Crash Course Astronomy—All Questions

Lessons 26/29-30: Stars/Low Mass Stars/
White Dwarfs and Planetary Nebulae

<u>Canvas Instructions</u>: 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. **<u>MUCH SUCCESS</u>!!!**

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.

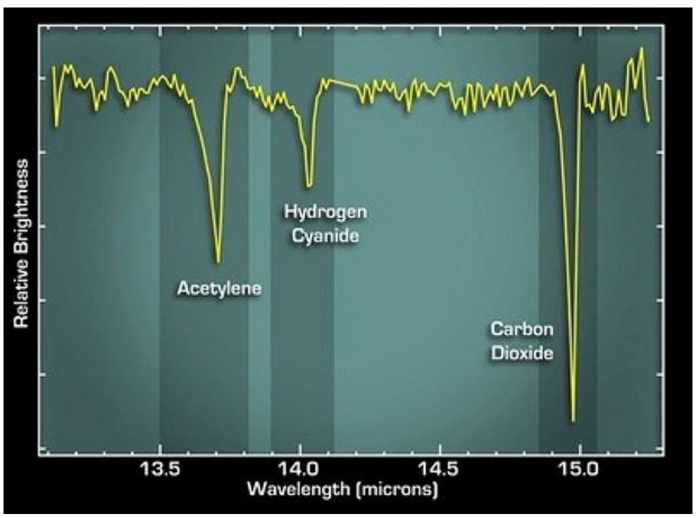
3. Max Planck, the German physicist (1858-1947) showed that there was a relationship between the frequency of electromagnetic radiation and its energy. Which parts of the electromagnetic spectrum are <u>totally</u> friendly to humans? Two correct answers must be provided for credit.
   a. gamma rays.
   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. Payne-Goposchkin also proved that stars were overwhelmingly composed of ______________ because the electrons of different elements "danced' uniquely at dissimilar temperatures.
    a. hydrogen.
    b. helium.
    c. carbon.
    d. oxygen.

12. The **basic** stellar classification scheme used today by astronomers today 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.

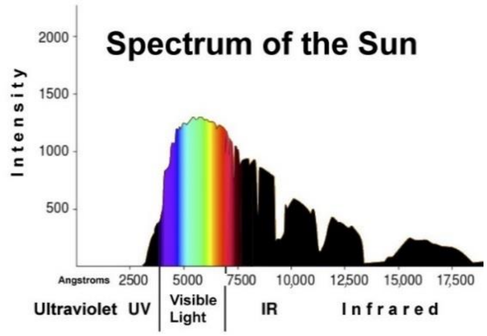
13. In the classification of stars, O-B-A-F-G-K-M, (Oh Becker's Astronomy Field Guide Kills Me), if a star is seen with compounds in it, that star would most likely be a (an) _______________ star.
    Hint: The chemical (electrostatic) bonds of the electrons in compounds holding the different elements 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

14. 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.

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

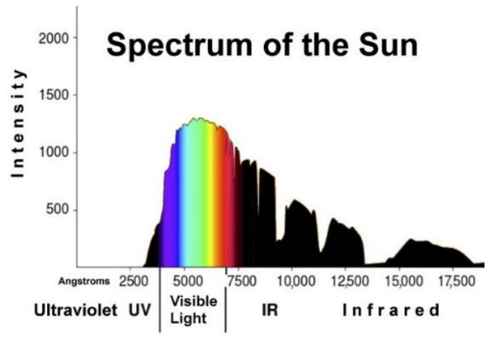
16. The total amount of energy emitted by a star is dependent upon _______________.
    a. its surface area and temperature.
    b. its age and density.
    c. its size and distance from us.
    d. luminosity and temperature.
    e. its age and distance from us.

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



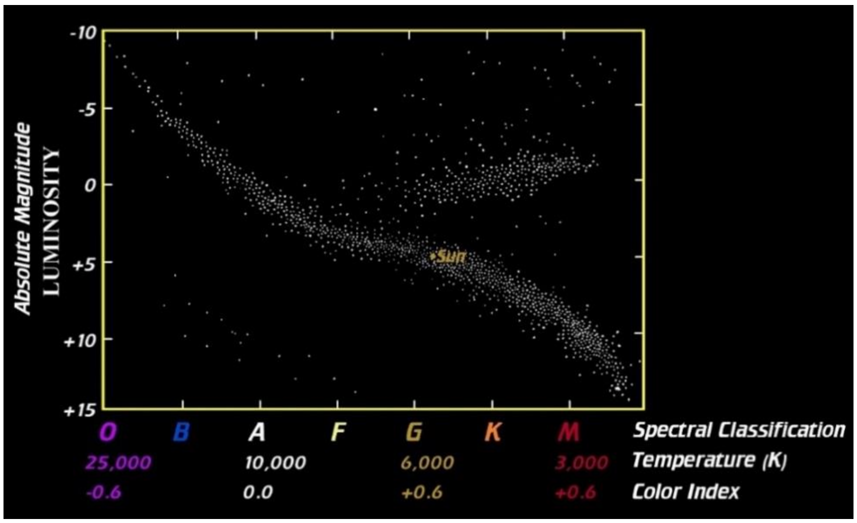
    a. in the red.
    b. in the blue.
    c. in the green.
    d. in the yellow.

18. 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 _______________.



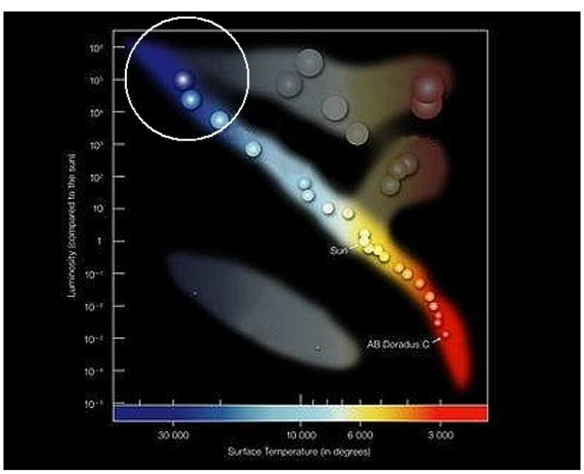
a. green. What a ridiculous statement. Green light dominates in the solar spectrum.
b. white, because basically equal amounts of other colors are on either side. All colors combine to form white.
c. red, because it is the way the sun looks near to the horizon—orange too.
d. blue, because the sky on a 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.

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



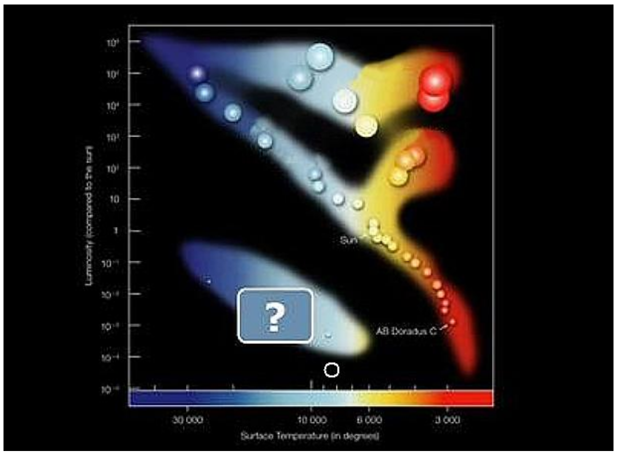
20. The thick line, running diagonally across the H-R diagram, is called ______________.
a. the general trend.
b. the main sequence.
c. the main trend.
e. the hydrogen burining cycle.
f. the sliding board.

21. 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.

22. 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.

23. 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.

24. 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.

25. 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.

26. 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.

27. The dividing line between low mass stars and high mass stars is positioned around ______________.
    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.

28. During the fusion of hydrogen inside the core of a star, essentially protons combine into the nucleus of ______________.
    a. four neutrons.
    b. four photons.
    c. one helium atom.
    d. one lithium atom.
    e. two hydrogen atoms.

29. 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 back into the mix.
    B. A deuterium nucleus fuses with a proton to become a light isotope of helium (two protons and one neutron).
    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.
    Hint: Watch the video on low mass stars because the correct sequence is shown in animation.
    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

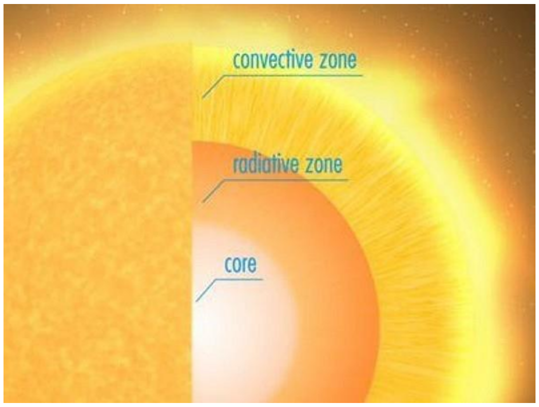
30. A higher mass star squeezes its plasma (hot gases) creating higher densities, making its core temperatures much higher so that hydrogen ______________.
    a. fuses more slowly.
    b. fuses more rapidly.
    c. fuses into carbon.
    d. fuses into a deuterium core.

31. For a star undergoing thermonuclear fusion, the lower its mass, _______________.
    a. the brighter its apparent magnitude.
    b. the brighter its luminosity becomes.
    c. the more evolutionary transitions it will go through.
    d. the longer that star lives.

32. 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 credit.
    a. there is less mass, lower core temperatures, and less rapid hydrogen fusion.
    b. there is a better mixing of the hydrogen from all parts of the star with the core and the star can consume all of its hydrogen fuel before it dies.
    c. because it slowly contracts producing energy as its gases are squeezed and densities increased.
    d. because there is incomplete hydrogen fusion and no helium is produced in the core of the star.

33. When a low mass red dwarf dies, it will be nearly pure ________________.
    a. hydrogen.
    b. helium.
    c. lithium.
    d. deuterium.

34. With stars like the sun, the hydrogen fusing in the core _______________.



    a. mixes directly with the convective zone.
    b. moves by convection through the radiative zone.
    c. stays in the 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.

35. What is the total life span of the Sun expected to be?
    a. about 2-3 million years
    b. about 12 million years
    c. about 5-6 billion years.
    d. about 11-12 billion years.

36. As more helium becomes compressed into the sun's core, it settles to the center causing the core to become _______________.
    a. less dense and much hotter.
    b. less dense and much cooler.
    c. denser and definitely cooler.
    d. denser and therefore hotter.

37. Since it was born, the Sun has increased in luminosity by about _______________.
    a. 8-10 percent.
    b. 30-40 percent.
    c. 80-100 percent.
    d. 400-500 percent.

38. Taking only the information from the last question, what does this tell us about the development of life four billion years ago on the early Earth?
    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.
    e. Meteorites were continuously bombarding Earth's surface causing mass extinctions.

39. When the sun runs out of hydrogen in its core ________________.
    a. it will begin to fuse helium into carbon in its core.
    b. it will begin to fuse helium into oxygen in its core.
    c. it will begin to fuse helium into neon in its core.
    d. it will begin to fuse hydrogen outside of the core in a thin shell.

40. As the Sun grows to well over twice its current size, it will be classified as _______________.
    a. a subgiant.
    b. a giant.
    c. a supergiant.
    d. a hypergiant.

41. If helium fusion begins in the sun's core, our daystar will bloat up to 10 to 150 times its present size, and it will be classified as _______________.
    a. a red subgiant.
    b. a red giant.
    c. a red supergiant.
    d. a red hypergiant

42. At some point, after becoming a red giant, the sun's core may become hot enough, 100 million K, to begin fusing helium into _______________.
    a. carbon.
    b. silicon.
    c. sodium.
    d. iron.

43. When fusion has stopped in its core and the sun has blown off its outer layers, it will be classified as _______________.
    a. a white dwarf.
    b. a red dwarf.
    c. a white subgiant.
    d. a red subdwarf.
    e. a planetary nebula.

44. These outer layers of the sun blown off by its last gasp to maintain its stability are called a _______________. The video is not really super clear here, but one of these answers is closest to the truth.
    a. event horizon.
    b. planetary nebula.
    c. supernova remnant.
    d. region of instability.

45. The gases surrounding the dead star's hot core are made to glow because ultraviolet radiation from the core _______________.
    a. reflects its light back into space allowing us to see it.
    b. causes the gases surrounding the star to fluoresce or glow.
    c. refracts the light energy of this star back into space, causing the gases to glow in different spectral colors, such as reds, blues, and greens.
    d. forward scatters the light similar to small ice particles in orbit around the planet Saturn.

46. As the sun expands, it will lose a great deal of its mass, causing the Earth to
    a. move towards the sun into a smaller, tighter orbit.
    b. move away from the sun, into a bigger orbit.
    c. move towards the sun and become tidally locked like the moon showing its same hemisphere towards Earth as it rotates and orbits in the same period.
    d. move away from the sun, into a tidally locked orbit.

47. Currently, the Sun is fusing ______________ into _______________ in its core. After the core becomes inert (nonreacting) but much hotter, _______________ burning will initiate in a shell surrounding the core.
    Possible answers… Answers can be used more than once or not at all.
    A. energy; **B.** gravity; **C.** carbon; **D.** lithium; **E.** helium; **F.** hydrogen; **G.** oxygen
    a. E, F, E
    b. F, F, E
    c. E, E, F
    d. F, E, F

48. Eventually, if the interior of the sun reaches 100,000,000 K the sun will begin fusing _______________ into _______________ (principal element here). A star like the sun, or any star for that matter, is really a balancing act between the outward pressure of the _______________ being produced and its _______________ which results from its mass trying to collapse the star. A star that is balanced is in hydrostatic equilibrium.
    Possible answers… Answers can be used more than once or not at all.
    A. energy; **B.** gravity; **C.** carbon; **D.** lithium; **F.** helium; **G.** hydrogen; **H.** oxygen
    a. F, C, F, G
    b. C, F, A, G
    c. F, C, A, B
    d. G, C, A, B

49. Once helium fusion stops in a low mass star, and shell burning is initiated around the core, the dominate force supporting the inert core from collapsing will be _______________.
    a. neutron degradation pressure.
    b. photon depravity pressure.
    c. electron degeneracy pressure.
    d. the pressure exerted by nutrinos.

50. Near the end of the life of a low mass star, possibly even the sun as a limiting low mass, the shell burning around the core will become more and more unstable. The star will begin to pulsate, losing even larger quantities of matter than in the earlier red giant phase of its existence. Eventually, these pulsations will become so great that shells of gas will be pumped into space causing a (an) _______________.
    a. exoplanet to be formed.
    b. dwarf nebula to be created.
    c. supernova to initiate.
    d. planetary nebula to form.
    e. cumulonimbus cloud to form around the star.

51. When the sun's core has contracted to about the size of the Earth (about 10,000 miles in diameter) will be classified as _______________.
    a. a white dwarf.
    b. a blue dwarf.
    c. a white subgiant.
    d. a blue subdwarf.

52. A single cubic centimeter of a white dwarf, about the size of a six-sided die, has a mass of _______________ Hint: There are 1000 grams/kilogram and 1000 kilograms/metric ton.
    a. a thousand grams — ten metric tons.
    b. a million grams — ten metric tons.
    c. a thousand grams — one metric ton.
    d. a million grams — one metric ton.

53. If you have a mass of 60 kg (132 pounds), and you stood on the surface of a white dwarf, you'd weigh _______________
    a. 132 pounds.
    b. 1320 pounds.
    c. 13,200 pounds.
    d. 132,000 pounds.
    e. Who cares! You'd be an ionized glob of slime.

54. Because white dwarfs are incredibly hot, but are very small, they are actually _______________. Two answers are correct and both must be provided.
    a. not always white.
    b. quite cool.
    c. quite faint.
    d. quite luminous.

55. Some planetary nebulae look like soap bubbles, which is what you'd expect when you look at _______________.
    a. a contracting shell of glowing gas if the gravitational source is much greater than expected.
    b. an expanding shell of glowing gas not under the influence of any additional gravitational forces.
    c. an expanding shell of dust reflecting the light from the dead star.
    d. an expanding shell of dust scattering the light from the dead star.
    e. a contracting shell of dust if the dead star becomes a black hole.

56. The structure of planetary nebulae come in all shapes that can be seen by amateur astronomers with relatively small telescopes and in more detail when imaged in different wavelengths of light. These different shapes tell us something about the region of space around these dying stars. Which one is not acceptable as a reason?
    a. Black holes swallow the dying star.
    b. Planets in orbit around the dying star are engulfed by the expanding shells of gases modifying their shape.
    c. The dying star was part of a double or multiple star system which churned up the gases.
    d. Magnetic fields sculpt (shape) the way material is ejected into jets.

57. The different colors of planetary nebulae that can be seen in long exposures result from the different ________________ of the gases which make up the nebula.

58. The human eye is most sensitive in the region of the visible spectrum which the sun most commonly produces. This area is in the ________________ part of the visible spectrum.
    a. red.
    b. orange.
    c. yellow.
    d. green.
    e. blue.
    f. violet.

59. When viewing a bright planetary nebula through a telescope, it often has a _____________ color.

60. How long can the glowing gases of a planetary nebula be seen, before they fade?
    a. a few years.
    b. a few thousand years.
    c. a few million year.
    d. a few billion years.