



- 1 Which of the following statements is scientific (as defined by Popper)?
  - a. Passenger pigeons are extinct.
  - b. Passenger pigeons were pests.
  - c. Passenger pigeons taste good.
  - d. Passenger pigeons taste terrible.
  - e. Passenger pigeons are not extinct.
  
- 2 Nuclei such as protons do not fuse at low temperatures because their speeds are not enough to overcome their
  - a. structural integrity.
  - b. electrical repulsion.
  - c. inertia.
  - d. nuclear friction.
  - e. hard shells.
  
- 3 Who discovered Newton's First Law of Motion?
  - a. Aristotle.
  - b. Kepler
  - c. Tycho Brahe
  - d. Galileo
  - e. Newton
  
- 4 The Moon's orbit
  - a. is somewhat tilted relative to the plane of the Earth's equator.
  - b. is perpendicular to the plane of the Earth's equator.
  - c. is in the plane of the ecliptic.
  - d. is in the plane of the Earth's equator.
  
- 5 The distances to the farthest galaxies can be measured using
  - a. heliocentric parallax.
  - b. the Tulley-Fisher relation.
  - c. radar ranging.
  - d. cepheid variable stars.
  - e. Hertzsprung-Russel diagrams.
  
- 6 An open cluster is usually
  - a. a flat disk of over a hundred thousand stars.
  - b. a few stars arranged in a line like the belt of Orion.
  - c. a chance collection of unrelated stars.
  - d. a few hundred stars that all formed together.
  - e. a spherical formation of over a hundred thousand stars.
  
- 7 An ion rocket engine produces 1 Newton of thrust. What acceleration can it give to a space probe with a mass of 1000kg?
  - a.  $0.01 \text{ m/s}^2$
  - b.  $1 \text{ m/s}^2$
  - c.  $0.001 \text{ m/s}^2$
  - d.  $0.1 \text{ m/s}^2$
  - e.  $1000 \text{ m/s}^2$

- 8 The jovian planets typically have
- large systems of moons.
  - only moons that they capture by accident.
  - no moons.
- 9 In one day, the position of the Sun on the Celestial Sphere
- moves westward along the ecliptic by  $1^\circ$ .
  - moves westward along the ecliptic by  $15^\circ$ .
  - does not change at all.
  - moves eastward along the ecliptic by  $1^\circ$ .
  - Moves eastward along the ecliptic by  $15^\circ$ .
- 10 The force of gravity explains
- how the tides and lightning work.
  - how things fall and how lightning works.
  - how planets move and how the tides work.
  - how planets move and how the Sun shines.
  - how things fall and how the Sun shines.
- 11 The motion of tectonic plates is driven by
- convection currents in the Earth's mantle.
  - The Sun's gravitational attraction.
  - convection currents in the Earth's core.
  - Asteroid impacts.
  - The Moon's gravitational attraction.
- 12 The main reason that telescope mirrors can be much larger than lenses is that the mirrors
- are lighter because they are thinner.
  - can have holes in them.
  - are stronger because they are thicker.
  - can be made of metal.
- 13 Adaptive optics is used to correct telescopes for
- chromatic aberration.
  - spherical aberration.
  - atmospheric turbulence.
  - the diffraction limit.
  - poor light collection ability.
- 14 The tail of a comet always points
- in its direction of motion.
  - toward the Sun.
  - away from the Sun.
  - opposite to its direction of motion.
  - toward the Earth.

- 15 You see a reflecting telescope with a short, stubby tube and the eyepiece at the back. This telescope uses the
- Cassegrain Focus.
  - Newtonian Focus.
  - Coudé Focus
  - Prime Focus.
- 16 Sunspots are caused by
- turbulence in the Sun's photosphere.
  - clouds of sodium vapor.
  - differential rotation and magnetic fields.
  - islands of excess iron content.
  - convection currents below the photosphere.
- 17 The main evidence for the presence of invisible matter in our galaxy is
- a prediction of the Big Bang Theory.
  - the velocities with which stars orbit.
  - the bending of light by dark stars.
- 18 The velocities with which objects in the galaxy orbit its center
- decrease with distance from the center.
  - decrease to a minimum and then rise.
  - increase in proportion to the distance from the center.
  - are approximately constant at all distances.
- 19 The first red giant phase of a star is caused by
- the exhaustion of hydrogen at its core.
  - the collapse of its core.
  - the exhaustion of helium at its core
  - the ignition of helium at its core.
  - the ignition of hydrogen at its core.
- 20 Once a star has evolved onto the Main Sequence in the HR Diagram, it
- evolves up the sequence toward higher brightness.
  - moves both up and down the sequence.
  - drifts slowly toward lower mass and brightness.
  - stays at the same point until it runs out of fuel.
- 21 The frequencies absorbed by a cold gas are
- always the same as those it emits when hot.
  - unrelated to those it emits when hot.
  - exactly double those it emits when hot.
- 22 Which of the following objects is usually found among the stars that make up the Milky Way?
- Planetary Nebulae.
  - Globular Clusters.
  - Extragalactic Nebulae.

- 23 The Large Magellanic Cloud is an example of a galaxy of type
- Peculiar
  - Sc
  - Irr I
  - Irr II
  - SBC
- 24 The Sun's corona is the place where
- spicules come from.
  - the Solar Wind comes from.
  - visible light comes from.
  - convection cells come from.
  - sunspots start.
- 25 Take Hubble's constant to be 65km/s/Mpc. If the red-shift of an object indicates that it is moving away from us at 650km/s, how far away is it?
- 65Mpc.
  - 0.1Mpc.
  - 10Mpc.
  - 26Mpc.
  - 650Mpc.
- 26 The "Little Green Men Standard Time" hypothesis for the repeating radio signals seen in 1968 was rejected partly because the repetition rate was
- speeding up.
  - exactly constant.
  - slowing down.
- 27 As seen from North America, the constellation Orion
- sets in the west and southwest.
  - sets in the northwest.
  - sets in the northeast.
  - never sets.
  - sets in the east and southeast.
- 28 The first indication that Cygnus X-1 might be a black hole was
- its detailed X-ray spectrum.
  - the weakness of its X-rays.
  - the steadiness of its X-ray signal.
  - the rapid fluctuations in its X-rays.
  - the intensity of its X-rays.
- 29 A star that is approximately the size of the Earth is probably a
- red giant star.
  - white dwarf star.
  - horizontal branch star.
  - brown dwarf star.
  - main sequence star.

- 30 Compared to stars of other colors, a blue star will have a surface temperature that is
- in the middle of the range.
  - among the highest.
  - among the lowest.
- 31 The first major failure of the Ptolemaic Theory to predict the results of observations was
- the retrograde motion of the planets.
  - the mountains of the Moon.
  - the phases of Venus.
  - the precise observations of Tycho Brahe.
  - the Moons of Jupiter.
- 32 Which of the following types of electromagnetic radiation has the shortest wavelength on this list?
- green light.
  - infrared light.
  - heat radiation.
  - ultraviolet light.
  - Radio waves.
- 33 A likely limitation on the usable life of an ultraviolet observatory would be
- the decay of its orbit.
  - obsolescence.
  - its supply of coolant.
  - its supply of electric power.
- 34 Galaxies A and B are 100Mpc from us while galaxy C is 200Mpc from us. From the viewpoint of galaxy A, we are moving away while
- B and C both move closer.
  - B and C both move away.
  - C moves away and B moves closer.
  - B moves away and C moves closer.
- 35 When the Earth passes through the orbit of a broken-up comet, we see
- a meteor shower.
  - increased levels of ozone.
  - fire on the Moon.
  - a display of Northern Lights.
  - a lightning storm.
- 36 Stars with more than 15 times the mass of our Sun usually evolve off the main sequence along a path in the HR diagram that
- starts out horizontal and then goes almost vertical.
  - starts out vertical and then goes almost horizontal.
  - is mostly horizontal.
  - is mostly vertical.

- 37 A total eclipse of the Sun can be seen
- Everywhere on the night side of the Earth.
  - Only in the Northern Hemisphere.
  - Everywhere on the day side of Earth.
  - Only along a narrow path.
  - Only near the Earth's equator.
- 38 The first generally accepted example of Sea-floor spreading was under the
- English Channel.
  - Gulf of Mexico.
  - Atlantic Ocean.
  - Pacific Ocean.
  - Indian Ocean.
- 39 A brown dwarf shines primarily with
- light reflected from nearby stars.
  - energy left over from its formation.
  - energy generated by radioactive decay.
  - energy generated by nuclear fusion.
- 40 In our Milky Way Galaxy, the Orion arm is the
- closest one to the central bulge.
  - farthest one from the central bulge.
  - closest one to our Sun.
- 41 Low tide should occur only when the Moon is
- setting.
  - on the horizon.
  - directly overhead.
  - rising.
  - over the opposite side of the Earth.
- 42 Which of the following spectral types corresponds to the star with the highest surface temperature?
- K5
  - G0
  - G5
  - K0
- 43 From the motions of nearby stars, the mass of the radio source Sgr A\* is found to be spread
- over a region a few light years across.
  - throughout the nearby stars.
  - over a region less than a few light days across.
- 44 Of the two tidal bulges in the ocean that are caused by the Moon's gravity, one is actually
- behind the Moon's motion.
  - directly under the Moon.
  - ahead of the Moon's motion.

- 45 The layer of the Earth's interior that consists of dense, semiliquid material is the
- mantle.
  - outer core.
  - inner core.
  - crust.
  - mesosphere.
- 46 Light with a continuous spectrum is usually generated by
- a cold, rarefied gas.
  - light from hot dense material passing through a rarefied gas.
  - hot, dense material.
  - a hot, rarefied gas.
- 47 Rising pressure at the center of a collapsing cloud usually
- causes the cloud to fragment.
  - stops the collapse.
  - makes the collapse go faster.
  - prevents the cloud from fragmenting.
  - blows the cloud apart.
- 48 The Virgo cluster is
- another name for the Local Supercluster.
  - a nearby large cluster of galaxies.
  - a cluster of clusters of galaxies.
  - another name for the Local Group.
- 49 A star is found to have absolute magnitude 4 and apparent magnitude 19. How far away is it?
- 20 parsecs.
  - 10 parsecs.
  - 10,000 parsecs.
  - 200 parsecs.
  - 100,000 parsecs.
- 50 If a sunspot on the Sun's equator goes around the Sun once, a sunspot far from the equator will go around
- exactly once.
  - less than once.
  - more than once.
- 51 The wavelength of the sound waves that correspond to middle-C is about 4 feet. If you are standing 8 feet away from a piano that is playing that note, then between you and the piano there will usually be
- two regions of maximum pressure.
  - maximum pressure every four seconds.
  - maximum pressure every two seconds.
  - three regions of maximum pressure.
  - one region of maximum pressure.



- 52 The gravitational influence of the planets mostly causes asteroids to
- move from the asteroid belt into the inner solar system.
  - remain in the asteroid belt.
  - stay out of the inner solar system.
  - move from the inner solar system to the asteroid belt.
- 53 Which of Kepler's Laws governs how a particular planet speeds up and slows down?
- Orbits are Ellipses.
  - The Law of Averages.
  - The Equal Area Law.
  - The Law of Inertia.
  - The Period-Radius Relation.
- 54 One indication that there is a lot of invisible matter in the outer halo of our galaxy is that stars in that region orbit with velocities that
- do not change with increasing distance from center.
  - increase with increasing distance from the center.
  - decrease with increasing distance from the center.
- 55 The motion of the Moon around the Earth causes
- Dandruff.
  - The seasons.
  - The phases of the Moon.
  - Meteor Showers.
  - Daily motions in the Heavens.
- 56 In the last step of the proton-proton chain reaction, helium-3 collides with
- a deuteron to form helium-4, and a proton.
  - a neutron to form helium-4.
  - a proton to form helium-4, a positron, and a neutrino.
  - a carbon-12 to form helium-4 and a carbon-11.
  - another helium-3 to form a helium-4 and two protons.
- 57 The event horizon of a black hole is the point at which
- inwardly directed light rays escape from the hole.
  - all light rays escape from the hole.
  - outwardly directed light rays are pulled into the hole.
  - light rays are bent into circular orbits.
- 58 The spiral arms of a galaxy such as our Milky Way contain stars that are orbiting around the galactic center. One current theory is that these spiral arms are places where
- intense magnetic fields confine the stars.
  - stars crowd closer together than usual and then move on.
  - the orbital motion of the stars has wound a bar shape into a spiral.

- 59 By making extensive observations of planetary motion, Tycho Brahe
- discovered new planets.
  - proved that Copernicus was right.
  - disproved Ptolemy's theory of planetary motion.
  - explained how planets move.
  - provided only a lot of accurate data.
- 60 The final core collapse that leads to a supernova is ended when
- the electrons in the core touch each other.
  - the neutrons are gone.
  - all of the iron has been broken up.
  - all of the electrons are gone.
  - the neutrons touch each other.
- 61 Hubble's constant is not very accurately determined. For the most accepted value of  $65\text{km/s/Mpc}$  the Hubble expansion time is about 13 billion years. If the correct value of Hubble's constant is actually  $50\text{km/s/Mpc}$ , the Hubble expansion time would
- be less than 13 billion years.
  - still be 13 billion years.
  - be greater than 13 billion years.
- 62 The Lunar Regolith is
- a layer of dirt on the lunar surface.
  - the layer just above the core.
  - a rock layer just beneath the lunar surface.
  - another name for the lunar crust.
  - the soft part of the lunar core.
- 63 In our Sun, the radiation zone is located
- at the very center.
  - above the central region but well below the surface.
  - near the surface.
- 64 Relative to the other layers of the atmosphere, the ionosphere is
- second from the bottom.
  - second from the top.
  - at the bottom.
  - at the top.
  - overlapping two other layers.
- 65 The velocity of sound waves is roughly the same for all wavelengths. Suppose that a sound wave has a wavelength of one meter and a frequency of  $1000\text{Hz}$ . The wavelength of a  $250\text{Hz}$  sound wave would then be
- $1/4$  m.
  - 1000 m.
  - 250 m.
  - 4 m.
  - 1 m.

- 66 Type II supernovas have the following properties:
- a spectrum with hydrogen lines and a standard maximum brightness.
  - a spectrum with no hydrogen lines and a variable maximum brightness.
  - a spectrum with hydrogen lines and a variable maximum brightness.
  - a spectrum with no hydrogen lines and a standard maximum brightness.
- 67 The Oort Cloud is thought to have originated when
- nearby stars exploded as supernovae.
  - icy objects condensed out of the interstellar medium.
  - a planet failed to form near Jupiter.
  - icy objects condensed out just beyond Neptune.
  - icy objects condensed out in the inner Solar System.
- 68 Cepheid variable stars with the same period
- have similar apparent magnitudes.
  - are at similar distances from us.
  - have similar luminosities.
  - usually belong to the same star cluster.
- 69 When a white dwarf star collects matter from a neighboring star, fusion reactions on the surface of the white dwarf cause
- a planetary nebula.
  - a helium flash.
  - a supernova.
  - re-expansion to a red giant.
  - novas.
- 70 A star with an absolute magnitude of 5.7 and an apparent magnitude of  $-1.2$  would appear in our sky as a star
- of dazzling brightness.
  - barely visible to the naked eye.
  - visible only with a telescope.
  - of average naked-eye brightness.
- 71 What total force will cause an object with a mass of 2kg to gain 5 meters per second every second?
- 2 Newton
  - 5 Newtons
  - 490 Newtons
  - 9.8 Newtons
  - 10 Newtons
- 72 The Earth orbits nearly in the plane of the Sun's equator as do
- all of the other planets except for Mars.
  - all of the other planets except for Uranus.
  - all of the other planets except for Pluto.
  - all of the other planets except for Venus.

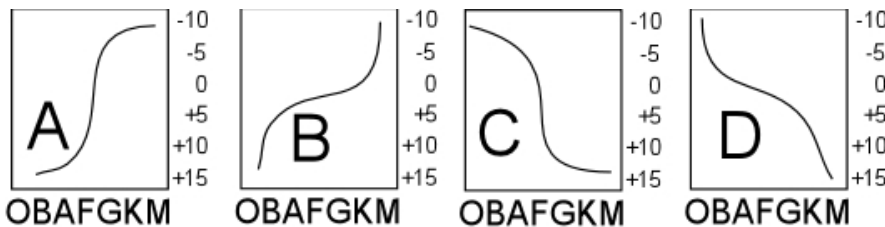
73 A star of spectral type M should look

- a. blue.
- b. red.
- c. white.
- d. yellow.
- e. orange.

74 The source that is called Sgr A\* emits

- a. only radio waves.
- b. only infrared light.
- c. both infrared light and radio waves.

75 Which of the following pictures is the most like the main sequence on a Hertzsprung-Russell Diagram?



76 The overall shape of our Milky Way Galaxy is thought to be

- a. like an irregular cloud.
- b. a featureless elliptical shape with no gas or dust.
- c. a featureless sphere of stars like M89.
- d. a spiral somewhat like the nearby Andromeda Galaxy.

77 In a region of the atmosphere in which the temperature falls with increasing altitude

- a. you expect rapid changes.
- b. you expect no changes.

78 Planetesimals of rock and iron, prevented from forming a planet by Jupiter's gravity, became

- a. the interstellar dust.
- b. the Moons of the Jovian planets.
- c. the Oort Cloud.
- d. the Kuiper belt.
- e. the asteroid belt.

79 Assume that the Hubble constant is 65 km/s/Mpc. If a galaxy is 2Mpc away, how fast is it moving away from us?

- a. 2km/s
- b. 260km/s
- c. 130km/s
- d. 32.5km/s
- e. 65km/s

- 80 A galaxy with thick spiral arms and a large bar-shaped central bulge would be a type
- Sb.
  - SBc.
  - Sc.
  - SBa.
  - S0.
- 81 Galileo said that a moving object with nothing pushing or pulling on it will always
- speed up.
  - slow down and stop.
  - follow a circular path.
  - keep moving at the same speed.
- 82 The Population I stars of our Milky Way
- are mostly in the central bulge.
  - orbit the central bulge in all directions.
  - orbit the central bulge only within the disk.
- 83 The Earth's motion around the Sun causes
- nearby stars to shift back and forth once a year.
  - all stars to jump randomly around.
  - nearby stars to shift steadily in the same direction.
  - all stars to move away from a point in the constellation Hercules.
- 84 In a Hertzsprung-Russell diagram, white dwarf stars such as Sirius B are
- at the upper left.
  - at the lower left.
  - at the lower right.
  - at the upper right.
- 85 The Greenhouse Effect is important because it suggests an effect on
- the Earth's rotation.
  - the Earth's climate.
  - shielding UV light from the Sun.
  - the availability of greenhouses.
  - near-Earth asteroids.
- 86 Stars usually come in clusters, all born at about the same time, because
- that is statistically the most probable situation.
  - supergiant stars often explode into pieces.
  - the formation of one star triggers others.
  - collapsing interstellar clouds usually fragment.
- 87 In a star with 15 to 20 times the mass of our Sun nuclear burning at the center stops
- several times during successive stages.
  - only when a silicon core develops.
  - only when an oxygen core develops.
  - only when a carbon core develops.
  - only when an iron core develops.

- 88 The presence of almost three million times the mass of our sun packed within a light day of the center of our galaxy suggests that there is
- a very large black hole there.
  - a planet the size of our solar system there.
  - a very dense swarm of stars there.
- 89 If the frequency of electromagnetic radiation goes from  $3 \times 10^{14} \text{Hz}$  to  $9 \times 10^{14} \text{Hz}$ , the energy of each individual photon in the radiation
- does not change.
  - is multiplied by 3.
  - is divided by 2.
  - is multiplied by 2.
  - is divided by 3.
- 90 Barnard's star shows a proper motion of 10.36 arc seconds per year. In 100 years, its position in the sky changes by
- 0 seconds of arc.
  - 103.6 seconds of arc.
  - 1036 seconds of arc.
  - 10.36 seconds of arc.
  - 518 seconds of arc.
- 91 The stars of the Milky Way are found
- only near the celestial equator.
  - only near the ecliptic.
  - only near the celestial poles.
  - in all parts of the celestial sphere.
  - in a band of stars stretching across the sky.
- 92 Newton's explanation of Kepler's Laws relied upon a force that
- acts on planets but not on comets.
  - acts only on heavenly bodies.
  - acts only on planets.
  - acts only on inorganic matter.
  - acts on all objects.
- 93 The answer to the 'solar neutrino problem' is now thought to be that
- nuclear reaction theory is wrong.
  - neutrinos are changing type as they travel.
  - neutrinos are being absorbed by the Sun.
  - the sun's core has shut down.
  - neutrinos are vanishing.
- 94 In an evolved high-mass star, when the electrons combine with protons to form a pure neutron core, the reaction
- generates an X-ray burst.
  - generates a neutrino burst.
  - absorbs gamma rays.
  - absorbs neutrinos.
  - generates a gamma ray burst.

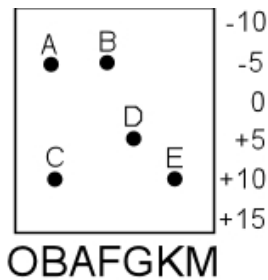
95 The diameter of the Milky Way Galaxy is close to

- a. 1000 light years.
- b. 30,000 light years.
- c. 100,000 light years.
- d. 6000 light years.
- e. 300,000 light years.

96 A planetary nebula forms when

- a. a new star is born.
- b. a star begins to burn helium.
- c. a supernova happens.
- d. a star becomes a white dwarf.
- e. a nova happens.

97 In the Hertzsprung-Russell Diagram shown, which point represents a star of type B with absolute magnitude -5?



98 Information about the structure of the Earth's interior comes mainly from

- a. deep ocean drilling.
- b. earthquake waves.
- c. satellite imaging.
- d. spelunking.
- e. ocean waves.

99 A star whose apparent brightness is  $10^{-6}$  times that of a first magnitude star would have magnitude

- a. 6.
- b. 21.
- c. 16.
- d. 11.
- e. 1.

100 The star  $\pi^3$ -Orionis is 8 parsecs from our Sun. The light from  $\pi^3$ -Orionis has been traveling for

- a. 8.0 years.
- b. 0.4 years.
- c. 26 years.
- d. 0.125 years.
- e. 2.4 years.

- 101 Galaxies are organized into clusters and other large non-uniform structures that
- stop with voids and filaments (made of superclusters), which are themselves uniformly distributed.
  - stop with superclusters (of clusters), which are themselves uniformly distributed.
  - stop with tapestries (made of voids and filaments), which are themselves uniformly distributed.
  - apparently continue to larger and larger structures without end.
- 102 Which of the following colors indicates the coldest star?
- yellow.
  - peach.
  - blue.
  - orange.
  - red.
- 103 An asteroid whose impact generates an explosion similar to that of a typical nuclear weapon probably has a diameter of about
- 1 to 5 meters.
  - 1000 to 10,000 meters.
  - 100,000 meters or larger.
  - 50 meters.
- 104 The word 'Parallax' in the term 'Spectroscopic Parallax' is used because that term refers to
- a method for finding distances to stars.
  - the use of parallel lines on the HR diagram.
  - the use of stellar parallax.
  - a method for finding the masses of stars.
- 105 The Kuiper Belt is mostly located
- between the orbits of Mars and Jupiter.
  - between the orbits of Uranus and Neptune.
  - between the orbits of Jupiter and Uranus.
  - beyond the orbit of Neptune.
- 106 A neutron star in orbit near a normal star is expected to emit
- no X-rays at all.
  - a constant X-ray signal with no bursts.
  - both a constant X-ray signal and X-ray bursts.
  - bursts of X-rays but no constant signal.
- 107 Suppose that a star has a spectrum that includes red, blue, and violet lines spaced in the pattern of the lines from hydrogen but the violet lines are at 444nm and 420nm instead of the usual 434nm and 410nm. From this evidence, you can conclude that the star is
- rotating.
  - unusually cold.
  - moving toward us.
  - unusually hot.
  - moving away from us.



- 108 The intense magnetic field of the Crab pulsar causes its rate of spin to
- vary up and down.
  - increase.
  - decrease.
- 109 One reason that the Copernican System failed to fit Tycho's observations was
- it placed the Sun at the center of the system.
  - it used elliptical orbits instead of circles.
  - it used circular orbits instead of ellipses.
  - it placed the Earth at the center of the universe.
- 110 Tycho Brahe's careful observations of the planets agreed, to within observational error, with
- None of these systems.
  - the Ptolemaic System.
  - the Tychonic System.
  - the Copernican System
- 111 The Tau-Tauri wind from the Sun's ignition
- moved Jupiter to its present orbit.
  - provided the heat that Jupiter needed to become a star.
  - provided gas to Jupiter and the other Jovian planets.
  - had no effect on the Jovian planets.
  - blew away the fuel that Jupiter needed to become a star.
- 112 Copernicus said that the rotation of the Earth on its axis caused the
- retrograde motion of the planets..
  - phases of the Moon.
  - eclipses of the Moon
  - motion of the Sun along the ecliptic.
  - daily motions in the heavens.
- 113 The closest star to the North Celestial Pole that is visible to the naked eye is
- Polaris.
  - Alcor.
  - Altair.
  - Sirius.
  - Mizar.
- 114 The paths of comets usually
- stay between the orbits of Uranus and Neptune.
  - stay closer to the Sun than Mars does.
  - stay within the orbit of Pluto.
  - stay between the orbits of Mars and Jupiter.
  - extend far beyond the orbit of Pluto.

- 115 When the iron nuclei in the core of an evolved high-mass star start to come apart, they
- cause the core to expand.
  - trigger a new round of nuclear fusion.
  - release energy and raise the core temperature.
  - absorb energy and limit the core temperature.
- 116 The mass of a carbon atom is 12.00amu while the mass of a helium-4 atom is 4.003amu. If three atoms of helium fuse to form carbon, how much mass is converted into energy?
- 0.006amu
  - 0.002amu
  - 0.004amu
  - 0.012amu
  - 0.009amu
- 117 The side of the Moon that faces away from the Earth
- looks exactly like the side that faces the Earth.
  - consists almost entirely of lunar maria.
  - has only a few small lunar maria.
- 118 The closest star to our sun is about four light years away. In the center of our galaxy, a typical distance between neighboring stars would be
- 40 light years.
  - 4000 light years.
  - 4 light years.
  - 0.004 light years.
  - 0.04 light years.

## Answer Key: Version 1 Fall 2004

- 1 Choice a. (Passenger pigeons are extinct.)
- 2 Choice b. (electrical repulsion.)
- 3 Choice d. (Galileo)
- 4 Choice a. (is somewhat tilted relative to the plane of the Earth's equator.)
- 5 Choice b. (the Tulley-Fisher relation.)
- 6 Choice d. (a few hundred stars that all formed together.)
- 7 Choice c. ( $0.001 \text{ m/s}^2$ )
- 8 Choice a. (large systems of moons.)
- 9 Choice d. (moves eastward along the ecliptic by  $1^\circ$ .)
- 10 Choice c. (how planets move and how the tides work.)
- 11 Choice a. (convection currents in the Earth's mantle.)
- 12 Choice a. (are lighter because they are thinner.)
- 13 Choice c. (atmospheric turbulence.)
- 14 Choice c. (away from the Sun.)
- 15 Choice a. (Cassegrain Focus.)
- 16 Choice c. (differential rotation and magnetic fields.)
- 17 Choice b. (the velocities with which stars orbit.)
- 18 Choice d. (are approximately constant at all distances.)
- 19 Choice a. (the exhaustion of hydrogen at its core.)
- 20 Choice d. (stays at the same point until it runs out of fuel.)
- 21 Choice a. (always the same as those it emits when hot.)
- 22 Choice a. (Planetary Nebulae.)
- 23 Choice c. (Irr I)
- 24 Choice b. (the Solar Wind comes from.)
- 25 Choice c. (10Mpc.)
- 26 Choice c. (slowing down.)
- 27 Choice a. (sets in the west and southwest.)
- 28 Choice d. (the rapid fluctuations in its X-rays.)
- 29 Choice b. (white dwarf star.)
- 30 Choice b. (among the highest.)
- 31 Choice c. (the phases of Venus.)
- 32 Choice d. (ultraviolet light.)
- 33 Choice b. (obsolescence.)
- 34 Choice b. (B and C both move away.)
- 35 Choice a. (a meteor shower.)
- 36 Choice c. (is mostly horizontal.)

- 37 Choice d. (Only along a narrow path.)
- 38 Choice c. (Atlantic Ocean.)
- 39 Choice b. (energy left over from its formation.)
- 40 Choice c. (closest one to our Sun.)
- 41 Choice b. (on the horizon.)
- 42 Choice b. (G0)
- 43 Choice c. (over a region less than a few light days across.)
- 44 Choice c. (ahead of the Moon's motion.)
- 45 Choice a. (mantle.)
- 46 Choice c. (hot, dense material.)
- 47 Choice d. (prevents the cloud from fragmenting.)
- 48 Choice b. (a nearby large cluster of galaxies.)
- 49 Choice c. (10,000 parsecs.)
- 50 Choice b. (less than once.)
- 51 Choice a. (two regions of maximum pressure.)
- 52 Choice a. (move from the asteroid belt into the inner solar system.)
- 53 Choice c. (The Equal Area Law.)
- 54 Choice b. (increase with increasing distance from the center.)
- 55 Choice c. (The phases of the Moon.)
- 56 Choice e. (another helium-3 to form a helium-4 and two protons.)
- 57 Choice c. (outwardly directed light rays are pulled into the hole.)
- 58 Choice b. (stars crowd closer together than usual and then move on.)
- 59 Choice e. (provided only a lot of accurate data.)
- 60 Choice e. (the neutrons touch each other.)
- 61 Choice c. (be greater than 13 billion years.)
- 62 Choice a. (a layer of dirt on the lunar surface.)
- 63 Choice b. (above the central region but well below the surface.)
- 64 Choice d. (at the top.)
- 65 Choice d. (4 m.)
- 66 Choice c. (a spectrum with hydrogen lines and a variable maximum brightness.)
- 67 Choice e. (icy objects condensed out in the inner Solar System.)
- 68 Choice c. (have similar luminosities.)
- 69 Choice e. (novas.)
- 70 Choice a. (of dazzling brightness.)
- 71 Choice e. (10 Newtons)
- 72 Choice c. (all of the other planets except for Pluto.)
- 73 Choice b. (red.)

- 74 Choice c. (both infrared light and radio waves.)
- 75 Choice d. (D)
- 76 Choice d. (a spiral somewhat like the nearby Andromeda Galaxy.)
- 77 Choice a. (you expect rapid changes.)
- 78 Choice e. (the asteroid belt.)
- 79 Choice c. (130km/s)
- 80 Choice d. (SBa.)
- 81 Choice d. (keep moving at the same speed.)
- 82 Choice c. (orbit the central bulge only within the disk.)
- 83 Choice a. (nearby stars to shift back and forth once a year.)
- 84 Choice b. (at the lower left.)
- 85 Choice b. (the Earth's climate.)
- 86 Choice d. (collapsing interstellar clouds usually fragment.)
- 87 Choice e. (only when an iron core develops.)
- 88 Choice a. (a very large black hole there.)
- 89 Choice b. (is multiplied by 3.)
- 90 Choice c. (1036 seconds of arc.)
- 91 Choice e. (in a band of stars stretching across the sky.)
- 92 Choice e. (acts on all objects.)
- 93 Choice b. (neutrinos are changing type as they travel.)
- 94 Choice b. (generates a neutrino burst.)
- 95 Choice c. (100,000 light years.)
- 96 Choice d. (a star becomes a white dwarf.)
- 97 Choice a. (A)
- 98 Choice b. (earthquake waves.)
- 99 Choice c. (16.)
- 100 Choice c. (26 years.)
- 101 Choice a. (stop with voids and filaments (made of superclusters), which are themselves uniformly distributed.)
- 102 Choice e. (red.)
- 103 Choice d. (50 meters.)
- 104 Choice a. (a method for finding distances to stars.)
- 105 Choice d. (beyond the orbit of Neptune.)
- 106 Choice c. (both a constant X-ray signal and X-ray bursts.)
- 107 Choice e. (moving away from us.)
- 108 Choice c. (decrease.)
- 109 Choice c. (it used circular orbits instead of ellipses.)
- 110 Choice a. (None of these systems.)

- 111 Choice e. (blew away the fuel that Jupiter needed to become a star.)
- 112 Choice e. (daily motions in the heavens.)
- 113 Choice a. (Polaris.)
- 114 Choice e. (extend far beyond the orbit of Pluto.)
- 115 Choice d. (absorb energy and limit the core temperature.)
- 116 Choice e. (0.009amu)
- 117 Choice c. (has only a few small lunar maria.)
- 118 Choice e. (0.04 light years.)

## Where the questions came from

- 1 Module 003 How to test a statement : Question 003.23
- 2 Module 042: Nuclear Fire Question 042.33
- 3 Module 007 The Law of Inertia: Question 007.11
- 4 Module 022: The Earth's Moon Question 022.43
- 5 Module 056: The Family of Galaxies Question 056.35
- 6 Module 047: Star Formation Question 047.51
- 7 Module 007 The Law of Force and Mass: Question 007.43
- 8 Module 014: Solar System Survey: Question 014.33
- 9 Module 001 The Path of the Sun: Question 001.54
- 10 Module 008 Unifying Physical Law: Question 008.22
- 11 Module 021: Continental Drift Question 021.31
- 12 Module 012 Focal Point of a Mirror: Question 012.23
- 13 Module 012 Telescope Limitations: Question 012.44
- 14 Module 015: Comets in Detail: Question 015.11
- 15 Module 012 Telescope Designs: Question 012.32
- 16 Module 041: Solar Magnetism and Activity Question 041.21
- 17 Module 054: Dark Matter in the Milky Way Question 054.31
- 18 Module 054: Dark Matter in the Milky Way Question 054.13
- 19 Module 048: The Quiet Deaths of Ordinary Stars Question 048.11
- 20 Module 047: Star Formation Question 047.33
- 21 Module 011 The Reason for Spectra: Question 011.43
- 22 Module 052: The Milky Way Question 052.23
- 23 Module 056: The Family of Galaxies Question 056.21
- 24 Module 040: Survey of the Sun Question 040.26
- 25 Module 057: The Expanding Universe Question 057.31
- 26 Module 050: Neutron Stars Question 050.11
- 27 Module 001 Star Motions: Question 001.32
- 28 Module 051: Black Holes Question 051.24
- 29 Module 048: The Quiet Deaths of Ordinary Stars Question 048.52
- 30 Module 010 Temperature and Color: Question 010.22
- 31 Module 005 The First Astrophysicist: Question 005.24
- 32 Module 010 The Electromagnetic Spectrum: Question 010.16
- 33 Module 013 Ultraviolet: Question 013.32
- 34 Module 057: The Expanding Universe Question 057.21
- 35 Module 015: Comets in Detail: Question 015.44
- 36 Module 049: Supernova Explosions Question 049.22

- 37 Module 002 Solar Eclipses: Question 002.21
- 38 Module 021: Continental Drift Question 021.22
- 39 Module 047: Star Formation Question 047.43
- 40 Module 053: Shape of the Milky Way Question 053.24
- 41 Module 018: The Moon and the Tides: Question 018.12
- 42 Module 045: Star Colors and Classes 045.31
- 43 Module 055: The Monster in the Milky Way Question 055.33
- 44 Module 018: The Moon and the Tides: Question 018.41
- 45 Module020: Earth and Moon Interiors Question 020.24
- 46 Module 010 Spectra: Question 010.31
- 47 Module 047: Star Formation Question 047.22
- 48 Module 056: The Family of Galaxies Question 056.43
- 49 Module 044: Stellar Magnitudes Question 044.44
- 50 Module 040: Survey of the Sun Question 040.32
- 51 Module 009 Wavelength: Question 009.12
- 52 Module 016: Earth Impacts: Question 016.12
- 53 Module 006 Equal Area Rule: Question 006.32
- 54 Module 054: Dark Matter in the Milky Way Question 054.24
- 55 Module 002 Phases of the Moon: Question 002.12
- 56 Module 042: Nuclear Fire Question 042.44
- 57 Module 051: Black Holes Question 051.11
- 58 Module 053: Shape of the Milky Way Question 053.43
- 59 Module 004 Tycho Brahe's Role: Question 004.42
- 60 Module 049: Supernova Explosions Question 049.51
- 61 Module 057: The Expanding Universe Question 057.42
- 62 Module 022: The Earth's Moon Question 022.32
- 63 Module 040: Survey of the Sun Question 040.12
- 64 Module019: The Earth's Atmosphere Question 019.28
- 65 Module 009 Speed of a Wave: Question 009.33
- 66 Module 049: Supernova Explosions Question 049.64
- 67 Module 017: Formation of the Solar System: Question 017.42
- 68 Module 052: The Milky Way Question 052.31
- 69 Module 048: The Quiet Deaths of Ordinary Stars Question 048.62
- 70 Module 044: Stellar Magnitudes Question 044.34
- 71 Module 007 Definitions of Force and Mass: Question 007.26
- 72 Module 017: Formation of the Solar System: Question 017.13
- 73 Module 045: Star Colors and Classes 045.23



- 74 Module 055: The Monster in the Milky Way Question 055.21
- 75 Module 046: The Hertzsprung-Russell Diagram Question 046.36
- 76 Module 053: Shape of the Milky Way Question 053.13
- 77 Module019: The Earth's Atmosphere Question 019.14
- 78 Module 017: Formation of the Solar System: Question 017.51
- 79 Module 057: The Expanding Universe Question 057.13
- 80 Module 056: The Family of Galaxies Question 056.13
- 81 Module 005 The First Physicist: Question 005.12
- 82 Module 053: Shape of the Milky Way Question 053.33
- 83 Module 043: Stellar Parallax Question 043.12
- 84 Module 046: The Hertzsprung-Russell Diagram Question 046.22
- 85 Module019: The Earth's Atmosphere Question 019.33
- 86 Module 047: Star Formation Question 047.14
- 87 Module 049: Supernova Explosions Question 049.11
- 88 Module 055: The Monster in the Milky Way Question 055.42
- 89 Module 011 Photons: Question 011.26
- 90 Module 043: Stellar Parallax Question 043.41
- 91 Module 052: The Milky Way Question 052.12
- 92 Module 008 Explaining Kepler's Laws: Question 008.12
- 93 Module 042: Nuclear Fire Question 042.53
- 94 Module 049: Supernova Explosions Question 049.42
- 95 Module 052: The Milky Way Question 052.43
- 96 Module 048: The Quiet Deaths of Ordinary Stars Question 048.43
- 97 Module 046: The Hertzsprung-Russell Diagram Question 046.15
- 98 Module020: Earth and Moon Interiors Question 020.11
- 99 Module 044: Stellar Magnitudes 044.23
- 100 Module 043: Stellar Parallax Question 043.33
- 101 Module 056: The Family of Galaxies Question 056.51
- 102 Module 045: Star Colors and Classes Question 045.12
- 103 Module 016: Earth Impacts: Question 016.22
- 104 Module 046: The Hertzsprung-Russell Diagram Question 046.52
- 105 Module 015: Comets in Detail: Question 015.21
- 106 Module 050: Neutron Stars Question 050.31
- 107 Module 010 The Doppler Effect: Question 010.41
- 108 Module 050: Neutron Stars Question 050.24
- 109 Module 006 Orbits are Ellipses: Question 006.22
- 110 Module 006 Death of a Theory: Question 006.12

- 111 Module 017: Formation of the Solar System: Question 017.32
- 112 Module 004 The Copernican System: Question 004.24
- 113 Module 001 The Celestial Sphere: Question 001.12
- 114 Module 014: Solar System Survey: Question 014.44
- 115 Module 049: Supernova Explosions Question 049.32
- 116 Module 042: Nuclear Fire Question 042.21
- 117 Module 022: The Earth's Moon Question 022.15
- 118 Module 055: The Monster in the Milky Way Question 055.12