



- 1 The term 'Greenhouse effect' refers to
  - a. a theory proposed by Charles T. Greenhouse.
  - b. the destruction of the ozone layer.
  - c. the fact that the atmosphere is transparent.
  - d. the absorption of ultraviolet light by gases in the atmosphere.
  - e. the absorption of infrared light by gases in the atmosphere.
  
- 2 Kepler's Laws
  - a. are explained by a force that repels each planet from the Sun.
  - b. have never been explained.
  - c. are explained by a force in the direction of each planet's motion.
  - d. are explained by a force that attracts each planet to the Sun.
  - e. are explained by the action of magnetic fields on each planet.
  
- 3 At 9pm, you see that the pointer stars of the Big dipper and the star Polaris are arranged in a vertical line. How long would you need to wait to see them arranged in a horizontal line?
  - a. 6 hours.
  - b. 24 hours.
  - c. It will never happen.
  - d. 12 hours.
  - e. 3 hours.
  
- 4 The first major failure of the Ptolemaic Theory to predict the results of observations was
  - a. the mountains of the Moon.
  - b. the phases of Venus.
  - c. the Moons of Jupiter.
  - d. the precise observations of Tycho Brahe.
  - e. the retrograde motion of the planets.
  
- 5 The Population I stars of our Milky Way
  - a. orbit the central bulge in all directions.
  - b. are mostly in the central bulge.
  - c. orbit the central bulge only within the disk.
  
- 6 The density of rock is about  $3000\text{kg/m}^3$ . The density of the Earth is
  - a. less than  $3000\text{kg/m}^3$  because so much of the Earth is water.
  - b. greater than  $3000\text{kg/m}^3$  because the Earth has an iron core.
  - c. close to  $3000\text{kg/m}^3$  because most of the Earth is rock.
  
- 7 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
  - a. B and C both move closer.
  - b. C moves away and B moves closer.
  - c. B and C both move away.
  - d. B moves away and C moves closer.

- 8 Galileo said that a moving object with nothing pushing or pulling on it will always
- slow down and stop.
  - keep moving at the same speed.
  - speed up.
  - follow a circular path.
- 9 A converging lens will send the light from a distant star through a point
- on the same side of the lens as the star.
  - on the side of the lens opposite the star.
  - at one edge of the lens.
  - infinitely far away from the lens.
  - in the center of the lens.
- 10 When a white dwarf star collects matter from a neighboring star, fusion reactions on the surface of the white dwarf cause
- a supernova.
  - novas.
  - a planetary nebula.
  - re-expansion to a red giant.
  - a helium flash.
- 11 The red line of a spectrum is normally at a wavelength of 656 nm. In the light of a star that is moving away from us, we might expect to see that red line at a wavelength of
- 650nm.
  - 660nm.
  - 656nm.
- 12 In addition to measuring the positions of all the planets all the time, Tycho Brahe measured them to an accuracy of
- five degrees of arc.
  - 1/60 degree of arc.
  - 1/10 degree of arc.
  - one degree of arc.
  - 1/3600 degree of arc.
- 13 The changing phases of the Moon are caused by
- the motion of the earth around the Sun.
  - the tilt of the Earth's axis.
  - the changing distance to the Moon.
  - the motion of the Moon around the Earth.
  - the rotation of the earth on its axis.
- 14 The observation that stars farther from the center of our galaxy orbit faster is thought to mean that
- most of the mass is in the central bulge.
  - much of the mass is outside the central bulge.
  - Newton's Theory of Gravitation is not correct.

- 15 Suppose that the color and behavior of a star identify it as a type that we know has absolute magnitude 4.8. If the star's apparent magnitude is found to be 9.8, how far away is it?
- 100 parsecs.
  - 1000 parsecs.
  - 10 parsecs.
  - 50 parsecs.
  - 5 parsecs.
- 16 Planetesimals of rock and iron, prevented from forming a planet by Jupiter's gravity, became
- the interstellar dust.
  - the Kuiper belt.
  - the Moons of the Jovian planets.
  - the asteroid belt.
  - the Oort Cloud.
- 17 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
  - 0.009amu
  - 0.012amu
  - 0.002amu
  - 0.004amu
- 18 We can use the pointer stars in the Big Dipper to locate a point in the sky near the
- Celestial Equator.
  - Star Sirius.
  - East Celestial Pole.
  - South Celestial Pole.
  - North Celestial Pole.
- 19 Ancient lava flows on the Moon are called Lunar
- maria.
  - valleys.
  - planitia.
  - terrae.
  - craters.
- 20 The Moon turns red during a lunar eclipse because
- it is completely covered with red dust.
  - it is very hot and its glow is revealed.
  - our eyes see an after-image when the light dies.
  - faint light is reddened more than bright light.
  - it is lit by a sunset all round the Earth.

- 21 Which of the following types of radiation has the lowest frequency on this list.
- green light.
  - heat radiation.
  - infrared light.
  - Radio waves.
  - red light.
- 22 The plane that contains the Earth's orbit around the Sun is also called the plane of the ecliptic. When you look for planets in the sky, you expect to find
- all of them except for Uranus near the ecliptic.
  - none of them except for Mars near the ecliptic.
  - all of them except Pluto near the ecliptic.
  - all of them except for Neptune near the ecliptic.
  - all of them except for Venus near the ecliptic.
- 23 The photosphere is a layer of the Sun that
- absorbs most photons.
  - attracts photons.
  - gives rise to the Solar Wind.
  - emits most sunlight.
  - is visible only during eclipses.
- 24 The idea that a supernova is preceded by a huge burst of neutrinos is
- a prediction that has now been observed.
  - a prediction that has not yet been observed.
  - no longer believed to be correct.
  - a purely theoretical idea that cannot be tested.
- 25 Suppose that you lift an object by exerting an upward force of 5 Newtons on it. If gravity exerts a force of 10 Newtons downward on the object, what is the total force on the object?
- 5 Newtons downward
  - 15 Newtons upward
  - 5 Newtons upward
  - 10 Newtons downward
  - 15 Newtons downward
- 26 During the Tau Tauri phase of a protostar's evolution,
- the surface area stops decreasing
  - the photosphere has yet to form.
  - the brightness increases.
  - the brightness decreases.
  - nuclear burning starts.

- 27 Stellar Parallax is caused by
- the actual motion of stars relative to their neighbors.
  - turbulence in the Earth's atmosphere.
  - the motion of our Sun relative to its neighbors.
  - the motion of the Earth around the Sun.
  - the finite speed of light.
- 28 Which of the following magnitudes corresponds to the dimmest star?
- +3.4.
  - +5.6.
  - 1.5.
  - +1.2
  - +2.1.
- 29 The velocities with which stars and gas clouds orbit the center of our galaxy is measured by observing their
- proper motions.
  - doppler shifts.
  - angular sizes.
  - brightness.
- 30 Kepler found that planetary orbits are
- ellipses with the Sun at the center.
  - circles with the Sun off-center.
  - ellipses with the Sun at one focus.
  - circles with the Sun at the center.
- 31 The force of gravity explains
- how the tides and lightning work.
  - how planets move and how the Sun shines.
  - how things fall and how lightning works.
  - how planets move and how the tides work.
  - how things fall and how the Sun shines.
- 32 Copernicus said that the daily motions in the heavens were caused by the
- planets moving on epicycles.
  - earth and the planets orbiting the Sun.
  - planets turning on their axes.
  - planets speeding up and slowing down.
  - earth turning on its axis.
- 33 A star with an absolute magnitude of 5.7 and an apparent magnitude of -1.2 would appear in our sky as a star
- visible only with a telescope.
  - barely visible to the naked eye.
  - of average naked-eye brightness.
  - of dazzling brightness.

- 34 A neutron star in orbit near a normal star is expected to emit
- 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.
  - no X-rays at all.
- 35 The Moon's orbit
- is perpendicular to the plane of the Earth's equator.
  - is in the plane of the ecliptic.
  - is in the plane of the Earth's equator.
  - is somewhat tilted relative to the plane of the Earth's equator.
- 36 The source that is called Sgr A\* emits
- only X-rays.
  - both X-rays and radio waves.
  - only radio waves.
- 37 The Moon's mantle is made
- entirely of solid rock.
  - of semiliquid rock near the core and solid rock near the crust.
  - of solid rock near the core and semiliquid rock near the crust.
  - entirely of semiliquid rock.
  - entirely of liquid rock.
- 38 The stars of the Milky Way are found
- in all parts of the celestial sphere.
  - only near the celestial poles.
  - only near the celestial equator.
  - only near the ecliptic.
  - in a band of stars stretching across the sky.
- 39 Our sun is roughly at the center of
- the entire Milky Way Galaxy.
  - a globular cluster.
  - the visible part of the Milky Way.
- 40 The iron core of an evolved massive star collapses because
- its temperature rise stops when iron nuclei come apart.
  - the weight of the rest of the star goes away.
  - its temperature rises faster when iron nuclei come apart.
  - its temperature suddenly goes to zero.
  - the weight of the rest of the star increases.
- 41 You see a reflecting telescope with a short, stubby tube and the eyepiece at the back. This telescope uses the
- Newtonian Focus.
  - Coudé Focus
  - Cassegrain Focus.
  - Prime Focus.

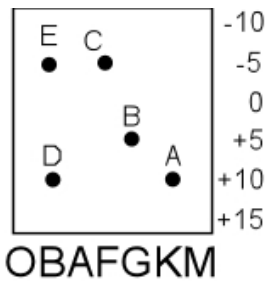
- 42 A solar sail is a large sheet of light-reflecting plastic spread on an extremely low-mass framework and attached to a spacecraft. Sunlight exerts a force on the sail and moves the spacecraft. Suppose the spacecraft has a total mass of 100kg (including the sail) and sunlight exerts a total force of 2N on the sail. What will be the acceleration of the spacecraft?
- $0.2\text{m/s}^2$
  - $0.02\text{m/s}^2$
  - $2\text{m/s}^2$
  - $100\text{m/s}^2$
  - $50\text{m/s}^2$
- 43 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
- the orbital motion of the stars has wound a bar shape into a spiral.
  - star formation is triggering more star formation.
  - intense magnetic fields confine the stars.
- 44 Take Hubble's constant to be  $65\text{km/s/Mpc}$ . If the red-shift of an object indicates that it is moving away from us at  $260\text{km/s}$ , how far away is it?
- $0.1\text{Mpc}$ .
  - $0.25\text{Mpc}$ .
  - $10\text{Mpc}$ .
  - $4\text{Mpc}$ .
  - $260\text{Mpc}$ .
- 45 The mass that is distributed in different parts of our Milky Way Galaxy is estimated by
- counting visible stars and adding up their masses.
  - measuring how much hydrogen there is from its emissions.
  - measuring how stars orbit the center of the galaxy.
  - measuring the bending of starlight by unseen objects.
  - measuring the temperature of the interstellar gas.
- 46 The gravitational influence of the planets mostly causes asteroids to
- stay out of the inner solar system.
  - remain in the asteroid belt.
  - move from the inner solar system to the asteroid belt.
  - move from the asteroid belt into the inner solar system.
- 47 Stars with more than 15 times the mass of our Sun usually evolve from the main sequence to red giants
- in several stages, some with almost constant temperature.
  - in several stages, but none with almost constant temperature.
  - without pausing while getting cooler at almost constant brightness.
  - without pausing while getting brighter at almost constant temperature.
- 48 According to Kepler's Laws of Planetary Motion, as planets orbit the sun, they
- speed up when in retrograde motion.
  - speed up when farthest from the Sun.
  - speed up when closest to the Sun.
  - move at constant speed.



- 49 The answer to the 'solar neutrino problem' is now thought to be that
- neutrinos are being absorbed by the Sun.
  - neutrinos are vanishing.
  - the sun's core has shut down.
  - neutrinos are changing type as they travel.
  - nuclear reaction theory is wrong.
- 50 A likely limitation on the usable life of an ultraviolet observatory would be
- its supply of electric power.
  - the decay of its orbit.
  - obsolescence.
  - its supply of coolant.
- 51 The part of a protostar where the density first becomes low enough for photons to escape is called the
- central core.
  - fragmentation point.
  - photosphere.
  - core boundary.
  - outer boundary.
- 52 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
- one region of maximum pressure.
  - two regions of maximum pressure.
  - maximum pressure every two seconds.
  - three regions of maximum pressure.
  - maximum pressure every four seconds.
- 53 In the core of a high-mass star, the formation of 'degenerate neutron matter' which consists entirely of neutrons that touch one another
- causes a gamma-ray burst.
  - starts the collapse of the star's core.
  - starts a supernova explosion.
  - triggers a nova.
  - releases a burst of neutrinos.
- 54 In one day, the position of the Sun on the Celestial Sphere
- does not change at all.
  - moves westward along the ecliptic by  $15^\circ$ .
  - moves eastward along the ecliptic by  $1^\circ$ .
  - Moves eastward along the ecliptic by  $15^\circ$ .
  - moves westward along the ecliptic by  $1^\circ$ .
- 55 The "Little Green Men Standard Time" hypothesis for the repeating radio signals seen in 1968 was rejected partly because the repetition rate was
- exactly constant.
  - speeding up.
  - slowing down.

- 56 The problem of stars "twinkling" due to atmospheric turbulence
- can be corrected by using a more powerful eyepiece.
  - can be corrected by going to larger telescope mirrors.
  - can only be corrected by putting telescopes in space.
  - can be corrected by using a guide star.
  - cannot be corrected.
- 57 The paths of comets usually
- stay between the orbits of Mars and Jupiter.
  - stay between the orbits of Uranus and Neptune.
  - stay closer to the Sun than Mars does.
  - extend far beyond the orbit of Pluto.
  - stay within the orbit of Pluto.
- 58 The cluster of galaxies that our own galaxy belongs to is called the
- Local Group.
  - Local Supercluster.
  - Coma Berenices Cluster.
  - Virgo Cluster.
  - Andromeda Cluster.
- 59 The velocity of a wave is defined to be
- the distance traveled by a crest divided by the time taken.
  - the number of crests that pass multiplied by the time taken.
  - the time taken for a crest to pass.
  - the number of crests that pass divided by the time taken.
  - the distance from one crest to the next.
- 60 Which of the following statements is scientific (as defined by Popper)?
- The Minoans were not the best civilization on Crete.
  - The Minoans were the best civilization on Crete.
  - The Minoans were the first civilization on Crete.
  - The Minoans were a civilization on Crete.
  - The Minoans were not the first civilization on Crete.
- 61 Earthquakes are often caused by
- drought.
  - slipping tectonic plates.
  - collapsing mountains.
  - high winds.
  - torrential rains.

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



- 63 Objects such as the Great Nebula in Andromeda were once called "extragalactic nebulae". It is now realized that they are actually
- other galaxies much like our own.
  - small objects just outside our own galaxy.
  - inside our own galaxy.
- 64 Who discovered Newton's First Law of Motion?
- Newton
  - Tycho Brahe
  - Galileo
  - Kepler
  - Aristotle.
- 65 An asteroid whose impact generates an explosion similar to that of a typical nuclear weapon probably has a diameter of about
- 50 meters.
  - 1 to 5 meters.
  - 100,000 meters or larger.
  - 1000 to 10,000 meters.
- 66 A galaxy that is a featureless spherical ball of stars would be called a type
- Sb.
  - Sa.
  - S0.
  - E7.
  - E0.
- 67 Warmer air always.
- goes eastward.
  - sinks.
  - moves in circles.
  - rises.
  - goes westward.
- 68 The frequencies absorbed by a cold gas are
- always the same as those it emits when hot.
  - exactly double those it emits when hot.
  - unrelated to those it emits when hot.

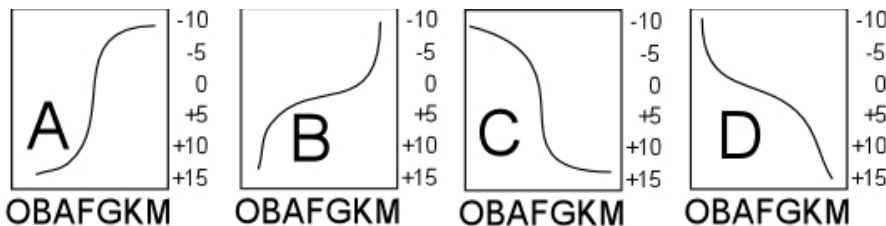
- 69 When there is a New Moon, you can expect that tides will be
- unusually strong.
  - of usual strength.
  - totally absent.
  - unusually weak.
- 70 In a Hertzsprung-Russell diagram, the brightest stars are found
- at the bottom.
  - at the top.
  - on the left side.
  - on the right side.
- 71 When the number of sunspots is a minimum, the energy output of the Sun is
- unaffected because the spots are small.
  - increased because the spots radiate less.
  - decreased because solar activity is less.
- 72 The time from one high tide to the next is lengthened by 24 minutes because of
- the rotation of the Moon on its axis.
  - the effects of land tides.
  - friction with the Earth.
  - the motion of the Moon in its orbit.
  - the presence of continents blocking the tidal flows.
- 73 It now (2002) appears that, except for the universe itself, the largest structure in nature has a size of approximately
- 30 thousand million light years.
  - 30 thousand light years.
  - 300 thousand light years.
  - 300 million light years.
  - 30 million light years.
- 74 A star of spectral type M should look
- orange.
  - white.
  - red.
  - yellow.
  - blue.
- 75 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 very dense swarm of stars there.
  - a planet the size of our solar system there.

- 76 Nuclei such as protons do not fuse at low temperatures because their speeds are not enough to overcome their
- inertia.
  - hard shells.
  - structural integrity.
  - electrical repulsion.
  - nuclear friction.
- 77 The mass of Sgr A\* has been determined by observing
- fluctuations in radio emissions from it.
  - the intensity of X-ray emissions from it.
  - interstellar space probes in orbit around it.
  - the motions of stars near it.
- 78 Black holes
- have been detected as pulsing radio sources.
  - have been detected because they block starlight.
  - cannot be detected because they emit no radiation.
  - have been detected because infalling matter emits X-rays.
- 79 The formation of electron-degenerate matter in the carbon core of a solar-mass red super giant
- returns the star to the horizontal branch.
  - causes the core to explode.
  - prevents carbon-burning from starting.
  - leads to further core collapse.
  - triggers a flash of carbon-burning.
- 80 The HR diagram of a globular cluster typically shows
- only the middle part of the main sequence still present.
  - only the upper part of the main sequence still present.
  - the entire main sequence still present.
  - only the lower part of the main sequence still present.
- 81 Our Sun is expected to last for about 10 billion years. Which of these is a likely lifespan for a star with 20 times the mass of our Sun?
- 1 million years.
  - 20-30 billion years.
  - 10-15 million years.
  - 200 billion years.
  - 0.5 - 1 billion years.
- 82 Our Sun is a G2V star with absolute magnitude 4.8. Suppose that a star of spectral type G2V is observed to have apparent magnitude  $-0.2$ . How far away is it?
- 5 parsecs.
  - 1000 parsecs.
  - 10 parsecs.
  - 1 parsec.
  - 100 parsecs.

- 83 The layer of dirt underfoot when you stand on the Moon is called the lunar
- crust.
  - monolith.
  - regolith.
  - lithosphere.
  - mantle.
- 84 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.
  - 10.36 seconds of arc.
  - 1036 seconds of arc.
  - 103.6 seconds of arc.
  - 518 seconds of arc.
- 85 The heat formed when an interstellar cloud collapses is carried away by
- outward flowing gas ejected by magnetic fields.
  - electromagnetic waves from large molecules.
  - the ejection of hot dust particles.
  - melting ice on dust particles.
  - sound waves caused by turbulence.
- 86 Hubble's constant is not very accurately determined. For the most accepted value of 65km/s/Mpc the Hubble expansion time is about 13 billion years. If the correct value of Hubble's constant is actually 100km/s/Mpc, the Hubble expansion time would
- still be 13 billion years.
  - be less than 13 billion years.
  - be greater than 13 billion years.
- 87 Which of the following spectral types corresponds to the star with the lowest surface temperature?
- K0
  - G5
  - K5
  - G0
- 88 On a HR diagram, a visible white dwarf star is in the
- upper left corner.
  - lower right corner.
  - upper right corner.
  - lower left corner.
  - main sequence.
- 89 The point at which even an outwardly directed light ray is pulled into a black hole is called the
- tipping point.
  - particle horizon.
  - critical point.
  - event horizon.

- 90 The star delta-Eridani shows a heliocentric stellar parallax of almost exactly  $1/9$  seconds of arc. The distance from our Sun to delta-Eridani is
- 18 parsecs.
  - 4 parsecs.
  - 9 parsecs.
  - $1/9$  parsecs.
  - 4.5 parsecs.
- 91 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
- 4000 light years.
  - 4 light years.
  - 0.04 light years.
  - 40 light years.
  - 0.004 light years.
- 92 Seismic waves are used to determine the Earth's
- mass.
  - rotation rate.
  - size.
  - interior structure.
- 93 Light with a continuous spectrum is usually generated by
- hot, dense material.
  - light from hot dense material passing through a rarefied gas.
  - a cold, rarefied gas.
  - a hot, rarefied gas.
- 94 Assume that the Hubble constant is  $65 \text{ km/s/Mpc}$ . If a galaxy is  $2\text{Mpc}$  away, how fast is it moving away from us?
- $2\text{km/s}$
  - $32.5\text{km/s}$
  - $130\text{km/s}$
  - $260\text{km/s}$
  - $65\text{km/s}$

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



- 96 In our Sun, the radiation zone is located
- near the surface.
  - at the very center.
  - above the central region but well below the surface.

- 97 Cepheid variable stars with the same period
- usually belong to the same star cluster.
  - have similar luminosities.
  - have similar apparent magnitudes.
  - are at similar distances from us.
- 98 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.
- 99 Which of the following colors indicates the coldest star?
- orange.
  - red.
  - peach.
  - yellow.
  - blue.
- 100 Kepler was an early advocate of the Copernican Theory. When he applied it to Tycho's observations, it
- failed but led to a better theory.
  - was as accurate as the observations.
  - failed and was completely discarded.
  - worked perfectly.
- 101 Stars that are much more massive than our Sun
- form more slowly and burn slower.
  - form more slowly but burn out faster.
  - form faster but burn slower.
  - form faster and burn out faster.
- 102 The layer of the atmosphere where one would find hurricanes is the
- ionosphere.
  - ozone layer.
  - stratosphere.
  - troposphere.
  - mesosphere.
- 103 After a comet's closest approach to the Sun, its tail points
- out of the plane of its orbit around the Sun.
  - in all directions at once.
  - nowhere.
  - behind its direction of motion.
  - ahead of its direction of motion.



- 104 In the reaction that powers our Sun, the nuclei that collide in the last step to form helium-4 are
- protons.
  - helium-2 nuclei.
  - neutrons.
  - helium-3 nuclei.
  - deuterons.
- 105 During a meteor shower, shooting stars seem to be coming from
- the equant.
  - all parts of the sky.
  - the celestial north pole.
  - the radiant.
  - the celestial equator.
- 106 Which of the following objects is usually found among the stars that make up the Milky Way?
- Planetary Nebulae.
  - Extragalactic Nebulae.
  - Globular Clusters.
- 107 An explosion just under the surface of the Sun with a jet of ejected material is probably a
- solar granule.
  - solar prominence.
  - solar flare.
  - sunspot.
  - solar eclipse.
- 108 The Tulley-Fisher relation is useful for determining distances
- to nearby galaxies.
  - to nearby stars.
  - to very distant galaxies.
  - within our solar system.
- 109 Neutron stars are often observed as
- novas.
  - Tau Tauri stars.
  - quasars.
  - asteroids.
  - pulsars.
- 110 If the frequency of electromagnetic radiation goes from  $2 \times 10^{14}$  Hz to  $6 \times 10^{14}$  Hz, the energy of each individual photon in the radiation
- is multiplied by 3.
  - is divided by 2.
  - is multiplied by 2.
  - is divided by 3.
  - does not change.

- 111 Once you know to look for it, you will see that different stars have different colors. Which of the following star colors indicates the highest surface temperature?
- Blue.
  - Peach.
  - Red.
  - Green.
  - Yellow.
- 112 Jupiter failed to become a star because
- It was made from the wrong material.
  - The Sun's gravity prevented it from growing.
  - It was too far from the Sun.
  - The Sun's ignition blew all the gas away.
  - When Jupiter ignited, the Sun blew it out.
- 113 Short-period comets are thought to be
- Asteroid belt objects deflected by Jupiter.
  - Kuiper belt objects deflected by Jupiter.
  - long period comets deflected by Neptune.
  - long period comets deflected by Jupiter.
  - Kuiper belt objects deflected by Neptune.
- 114 Europe and North America are
- each on a different plate and move toward each other.
  - each on a different plate and move away from each other.
  - atop a single plate and move in unison.
  - on plates that are moving past each other.
- 115 Type I supernovas have the following properties:
- a spectrum with hydrogen lines and a variable maximum brightness.
  - a spectrum with no hydrogen lines and a variable maximum brightness.
  - a spectrum with hydrogen lines and a standard maximum brightness.
  - a spectrum with no hydrogen lines and a standard maximum brightness.
- 116 The red giant stage of a one solar mass star's life usually ends with
- a quiet transition to helium burning
  - a complete shutdown of all nuclear reactions.
  - blowing out the hydrogen burning shell.
  - an explosion in the helium core.
  - a core collapse.
- 117 A ring galaxy such as the Cartwheel that is the result of a collision would be classified as a
- type SBc.
  - type Irr I.
  - type Sc.
  - type Irr II.
  - peculiar galaxy.

- 118 The Oort Cloud is thought to have originated when
- nearby stars exploded as supernovae.
  - icy objects condensed out of the interstellar medium.
  - icy objects condensed out in the inner Solar System.
  - icy objects condensed out just beyond Neptune.
  - a planet failed to form near Jupiter.

## Answer Key: Version 2 Fall 2004

- 1 Choice e. (the absorption of infrared light by gases in the atmosphere.)
- 2 Choice d. (are explained by a force that attracts each planet to the Sun.)
- 3 Choice a. (6 hours.)
- 4 Choice b. (the phases of Venus.)
- 5 Choice c. (orbit the central bulge only within the disk.)
- 6 Choice b. (greater than  $3000\text{kg/m}^3$  because the Earth has an iron core.)
- 7 Choice c. (B and C both move away.)
- 8 Choice b. (keep moving at the same speed.)
- 9 Choice b. (on the side of the lens opposite the star.)
- 10 Choice b. (novas.)
- 11 Choice b. (660nm.)
- 12 Choice b. ( $1/60$  degree of arc.)
- 13 Choice d. (the motion of the Moon around the Earth.)
- 14 Choice b. (much of the mass is outside the central bulge.)
- 15 Choice a. (100 parsecs.)
- 16 Choice d. (the asteroid belt.)
- 17 Choice b. (0.009amu)
- 18 Choice e. (North Celestial Pole.)
- 19 Choice a. (maria.)
- 20 Choice e. (it is lit by a sunset all round the Earth.)
- 21 Choice d. (Radio waves.)
- 22 Choice c. (all of them except Pluto near the ecliptic.)
- 23 Choice d. (emits most sunlight.)
- 24 Choice a. (a prediction that has now been observed.)
- 25 Choice a. (5 Newtons downward)
- 26 Choice d. (the brightness decreases.)
- 27 Choice d. (the motion of the Earth around the Sun.)
- 28 Choice b. (+5.6.)
- 29 Choice b. (Doppler shifts.)
- 30 Choice c. (ellipses with the Sun at one focus.)
- 31 Choice d. (how planets move and how the tides work.)
- 32 Choice e. (Earth turning on its axis.)
- 33 Choice d. (of dazzling brightness.)
- 34 Choice b. (both a constant X-ray signal and X-ray bursts.)
- 35 Choice d. (is somewhat tilted relative to the plane of the Earth's equator.)
- 36 Choice b. (both X-rays and radio waves.)

- 37 Choice b. (of semiliquid rock near the core and solid rock near the crust.)
- 38 Choice e. (in a band of stars stretching across the sky.)
- 39 Choice c. (the visible part of the Milky Way.)
- 40 Choice a. (its temperature rise stops when iron nuclei come apart.)
- 41 Choice c. (Cassegrain Focus.)
- 42 Choice b. ( $0.02\text{m/s}^2$ )
- 43 Choice b. (star formation is triggering more star formation.)
- 44 Choice d. (4Mpc.)
- 45 Choice c. (measuring how stars orbit the center of the galaxy.)
- 46 Choice d. (move from the asteroid belt into the inner solar system.)
- 47 Choice c. (without pausing while getting cooler at almost constant brightness.)
- 48 Choice c. (speed up when closest to the Sun.)
- 49 Choice d. (neutrinos are changing type as they travel.)
- 50 Choice c. (obsolescence.)
- 51 Choice c. (photosphere.)
- 52 Choice b. (two regions of maximum pressure.)
- 53 Choice c. (starts a supernova explosion.)
- 54 Choice c. (moves eastward along the ecliptic by  $1^\circ$ .)
- 55 Choice c. (slowing down.)
- 56 Choice d. (can be corrected by using a guide star.)
- 57 Choice d. (extend far beyond the orbit of Pluto.)
- 58 Choice a. (Local Group.)
- 59 Choice a. (the distance traveled by a crest divided by the time taken.)
- 60 Choice c. (The Minoans were the first civilization on Crete.)
- 61 Choice b. (slipping tectonic plates.)
- 62 Choice c. (C)
- 63 Choice a. (other galaxies much like our own.)
- 64 Choice c. (Galileo)
- 65 Choice a. (50 meters.)
- 66 Choice e. (E0.)
- 67 Choice d. (rises.)
- 68 Choice a. (always the same as those it emits when hot.)
- 69 Choice a. (unusually strong.)
- 70 Choice b. (at the top.)
- 71 Choice c. (decreased because solar activity is less.)
- 72 Choice d. (the motion of the Moon in its orbit.)
- 73 Choice d. (300 million light years.)

- 74 Choice c. (red.)
- 75 Choice a. (a very large black hole there.)
- 76 Choice d. (electrical repulsion.)
- 77 Choice d. (the motions of stars near it.)
- 78 Choice d. (have been detected because infalling matter emits X-rays.)
- 79 Choice c. (prevents carbon-burning from starting.)
- 80 Choice d. (only the lower part of the main sequence still present.)
- 81 Choice c. (10-15 million years.)
- 82 Choice d. (1 parsec.)
- 83 Choice c. (regolith.)
- 84 Choice c. (1036 seconds of arc.)
- 85 Choice b. (electromagnetic waves from large molecules.)
- 86 Choice b. (be less than 13 billion years.)
- 87 Choice c. (K5)
- 88 Choice d. (lower left corner.)
- 89 Choice d. (event horizon.)
- 90 Choice c. (9 parsecs.)
- 91 Choice c. (0.04 light years.)
- 92 Choice d. (interior structure.)
- 93 Choice a. (hot, dense material.)
- 94 Choice c. (130km/s)
- 95 Choice d. (D)
- 96 Choice c. (above the central region but well below the surface.)
- 97 Choice b. (have similar luminosities.)
- 98 Choice c. (closest one to our Sun.)
- 99 Choice b. (red.)
- 100 Choice a. (failed but led to a better theory.)
- 101 Choice d. (form faster and burn out faster.)
- 102 Choice d. (troposphere.)
- 103 Choice e. (ahead of its direction of motion.)
- 104 Choice d. (helium-3 nuclei.)
- 105 Choice d. (the radiant.)
- 106 Choice a. (Planetary Nebulae.)
- 107 Choice c. (solar flare.)
- 108 Choice c. (to very distant galaxies.)
- 109 Choice e. (pulsars.)
- 110 Choice a. (is multiplied by 3.)

- 111 Choice a. (Blue.)
- 112 Choice d. (The Sun's ignition blew all the gas away.)
- 113 Choice e. (Kuiper belt objects deflected by Neptune.)
- 114 Choice b. (each on a different plate and move away from each other.)
- 115 Choice d. (a spectrum with no hydrogen lines and a standard maximum brightness.)
- 116 Choice d. (an explosion in the helium core.)
- 117 Choice e. (peculiar galaxy.)
- 118 Choice c. (icy objects condensed out in the inner Solar System.)

## Where the questions came from

- 1 Module019: The Earth's Atmosphere Question 019.31
- 2 Module 008 Explaining Kepler's Laws: Question 008.11
- 3 Module 001 Star Motions: Question 001.33
- 4 Module 005 The First Astrophysicist: Question 005.24
- 5 Module 053: Shape of the Milky Way Question 053.33
- 6 Module 014: Solar System Survey: Question 014.22
- 7 Module 057: The Expanding Universe Question 057.21
- 8 Module 005 The First Physicist: Question 005.12
- 9 Module 012 Focal Point of a Lens: Question 012.11
- 10 Module 048: The Quiet Deaths of Ordinary Stars Question 048.62
- 11 Module 010 The Doppler Effect: Question 010.43
- 12 Module 004 Tycho Brahe's Role: Question 004.44
- 13 Module 002 Phases of the Moon: Question 002.11
- 14 Module 054: Dark Matter in the Milky Way Question 054.32
- 15 Module 044: Stellar Magnitudes 044.41
- 16 Module 017: Formation of the Solar System: Question 017.51
- 17 Module 042: Nuclear Fire Question 042.21
- 18 Module 001 The Celestial Sphere: Question 001.11
- 19 Module 022: The Earth's Moon Question 022.12
- 20 Module 002 Lunar Eclipses: Question 002.33
- 21 Module 010 The Electromagnetic Spectrum: Question 010.13
- 22 Module 017: Formation of the Solar System: Question 017.14
- 23 Module 040: Survey of the Sun Question 040.22
- 24 Module 049: Supernova Explosions Question 049.43
- 25 Module 007 Definitions of Force and Mass: Question 007.33
- 26 Module 047: Star Formation Question 047.31
- 27 Module 043: Stellar Parallax Question 043.11
- 28 Module 044: Stellar Magnitudes Question 043.22
- 29 Module 054: Dark Matter in the Milky Way Question 054.11
- 30 Module 006 Orbits are Ellipses: Question 006.21
- 31 Module 008 Unifying Physical Law: Question 008.22
- 32 Module 004 The Copernican System: Question 004.23
- 33 Module 044: Stellar Magnitudes Question 044.34
- 34 Module 050: Neutron Stars Question 050.31
- 35 Module 022: The Earth's Moon Question 022.43
- 36 Module 055: The Monster in the Milky Way Question 055.22



- 37 Module020:Earth and Moon Interiors Question 020.33
- 38 Module 052: The Milky Way Question 052.12
- 39 Module 052: The Milky Way Question 052.42
- 40 Module 049: Supernova Explosions Question 049.31
- 41 Module 012 Telescope Designs: Question 012.32
- 42 Module 007 The Law of Force and Mass: Question 007.44
- 43 Module 053: Shape of the Milky Way Question 053.44
- 44 Module 057: The Expanding Universe Question 057.32
- 45 Module 054: Dark Matter in the Milky Way Question 054.22
- 46 Module 016: Earth Impacts: Question 016.12
- 47 Module 049: Supernova Explosions Question 049.21
- 48 Module 006 Equal Area Rule: Question 006.31
- 49 Module 042: Nuclear Fire Question 042.53
- 50 Module 013 Ultraviolet: Question 013.32
- 51 Module 047: Star Formation Question 047.24
- 52 Module 009 Wavelength: Question 009.12
- 53 Module 049: Supernova Explosions Question 049.52
- 54 Module 001 The Path of the Sun: Question 001.54
- 55 Module 050: Neutron Stars Question 050.11
- 56 Module 012 Telescope Limitations: Question 012.43
- 57 Module 014: Solar System Survey: Question 014.44
- 58 Module 056: The Family of Galaxies Question 056.41
- 59 Module 009 Speed of a Wave: Question 009.32
- 60 Module 003 How to test a statement : Question 003.22
- 61 Module 021: Continental Drift Question 021.42
- 62 Module 046: The Hertzsprung-Russell Diagram Question 046.12
- 63 Module 053: Shape of the Milky Way Question 053.11
- 64 Module 007 The Law of Inertia: Question 007.11
- 65 Module 016: Earth Impacts: Question 016.22
- 66 Module 056: The Family of Galaxies Question 056.14
- 67 Module019: The Earth's Atmosphere Question 019.11
- 68 Module 011 The Reason for Spectra: Question 011.43
- 69 Module 018: The Moon and the Tides: Question 018.22
- 70 Module 046: The Hertzsprung-Russell Diagram Question 046.23
- 71 Module 040: Survey of the Sun Question 040.36
- 72 Module 018: The Moon and the Tides: Question 018.32
- 73 Module 056: The Family of Galaxies Question 056.52

- 74 Module 045: Star Colors and Classes 045.23
- 75 Module 055: The Monster in the Milky Way Question 055.42
- 76 Module 042: Nuclear Fire Question 042.33
- 77 Module 055: The Monster in the Milky Way Question 055.31
- 78 Module 051: Black Holes Question 051.21
- 79 Module 048: The Quiet Deaths of Ordinary Stars Question 048.42
- 80 Module 047: Star Formation Question 047.54
- 81 Module 049: Supernova Explosions Question 049.13
- 82 Module 046: The Hertzsprung-Russell Diagram Question 046.54
- 83 Module 022: The Earth's Moon Question 022.31
- 84 Module 043: Stellar Parallax Question 043.41
- 85 Module 047: Star Formation Question 047.11
- 86 Module 057: The Expanding Universe Question 057.41
- 87 Module 045: Star Colors and Classes Question 045.32
- 88 Module 048: The Quiet Deaths of Ordinary Stars Question 048.54
- 89 Module 051: Black Holes Question 051.12
- 90 Module 043: Stellar Parallax Question 043.32
- 91 Module 055: The Monster in the Milky Way Question 055.12
- 92 Module 020: Earth and Moon Interiors Question 020.12
- 93 Module 010 Spectra: Question 010.31
- 94 Module 057: The Expanding Universe Question 057.13
- 95 Module 046: The Hertzsprung-Russell Diagram Question 046.36
- 96 Module 040: Survey of the Sun Question 040.12
- 97 Module 052: The Milky Way Question 052.31
- 98 Module 053: Shape of the Milky Way Question 053.24
- 99 Module 045: Star Colors and Classes Question 045.12
- 100 Module 006 Death of a Theory: Question 006.11
- 101 Module 047: Star Formation Question 047.41
- 102 Module 019: The Earth's Atmosphere Question 019.21
- 103 Module 015: Comets in Detail: Question 015.12
- 104 Module 042: Nuclear Fire Question 042.43
- 105 Module 015: Comets in Detail: Question 015.45
- 106 Module 052: The Milky Way Question 052.23
- 107 Module 041: Solar Magnetism and Activity Question 041.44
- 108 Module 056: The Family of Galaxies Question 056.36
- 109 Module 050: Neutron Stars Question 050.22
- 110 Module 011 Photons: Question 011.23

- 111 Module 010 Temperature and Color: Question 010.21
- 112 Module 017: Formation of the Solar System: Question 017.31
- 113 Module 015: Comets in Detail: Question 015.24
- 114 Module 021: Continental Drift Question 021.21
- 115 Module 049: Supernova Explosions Question 049.63
- 116 Module 048: The Quiet Deaths of Ordinary Stars Question 048.23
- 117 Module 056: The Family of Galaxies Question 056.22
- 118 Module 017: Formation of the Solar System: Question 017.42