

Write the color of your test booklet on the top of your bubble sheet!

Be sure to fill in your name and ID#

Also, please follow the standard bubble-sheet drill:

- use a #2 pencil
- completely fill in the circles
- If you want to change an answer, be sure to completely erase the old one

1. Where did the Big Bang occur?
 - A) First the fabric of space came into existence, then the Big Bang appeared at some arbitrary point within it.
 - B) At all points simultaneously on the surface of an expanding balloon.
 - C) Everywhere in the universe at once, because the entire universe (including space itself) was a point.
 - D) All of these statements are equally correct.
 - E) At a single point in the center of the then-existing universe.
2. Masses of galaxies can be determined by calculations based on
 - A) their motions within a cluster.
 - B) galaxies' rotations.
 - C) their revolution around companion galaxies.
 - D) All of the above.
 - E) None of the above; there is no way to determine masses of galaxies.
3. The rings of Saturn sometimes disappear from view because
 - A) they are thin and disappear when we see them "on edge."
 - B) they dissipate, and later new rings form from large objects that collide.
 - C) they exhibit phases like the Moon caused by the angle between the Sun, Saturn, and the Earth.
 - D) when Saturn is at opposition the rings are too far away to be seen.
4. The most likely wavelength at which to search for extraterrestrial intelligence is thought to be about
 - A) 1400 cm, the wavelength used to detect carbon.
 - B) 140 cm, the wavelength used to detect water.
 - C) 21 cm, the wavelength used to detect cool hydrogen clouds.
 - D) Any of the above, for no wavelength is more likely than another.
5. "One of the negatively charged particles that orbit the nucleus of an atom" describes
 - A) a photon. B) one hertz. C) a wavelength. D) a proton. E) an electron.
6. In appearance, an emission spectrum is
 - A) a continuous spectrum disrupted by dark lines.
 - B) a number of distinct lines.
 - C) similar to a continuous spectrum.
 - D) Any of the above, depending on the temperature of the emitting object.
7. What product of the fusion reaction occurring in the core of the Sun is directly observable?
 - A) helium B) positrons C) neutrinos D) photons
8. The most likely method of contact with extraterrestrial intelligence is

- A) sound waves B) actual visits C) light waves D) radio waves
9. In the late 1970's the *Viking* landers found
A) definite evidence that life once existed on Mars, but that it no longer is there.
B) definite evidence that life still exists on Mars.
C) no evidence that life exists on Mars.
D) probable evidence that life existed at one time on Mars.
E) that there was definitely no life on Mars.
10. A closed universe is one that
A) will eventually stop expanding.
B) will never stop expanding.
C) Either of the above, depending upon the density of the universe.
11. Which of the following lists the objects correctly in size from smallest to largest?
A) Jupiter, Sun, Earth, Galaxy. D) Sun, Earth, Galaxy, Jupiter.
B) Earth, Sun, Jupiter, Galaxy. E) None of the above.
C) Sun, Earth, Jupiter, Galaxy.
12. A star leaves the main sequence when
A) the core starts fusing helium by the triple alpha process.
B) photo-disintegration starts to take place.
C) its core of hydrogen is depleted.
D) the "helium flash" occurs.
13. Which of the following is produced by a very hot solid?
A) A continuous spectrum D) All of the above.
B) An emission spectrum E) None of the above.
C) An absorption spectrum
14. What relationship has been found between the distance to faraway galaxies and their speed?
A) The farther away a galaxy is, the faster it is moving toward us.
B) The farther away a galaxy is, the dimmer it appears.
C) The farther away a galaxy is, the faster it is moving away from us.
D) Galaxies move with a speed across our line of sight.
E) The farther away a galaxy is, the dimmer it is.
15. Stars on the main sequence that have a great mass are
A) dim and cool.
B) bright and cool.
C) dim and hot.
D) bright and hot.
E) Any of the above; there is no regular relationship.
16. There is a force of gravitation between
A) two objects only when one of them is very massive.

- B) two objects only when both of them are very massive.
 - C) two objects only when one of them is a planet.
 - D) any two objects.
 - E) Answers A, B and C only, for they are equivalent.
17. Quasars are thought to be
- A) nearby objects that have unknown energy sources.
 - B) very young galaxies.
 - C) mysterious objects that seem to have no connection with more familiar objects.
 - D) very old active galaxies.
18. Which of the following objects are considered the most likely three Solar system candidates for the search for extraterrestrial life?
- A) Uranus, Venus and Mars.
 - B) Jupiter, Saturn and Earth's Moon.
 - C) Mars, Europa and Titan.
 - D) Venus, Mars and Pluto.
 - E) Mercury, Venus and Mars.
19. Galaxies are
- A) invisible with anything but the very largest telescopes.
 - B) dust clouds in space.
 - C) groups of billions of stars.
 - D) typically 10 to 100 times larger than the solar system.
 - E) More than one of the above.
20. Suppose that a certain spectral line has a wavelength of 600 nm and that when it is observed in a distant galaxy it is observed to have a wavelength of 612 nm. How can this be?
- A) The galaxy is moving toward Earth.
 - B) This is a misleading question, because the situation is impossible.
 - C) The galaxy is moving away from Earth.
 - D) The line is from a previously unknown element.
 - E) The wavelength of the line may have been changed by material between the galaxy and Earth.
21. Judging from their Doppler shift, all quasars
- A) are moving fast relative to us (compared to speeds of most galaxies).
 - B) are very distant.
 - C) are moving away from us.
 - D) All of the above.
 - E) None of the above.
22. The wavelength where the peak of the spectrum of a star is located tells us
- A) the velocity of the star away from Earth.
 - B) the chemical composition of the star.
 - C) the temperature of the star.
 - D) the velocity of the star towards Earth.
 - E) Two of the above.
23. Cepheid variables are important in calculating
- A) the compositions of stars.
 - D) the composition of the interstellar medium.

31. The idea that the universe is expanding comes from what experimental observation?
A) general relativity **C)** the big bang theory
B) the redshift from distant galaxies **D)** the cosmic microwave background
32. During the night, as viewed from the central US, most stars
A) rise in the west and set in the east. **D)** rise in the east and set in the west.
B) move in retrograde motion across the sky. **E)** rise in the north and set in the south.
C) No general statement can be made.
33. An open universe is one that will
A) remain in its steady state.
B) stop its expansion and contract, but a new big bang will not occur.
C) stop its expansion and contract, but then a new big bang may occur.
D) expand forever, never stopping.
34. The most-massive stars end up finally as
A) black holes. **B)** neutron stars. **C)** white dwarfs. **D)** red giants. **E)** brown dwarfs.
35. The Hubble law is a relationship between galaxies'
A) colors and spectral types. **C)** distances and redshifts.
B) redshifts and colors. **D)** redshifts and spectral types.
36. When viewed from two different places on Earth, which of these objects exhibits the greatest parallax angle against the distant stars?
A) the Sun. **B)** the Moon. **C)** Mars. **D)** All of the above. **E)** None of the above.
37. Aristotle and Ptolemy held that the center of the universe is
A) Venus. **B)** the Milky Way. **C)** the Sun. **D)** Earth. **E)** None of the above.
38. The Miller-Urey experiment showed that if the chemical elements of the early Earth are put into a sealed container and energy is added,
A) living matter in the form of virii is formed.
B) some organic molecules are formed.
C) living matter in the form of bacteria is formed.
D) Two of the above.
E) None of the above.
39. Hubble found that the objects that were first called spiral nebulae are instead spiral galaxies by observing
A) black holes in their centers.
B) supernovae in them.
C) that their spectra are characteristic of spectra of stars.
D) radiation characteristic of black holes coming from them.
E) Cepheid variables in them.
40. A meteor shower is formed when

- A) the Earth passes through the Oort cloud.
 - B) the Earth passes through a cluster of particles in the solar system.
 - C) a meteoroid passes through the Oort cloud in our atmosphere, causing rain.
 - D) the constellation Leo releases meteoroids.
 - E) Either A or B above.
41. If the Sun were less massive than it is, the force of gravitational force that the Earth exerts on the Sun would be
- A) unchanged.
 - B) weaker.
 - C) stronger.
 - D) The item is misleading; the Earth does not exert a gravitational force on the Sun.
 - E) zero.
42. Which of the planets have a period of revolution around the Sun of less than 1 year?
- A) Neptune and Pluto only
 - B) Mars, Venus, and Mercury only
 - C) Mercury and Venus only
 - D) Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto only
 - E) Mars and Venus only
43. Tides on the Earth are primarily due to the mutual gravitational attraction between the Earth and
- A) the Moon. B) Jupiter. C) the Sun. D) None of the above.
44. The phenomenon of the gravitational lens
- A) can be explained by Newton's theory of gravitation.
 - B) can be explained by Einstein's theory of relativity.
 - C) was a complete surprise and can't be explained by any theory.
 - D) Both A and B above.
45. The Local Group consists of
- A) about 15 to 30 nearby galaxies.
 - B) the closest planetary nebulae.
 - C) about 15 to 30 nearby stars.
 - D) about 100 nearby stars.
 - E) about 100 nearby galaxies.
46. According to Kepler's laws, a planet moves most slowly when
- A) it is closest to the Sun.
 - B) it is midway between closest to the Sun and farthest.
 - C) it is farthest from the Sun.
 - D) None of the above.
47. Most asteroids are probably

- A) There is no generally accepted theory that answers this question.
 - B) material that was captured by the Sun as it passed close to the Sun.
 - C) the remains of an exploded planet that once orbited between Mars and Jupiter.
 - D) material from the early solar system that never formed into a planet.
 - E) the remains of comets that have lost their volatile material.
48. The greenhouse effect keeps Venus hot because
- A) the atmosphere is rich in carbon dioxide.
 - B) the surface converts infrared radiation into visible light.
 - C) the planet rotates so slowly.
 - D) the atmosphere contains oxygen gas.
 - E) the surface is free of sulfur compounds.
49. At about what time of night would you expect to see a full Moon highest in the sky?
- A) 6 PM
 - B) 6 AM
 - C) 9 PM
 - D) 12 midnight
 - E) 3 AM
50. Which of the following is used as a distance indicator to galaxies?
- A) The brightest supernovae.
 - B) Globular clusters.
 - C) Cepheid variables.
 - D) All of the above.
 - E) None of the above.
51. A supernova
- A) can be classified into one of three types.
 - B) has been observed within 100 light-years of the Earth.
 - C) can outshine the entire galaxy in which it occurs.
 - D) All of the above.
52. The event horizon is associated with
- A) planetary nebulae.
 - B) white dwarfs.
 - C) red giants.
 - D) black holes.
 - E) reflecting telescopes.
53. The nucleus of a comet resembles
- A) the makeup of Ceres.
 - B) material at the center of the Earth.
 - C) material in the Sun.
 - D) a dirty snowball.
54. A galaxy that is 8 billion light-years from us has a look back time of
- A) 8 billion years.
 - B) There is no way to determine the answer from the information given.
 - C) 4 billion years.
 - D) 16 billion years.
55. Auroras are caused by
- A) gravitational attraction of light toward the Earth.
 - B) sunlight being reflected by upper layers of the atmosphere.
 - C) sunlight being refracted by upper layers of the atmosphere.

- D) charged particles impacting on the Earth's atmosphere.
 - E) moonlight being refracted and reflected by upper layers of the atmosphere.
56. Stars are formed from
- A) the expansion of dense objects such as black holes.
 - B) the expansion of white dwarfs.
 - C) the collapse of constellations.
 - D) the collapse of galaxies.
 - E) the collapse of interstellar clouds.
57. Clusters of stars are important to astronomers because
- A) they give astronomers a direct measurement of the age of the Sun.
 - B) they are the most likely places to contain dark nebulae.
 - C) the stars in them are about the same mass.
 - D) the stars in them are about the same age.
 - E) Both C and D above.
58. Fundamentally, solar energy comes from
- A) chemical reactions.
 - B) nuclear fission.
 - C) nuclear fusion.
 - D) Both B and C, for they are the same.
 - E) Both A and B, for they are the same.
59. When four hydrogen nuclei fuse to form one helium nucleus,
- A) the resulting mass of the helium is less than the original mass of the hydrogen.
 - B) The question is phony; such a reaction does not take place.
 - C) the resulting mass of the helium is exactly the same as the original mass of the hydrogen.
 - D) the resulting mass of the helium is greater than the original mass of the hydrogen.
60. A red shift in the spectrum of a distant galaxy indicates that the galaxy is
- A) hot. B) advancing toward us. C) receding from us. D) cool. E) None of the above.
61. How quickly a celestial object is observed to change in brightness puts an upper limit on the object's
- A) size. B) distance from us. C) mass. D) absolute magnitude. E) temperature.
62. There is good evidence that black holes have been detected
- A) in galactic clusters.
 - B) in planetary nebulae.
 - C) by observing planets falling into them.
 - D) by use of data concerning their chemical compositions.
 - E) in binary systems.
63. The number of sunspots
- A) change with a cycle of about 104 years.
 - B) has been decreasing since they were first recorded by Galileo.
 - C) change with a cycle of about eleven years.
 - D) has been increasing since they were first recorded.
64. At the same time an astronaut on the Moon sees a solar eclipse, observers on Earth can

- A) see a lunar eclipse.
 - B) also see a solar eclipse.
 - C) see either a solar or a lunar eclipse, depending on Earth's orientation.
65. The diameter of the Galaxy is about
- A) 160,000 light years.
 - B) 1000 light years.
 - C) Astronomers have no idea.
 - D) 100 light years.
66. What remains after a type-II supernova?
- A) A main sequence star
 - B) A white dwarf
 - C) A neutron star or a black hole
 - D) Nothing
 - E) Any of the above, depending on the mass of the original star.
67. From all available evidence, quasars are
- A) the most distant objects that we can see.
 - B) the nuclei of young active galaxies.
 - C) extremely red-shifted.
 - D) Both B and C above.
 - E) All of the above.
68. The spiral arms of the Galaxy
- A) lie closer to the center than the Sun, but not farther.
 - B) lie farther from the center than the Sun, but not closer.
 - C) The answer is not known.
 - D) are found both inside and outside the Sun's orbit.
69. "Spiral Nebulae" turned out to be
- A) rotating hydrogen clouds outside our Galaxy.
 - B) superclusters.
 - C) rotating hydrogen clouds in our Galaxy.
 - D) galaxies outside the Milky Way.
 - E) None of the above.
70. One theory postulates that right after the big bang the universe suddenly expanded at an extremely fast rate. This theory is called the
- A) inflationary model.
 - B) Olber's solution.
 - C) flatness problem.
 - D) steady state theory.
 - E) horizon solution.
71. How can a cool star have a great absolute luminosity?
- A) The star can be a very large star.
 - B) The star can be a nearby star.
 - C) It can be a main sequence star.
 - D) The question is misleading; most cool stars have a high absolute luminosity.
 - E) It can't.
72. Nebulae are
- A) dust and gas clouds within our solar system.
 - B) interstellar dust and gas clouds.
 - C) dust and gas clouds on planets.
 - D) Both A and C above.
73. What types of stars tend to be found along spiral arms in the Milky Way and other similar galaxies?

- A) The spiral arms tend to be depleted in young, hot stars compared to other regions of these galaxies.
 - B) The mix of stars in the spiral arms is similar to that in other regions of these galaxies.
 - C) A larger number of young, bright stars are found in the spiral arms than in other regions of these galaxies.
 - D) We cannot measure the mix of star types in such spiral arms due to absorption in the dust lanes that surround them.
 - E) The spiral arms consist almost entirely of older stars, but have occasional "blue stragglers" among them.
74. Black holes can be detected by
- A) observing light being drawn into it.
 - B) X-ray radiation from its accretion disk.
 - C) observing stars falling into it.
 - D) finding completely black areas in the sky.
75. If a given light is moved three times as far from the observer, its intensity will change by a factor of
- A) 1/6.
 - B) 1/2.
 - C) 1/3.
 - D) 1/27.
 - E) 1/9.
76. The horizon problem and the flatness problem
- A) are solved by the standard big bang theory.
 - B) are solved by the inflationary universe theory.
 - C) The question is misleading; these problems do not pertain to cosmology.
 - D) have not yet been solved by cosmologists.
77. The masses of galaxies are determined by using the Doppler effect to measure the speeds
- A) of individual galaxies in a cluster.
 - B) of parts of individual galaxies.
 - C) of galaxies which are part of a binary pair.
 - D) All of the above.
 - E) None of the above; we cannot determine the masses of galaxies.
78. The prediction that light should bend near a massive object was first confirmed by observing
- A) the time kept by clocks traveling at great speeds.
 - B) a beam of light entering a spaceship.
 - C) stars during a solar eclipse.
 - D) the speed of light as a spaceship passed by.
 - E) a black hole.
79. The solar wind is
- A) gas flowing across the surface of the Sun.
 - B) material flowing from the Sun out into space.
 - C) the motion of granules across the Sun's surface.
 - D) the motion of sunspots across the Sun's surface.

- E) Both C and D above.
80. The Milky Way Galaxy has the shape of a
A) sphere, like a basketball.
B) round disk (like a pancake) with a ball at its center.
C) elongated disk, like a flattened football.
D) oval, like a football.
81. Which of these planets has rings?
A) Mars B) Mercury C) Earth D) Venus E) Uranus
82. As a comet travels around the Sun, its ion tail
A) points at right angles to the Earth.
B) keeps the same face pointed toward Venus.
C) trails behind it.
D) stretches from the comet in a direction away from the Sun.
E) stretches from the comet in a direction toward the Sun.
83. The light-year is a unit of
A) time. B) mass or weight. C) distance. D) speed. E) age.
84. The spiral nature of our Galaxy was detected from
A) 21-cm radiation. B) gamma radiation. C) visible light. D) ultraviolet radiation.
85. What are the assumptions upon which the cosmological principle is based?
A) Olber's paradox and the redshift
B) the Hubble law and the critical density of the universe
C) homogeneity and isotropy
D) the Hubble law and general relativity
86. If quasars are young and very far away they are thought likely to be
A) black holes. D) All of the above.
B) the first phase in the life of a star. E) None of the above.
C) the first phase in the life of galaxies.
87. Another name for the cosmic background radiation is the
A) 3-degree blackbody radiation. D) horizon radiation.
B) inflationary radiation. E) Hawking radiation.
C) general theory radiation.
88. Radio waves from a radio galaxy can come from an area
A) only the size of the galactic disk.
B) many times larger than the galaxy itself.
C) on the size of the galactic nucleus.

- D)** None of the above; the statement is misleading since radio waves don't come from a radio galaxy at all.
- 89.** The Sun is a
- A)** red giant.
 - B)** B-type main sequence star.
 - C)** M-type main sequence star.
 - D)** white dwarf.
 - E)** G-type main sequence star.
- 90.** At its extreme, parallax can be used to measure distances to the
- A)** nearer stars.
 - B)** Magellanic Clouds.
 - C)** Virgo cluster of galaxies.
 - D)** galaxies in the local group.
- 91.** Mars would be expected to have seasons,
- A)** but all evidence points to the fact that it does not have seasons.
 - B)** and they are observed in changes in vegetation over the planet.
 - C)** but the only evidence has come from the recent Mars landing.
 - D)** and they are observed in the changing size of the frozen areas at the poles.
 - E)** but no evidence of seasons is visible from Earth.
- 92.** In which of the basic regions of the Galaxy is the Sun located?
- A)** galactic bulge
 - B)** galactic halo
 - C)** galactic center
 - D)** galactic disk
- 93.** Suppose that you read that astronomers list the age of the universe as such-and-such. This value is based on
- A)** Star formation rates.
 - B)** the age of rock on the Earth and Moon.
 - C)** changes in the solar system.
 - D)** the Hubble law.
 - E)** Biblical references.
- 94.** The Drake equation shows us the factors that we need to know in order to calculate
- A)** the number of Earth-like planets in the galaxy.
 - B)** the number of places in the galaxy that contain technologically advanced civilizations sending out signals.
 - C)** the number of planets in an average planetary system.
 - D)** the number of places in the galaxy that contain the most basic life.
 - E)** the rate at which stars form in the galaxy.
- 95.** The atmosphere of Venus
- A)** has about the same cloud cover as Earth.
 - B)** is covered with clouds that make the surface invisible to optical telescopes.
 - C)** is clear, with almost no clouds.

96. What is the central engine of active galaxies?
 A) large numbers of supernovae
 B) supermassive black holes
 C) large numbers of stars; about 10^{12}
 D) collisions between large molecular clouds
97. The evidence for the small size of quasars is
 A) the amount of energy released.
 B) the size of their radio images.
 C) comparison with Cepheid variables.
 D) the rapidity of luminosity changes.
 E) their distance from us.
98. What determines the color of a star?
 A) Its size B) Its radial velocity C) Its space velocity D) Its albedo E) Its temperature
99. Olbers's paradox asks the question
 A) "Why is the sky dark at night?"
 B) "Why does the universe seem to be expanding?"
 C) "Why does the Earth orbit the Sun?"
 D) "Why do the same laws work throughout the universe?"
 E) "Why is there a flatness problem?"
100. The most massive element that can be formed by fusion with a release of energy is
 A) oxygen. B) carbon. C) helium D) uranium. E) iron.
101. The Great Red Spot is
 A) condensation from winds off the top of a mountain.
 B) an enormous storm system.
 C) an area of pollution in the atmosphere.
 D) a hole in the cloud cover of the planet.
 E) the top of a gigantic mountain.
102. _____ cause shock waves to trigger interstellar clouds to collapse into protostars.
 A) Shock waves moving around the galaxy D) Radiation from supernovae
 B) Bursts of material from massive stars E) Any of the above could be possible causes.
 C) Radiation from newly formed stars
103. An H-R diagram plots
 A) temperature vs. distance. D) temperature vs. space velocity.
 B) temperature vs. absolute magnitude. E) distance vs. space velocity.
 C) stellar mass vs. distance.
104. The distance to other galaxies may be determined by using
 A) radar.
 B) parallax.
 C) Kepler's laws.
 D) absolute and apparent luminosity of the brightest stars.
105. When a star is in hydrostatic equilibrium,

- A) the downward forces on each layer are balanced by upward force so the star neither expands nor contracts.
 - B) the star's energy is trapped inside, so none is released from the surface.
 - C) it is contracting rapidly.
 - D) it is expanding rapidly.
 - E) Two of the above.
106. The density wave theory holds that as the waves move around the Galaxy they
- A) push stars away from the dense regions, which forms the space between spiral arms.
 - B) cause stars to collide, thus resulting in big bright stars that form the spiral arms.
 - C) push stars nearer one another, therefore making that region appear bright.
 - D) cause the formation of new stars by compressing the interstellar material.
107. Which of the following waves is fundamentally different from the others?
- A) infrared
 - B) ultraviolet
 - C) visible light
 - D) microwave
 - E) sound
108. Which of the following properties is constant for all types electromagnetic waves in a vacuum?
- A) wavelength
 - B) color
 - C) energy
 - D) speed
 - E) frequency
109. What branch of astronomy best fits the description "a study of the universe as a whole"?
- A) X-ray astronomy
 - B) Extra-galactic astronomy
 - C) Cosmology
 - D) Astrometry
 - E) Radio astronomy
110. The source of the energy that comes from the galactic nucleus seems to be due to
- A) nuclear reactions in the great numbers of stars there.
 - B) matter falling into a giant black hole there.
 - C) heat still retained there from the original formation of the Galaxy.
 - D) collisions between stars there.
111. Globular clusters
- A) are very irregular in shape and stay in the galactic disk.
 - B) No general statement can be made.
 - C) are symmetrical in shape and spend most of their time outside the galactic disk.
 - D) are symmetrical in shape and stay in the galactic disk.
 - E) are very irregular in shape and spend most of their time outside the galactic disk.
112. How do we determine whether a galaxy is moving toward or away from our Galaxy?
- A) We compare its apparent size now to what it was years ago.
 - B) We compare its measured distance now to what it was years ago.
 - C) We compare its apparent brightness now to what it was years ago.
 - D) We compare its spectrum to that of matter that is stationary with respect to us.
 - E) None of the above. We cannot determine a galaxy's motion toward or away from us.
113. The spectra of spectroscopic binaries changes regularly due to
- A) changes in the temperatures of the stars as they revolve.

- B) changes in the size of the stars as they revolve.
 - C) changes in the absolute magnitudes of the stars as they revolve.
 - D) the Doppler effect.
 - E) A, B, and C above.
114. Why are craters more visible on the Moon than on Earth?
- A) More meteorites have fallen to the Moon because of its greater gravitational pull.
 - B) More meteorites have fallen to the Moon because of the Moon's greater speed in orbit.
 - C) The Earth's atmosphere stops and/or slows the progress of meteorites.
 - D) Weather on Earth has removed evidence of old craters.
 - E) Both C and D above.
115. A lunar eclipse occurs only at _____ Moon and a solar eclipse at _____ Moon.
- A) crescent... gibbous
 - B) No general statement can be made concerning the phase of the Moon during eclipses.
 - C) gibbous... crescent
 - D) new... full
 - E) full... new
116. Which of the following regions of the spectrum is emitted by celestial objects?
- A) infrared
 - B) ultraviolet
 - C) radio
 - D) All of the above are from celestial objects.
 - E) Celestial objects emit none of the above.
117. Dark matter is hypothesized in order to explain
- A) quasars.
 - B) missing mass.
 - C) interstellar clouds.
 - D) black holes.
 - E) how planets can exist.
118. The Bohr model of the atom predicts that light is emitted when an electron
- A) is heated in a fire.
 - B) orbits the nucleus.
 - C) falls from an outer to an inner orbit.
 - D) jumps from an inner orbit to an outer orbit.
119. The discovery of the cosmic background radiation
- A) conflicted with the big bang theory, but not enough to destroy the theory.
 - B) had no relationship to the big bang theory.
 - C) was a confirmation of the big bang theory.
 - D) conflicted very seriously with the big bang theory.
120. Which planet (of those listed) gets farthest from Earth?
- A) Mars
 - B) Saturn
 - C) Jupiter
 - D) Mercury
 - E) Venus

Answer Key -- Fall 2003 Final

1. C Everywhere in the universe at once, because the entire universe (including space itself) was a point.
Origin: Fall 2002 Final....115
2. D All of the above.
Origin: Chapter 17....95
3. A they are thin and disappear when we see them "on edge."
Origin: Chapter 9....87
4. C 21 cm, the wavelength used to detect cool hydrogen clouds.
Origin: Spring'02 Final....54
5. E an electron.
Origin: Chapter 4....111
6. B a number of distinct lines.
Origin: Chapter 4....96
7. C neutrinos
Origin: Fall'02 Test #3....85
8. D radio waves
Origin: Spring'02 Final....53
9. C no evidence that life exists on Mars.
Origin: Chapter 8....128
10. A will eventually stop expanding.
Origin: Chapter 18....64
11. E None of the above.
Origin: Chapter 1....59
12. C its core of hydrogen is depleted.
Origin: Chapter 14....56
13. A A continuous spectrum
Origin: Chapter 4....69
14. C The farther away a galaxy is, the faster it is moving away from us.
Origin: Chapter 17....83
15. D bright and hot.
Origin: Chapter 12....59
16. D any two objects.
Origin: Chapter 3....69
17. B very young galaxies.
Origin: Chapter 17....56
18. C Mars, Europa and Titan.
Origin: Fall 2002 Final....117
19. C groups of billions of stars.
Origin: Chapter 16....97
20. C The galaxy is moving away from Earth.
Origin: Chapter 4....104
21. D All of the above.
Origin: Chapter 17....52
22. C the temperature of the star.

- Origin: Chapter 4....107
23. E the distances to galaxies
Origin: Chapter 16....98
24. B A region of new stars would contain a higher percentage of high mass stars than a region of old stars.
Origin: Chapter 16....88
25. D the universe looks about the same no matter where you are.
Origin: Chapter 18....57
26. A one of a few hundred billion galaxies in the universe.
Origin: Chapter 17....64
27. A stay a shorter time on the main sequence
Origin: Chapter 14....70
28. C hydrogen and helium.
Origin: Chapter 9....71
29. B the tilt of the equatorial plane of the Earth with respect to the plane of the ecliptic.
Origin: Chapter 1....52
30. A visible mass and mass calculated from Kepler's laws.
Origin: Chapter 17....94
31. B the redshift from distant galaxies
Origin: Chapter 18....60
32. D rise in the east and set in the west.
Origin: Chapter 1....73
33. D expand forever, never stopping.
Origin: Chapter 18....63
34. A black holes.
Origin: Chapter 15....59
35. C distances and redshifts.
Origin: Chapter 17....54
36. B the Moon.
Origin: Chapter 6....77
37. D Earth.
Origin: Chapter 1....89
38. B some organic molecules are formed.
Origin: Spring'02 Final....55
39. E Cepheid variables in them.
Origin: Chapter 16....52
40. B the Earth passes through a cluster of particles in the solar system.
Origin: Chapter 10....91
41. B weaker.
Origin: Chapter 3....90
42. C Mercury and Venus only
Origin: Chapter 2....50
43. A the Moon.
Origin: Chapter 6....64
44. B can be explained by Einstein's theory of relativity.
Origin: Chapter 17....107
45. A about 15 to 30 nearby galaxies.

- Origin: Chapter 16...47
46. C it is farthest from the Sun.
Origin: Chapter 2...72
47. D material from the early solar system that never formed into a planet.
Origin: Chapter 10...70
48. A the atmosphere is rich in carbon dioxide.
Origin: Chapter 8...80
49. D 12 midnight
Origin: Chapter 6...71
50. D All of the above.
Origin: Chapter 16...48
51. C can outshine the entire galaxy in which it occurs.
Origin: Chapter 14...64
52. D black holes.
Origin: Chapter 15...73
53. D a dirty snowball.
Origin: Chapter 10...78
54. A 8 billion years.
Origin: Chapter 17...93
55. D charged particles impacting on the Earth's atmosphere.
Origin: Chapter 6...113
56. E the collapse of interstellar clouds.
Origin: Chapter 13...44
57. D the stars in them are about the same age.
Origin: Chapter 13...90
58. C nuclear fusion.
Origin: Chapter 11...59
59. A the resulting mass of the helium is less than the original mass of the hydrogen.
Origin: Chapter 11...76
60. C receding from us.
Origin: Chapter 17...49
61. A size.
Origin: Chapter 15...63
62. E in binary systems.
Origin: Chapter 15...55
63. C change with a cycle of about eleven years.
Origin: Chapter 11...97
64. A see a lunar eclipse.
Origin: Chapter 6...67
65. A 160,000 light years.
Origin: Chapter 16...81
66. C A neutron star or a black hole
Origin: Chapter 15...74
67. E All of the above.
Origin: Chapter 17...97
68. D are found both inside and outside the Sun's orbit.
Origin: Chapter 16...84

69. D galaxies outside the Milky Way.
Origin: Chapter 17....91
70. A inflationary model.
Origin: Chapter 18....90
71. A The star can be a very large star.
Origin: Chapter 12....60
72. B interstellar dust and gas clouds.
Origin: Chapter 13....42
73. C A larger number of young, bright stars are found in the spiral arms than in other regions of these galaxies.
Origin: Fall 2002 Final....112
74. B X-ray radiation from its accretion disk.
Origin: Chapter 15....91
75. E $1/9$.
Origin: Chapter 4....117
76. B are solved by the inflationary universe theory.
Origin: Chapter 18....79
77. D All of the above.
Origin: Chapter 16....50
78. C stars during a solar eclipse.
Origin: Chapter 3....108
79. B material flowing from the Sun out into space.
Origin: Chapter 11....96
80. B round disk (like a pancake) with a ball at its center.
Origin: Chapter 16....62
81. E Uranus
Origin: Chapter 7....69
82. D stretches from the comet in a direction away from the Sun.
Origin: Chapter 10....79
83. C distance.
Origin: Chapter 1....65
84. A 21-cm radiation.
Origin: Chapter 16....65
85. C homogeneity and isotropy
Origin: Fall 2002 Final....116
86. C the first phase in the life of galaxies.
Origin: Chapter 17....102
87. A 3-degree blackbody radiation.
Origin: Chapter 18....94
88. B many times larger than the galaxy itself.
Origin: Chapter 17....60
89. E G-type main sequence star.
Origin: Chapter 12....62
90. A nearer stars.
Origin: Chapter 17....63
91. D and they are observed in the changing size of the frozen areas at the poles.
Origin: Chapter 8....110

92. D galactic disk
Origin: Fall 2002 Final....113
93. D the Hubble law.
Origin: Chapter 18....100
94. B the number of places in the galaxy that contain technologically advanced civilizations sending out signals.
Origin: Spring'02 Final....56
95. B is covered with clouds that make the surface invisible to optical telescopes.
Origin: Chapter 8....100
96. B supermassive black holes
Origin: Fall 2002 Final....114
97. D the rapidity of luminosity changes.
Origin: Chapter 17....99
98. E Its temperature
Origin: Chapter 12....76
99. A "Why is the sky dark at night?"
Origin: Chapter 18....89
100. E iron.
Origin: Chapter 15....96
101. B an enormous storm system.
Origin: Chapter 9....69
102. E Any of the above could be possible causes.
Origin: Chapter 13....70
103. B temperature vs. absolute magnitude.
Origin: Chapter 12....78
104. D absolute and apparent luminosity of the brightest stars.
Origin: Chapter 16....54
105. A the downward forces on each layer are balanced by upward force so the star neither expands nor contracts.
Origin: Chapter 11....53
106. D cause the formation of new stars by compressing the interstellar material.
Origin: Chapter 16....87
107. E sound
Origin: Chapter 4....76
108. D speed
Origin: Chapter 4....121
109. C Cosmology
Origin: Chapter 18....78
110. B matter falling into a giant black hole there.
Origin: Chapter 16....95
111. C are symmetrical in shape and spend most of their time outside the galactic disk.
Origin: Chapter 16....74
112. D We compare its spectrum to that of matter that is stationary with respect to us.
Origin: Chapter 17....65
113. D the Doppler effect.
Origin: Chapter 12....103
114. E Both C and D above.

- Origin: Chapter 6....117
115. E full... new
Origin: Chapter 6....105
116. D All of the above are from celestial objects.
Origin: Chapter 4....87
117. B missing mass.
Origin: Chapter 17....96
118. C falls from an outer to an inner orbit.
Origin: Chapter 4....91
119. C was a confirmation of the big bang theory.
Origin: Chapter 18....61
120. B Saturn
Origin: Chapter 7....78