1 According to the definition of "habitable zone" that we are using, Earth is
   a. no longer in the habitable zone of our Solar System.
   b. near the outer edge of the habitable zone of our Solar System.
   c. at the center of the habitable zone of our Solar System.
   d. near the inner edge of the habitable zone of our Solar System.

2 In the Hertzsprung-Russell Diagram shown, which point represents a star of type K with absolute magnitude +10?

   A B
   -10 -5 0 +5 +10 +15
   C D E
   OBAFGKM

3 A starship observes that a nearby star has apparent magnitude 4.0. The spectrum of the star indicates that it is a type that normally has absolute magnitude 4.0. From these observations, the starship knows that it is
   a. 1 parsec from the star.
   b. 100 parsecs from the star.
   c. 10 parsecs from the star.
   d. 10,000 parsecs from the star.
   e. 1000 parsecs from the star.

4 Which of the following spectral types would you expect to look red in color?
   a. M.
   b. G.
   c. A.
   d. F.

5 A star is observed to have an apparent brightness which is $10^{-4}$ times its absolute brightness. How far away is it?
   a. 10 parsecs.
   b. 1000 parsecs.
   c. 10,000 parsecs.
   d. 100 parsecs.
   e. $10^6$ parsecs.

6 The diffraction limit of a telescope refers to the effect of
   a. its light collection area.
   b. atmospheric turbulence.
   c. chromatic aberration.
   d. errors in the lens shape.
   e. the wavelength of light.
7 The frequency of a wave is defined to be
   a. The number of seconds that it takes for a crest to pass.
   b. The distance from one crest to the next.
   c. The time for a set of crests to pass divided by the number of crests.
   d. The number of crests that pass in one second.
   e. The distance from a maximum to a minimum.

8 Which of the following spectral types corresponds to a star on the main sequence?
   a. K2III
   b. G2V
   c. B4IV
   d. A2Ib
   e. O2Ia

9 Ham radio operators sometimes operate receivers for the 2 meter wavelength. The 2 meters refers to the
   a. length of the required radio antenna.
   b. frequency of the radio waves.
   c. size of the near-field zone of the receiver.
   d. distance from one maximum of the radio waves to the next.
   e. maximum amplitude of the radio waves.

10 For stars on the main-sequence, stars with increasing mass have
    a. increasing surface temperature and decreasing absolute brightness.
    b. increasing surface temperature and absolute brightness.
    c. decreasing surface temperature and increasing absolute brightness.
    d. decreasing surface temperature and absolute brightness.

11 In a Hertzsprung-Russelll diagram, the brightest stars are found
    a. on the right side.
    b. at the top.
    c. at the bottom.
    d. on the left side.

12 Suppose that a flash of lightning from a cloud 2000 meters away is followed by a clap of thunder two seconds
    later. Assume that the light arrived in a negligible time and calculate the speed of the sound waves.
    a. 5000m/s
    b. 1250m/s
    c. 2500m/s
    d. 1000m/s
    e. 2m/s
13 Of all the things that might go wrong with distances found by using the method that astronomers refer to as the "distance ladder," which of these is the one that an astronomer would say is most likely?
   a. The distance-distance modulus formula is incorrect.
   b. The apparent magnitudes of distant objects have been measured incorrectly.
   c. The parallax-distance formula is incorrect.
   d. The parallaxes of nearby objects have been measured incorrectly.
   e. Distant objects are not behaving the same as nearby objects.

14 Which of the following magnitudes corresponds to the dimmest star?
   a. 0
   b. +3
   c. +1
   d. +2
   e. +4

15 Heliocentric Stellar Parallax causes
   a. all stars to move away from a point in the constellation Hercules.
   b. all stars to jump randomly around.
   c. nearby stars to shift steadily in the same direction.
   d. nearby stars to shift back and forth once a year.

16 The star Vega is 25 parsecs from our Sun. The light from Vega has been traveling for about
   a. 80 years.
   b. 25 years.
   c. 0.04 years.
   d. 12.5 years.
   e. 7.5 years.

17 Which of the following colors indicates the hottest star?
   a. red.
   b. orange.
   c. yellow.
   d. blue.
   e. peach.

18 The star Tau Ceti has moved across the sky by 1922 seconds of arc during the last thousand years, more than a half of a degree of arc. Its proper motion is closest to
   a. 1.9265″/yr.
   b. 19.22″/yr.
   c. 3.853″/yr.
   d. 0.26″/yr.
   e. 1922″/yr.

19 A spectroscopic binary star system is one in which we see
   a. spectral lines shifting back and forth.
   b. regular dips in light intensity.
   c. a wobbling image of one star.
   d. images of both stars.
20 Suppose that the color and behavior of a star identify it as a type that we know has absolute magnitude \(-3\). If the star’s apparent magnitude is found to be 7, how far away is it?
   a. 100 parsecs.
   b. 1000 parsecs.
   c. 5 parsecs.
   d. 10 parsecs.
   e. 50 parsecs.

21 Which of the following spectral classes corresponds to the lowest surface temperature (on this list)?
   a. A
   b. G
   c. K
   d. B
   e. F

22 The apparent brightness of our Sun is roughly 1000 watts per square meter. At a distance of 30 times the Earth-Sun distance, the apparent brightness of our Sun would be
   a. 33 watts per square meter.
   b. 30000 watts per square meter.
   c. 1000 watts per square meter.
   d. 900,000 watts per square meter.
   e. 1.1 watts per square meter.

23 The range of signal frequencies between absorption bands caused by hydrogen and hydroxyl molecules
   a. is referred to as the "water hole" and is the frequency band that SETI programs usually choose.
   b. is always avoided by SETI programs because signals there are strongly absorbed.
   c. is referred to as the "hydrogen band" and is usually avoided by SETI programs.
   d. has no particular significance for SETI programs.

24 A star is seen to move by 0.4 seconds of arc between March 1, 1999 and September 1, 1999 and then back to its starting point on March 1, 2000. What is the parallax angle for this star?
   a. 0.3 seconds of arc.
   b. 0.1 seconds of arc.
   c. 0.4 seconds of arc.
   d. 0.8 seconds of arc.
   e. 0.2 seconds of arc.

25 Spectroscopic Parallax refers to
   a. a method for finding distances to stars.
   b. the pressure broadening of spectral lines.
   c. the shifting of spectral lines due to star motion.
   d. the use of stellar parallax.
26 The main reason that the SETI@home system needs to use the computing power of 5.2 million participating home computers is that
   a. they are performing highly sophisticated and time-consuming analyses of each individual signal.
   b. they think it is cool to use that many computers.
   c. each computer does not do very much.
   d. they are collecting and analyzing signals on millions of different radio channels.

27 Spectroscopic parallax uses
   a. timing variations in brightness to estimate mass.
   b. annual position shifts of stars to calculate distance.
   c. stellar spectra to locate stars in the HR diagram.
   d. the doppler shift to find star velocities.

28 Compared to a magnitude 16 star, a magnitude 1 star would be
   a. 10,000,000 times as bright.
   b. 100 times as bright.
   c. 10,000 times as bright.
   d. 1,000,000 times as bright.
   e. 1000 times as bright.

29 Suppose that a sound wave has a wavelength of 12 meters and a frequency of 100Hz. What is the speed of sound?
   a. 0.012 m/s
   b. 1200 m/s
   c. 8.34 m/s
   d. 100 m/s
   e. 12 m/s

30 To see a large but faint object such as a nebula, you would need a telescope with large
   a. light gathering power.
   b. magnification power.
   c. resolving power.

31 The Viking Landers carried out several experiments on Martian surface soil. The final conclusion from those experiments (as interpreted at the time) was:
   a. There are definitely microbes living in the soil of Mars.
   b. The surface of Mars is extremely hostile to all forms of organic matter.
   c. No conclusion could be reached.

32 The star delta-Eridani shows a heliocentric stellar parallax of almost exactly 1/9 seconds of arc. The distance from our Sun to delta-Eridani is
   a. 9 parsecs.
   b. 4.5 parsecs.
   c. 18 parsecs.
   d. 1/9 parsecs.
   e. 4 parsecs.
33 Here is the Drake Equation: 

\[ N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L \]

In this equation, \( n_e \) stands for the 

a. number of communication-capable civilizations in our galaxy.
b. average number of new stars that form in a year.
c. expected lifetime of a communication-capable civilization.
d. number of extraterrestrial messages that we might expect to detect in a year.
e. average number of habitable planets in a planetary system.

34 A converging lens will send the light from a distant star through a point 

a. infinitely far away from the lens.
b. in the center of the lens.
c. on the side of the lens opposite the star.
d. on the same side of the lens as the star.
e. at one edge of the lens.

35 In the Hertzsprung-Russell Diagram, a main sequence star might be found 

a. halfway up at the right or left.
b. in the upper right or lower left.
c. in the center at the top or bottom.
d. in the lower right or upper left.

36 Here is the Drake Equation: 

\[ N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L \]

In this equation, \( L \) stands for the 

a. number of extraterrestrial messages that we might expect to detect in a year.
b. average number of habitable planets in a planetary system.
c. number of communication-capable civilizations in our galaxy.
d. expected lifetime of a communication-capable civilization.

37 The star Wemadeit shows a stellar parallax angle of 0.3 seconds of arc while the star Waytoo far shows a stellar parallax angle of 0.2 seconds of arc. From this, you can conclude that 

a. Wemadeit is closer to our Sun than Waytoo far.
b. Waytoo far is closer to our Sun than Wemadeit.
c. Waytoo far is moving faster than Wemadeit.
d. Wemadeit is moving faster than Waytoo far.
e. Both stars are at the same distance from our Sun.

38 The Alpha Centauri star system consists of 

a. two stars in orbit around each other.
b. two stars in close orbit around each other and a third star orbiting farther out.
c. three stars in close orbit around each other and two stars orbiting farther out.
d. a single star.
e. three stars in close orbit around each other.
39 Planets that are in orbit around stars other than our own Sun are *most often* found by observing
   a. small changes in pulsar emissions.
   b. telescope images of the planets.
   c. small wobbles in our own Sun.
   d. small wobbles in their primary stars.

40 The main reason to suspect that Europa has a subsurface ocean of water is
   a. low fluxes of epithermal neutrons.
   b. patterns of cracks in the ice on its surface.
   c. geysers of water shooting out through cracks in the moon.
   d. landmarks that are not rotating with the rest of the moon.

41 You see a reflecting telescope with a short, stubby tube and the eyepiece at the back. This telescope uses the
   a. Prime Focus.
   b. Coudé Focus.
   c. Cassegrain Focus.
   d. Newtonian Focus.

42 If we detect that the intensity of the light from a star is mostly constant but drops slightly to a new constant
   value for a while and then returns to its normal level and repeats this behavior at regular intervals, we can
   reasonably suspect that
   a. a rogue planet is passing between us and the star.
   b. the star has a large dark spot on it.
   c. the star is vibrating.
   d. the star has a planet in orbit around it.

43 Barnard's star is a near neighbor of the Sun whose properties we know quite well. It is a type M4V with absolute
   magnitude 13.22. Suppose that another star of spectral type M4V is observed to have apparent magnitude 23.22. How far away is it?
   a. 5 parsecs.
   b. 10 parsecs.
   c. 100 parsecs.
   d. 1 parsec.
   e. 1000 parsecs.

44 Which of the following spectral types corresponds to the star with the highest surface temperature?
   a. K0
   b. G5
   c. G0
   d. K5

45 Compared to a magnitude 6 star, a magnitude 1 star would be
   a. 1,000,000 times as bright.
   b. 10,000,000 times as bright.
   c. 10,000 times as bright.
   d. 1000 times as bright.
   e. 100 times as bright.
46 Which of the following statements best describes the presence of water on Mars?
   a. Mars has liquid water flowing steadily on its surface at the present time.
   b. Mars is completely without any form of water.
   c. Mars has water frozen in its ice caps and may have liquid water below its surface.
   d. Mars has never had liquid water on its surface.

47 The violet lines in the Hydrogen spectrum are normally seen with wavelengths 410nm and 434nm. In the light of a star that is moving away from us, we might expect to see those lines at wavelengths of
   a. 400nm and 424nm
   b. 410nm and 434nm
   c. 415nm and 439nm

48 Which of these moons could have two levels of oceans, with oceans of liquid hydrocarbons on the surface and oceans of liquid water beneath the surface?
   a. Europa.
   b. Enceladus.
   c. Ganymede.
   d. Titan.

49 The luminosity class of a star is
   a. an indication of the broadening of its spectral lines.
   b. an indication of its mass.
   c. another name for its spectral type.
   d. another name for its absolute magnitude.

50 A star with an absolute magnitude of 8.4 and an apparent magnitude of −1.0 would appear in our sky as a star
   a. of average naked-eye brightness.
   b. visible only with a telescope.
   c. barely visible to the naked eye.
   d. of dazzling brightness.
Answer Key: Exam 4 Preview, Version 2

1 Choice d. (near the inner edge of the habitable zone of our Solar System.)
2 Choice e. (E)
3 Choice c. (10 parsecs from the star.)
4 Choice a. (M.)
5 Choice b. (1000 parsecs.)
6 Choice e. (the wavelength of light.)
7 Choice d. (The number of crests that pass in one second.)
8 Choice b. (G2V)
9 Choice d. (distance from one maximum of the radio waves to the next.)
10 Choice b. (increasing surface temperature and absolute brightness.)
11 Choice b. (at the top.)
12 Choice d. (1000m/s)
13 Choice e. (Distant objects are not behaving the same as nearby objects.)
14 Choice e. (+4)
15 Choice d. (nearby stars to shift back and forth once a year.)
16 Choice a. (80 years.)
17 Choice d. (blue.)
18 Choice a. (1.9265°/yr.)
19 Choice a. (spectral lines shifting back and forth.)
20 Choice b. (1000 parsecs.)
21 Choice c. (K)
22 Choice e. (1.1 watts per square meter.)
23 Choice a. (is referred to as the "water hole" and is the frequency band that SETI programs usually choose.)
24 Choice e. (0.2 seconds of arc.)
25 Choice a. (a method for finding distances to stars.)
26 Choice d. (they are collecting and analyzing signals on millions of different radio channels.)
27 Choice c. (stellar spectra to locate stars in the HR diagram.)
28 Choice d. (1,000,000 times as bright.)
29 Choice b. (1200 m/s)
30 Choice a. (light gathering power.)
31 Choice b. (The surface of Mars is extremely hostile to all forms of organic matter.)
32 Choice a. (9 parsecs.)
33 Choice e. (average number of habitable planets in a planetary system.)
34 Choice c. (on the side of the lens opposite the star.)
35 Choice d. (in the lower right or upper left.)
36 Choice d. (expected lifetime of a communication-capable civilization.)
37 Choice a. (Wemadeit is closer to our Sun than Waytoofar.)
38 Choice b. (two stars in close orbit around each other and a third star orbiting farther out.)
39 Choice d. (small wobbles in their primary stars.)
40 Choice b. (patterns of cracks in the ice on its surface.)
41 Choice c. (Cassegrain Focus.)
42 Choice d. (the star has a planet in orbit around it.)
43 Choice e. (1000 parsecs.)
44 Choice c. (G0)
45 Choice e. (100 times as bright.)
46 Choice c. (Mars has water frozen in its ice caps and may have liquid water below its surface.)
47 Choice c. (415nm and 439nm)
48 Choice d. (Titan.)
49 Choice a. (an indication of the broadening of its spectral lines.)
50 Choice d. (of dazzling brightness.)
Where to find these questions in the notes

1. Module 019.401-g01 The Search for Life Extrasolar Planets
2. Module 024.102B-g01 The Hertzsprung-Russell Diagram, A dot for each star
3. Module 022.301-g01 Stellar Magnitudes and Distance Luminosity, Apparent and Absolute Magnitudes
4. Module 023.204-g01 Star Colors and Classes, Spectral Types
5. Module 022.103-g01 Stellar Magnitudes and Distance Luminosity, Brightness and Distance
6. *Module 020.203 Stellar Parallax and Distance Telescopes (35%)
7. *Module 021.103 Using the Doppler Shift Describing Waves (40%)
8. Module 024.403-g01 The Hertzsprung-Russell Diagram, Luminosity Class
9. Module 021.101-g01 Using the Doppler Shift Describing Waves
10. Module 024.303-g01 The Hertzsprung-Russell Diagram, The Main Sequence
11. Module 024.203 The Hertzsprung-Russell Diagram, Interpreting the diagram
12. Module 021.106-g01 Using the Doppler Shift Describing Waves
13. Module 022.504 Stellar Magnitudes and Distance Luminosity, Preview of the Distance Ladder
14. Module 022.202-g01 Stellar Magnitudes and Distance Luminosity, The Magnitude Scale
15. Module 020.302-g01 Stellar Parallax and Distance What Causes Parallax?
16. Module 020.407-g01 Stellar Parallax and Distance Parallax Angle and Distance
17. Module 023.101 Star Colors and Classes, Colors and Temperatures
18. Module 020.502-g01 Stellar Parallax and Distance Parallax Angle and Distance
19. Module 021.301-g01 Using the Doppler Shift Binary Systems
20. Module 022.402-g01 Stellar Magnitudes and Distance Luminosity, Finding the distance (54%)
21. Module 023.202 Star Colors and Classes, Spectral Types
22. ***Module 022.101 Stellar Magnitudes and Distance Luminosity, Brightness and Distance (24%)
23. Module 019.504 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
24. Module 020.402 Stellar Parallax and Distance Parallax Angle and Distance
25. Module 024.502-g01 The Hertzsprung-Russell Diagram, Spectroscopic Parallax
26. Module 019.509 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
27. *Module 024.501 The Hertzsprung-Russell Diagram, Spectroscopic Parallax (40%)
28. **Module 022.203-g01 Stellar Magnitudes and Distance Luminosity, The Magnitude Scale (35%)
29. Module 021.110 Using the Doppler Shift Describing Waves
30. Module 020.203-g01 Stellar Parallax and Distance Telescopes
31. Module 019.205 The Search for Life Mars (50%)
32. EModule 020.406 Stellar Parallax and Distance Parallax Angle and Distance
33. ***Module 019.505-g01 The Search for Life SETI: Search for ExtraTerrestrial Intelligence (28%)
34. Module 020.101 Stellar Parallax and Distance Lenses and Mirrors (43%)
35. Module 024.301 The Hertzsprung-Russell Diagram, The Main Sequence
Module 019.506 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
EModule 020.403-g01 Stellar Parallax and Distance Parallax Angle and Distance
Module 019.409 The Search for Life Extrasolar Planets
Module 019.405 The Search for Life Extrasolar Planets
Module 019.305 The Search for Life The Jovian Moons
Module 020.202 Stellar Parallax and Distance Telescopes
Module 019.414 The Search for Life Extrasolar Planets
Module 024.503-g01 The Hertzsprung-Russell Diagram, Spectroscopic Parallax
Module 023.301 Star Colors and Classes, Spectral Subclasses
Module 022.203-g03 Stellar Magnitudes and Distance Luminosity, The Magnitude Scale
Module 019.203 The Search for Life Mars
Module 021.201-g01 Using the Doppler Shift The Doppler Shift
**Module 019.302-g01 The Search for Life The Jovian Moons (29%)**
Module 024.402-g01 The Hertzsprung-Russell Diagram, Luminosity Class
Module 022.304-g01 Stellar Magnitudes and Distance Luminosity, Apparent and Absolute Magnitudes