

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

- 1) This is version A of the exam. Please fill in (A) 1) _____
A) This is the CORRECT Answer
B) This is WRONG
C) This is WRONG
D) This is WRONG
E) This is WRONG
- 2) How do we know how old the Earth is? 2) _____
A) From radioactive dating of rocks and meteorites.
B) From the layering of materials within the Earth.
C) By measuring the rate of change of the Sun's luminosity
D) From the cratering history of Earth's surface
E) From fossils of ancient life.
- 3) Which is *not* an essential requirement for life as we know it? 3) _____
A) The ability to breathe oxygen
B) The ability to make energy from sunlight, or to eat things that do
C) A source of organic molecules
D) Liquid water
E) A and B
- 4) Which of the following lists the ingredients of the solar nebula from highest to lowest percentage of mass in the nebula? 4) _____
A) hydrogen compounds (H₂O, CH₄, NH₃), light gases (H, He), metals, rocks
B) hydrogen compounds (H₂O, CH₄, NH₃), light gases (H, He), rocks, metals
C) light gases (H, He), hydrogen compounds (H₂O, CH₄, NH₃), metals, rocks
D) light gases (H, He), hydrogen compounds (H₂O, CH₄, NH₃), rocks, metals
E) hydrogen compounds (H₂O, CH₄, NH₃), rocks, metals, light gases (H, He)
- 5) What do meteorites reveal about the solar system? 5) _____
A) They reveal that the early solar system consisted mostly of hydrogen and helium gas.
B) They reveal that meteorites are much older than the comets and planets.
C) They reveal that the age of the solar system is approximately 4.6 billion years.
D) They reveal that the solar system once contained 10 planets.
E) Nothing, because they come from other star systems.
- 6) Why does the plasma (ion) tail of a comet always point away from the Sun? 6) _____
A) Radiation pressure from the Sun's light pushes the ions away.
B) The conservation of the angular momentum in the tail keeps it always pointing away from the Sun.
C) The ions are following Keplerian orbits that lead away from the Sun.
D) The solar wind electromagnetically "blows" the ions directly away from the Sun.
E) The ions feel a lower gravity force from the Sun than the comet's nucleus feels.

- 7) How did the lunar *maria* form? 7) _____
- A) The giant impact that created the Moon left smooth areas that we call the *maria*.
 - B) Volatiles escaping from the Moon's interior heated and eroded the surface in the regions of the *maria*.
 - C) The early bombardment created heat that melted the lunar surface in the regions of the *maria*.
 - D) The *maria* are the result of gradual erosion by micrometeorites striking the Moon.
 - E) Large impacts fractured the Moon's lithosphere, allowing lava to fill the impact basins.
- 8) Life on Earth originated from 8) _____
- A) We don't know for sure.
 - B) aliens (panspermia).
 - C) comets.
 - D) the Earth's oceans.
 - E) ALH84001 (the oldest known Martian Meteorite).
- 9) Mars has an atmosphere that is almost entirely carbon dioxide. Why isn't there a strong greenhouse effect keeping the planet warm? 9) _____
- A) Mars does not have enough internal heat to drive the greenhouse effect
 - B) Mars is too far from the sun for the greenhouse effect to work
 - C) the greenhouse effect requires an ozone layer, which Mars does not have
 - D) there *is* a strong greenhouse effect: without it Mars would be much colder than it currently is
 - E) the atmosphere on Mars is too thin to trap a significant amount of heat
- 10) Which of the following is/are NOT caused by orbital resonance? 10) _____
- A) 2:3 periodic ratio of Neptune:Pluto
 - B) Kirkwood Gaps.
 - C) Gaps in Saturn's rings.
 - D) Breaking of small Jovian moons to form ring materials.
 - E) The eccentricity of Io's orbit.
- 11) How do scientists know that the majority of meteorites come from the asteroid belt? 11) _____
- A) Bubbles of gas trapped in the crystals within meteorites are identical to the gases trapped in asteroids.
 - B) The spectra of some meteorites are similar to the spectra of asteroids in the asteroid belt.
 - C) Collisions are common in the asteroid belt, and we can track the fragments from their source asteroid to the Earth, where they become meteorites.
 - D) The asteroid belt is the only possible source of meteorites, therefore they must originate there.
 - E) High levels of Iridium have been detected in both asteroids and meteorites, therefore meteorites come from the asteroid belt.
- 12) 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? 12) _____
- A) Planets orbit around the Sun in nearly circular orbits in a flattened disk.
 - B) the equal number of terrestrial and jovian planets
 - C) the craters on the Moon
 - D) asteroids, Kuiper-belt comets, and the Oort cloud
 - E) the compositional differences between the terrestrial and jovian planets

- 13) Which of the following methods has led to the most discoveries of massive planets orbiting near their parent stars? 13) _____
- A) detecting the gravitational effect of an orbiting planet by looking for the Doppler shifts in the star's spectrum
 - B) detecting the shift of the star's position against the sky due to the planet's gravitational pull
 - C) detecting a planet ejected from a binary star system
 - D) detecting the starlight reflected off the planet
 - E) detecting the infrared light emitted by the planet
- 14) What Mars mission will be landing on May 25, 2008 and will dig a trench into (hopefully) ice-rich soil? 14) _____
- A) ExoMars
 - B) Mars Exploration Rovers
 - C) Mars Science Laboratory
 - D) Astrobiology Field Laboratory
 - E) Phoenix Mars Lander
- 15) How do we think the "hot Jupiters" around other stars were formed? 15) _____
- A) They were formed when their stars flung material out into the system in a process similar to planetary fission.
 - B) They formed as gas giants beyond the frost line and then migrated inwards.
 - C) They formed as dense, rocky planets close to the star in the same orbits that they are seen today.
 - D) They formed as gas giants close to the star in the same orbits that they are seen today.
 - E) Many planets were formed around the star but coalesced into a single planet close in.
- 16) How do astronomers think Jupiter generates its internal heat? 16) _____
- A) through exothermic chemical reactions, converting chemical potential energy into thermal energy
 - B) nuclear fusion
 - C) by contracting, changing gravitational potential energy into thermal energy
 - D) internal friction due to its rapid rotation rate and differential rotation
 - E) radioactive decay
- 17) Which property of our solar system does a formation theory NOT need to explain? 17) _____
- A) patterns of motion
 - B) the presence of asteroids and comets
 - C) the measured ages of meteorites
 - D) the presence of life on Earth
 - E) differences between the terrestrial and jovian planets
- 18) Most rocks on the Moon's surface are older than those on the Earth's surface. The *best* evidence for this is: 18) _____
- A) Lunar rocks are composed of fragments pulverized by many impacts.
 - B) Radioactive dating of lunar samples shows that they are older.
 - C) The Moon's surface is more heavily eroded than the Earth's surface.
 - D) The Moon's surface has more impact craters than the Earth's surface.
 - E) None of the above; most lunar rocks are actually less ancient than rocks from Earth.

- 19) Why doesn't Venus have seasons like Mars and Earth do? 19) _____
A) Its rotation axis is nearly perpendicular to the plane of the Solar System.
B) It does not have an ozone layer.
C) It does not rotate fast enough.
D) It is too close to the Sun.
E) all of the above
- 20) What is true about the rotation of a solid disk? 20) _____
A) The velocity is the same on every point on the disk
B) The part closer to the axis has a longer period
C) The period of rotation is the same on every point on the disk
D) The part closer to the axis has a shorter period
E) None of the above
- 21) Jupiter's orbital distance is roughly 5 AU. How many times brighter would the Sun have to be for Europa to receive the same solar flux that we currently receive on Earth ($1380\text{W}/\text{m}^2$)? 21) _____
A) 100 times brighter
B) 25 times brighter
C) 2 times brighter
D) 50 times brighter
E) 5 times brighter
- 22) Which living organisms most resemble the common ancestor of all life according to genetic testing? 22) _____
A) viruses
B) bacteria such as *E. coli*
C) organisms living deep in the oceans around seafloor volcanic vents and in hot springs
D) plankton that use sunlight as an energy source through photosynthesis
E) stromatolites
- 23) Jupiter and the other jovian planets are sometimes called "gas giants." In what sense is this term misleading? 23) _____
A) The materials they are made of are not normally gaseous in everyday experience.
B) They actually contain a significant fraction of non-gaseous matter.
C) The materials that make up these planets are primarily in the form of a plasma, not a gas.
D) Actually, it's a great description, because these worlds are big and gaseous throughout.
E) They are not in any sense "giants."
- 24) According to the Solar Nebular theory, what are asteroids and comets? 24) _____
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 leftover planetesimals that never accreted into planets.
E) They are the shattered remains of collisions between moons.

- 25) Why are the inner planets made of denser materials than the outer planets? 25) _____
- A) In the beginning, when the protoplanetary disk was spinning faster, centrifugal forces flung the lighter materials toward the outer parts of the solar nebula.
 - B) In the inner part of the nebula only metals and rocks were able to condense because of the high temperatures, whereas hydrogen compounds, although more abundant, were only able to condense in the cooler outer regions.
 - C) Denser materials were heavier and sank to the center of the nebula.
 - D) When the solar nebula formed a disk, materials naturally segregated into bands, and in our particular solar system the denser materials settled nearer the Sun while lighter materials are found in the outer part.
 - E) The Sun's gravity pulled denser materials toward the inner part of the solar nebula, while lighter gases escaped more easily.
- 26) How does the greenhouse effect work? 26) _____
- 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) Greenhouse gases absorb X-rays and ultraviolet light from the Sun, which then heat the atmosphere and the surface.
 - E) The higher pressure of the thick atmosphere at lower altitudes traps heat in more effectively.
- 27) Mars has an atmospheric pressure of 600 pascals. If the acceleration due to gravity on Mars is (roughly) 4 m/s^2 , and the surface area of Mars is about 145,000,000 square km, what is the approximate mass of the martian atmosphere? 27) _____
- A) $2.2 \times 10^{11} \text{ kg}$
 - B) $2.2 \times 10^{14} \text{ kg}$
 - C) $2.2 \times 10^{20} \text{ kg}$
 - D) $2.2 \times 10^{16} \text{ kg}$
 - E) $2.2 \times 10^{17} \text{ kg}$
- 28) What would weigh the most on the moon? 28) _____
- A) A kilogram of feathers
 - B) Five pounds of bricks as measured on Earth
 - C) Five kilograms of feathers
 - D) A kilogram of bricks
 - E) A pound of feathers as measured on Earth

- 29) What dangers are currently faced by each Mars Exploration Rover? 29) _____
- A) Opportunity may not be able to drive out of Victoria Crater due to its broken sixth wheel; Spirit's instruments are being corroded by the acidic hot spring environment it is exploring.
 - B) Opportunity may not be able to move its arm again; Spirit may not be able to drive out of Victoria Crater due to its broken sixth wheel.
 - C) Opportunity may not be able to drive out of Victoria Crater due to its broken sixth wheel; Spirit may not get enough solar power during the winter months immediately ahead.
 - D) Opportunity may not be able to move its arm again; Spirit may not get enough solar power during the winter months immediately ahead.
 - E) Opportunity may not be able to move its arm again; Spirit may not get enough solar power due to the ongoing dust storm.
- 30) What defines the *habitable zone* around a star? 30) _____
- A) the region around a star where liquid water can potentially exist on planetary surfaces
 - B) the region around a star where humans can survive
 - C) the region around a star where the ultraviolet radiation does not destroy organisms on a planetary surface
 - D) the region around a star where life exists
 - E) the region around a star where rocky planets form
- 31) Imagine that the Earth was instantly moved to an orbit three times further away from the Sun. How much longer would a year be? 31) _____
- A) exactly 3 times longer
 - B) about 5.2 times longer
 - C) Not enough information. It will depend on the inclination of the new orbit
 - D) The length of the year wouldn't change because the Earth's mass stays the same.
 - E) about 1.7 times longer
- 32) The terrestrial planet cores contain mostly metal because 32) _____
- A) the entire planets are made mostly of metal.
 - B) radioactivity created metals in the core from the decay of uranium.
 - C) metals condensed first in the solar nebula and the rocks then accreted around them.
 - D) convection carried the metals to the core.
 - E) metals differentiated to the center during a time when the interiors were molten throughout.
- 33) What is *not true* of Jupiter's magnetic field? 33) _____
- A) it is about 20,000 times stronger than Earth's magnetic field
 - B) it traps charged particles from Io's volcanoes in a "plasma torus" around the planet
 - C) it causes spectacular auroral displays at Jupiter's north and south poles
 - D) if you could see it with the naked eye from Earth, it would appear to be the size of the full Moon
 - E) it switches polarity every 11 years
- 34) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 486.1 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 485.9 nm. What can we conclude? 34) _____
- A) The star is getting hotter.
 - B) The star is getting colder.
 - C) The star is moving toward us.
 - D) The star is moving away from us.
 - E) The "star" actually is a planet.

- 35) Which *is not* a similarity between Saturn and Jupiter's atmospheres? 35) _____
- A) a composition dominated by hydrogen and helium
 - B) the presence of belts, zones and storms
 - C) an equatorial wind speed of more than 900 miles per hour
 - D) significant "shear" between bands of circulation at different latitudes
 - E) a layer of ammonia clouds
- 36) How did Eratosthenes estimate the size of the Earth in 240 B.C.? 36) _____
- A) By measuring the maximum altitude of the Sun in two cities at different latitudes at the same time on the same day.
 - B) By measuring the size of Earth's shadow on the Moon during a lunar eclipse.
 - C) By finding a place on Earth where the Sun passes directly overhead.
 - D) By sending fleets of ships around the Earth.
 - E) By observing the duration of a solar eclipse.
- 37) Suppose the angular separation of two stars is smaller than the angular resolution of your eyes. 37) _____
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 two distinct stars.
 - C) The two stars will look like a single point of light.
 - D) The two stars will appear to be touching, looking rather like a small dumbbell.
 - E) You will see only the larger of the two stars, not the smaller one.
- 38) Why is Saturn almost as big as Jupiter, despite its smaller mass? 38) _____
- A) Jupiter's greater mass compresses it more, thus increasing its density.
 - B) Saturn has a larger proportion of hydrogen and helium than Jupiter, and is therefore less dense.
 - C) Jupiter's strong magnetic field constrains its size.
 - D) Saturn is further from the Sun, thus cooler, and therefore less compact.
 - E) Saturn's rings make the planet look bigger.
- 39) Which of the jovian planets have rings? 39) _____
- A) Neptune
 - B) Uranus
 - C) Saturn
 - D) Jupiter
 - E) all of the above

- 40) What is the source of the material that causes meteor showers? 40) _____
- A) Asteroid impacts elsewhere in the solar system throw sand-sized particles into space, and occasionally the Earth passes through a cloud of these particles, which burn up in our atmosphere and cause a meteor shower.
 - B) Near-Earth asteroids gradually disintegrate and spread out along their orbital paths. When the Earth passes through the orbit of an asteroid, we are bombarded by sand-sized particles that cause a meteor shower.
 - C) Near-Earth asteroids disintegrate as they enter Earth's atmosphere, creating hundreds of bright meteors that appear to radiate from a single location in the sky.
 - D) The nuclei of comets gradually disintegrate and spread out along their orbital paths. When the Earth passes through the orbit of a comet, we are bombarded by sand-sized particles that cause a meteor shower.
 - E) The nuclei of comets disintegrate as they enter Earth's atmosphere, creating hundreds of bright meteors that appear to radiate from a central location in the sky.
- 41) Which of the following is *not* true? 41) _____
- A) The Earth and Venus are in a 1:1 orbital resonance (for every 1 Earth orbit, there is exactly 1 Venus orbit)
 - B) Neptune and Pluto are in a 3:2 orbital resonance (for every 3 Neptune orbits, there are exactly 2 Pluto orbits)
 - C) The Kirkwood Gaps in the asteroid belt are due to resonances with Jupiter
 - D) Neptune and Pluto won't collide, because of their orbital resonance
 - E) Ganymede, Europa and Io are in a 1:2:4 orbital resonance (for every 1 Ganymede orbits, there are exactly 2 Europa orbits and exactly 4 Io orbits)
- 42) Why can't we see the Sun's corona except during total solar eclipses? 42) _____
- A) The corona is made up mostly of charged particles which aren't luminous.
 - B) It's much too cool to emit visible light
 - C) We can't see magnetic fields
 - D) It's too diffuse
 - E) Because the corona is created only when the moon passes in front of the sun
- 43) Why does Earth have the strongest magnetic field among the terrestrial worlds? 43) _____
- A) It is by far the largest terrestrial world.
 - B) It is the most volcanically active world.
 - C) It is the only one that has both a partially molten metallic core and reasonably rapid rotation.
 - D) It rotates much faster than any other terrestrial world.
 - E) It is the only one that has a metallic core.
- 44) Why is Europa so interesting in the search for life in the solar system? 44) _____
- A) Plumes of liquid water have been observed coming from cracks in the ice at the south pole
 - B) It may have an ocean of liquid water
 - C) Variations in surface albedo may be due to life forms moving with the seasons
 - D) Organic molecules have been detected on the surface
 - E) It is explicitly mentioned as an abode for life in the Arthur C. Clarke novel 2010: Odyssey Two

- 45) Why are there 366 sidereal days in one earth year? 45) _____
A) It takes longer than one sidereal day for the sun to return to the same place in the sky every day.
B) The Earth is undergoing epicycles and thus the length of day changes.
C) The Earth's spin rate is slowly increasing and this is reflected in the sidereal day.
D) The Earth's spin rate is slowly decreasing.
- 46) Why do jovian planets bulge around the equator, that is, have a "squashed" appearance? 46) _____
A) Their large systems of moons and rings gravitationally attract the mass around the equator more.
B) They are much more massive than the terrestrial planets.
C) Their rapid rotation flings the mass near the equator outward.
D) Their internal heat sources exert a pressure against the sides of the planets.
E) all of the above
- 47) Which of the following *was not* cited as evidence for life in the martian meteorite ALH84001? 47) _____
A) Complex organic molecules, specifically PAHs
B) Magnetite grains similar to those formed by bacteria on Earth
C) Carbonate minerals, indicating a thicker, warmer Martian atmosphere
D) Amino acids with a preferred orientation or "chirality"
E) Segmented "bacteria-like" shapes
- 48) The sky is blue because 48) _____
A) the Sun mainly emits blue light.
B) the atmosphere absorbs mostly blue light.
C) molecules scatter red light more effectively than blue light.
D) molecules scatter blue light more effectively than red light.
E) the atmosphere transmits mostly blue light.
- 49) What is the significance of the 1:2:4 resonance in the Jupiter's moons system? 49) _____
A) The resonance pulls Io in different directions and generates heat.
B) It makes the orbit of Io slightly elliptical.
C) It creates a gap with no asteroids between the orbits.
D) It prevents formation of the ring material into other moons.
E) The resonance creates the tidal force which heats up Io.
- 50) Why did the solar nebula heat up as it collapsed? 50) _____
A) Collisions among planetesimals generated friction and heat.
B) Radiation from other nearby stars that had formed earlier heated the nebula.
C) The shock wave from a nearby supernova heated the gas.
D) As the cloud shrank, its gravitational potential energy was converted to kinetic energy and then into thermal energy.
E) Nuclear fusion occurring in the core of the protosun produced energy that heated the nebula.

- 51) You've made a scientific theory that there is a force between all objects. This force has both a dark and light side. When will your theory be proven correct? 51) _____
- A) When you and many other Jedi have tested the hypothesis
 - B) Jean-Luc Skywalker drops Yoda during the day and he falls to the ground, proving your theory.
 - C) You can never prove your theory to be correct, only "yet to be proven wrong."
 - D) After you've repeated your experiment many times
 - E) When Jean-Luc Skywalker drops Yoda *and* R2-D2, Yoda crashes into the earth and R2-D2 flies into space, thus proving your theory.
- 52) Which of the following most likely explains why Venus does *not* have a strong magnetic field? 52) _____
- A) Its rotation is too slow.
 - B) It has too thick an atmosphere.
 - C) It is too large.
 - D) It does not have a metallic core.
 - E) It is too close to the Sun.
- 53) Some of Mars' water is frozen in the soil and the ice caps, and some was lost due to solar wind stripping, but much of the original water is thought to have been lost through another mechanism. What happened to this "lost" water? 53) _____
- A) it was stripped away by the magnetic field when it rapidly decreased in strength
 - B) it was broken into hydrogen and oxygen by ultraviolet light, and the hydrogen was lost through thermal escape
 - C) it was consumed by a civilization of thirsty Martians
 - D) it was vaporized during a period of intense volcanism and was lost to space through thermal escape
 - E) it reacted with the solar wind to form rust, which is why Mars is red
- 54) Meteorites with high metal content probably are 54) _____
- A) pieces of comets rather than of asteroids.
 - B) chunks of large, differentiated asteroids that were shattered by collisions.
 - C) chunks of rock chipped off the planet Mars.
 - D) leftover chunks of rock from the earliest period in the formation of the solar system.
 - E) chunks of rock chipped off the planet Mercury.
- 55) The Coriolis effect is observed on planets because 55) _____
- A) they are rotating and spherical, so different latitudes rotate at different speeds (meters/second)
 - B) their surfaces rotate at the same speed (meters/second) at all latitudes
 - C) they rotate and have magnetic fields
 - D) the solar wind interacts with their magnetospheres
 - E) they rotate in the same direction as their orbits revolve around the Sun
- 56) What is the second most common element in the solar system? 56) _____
- A) Iron B) Hydrogen C) Methane D) Helium E) Nitrogen

Answer Key

Testname: ASTRO102_FINAL_PRACTICE

- 1) A
- 2) A
- 3) E
- 4) D
- 5) C
- 6) D
- 7) E
- 8) A
- 9) E
- 10) D
- 11) B
- 12) B
- 13) A
- 14) E
- 15) B
- 16) C
- 17) D
- 18) B
- 19) A
- 20) C
- 21) B
- 22) C
- 23) B
- 24) D
- 25) B
- 26) B
- 27) D
- 28) C
- 29) D
- 30) A
- 31) B
- 32) E
- 33) E
- 34) C
- 35) C
- 36) A
- 37) C
- 38) A
- 39) E
- 40) D
- 41) A
- 42) D
- 43) C
- 44) B
- 45) A
- 46) C
- 47) D
- 48) D
- 49) B
- 50) D

Answer Key

Testname: ASTRO102_FINAL_PRACTICE

51) C

52) A

53) B

54) B

55) A

56) D