

# Review for Astronomy 2 Midterm and Final

*Midterm covers first 70 questions, Final covers all 105.*

**MULTIPLE CHOICE.** Choose the one alternative that best completes the statement or answers the question. Chapter 1 is covered by Q1-3; Ch. 2 Q4-18; Ch. 3 Q19-27; Ch. 4 Q28-34; Ch. 5 Q35-45; Ch. 6 Q46-51; Ch. 7 Q52-63; Ch. 8 Q64-70; Ch. 9 Q71-77; Ch. 10 Q78-82; Ch. 11 Q83-91; Ch. 12 Q92-96; Ch. 13 Q97-100; Ch. 14 Q101-105

- 1) Which of the following has your "address" in the correct order?
  - A) you, Earth, solar system, Milky Way, Local Group, Local Supercluster
  - B) you, Earth, solar system, Local Group, Local Supercluster, Milky Way
  - C) you, Earth, solar system, Local Group, Milky Way, Local Supercluster
  - D) you, Earth, Local Group, Local Supercluster, solar system, Milky Way
  - E) you, Earth, solar system, Milky Way, Local Supercluster, Local Group
  
- 2) What is an *astronomical unit*?
  - A) any basic unit used in astronomy
  - B) the length of time it takes Earth to revolve around the Sun
  - C) the average speed of Earth around the Sun
  - D) the diameter of Earth's orbit around the Sun
  - E) the average distance from Earth to the Sun
  
- 3) Roughly how many stars are in the Milky Way Galaxy?
  - A) 1 billion
  - B) 100 trillion
  - C) 100 million
  - D) 10 billion
  - E) 100 billion
  
- 4) Which of the following statements about the celestial sphere is *not* true?
  - A) The celestial sphere does not exist physically.
  - B) The "celestial sphere" is just another name for our universe.
  - C) From any location on Earth, we can see only half the celestial sphere at any one time.
  - D) When we look in the sky, the stars all appear to be located on the celestial sphere.
  - E) Earth is placed at the center of the celestial sphere.
  
- 5) Which of the following statements about the celestial equator is true at *all* latitudes?
  - A) It extends from your horizon due north, through your zenith, to your horizon due south.
  - B) It represents an extension of Earth's equator onto the celestial sphere.
  - C) It extends from your horizon due east, through your zenith, to your horizon due west.
  - D) It lies along the band of light we call the Milky Way.
  - E) It cuts the dome of your sky exactly in half.

- 6) How many stars can you see with your naked eye on a clear, moonless night from a dark location?
- A) about a hundred thousand
  - B) a few thousand
  - C) less than a thousand
  - D) about ten thousand
  - E) more than you could count in your lifetime
- 7) What is the *ecliptic*?
- A) the Sun's apparent path along the celestial sphere
  - B) the constellations commonly used in astrology to predict the future
  - C) the Sun's daily path across the sky
  - D) the Moon's apparent path along the celestial sphere
  - E) when the Moon passes in front of the Sun
- 8) Which scientists played a major role in overturning the ancient idea of an Earth-centered universe, and about when?
- A) Copernicus, Kepler, and Galileo; about 400 years ago
  - B) Aristotle and Copernicus; about 400 years ago
  - C) Huygens and Newton; about 300 years ago
  - D) Aristotle and Plato; about 2,000 years ago
  - E) Newton and Einstein; about 100 years ago
- 9) Which of the following correctly describes the *meridian* in your sky?
- A) a half-circle extending from your horizon due east, through your zenith, to your horizon due west
  - B) the point directly over your head
  - C) the boundary between the portion of the celestial sphere you can see at any moment and the portion that you cannot see
  - D) a half-circle extending from your horizon due north, through your zenith, to your horizon due south
  - E) a half-circle extending from your horizon due east, through the north celestial pole, to your horizon due west
- 10) How many arcseconds are in  $1^\circ$ ?
- A) 3,600
  - B) 100
  - C) 60
  - D) 360
  - E) 10,000
- 11) Which of the following statements does *not* use the term *angular size* or *angular distance* correctly?
- A) You can use your outstretched hand to estimate angular sizes and angular distances.
  - B) The angular distance between those two bright stars in the sky is about 2 meters.
  - C) The angular size of the Sun is about the same as that of the Moon.
  - D) The angular size of the Moon is about  $1/2$  degree.
  - E) The angular distance between those two houses in the distance is  $30^\circ$ .

- 12) What is a *circumpolar* star?
- A) a star that is close to the south celestial pole
  - B) a star that is close to the north celestial pole
  - C) a star that makes a daily circle around the celestial sphere
  - D) a star that always remains above your horizon
  - E) a star that is visible from the Arctic or Antarctic circles
- 13) We describe a position on Earth's surface by stating its
- A) altitude and azimuth.
  - B) latitude and longitude.
  - C) altitude and direction.
  - D) latitude and direction.
  - E) meridian and longitude.
- 14) What makes the North Star, Polaris, special?
- A) It is the brightest star in the sky.
  - B) It appears very near the north celestial pole.
  - C) It is the star directly on your northern horizon.
  - D) It is the star straight overhead.
  - E) It can be used to determine your longitude on Earth.
- 15) Orion is visible on winter evenings but not summer evenings because of
- A) the location of Earth in its orbit.
  - B) interference from the full Moon.
  - C) baseball on television.
  - D) the tilt of Earth's axis.
  - E) the precession of Earth's axis.
- 16) Which of the following is *not* a phase of the Moon?
- A) third-quarter Moon
  - B) new Moon
  - C) half Moon
  - D) first-quarter Moon
  - E) full Moon
- 17) If the Moon is setting at 6 A.M., the phase of the Moon must be
- A) first quarter.
  - B) new.
  - C) third quarter.
  - D) full.
  - E) waning crescent.
- 18) Which of the following never goes in retrograde motion?
- A) Mars
  - B) Saturn
  - C) Jupiter
  - D) the Sun
  - E) Venus

- 19) How did Eratosthenes estimate the size of Earth in 240 B.C.?
- A) by sending fleets of ships around Earth
  - B) by comparing the maximum altitude of the Sun in two cities at different latitudes
  - C) by measuring the size of Earth's shadow on the Moon in a lunar eclipse
  - D) by observing the duration of a solar eclipse
  - E) We don't know how he did it since all his writings were destroyed.
- 20) Why did Ptolemy have the planets orbiting Earth on "circles upon circles" in his model of the universe?
- A) to properly account for the varying distances of the planets from Earth
  - B) to explain why more distant planets take longer to make a circuit through the constellations of the zodiac
  - C) to explain why Venus goes through phases as seen from Earth
  - D) to explain why the Greeks were unable to detect stellar parallax
  - E) to explain the fact that planets sometimes appear to move westward, rather than eastward, relative to the stars in our sky
- 21) Where was the Sun in Ptolemy's model of the universe?
- A) at the center
  - B) between the orbits of Venus and Mars
  - C) slightly offset from the center
  - D) at the outer edge, beyond Saturn's orbit
  - E) between Earth and the Moon's orbit
- 22) The controversial book of this famous person, published in 1543 (the year of his death), suggested that Earth and other planets orbit the Sun.
- A) Ptolemy
  - B) Kepler
  - C) Copernicus
  - D) Galileo
  - E) Tycho Brahe
- 23) He discovered that the orbits of planets are ellipses.
- A) Tycho Brahe
  - B) Ptolemy
  - C) Kepler
  - D) Copernicus
  - E) Galileo
- 24) He discovered that Jupiter has moons.
- A) Ptolemy
  - B) Tycho Brahe
  - C) Kepler
  - D) Aristotle
  - E) Galileo

- 25) From Kepler's third law, an asteroid with an orbital period of 8 years lies at an average distance from the Sun equal to
- A) 2 astronomical units.
  - B) 4 astronomical units.
  - C) 8 astronomical units.
  - D) 16 astronomical units.
  - E) It depends on the asteroid's mass.
- 26) What is meant by a *hypothesis*?
- A) a tentative understanding of a natural phenomenon
  - B) a pseudoscientific idea
  - C) an explanation for a phenomenon that makes a prediction
  - D) a natural phenomenon that requires explanation
  - E) a historical theory that has been proved inaccurate
- 27) Which of the following was *not* observed by Galileo?
- A) stellar parallax
  - B) craters on the Moon
  - C) sunspots
  - D) phases of Venus
  - E) Jupiter's moons
- 28) If your mass is 60 kg on Earth, what would your mass be on the Moon?
- A) 60 lb
  - B) 10 kg
  - C) 60 kg
  - D) 50 kg
  - E) 10 lb
- 29) What would happen if the Space Shuttle were launched with a speed greater than Earth's *escape velocity*?
- A) It would take less time to reach its bound orbit.
  - B) It would travel away from Earth into the solar system.
  - C) It would orbit Earth at a faster velocity.
  - D) It would be in an unstable orbit.
  - E) It would travel in a higher orbit around Earth.
- 30) The movement of a pool ball, after being struck by a cue, is an example of
- A) conservation of momentum.
  - B) Newton's second law of motion.
  - C) Newton's third law of motion.
  - D) Newton's first law of motion.
  - E) the universal law of gravitation.
- 31) The force of gravity is an inverse square law. This means that, if you double the distance between two large masses, the gravitational force between them
- A) weakens by a factor of 2.
  - B) weakens by a factor of 4.
  - C) also doubles.
  - D) is unaffected.
  - E) strengthens by a factor of 4.

- 32) According to the *universal law of gravitation*, if you double the masses of *both* attracting objects, then the gravitational force between them will
- A) not change at all.
  - B) decrease by a factor of 4.
  - C) increase by a factor of 4.
  - D) increase by a factor of 2.
  - E) decrease by a factor of 2.
- 33) The mass of Jupiter can be calculated by
- A) measuring the orbital period and distance of Jupiter's orbit around the Sun.
  - B) measuring the orbital period and distance of one of Jupiter's moons.
  - C) knowing the Sun's mass and measuring how Jupiter's speed changes during its elliptical orbit around the Sun.
  - D) measuring the orbital speed of one of Jupiter's moons.
  - E) knowing the Sun's mass and measuring the average distance of Jupiter from the Sun.
- 34) At which lunar phase(s) are tides most pronounced (e.g., the highest high tides)?
- A) new Moon
  - B) full Moon
  - C) first quarter
  - D) both new and full Moons
  - E) both first and third quarters
- 35) An atom in an *excited state* contains more of what type of energy than the same atom in the *ground state*?
- A) mass-energy
  - B) electric potential energy
  - C) gravitational potential energy
  - D) kinetic energy
  - E) thermal energy
- 36) If a material is highly *opaque*, then it
- A) scatters most light.
  - B) reflects most light.
  - C) transmits most light.
  - D) emits most light.
  - E) absorbs most light.
- 37) The *wavelength* of a wave is
- A) equal to the speed of the wave times the wave's frequency.
  - B) the distance between two adjacent peaks of the wave.
  - C) the distance between where the wave is emitted and where it is absorbed.
  - D) how strong the wave is.
  - E) the distance between a peak of the wave and the next trough.

- 38) How are wavelength, frequency, and energy related for photons of light?
- A) Longer wavelength means lower frequency and higher energy.
  - B) Longer wavelength means higher frequency and lower energy.
  - C) Longer wavelength means higher frequency and higher energy.
  - D) Longer wavelength means lower frequency and lower energy.
  - E) There is no simple relationship because different photons travel at different speeds.
- 39) From lowest energy to highest energy, which of the following correctly orders the different categories of electromagnetic radiation?
- A) radio, X rays, visible light, ultraviolet, infrared, gamma rays
  - B) visible light, infrared, X rays, ultraviolet, gamma rays, radio
  - C) gamma rays, X rays, visible light, ultraviolet, infrared, radio
  - D) infrared, visible light, ultraviolet, X rays, gamma rays, radio
  - E) radio, infrared, visible light, ultraviolet, X rays, gamma rays
- 40) When an atom loses an electron, it becomes
- A) dissociated.
  - B) an isotope.
  - C) a plasma.
  - D) ionized.
  - E) sublimated.
- 41) When an electron in an atom goes from a higher energy state to a lower energy state, the atom
- A) can emit a photon of any frequency.
  - B) can absorb a photon of any frequency.
  - C) emits a photon of a specific frequency.
  - D) absorbs a photon of a specific frequency.
  - E) absorbs several photons of a specific frequency.
- 42) If two objects are the same size but one object is 3 times hotter than the other object, the hotter object emits
- A) 12 times more energy.
  - B) 3 times more energy.
  - C) 9 times more energy.
  - D) 81 times more energy.
  - E) none of the above
- 43) The spectra of most galaxies show redshifts. This means that their spectral lines
- A) have wavelengths that are longer than normal.
  - B) have wavelengths that are shorter than normal.
  - C) always are in the red part of the visible spectrum.
  - D) have a higher intensity in the red part of the spectrum.
  - E) have normal wavelengths, but absorption of light makes them appear red.

- 44) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 121.6 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 121.8 nm. What can we conclude?
- A) The star is getting hotter.
  - B) The "star" actually is a planet.
  - C) The star is getting colder.
  - D) The star is moving away from us.
  - E) The star is moving toward us.
- 45) Suppose you see two stars: a blue star and a red star. Which of the following can you conclude about the two stars? Assume that no Doppler shifts are involved. (*Hint*: Think about the laws of thermal radiation.)
- A) The blue star has a hotter surface temperature than the red star.
  - B) The blue star is farther away than the red star.
  - C) The red star has a hotter surface temperature than the blue star.
  - D) The blue star is more massive than the red star.
  - E) The red star is more massive than the blue star.
- 46) Telescopes operating at this wavelength must be cooled to observe faint astronomical objects.
- A) visible
  - B) X-ray
  - C) radio
  - D) extreme infrared
  - E) gamma-ray
- 47) Suppose the angular separation of two stars is smaller than the angular resolution of your eyes. How will the stars appear to your eyes?
- A) You will not be able to see these two stars at all.
  - B) You will see only the larger of the two stars, not the smaller one.
  - C) You will see two distinct stars.
  - D) The two stars will look like a single point of light.
  - E) The two stars will appear to be touching, looking rather like a small dumbbell.
- 48) Which of the following statements best describes the two principal advantages of telescopes over eyes?
- A) Telescopes have much more magnification and better angular resolution.
  - B) Telescopes can collect far more light with far better angular resolution.
  - C) Telescopes can collect far more light with far greater magnification.
  - D) Telescopes collect more light and are unaffected by twinkling.
  - E) Telescopes can see farther without image distortion and can record more accurate colors.

- 49) What do astronomers mean by *light pollution*?
- A) Light pollution refers to harmful gases emitted by common street lights.
  - B) Light pollution is another name for sunlight, which makes it impossible to see stars in the daytime.
  - C) Light pollution refers to pollution caused by light industry as opposed to heavy industry.
  - D) Light pollution refers to light used for human activities that brightens the sky and hinders astronomical observations.
  - E) Light pollution refers to the lights that must be used inside major observatories and that make it difficult for astronomers' eyes to adapt to darkness.
- 50) Which of the following is *not* an advantage of the Hubble Space Telescope over ground-based telescopes?
- A) It can observe infrared and ultraviolet light, as well as visible light.
  - B) Stars do not twinkle when observed from space.
  - C) Observers on the ground can use it at any time of day (i.e., not only during their night).
  - D) It is closer to the stars.
  - E) It never has to close because of bad weather.
- 51) In what part of the electromagnetic spectrum do the biggest telescopes on Earth operate?
- A) visible
  - B) infrared
  - C) X-ray
  - D) radio
  - E) ultraviolet
- 52) How do asteroids differ from comets?
- A) Asteroids are made of icy material and are less dense than the comets, which are rockier.
  - B) Asteroids and comets are both made of rocky and icy material, but asteroids are smaller in size than comets.
  - C) Asteroids are rocky bodies and are denser than the comets, which are made of icy material.
  - D) Asteroids are made of icy material and are denser than the comets, which are more rocky.
  - E) Asteroids are rocky bodies and are less dense than the comets, which are made of icy material.
- 53) How does the Sun's mass compare with that of the planets?
- A) It is a thousand times more massive than Earth.
  - B) It is a thousand times more massive than all the planets combined.
  - C) It is a hundred times more massive than all the planets combined.
  - D) It is a hundred times more massive than Earth.
  - E) It is about as massive as all the planets combined.

- 54) Which planet has the highest *average* surface temperature, and why?
- A) Venus, because of its dense carbon dioxide atmosphere
  - B) Mars, because of its red color
  - C) Mercury, because of its dense carbon dioxide atmosphere
  - D) Jupiter, because it is so big
  - E) Mercury, because it is closest to the Sun
- 55) Which planet, other than Earth, has visible water ice on it?
- A) Mercury
  - B) Jupiter
  - C) Mars
  - D) Venus
  - E) the Moon
- 56) Which of the following is furthest from the Sun?
- A) a comet in the Kuiper belt
  - B) Pluto
  - C) Neptune
  - D) a comet in the Oort cloud
  - E) an asteroid in the asteroid belt
- 57) Which of the following is *not* an exception to the general patterns of motion in the solar system?
- A) the extreme axis tilt of Uranus
  - B) the counterclockwise rotation of Venus
  - C) the large size of Earth's Moon
  - D) the rings of Saturn
  - E) the retrograde rotation of Triton around Neptune
- 58) Which is the densest planet in the solar system?
- A) Mercury
  - B) Mars
  - C) Jupiter
  - D) Venus
  - E) Earth
- 59) The planet closest in size to Earth is
- A) Pluto.
  - B) Venus.
  - C) the Moon.
  - D) Mercury.
  - E) Mars.
- 60) Which of the following is *not* a characteristic of the inner planets?
- A) They are relatively smaller than the outer planets.
  - B) They have very few, if any, satellites.
  - C) They all have solid, rocky surfaces.
  - D) They all have substantial atmospheres.
  - E) Their orbits are relatively closely spaced.

- 61) Which of the following is *not* a characteristic of the outer planets?
- A) They have very few, if any, satellites.
  - B) They are primarily made of hydrogen and helium.
  - C) They are all large balls of gas.
  - D) Their orbits are separated by relatively large distances.
  - E) They all have rings.
- 62) What is *aerobraking*?
- A) the technique of using a planetary atmosphere to change the orbit of a spacecraft
  - B) the destruction of a spacecraft by the intense pressure as it descends into the atmosphere
  - C) the gradual decrease of speed as a spacecraft leaves the solar system
  - D) the use of a planetary atmosphere to redirect a spacecraft to another planet
  - E) the controlled landing of a spacecraft on a planetary surface
- 63) Which of the following is *not* an advantage of spacecraft flybys over ground-based telescope observations?
- A) Spacecraft can sample the gravitational field of a planet.
  - B) Spacecraft can make highly detailed images of the planet and its moons.
  - C) Spacecraft can monitor changes in a planet's atmosphere over long times.
  - D) Spacecraft can measure local magnetic fields.
  - E) Spacecraft can view "backlit" views of planetary rings.
- 64) Why did the solar nebula heat up as it collapsed?
- A) As the cloud shrank, its gravitational potential energy was converted to kinetic energy and then into thermal energy.
  - B) Nuclear fusion occurring in the core of the protosun produced energy that heated the nebula.
  - C) Collisions among planetesimals generated friction and heat.
  - D) The shock wave from a nearby supernova heated the gas.
  - E) Radiation from other nearby stars that had formed earlier heated the nebula.
- 65) What percentage of the solar nebula's mass consisted of *rocky* material?
- A) 0.4 percent
  - B) 20 percent
  - C) 0 percent
  - D) 2 percent
  - E) 80 percent
- 66) What kind of material in the solar nebula could remain solid at temperatures as high as 1,500 K, such as existed in the inner regions of the nebula?
- A) molecules such as methane and ammonia
  - B) rocks
  - C) metals
  - D) silicon-based minerals
  - E) hydrogen compounds

- 67) What was the *frost line* of the solar system?
- A) the distance from the Sun where temperatures were low enough for metals to condense, between the Sun and the present-day orbit of Mercury
  - B) the distance from the Sun where temperatures were low enough for hydrogen compounds to condense into ices, between the present-day orbits of Mars and Jupiter
  - C) the distance from the Sun where temperatures were low enough for rocks to condense, between the present-day orbits of Mercury and Venus
  - D) the distance from the Sun where temperatures were low enough for hydrogen and helium to condense, between the present-day orbits of Jupiter and Saturn
  - E) the distance from the Sun where temperatures were low enough for asteroids to form, between the present-day orbits of Venus and Earth
- 68) According to the nebular theory, what are asteroids and comets?
- A) They are chunks of rock or ice that were expelled from planets by volcanoes.
  - B) They are the shattered remains of collisions between planets.
  - C) They are the shattered remains of collisions between moons.
  - D) They are leftover planetesimals that never accreted into planets.
  - E) They are chunks of rock or ice that condensed long after the planets and moons had formed.
- 69) The heavy bombardment phase of the solar system lasted
- A) to the present time.
  - B) several tens of millions of years.
  - C) several million years.
  - D) about a billion years.
  - E) several hundreds of millions of years.
- 70) The nebular theory of the formation of the solar system successfully predicts all but one of the following. Which one does the theory *not* predict?
- A) Planets orbit around the Sun in nearly circular orbits in a flattened disk.
  - B) the compositional differences between the terrestrial and jovian planets
  - C) the equal number of terrestrial and jovian planets
  - D) asteroids, Kuiper-belt comets, and the Oort cloud
  - E) the craters on the Moon
- 71) Rank the five terrestrial worlds in order of size from smallest to largest:
- A) Mercury, Moon, Venus, Earth, Mars.
  - B) Moon, Mercury, Mars, Venus, Earth.
  - C) Mercury, Venus, Earth, Moon, Mars.
  - D) Mercury, Moon, Mars, Earth, Venus.
  - E) Moon, Mercury, Venus, Earth, Mars.
- 72) Which of the following most likely explains why Venus does *not* have a strong magnetic field?
- A) Its rotation is too slow.
  - B) It has too thick an atmosphere.
  - C) It is too close to the Sun.
  - D) It does not have a metallic core.
  - E) It is too large.

- 73) Which two properties are most important in determining the surface temperature of a planet?
- A) composition and distance from the Sun
  - B) size and atmosphere
  - C) internal temperature and atmosphere
  - D) size and chemical composition
  - E) distance from the Sun and atmosphere
- 74) Which of the following does *not* have a major effect in shaping planetary surfaces?
- A) tectonics
  - B) volcanism
  - C) magnetism
  - D) erosion
  - E) impact cratering
- 75) The relatively few craters that we see within the lunar *maria*
- A) were formed by impacts that occurred after those that formed most of the craters in the lunar highlands.
  - B) are sinkholes that formed when sections of the *maria* collapsed.
  - C) were formed by impacts that occurred before those that formed most of the craters in the lunar highlands.
  - D) are volcanic in origin, rather than from impacts.
  - E) were created by the same large impactor that led to the formation of the *maria*.
- 76) The *Caloris Basin* on Mercury covers a large region of the planet, but few smaller craters have formed on top of it. From this we conclude that
- A) the *Caloris Basin* formed toward the end of the solar system's period of heavy bombardment.
  - B) the *Caloris Basin* was formed by a volcano.
  - C) Mercury's atmosphere prevented smaller objects from hitting the surface.
  - D) only very large impactors hit Mercury's surface in the past.
  - E) erosion destroyed the smaller craters that formed on the basin.
- 77) *Olympus Mons* is a
- A) stratovolcano on Mercury.
  - B) large lava plain on the Moon.
  - C) shield volcano on Mars.
  - D) shield volcano on Venus.
  - E) stratovolcano on the Moon.
- 78) Why does Venus have such a great difference in temperature between its "no atmosphere" temperature and its actual temperature?
- A) It has a large amount of greenhouse gases in its atmosphere.
  - B) It has a high level of volcanic activity.
  - C) It has no cooling effects from oceans.
  - D) It is so close to the Sun.
  - E) It has a slow rotation.

- 79) What are *greenhouse gases*?
- A) gases that absorb visible light
  - B) gases that absorb ultraviolet light
  - C) gases that transmit infrared light
  - D) gases that transmit visible light
  - E) gases that absorb infrared light
- 80) There are no aurora on Venus because it
- A) is too hot.
  - B) lacks atmospheric oxygen.
  - C) lacks a strong magnetic field.
  - D) lacks an ionosphere.
  - E) lacks strong winds.
- 81) Where is most of the water on Mars?
- A) in its polar caps and subsurface ground ice
  - B) in deep underground deposits
  - C) frozen on the peaks of its tall volcanoes
  - D) in its clouds
  - E) distributed evenly throughout its atmosphere
- 82) Why is Mars red?
- A) Its surface rocks were rusted by oxygen.
  - B) Its surface is made of ices that absorb blue light.
  - C) Its atmosphere scatters blue light more effectively than red light.
  - D) Its surface is made of ices that absorb red light.
  - E) It is made primarily of red clay.
- 83) How does Jupiter's core compare to Earth's?
- A) It is about the same size but is 10 times more massive.
  - B) Jupiter doesn't have a core—it is made entirely from hydrogen and helium.
  - C) It is about 10 times larger both in size and mass.
  - D) It is the same size and mass.
  - E) It is about 10 times larger in size and the same mass.
- 84) The fact that most moons always show the same face to their planet is
- A) a result of the fact that the moons once had atmospheres.
  - B) explained by the law of conservation of angular momentum.
  - C) a natural consequence of the fact that the entire solar nebula rotated in the same direction.
  - D) a natural consequence of tidal forces acting on the moons.
  - E) very surprising and a great mystery.
- 85) What is the most important reason why an icy moon is more likely to be geologically active than a rocky moon of the same size?
- A) Ice has a lower melting point than rock.
  - B) Ice is less dense than rock.
  - C) Ice contains more radioactive elements than rock.
  - D) Ice is less rigid than rock.
  - E) Ice is affected by tidal forces to a greater extent than rock.

- 86) Why is Jupiter denser than Saturn?
- A) It has a greater proportion of helium to hydrogen compared to Saturn.
  - B) The extra mass of Jupiter compresses its interior to a greater extent than that of Saturn.
  - C) Its core is much larger than Saturn's.
  - D) It is made of a different composition than Saturn, including a higher proportion of hydrogen compounds and rocks.
  - E) It is unknown why this is so.
- 87) What is Jupiter's Great Red Spot?
- A) a long-lived, high-pressure storm
  - B) a large mountain peak poking up above the clouds
  - C) the place where reddish particles from Io impact Jupiter's surface
  - D) a hurricane that comes and goes on Jupiter
  - E) the place where Jupiter's aurora is most visible
- 88) The four Galilean moons around Jupiter are
- A) all made of rock.
  - B) a mixture of rock and ice, with the ice fraction increasing with distance from Jupiter.
  - C) a mixture of rock and ice, with the rock fraction increasing with distance from Jupiter.
  - D) hydrogen and helium gas.
  - E) all made of ice.
- 89) Why are there no impact craters on the surface of Io?
- A) Io did have impact craters but they have all been buried in lava flows.
  - B) It is too small to have been bombarded by planetesimals in the early solar system.
  - C) Any craters that existed have been eroded through the strong winds on Io's surface.
  - D) Io's thick atmosphere obscures the view of the craters.
  - E) Jupiter's strong gravity attracted the planetesimals more strongly than Io and thus none landed on its surface.
- 90) Which moon has the most substantial atmosphere?
- A) Mimas
  - B) Titan
  - C) Io
  - D) Europa
  - E) Ganymede
- 91) How thick are Saturn's rings from top to bottom?
- A) a few kilometers
  - B) a few tens of meters
  - C) a few hundred kilometers
  - D) a few tens of thousands of kilometers
  - E) a few million kilometers

- 92) Which is closest to the average distance between asteroids in the asteroid belt?
- A) 1 million km
  - B) 1 thousand km
  - C) 10 thousand km
  - D) 100 thousand km
  - E) 10 million km
- 93) Why isn't there a planet where the asteroid belt is located?
- A) The temperature in this portion of the solar nebula was just right to prevent rock from sticking together.
  - B) There was not enough material in this part of the solar nebula to form a planet.
  - C) Gravitational tugs from Jupiter prevented material from collecting together to form a planet.
  - D) There was too much rocky material to form a terrestrial planet, but not enough gaseous material to form a jovian planet.
  - E) A planet once formed here, but it was broken apart by a catastrophic collision.
- 94) What do we call a small piece of solar system debris found on Earth?
- A) solar system debris
  - B) cometary fragment
  - C) meteor
  - D) meteorite
  - E) meteoroid
- 95) Halley's comet is named after the English scientist Edmund Halley because he
- A) calculated its orbit and predicted that it would return in 1758.
  - B) was the first to see it in 1682.
  - C) discovered it.
  - D) was the most famous astronomer in England during its appearance.
  - E) was the first to publish pictures of it and report it to the International Astronomical Union (IAU).
- 96) What part of a comet points most directly away from the Sun?
- A) the coma
  - B) the dust tail
  - C) the plasma tail
  - D) the nucleus
  - E) the jets of gas
- 97) Most of the planets discovered around other stars
- A) are more massive than Earth and orbit very far from the star.
  - B) are more massive than Earth and orbit very close to the star.
  - C) are less massive than Earth and orbit very far from the star.
  - D) are found around neutron stars.
  - E) are less massive than Earth and orbit very close to the star.
- 98) What is *astrometry*?
- A) measuring distances to stars
  - B) searching for planets around stars
  - C) measuring the positions of stars on the sky
  - D) using metric units for distance (e.g. meters rather than light years)
  - E) measuring the velocities of stars via the Doppler effect

- 99) Current techniques can measure stellar motion to less than
- A) cruising speed of an airplane.
  - B) freeway speed.
  - C) orbital speed of Jupiter.
  - D) running speed.
  - E) walking speed.
- 100) Why are many of the newly detected extrasolar planets called "hot Jupiters"?
- A) because the discovery of other planets is very exciting
  - B) Their masses and composition are similar to what we would expect if Jupiter were hotter.
  - C) Their masses are similar to Jupiter but their composition is similar to Mercury.
  - D) Their masses are similar to Jupiter but they are very close to the central star and therefore hot.
  - E) The planets tend to be detected around more massive, hotter stars than our Sun.
- 101) The core of the Sun is
- A) at the same temperature and density as the surface.
  - B) constantly rising to the surface through convection.
  - C) at the same temperature but denser than the surface.
  - D) hotter and denser than the surface.
  - E) composed of iron.
- 102) What two forces are balanced in what we call *gravitational equilibrium*?
- A) outward pressure and gravity
  - B) the strong force and kinetic energy
  - C) outward pressure and the strong force
  - D) the strong force and gravity
  - E) the electromagnetic force and gravity
- 103) What is the average temperature of the *surface* of the Sun?
- A) 10,000 K
  - B) 1 million K
  - C) 1,000 K
  - D) 6,000 K
  - E) 100,000 K
- 104) Which layer of the Sun do we normally see?
- A) corona
  - B) photosphere
  - C) convection zone
  - D) chromosphere
  - E) radiation zone
- 105) At the center of the Sun, fusion converts hydrogen into
- A) radiation and elements like carbon and nitrogen.
  - B) helium, energy, and neutrinos.
  - C) plasma.
  - D) hydrogen compounds.
  - E) radioactive elements like uranium and plutonium

