1. Galileo was able to determine a precise value of the speed of light by using a technique that involved shuttered lanterns and his assistant on a different hill of known distance.
   A) True
   B) False

2. According to Einstein's special theory of relativity, nothing can travel faster than the speed of light.
   A) True
   B) False

3. Isaac Newton was the first person to offer an explanation of light as being in the form of waves.
   A) True
   B) False

4. Our eyes can only see a small band of the entire spectrum of light.
   A) True
   B) False

5. Light has properties of both waves and particles.
   A) True
   B) False

6. As the frequency of light increases, the wavelength of light also increases.
   A) True
   B) False

7. X-rays are a form of light and, because of this, will travel at the speed of light.
   A) True
   B) False

8. Infrared light allows astronomers to view warm stars in clouds of dust and gas that are not viewable in visible light.
   A) True
   B) False

9. The wavelength of the maximum emission of an object depends only on the size of an object.
   A) True
   B) False

10. How much energy a star emits is determined by both temperature and surface area.
   A) True
   B) False

11. A hot, transparent gas produces a continuous spectrum.
   A) True
   B) False

12. Electrons can jump only to specific orbits with certain energy levels within atoms.
   A) True
   B) False

13. The Doppler effect is an important tool in astronomy because it uncovers basic information about the temperature of objects in space.
   A) True
   B) False

14. The successor of the Hubble Space Telescope is the James Webb Space Telescope.
   A) True
   B) False

15. The atmosphere is transparent to most radio waves.
   A) True
   B) False

16. The first recorded experiment on passing light through a glass prism was performed by Isaac Newton.
   A) True
   B) False

17. Sunlight is made of a mixture of all colors that can be spread out into a spectrum.
    A) True
    B) False

18. A blackbody curve graphs brightness of a star over time.
    A) True
    B) False

19. The Compton Gamma Ray Observatory was designed to capture intense energy bursts from black holes and the merging of neutron stars.
    A) True
    B) False

20. A blackbody curve graphs brightness of a star over time.
    A) True
    B) False

21. Who first demonstrated that light does NOT travel at infinite speed?
    A) Isaac Newton
    B) Ole Rømer
    C) James Clerk Maxwell
    D) Joseph von Fraunhofer

22. How far apart from each other would Galileo and his assistant had to have been in order for the round-trip time of their beam of light to equal 1 second?
    A) 1500 km
    B) 15,000 km
    C) 150,000 km
    D) 150,000,000 km

23. Who performed an experiment with an assistant at night on two hilltops a known distance apart with lanterns to try to measure the speed of light?
    A) Aristotle
    B) Galileo
    C) Newton
    D) Einstein

24. In 1675, Rømer measured the speed of light by
    A) timing eclipses of Jupiter's satellites, which appeared to occur later when Earth was farther from Jupiter.
    B) measuring how long it took the light from stars located at different distances to reach Earth.
    C) reflecting light from a mirror rotating at a known speed and measuring the angle of deflection of the light beam.
    D) opening a shutter on a lantern on a hilltop and measuring the time taken for light from an assistant's shuttered lantern to return.

25. The first reliable method developed to measure the speed of light involved
    A) careful observation of the motions of the moons of Jupiter at different times in Jupiter's orbit.
    B) observing the opening and closing of shutters on lanterns on hilltops separated by a known distance.
    C) bouncing a beam of light off several different mirrors.
    D) making careful measurements of the orbital path of the Moon around Earth.

26. Which has the greatest energy?
    A) Infrared light
    B) Visible light
    C) Ultraviolet light
    D) They all have the same energy.

27. What kind of light has the lowest energy?
    A) X-ray
    B) Ultraviolet
    C) Radio
    D) They all have the same energy

28. Radio waves travel through space at what speed?
    A) Much faster than the speed of light
    B) Faster than the speed of light because their wavelength is longer
    C) Slower than the speed of light
    D) At the speed of light, 3×10^8 m/s

29. When light passes through a prism of glass, the
    A) different colors are caused by multiple reflections in the prism and interference between the resulting beams.
    B) prism absorbs colors from different parts of the broad beam coming out of the prism, leaving the complementary colors that we see.
    C) prism adds colors to different parts of the broadly scattered beam coming out of it.
    D) different colors or wavelengths of light are separated in angle by the prism.

30. Around 1670, Isaac Newton performed a crucial experiment on the nature of light when he
    A) showed the wave nature of light by passing light through two slits and obtaining a pattern of bright interference bands on a screen.
    B) showed that light that passes through a prism has a spectrum of colors added to it by the prism.
    C) proved mathematically that light can be described by oscillating electric and magnetic fields.
    D) demonstrated that the colors that make up white light are intrinsic, not produced by the glass through which the light passes.

31. White light passes through a prism and separates into a spectrum of colors. All of these colors are recombined into a single beam by means of a lens. What color is this beam?
    A) White
    B) Black (there will be no light left)
    C) It will be in the ultraviolet region of the spectrum.
    D) It will be in the infrared region of the spectrum.

32. Who first proved that light is a wave?
    A) James Clerk Maxwell
    B) Albert Einstein
    C) Isaac Newton
    D) Thomas Young

33. Who was the first person to suggest that light is an electromagnetic wave?
    A) Albert Einstein
    B) Thomas Young
    C) Isaac Newton
    D) James Clerk Maxwell

34. Visible light occupies which position in the whole electromagnetic spectrum?
    A) Between radio and infrared radiation
    B) Between ultraviolet and X-rays
    C) Between infrared and ultraviolet
    D) Between infrared and microwave

35. Around 1800, William Herschel passed light through a prism and discovered that part of the NONVISIBLE radiation in the resulting spectrum would raise the temperature of a thermometer. This portion of the electromagnetic spectrum is
    A) radio.
    B) infrared.
    C) ultraviolet.
    D) X-ray.

36. Violet light differs from red light in that violet light
    A) has a longer wavelength than red light.
    B) travels more slowly (through a vacuum) than red light.
    C) travels more quickly (through a vacuum) than red light.
    D) has a shorter wavelength than red light.

37. In terms of wavelengths, gamma rays are
    A) the shortest wavelength electromagnetic waves.
    B) intermediate between radio and infrared waves.
    C) intermediate between X-rays and ultraviolet waves.
    D) the longest wavelength electromagnetic waves.

38. Which of the following is an electromagnetic wave?
    A) Microwave
    B) Gravitational wave
    C) Cosmic-ray proton
    D) Sound wave

39. What is the wavelength of radiation emitted by an FM radio station transmitting at a frequency of 100 MHz (or 10^8 Hz)?
    A) 300 m
    B) 0.03 m
    C) 1 m
    D) 3 m

40. On the absolute scale of temperature (in kelvins), the zero of the scale corresponds to the
    A) freezing point of hydrogen.
    B) melting point of ice.
    C) mean temperature of space.
    D) temperature at which motions of atoms and molecules essentially cease.

41. The Kelvin scale measures
    A) temperature referenced to zero at the freezing point of water.
    B) mass per unit volume, or density, with water having a value of 1.0.
    C) temperature in Fahrenheit-sized degrees above absolute zero.
    D) temperature in Celsius-sized degrees above absolute zero.

42. A typical but very cool star might have a temperature of 3100°C. On the Kelvin scale, this is about
    A) 2827 K.
    B) 3068 K.
    C) 3373 K.
    D) 3100 K, because Kelvin and Celsius degrees are the same.

43. A scientist measures the temperature change between freezing water and boiling water with a thermometer calibrated in the Kelvin or absolute scale. How many degrees kelvin (K) will he measure?
    A) 180
    B) 273
    C) 373
    D) 100

44. The “color” or wavelength of maximum emission of radiation for a hot, solid body (or a dense gas such as a star) when the body cools from a temperature of several thousand degrees
    A) remains fixed, as the light fades and eventually becomes invisible to the eye.
    B) moves toward the red end of the spectrum.
    C) moves toward the blue end of the spectrum.
    D) remains absolutely constant, depending only on the original color of the body.

45. The human eye has evolved over time so that its peak wavelength sensitivity is about 0.5 μm (1 μm = 10^{-6} m). Use Wien's law to calculate the temperature of blackbody radiation to which the eye is most sensitive.
    A) 14,240 K
    B) 0.58 K
    C) 580 K
    D) 5800 K

46. The energy flux *F* from a star is the
    A) amount of visible light energy emitted by each square meter of the star's surface each second.
    B) amount of energy emitted by each square meter of the star's surface each second.
    C) total energy emitted by the star over its lifetime.
    D) amount of energy emitted by the entire star each second.

47. The total energy emitted per unit time at all wavelengths from an object increases by what factor if its temperature is increased by a factor of 3 (e.g., from room temperature to 900 K)?
    A) 27
    B) 81
    C) 3
    D) 9

48. The star Vega has a higher surface temperature than the Sun; therefore (with IR = infrared and UV = ultraviolet),
    A) Vega emits less IR and more UV flux than the Sun.
    B) Vega emits less IR and less UV flux than the Sun.
    C) Vega emits more IR and less UV flux than the Sun.
    D) Vega emits more IR and more UV flux than the Sun.

49. A metal rod is heated in a flame. It is at its hottest when the color of the rod glows
    A) red.
    B) orange.
    C) yellow.
    D) red-orange.

50. What changes would you expect to see in the resulting spectrum of emitted light from a piece of metal when it is heated slowly in an intense flame from 500 K to 1500 K?
    A) The intensity of radiation would decrease and the color would remain the same.
    B) The intensity of radiation would increase and its color would change from red through orange toward yellow.
    C) The intensity of radiation would increase, and the color would remain the same.
    D) The intensity of radiation would remain constant, while the color would change from yellow to orange and red.

51. The hot, dense gas existing in the Sun emits energy
    A) at all wavelengths uniformly.
    B) at all wavelengths, with a peak at one particular wavelength (color).
    C) only at certain wavelengths and no others.
    D) mostly at the longest and shortest wavelengths, less in between.

52. The early workers in spectroscopy (Fraunhofer with the solar spectrum; Bunsen and Kirchhoff with laboratory spectra) discovered what very significant fact about the spectra produced by hot gases, such as elements heated in a flame?
    A) The higher the temperature, the greater the proportion of red in the emitted spectral lines.
    B) They produce their own characteristic pattern of spectral lines, which remain fixed as the temperature increases.
    C) They emit spectral lines that move continuously toward the blue end of the spectrum as the gas temperature increases.
    D) They produce the same set of spectral lines and are hence indistinguishable.

53. The chemical makeup of a star's surface is obtained by
    A) measuring the chemical elements present in the stellar wind.
    B) theoretical methods, considering the evolution of the star.
    C) taking a sample of the surface with a space probe.
    D) spectroscopy of the light emitted by the star.

54. Spectral lines are of particular importance in astronomy because
    A) each different element has a characteristic line spectrum.
    B) they can be observed through a diffraction grating.
    C) they are the only light bright enough to be seen at large distances.
    D) only stars produce bright line spectra.

55. An astronomer studying a particular object in space finds that the object emits light only in specific, narrow emission lines. The correct conclusion is that this object
    A) cannot consist of gases but must be a solid object.
    B) is made up of a hot, dense gas surrounded by a rarefied gas.
    C) is made up of a hot, dense gas.
    D) is made up of a hot, low-density gas.

56. The gas in interstellar space between the stars is very tenuous ("thin"). Near a hot star, this gas is heated to a high temperature. Any such hot, tenuous gas emits light
    A) at all wavelengths, peaking at a certain wavelength or color.
    B) at no wavelength, because hot thin gases do not emit light.
    C) only at specific wavelengths ("spectral lines"), and these spectral lines do not change in wavelength as the temperature changes.
    D) only of specific colors ("spectral lines") whose wavelengths change as the temperature changes.

57. Atoms in a hot, low-density gas (e.g., in a laboratory-type spectral source) emit a spectrum that is
    A) a series of specific colors at the same wavelengths, independent of the type of atom excited.
    B) a series of specific colors, whose positions change as the gas temperature changes.
    C) continuous over all visible wavelengths, with maximum intensity in the blue.
    D) a series of specific colors, unique to the type of atom in the tube, but fixed in position even when the gas temperature changes.

58. If a certain gas is heated and observed through a grating, a bright line spectrum will be seen. If, instead, a source of continuous spectrum shines through a cooler sample of this same gas, a dark absorption spectrum is observed. How do the positions of the lines in these two spectra compare?
    A) All of the lines in the spectrum from the hot gas will be at higher frequencies than the corresponding lines in the spectrum of the cooler gas.
    B) All of the lines in the spectrum from the hot gas will be at lower frequencies than the corresponding lines in the spectrum of the cooler gas.
    C) The lines in the two spectra will be at the same frequencies. They will be the same spectra.
    D) These two processes produce spectra by completely different means, and there will be no relationship at all between the two spectra.

59. Why is the sky blue?
    A) The air molecules absorb red light better than blue light, allowing more blue light to reach our eyes.
    B) The air molecules scatter blue light better than red light, so more blue light reaches our eyes.
    C) The air molecules scatter red light better than blue light, so less red light reaches our eyes.
    D) The air molecules absorb blue light better than red light, making the sky appear bluer.

60. The setting Sun appears red because
    A) its light is scattered by a thicker layer of air than during the day.
    B) red light is more refracted around the horizon than is blue light.
    C) the Sun is cooler in the evening.
    D) red light is more diffracted around the horizon than is blue light.

61. Chemical pollution often results in large numbers of very small particles being emitted into the atmosphere. What effect, if any, will this have on the color of the sunset?
    A) It should have no effect.
    B) It should make the sunset look less red.
    C) It should make the sunset look more red.
    D) Its effect depends on the color of the pollutants.

62. The basic makeup of an atom is
    A) small, negatively charged particles orbiting around a central positive charge.
    B) negative and positive charges mixed uniformly over the volume of the atom.
    C) small, positively charged particles orbiting around a central negative charge.
    D) miniature planets, possibly with miniature people, gravitationally bound in orbits around a miniature star.

63. The specific colors of light emitted by an atom in a hot, thin gas (e.g., in a tube in a laboratory or a gas cloud in space) are caused by
    A) the vibrations of the electrons within the atom.
    B) an electron dropping into the nucleus and causing changes in the energy of the nucleus.
    C) electrons jumping to lower energy levels, losing energy as they do so.
    D) protons jumping from level to level.

64. When astronomers look for evidence of hydrogen gas in the spectra of the Sun, the planets, and nearby stars, the positions of the spectral features or “lines” due to hydrogen
    A) are in a very different pattern, depending on the location of the planet or star, and are reproduced only with difficulty in the laboratory.
    B) are always in the same pattern, characteristic of hydrogen gas, as seen in the laboratory.
    C) change systematically, depending on the distance from the source, starting with a laboratory pattern.
    D) are in the same pattern for solar and planetary sources but are very different for stars at larger distances because of absorption of light by the interstellar matter.

65. Electrons in atoms
    A) occupy levels whose energies are fixed.
    B) can have any energy.
    C) cannot interact with light.
    D) can only absorb light.

66. The observed change in wavelength due to the Doppler effect occurs
    A) whenever the light source is moving with respect to the observer (regardless of direction).
    B) only when the light source has a radial velocity (toward or away from the observer).
    C) only when the temperature of an object changes.
    D) only when the light source has a proper motion (across the line of sight).

67. According to the Doppler effect,
    A) the wavelength of light is shifted to a shorter wavelength if the source of light is moving toward you.
    B) the wavelength of light is shifted to a longer wavelength if the source of the light is moving toward you.
    C) the wavelength of peak emission of light from a source changes as the temperature of the source changes.
    D) spectral lines are split into two or more wavelengths when the source of the light is in a strong magnetic field.

68. The spectrum of a star shows an equivalent set of dark absorption lines to those of the Sun, with one exception: Every line appears at a slightly longer wavelength, shifted toward the red end of the spectrum. What conclusion can be drawn from this observation?
    A) The star is moving rapidly toward Earth.
    B) A cloud of dust surrounds the star and absorbs the light.
    C) The star is moving rapidly away from Earth.
    D) The temperature of the star's surface is higher than that of the Sun.

69. When an object is moving toward you, the visible radiation that it emits is Doppler shifted toward the
    A) ultraviolet.
    B) infrared.
    C) microwave.
    D) radio.

70. Normal human body temperature is about how much in the Kelvin scale?
    A) 37 K
    B) 100 K
    C) 310 K
    D) 1000 K

71. The main optical element in a refracting telescope is a
    A) lens.
    B) mirror.
    C) combination of many small plane mirrors.
    D) prism of glass.

72. A typical refracting telescope is made up of
    A) a long-focal-length lens at the front and a short-focal-length lens at the rear (next to your eye as you look through the telescope).
    B) a short-focal-length lens at the front and a long-focal-length lens at the rear (next to your eye as you look through the telescope).
    C) a mirror that gathers and focuses the light, and a lens next to your eye to examine the image.
    D) two mirrors: one concave in shape and the second convex in shape.

73. The major reason astronomers seek funds to build larger telescopes is to
    A) bring stars closer to Earth.
    B) measure a wider spectrum of light from stars.
    C) provide magnified images of stars.
    D) collect more light from distant objects.

74. The light-gathering power of a telescope is related directly to the
    A) image quality of its optics (resolution).
    B) area of its primary mirror or lens.
    C) focal length of its primary mirror or lens.
    D) ratio of the focal lengths of its primary element (mirror or lens) and its eyepiece.

75. By what factor is the amount of light gathered by the 10-m diameter Keck telescope on Mauna Kea, Hawaii, greater than that gathered by the 2.5-m diameter Mount Wilson telescope?
    A) 4
    B) 16
    C) 256
    D) 2

76. A particular reflecting telescope has an objective mirror with a focal length of 1.2 m and an eyepiece lens of focal length 6 mm. What is the magnifying power of this telescope?
    A) 5×
    B) 2000×
    C) 20×
    D) 200×

77. A department store sells an “astronomical telescope” with an objective lens of 30 cm focal length and an eyepiece lens of focal length 5 mm. What is the magnifying power of this telescope?
    A) 150×
    B) 6×
    C) 15×
    D) 60×

78. Which of the following does NOT represent a major drawback when developing a refracting telescope for astronomy?
    A) Lenses cannot be made with focal lengths that produce very high magnifications.
    B) Glass lenses are not completely transparent to certain kinds of light, restricting the observable wavelength range.
    C) The lens brings different wavelengths of light to a focus at different positions.
    D) The presence of defects in the glass lens through which the light must pass causes some of the light to scatter out of the beam.

79. How can you increase the magnification of a refracting telescope without decreasing the light-gathering power?
    A) Decrease both the diameter and the focal length of the objective lens.
    B) Increase the focal length of the eyepiece.
    C) Decrease the focal length of the eyepiece.
    D) Increase the diameter of the eyepiece.

80. Why was adaptive optics developed?
    A) To prevent distortion of mirrors by the vacuum of space
    B) To prevent distortion by sagging in very thin, lightweight mirrors
    C) To compensate for spherical aberration
    D) To compensate for image distortion caused by Earth's atmosphere

81. In many instances, the detector that has replaced the photographic plate for astronomical photography is the
    A) diffraction grating.
    B) CCD (charge-coupled device).
    C) interferometer.
    D) PMT (photomultiplier tube).

82. What percentage of the light falling on a piece of photographic film is typically wasted (does not contribute to the formation of the image)?
    A) 2%
    B) 45%
    C) 18%
    D) 98%

83. The fraction of incoming photons recorded by a charge-coupled device (CCD) is greater than that recorded by a typical photographic plate by what factor?
    A) 10 times
    B) 2 times
    C) More than 100 times
    D) 35 times

84. Which part of the electromagnetic spectrum do mammals emit most strongly?
    A) Radio
    B) Infrared
    C) Ultraviolet
    D) X-ray

85. The two ranges of electromagnetic radiation for which Earth's atmosphere is reasonably transparent are
    A) UV and radio waves.
    B) visible and far-infrared radiation.
    C) X-rays and visible radiation.
    D) visible and radio radiation.

86. Earth's atmosphere is transparent and allows radiation to pass through
    A) all across the electromagnetic spectrum.
    B) only in the visible range of the electromagnetic spectrum.
    C) mostly in the visible and radio ranges of the electromagnetic spectrum.
    D) everywhere, except the radio range of the electromagnetic spectrum.

87. The main reason for placing astronomical telescopes and detectors on satellites is to
    A) avoid dust and haze in Earth's atmosphere.
    B) avoid light pollution from cities and other built-up areas.
    C) get closer to the objects being viewed.
    D) get above the absorption in Earth's atmosphere.

88. How much more light will be collected by the optics of one side of a pair of binoculars (7×50, with magnification of 7 and an objective lens aperture diameter of 50 mm) compared to that collected by an average human eye with a typical aperture diameter of 5 mm?
    A) 10
    B) 2500
    C) 100
    D) 1.4, or 7/5

89. An amateur astronomer has a telescope with an objective lens that measures 20 cm in diameter and 100 cm in focal length. What focal length of eyepiece should he or she choose in order to obtain a magnification of 50× (“50 power”)?
    A) 0.5 cm
    B) 0.4 cm
    C) 2 cm
    D) 5 cm

90. Many fortunate amateur astronomers have telescopes with primary mirrors 20 cm in diameter. The recently built Keck telescopes on Hawaii have mirrors 10 m in diameter. How much more light is collected by one of the Keck telescopes compared with the amateur's telescope?
    A) 2500 times more
    B) 50 times more
    C) About 7 times more
    D) 2 times less

91. X-ray telescopes in space are primarily used for examining which kind of environment in the universe?
    A) Extremely cool regions of space, because only X-rays can penetrate them
    B) Extremely hot regions around stars and galactic centers
    C) The deep interiors of normal stars from which only the penetrating X-rays can escape
    D) Comets and planets

92. Which of the following sentences CORRECTLY describes an advantage of a large refracting telescope over a large reflecting telescope?
    A) A refracting telescope is not subject to as many aberrations as a reflecting telescope.
    B) A refracting telescope has no obstruction that blocks part of the light entering the telescope.
    C) The lens in a refracting telescope can be made larger than the mirror in a reflecting telescope.
    D) A refracting telescope does not sag like a reflecting mirror does.

93. For a telescope in space, above the distortion due to Earth's atmosphere, the angular resolution of the telescope
    A) is better (can see finer detail) in blue light than in red light.
    B) is better (can see finer detail) in red light than in blue light.
    C) is the same for all wavelengths of light.
    D) cannot be determined from the information given.

94. The frequency associated with blue light compared to that of red light is
    A) the same, because both red and blue are part of the visible light spectrum.
    B) higher.
    C) lower.
    D) cannot be determined from the information given.

95. Which of the following objects is most likely to be studied in infrared light?
    A) A halo of hot, tenuous gas around a galaxy
    B) Dust disks around stars
    C) Radioactive elements in the debris cloud from a supernova explosion
    D) Stars like our Sun

96. Young's double-slit experiment demonstrates that
    A) light acts like a stream of particles, producing two bright images of the slits on a screen.
    B) light acts like waves that interfere with one another, producing light and dark bands projected on a screen.
    C) it is impossible to predict what pattern will be projected on a screen.
    D) it depends on the color of the light as to whether you see two bright images or multiple light and dark bands.

97. Sir William Hershel passed a beam of sunlight through a prism and held a thermometer just beyond the end of the visible spectrum. The thermometer registered a temperature increase, indicating that it was being exposed to an invisible form of energy that is now called
    A) radio waves.
    B) microwaves.
    C) infrared light.
    D) ultraviolet light.

98. Infrared astronomy is especially important for studying what kind of objects?
    A) Planets around stars other than the Sun
    B) Black holes at the centers of galaxies
    C) Large stars when they explode
    D) Newborn stars hidden in dusty gas clouds

99. All objects, including stars, emit light
    A) over a range of wavelengths.
    B) at only one specific wavelength.
    C) at only a few specific wavelengths.
    D) at any of these options.

100. The speed of light is 3×10^8 m/s. If the frequency of a radio wave from an AM station is 900 kilohertz (or 900,000 Hertz), what is its wavelength?
    A) About 0.003 meters
    B) About 27,000 meters
    C) About 333 meters
    D) About 900,000 meters

101. What would you see if you passed the light from firework displays through a prism?
    A) A full, continuous rainbow of colors
    B) Only one color, the color of the firework display
    C) A pattern of thin, dark lines against a rainbow background
    D) A pattern of thin, bright lines against a dark background

102. When an object is moving away from you, the visible radiation that it emits is Doppler shifted toward the
    A) ultraviolet.
    B) infrared.
    C) gamma rays.
    D) X-rays.

103. Why are spectral lines so tremendously important in astronomy?
    A) They allow us to see black holes and other hidden objects in space.
    B) They can help determine unknown substances in the laboratory.
    C) They provide reliable evidence of the chemical composition of distant objects.
    D) They are difficult and expensive to obtain.

104. Doppler radar is used in meteorology. What does this measure?
    A) Composition of the clouds and atmosphere
    B) Color of the clouds and atmosphere
    C) Speeds of the clouds and atmosphere
    D) Weight of the clouds and atmosphere

105. When an electron jumps from a higher energy level to a lower one, the atom will
    A) emit a particular wavelength of light.
    B) absorb a particular wavelength of light.
    C) emit light of any random wavelength.
    D) absorb light of any random wavelength.

106. How is the spectrum of a bright-line emission spectrum changed from a cloud of interstellar gas that is moving away as opposed to a stationary one relative to us?
    A) The bright lines will be shifted toward the blue part of the spectrum.
    B) The emission spectrum would be turned into an absorption spectrum.
    C) The bright lines will be shifted toward the red part of the spectrum.
    D) Some bright lines would shift toward the red part of the spectrum and some would shift toward the blue part of the spectrum.

107. If someone says they are using a 12-inch telescope, to what dimension of the telescope's size are they most likely referring?
    A) Focal length
    B) Diameter
    C) Radius
    D) Length of the tube

108. How do eyepieces with the smallest focal lengths change a telescope's overall magnification?
    A) The smaller the eyepiece focal length, the greater the magnification.
    B) The smaller the eyepiece focal length, the smaller the magnification.
    C) The magnification does not depend at all on the eyepiece's focal length.
    D) The answer depends on whether you are using a reflecting or refracting telescope.

109. The frequency associated with orange light compared to that of violet light is
    A) the same, because both orange and violet are part of the visible light spectrum.
    B) lower.
    C) higher.
    D) cannot be determined from the information given.

110. The wavelength associated with blue light compared to that of red light is
    A) the same, because both red and blue are part of the visible light spectrum.
    B) bigger.
    C) smaller.
    D) cannot be determined from the information given.

111. What instrument is planned to be the successor to the Hubble Space Telescope?
    A) The Spitzer Telescope
    B) The James Webb Space Telescope
    C) The Extreme Ultraviolet Telescope
    D) The Chandra X-Ray Telescope

112. The light gathering capability of a telescope depends mainly on its
    A) focal length.
    B) eyepiece size.
    C) length of the tube.
    D) area of the primary lens or mirror.

113. For which of these wavelengths would it not be as beneficial to put a telescope in orbit as a space telescope to detect because of its transparency through Earth's atmosphere.
    A) Ultraviolet
    B) X-Ray
    C) Gamma rays
    D) Radio

114. What was Galileo's method for trying to determine the speed of light?

115. How does Wien's law help us determine the temperature of celestial objects?

116. Why is the study of spectroscopy so important for the study of astronomy?

117. How do the interactions between light and atoms produce spectrum lines?

118. Why is the sky blue?

119. What are the different types of spectra, as described by Kirchhoff's laws, and what kinds of objects produce each?

120. What causes the Doppler effect and why is it so important for the study of astronomy?

121. What advantages do space-based telescopes have over Earth-based observatories?

122. Why are CCD cameras used more often than photographic plates in current astronomical research?

123. How do adaptive optics allow telescopes to achieve such high resolution?

124. In large sizes, which telescopes can be made lightest and most inexpensively, reflecting or refracting telescopes?

125. Why must you use Kelvin units instead of Celsius or Fahrenheit in many of the relationships that include temperature?

Answer Key

1. B
2. A
3. B
4. A
5. A
6. B
7. A
8. A
9. B
10. A
11. B
12. A
13. B
14. A
15. A
16. A
17. A
18. B
19. A
20. B
21. B
22. C
23. B
24. A
25. A
26. C
27. C
28. D
29. D
30. D
31. A
32. D
33. D
34. C
35. B
36. D
37. A
38. A
39. D
40. D
41. D
42. C
43. D
44. B

45. D
46. B
47. B
48. D
49. C
50. B
51. B
52. B
53. D
54. A
55. D
56. C
57. D
58. C
59. B
60. A
61. C
62. A
63. C
64. B
65. A
66. B
67. A
68. C
69. A
70. C
71. A
72. A
73. D
74. B
75. B
76. D
77. D
78. A
79. B
80. D
81. B
82. D
83. D
84. B
85. D
86. C
87. D
88. C
89. C
90. A

91. B
92. B
93. A
94. B
95. B
96. B
97. C
98. D
99. A
100. C
101. D
102. B
103. C
104. C
105. A
106. C
107. B
108. A
109. B
110. C
111. B
112. D
113. D
114. Galileo and an assistant stood at night on two hilltops a known distance apart, each holding a shuttered lantern. First, Galileo opened the shutter of his lantern; as soon as his assistant saw the flash of light, he opened his own. Using his pulse as a timer. Galileo found that the measured time failed to increase noticeably, no matter how distant the assistant was stationed. Galileo therefore concluded that the speed of light is too high to be measured by slow human reactions.
115. The higher an object's temperature, the more intensely the object emits light and the shorter the wavelength at which it emits light most strongly. So, if you can determine the wavelength at which the object emits light most strongly, you can determine the temperature at a distance.
116. Spectroscopy, the study of unique spectral lines for each chemical substance, provides the identification of elements in objects at a distance.
117. An atom absorbs a photon of energy of the precise amount to jump to a higher excited orbit. When that electron relaxes or jumps back down to a lower energy level, a photon of the same precise energy is released producing an emission line of a specific frequency and wavelength.
118. The light is scattered by a process in which very small particles—ones that are smaller than a wavelength of visible light are quite effective at scattering short-wavelength photons of blue light, but less effective at scattering long-wavelength photons of red light.
119. The three different types of spectra are continuous, emission, and absorption. A hot, opaque body or a hot, dense gas produces a continuous spectrum; a hot, transparent gas produces an emission spectrum; and a cool, transparent gas in front of a source of a

continuous spectrum produces an absorption spectrum.

120. The Doppler effect is the difference in the observed wavelength from a moving source of waves, sound and light, compared to the emitted wavelength. This is important for the study of astronomy because the red or blue shift determines the relative motion toward or away from the observer.
121. Space-based telescopes are above the atmosphere of Earth and are not susceptible to atmospheric distortion, bright skies during the day, as well as cloudy nights. They are also able to resolve light that does not penetrate the atmosphere, such as UV and X-rays.
122. CCD cameras are much more effective at collecting light than photographic film because they are more sensitive and provide very fine image details. They can also save these images easily on a computer.
123. Optical sensors monitor the motion of the atmosphere that blurs stars, and fast-acting mechanical devices called actuators move to distort the mirror to compensate for the atmospheric distortion and make objects much clearer.
124. Reflecting telescopes can be made with lightweight segment of mirror rather than the expensive and heavy lenses required in refracting telescopes.
125. Kelvin is an absolute scale, which means that the limit for the coldest it could every possibly get is zero. This means that the values never have negative numbers, which would make many of our relationships meaningless.