1 A star is found to have absolute magnitude 9 and apparent magnitude 24. How far away is it?
   a. 10,000 parsecs.
   b. 10 parsecs.
   c. 20 parsecs.
   d. 200 parsecs.
   e. 100,000 parsecs.

2 Stellar Parallax
   a. could have been detected by Tycho Brahe’s angle-measuring instruments.
   b. is easily seen with the naked eye.
   c. can only be seen with a telescope.

3 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. 1250m/s
   b. 5000m/s
   c. 1000m/s
   d. 2m/s
   e. 2500m/s

4 The Alpha Centauri star system consists of
   a. a single star.
   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.
   d. two stars in orbit around each other.
   e. three stars in close orbit around each other and two stars orbiting farther out.

5 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 lower right or upper left.
   d. in the center at the top or bottom.

6 The star $\pi^3$-Orionis is 8 parsecs from our Sun. The light from $\pi^3$-Orionis has been traveling for
   a. 0.4 years.
   b. 8.0 years.
   c. 26.4 years.
   d. 2.4 years.
   e. 0.125 years.

7 When you tune your radio to a frequency of 101 Mega Hertz, you are setting it to accept a radio signal that
   a. is sent from a tower that is 101 meters tall.
   b. has packets labeled “101 MHZ.”
   c. travels at a speed of 101 million meters per second.
   d. has a distance of 101 meters from one maximum to the next.
   e. vibrates with 101 million maximums per second.
8. From the broadening of its spectral lines, one can determine a star’s
   a. luminosity class.
   b. radial velocity.
   c. apparent brightness.
   d. spectral type.

9. The one-wave turning angle of a telescope mirror determines its
   a. atmospheric limit on its resolution.
   b. chromatic aberration.
   c. light collection ability.
   d. diffraction limit on its resolution.
   e. spherical aberration.

10. The star Wemadeit shows a stellar parallax angle of 0.3 seconds of arc while the star Waytoofar shows a stellar
    parallax angle of 0.2 seconds of arc. From this, you can conclude that
    a. Both stars are at the same distance from our Sun.
    b. Waytoofar is moving faster than Wemadeit.
    c. Wemadeit is moving faster than Waytoofar.
    d. Wemadeit is closer to our Sun than Waytoofar.
    e. Waytoofar is closer to our Sun than Wemadeit.

11. A star that is hotter than most other stars will probably look
    a. blue.
    b. red.
    c. yellow.
    d. peach.
    e. orange.

12. You see a telescope with a long tube and the eyepiece sticking out the side near the top. This telescope uses the
    a. Newtonian Focus.
    b. Cassegrain Focus.
    c. Coudé Focus
    d. Prime Focus.

13. A converging mirror of the sort that is used to collect light in astronomical telescopes
    a. has a focal point on the same side of the mirror as the light source.
    b. has a focal point on the side of the mirror that is farthest from the light source.
    c. spreads parallel light rays apart so that they look as if they are coming from a virtual focal point.
    d. brings parallel light rays to a focus at a point in the center of the mirror.

14. 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. Distant objects are not behaving the same as nearby objects.
    d. The parallaxes of nearby objects have been measured incorrectly.
    e. The parallax-distance formula is incorrect.
15 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. the star has a large dark spot on it.
   b. the star is vibrating.
   c. a rogue planet is passing between us and the star.
   d. the star has a planet in orbit around it.

16 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. 100 parsecs.
   c. 10,000 parsecs.
   d. $10^6$ parsecs.
   e. 1000 parsecs.

17 Which of these moons has landmarks that are not rotating with the rest of the moon, indicating a subsurface ocean?
   a. Enceladus.
   b. Titan.
   c. Europa.
   d. Ganymede.

18 The Viking Landers carried out several experiments on Martian surface soil. One of those experiments, the Pyrolytic Release Experiment gave a positive result for the presence of life forms. That result was interpreted to mean
   a. that life might exist in Martian surface soil.
   b. nothing because a sterilized control sample gave the same result.
   c. nothing because it contradicted the results of the other experiments.

19 A star is seen to move by 2 seconds of arc between February 1, 1999 and August 1, 1999 and then back to its starting point on February 1, 2000. What is the parallax angle for this star?
   a. 3 seconds of arc.
   b. 4 seconds of arc.
   c. 2 seconds of arc.
   d. 5 seconds of arc.
   e. 1 seconds of arc.

20 For stars on the main-sequence, stars with decreasing mass have
   a. decreasing surface temperature and absolute brightness.
   b. decreasing surface temperature and increasing absolute brightness.
   c. increasing surface temperature and decreasing absolute brightness.
   d. increasing surface temperature and absolute brightness.
21 The range of distances of a planet from its primary star that will permit the existence of liquid water on the planet’s surface is called the
   a. inner system.
   b. water hole.
   c. habitable zone.
   d. triple point.

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

23 For an eclipsing spectroscopic binary star system, we can determine
   a. the diameters of both stars in the system.
   b. only a minimum mass for each star.
   c. the masses and diameters of both stars in the system.
   d. only the mass of the smaller star in the system.
   e. the masses of both stars in the system.

24 In a Hertzsprung-Russell diagram, the absolute brightness of stars increases going
   a. to the left.
   b. downward.
   c. upward.
   d. to the right.

25 Barnard’s Star shows a heliocentric stellar parallax near 1/2 seconds of arc. The distance from our Sun to Barnard’s Star is
   a. 2 parsecs.
   b. 0.25 parsecs.
   c. 4 parsecs.
   d. 0.75 parsecs.
   e. 8 parsecs.

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

![Hertzsprung-Russell Diagram](image)
27 The main reason to suspect that Europa has a subsurface ocean of water is
   a. patterns of cracks in the ice on its surface.
   b. low fluxes of epithermal neutrons.
   c. geysers of water shooting out through cracks in the moon.
   d. landmarks that are not rotating with the rest of the moon.

28 A converging lens will send the light from a distant star through a point
   a. on the axis of the lens.
   b. on the focal plane of the lens.
   c. in the center of the lens.
   d. at one edge of the lens.
   e. infinitely far away from the lens.

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

30 A main-sequence star with more mass than our sun will be
   a. hotter and dimmer.
   b. cooler and dimmer.
   c. hotter and brighter.
   d. cooler and brighter.

31 Planets that are in orbit around stars other than our own Sun are *most often* found by observing
   a. telescope images of the planets.
   b. small changes in pulsar emissions.
   c. small wobbles in their primary stars.
   d. small wobbles in our own Sun.

32 Here is the Drake Equation:
   \[ N = R^* \times f_p \times n_e \times f_l \times f_i \times L \]
   In this equation, \( N \) stands for the
   a. number of communication-capable civilizations in our galaxy.
   b. expected lifetime of a communication-capable civilization.
   c. average number of habitable planets in a planetary system.
   d. number of extraterrestrial messages that we might expect to detect in a year.

33 The word 'Parallax' in the term 'Spectroscopic Parallax' is used because that term refers to
   a. the use of parallel lines on the HR diagram.
   b. a method for finding distances to stars.
   c. a method for finding the masses of stars.
   d. the use of stellar parallax.
34 A star whose full spectral type is K2V is
   a. a red supergiant star.
   b. a red subgiant star.
   c. a bright blue supergiant star.
   d. a red giant star.
   e. a red main sequence star.

35 In SETI programs, the "water hole" refers to
   a. a quiet spot in the radio band that is caused by interactions with water molecules in interstellar space.
   b. the range of signal frequencies that are not strongly absorbed or interfered with in our atmosphere and in interstellar space.
   c. the range of signal frequencies between emissions caused by hydrogen and hydroxyl molecules.

36 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. 900,000 watts per square meter.
   b. 33 watts per square meter.
   c. 1000 watts per square meter.
   d. 30000 watts per square meter.
   e. 1.1 watts per square meter.

37 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 are collecting and analyzing signals on millions of different radio channels.
   c. they think it is cool to use that many computers.
   d. each computer does not do very much.

38 A star of spectral type M should look
   a. blue.
   b. yellow.
   c. orange.
   d. white.
   e. red.

39 Black holes are often discovered by observing the shifting of spectral lines in an ordinary star that they are orbiting. Careful measurements of the shifting spectral lines can provide
   a. only a minimum mass for the black hole.
   b. the masses of both the black hole and the normal star.
   c. the masses and diameters of both objects.
   d. only the mass of the normal star in the system.
   e. the diameters of both objects.
40 A star is observed to have an apparent brightness which is $10^{-6}$ times its absolute brightness. How far away is it?
   a. 100 parsecs.
   b. 10,000 parsecs.
   c. 10 parsecs.
   d. $10^6$ parsecs.
   e. 1000 parsecs.

41 The red line of a spectrum is normally at a wavelength of 656 nm. In the light of a star that is moving toward us, we might expect to see that red line at a wavelength of
   a. 660 nm.
   b. 656 nm.
   c. 650 nm.

42 Our Sun is a G2V star with absolute magnitude 4.8. Suppose that a star of spectral type G2V is observed to have apparent magnitude 9.8. How far away is it?
   a. 5 parsecs.
   b. 1000 parsecs.
   c. 100 parsecs.
   d. 1 parsec.
   e. 10 parsecs.

43 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. 10 parsecs from the star.
   b. 100 parsecs from the star.
   c. 1000 parsecs from the star.
   d. 10,000 parsecs from the star.
   e. 1 parsec from the star.

44 The star alpha-Centauri C has moved across the sky by 3853 seconds of arc during the last thousand years - slightly more than one full degree of arc. Its proper motion is closest to
   a. $3853''$/yr.
   b. $0.26''$/yr.
   c. $3.853''$/yr.
   d. $1.9265''$/yr.
   e. $38.53''$/yr.

45 Suppose that a sound wave has a wavelength of 12 meters and a frequency of 1 Hz. What is the speed of sound?
   a. 1200 m/s
   b. 100 m/s
   c. 8.34 m/s
   d. 12 m/s
   e. 0.012 m/s
46 Which of the following spectral types corresponds to the star with the highest surface temperature?
   a. G5
   b. K5
   c. K0
   d. G0

47 Compared to a magnitude 11 star, a magnitude 1 star would be
   a. 10,000 times as bright.
   b. 100 times as bright.
   c. 1,000,000 times as bright.
   d. 10,000,000 times as bright.
   e. 1000 times as bright.

48 Which of the following statements qualifies as a falsifiable working hypothesis of the sort that Karl Popper would favor?
   a. Life arose somewhere and spreads from planet to planet through space-born spores.
   b. Life arises whenever and wherever the conditions are right for it.
   c. Life arose on Earth and exists only there.

49 A star with an absolute magnitude of 5.7 and an apparent magnitude of −1.2 would appear in our sky as a star
   a. of average naked-eye brightness.
   b. that is visible only with a telescope.
   c. that is barely visible to the naked eye.
   d. of dazzling brightness.

50 Which of the following magnitudes corresponds to the brightest star?
   a. +3.4.
   b. +2.1.
   c. −1.5.
   d. +1.2
   e. +5.6.
Answer Key:  Spring 2018 HX04-01

1 Choice a. (10,000 parsecs.)
2 Choice c. (can only be seen with a telescope.)
3 Choice c. (1000m/s)
4 Choice b. (two stars in close orbit around each other and a third star orbiting farther out.)
5 Choice c. (in the lower right or upper left.)
6 Choice c. (26.4 years.)
7 Choice e. (vibrates with 101 million maximums per second.)
8 Choice a. (luminosity class.)
9 Choice d. (diffraction limit on its resolution.)
10 Choice d. (Wemadeit is closer to our Sun than Waytoofar.)
11 Choice a. (blue.)
12 Choice a. (Newtonian Focus.)
13 Choice a. (has a focal point on the same side of the mirror as the light source.)
14 Choice c. (Distant objects are not behaving the same as nearby objects.)
15 Choice d. (the star has a planet in orbit around it.)
16 Choice e. (1000 parsecs.)
17 Choice b. (Titan.)
18 Choice b. (nothing because a sterilized control sample gave the same result.)
19 Choice e. (1 seconds of arc.)
20 Choice a. (decreasing surface temperature and absolute brightness.)
21 Choice c. (habitable zone.)
22 Choice e. (K)
23 Choice c. (the masses and diameters of both stars in the system.)
24 Choice c. (upward.)
25 Choice a. (2 parsecs.)
26 Choice d. (D)
27 Choice a. (patterns of cracks in the ice on its surface.)
28 Choice b. (on the focal plane of the lens.)
29 Choice b. (is referred to as the "water hole" and is the frequency band that SETI programs usually choose.)
30 Choice c. (hotter and brighter.)
31 Choice c. (small wobbles in their primary stars.)
32 Choice a. (number of communication-capable civilizations in our galaxy.)
33 Choice b. (a method for finding distances to stars.)
34 Choice e. (a red main sequence star.)
35 Choice c. (the range of signal frequencies between emissions caused by hydrogen and hydroxyl molecules.)
36 Choice e. (1.1 watts per square meter.)
37 Choice b. (they are collecting and analyzing signals on millions of different radio channels.)
38 Choice e. (red.)
39 Choice a. (only a minimum mass for the black hole.)
40 Choice b. (10,000 parsecs.)
41 Choice c. (650nm.)
42 Choice c. (100 parsecs.)
43 Choice a. (10 parsecs from the star.)
44 Choice c. (3.853''/yr.)
45 Choice d. (12 m/s)
46 Choice d. (G0)
47 Choice a. (10,000 times as bright.)
48 Choice c. (Life arose on Earth and exists only there.)
49 Choice d. (of dazzling brightness.)
50 Choice c. (−1.5.)
Where to find these questions in the online notes

1. Module 022.403-g01 Stellar Magnitudes and Distance Luminosity, Finding the distance
2. Module 020.301-g01 Stellar Parallax and Distance What Causes Parallax?
3. Module 021.106-g01 Using the Doppler Shift Describing Waves
4. Module 019.409 The Search for Life Extrasolar Planets
5. Module 024.301 The Hertzsprung-Russell Diagram, The Main Sequence
6. Module 020.407 Stellar Parallax and Distance Parallax Angle and Distance
7. Module 021.103-g01 Using the Doppler Shift Describing Waves
8. Module 024.402 The Hertzsprung-Russell Diagram, Luminosity Class
9. Module 020.204 Stellar Parallax and Distance Telescopes
10. Module 020.403-g01 Stellar Parallax and Distance Parallax Angle and Distance
11. Module 023.101-g01 Star Colors and Classes, Colors and Temperatures
12. Module 020.201 Stellar Parallax and Distance Telescopes
13. ***Module 020.104-g01 Stellar Parallax and Distance Lenses and Mirrors (20%)
14. Module 022.504 Stellar Magnitudes and Distance Luminosity, Preview of the Distance Ladder
15. Module 019.414 The Search for Life Extrasolar Planets
16. Module 022.103-g01 Stellar Magnitudes and Distance Luminosity, Brightness and Distance
17. *Module 019.302 The Search for Life The Jovian Moons (37%)
18. Module 019.207 The Search for Life Mars
19. Module 020.401-g01 Stellar Parallax and Distance Parallax Angle and Distance
20. **Module 024.304-g01 The Hertzsprung-Russell Diagram, The Main Sequence (33%)
21. Module 019.402 The Search for Life Extrasolar Planets
22. Module 023.202 Star Colors and Classes, Spectral Types
23. Module 021.307 Using the Doppler Shift Binary Systems
24. Module 024.203-g01 The Hertzsprung-Russell Diagram, Interpreting the diagram
25. EModule 020.405-g01 Stellar Parallax and Distance Parallax Angle and Distance
26. Module 024.102A The Hertzsprung-Russell Diagram, A dot for each star
27. Module 019.305 The Search for Life The Jovian Moons
28. Module 020.101-g01 Stellar Parallax and Distance Lenses and Mirrors
29. Module 019.504 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
30. Module 024.303 The Hertzsprung-Russell Diagram, The Main Sequence
31. Module 019.405 The Search for Life Extrasolar Planets
32. Module 019.505 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
33. Module 024.502 The Hertzsprung-Russell Diagram, Spectroscopic Parallax
34. Module 024.404 The Hertzsprung-Russell Diagram, Luminosity Class
35. *Module 019.503 The Search for Life SETI: Search for ExtraTerrestrial Intelligence (37%)
36 ***Module 022.101 Stellar Magnitudes and Distance Luminosity, Brightness and Distance (24%)
37 Module 019.509 The Search for Life SETI: Search for ExtraTerrestrial Intelligence
38 Module 023.203 Star Colors and Classes, Spectral Types
39 ****Module 021.305-g01 Using the Doppler Shift Binary Systems(15%)
40 *Module 022.103 Stellar Magnitudes and Distance Luminosity, Brightness and Distance (35%)
41 Module 021.204 Using the Doppler Shift The Doppler Shift
42 Module 024.503 The Hertzsprung-Russell Diagram, Spectroscopic Parallax
43 Module 022.301-g01 Stellar Magnitudes and Distance Luminosity, Apparent and Absolute Magnitudes
44 Module 020.502 Stellar Parallax and Distance Parallax Angle and Distance
45 Module 021.110-g01 Using the Doppler Shift Describing Waves
46 Module 023.301 Star Colors and Classes, Spectral Subclasses
47 Module 022.203-g02 Stellar Magnitudes and Distance Luminosity, The Magnitude Scale
48 Module 019.101-g01 The Search for Life The Motivation
49 Module 022.304 Stellar Magnitudes and Distance Luminosity, Apparent and Absolute Magnitudes
50 Module 022.201 Stellar Magnitudes and Distance Luminosity, The Magnitude Scale