Astronomy 07 Life in the Universe Exam #3 Test Bank

Chapters 11-13: Life in the Galaxy

1. Stars spend 90% of their lives
   A) fusing hydrogen into helium in their cores and slowly dimming
   B) slowly dimming as they die with no fusion occurring in their cores
   C) fusing hydrogen into helium in their cores and slowly brightening
   D) as slowly brightening protostars
   E) fusing helium into carbon

2. The total amount of energy that a star radiates out into space is referred to as its
   A) radiance
   B) surface temperature
   C) apparent brightness
   D) luminosity
   E) parallax

3. Which of the following stars is the hottest?
   A) O7
   B) G2
   C) K7
   D) K4
   E) B9

4. Which of the following stars is the coolest?
   A) O7
   B) G2
   C) K7
   D) K4
   E) B9

5. What is the spectral type of the Sun?
   A) O7
   B) G2
   C) K7
   D) K4
   E) B9

6. Which of the following are in order of decreasing temperature?
   A) F2, F7, O9, K0, G2
   B) K0, G2, F7, F2, O9
   C) F7, F2, O9, K0, G2
   D) O9, F7, F2, G2, K0
   E) O9, F2, F7, G2, K0

7. One of the fundamental principles of stellar evolution is that the more massive a star is
   A) the more heavy elements it contains
   B) the more planets it has around it
   C) the slower it evolves
   D) the more likely it is to be in a binary system
   E) the faster it evolves

8. A star significantly less massive than our Sun
   A) will have a shorter lifetime
   B) will have the same lifetime as the Sun
   C) will have a longer lifetime
   D) could have either a longer lifetime or a shorter lifetime depending on its chemical composition
   E) is almost certain to have planets

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10. What is the most common class of star in our galaxy?
   A) G-type
   B) O-type
   C) M-type
   D) A-type
   E) B-type

11. What is the least common class of star in our galaxy?
   A) G-type
   B) O-type
   C) M-type
   D) A-type
   E) B-type

12. Solar-type stars in our galaxy are
   A) unlikely to still exist, although they were once very common
   B) very rare (less than 1%)
   C) very common, making up about 50% of the total
   D) fairly common (several percent)
   E) the most common type of stars in our galaxy (75% or more)

13. O-type stars in our galaxy are
    A) unlikely to still exist, although they were once very common
    B) very rare (less than 1%)
    C) very common, making up about 50% of the total
    D) fairly common (several percent)
    E) the most common type of stars in our galaxy (75% or more)

14. O-type stars probably
    A) have lifetimes long enough for advanced life to evolve
    B) have lifetimes long enough for planets to form and for life to appear, but not long enough for advanced life
    C) do not contain enough heavy elements to form planets
    D) are unlikely to still exist, although they were once very common
    E) have lifetimes too short for planet formation

15. B-type stars probably have lifetimes
    A) long enough for advanced life to evolve
    B) too short for planet formation
    C) long enough for planets to form and for simple life to appear, but not long enough for advanced life to develop
    D) long enough for planets to form but not for life to appear
    E) too long for life to be able to evolve on their planets.

16. A- and F-type stars probably
    A) have lifetimes long enough for planets to form and for simple life to appear, but not long enough for advanced life to develop
    B) do not contain enough heavy elements to form planets
    C) have lifetimes long enough for advanced life to evolve
    D) have lifetimes too short for planet formation
    E) are unlikely to still exist, although they were once very common

17. G-, K-, and M-type stars
    A) do not contain enough heavy elements to form planets
    B) have lifetimes long enough for advanced life to evolve
    C) have lifetimes long enough for planets to form and for simple life to appear, but not long enough for advanced life to develop
    D) have lifetimes too short for planet formation
    E) are unlikely to still exist, although they were once very common

18. Even though K- and M-type stars are suitable for life, why might they not have many habitable planets around them?
    A) because their habitable zones are very narrow
    B) because their habitable zones are very wide
    C) because their lifetimes are too short
    D) because they contain too few heavy elements to form planets
    E) they are too hot and bright to support habitable planets

19. Planets orbiting which of the following types of stars are NOT suitable for advanced life?
    A) K-type
    B) M-type
    C) G-type
    D) B-type
    E) none of those star types are suitable for advanced life

20. Brown dwarfs have
    A) very narrow habitable zones
    B) very wide habitable zones
    C) habitable zones similar to the Sun
    D) habitable zones slightly smaller than the Sun's
    E) no habitable zones

21. Multiple star systems in our galaxy
    A) do not exist
    B) may exist, but they simply haven't been discovered yet
    C) are extremely rare, making up less than 1% of the total
    D) are very common, making up about 98% of the total
    E) are fairly common, making up around 30% or more of the total

22. Which of the following could be a stable planetary orbit in a binary system?
    A) no orbits in a binary star system are stable
    B) a "figure-of-eight" orbit about both stars in a close binary system
    C) an orbit close to one of the stars in a close binary system
    D) an orbit around both stars in a wide binary system, just barely travelling around both stars
    E) a large orbit around both stars in a close binary system

23. The center of mass of the solar system is
    A) midway between the Sun and Jupiter
    B) exactly at the center of the Sun
    C) just outside the orbit of Mercury
    D) at the center of the Earth
    E) close to center but not exactly at the center of the Sun

24. Which of the following methods has been extremely successful in detecting extrasolar planets around other star systems?
    A) detection of Doppler shifts in the spectra of the parent stars
    B) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky
    C) detection of temperature changes in a star
    D) detection of reflected starlight
    E) detection of radio signals from the extrasolar planet

25. Which of the following methods has been extremely successful in detecting extrasolar planets around other star systems?
    A) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky
    B) detection of temperature changes in a star
    C) detection of reflected starlight
    D) detection of radio signals from the extrasolar planet
    E) detection of brightness changes of the parent stars

26. In an extrasolar planetary system containing a single planet, the parent star is measured to move about its center of mass every 24 years. Given this, what is the orbital period of the planet?
    A) 2 years
    B) 12 years
    C) 24 years
    D) 48 years
    E) this cannot be determined from this observation

27. Which of the following is a description of the astrometric method of detection of extrasolar planets?
    A) detection of Doppler shifts in the spectra of the parent stars
    B) detection of reflected starlight
    C) detection of brightness changes in a star as a planet passes in front of it
    D) measuring the temperature of the planet
    E) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky

28. Stars only exhibit a Doppler shift if some of their motion is
    A) perpendicular to our line of sight
    B) either towards or away from us along the line of sight
    C) away from us along the line of sight
    D) towards us along the line of sight
    E) in a circular motion about us

29. The wavelengths of radiation from a star that is moving toward us
    A) are shorter than if the star were not moving
    B) can be longer or shorter depending on the distance to the star
    C) are longer than if the star were not moving
    D) are the same as if the star were not moving
    E) disappear into the ether

30. The radial velocity curve of a star with an extrasolar planet is a plot of
    A) radial velocity vs. time
    B) radial velocity vs. luminosity
    C) radial velocity vs.brightness
    D) radial velocity vs. distance
    E) radial velocity vs. temperature

31. When we measure the mass of a planet using the Doppler shift method, we know that its mass
    A) is exactly as measured
    B) could well be larger
    C) could well be smaller
    D) could be larger or smaller
    E) could be zero

32. Why does the Doppler shift method of detecting extrasolar planets only give us the minimum mass of a planet?
    A) because we don't necessarily know the angle the planet's orbit makes with our line of sight
    B) because we don't necessarily know the density of the planet
    C) because we don't necessarily know the diameter (size) of the planet
    D) because we don't necessarily know the mass of the parent star very accurately
    E) because we aren't sure the method really works

33. Most of the extrasolar planets detected to date are found
    A) at about the same distance as the Earth is from the Sun
    B) at about the same distance as the planet Jupiter is from the Sun
    C) very far from their parent stars
    D) orbiting the star in the reverse direction
    E) very close to the parent stars

34. For the first decade or so of searches for extrasolar planets, the masses of the extrasolar planets detected were
    A) much smaller than the Earth's
    B) very similar to the Earth's
    C) much larger than the Earth's
    D) consistent with their being super-Earths
    E) larger than the Sun itself

35. A super-Earth planet is typically
    A) a planet with life
    B) a planet with liquid water
    C) a Jupiter-sized planet with an orbit smaller than Mercury's
    D) a planet with a mass in the range of about 2 to 10 Earth masses
    E) the planet on which scientists believe Super-man grew up

36. Which of the following methods describes the transit method for detecting extrasolar planets?
    A) detection of brightness changes in a star as a planet passes in front of it
    B) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky
    C) detection of Doppler shifts in the spectra of the parent stars
    D) detection of reflected starlight
    E) detection of radio signals from the extrasolar planet

37. Which of the following methods allows us to determine the size of an extrasolar planet around another star?
    A) detection of brightness changes in a star as a planet passes in front of it
    B) detection of reflected starlight
    C) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky
    D) detection of Doppler shifts in the spectra of the parent stars
    E) detection of radio signals from the extrasolar planet

38. Which of the following methods is used by Kepler?
    A) detection of reflected starlight
    B) regular changes in the positions of the parent stars with respect to more distant stars as they move across the sky
    C) detection of Doppler shifts in the spectra of the parent stars
    D) detection of radio signals from the extrasolar planet
    E) detection of brightness changes in a star as a planet passes in front of it

39. Gravitational lensing is the process by which
    A) the wavelengths of light from a star are shifted as it moves about its center of mass
    B) a planet passes in front of its parent star and blocks part of its light
    C) a massive object accelerates another object that passes close to it
    D) a massive object magnifies and distorts the light from an object behind it
    E) we detect of radio signals from the extrasolar planet

40. A rogue planet is one that
    A) has been wounded, and eats people
    B) orbits the star in the wrong direction
    C) orbits around another planet, instead of around a star
    D) orbits very close to its star
    E) travels through space, without orbiting a parent star

41. According to the simple nebular theory of planet formation discussed in class, can a Jupiter-like planet form close to its parent star?
    A) no, because the gases would be attracted to rocky terrestrial planets, forming atmospheres
    B) no, because it would be too hot for gases to condense
    C) yes, because we see Jupiter-like planets with small orbits around other stars
    D) no, because there is no gas, only rock in the inner part of the disk
    E) yes, because there is plenty of hydrogen and helium throughout the protostellar disk

42. How would the inward migration of a Jovian-like planet in an extrasolar planetary system alter the probability of life appearing on inner terrestrial planets?
    A) it would improve chances slightly because some of the terrestrial planets may become moons of the Jovian planet
    B) it would make no difference at all
    C) it would improve chances because it would protect inner, terrestrial-like planets from impacts
    D) it would greatly decrease the chance because the orbits of the inner, terrestrial-like planets would be disrupted
    E) it would help life, by disrupting any nonhabitable planets

43. How might we explain the presence of extrasolar planetary systems with Jovian-sized planets at distances at which we normally find terrestrial planets?
    A) they are brown dwarfs that were captured by their parent stars
    B) the Jovian planets formed farther out and then migrated inward
    C) these are massive terrestrial planets that formed close to their parent stars
    D) they are Jovian planets that were spun out from their rapidly spinning parent stars
    E) they Jovian planets were ejected from the Sun

44. The Rare Earth Hypothesis suggests that
    A) Earth and life on it were created by some omnipotent being
    B) the orbits of any Earth-like planets around other stars would have been disrupted by inward migration of Jovian planets
    C) the circumstances that have allowed life on the Earth to appear and develop may be so improbable that it is unlikely to have occurred anywhere else
    D) Earth-like planets are unlikely to have formed around any other stars
    E) the Earth has been ejected from the interior of the Sun

45. What parameter(s) may determine the position of a galaxy's Galactic Habitable Zone?
    A) the amount of heavy elements in the disk
    B) both the amount of heavy elements AND the amount of harmful radiation from the galactic core
    C) the temperature in the galactic disk
    D) the amount of harmful radiation from the galactic core
    E) how often planets form around stars

46. Why might it be difficult for Earth-like planets to form around Sun-like stars in the inner parts of the disk of our galaxy?
    A) any stars would be sucked into the central supermassive black hole
    B) there would be insufficient amounts of heavy elements
    C) the stars would be packed together too densely for planets to be stable
    D) there would be too much harmful radiation
    E) they would be drawn into their stars by gravity

47. Why might it be difficult for Earth-like planets to form around Sun-like stars in the outer parts of the disk of our galaxy?
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    D) there would be too much harmful radiation
    E) they would be drawn into their stars by gravity

48. If our solar system hadn't formed with a Jupiter-sized planet,
    A) the Sun would have been more massive, with a lifetime too short for life to evolve
    B) the rate of cometary impacts on the Earth may have been much higher, possibly preventing the appearance of life
    C) the Earth would have never formed
    D) the rate of cometary impacts on the Earth may have been much lower, enabling the appearance of life much earlier
    E) the Sun would have blown up long ago

49. The Hertzprung–Russell diagram is a plot of
    A) radial velocity against distance
    B) apparent brightness against time
    C) luminosity against distance
    D) Hertzprung against Russell
    E) luminosity against surface temperature

50. In the Hertzprung–Russell diagram most stars are found
    A) in the red giant region
    B) in the white dwarf region
    C) in the supergiant region
    D) in the mystery region
    E) on the main sequence

51. All stars on the main sequence
    A) are mature stars that are fusing hydrogen into helium in their cores
    B) are in the process of forming
    C) are dead stars
    D) have exhausted their nuclear fuel and are in the process of dying
    E) are white dwarf stars

52. At the upper right of the Hertzprung–Russell diagram we find
    A) supergiant stars
    B) red giant stars
    C) white dwarfs
    D) main sequence stars
    E) planets

53. At the lower left of the Hertzprung–Russell diagram we find
    A) supergiant stars
    B) red giant stars
    C) white dwarfs
    D) main sequence stars
    E) planets

54. How is intelligence defined in the Drake Equation?
    A) a civilization that has developed fire and the wheel
    B) a civilization that communicates using telepathy
    C) a civilization able to communicate over interstellar distances
    D) a civilization that communicates via speech
    E) a civilization capable of spaceflight

55. In principle, the Drake equation should enable us to calculate the exact number of intelligent civilizations capable of interstellar communication in our galaxy right now. However, currently this is not feasible because
    A) it is impossible for us to ever know the values of any of the factors
    B) the values of all the factors are zero
    C) the equation is too mathematically complex
    D) we do not have exact numbers for the factors in the equation
    E) NASA does not have enough funding

56. Suppose there are a million habitable planets in our galaxy, that one in ten have life, that one in a thousand planets with life had at some point had an intelligent civilization, and that one in a hundred civilizations that has ever existed is in existence now. Given this, how many civilizations are in existence now?
    A) 1
    B) 10
    C) 1000
    D) 10000
    E) 100000

57. Life on Earth appears to have arisen quite easily and rapidly. This suggests that the factor in the Drake equation, which governs the fraction of habitable planets that have life, could be close to
    A) 0
    B) 0.25
    C) 0.5
    D) 1
    E) 100

58. The rare-Earth hypothesis would predict that the factor f_{life} (the fraction of habitable planets that have life) in the Drake equation should be close to
    A) 0
    B) 0.25
    C) 0.5
    D) 1
    E) 100

59. Which of the following cases in the Drake equation would be the minimum necessary condition for us to be the only intelligent civilization currently in our galaxy?
    A) any two of the factors to be zero
    B) any three of the factors to be zero
    C) all of the factors to be zero
    D) any one of the factors to be zero
    E) It is impossible to tell from what we currently know

60. The adoption of very similar streamlined body shapes by both sharks and dolphins provides evidence for
    A) cross-breeding
    B) genetic mutations
    C) life originating in the oceans
    D) intelligent design
    E) convergent evolution

61. The fact that many different organisms on Earth have developed eyesight provides evidence for
    A) cross-breeding
    B) genetic mutations
    C) life originating in the oceans
    D) intelligent design
    E) convergent evolution

62. Intelligence may be subject to convergent evolution because it
    A) has survival value
    B) is inevitable
    C) is a fundamental characteristic of life
    D) is required for survival
    E) is so unlikely

63. An organism with an Encephalization Quotient (EQ) of 1 is expected to be
    A) completely nonintelligent
    B) of the lowest possible intelligence
    C) of below-average intelligence
    D) of average intelligence
    E) of above-average intelligence

64. An organism with an Encephalization Quotient (EQ) of 4 is expected to be
    A) completely nonintelligent
    B) of the lowest possible intelligence
    C) of below-average intelligence
    D) of average intelligence
    E) of above-average intelligence

65. A traditional “grey” alien, with small body and huge head, would have an Encephalization Quotient (EQ) of
    A) -1
    B) 0
    C) in the range of 0 to 1
    D) 1
    E) greater than 1

66. The organisms with the highest Encephalization Quotient (EQ) ratios are
    A) dolphins
    B) whales
    C) chimps
    D) humans
    E) crows

67. The organisms with the next highest Encephalization Quotient (EQ) ratios after humans are
    A) dolphins
    B) whales
    C) chimps
    D) humans
    E) crows

68. A diplodocus (a dinosaur like a “Brontosaurus”) with a small head and a large body would be expected to have an Encephalization Quotient (EQ) of
    A) -1
    B) 0
    C) in the range of 0 to 1
    D) 1
    E) greater than 1

69. Encephalization Quotient (EQ) values can be estimated for extinct species because
    A) there is a linear relationship between the EQ and time, thus allowing extrapolation
    B) we can estimate their body masses from their fossilized remains and their brain masses from the sizes of their fossilized cranial cavities
    C) extinct species always have the same EQ value
    D) we can always find similar species in existence today to make measurements of
    E) extinct species were not smart—that’s why they became extinct!

70. The fact that Encephalization Quotients (EQs) of organisms have generally increased with time provides evidence for
    A) cross-breeding between organisms
    B) convergent evolution toward intelligence
    C) artificial selection
    D) genetic mutations
    E) intelligent design

71. The 1420 MHz (21 cm) radio line generated by neutral hydrogen atoms is a good choice for interstellar communications because
    A) it is the easiest radio frequency to generate
    B) it is the only radio frequency that is not blocked by interstellar matter
    C) it is the only frequency to which radio telescopes can be tuned
    D) all intelligent civilizations should be aware of its universal significance and would probably also think of sending and receiving signals at this frequency
    E) it is commonly used by radio stations to broadcast news and music

72. If we were to intercept a strong radio signal at 1420 MHz in binary format from another civilization, this would probably be an example of
    A) a signal used for communication between a civilization’s home world and another planet in its own planetary system
    B) a signal used for local communication in the world where the intelligent beings exist
    C) a signal used for communication between a civilization’s home world and another star system
    D) an intentional signal beacon
    E) an echo of our own broadcasts, bouncing off the Sun

73. Which of the following kinds of signal do we currently have the best chance of detecting with currently technology?
    A) an intentional signal beacon
    B) a signal used for communication between a civilization's home world and another star system
    C) a signal used for communication between a civilization's home world and another planet in its own planetary system
    D) a signal used for local communication in the world where the intelligent beings exist
    E) an echo of our own broadcasts, bouncing off the Sun

74. What is a reason that justifies the selection of the globular cluster like M13 as the target for the 1974 Arecibo message?
    A) globular clusters are the most likely place to find stars with planetary systems
    B) stars in globular clusters are rich in heavy elements, the building blocks of life
    C) signals from advanced civilizations have previously been detected coming from this cluster
    D) globular clusters are well known to be filled with Earthlike planets
    E) globular clusters are densely packed with stars, hence maximizing the probability of interception by an advanced civilization

75. In 1974 we transmitted a message toward the globular cluster M13 which is 21,000 ly away. What is one reason that such clusters are not ideal for sending messages to?
    A) aliens that live in them don't want to talk
    B) globular clusters contain young, high mass stars with insufficiently long main sequence lifetimes and hence are unsuitable places for life
    C) the message will be absorbed by interstellar dust before it reaches the cluster
    D) globular clusters contain, old, low mass stars with fewer heavy elements and hence are not ideal places for life
    E) clusters are filled with black holes that would absorb our broadcasts

76. Approximately how soon might we expect an immediate response from a civilization that received the signal we sent to the globular cluster M13 (21,000 light-years away) in 1974?
    A) 10,500 years
    B) 21,000 years
    C) 42,000 years
    D) 84,000 years
    E) 4.6 billion years

77. The search for radio signals from intelligent civilizations on planets around nearby solar-type stars is an example of a
    A) sky survey
    B) unintentional search
    C) random sweep
    D) targeted search
    E) a series-based sweep

78. An optical SETI signal would most likely consist of
    A) using mirrors to reflect light from the surface of a planet
    B) using a giant disk to block out the light from the parent star
    C) a continuous beam of laser light
    D) rapid, short bursts of intense laser light
    E) a redirection of beams of sunlight using giant disk-shaped mirrors

79. A Lagrange point in the Earth–Moon system is a position
    A) directly between the Earth and Moon
    B) in space where the effects of the Earth's and Moon's gravity cancel each other out
    C) on the surface of the Moon that points directly away from the Earth
    D) on the Earth's surface that the Moon's gravity is concentrated
    E) on the Martian surface, where it seems geysers might exist

80. Which Lagrange points in the Earth–Moon system are stable?
    A) L1 only
    B) L4 and L5
    C) L2 and L3
    D) all are stable
    E) none are stable

81. One of the most likely places an advanced civilization might leave an artifact for us to find would be
    A) in the desert of Roswell, New Mexico
    B) in the Cydonia region of Mars
    C) on the surface of Europa
    D) the L4 and L5 points in the Earth–Moon system
    E) under the ocean

82. One of the most likely places an advanced civilization might leave an artifact for us to find would be
    A) in the desert of Roswell, New Mexico
    B) in the Cydonia region of Mars
    C) on the surface of Europa
    D) on the surface of Callisto
    E) under the ocean

83. What kind of civilization can life on Earth currently be classified as?
    A) Type I or lower
    B) Type II
    C) Type III
    D) Type IV
    E) Type V

84. What type of civilization would be able to construct a "Dyson Sphere" around its parent star to capture its radiation?
    A) Type I or lower
    B) Type II
    C) Type III
    D) Type IV
    E) Type V

85. In the novel and movie *Contact* by Carl Sagan, an extremely advanced civilization has constructed a labyrinth of wormholes throughout the galaxy. A civilization capable of such a feat would most likely be classified as what kind of civilization?
    A) Type I or lower
    B) Type II
    C) Type III
    D) Type IV
    E) Type V

86. The Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence states that the first thing to do after the detection of a possible signal is to
    A) send a reply
    B) announce the discovery to the public
    C) classify it top secret
    D) notify the White House
    E) confirm that it is genuine

87. A UFO is
    A) an alien spaceship
    B) an observation of an unidentified object seen in the sky
    C) a hoax
    D) a natural phenomenon
    E) any kind of mysterious craft launched by the US Air Force

88. After World War II, the U.S. Government spent two decades investigating UFOs because they
    A) thought that they might be new types of aircraft being developed by the Soviet Union
    B) were themselves developing new types of aircraft and used the official investigation as a cover-up
    C) thought that they might be new types of aircraft being developed by the US Air Force
    D) knew that UFOs were alien craft and used the official investigation as a cover-up
    E) were afraid that an alien civilization was in the process of invading the Earth

89. About 90% of UFO sightings
    A) are hoaxes
    B) can be explained by natural phenomena
    C) cannot be explained
    D) are real sightings of alien craft
    E) are psychic phenomena

90. The 10% of UFO sightings that cannot be explained by natural phenomena
    A) are simply that—sightings that are mysteries because they suffer from a lack of hard evidence (but might indeed by alien craft)
    B) are secret government plots
    C) are hoaxes
    D) are therefore sightings of alien craft
    E) are psychic phenomena

91. On the basis of the scientific method, which of the following would be considered conclusive evidence that we are being visited by aliens?
    A) an eyewitness account
    B) claims of alien abduction made under hypnosis
    C) a photograph
    D) none of these would be conclusive
    E) all A, B, C would be considered conclusive

92. Which of the following is not a difficulty associated with interstellar travel?
    A) the large distances between the stars
    B) the speed of light being the fastest possible speed we can travel
    C) the enormous amount of energy required to accelerate any ship to high speed
    D) the long periods of time to travel between the stars
    E) all four are difficulties

93. Traveling at their current speeds, how long will it take the *Pioneer* and *Voyager* probes to reach the nearest stars?
    A) around 4.4 years
    B) about a 1,000 years
    C) at least 100,000 years
    D) 2 billion years
    E) several billion years

94. The energy required to accelerate an interstellar spaceship depends on
    A) its mass and final velocity reached
    B) its mass only
    C) its final velocity only
    D) the type of fuel it uses
    E) the distance it must travel

95. The Earth's escape velocity is defined to be the
    A) minimum velocity required for an object to escape the Earth's gravity
    B) minimum orbital speed for the Moon to escape from the Earth's gravity
    C) minimum orbital speed for the Earth to escape from the Sun's gravity
    D) velocity that objects are pulled toward the Earth's surface by gravity
    E) the speed of light

96. Chemical rockets work on which basic physical principle?
    A) Kepler's first law of planetary motion
    B) Einstein's special theory of relativity
    C) Newton's third law of motion
    D) Drake's equation
    E) the Hubble Law

97. Which is the most common type of spacecraft propulsion used today?
    A) solar sails
    B) chemical rockets
    C) nuclear rockets
    D) ion engines
    E) warp engines

98. The fastest we could reasonably accelerate a chemical rocket to (assuming using a rocket with about 100 stages!) is approximately
    A) the speed of sound
    B) 0.001% of the speed of light
    C) 0.1% of the speed of light
    D) the speed of light
    E) three times the speed of light

99. Nuclear fission is the process by which
    A) a number of smaller nuclei combine to form a larger nucleus with the release of energy
    B) electrons are rearranged inside an atom, releasing energy
    C) an electron is ejected from the nucleus of an atom, releasing energy
    D) electrons interact with photons
    E) large nuclei break up into smaller nuclei with the release of energy

100. Nuclear fusion is the process by which
    A) a number of smaller nuclei combine to form a larger nucleus with the release of energy
    B) electrons are rearranged inside an atom, releasing energy
    C) an electron is ejected from the nucleus of an atom, releasing energy
    D) electrons interact with photons
    E) large nuclei break up into smaller nuclei with the release of energy

101. Compared to a chemical rocket, an ion engine has a
   A) smaller thrust but can be operated continuously for a longer time period
   B) smaller thrust and can only be operated for a shorter time period
   C) larger thrust and can be operated for a longer time period
   D) larger thrust but can only be operated for a shorter time period
   E) larger thrust but must be fueled by nuclear fuel

102. Which type of spacecraft does not need to carry any fuel?
   A) nuclear rockets
   B) ion engines
   C) solar sails
   D) chemical rockets
   E) matter–antimatter rockets

103. In order for a solar sail spacecraft to be accelerated to speeds high enough to accomplish interstellar travel in a reasonable amount of time, it would need to be launched
   A) from a lunar orbit where the gravity is weaker
   B) close to Earth using mirrors on the surface to reflect sunlight onto the sails
   C) far from the Sun so Jupiter could be provide a gravitational assist
   D) close to the Sun, because that is where the radiation pressure is higher
   E) close to the Sun, so it can feed off the Sun's gravity

104. Which kind of interstellar spacecraft would require access to a kind of fuel that is currently available only in tiny amounts?
   A) solar sail
   B) matter–antimatter rocket
   C) interstellar ark
   D) nuclear rocket
   E) ion drives

105. The observed slowing down of time predicted by Einstein's Special Theory of Relativity for an object traveling close to the speed of light is referred to as
   A) time expansion
   B) a time warp
   C) time contraction
   D) time dilation
   E) a wormhole

106. Bert and Ernie are two friends of the same age. Bert visits a nearby star system on a spaceship that travels close to the speed of light while Ernie stays at home. Which of the following will be true on Bert's return to Earth?
   A) Ernie will be younger than Bert
   B) Bert and Ernie will still be the same age
   C) Ernie will not have been born
   D) Ernie will be older than Bert
   E) Ernie will be out at a café, catching up with some old friends

107. The Booboo 726-8 binary system is approximately 10 light-years away. If we send a spacecraft to visit this system traveling at 50% of the speed of light, how long will a one-way trip take as measured from the Earth?
A) it's impossible to tell unless we know the spacecraft's method of propulsion
B) 10 years
C) 20 years
D) 40 years
E) hundreds of thousands of years

108. When an electron collides with a positron, the two particles
A) fuse to form a heavier particle
B) bounce off each other
C) produce hydrogen
D) go into orbit around each other
E) are destroyed, producing a pair of high-energy gamma rays

109. During the annihilation of matter and antimatter, what percentage of the mass of the colliding particles is converted into energy?
A) 0.7%
B) 0.07%
C) 50%
D) 70%
E) 100%

110. Which kind of interstellar spacecraft collects its fuel during its passage?
A) interstellar ark
B) matter-antimatter rocket
C) interstellar ramjet
D) solar sail
E) ion drive

111. The main practical problem associated with building an interstellar ramjet is
A) producing enough thrust to accelerate the spacecraft to a high enough speed
B) separating the matter and antimatter fuels from each other
C) making the ship large enough to scoop up enough hydrogen fuel given that the density of hydrogen in space is so low
D) receiving enough photon energy to propel the craft
E) finding exotic matter

112. In Einstein's General Theory of Relativity, spacetime has
A) one dimension
B) two dimensions
C) three dimensions
D) four dimensions
E) eleven dimensions

113. Einstein's General Theory of Relativity tells us that a photon traveling close to a massive object will
    A) travel in a straight line past the object
    B) be reflected by the object
    C) be absorbed by the object
    D) follow the curvature of spacetime around the object
    E) transform directly into matter

114. A wormhole is
    A) a passageway to a parallel universe through a black hole
    B) a shortcut between two distant parts of the universe through a black hole
    C) a way of traveling faster than the speed of light
    D) a shortcut between two distant parts of the universe through hyperspace
    E) how spacecraft can gather matter and antimatter

115. How is the "Fermi Paradox" normally stated?
    A) Why are we here, and what is our purpose?
    B) If aliens are common, why aren't they all over the place?
    C) Who are we, and how did we get here?
    D) Where are we in the galaxy?
    E) How did life evolve?

116. Given how many times intelligent civilizations could have appeared over the universe's history, it is most likely that if other civilizations exist, they will
    A) be slightly less advanced than us
    B) be much more advanced than us
    C) be much less advanced than us
    D) have about the same level of technology as us
    E) be hostile

117. Von Neumann machines are hypothetical
    A) devices capable of creating wormholes
    B) self-replicating probes sent out to explore the galaxy by an advanced civilization
    C) devices capable of time travel
    D) spacecraft capable of traveling faster than the speed of light
    E) 3D printers capable of manufacturing life itself

118. The idea that other civilizations are aware of our existence but have deliberately chosen to observe us quietly, like a museum exhibit, is referred to as the
    A) deadly probes hypothesis
    B) conspiracy hypothesis
    C) sentinel hypothesis
    D) UFO hypothesis
    E) zoo hypothesis

119. The idea that other civilizations are waiting for us to reach a certain technological level before revealing themselves to us is referred to as the
    A) immaturity hypothesis
    B) conspiracy hypothesis
    C) UFO hypothesis
    D) zoo hypothesis
    E) deadly probes hypothesis

120. You are traveling in a space ship at half the speed of light (0.5c) directly toward an oncoming photon traveling at the speed of light (c). At what speed would you see the photon coming toward you?
    A) 0.25c
    B) 0.5c
    C) c
    D) 1.5c
    E) 2c