Astronomy—All Questions

Hertzsprung-Russell Diagram/Stellar Birth/Stars in General/Low Mass Stars

Instructions: This Quest is in the form of multiple-choice questions and a few fill-in the blanks. Written responses must be spelled correctly. After reading each question carefully, select your answer or answers. **If the question calls for multiple answers, two or more, you must provide all correct answers.** Because of this, I will give you two attempts to take the test. Consider this open book. All answers can be found in Crash Course Astronomy, the lecture materials created for class which includes vocabulary, the assigned exercises, and the PowerPoint presentations; but if you feel the need to consult online sources, books, or magazines, please feel free to do so. This Quest has a total value of 30 points. **MUCH SUCCESS!!!**

1. When you divide the incoming light from an object into individual colors or wavelengths, the resulting phenomenon is called _____
   a. an H-R diagram.
   b. a spectrum.
   c. a color wheel.
   d. a single line spectrum.
   e. a spectrometer.

2. A star emits light in all colors of the visible spectrum and in all wavelengths of the rest of the electromagnetic spectrum. In the visible colors that we see is called a (an) _____
   a. continuous spectrum.
   b. continuous HR spectrum.
   c. extended continuous spectrum.
   d. continuous spectrometer.
   e. absorption spectrum.

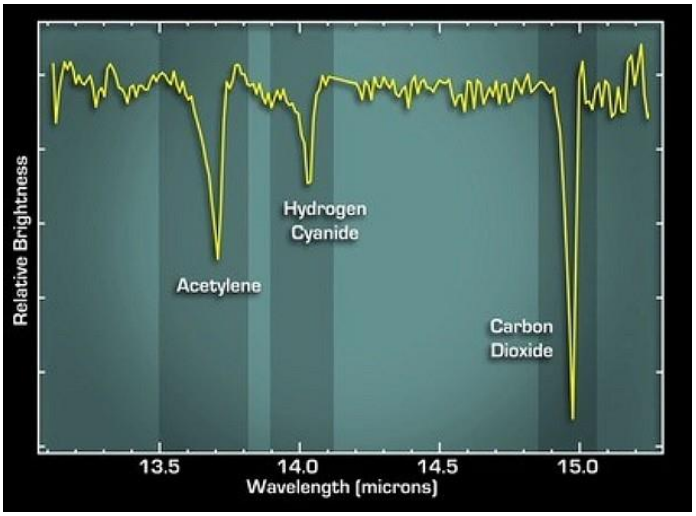
3. Max Planck, the German physicist (1858-1947) showed that there was a relationship between the frequency of electromagnetic radiation and its energy. Which parts of the electromagnetic spectrum are <u>totally</u> friendly to humans? Two correct answers must be provided for credit.
   a. gamma rays.
   b. radio waves.
   c. microwaves.
   d. infrared radiation.
   e. visible light.
   f. X-rays.
   g. ultraviolet light.

4. Hotter stars output more light in the _____ end of the visible spectrum, and hence, look this color when observed in the nighttime sky.
   a. red
   b. yellow
   c. green
   d. blue
   e. violet

5. Cooler stars produce more energy in the _____ part of the spectrum, and hence, look this color when observed in the sky at night.
   a. red.
   b. yellow.
   c. green.
   d. blue.
   e. violet.

6. The continuous spectrum of a star has gaps in it, darker bands where different elements _____.
   a. absorb specific wavelengths of light.
   b. reflect specific frequencies of light.
   c. emit specific colors of light.
   d. refract different colors of light into a rainbow.
   e. deflect different colors of light.

7. The continuous spectrum created by stars shines through their own gases. Those gases absorb the energy from the specific (unique) transitions created by their electrons jumping from lower to higher energy levels to produce a unique fingerprint of the elements or compounds that the star possesses. This type of spectrum is called a (an) _____.



   a. emission spectrum.
   b. color wheel spectrum.
   c. luminosity spectrum.
   d. fractured spectrum.
   e. absorption spectrum.
   f. absorption H-R spectrum.

8. This type of spectrum listed in the last problem was the key to understanding a star's _____ and _____ Two answers here, and both must be correct for credit.
   a. temperature.
   b. luminosity.
   c. mass.
   d. composition.
   e. abundance of hydrogen the star contained.

9. In the classification of stars, O-B-A-F-G-K-M we are looking at a (an) _____. Two answers must be provided for credit.
   a. temperature sequence with the hottest the O stars and the coolest luminaries the M stars.
   b. luminosity sequence with the brightest luminaries the O and the faintest the M.
   c. color sequence with the reddest stars being the M and the bluest the O.
   d. unrealistic and very confusing way of classifying stars.

e. classification sequence for stars developed by Harvard astronomer Annie Jump Cannon (1863-1941) in the very early twentieth century.

10. Cecelia Payne-Gaposchkin showed that the line intensity of the absorption spectra of stars depended _____.
    a. upon the fact that she had no dates on Saturday nights which allowed her the time to formulate her groundbreaking work in astronomy. She did eventually marry.
    b. on the star's atmospheric density and elemental composition.
    c. on the star's temperature and elements in their atmospheres.
    d. upon the temperature and luminosity of a star's atmosphere.
    e. upon the age and molecular composition of a star's atmosphere.

11. Stars are overwhelmingly composed of _____ because the electrons of different elements "danced' uniquely at dissimilar temperatures. This was first shown by Harvard astronomers Cecelia Payne-Goposchkin.
    a. hydrogen.
    b. helium.
    c. nitrogen
    d. carbon.
    e. oxygen.

12. Until the 19th century (early 1800s), it was impossible to compare the true brightnesses of the stars with each other because **Two answers** are correct here
    a. The distances to the stars were unknown except for the sun.
    b. The color of the stars, a trait which affects their brightnesses, had not been properly investigated.
    c. The magnitude system had not been properly calibrated.
    d. No parallax measurement of a star had ever been successfully made.
    e. Spectroscopy was only in its infancy.

13. The **basic** stellar classification scheme proposed by Harvard and used today by all astronomers arranges stars by _____
    a. their size, assigning each a number.
    b. their size, assigning each a letter and number.
    c. their temperature, assigning each a number.
    d. their temperature, assigning each a letter.

14. The star with the brightest absolute magnitude in the list is
    a. Venus (G_2 reflected main sequence).
    b. Sirius (A_1 main sequence).
    c. Polaris (F_7 supergiant).
    d. the Sun (G_2 main sequence).
    e. Alpha Centauri (G_2 main sequence).
    f. Vega (A_0 main sequence)

15. In the classification of stars, O-B-A-F-G-K-M, (Oh Becker's Astronomy Field Guide Kills Me), if a star is seen with compounds in it, that star would most likely be a (an) _____ star.
    Hint: The chemical (electrostatic) bonds of the electrons in compounds holding the different elements together are much weaker than the electrostatic (electromagnetic) bonds that hold electrons to the nucleus of atoms. Compounds can be broken apart more

easily by lower temperatures. If you have had a chemistry course, you could call this the ionization potential of the element or the necessary energy to break apart the compound.

a. O
b. B
c. A
d. F
e. G
f. K
g. M

16. The Harvard classification system of stars using absorption spectrums _____.
    a. was based on the relative strength of the hydrogen absorption lines in the spectrums of different stars.
    b. was based on the relative strength of helium in the absorption spectrum of different stars.
    c. was based on the relative line strengths of certain key elements in the absorption spectrums of stars to identify their temperatures.
    d. was based on the color and brightness (luminosity) of the star in the absorption spectrum.

17. The total amount of energy emitted by a star is called its _____.
    a. incandescence.
    b. luminosity.
    c. spectral brightness.
    d. magnitude.
    e. apparent brightness.

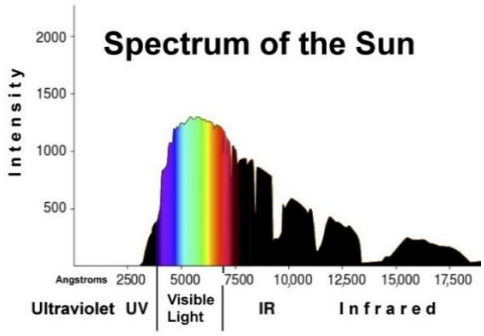
18. The total amount of energy emitted by a star is dependent upon _____.
    a. its surface area and temperature.
    b. its age and density.
    c. its size and distance from us.
    d. luminosity and temperature.
    e. its age and distance from us.

19. Star A is hotter than star B. Star A will
    a. radiate more energy at all wavelengths across its visible and invisible spectrum than star B.
    b. be redder than star B.
    c. will have a peak energy emission at a shorter wavelength than star B.
    d. be less massive than star B.
    e. evolve more slowly than star B.

20. If an electron in a hydrogen atom were to jump from the n = 3 level to the n = 2 level,
    a. the atom will become more excited. **(Three answers here)**
    b. the total energy of the atom would become less.
    c. a specific quanta (amount) of energy would be released.
    d. the atom would return to its ground state.
    e. a photon of light visible to the human eye would be emitted.
    f. the atom would probably be radioactive.

21. According to the Bohr Theory of the atom, when a specific quanta or energy level is absorbed by an electron **(Two answers here)**,
    a. the atom will be said to be in an excited state.
    b. the total energy of the atom will become less.
    c. the electron will jump from a higher energy level to a lower energy level.
    d. the atom will become an ion.
    e. the atom will start to fluoresce or "glow."
    f. the total amount of energy of the atom will become greater.

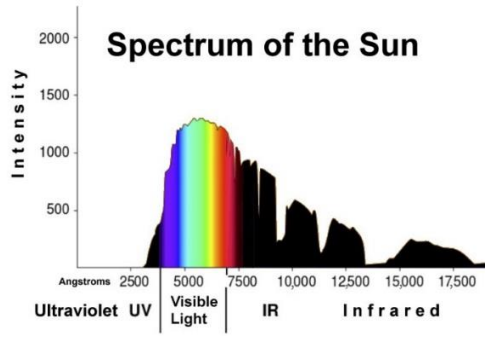
22. If you look at the Sun's spectrum, it actually peaks



    a. in the red.
    b. in the blue.
    c. in the green.
    d. in the yellow.

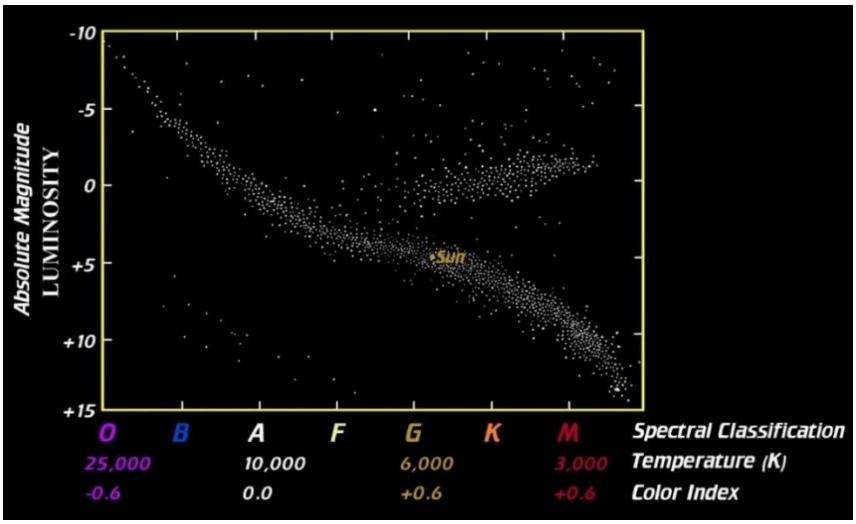
23. The following statements are true. The sun's surface temperature is 5778K. If that number is plugged into Wein's Law, the wavelength of light which the sun most frequently emits is at 5016 Angstroms or 501.6 nanometers. This wavelength is converted into a color that is in the green part of the visible spectrum. Why is the sun not a green star? There are **two correct answers** for this question.
    a. Filters to view the sun selectively block shorter wavelengths of visible light giving the sun a misleading color of yellow to orange in appearance.
    b. The Earth's atmosphere causes the sun to appear yellow or even orange, especially when the sun is high in the sky.
    c. The blackbody radiation curve for the sun puts it pretty much in the middle of the visible spectrum which is the color that we perceive as yellow.
    d. Actually, the presumption is incorrect. All of the colors in the visible part of the spectrum pretty much blend to make the sun appear white in visible light. The sun is really not a yellow star.
    e. None of the above.

24. If a star like our sun emits more green light in its visible spectrum than any other wavelength, we will see the color of that star as appearing _____.



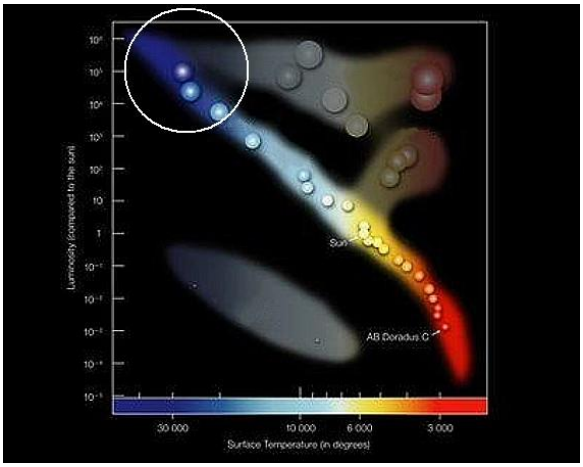
a. green. What a ridiculous statement. Green light dominates in the solar spectrum.
b. white, because basically equal amounts of other colors are on either side. All colors combine to form white.
c. red, because it is the way the sun looks near to the horizon—orange too.
d. blue, because the sky on a clear day is blue indicating the absorption of the other colors by air molecules.
e. yellow, because the blue sky and the green light being emitted by the sun combine to form the color yellow.

25. The plot of a star's (absolute) luminosity verses its temperature is called an _____ diagram (Two words, hyphenated; spelling counts).



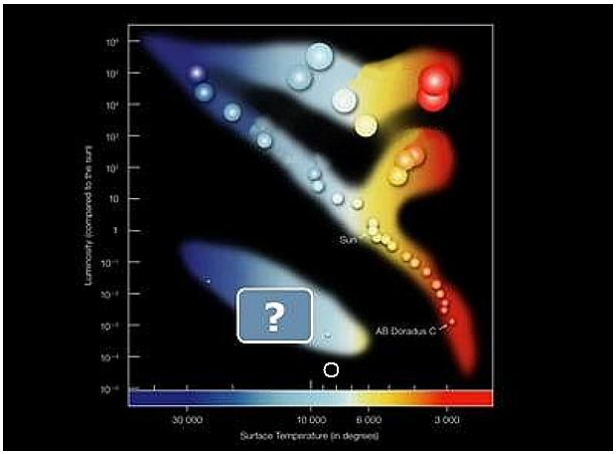
26. The thick line, running diagonally across the H-R diagram, is called _____.
a. the general trend.
b. the main sequence.
c. the main trend.
e. the hydrogen burning cycle.
f. the sliding board.

27. Massive stars positioned along the upper left of an H-R diagram are _____.



a. hotter and more luminous.
b. cooler and more luminous.
c. hotter and less luminous.
d. cooler and less luminous.

28. The stars on the lower left of an HR diagram are hot, blue/white but very faint, and are called _____.



a. white giants.
b. blue giants.
c. white dwarfs.
d. blue dwarfs.
f. black dwarfs.

29. Most stars live the majority of their thermonuclear lives, about 90 percent _____.

a. as white dwarfs changing carbon into neon.
b. along the main sequence fusing hydrogen into helium.
c. as red giants changing carbon into oxygen and neon.
d. as red super giants changing neon into silicon, and iron.

30. Find the **INCORRECT** statement. The Hertzsprung-Russell diagram
    a. can be used to understand the evolution of stars or the age of a star cluster.
    b. shows the relationship of the "sliding board" effect of stellar evolution. New stars begin their lives as high luminosity, high mass objects, rapidly consume their fuel, and gradually over billions of years lose mass and become low luminosity, low mass stars which continue thermonuclear fusion for trillions of years.
    c. shows the evolutionary relationship between main sequence stars, white dwarf stars, and red giant stars.
    d. shows the relationship between the mass of a hydrogen-burning star and its absolute magnitude.
    e. can be interpreted to show how some stars can be huge while other stars must be very small in size.

31. The spectral classification of a star that falls along the main sequence of the Hertzsprung-Russell diagram, **FAILS** to directly tell astronomers which one of the following characteristics about that star.
    a. apparent magnitude
    b. mass
    c. color
    d. temperature
    e. absolute magnitude

32. When a low mass star reaches the final stages of its life as a hydrogen burning star, it wanders away from the diagonal line that bisects the H-R diagram and moves to the right and upwards
    a. becoming more luminous and a cooler red giant or subgiant.
    b. becoming more luminous and hotter, a blue giant.
    c. fading away to become a red dwarf.
    d. fading away to become a white dwarf.

33. A star is a mass of hot, glowing plasma creating its energy through the process of _____. There are two correct answers, and both must be provided.
    a. thermonuclear fusion in its core.
    b. light reflecting off its surface from nearby planets.
    c. the moon.
    d. combustion, the chemical burning of hydrogen and oxygen.
    e. matter being converted into energy.

34. Very roughly speaking, we can divide stars into two basic groups: _____.
    a. low mass stars, and super-giants.
    b. bright stars and dim stars.
    c. dwarfs and giants.
    d. low mass stars, and high mass stars.
    e. stars that are close to the sun and those that are far away from the sun.

35. The dividing line between low mass stars and high mass stars is positioned around _____. **Two answers** are necessary here.
    a. half the mass of the sun.
    b. twice the mass of the sun.
    c. eight to nine times the mass of the sun.
    d. 80-100 times the mass of the sun.
    e. the position where the end of the life of a star is either a neutron star or a black hole.
    f. whether a star will end its life as a supernova or not.

36. During the fusion of hydrogen inside the core of a star, essentially four protons combine into the nucleus of _____ releasing enormous amounts of energy in the process.
    a. four neutrons.
    b. four photons.
    c. one helium atom.
    d. one lithium atom.
    e. two hydrogen atoms.

37. The thermonuclear fusion reaction goes something like this. Put the Proton-Proton nuclear reaction into its correct order.
    A. Two protons (hydrogen nuclei) are put into the mix.
    B. A deuterium nucleus fuses with a proton to become a light isotope of helium (two protons and one neutron). Isotopes have a different number of neutrons in their nucleus over the most common atoms of that element.
    C. Two hydrogen protons fuse to become one proton and one neutron (deuterium).
    D. Two light helium nuclei fuse to become a nucleus of helium.

    Below can be found the possible answers.
    a. A, B, C, D
    b. C, B, A, D
    c. C, B, D, A
    d. A, B, C, D

38. A higher mass star squeezes its plasma (hot gases) creating higher densities, making its core temperatures much higher so that hydrogen _____.
    a. fuses more slowly.
    b. fuses into carbon.
    c. fuses into a deuterium core.
    d. fuses more rapidly.
    e. fuses more rapidly into much heavier elements.
    f. explodes into a supernova event.

39. Considering the Hertzsprung-Russell diagram, a low mass hydrogen burning star compared to a star of higher mass, _____.
    a. the brighter its apparent magnitude will become.
    b. the higher its luminosity will become.
    c. the more evolutionary transitions it will go through before it goes supernova.
    d. the longer that star will live.
    e. the more to the lower left of the main sequence it will be found.

40. A really low mass star found at the lower right of the H-R diagram can keep producing energy for a trillion years or more because _____. There are two correct answers and both must be given to receive full credit.
    a. there is less mass, lower core temperatures, and less rapid hydrogen fusion.
    b. there is a better mixing of hydrogen from all parts of the star with the core. The star can consume all of its hydrogen fuel before it evolves into something else.
    c. because it slowly contracts producing energy as its gases are squeezed and its densities are increased.
    d. because there is incomplete hydrogen fusion and no helium is produced in the core of the star.

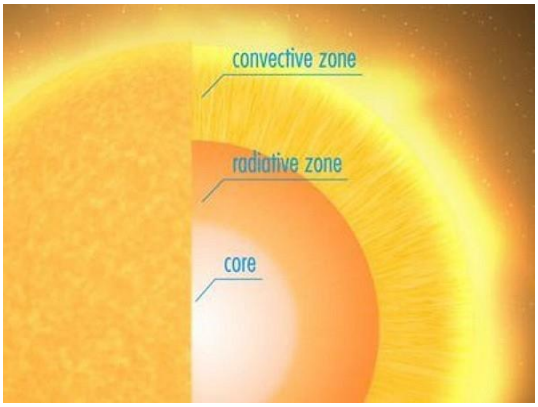
41. When a low mass red dwarf dies, it will be nearly pure _____.
    a. hydrogen.
    b. helium.
    c. lithium.
    c. carbon-oxygen.
    d. deuterium.

42. A shock front is
    a. similar to an earthquake, but occurring under a body of water.
    b. an area of higher density created when faster moving matter collides with slower moving matter.
    c. a necessary requirement for the formation of stars.
    d. your mother's complete disgust when she discovers the recent websites you have been visiting.
    e. is produced by supernovas, OB associations, galaxies colliding, and globular clusters punching through the galactic plane.

43. Which of the following events could realistically **trigger** the formation of a star cluster? You are required to state **Three** answers.
    a. galactic collisions and sideswipes
    b. a supernova explosion
    c. gravity
    d. random movements of matter
    e. another star passing close to our sun.
    f. an OB association like the Orion Nebula

44. Pick the **INCORRECT** answer. When a cluster of stars is formed through some shock front mechanism,
    a. the least massive stars normally form first.
    b. this may occur through galactic collisions or sideswipes.
    c. densities and masses must be sufficiently great in order to allow gravity to collapse the system into a star.
    d. the first stars that form trigger the evolution of other stars.
    e. eventually the light pressure from the formation of the first stars that evolved blow away the remaining gases in the nebula forming another shock front.

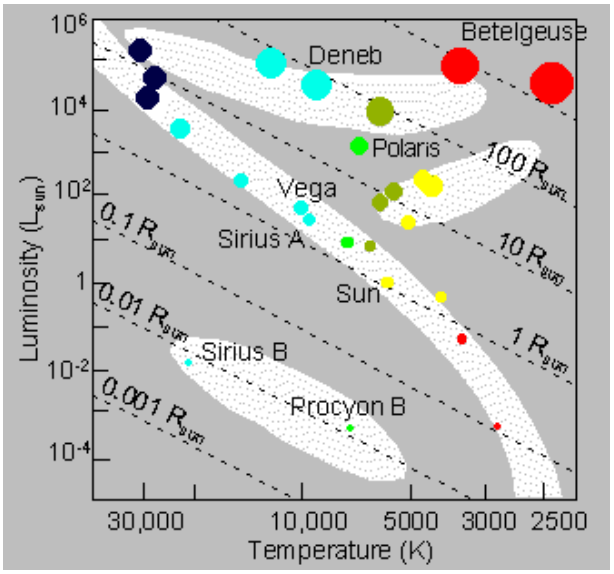
45. With stars like the sun, the hydrogen fusing into helium in the core _____.



a. mixes directly with the convective zone of the star.
b. moves by convection through the radiative zone of the star.
c. stays in the star's core.
d. is transported from the core to the surface by convection similar to low mass stars because the sun is a low mass star.
e. will eventually make it to the surface of the sun right before it becomes a white dwarf.

46. Considering where the sun was at its zero age main sequence position, since it became a star, the sun has increased in luminosity by about _____.
a. 8-10 percent.
b. 30-40 percent.
c. 50-70 percent.
d. 80-100 percent.
e. 400-500 percent.

47. Since the sun came into being it has increased in luminosity. Taking only the information from this last statement, what does this tell us about the development of early life on Earth four billion years ago?
a. The days were shorter because the Earth was rotating much faster.
b. Life had to have developed only recently when conditions were warmer.
c. The earliest forms of life had to be incredibly hardy to survive this period of time.
d. There was no oxygen in the Earth's atmosphere when life first developed.
e. Meteorites were continuously bombarding Earth's surface causing mass extinctions.



INSTRUCTIONS: Make use of this H-R diagram from question 60 through question 72. The same star may be used multiple times.

48. Which of the named stars in the H-R diagram printed above are undergoing core hydrogen burning?

49. Name the stars which are burning helium or heavier elements as fuels?

50. Which one of the named stars listed is closest to death?

51. Which one of the named white dwarf stars might be assumed to be the oldest?

52. Which one of the named stars listed below has the highest absolute luminosity?

53. Which one of the named stars has the lowest luminosity?

54. Which one of the named stars has the highest surface temperature?

55. What condition causes blue stars in the upper left of the H-R diagram to be extremely luminous?

56. What will be the ultimate fate of the three main sequence stars named in the H-R diagram?

57. Was Procyon B ever a main sequence star?

58. Predict the next life stage into which the star Vega will evolve?

59. At 19 solar masses, what will be the ultimate fate of Deneb as a dead star? **Three Answers.**