.57 |

|  |  |
| --- | --- |
| a. |  Boo |
| b. |  Peg |
| c. |  Leo |
| d. |  Leo |
| e. |  Peg |

\_\_\_\_ 8. The table below lists the color index for each of several stars. Which star in this table would be the hottest?

|  |  |
| --- | --- |
| Star Name | Color Index |
|  Boo | +1.23 |
|  Peg | -0.23 |
|  Leo | +0.08 |
|  Leo | -0.11 |
|  Peg | +1.57 |

|  |  |
| --- | --- |
| a. |  Boo |
| b. |  Peg |
| c. |  Leo |
| d. |  Leo |
| e. |  Peg |

\_\_\_\_ 9. The table below lists the color index for each of several stars. Which star in this table would be the brightest?

|  |  |
| --- | --- |
| **Star Name** | **Color Index** |
|  Boo | +1.23 |
|  Peg | -0.23 |
|  Leo | +0.08 |
|  Leo | -0.11 |
|  Peg | +1.57 |

|  |  |
| --- | --- |
| a. |  Boo |
| b. |  Peg |
| c. |  Leo |
| d. |  Leo |
| e. | Color index is not related to brightness. |

\_\_\_\_ 10. A(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ contains two or more atoms that are bound together by sharing electrons with each other.

|  |  |
| --- | --- |
| a. | nucleus |
| b. | ion |
| c. | proton |
| d. | electron cloud |
| e. | molecule |

\_\_\_\_ 11. In the diagram below, which of the transitions would absorb a photon with the smallest energy?



|  |  |
| --- | --- |
| a. | Transition 1 |
| b. | Transition 2 |
| c. | Transition 3 |
| d. | Transition 4 |
| e. | Transition 5 |

\_\_\_\_ 12. In the diagram below, which of the transitions would absorb a photon with the shortest wavelength?



|  |  |
| --- | --- |
| a. | Transition 1 |
| b. | Transition 2 |
| c. | Transition 3 |
| d. | Transition 4 |
| e. | Transition 5 |

\_\_\_\_ 13. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a gas is a measure of the average speed of the particles in the gas.

|  |  |
| --- | --- |
| a. | heat |
| b. | composition |
| c. | temperature |
| d. | blue shift |
| e. | binding energy |

\_\_\_\_ 14. The two most abundant elements in the sun are

|  |  |
| --- | --- |
| a. | nitrogen and oxygen. |
| b. | hydrogen and helium. |
| c. | sulfur and iron. |
| d. | carbon and hydrogen. |
| e. | carbon and nitrogen. |

\_\_\_\_ 15. You are standing near a railroad track and a train is moving toward you at 60 mph and blowing his horn. What will you notice as the train moves past you.

|  |  |
| --- | --- |
| a. | As the train approaches, the horn will sound lower in pitch than when it is moving away. |
| b. | As the train approaches, the horn will sound higher in pitch than when it is moving away. |
| c. | There will be no change in the pitch of the horn as it moves by. |
| d. | The horn will get louder as the train moves away from me. |
| e. | The horn will get quieter as the train moves toward me |

\_\_\_\_ 16. The spectra of two stars indicate that they are of the same spectral type. However, Star A has a very broad line profile for the H line while Star B has a very narrow line profile for H. What might this tell us about the two stars.

|  |  |
| --- | --- |
| a. | Star A is hotter than star B. |
| b. | Star B is hotter than star A. |
| c. | Star A has a higher density than Star B. |
| d. | Star B is moving away from us faster than Star A. |
| e. | Star A is moving away from us faster than Star B. |

\_\_\_\_ 17. Which of the following can be determined by using the Doppler effect?

|  |  |
| --- | --- |
| I. | The speed at which a star is moving away from an observer. |
| II. | The transverse velocity of a star. |
| III. | The radial velocity of a star. |
| IV. | The speed at which a car is traveling toward an observer. |

|  |  |
| --- | --- |
| a. | I & IV |
| b. | II & III |
| c. | II & IV |
| d. | I & III |
| e. | I, III, & IV |

\_\_\_\_ 18. The diagram below illustrates a light source, a gas cloud, and three different lines of sight. Along which line of sight would an observer see an emission spectrum?



|  |  |
| --- | --- |
| a. | 1 |
| b. | 2 |
| c. | 3 |
| d. | 2 and 3 |
| e. | none of them |

\_\_\_\_ 19. The table below lists the spectral types for each of five stars. Which star in this table would have the lowest temperature?

|  |  |
| --- | --- |
| **Star Name** | **Spectral Type** |
| For | F8 |
|  Cet | M7 |
| 35 Ari | B3 |
|  Tri | A0 |
|  Per | O7 |

|  |  |
| --- | --- |
| a. |  For |
| b. |  Cet |
| c. | 35 Ari |
| d. |  Tri |
| e. |  Per |

\_\_\_\_ 20. The table below lists the spectral types for each of five stars. Which star in this table would have the highest temperature?

|  |  |
| --- | --- |
| **Star Name** | **Spectral Type** |
| For | F8 |
|  Cet | M7 |
| 35 Ari | B3 |
|  Tri | A0 |
|  Per | O7 |

|  |  |
| --- | --- |
| a. |  For |
| b. |  Cet |
| c. | 35 Ari |
| d. |  Tri |
| e. |  Per |

\_\_\_\_ 21. The table below lists the spectral types for each of five stars. Which star in this table would have the have the strongest hydrogen lines?

|  |  |
| --- | --- |
| **Star Name** | **Spectral Type** |
| For | F8 |
|  Cet | M7 |
| 35 Ari | B3 |
|  Tri | A0 |
|  Per | O7 |

|  |  |
| --- | --- |
| a. |  For |
| b. |  Cet |
| c. | 35 Ari |
| d. |  Tri |
| e. |  Per |

\_\_\_\_ 22. Why don't we see hydrogen Balmer lines in the spectra of stars with temperatures of 3200 K?

|  |  |
| --- | --- |
| a. | There is no hydrogen in stars this cool. |
| b. | The stars are hot enough that most of the hydrogen is ionized and the atoms cannot absorb energy. |
| c. | These stars are so cool that nearly all of the electrons in the hydrogen atom are in the ground state. |
| d. | Stars of this temperature are too cool to produce an absorption spectrum. |
| e. | Stars of this temperature are too hot to produce an absorption spectrum. |

\_\_\_\_ 23. The absorption lines in the visible portion of the spectrum of a star that are produced by hydrogen are from the

|  |  |
| --- | --- |
| a. | Lyman series. |
| b. | Balmer series. |
| c. | Paschen series. |
| d. | isotopes of hydrogen. |
| e. | ions of hydrogen. |

\_\_\_\_ 24. The radiation emitted from a star has a maximum intensity at a wavelength of 300 nm. What is the temperature of this star?

|  |  |
| --- | --- |
| a. | 300 K |
| b. | 100 K |
| c. | 900,000,000 K |
| d. | 90,000 K |
| e. | 10,000 K |

\_\_\_\_ 25. The radiation emitted from a star has a maximum intensity at a wavelength of 500 nm. What is the temperature of this star?

|  |  |
| --- | --- |
| a. | 6,000 K |
| b. | 5,000 K |
| c. | 1.5109 K |
| d. | 500 K |
| e. | 10,000 K |

\_\_\_\_ 26. At what wavelength would a star radiate the greatest amount of energy if the star has a surface temperature of 60,000 K?

|  |  |
| --- | --- |
| a. | 50 nm |
| b. | 500 nm |
| c. | 300 nm |
| d. | 1.81011 nm |
| e. | 180 nm |

\_\_\_\_ 27. At what wavelength would a star radiate the greatest amount of energy if the star has a surface temperature of 10,000 K?

|  |  |
| --- | --- |
| a. | 10 nm |
| b. | 100 nm |
| c. | 300 nm |
| d. | 1.0104 nm |
| e. | 3.01010 nm |

\_\_\_\_ 28. The sun has a surface temperature of approximately 5,800 K. At what wavelength does the maximum energy radiated by the sun occur?

|  |  |
| --- | --- |
| a. | 5,800 nm |
| b. | 300 nm |
| c. | 174 nm |
| d. | 520 nm |
| e. | 3,000 nm |

\_\_\_\_ 29. One star has a temperature of 10,000 K and another star has a temperature of 5000 K Compared to the cooler star, how much more energy per second will the hotter star radiate from each square meter of its surface?

|  |  |
| --- | --- |
| a. | 16 times |
| b. | 2 times |
| c. | 11016 times |
| d. | 625 times |
| e. | 6.31014 times |

\_\_\_\_ 30. If  in the Stefan-Boltzmann law is equal to , how much energy is radiated each second by one square meter of a star whose temperature is 10,000 °K?

|  |  |
| --- | --- |
| a. | 5.6710-12 J |
| b. | 5.6710-8 J |
| c. | 5.6710-4 J |
| d. | 300 nm |
| e. | 300,000,000 nm |

\_\_\_\_ 31. The H line has a wavelength of 434.0 nm when observed in the laboratory. If the H line appears in a stars spectrum at 434.5 nm, what is the radial velocity of the star?

|  |  |
| --- | --- |
| a. | 346 km/sec away from the observer. |
| b. | 346 km/sec toward the observer. |
| c. | 1.3108 m/sec away from the observer. |
| d. | 1.3108 m/sec toward the observer. |
| e. | The radial velocity of the star can not be determined from this information. |

\_\_\_\_ 32. The binding energy of the first level in an atom is 2.210-18 J, and the binding energy of the second energy level is 1.610-18 J. What is the energy of the photon that is emitted if an electron moves from the second level to the first?

|  |  |
| --- | --- |
| a. | 3.310-18 J |
| b. | 3.510-36 J |
| c. | 1.4 J |
| d. | 3.510-18 J |
| e. | 6.010-19 J |

**True/False**

*Indicate whether the sentence or statement is true or false.*

\_\_\_\_ 33. The nucleus of the hydrogen atom consists of a single neutron.

\_\_\_\_ 34. Blue stars are hotter than red stars.

\_\_\_\_ 35. Isotopes of the same element have the same number of protons.

\_\_\_\_ 36. Hydrogen alpha is the longest wavelength Balmer line.

\_\_\_\_ 37. An absorption spectrum is also called a bright line spectrum.

\_\_\_\_ 38. Stars of spectra type K have strong Balmer lines.

\_\_\_\_ 39. The Doppler effect is sensitive only to motion along the line of sight.

\_\_\_\_ 40. An atom that has lost an electron is called an ion.

\_\_\_\_ 41. The Lyman series lines of hydrogen all lie in the infrared.

\_\_\_\_ 42. Hydrogen lines are weak in the spectra of hot stars because many of the hydrogen atoms have their electrons in levels above the second level.

**Answer Section**

**MULTIPLE CHOICE**

 1. ANS: B

 2. ANS: D

 3. ANS: A

 4. ANS: B

 5. ANS: A

 6. ANS: D

 7. ANS: E

 8. ANS: B

 9. ANS: E

 10. ANS: E

 11. ANS: E

 12. ANS: D

 13. ANS: C

 14. ANS: B

 15. ANS: B

 16. ANS: C

 17. ANS: E

 18. ANS: B

 19. ANS: B

 20. ANS: E

 21. ANS: D

 22. ANS: C

 23. ANS: B

 24. ANS: E

 25. ANS: A

 26. ANS: A

 27. ANS: C

 28. ANS: D

 29. ANS: A

 30. ANS: C

 31. ANS: A

 32. ANS: E

**TRUE/FALSE**

 33. ANS: F

 34. ANS: T

 35. ANS: T

 36. ANS: T

 37. ANS: F

 38. ANS: F

 39. ANS: T

 40. ANS: T

 41. ANS: F

 42. ANS: T