

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 1) Astronomy originally was developed 1) \_\_\_\_\_  
A) .as a timekeeping tool  
B) as a scientific way in which to understand the evolution of the Universe  
C) to form the basis of our understanding of how life started on Earth  
D) as a way to understand the seasonal variations.  
E) as a way to determine precise distances on the Earth.
- 2) Which of the following statements about the celestial equator is true at *all* latitudes? 2) \_\_\_\_\_  
A) It extends from your horizon due east, through your zenith, to your horizon due west.  
B) It lies along the band of light we call the Milky Way.  
C) It cuts the dome of your sky exactly in half.  
D) It extends from your horizon due north, through your zenith, to your horizon due south.  
E) It represents an extension of Earth's equator onto the celestial sphere.
- 3) The detection of hot Jupiters has been interpreted to mean 3) \_\_\_\_\_  
A) that core-accretion model for planet formation is completely wrong and must be discarded.  
B) that our understanding of planetary system formation is probably correct but not complete.  
C) that our solar system is unique  
D) that large impacts as planets form havr played a large role in the evolution of nearly all planets  
E) that at one time, terrestrial planets had larger masses than did jovian planets
- 4) By locating the north celestial pole (NCP) in the sky, how can you determine your latitude? 4) \_\_\_\_\_  
A) The altitude of the NCP is your angular distance from the North Pole.  
B) The azimuth of the NCP is the same as your latitude.  
C) The altitude of the NCP is the same as your distance from the North Pole.  
D) The azimuth of the NCP is the angular distance from the North Pole.  
E) The altitude of the NCP is the same as your latitude.
- 5) Seasonal variations in Eugene are driven by 5) \_\_\_\_\_  
A) the misalignment between the spin axis of the earth and the orbital axis of the earth about the sun.  
B) the varying hours of sunlight over a year  
C) the varying distance of the earth from the sun over a year  
D) A & B drive the seasons  
E) A, B, & C drive the seasons

- 6) Which of the following statements is *true*? 6) \_\_\_\_\_
- A) Both the Northern and Southern hemispheres receive the same amount of sunlight on the equinoxes.
  - B) The Southern Hemisphere receives the most direct sunlight on the summer solstice.
  - C) The Northern Hemisphere receives the most direct sunlight on the summer solstice.
  - D) Both the Northern and Southern hemispheres receive the same amount of sunlight on the solstices.
  - E) Both A and C are true.
- 7) If the Moon is setting at noon, the phase of the Moon must be 7) \_\_\_\_\_
- A) full.
  - B) waning crescent.
  - C) third quarter.
  - D) first quarter.
  - E) waxing crescent.
- 8) If the moon is first quarter and on the meridian, we expect 8) \_\_\_\_\_
- A) that the observer is experiencing low tide
  - B) that the observer is experiencing high tide
  - C) that the observer is experiencing a spring tide
  - D) that the observer is experiencing an average tide level, neither low nor high
  - E) that the observer is experiencing the same tide as if the moon were waning crescent
- 9) Why do we see essentially the same face of the Moon at all times? 9) \_\_\_\_\_
- A) because the other face points toward us only at new Moon, when we can't see the Moon
  - B) because the Moon does not rotate
  - C) because the Moon's rotational and orbital periods are equal
  - D) because the Moon has a nearly circular orbit around Earth
  - E) because the Sun illuminates only one half at a time
- 10) If the earth's orbital period about the sun was 360 days, 10) \_\_\_\_\_
- A) then the seasonal changes on earth would be smaller than they are today
  - B) then it would be easier to detect stellar parallax
  - C) then the solar day would be longer than 24 hours
  - D) then the phases of the moon would change with a period shorter than 273 days, the sidereal orbital period of the moon
  - E) then the moon would rise earlier each day rather than later.
- 11) What causes the apparent retrograde motion of the planets? 11) \_\_\_\_\_
- A) The other planets never really appear to move backward; the background stars shift due to Earth's revolution around the Sun.
  - B) As Earth passes another planet, its gravitational pull slows down the other planet so that it appears to be traveling backward.
  - C) Apparent retrograde motion is an illusion created by turbulence in Earth's atmosphere.
  - D) When planets are farther from the Sun, they move slower than when they are nearer the Sun; it is during this slower period that they appear to move backwards.
  - E) As Earth passes another planet, the other planet appears to move backward with respect to the background stars, but the planet's motion does not actually change.

- 12) Which of the following statements about stellar parallax is *true*? 12) \_\_\_\_\_
- A) Stellar parallax was first observed by ancient Greek astronomers.
  - B) The amount of parallax we see depends on how fast a star is moving relative to us.
  - C) The detection of stellar parallax was used to show that the earth was spherical in shape.
  - D) If we observed from Jupiter, stellar parallax would be easier to detect
  - E) It takes at least 20 years of observation to measure a star's parallax.
- 13) When Copernicus first created his Sun-centered model of the solar system, it was not immediately accepted . Why not? Of the following choose the best choice. 13) \_\_\_\_\_
- A) Copernicus placed the Sun at the center but did not realize that the Moon orbits Earth.
  - B) Copernicus misjudged the distances between the planets.
  - C) Copernicus placed the planets in the wrong order going outward from the Sun.
  - D) Copernicus misjudged the speeds at which the planets orbit the Sun.
  - E) Copernicus 's model did not fit the data any better than did Ptolemy's.
- 14) Which of the following is *not* one of, nor follows directly from, Kepler's laws? 14) \_\_\_\_\_
- A) More distant planets move at slower speeds.
  - B) The orbit of each planet about the Sun is an ellipse with the Sun at one focus.
  - C) The force of attraction between any two objects decreases with the square of the distance between their centers.
  - D) As a planet moves around its orbit, it sweeps out equal areas in equal times.
  - E) A planet travels faster when it is nearer to the Sun and slower when it is farther from the Sun.
- 15) From Kepler's second law of planetary motion, the equal areas law, we may infer 15) \_\_\_\_\_
- A) that the shape of a planet's orbit is an ellipse
  - B) that the orbital period of a planet increases as the size of its orbit increases
  - C) the speed a planet moves in its orbit depends on how far it is from the sun in its orbit
  - D) A & B both follow from Kepler's second law
  - E) A, B, & C follow from Kepler's second law
- 16) Which of Kepler's laws of planetary motion are extra-solar planetary systems expected to obey 16) \_\_\_\_\_
- A) First law, law of ellipses
  - B) Second law, equal areas law
  - C) Third law, harmonic law
  - D) The first and third laws only
  - E) All of Kepler's laws
- 17) Of the following, which is evidence that the earth spins on its axis? 17) \_\_\_\_\_
- A) falling objects deflect in the direction of rotation
  - B) Foucault pendulum
  - C) Annual trigonometric parallax
  - D) The variation of the seasons on earth
  - E) A & B
  - F) C & D
  - G) the law of gravity.

- 18) Which of the following statements about parallax is *not* true? 18) \_\_\_\_\_
- A) You can demonstrate parallax simply by holding up a finger and looking at it alternately from your left and right eyes.
  - B) Ancient astronomers were unable to measure parallax and used the absence of observed parallax as an argument in favor of an Earth-centered universe.
  - C) Measurement of stellar parallax allows us to determine distances to nearby stars.
  - D) The existence of stellar parallax is direct proof that Earth spins on its axis.
  - E) Stellar parallaxes are tiny and were not observed until the 1800s.
- 19) Which of the following observations indicates that conditions on Mars may have been suitable for life in the past? 19) \_\_\_\_\_
- A) The discovery of sedimentary rock formations.
  - B) The discovery of the Valles Marineris.
  - C) Observations of the Tharsis Bulge
  - D) The discovery of the Martian moons, Phobos and Deimos
  - E) Mars has polar caps made of "dry ice."
- 20) Which planet has the highest *average* surface temperature, and why? 20) \_\_\_\_\_
- A) Venus, because of its dense carbon dioxide atmosphere
  - B) Mars, because of its red color
  - C) Jupiter, because it is so big
  - D) Mercury, because of its dense carbon dioxide atmosphere
  - E) Mercury, because it is closest to the Sun
- 21) Which of the following objects is not considered an *ocean world*? 21) \_\_\_\_\_
- A) Venus
  - B) Enceladus
  - C) Earth
  - D) Europa
  - E) Pluto
- 22) Which of the following is *not* an exception to the general patterns for planetary systems discovered through studies of our solar system? 22) \_\_\_\_\_
- A) the large size of Earth's Moon
  - B) the chemical composition of Jupiter and Saturn
  - C) the fuzzy core of Jupiter discovered by JUNO
  - D) the extreme axis tilt of Uranus
  - E) the discovery of *hot Jupiters*
- 23) Which of the following is a characteristic of the inner planets? 23) \_\_\_\_\_
- A) Their orbits are separated by relatively large distances.
  - B) They are large balls of gas.
  - C) They are primarily made of hydrogen and helium.
  - D) They have few, if any, satellites.
  - E) They all have rings.

- 24) What happened during the *accretion* phase of the early solar system? 24) \_\_\_\_\_
- A) The solar nebula differentiated into metals inside of the frost line and ices beyond.
  - B) Atoms and molecules in the gas bonded together and solidified.
  - C) Large planetesimals captured atmospheres from the solar nebula.
  - D) Particles grew by colliding and sticking together.
  - E) Earth gained its oceans from icy planetesimal capture.
- 25) What was the *snowline* of the solar system? 25) \_\_\_\_\_
- A) 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
  - 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 metals to condense, between the Sun and the present-day orbit of Mercury
  - D) the distance from the Sun where temperatures were low enough for rocks to condense, between the present-day orbits of Mercury and Venus
  - E) the distance from the Sun where temperatures were low enough for asteroids to form, between the present-day orbits of Venus and Earth
- 26) What is the most likely reason that there are no giant planets beyond Neptune? 26) \_\_\_\_\_
- A) Any planets forming beyond Neptune would have drifted out of the solar system due to the weakness of the Sun's gravity at this distance.
  - B) By the time planetesimals grew to a large enough mass to hold onto an atmosphere, the solar nebula had been blown away.
  - C) There may be, but they would be so faint that astronomers have not found them yet.
  - D) There was no material to create planetesimals beyond the orbit of Neptune.
  - E) Any planet forming beyond Neptune's orbit would have been scattered outside of the solar system by gravitational encounters.
- 27) Asteroids are 27) \_\_\_\_\_
- A) thought to be representative of materials left-over from the formation of the solar system
  - B) predominantly found between the orbits of Mars and Jupiter
  - C) objects predicted by the Titus-Bode relation
  - D) sometimes perturbed into orbits in which they can strike the terrestrial planets
  - E) all of the above
- 28) According to our theory of solar system formation, why do we find some exceptions to the general rules and patterns of the planets? 28) \_\_\_\_\_
- A) Our theory is not quite correct because it cannot explain these exceptions.
  - B) The exceptions probably represent objects that were captured by our solar system from interstellar space.
  - C) The exceptions probably represent objects that formed recently, rather than early in the history of the solar system.
  - D) Most of the exceptions are the result of giant impacts.
  - E) The exceptions exist because, even though our theory is as correct as possible, nature never follows rules precisely.

- 29) Why does Venus have such a great difference in temperature between its "no atmosphere" temperature and its actual temperature? 29) \_\_\_\_\_
- 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 no cooling effects from oceans.
  - E) It has a high level of volcanic activity.
- 30) Earth's stratosphere is heated primarily by which process? 30) \_\_\_\_\_
- A) Absorption of visible light by ozone.
  - B) Atoms and molecules absorb infrared sunlight.
  - C) Convection from the Earth's surface.
  - D) Absorption of ultraviolet radiation by ozone.
  - E) Absorption of infrared radiation by greenhouse gases.
- 31) How does the greenhouse effect work? 31) \_\_\_\_\_
- A) Ozone transmits visible light, allowing it to heat the surface, but then absorbs most of the infrared heat, trapping the heat near the surface.
  - B) Greenhouse gases transmit visible light, allowing it to heat the surface, but then absorb infrared light from Earth, trapping the heat near the surface.
  - C) Greenhouse gases absorb infrared light from the Sun, which then heats the atmosphere and the surface.
  - D) The higher pressure of the thick atmosphere at lower altitudes traps heat in more effectively.
  - E) Greenhouse gases absorb X-rays and ultraviolet light from the Sun, which then heat the atmosphere and the surface.
- 32) Which of the following factors could explain a gradual warming trend in a planet's climate? 32) \_\_\_\_\_
- A) a decrease in the amount of greenhouse gases
  - B) a decrease in the brightness of the Sun
  - C) a decrease in its cloud cover
  - D) a decrease in plate tectonic activity
  - E) none of the above
- 33) Where is most of the water on Mars? 33) \_\_\_\_\_
- A) distributed evenly throughout its atmosphere
  - B) in its polar caps and subsurface ground ice
  - C) frozen on the peaks of its tall volcanoes
  - D) in its clouds
  - E) in deep underground deposits
- 34) Venus may have started with an ocean's worth of water. Where is its water now? 34) \_\_\_\_\_
- A) The water was lost when ultraviolet light broke apart water molecules and the hydrogen escaped to space.
  - B) The original water remains vaporized in the atmosphere due to Venus's intense heat.
  - C) Most of the water combined with rocks in chemical reactions.
  - D) Most of the water is frozen beneath the surface.
  - E) The water changed to carbon dioxide through chemical reactions.

- 35) Deuterium is more abundant on Venus than elsewhere in the solar system. What do we think this fact tells us about Venus? 35) \_\_\_\_\_
- A) Its volcanoes outgassed primarily carbon dioxide and deuterium, but little water.
  - B) It was formed in a part of the solar nebula where deuterium condensed easily.
  - C) It once had huge amounts of water in its atmosphere.
  - D) It was formed in a part of the solar nebula where deuterium was surprisingly abundant.
  - E) It once had an atmosphere made mostly of hydrogen.
- 36) Which of the following statements about the greenhouse effect is *true*? 36) \_\_\_\_\_
- A) A weak greenhouse effect operates on Mars.
  - B) The burning of fossil fuels increases the greenhouse effect on Earth because of the release of carbon dioxide.
  - C) One result of an increased greenhouse effect on Earth may be an increased number of severe storms.
  - D) Without the naturally occurring greenhouse effect, Earth would be too cold to have liquid oceans.
  - E) All of the above are true.
- 37) Earth's atmosphere contains only small amounts of carbon dioxide because 37) \_\_\_\_\_
- A) Earth's volcanoes did not outgas as much carbon dioxide as those on Venus and Mars.
  - B) most of the carbon dioxide was lost during the age of bombardment.
  - C) carbon dioxide dissolves in water, and most of it is now contained in the oceans and carbonate rocks.
  - D) chemical reactions with other gases destroyed the carbon dioxide and replaced it with the nitrogen that is in the atmosphere now.
  - E) Earth doesn't have as strong a greenhouse effect as is present on Venus.
- 38) The interiors of planets may be studied from 38) \_\_\_\_\_
- A) seismology.
  - B) their magnetic fields
  - C) their gravitational fields
  - D) their rotation and flattening
  - E) all of the above
- 39) Jupiter 39) \_\_\_\_\_
- A) orbits about the center of the Sun
  - B) orbits about the distant companion star to the sun known as nemesis
  - C) strictly speaking, doesn't orbit the sun, it orbits about the center-of-mass of the solar system
  - D) strictly speaking, Jupiter actually orbits about the earth
  - E) is stationary, the earth and other objects orbit about Jupiter and the sun
- 40) How do astronomers think Saturn generates its excess internal heat? 40) \_\_\_\_\_
- A) by raining dense helium droplets from higher to lower altitudes, resembling the process of differentiation
  - B) internal friction due to its high rotation rate
  - C) radioactive decay
  - D) chemical processes
  - E) nuclear fusion in the core

- 41) Why does Jupiter have several distinct cloud layers? 41) \_\_\_\_\_
- A) Different layers represent the various regions where the temperature is cool enough for liquid water to condense.
  - B) Winds prevent clouds from forming at some altitudes, so we see clouds only at the other altitudes.
  - C) Different layers represent clouds made of gases that condense at different temperatures.
  - D) Clouds form randomly, so on average there are always several layers.
  - E) Different gases are present at different altitudes in Jupiter's atmosphere.
- 42) The *belts* and *zones* of Jupiter are 42) \_\_\_\_\_
- A) names for different cloud layers on Jupiter.
  - B) alternating regions of charged particles in Jupiter's magnetic field.
  - C) cyclonic and anticyclonic storms.
  - D) alternating bands of rising and falling air at different latitudes.
  - E) the thermosphere and stratosphere respectively.
- 43) What is Jupiter's Great Red Spot? 43) \_\_\_\_\_
- A) a long-lived, high-pressure storm
  - B) the place where reddish particles from Io impact Jupiter's surface
  - C) the place where Jupiter's aurora is most visible
  - D) a hurricane that comes and goes on Jupiter
  - E) a large mountain peak poking up above the clouds
- 44) What mechanism is most responsible for generating the internal heat of Io that drives its volcanic activity? 44) \_\_\_\_\_
- A) radioactive decay
  - B) bombardment
  - C) tidal heating
  - D) differentiation
  - E) accretion
- 45) Why are there few or no impact craters on the surface of Europa? 45) \_\_\_\_\_
- A) Jupiter's strong gravity attracted the planetesimals more strongly than Europa and thus none landed on its surface.
  - B) Europa did have impact craters but they have all been buried in lava flows.
  - C) It is too small to have been bombarded by planetesimals in the early solar system.
  - D) Any craters that existed have been eroded through the strong winds on Europa's surface.
  - E) Europa's thick atmosphere obscures the view of the craters.
- 46) Why do the jovian planet interiors differ from each other? 46) \_\_\_\_\_
- A) Accretion took longer further from the Sun, so the more distant planets formed their cores later and captured less gas from the solar nebula than the closer jovian planets.
  - B) They may differ due to giant impacts at the late stages of planet formation.
  - C) The more distant planets formed in a cooler region of the solar nebula and therefore contain a greater proportion of iron than the closer jovian planets
  - D) A & B are correct
  - E) A, B, & C are correct



- 47) From where did the molecular oxygen in Earth's atmosphere originate? 47) \_\_\_\_\_  
A) outgassing from volcanoes  
B) atmospheric bombardment  
C) oxidation of surface rocks  
D) photosynthesis from single-celled organisms  
E) photosynthesis from plant life
- 48) The first planets around other Sun-like stars were discovered 48) \_\_\_\_\_  
A) using the transit method  
B) by Kepler around 15 years ago.  
C) using the spectroscopic method.  
D) through reanalysis of early work of TESS  
E) through use of trigonometric parallax
- 49) When did oxygen begin to accumulate at significant levels in the atmosphere of the earth? 49) \_\_\_\_\_  
A) as soon as life appeared  
B) about 2 billion years ago  
C) about 200 million years ago  
D) as soon as the early bombardment ended  
E) as soon as Earth was formed
- 50) What is absolutely necessary for living organisms to survive? 50) \_\_\_\_\_  
A) oxygen  
B) food in the form of other organisms  
C) sunlight  
D) energy  
E) all of the above
- 51) After Mars, the next most likely candidates for life in the solar system are 51) \_\_\_\_\_  
A) the large moons of the jovian planets.  
B) Kuiper-belt comets.  
C) the jovian planets.  
D) Oort-cloud comets.  
E) asteroids.
- 52) What defines the *habitable zone* around a star? 52) \_\_\_\_\_  
A) the region around a star where the ultraviolet radiation does not destroy organisms on a planetary surface  
B) the region around a star where life exists  
C) the region around a star where rocky planets form  
D) the region around a star where humans can survive  
E) the region around a star where liquid water can be found on or in a planet

- 53) Cassini showed that
- A) the plumes on Enceladus contained small amounts of molecular hydrogen and carbon dioxide
  - B) the interior of Saturn contained a large fuzzy core
  - C) the surface of Enceladus was surprisingly heavily cratered
  - D) there are large hydrothermal vents on the floors of the oceans on Enceladus that are teeming with microbial life
  - E) Enceladus had a very magnetic field that protected its atmosphere

53) \_\_\_\_\_

- 54) It was proposed that possible life on Enceladus could
- A) generate energy through methanogenesis
  - B) exist without sunlight if the life used radioactive elements released from the vents
  - C) generate energy through photosynthesis during the summer on Enceladus
  - D) exist on its surface if the life was shielded from the Solar wind by hiding in craters
  - E) have existed in the past when it was thought that Enceladus had a thick atmosphere

54) \_\_\_\_\_