

Review for Astronomy 10 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 Q4-11; Ch. 3 Q12-16; Ch. 4 Q17-20; Ch. 5 Q21-27; Ch. 6/10 Q28-40; Ch. 7 Q41-52; Ch. 8 Q53-59; Ch. 9 Q60-64; Ch. 11 Q65-70; Ch. 12 Q71-76; Ch. 13 Q77-82; Ch. 14 Q83-90; Ch. 15 Q91-94; Ch. 16 Q95-102; Ch. 17,18 Q103-105

- 1) Which of the following has your "address" in the correct order?
 - A) you, Earth, solar system, Milky Way, Local Supercluster, Local Group
 - B) you, Earth, solar system, Milky Way, Local Group, Local Supercluster
 - 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, Local Group, Local Supercluster, Milky Way

- 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 distance from Earth to the Sun
 - D) the diameter of Earth's orbit around the Sun
 - E) the average speed of Earth around the Sun

- 3) Roughly how many stars are in the Milky Way Galaxy?
 - A) 100 million
 - B) 10 billion
 - C) 1 billion
 - D) 100 trillion
 - E) 100 billion

- 4) Which of the following statements about the celestial sphere is *not* true?
 - A) The "celestial sphere" is just another name for our universe.
 - B) The celestial sphere does not exist physically.
 - C) Earth is placed at the center of the celestial sphere.
 - D) From any location on Earth, we can see only half the celestial sphere at any one time.
 - E) When we look in the sky, the stars all appear to be located on the celestial sphere.

- 5) Which of the following statements about the celestial equator is true at *all* latitudes?
 - A) It cuts the dome of your sky exactly in half.
 - B) It extends from your horizon due north, through your zenith, to your horizon due south.
 - C) It lies along the band of light we call the Milky Way.
 - D) It represents an extension of Earth's equator onto the celestial sphere.
 - E) It extends from your horizon due east, through your zenith, to your horizon due west.

- 6) What is the *ecliptic*?
 - A) when the Moon passes in front of the Sun
 - B) the Sun's apparent path along the celestial sphere
 - C) the Moon's apparent path along the celestial sphere
 - D) the Sun's daily path across the sky
 - E) the constellations commonly used in astrology to predict the future

- 7) Which of the following correctly describes the *meridian* in your sky?
- A) a half-circle extending from your horizon due east, through the north celestial pole, to your horizon due west
 - B) a half-circle extending from your horizon due east, through your zenith, to your horizon due west
 - C) the boundary between the portion of the celestial sphere you can see at any moment and the portion that you cannot see
 - D) the point directly over your head
 - E) a half-circle extending from your horizon due north, through your zenith, to your horizon due south
- 8) How many arcseconds are in 1° ?
- A) 3,600
 - B) 100
 - C) 10,000
 - D) 360
 - E) 60
- 9) What is a *circumpolar* star?
- A) a star that is close to the north celestial pole
 - B) a star that is visible from the Arctic or Antarctic circles
 - C) a star that makes a daily circle around the celestial sphere
 - D) a star that is close to the south celestial pole
 - E) a star that always remains above your horizon
- 10) Which of the following is *not* a phase of the Moon?
- A) new Moon
 - B) first-quarter Moon
 - C) half Moon
 - D) third-quarter Moon
 - E) full Moon
- 11) If the Moon is setting at 6 A.M., the phase of the Moon must be
- A) waning crescent.
 - B) first quarter.
 - C) new.
 - D) third quarter.
 - E) full.
- 12) How did Eratosthenes estimate the size of Earth in 240 B.C.?
- A) by observing the duration of a solar eclipse
 - 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 sending fleets of ships around Earth
 - E) We don't know how he did it since all his writings were destroyed.

- 13) Where was the Sun in Ptolemy's model of the universe?
- A) between the orbits of Venus and Mars
 - B) slightly offset from the center
 - C) at the outer edge, beyond Saturn's orbit
 - D) at the center
 - E) between Earth and the Moon's orbit
- 14) 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) Galileo
 - C) Tycho Brahe
 - D) Kepler
 - E) Copernicus
- 15) He discovered that the orbits of planets are ellipses.
- A) Copernicus
 - B) Galileo
 - C) Kepler
 - D) Tycho Brahe
 - E) Ptolemy
- 16) He discovered that Jupiter has moons.
- A) Aristotle
 - B) Galileo
 - C) Tycho Brahe
 - D) Kepler
 - E) Ptolemy
- 17) If your mass is 60 kg on Earth, what would your mass be on the Moon?
- A) 10 lb
 - B) 50 kg
 - C) 60 kg
 - D) 10 kg
 - E) 60 lb
- 18) What would happen if the Space Shuttle were launched with a speed greater than Earth's *escape velocity*?
- A) It would orbit Earth at a faster velocity.
 - B) It would travel in a higher orbit around Earth.
 - C) It would be in an unstable orbit.
 - D) It would travel away from Earth into the solar system.
 - E) It would take less time to reach its bound orbit.
- 19) 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) also doubles.
 - B) strengthens by a factor of 4.
 - C) weakens by a factor of 2.
 - D) is unaffected.
 - E) weakens by a factor of 4.

- 20) 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.
- 21) An atom in an *excited state* contains more of what type of energy than the same atom in the *ground state*?
- A) gravitational potential energy
 - B) thermal energy
 - C) electric potential energy
 - D) mass-energy
 - E) kinetic energy
- 22) The *wavelength* of a wave is
- A) the distance between where the wave is emitted and where it is absorbed.
 - B) the distance between two adjacent peaks of the wave.
 - C) the distance between a peak of the wave and the next trough.
 - D) how strong the wave is.
 - E) equal to the speed of the wave times the wave's frequency.
- 23) How are wavelength, frequency, and energy related for photons of light?
- A) Longer wavelength means lower frequency and lower 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 higher energy.
 - E) There is no simple relationship because different photons travel at different speeds.
- 24) From lowest energy to highest energy, which of the following correctly orders the different categories of electromagnetic radiation?
- A) infrared, visible light, ultraviolet, X rays, gamma rays, radio
 - B) radio, X rays, visible light, ultraviolet, infrared, gamma rays
 - C) visible light, infrared, X rays, ultraviolet, gamma rays, radio
 - D) radio, infrared, visible light, ultraviolet, X rays, gamma rays
 - E) gamma rays, X rays, visible light, ultraviolet, infrared, radio
- 25) When an electron in an atom goes from a higher energy state to a lower energy state, the atom
- A) absorbs several photons of a specific frequency.
 - B) emits a photon of a specific frequency.
 - C) absorbs a photon of a specific frequency.
 - D) can absorb a photon of any frequency.
 - E) can emit a photon of any frequency.

- 26) The spectra of most galaxies show redshifts. This means that their spectral lines
- A) have wavelengths that are shorter than normal.
 - B) have normal wavelengths, but absorption of light makes them appear red.
 - C) have wavelengths that are longer than normal.
 - D) have a higher intensity in the red part of the spectrum.
 - E) always are in the red part of the visible spectrum.
- 27) 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 is moving toward us.
 - C) The star is moving away from us.
 - D) The "star" actually is a planet.
 - E) The star is getting colder.
- 28) How does the Sun's mass compare with that of the planets?
- A) It is a hundred times more massive than Earth.
 - B) It is a thousand times more massive than all the planets combined.
 - C) It is a thousand times more massive than Earth.
 - D) It is a hundred times more massive than all the planets combined.
 - E) It is about as massive as all the planets combined.
- 29) Which planet has the highest *average* surface temperature, and why?
- A) Jupiter, because it is so big
 - B) Venus, because of its dense carbon dioxide atmosphere
 - C) Mercury, because it is closest to the Sun
 - D) Mars, because of its red color
 - E) Mercury, because of its dense carbon dioxide atmosphere
- 30) Which planet, other than Earth, has visible water ice on it?
- A) Mars
 - B) Mercury
 - C) Venus
 - D) the Moon
 - E) Jupiter
- 31) Which of the following is furthest from the Sun?
- A) Neptune
 - B) Pluto
 - C) a comet in the Kuiper belt
 - D) an asteroid in the asteroid belt
 - E) a comet in the Oort cloud
- 32) Which is the densest planet in the solar system?
- A) Venus
 - B) Mars
 - C) Mercury
 - D) Earth
 - E) Jupiter

- 33) The planet closest in size to Earth is
- A) Mars.
 - B) Venus.
 - C) the Moon.
 - D) Pluto.
 - E) Mercury.
- 34) Which of the following is *not* a characteristic of the inner planets?
- A) They all have solid, rocky surfaces.
 - B) Their orbits are relatively closely spaced.
 - C) They have very few, if any, satellites.
 - D) They are relatively smaller than the outer planets.
 - E) They all have substantial atmospheres.
- 35) Which of the following is *not* a characteristic of the outer planets?
- A) They are all large balls of gas.
 - B) Their orbits are separated by relatively large distances.
 - C) They are primarily made of hydrogen and helium.
 - D) They all have rings.
 - E) They have very few, if any, satellites.
- 36) Why did the solar nebula heat up as it collapsed?
- A) Collisions among planetesimals generated friction and heat.
 - B) The shock wave from a nearby supernova heated the gas.
 - C) Radiation from other nearby stars that had formed earlier heated the nebula.
 - D) Nuclear fusion occurring in the core of the protosun produced energy that heated the nebula.
 - E) As the cloud shrank, its gravitational potential energy was converted to kinetic energy and then into thermal energy.
- 37) 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) hydrogen compounds
 - C) metals
 - D) rocks
 - E) silicon-based minerals
- 38) 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

- 39) According to the nebular theory, what are asteroids and comets?
- A) They are the shattered remains of collisions between planets.
 - B) They are chunks of rock or ice that condensed long after the planets and moons had formed.
 - C) They are chunks of rock or ice that were expelled from planets by volcanoes.
 - D) They are the shattered remains of collisions between moons.
 - E) They are leftover planetesimals that never accreted into planets.
- 40) Most of the planets discovered around other stars
- A) are found around neutron stars.
 - B) are more massive than Earth and orbit very far from the star.
 - C) are more massive than Earth and orbit very close to the star.
 - D) are less massive than Earth and orbit very far from the star.
 - E) are less massive than Earth and orbit very close to the star.
- 41) Rank the five terrestrial worlds in order of size from smallest to largest:
- A) Moon, Mercury, Venus, Earth, Mars.
 - B) Moon, Mercury, Mars, Venus, Earth.
 - C) Mercury, Venus, Earth, Moon, Mars.
 - D) Mercury, Moon, Venus, Earth, Mars.
 - E) Mercury, Moon, Mars, Earth, Venus.
- 42) Which of the terrestrial worlds has the strongest magnetic field?
- A) Mars
 - B) the Moon
 - C) Mercury
 - D) Earth
 - E) Venus
- 43) Which of the following most likely explains why Venus does *not* have a strong magnetic field?
- A) It is too large.
 - B) It does not have a metallic core.
 - C) It is too close to the Sun.
 - D) Its rotation is too slow.
 - E) It has too thick an atmosphere.
- 44) Which two properties are most important in determining the surface temperature of a planet?
- A) size and chemical composition
 - B) distance from the Sun and atmosphere
 - C) size and atmosphere
 - D) composition and distance from the Sun
 - E) internal temperature and atmosphere
- 45) How large is an impact crater compared to the size of the impactor?
- A) 10 times larger
 - B) 10–20 percent larger
 - C) 100 times larger
 - D) 1,000 times larger
 - E) the same size

- 46) 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) were formed by impacts that occurred before those that formed most of the craters in the lunar highlands.
 - C) are sinkholes that formed when sections of the *maria* collapsed.
 - 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*.
- 47) 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* was formed by a volcano.
 - B) Mercury's atmosphere prevented smaller objects from hitting the surface.
 - C) the *Caloris Basin* formed toward the end of the solar system's period of heavy bombardment.
 - D) only very large impactors hit Mercury's surface in the past.
 - E) erosion destroyed the smaller craters that formed on the basin.
- 48) *Olympus Mons* is a
- A) shield volcano on Venus.
 - B) large lava plain on the Moon.
 - C) shield volcano on Mars.
 - D) stratovolcano on the Moon.
 - E) stratovolcano on Mercury.
- 49) Why does Venus have such a great difference in temperature between its "no atmosphere" temperature and its actual temperature?
- A) It has a slow rotation.
 - B) It is so close to the Sun.
 - C) It has a large amount of greenhouse gases in its atmosphere.
 - D) It has a high level of volcanic activity.
 - E) It has no cooling effects from oceans.
- 50) Which of the following worlds has the most substantial atmosphere?
- A) the Moon
 - B) Earth
 - C) Mars
 - D) Venus
 - E) Mercury
- 51) Why doesn't Venus have seasons like Mars and Earth do?
- A) Its rotation axis is not tilted.
 - B) It is too close to the Sun.
 - C) It does not have an ozone layer.
 - D) It does not rotate fast enough.
 - E) all of the above

- 52) Where is most of the water on Mars?
- A) in its polar caps and subsurface ground ice
 - B) distributed evenly throughout its atmosphere
 - C) in deep underground deposits
 - D) frozen on the peaks of its tall volcanoes
 - E) in its clouds
- 53) How does Jupiter's core compare to Earth's?
- A) It is the same size and mass.
 - B) It is about the same size but is 10 times more massive.
 - C) It is about 10 times larger in size and the same mass.
 - D) Jupiter doesn't have a core—it is made entirely from hydrogen and helium.
 - E) It is about 10 times larger both in size and mass.
- 54) If we know the size of an asteroid, we can determine its density by
- A) determining its mass from its gravitational pull on a spacecraft, satellite, or planet.
 - B) looking for brightness variations as it rotates.
 - C) spectroscopic imaging.
 - D) radar mapping.
 - E) comparing its reflectivity to the amount of light it reflects.
- 55) What is Jupiter's Great Red Spot?
- A) the place where Jupiter's aurora is most visible
 - B) a hurricane that comes and goes on Jupiter
 - C) the place where reddish particles from Io impact Jupiter's surface
 - D) a large mountain peak poking up above the clouds
 - E) a long-lived, high-pressure storm
- 56) The four Galilean moons around Jupiter are
- A) all made of rock.
 - B) hydrogen and helium gas.
 - C) a mixture of rock and ice, with the ice fraction increasing with distance from Jupiter.
 - D) all made of ice.
 - E) a mixture of rock and ice, with the rock fraction increasing with distance from Jupiter.
- 57) Why are there no impact craters on the surface of Io?
- A) Any craters that existed have been eroded through the strong winds on Io's surface.
 - B) Io did have impact craters but they have all been buried in lava flows.
 - C) Jupiter's strong gravity attracted the planetesimals more strongly than Io and thus none landed on its surface.
 - D) It is too small to have been bombarded by planetesimals in the early solar system.
 - E) Io's thick atmosphere obscures the view of the craters.

- 58) Which moon has the most substantial atmosphere?
- A) Mimas
 - B) Europa
 - C) Io
 - D) Ganymede
 - E) Titan
- 59) How thick are Saturn's rings from top to bottom?
- A) a few tens of thousands of kilometers
 - B) a few tens of meters
 - C) a few million kilometers
 - D) a few kilometers
 - E) a few hundred kilometers
- 60) Which is closest to the average distance between asteroids in the asteroid belt?
- A) 10 thousand km
 - B) 1 million km
 - C) 10 million km
 - D) 100 thousand km
 - E) 1 thousand km
- 61) Why isn't there a planet where the asteroid belt is located?
- A) There was too much rocky material to form a terrestrial planet, but not enough gaseous material to form a jovian planet.
 - 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) The temperature in this portion of the solar nebula was just right to prevent rock from sticking together.
 - E) A planet once formed here, but it was broken apart by a catastrophic collision.
- 62) What do we call a small piece of solar system debris found on Earth?
- A) meteorite
 - B) solar system debris
 - C) cometary fragment
 - D) meteoroid
 - E) meteor
- 63) Halley's comet is named after the English scientist Edmund Halley because he
- A) discovered it.
 - B) was the most famous astronomer in England during its appearance.
 - C) calculated its orbit and predicted that it would return in 1758.
 - D) was the first to see it in 1682.
 - E) was the first to publish pictures of it and report it to the International Astronomical Union (IAU).
- 64) What part of a comet points most directly away from the Sun?
- A) the nucleus
 - B) the jets of gas
 - C) the dust tail
 - D) the coma
 - E) the plasma tail

- 65) The core of the Sun is
- A) composed of iron.
 - B) at the same temperature and density as the surface.
 - C) at the same temperature but denser than the surface.
 - D) hotter and denser than the surface.
 - E) constantly rising to the surface through convection.
- 66) What two forces are balanced in what we call *gravitational equilibrium*?
- A) the strong force and gravity
 - B) outward pressure and the strong force
 - C) the electromagnetic force and gravity
 - D) outward pressure and gravity
 - E) the strong force and kinetic energy
- 67) What is the average temperature of the *surface* of the Sun?
- A) 10,000 K
 - B) 1,000 K
 - C) 1 million K
 - D) 6,000 K
 - E) 100,000 K
- 68) Which layer of the Sun do we normally see?
- A) chromosphere
 - B) convection zone
 - C) photosphere
 - D) corona
 - E) radiation zone
- 69) At the center of the Sun, fusion converts hydrogen into
- A) radiation and elements like carbon and nitrogen.
 - B) radioactive elements like uranium and plutonium.
 - C) plasma.
 - D) helium, energy, and neutrinos.
 - E) hydrogen compounds.
- 70) What is *granulation* in the Sun?
- A) the bubbling pattern on the photosphere produced by the underlying convection
 - B) another name for the way sunspots look on the surface of the Sun
 - C) elements in the Sun other than hydrogen and helium
 - D) lumps of denser material in the Sun
 - E) dust particles in the Sun that haven't been turned into plasma

- 71) Approximately, what basic composition are all stars born with?
- A) one-quarter hydrogen, three-quarters helium, no more than 2 percent heavier elements
 - B) 98 percent hydrogen, 2 percent helium
 - C) half hydrogen, half helium, no more than 2 percent heavier elements
 - D) three-quarters hydrogen, one-quarter helium, no more than 2 percent heavier elements
 - E) 90 percent hydrogen, 10 percent helium, no more than 1 percent heavier elements
- 72) Since all stars begin their lives with the same basic composition, what characteristic most determines how they will differ?
- A) color they are formed with
 - B) luminosity they are formed with
 - C) time they are formed
 - D) mass they are formed with
 - E) location where they are formed
- 73) A star's *luminosity* is the
- A) total amount of light that the star radiates each second.
 - B) surface temperature of the star.
 - C) apparent brightness of the star in our sky.
 - D) lifetime of the star.
 - E) total amount of light that the star will radiate over its entire lifetime.
- 74) Suppose that you measure the parallax angle for a particular star to be 0.5 arcsecond. The distance to this star is
- A) 0.5 parsec.
 - B) 2 parsecs.
 - C) 5 parsecs.
 - D) 0.5 light-year.
 - E) 5 light-years.
- 75) The spectral sequence in order of decreasing temperature is
- A) ABFGKMO.
 - B) BAGFKMO.
 - C) OBAGFKM.
 - D) OFBAGKM.
 - E) OBAFGKM.
- 76) Which of the following best describes the axes of a Hertzsprung–Russell (H–R) diagram?
- A) interior temperature on the horizontal axis and mass on the vertical axis
 - B) surface temperature on the horizontal axis and radius on the vertical axis
 - C) mass on the horizontal axis and stellar age on the vertical axis
 - D) surface temperature on the horizontal axis and luminosity on the vertical axis
 - E) mass on the horizontal axis and luminosity on the vertical axis

- 77) What is the smallest mass a newborn star can have?
- A) about 1/80 the mass of our Sun
 - B) 800 times the mass of Jupiter
 - C) 8 times the mass of Jupiter
 - D) 80 times the mass of Jupiter
 - E) about 1/800 the mass of our Sun
- 78) What happens when a star exhausts its core hydrogen supply?
- A) Its core contracts, but its outer layers expand and the star becomes bigger but cooler and therefore remains at the same brightness.
 - B) Its core contracts, but its outer layers expand and the star becomes bigger and brighter.
 - C) It contracts, becoming smaller and dimmer.
 - D) It contracts, becoming hotter and brighter.
 - E) It expands, becoming bigger but dimmer.
- 79) Compared to the star it evolved from, a red giant is
- A) hotter and brighter.
 - B) hotter and dimmer.
 - C) cooler and dimmer.
 - D) the same temperature and brightness.
 - E) cooler and brighter.
- 80) What is a planetary nebula?
- A) a disk of gas surrounding a protostar that may form into planets
 - B) the molecular cloud from which protostars form
 - C) the expanding shell of gas that is left when a white dwarf explodes as a supernova
 - D) what is left of the planets around a star after a low-mass star has ended its life
 - E) the expanding shell of gas that is no longer gravitationally held to the remnant of a low-mass star
- 81) Which of the following sequences correctly describes the stages of life for a low-mass star?
- A) protostar, main-sequence, white dwarf, red giant
 - B) protostar, red giant, main-sequence, white dwarf
 - C) protostar, main-sequence, red giant, white dwarf
 - D) white dwarf, main-sequence, red giant, protostar
 - E) red giant, protostar, main-sequence, white dwarf
- 82) After a supernova event, what is left behind?
- A) either a neutron star or a black hole
 - B) always a neutron star
 - C) always a black hole
 - D) always a white dwarf
 - E) either a white dwarf or a neutron star

- 83) White dwarfs are so called because
- A) they are supported by electron degeneracy pressure.
 - B) it amplifies the contrast with red giants.
 - C) they are the opposite of black holes.
 - D) they are the end-products of small, low-mass stars.
 - E) they are both very hot and very small.
- 84) How does a 1.2-solar-mass white dwarf compare to a 1.0-solar-mass white dwarf?
- A) It has a smaller radius.
 - B) It has a lower surface temperature.
 - C) It has a higher surface temperature.
 - D) It is supported by neutron, rather than electron, degeneracy pressure.
 - E) It has a larger radius.
- 85) Which of the following is closest in size (radius) to a white dwarf?
- A) a football stadium
 - B) Earth
 - C) a small city
 - D) a basketball
 - E) the Sun
- 86) Which of the following is closest in size (radius) to a neutron star?
- A) a city
 - B) the Sun
 - C) Earth
 - D) a basketball
 - E) a football stadium
- 87) From a theoretical standpoint, what is a pulsar?
- A) a neutron star or black hole that happens to be in a binary system
 - B) a star that alternately expands and contracts in size
 - C) a binary system that happens to be aligned so that one star periodically eclipses the other
 - D) a star that is burning iron in its core
 - E) a rapidly rotating neutron star
- 88) What is the basic definition of a *black hole*?
- A) a dead star that has faded from view
 - B) any compact mass that emits no light
 - C) a dead galactic nucleus that can only be viewed in infrared
 - D) any object from which the escape velocity exceeds the speed of light
 - E) any object made from dark matter

- 89) Which of the following statements about black holes is *not* true?
- A) If we watch a clock fall toward a black hole, we will see it tick slower and slower as it falls nearer to the black hole.
 - B) A black hole is truly a hole in spacetime, through which we could leave the observable universe.
 - C) If the Sun magically disappeared and was replaced by a black hole of the same mass, Earth would soon be sucked into the black hole.
 - D) If you watch someone else fall into a black hole, you will never see him or her cross the event horizon. However, he or she will fade from view as the light he or she emits (or reflects) becomes more and more redshifted.
 - E) If you fell into a black hole, you would experience time to be running normally as you plunged rapidly across the event horizon.
- 90) If you were to come back to our Solar System in 6 billion years, what might you expect to find?
- A) a rapidly spinning pulsar
 - B) a white dwarf
 - C) a red giant star
 - D) a black hole
 - E) Everything will be pretty much the same as it is now.
- 91) What is the diameter of the disk of the Milky Way?
- A) 100 light-years
 - B) 100,000 light-years
 - C) 10,000 light-years
 - D) 1,000 light-years
 - E) 1,000,000 light-years
- 92) Which of the following comprise the oldest members of the Milky Way?
- A) O stars
 - B) the Sun and other solar mass stars
 - C) Cepheid variables
 - D) globular clusters
 - E) red giant stars in spiral arms
- 93) Approximately how long does it take the Sun to orbit the Milky Way Galaxy?
- A) 2.3 million years
 - B) 230 million years
 - C) 230,000 years
 - D) 23,000 years
 - E) 23 billion years
- 94) Which constellation lies in the direction toward the galactic center?
- A) Orion
 - B) Sagittarius
 - C) Taurus
 - D) the Big Dipper
 - E) Leo

- 95) Compared to spiral galaxies, elliptical galaxies are
- A) bluer and rounder.
 - B) redder and rounder.
 - C) bluer and flattened.
 - D) always much smaller.
 - E) redder and flattened.
- 96) The disk component of a spiral galaxy includes which of the following parts?
- A) bulge
 - B) spiral arms
 - C) globular clusters
 - D) halo
 - E) all of the above
- 97) Why are Cepheid variables important?
- A) Cepheid variables are stars that vary in brightness because they harbor a black hole.
 - B) Cepheids are pulsating variable stars, and their pulsation periods are directly related to their true luminosities. Hence, we can use Cepheids as "standard candles" for distance measurements.
 - C) Cepheids are supermassive stars that are on the verge of becoming supernovae and therefore allow us to choose candidates to watch if we hope to observe a supernova in the near future.
 - D) Cepheids are a type of young galaxy that helps us understand how galaxies form.
- 98) What is *Hubble's law*?
- A) The longer the time period between peaks in brightness, the greater the luminosity of the Cepheid variable star.
 - B) The faster a spiral galaxy's rotation speed, the less luminous it is.
 - C) The faster a spiral galaxy's rotation speed, the more luminous it is.
 - D) The recession velocity of a galaxy is inversely proportional to its distance from us.
 - E) The recession velocity of a galaxy is directly proportional to its distance from us.
- 99) Based on current estimates of the value of Hubble's constant, how old is the universe?
- A) between 12 and 16 billion years old
 - B) between 8 and 12 billion years old
 - C) between 16 and 20 billion years old
 - D) between 4 and 6 billion years old
 - E) between 20 and 40 billion years old
- 100) I observe a galaxy that is 100 million light-years away: what do I see?
- A) the light from the galaxy as it was 100 million years ago and it is redshifted
 - B) the light from the galaxy as it is today, but it is blueshifted
 - C) the light from the galaxy as it was 100 million years ago and it is blueshifted
 - D) the light from the galaxy as it is today, but it is redshifted
 - E) Nothing: the galaxy lies beyond the cosmological horizon.

- 101) Why should galaxy collisions have been more common in the past than they are today?
- A) Galaxies were closer together in the past because the universe was smaller.
 - B) Galaxies were much bigger in the past since they had not contracted completely.
 - C) Galaxy collisions shouldn't have been more common in the past than they are now.
 - D) Galaxies were more active in the past and therefore would have collided with each other more frequently.
 - E) Galaxies attracted each other more strongly in the past because they were more massive; they had not yet turned most of their mass into stars and light.
- 102) What is a *quasar*?
- A) another name for very bright stars of spectral type O
 - B) a very large galaxy thought to be formed by the merger of several smaller galaxies, typically found in the center of a galaxy cluster
 - C) the extremely bright center of a distant galaxy, thought to be powered by a massive black hole
 - D) a specialized astronomical instrument for observing distant stars
 - E) a starlike object that actually represents a bright patch of gas in the Milky Way
- 103) What is meant by "dark energy"?
- A) the agent causing the universal expansion to accelerate
 - B) any unknown force that opposes gravity
 - C) highly energetic particles that are believed to constitute dark matter
 - D) the energy associated with dark matter through $E=mc^2$
 - E) the total energy in the Universe after the Big Bang but before the first stars
- 104) What is the evidence for an accelerating universe?
- A) There is far more dark matter than visible matter in the universe.
 - B) White-dwarf supernovae are the same brightness regardless of redshift.
 - C) The Andromeda Galaxy is moving away from the Milky Way at an ever-increasing speed.
 - D) White-dwarf supernovae are slightly dimmer than expected for a coasting universe.
 - E) White-dwarf supernovae are slightly brighter than expected for a coasting universe.
- 105) To date, physicists have investigated the behavior of matter and energy at temperatures as high as those that existed in the universe as far back as _____ after the Big Bang.
- A) 300 years
 - B) 1 million years
 - C) 300,000 years
 - D) 3 minutes
 - E) 10^{-10} second