AST 1002 Fall 2014 Midterm Exam **Version 1**
Name_____

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

1) When considering light as made up of individual "pieces," each characterized by a particular amount of energy, the pieces are called _____. 1) _____
A) gamma rays B) wavicles C) frequencies D) photons

2) Why are there no impact craters on the surface of Io? 2) _____
A) Any craters that existed have been eroded through the strong winds on Io's surface.
B) Jupiter's strong gravity attracted the planetesimals more strongly than Io and thus none landed on its surface.
C) It is too small to have been bombarded by planetesimals in the early solar system.
D) Io's thick atmosphere obscures the view of the craters.
E) Io did have impact craters but they have all been buried in lava flows.

3) 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 3) _____
A) also doubles.
B) weakens by a factor of 2.
C) strengthens by a factor of 4.
D) weakens by a factor of 4.
E) is unaffected.

4) Which of the following statements about scientific theories is *not* true? 4) _____
A) A theory is a model designed to explain a number of observed facts.
B) A theory cannot be taken seriously by scientists if it contradicts other theories developed by scientists over the past several hundred years.
C) If even a single new fact is discovered that contradicts what we expect according to a particular theory, then the theory must be revised or discarded.
D) A theory can never be proved beyond all doubt; we can only hope to collect more and more evidence that might support it.
E) A theory must make predictions that can be checked by observation or experiment.

5) The controversial book of this famous person, published in 1543 (the year of his death), suggested that Earth and other planets orbit the Sun. 5) _____
A) Galileo
B) Copernicus
C) Ptolemy
D) Tycho Brahe
E) Kepler

6) Earth is made mostly of metals and rocks. Where did this material come from? 6) _____
A) It was produced by nuclear fusion in stars.
B) It was produced in the Big Bang.
C) It was made by nuclear fission of uranium and other radioactive materials.
D) It was made by our Sun.
E) It was created by chemical reactions in interstellar space.

7) When a spinning ice skater pulls in his arms, he spins faster because _____. 7) _____
A) there is less friction with the air
B) his angular momentum must be conserved, so reducing his radius must increase his speed of rotation
C) there exists an unbalanced reaction force
D) there is less friction with the ice

8) Which jovian planet does *not* have rings? 8) _____
A) All the jovian planets have rings.
B) Mars
C) Uranus
D) Jupiter
E) Neptune

9) The Earth is instantly replaced in its orbit by a speak of dust. Which statement best describes the subsequent orbital motion of that piece of dust? 9) _____
A) The dust particle will move to a larger orbit and orbit the Sun in more than 1 year.
B) The dust particle will be ejected from the Solar System.
C) The dust particle will spiral into the Sun.
D) The dust particle will continue in the same orbit as the Earth did, orbiting the Sun in 1 year.
E) The dust particle will move to a smaller orbit and orbit the Sun in less than 1 year.

10) What do we mean when we say that the terrestrial worlds underwent *differentiation*? 10) _____
A) The five terrestrial worlds all started similarly but ended up looking quite different.
B) When their interiors were molten, denser materials sank toward their centers and lighter materials rose toward their surfaces.
C) They lost interior heat to outer space.
D) Their surfaces show a variety of different geological features resulting from different geological processes.

11) Which of the following best describes the lunar *maria*? 11) _____
A) frozen oceans of liquid water on the Moon
B) densely cratered regions on the Moon
C) mountainous regions on the Moon
D) relatively smooth, flat cooled lava plains on the Moon

12) Which of the following best describes *convection*? 12) _____
A) It is the process by which rocks sink in water.
B) It is the process in which bubbles of gas move upward through a liquid.
C) It is the process in which warm material expands and rises while cool material contracts and falls.
D) It is the process in which a liquid separates according to density, such as oil and water separating in a jar.
E) It is the process in which warm material gets even warmer and cool material gets even cooler.

13) Suppose you use Polaris to determine that the north celestial pole appears 40 degrees above your horizon. Then you must be located at _____. 13) _____
A) latitude 50 degrees south
B) latitude 40 degrees south
C) latitude 40 degrees north
D) longitude 40 degrees

14) What do we mean by the *frost line* when we discuss the formation of planets in the solar nebula? 14) _____

A) It is the altitude in a planet's atmosphere at which snow can form.
B) It is another way of stating the temperature at which water freezes into ice.
C) It marks the special distance from the Sun at which hydrogen compounds become abundant; closer to the Sun, there are no hydrogen compounds.
D) It is a circle at a particular distance from the Sun, beyond which the temperature was low enough for ices to condense.

15) Which of the following statements does *not* use the term *light–year* in an appropriate way? 15) _____

A) It's about 4 light–years from here to Alpha Centauri.
B) The Milky Way Galaxy is about 100,000 light–years in diameter.
C) A light–year is about 10 trillion kilometers.
D) It will take the Voyager spacecraft about 20,000 years to travel just 1 light–year.
E) It will take me light–years to complete this homework assignment.

16) You are standing on Earth's North pole. Where is the celestial equator in your sky? 16) _____

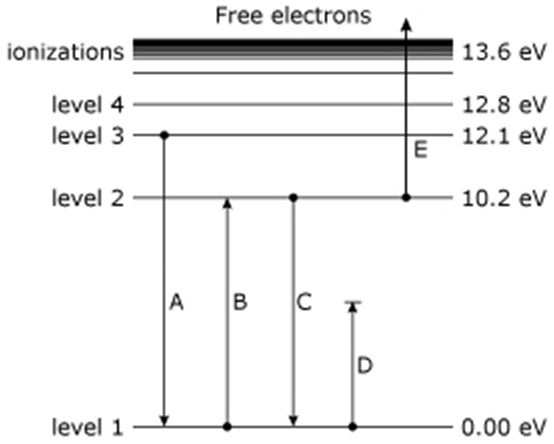
A) The answer depends on whether it's winter or summer.
B) 30 degrees up, due West
C) directly overhead
D) The answer depends on what time of day (or night) it is.
E) on the horizon

17) He developed a system for predicting planetary positions that remained in use for some 1,500 years. 17) _____

A) Copernicus
B) Ptolemy
C) Kepler
D) Galileo
E) Tycho Brahe

18) Overall, Jupiter's composition is most like that of _____. 18) _____

A) Earth B) the Sun C) an asteroid D) a comet



19) The diagram represents energy levels in a hydrogen atom. The labeled transitions (A through E) represent an electron moving between energy levels. Which labeled transition represents an electron that *absorbs* a photon with 10.2 eV of energy? 19) _____

A) A B) B C) C D) D E) E

20) The terrestrial planets in our solar system are _____. 20) _____

A) Mercury, Venus, Earth, and Mars
B) Mars, Jupiter, Saturn, Uranus, and Neptune
C) Jupiter, Saturn, Uranus, and Neptune
D) Pluto and Eris

21) What do astronomers mean by a *constellation*? 21) _____

A) A constellation is a group of stars related through an ancient story.
B) A constellation is a group of stars that are all located in about the same place in space.
C) A constellation is any random grouping of stars in the sky.
D) A constellation is a region in the sky as seen from Earth.

22) How are wavelength, frequency, and energy related for photons of light? 22) _____

A) Longer wavelength means lower frequency and lower energy.
B) Longer wavelength means lower frequency and higher energy.
C) Longer wavelength means higher frequency and lower energy.
D) Longer wavelength means higher frequency and higher energy.
E) There is no simple relationship because different photons travel at different speeds.

23) In essence, the *nebular theory* holds that _____. 23) _____

A) the planets each formed from the collapse of its own separate nebula
B) nebulae are clouds of gas and dust in space
C) The nebular theory is a discarded idea that imagined planets forming as a result of a near–collision between our Sun and another star.
D) our solar system formed from the collapse of an interstellar cloud of gas and dust

24) Suppose we imagine the Sun to be about the size of a grapefruit. How big an area would the orbits of the nine planets of the Solar System cover? 24) _____

A) the size of a typical campus building
B) the size of a small city
C) the size of a typical campus
D) the size of a typical dorm room
E) the size of a western state (*e.g.*,Colorado)

25) We can't detect stellar parallax with naked–eye observations. Which of the following would make parallax easier to observe? 25) _____

A) getting away from streetlights
B) increasing the size of Earth's orbit
C) speeding up Earth's orbital motion
D) Speeding up the precession of Earth's axis
E) slowing down Earth's orbital motion

26) The point directly over your head is called _____. 26) _____

A) the north celestial pole
B) the zenith
C) the meridian
D) the North Star

27) Suppose you view the solar system from high above Earth's North Pole. Which of the following statements about planetary orbits will be true? 27) _____

A) The inner planets orbit the Sun clockwise while the outer planets orbit the Sun counterclockwise.
B) All the planets orbit counterclockwise around the Sun.
C) All the planets except Uranus orbit the Sun counterclockwise; Uranus orbits in the opposite direction.
D) The inner planets orbit the Sun counterclockwise while the outer planets orbit the Sun clockwise.

28) Suppose that two objects collide. Which of the following things is *not* the same both before and after the collision? 28) _____

A) The total angular momentum of the objects
B) The total energy of the objects
C) The total momentum of the objects
D) The total temperature of the objects

29) Which internal energy source produces heat by converting gravitational potential energy into thermal energy? 29) _____

A) accretion
B) differentiation
C) radioactivity
D) both A and B
E) all of the above

30) When we look at an object that is 1,000 light–years away, we see it _____. 30) _____

A) as it was 1,000 years ago
B) as it was 1,000 light–years ago
C) looking just the same as our ancestors would have seen it 1,000 years ago
D) as it is right now, but it appears 1,000 times dimmer

31) Suppose we represent Earth with a basketball. On this scale, most of the air in Earth's atmosphere would fit in a layer that is _____. 31) _____

A) about a half–inch thick
B) about the thickness of a sheet of paper
C) about 6 inches thick
D) about an inch thick

32) *Thermal radiation* is defined as _____. 32) _____

A) radiation produced by an extremely hot object
B) radiation with a spectrum whose shape depends only on the temperature of the emitting object
C) radiation that is felt as heat radiation in the form of emission lines from an object

33) Stars that are visible in the local sky on any clear night of the year, at any time of the night, are called _____. 33) _____

A) circumpolar B) seasonal C) celestial D) bright

34) We can see each other in the classroom right now because we 34) _____

A) reflect visible light.
B) emit infrared light.
C) emit visible light.
D) reflect infrared light.
E) emit thermal radiation.

35) Which of the following is the most basic definition of a *greenhouse gas*? 35) _____

A) a gas that makes a planet much hotter than it would be otherwise, even in small amounts
B) a gas that absorbs infrared light
C) a gas that reflects a lot of sunlight
D) a gas that keeps warms air from rising, and therefore warms the surface

36) Kepler's second law, which states that as a planet moves around its orbit it sweeps out equal areas in equal times, means that 36) _____

A) planets that are farther from the Sun move at slower average speeds than nearer planets.
B) the period of a planet does not depend on its mass.
C) a planet's period does not depend on the eccentricity of its orbit.
D) planets have circular orbits.
E) a planet travels faster when it is nearer to the Sun and slower when it is farther from the Sun.

37) 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? 37) _____

A) The star is moving toward us.
B) The star is getting hotter.
C) The "star" actually is a planet.
D) The star is moving away from us.
E) The star is getting colder.

38) The terrestrial planets are made almost entirely of elements heavier than hydrogen and helium. According to modern science, where did these elements come from? 38) _____

A) They have been present in the universe since its birth.
B) They were made by chemical reactions in interstellar gas.
C) They were produced by stars that lived and died before our solar system was born.
D) They were produced by gravity in the solar nebula as it collapsed.

39) Which of the following best describes why we have seasons on Earth? 39) _____

A) The tilt of Earth's axis causes the northern hemisphere to be closer to the Sun than the southern hemisphere in summer, and visa versa in winter.
B) Earth's elliptical orbit means we are closer to the Sun and therefore receive more intense sunlight at some times of year than at others.
C) The tilt of Earth's axis causes different portions of the Earth to receive more or less direct sunlight at different times of year.
D) The varying speed of Earth in its orbit around the Sun gives us summer when we are moving fastest and winter when we are moving slowest.

40) If your mass is 60 kg on Earth, what would your mass be on the Moon? 40) _____

A) 50 kg B) 10 lb C) 60 lb D) 10 kg E) 60 kg

41) What do we mean by *accretion* in the context of planet formation? 41) _____

A) the growth of planetesimals from smaller solid particles that collided and stuck together
B) the growth of the Sun as the density of gas increased in the center of the solar nebula
C) the formation of moons around planets
D) the solidification of ices, rocks, and metal from the gas of the solar nebular

42) The energy attributed to an object by virtue of its motion is known as _____. 42) _____

A) mass–energy B) potential energy
C) kinetic energy D) radiative energy

43) An astronomical unit (AU) is _____. 43) _____

A) the *average* distance between Earth and the Sun
B) the average distance between any planet and the Sun
C) the *current* distance between Earth and the Sun
D) any very large unit, such as a light–year

44) What is the *ecliptic*? 44) _____

A) The path traced by the Moon's shadow on Earth during a solar eclipse
B) The Sun's daily path from east to west in our sky
C) A half–circle extending from your horizon due north, through your zenith, to your horizon due south
D) The path the Sun appears to trace around the celestial sphere each year

45) Why are Saturn's rings so thin? 45) _____

A) The "gap" moons shepherd the particles and maintain its thin profile.
B) Solar radiation pressure keeps particles pressed into the rings.
C) Any particle in the ring with an orbital tilt would collide with other ring particles, flattening its orbit.
D) The current thinness is a short–lived phenomenon that is special to this time.
E) Saturn's gravity prevents particles from migrating upwards out of the rings.

46) What causes the apparent retrograde motion of the planets? 46) _____

A) 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.
B) Apparent retrograde motion is an illusion created by turbulence in Earth's atmosphere.
C) 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 really change.
D) As Earth passes another planet, its gravitational pull slows down the other planet so that it appears to be traveling backward.
E) The other planets never really appear to move backward; the background stars shift due to Earth's revolution around the Sun.

47) The planet in our solar system with the highest average surface temperature is _____. 47) _____

A) Venus B) Mercury C) Neptune D) Earth

48) If the Moon is setting at 6 A.M., the phase of the Moon must be 48) _____

A) new.
B) full.
C) third quarter.
D) first quarter.
E) waning crescent.

49) What does *temperature* measure? 49) _____

A) The total potential energy of particles in a substance
B) The average mass of particles in a substance
C) The total amount of heat in a substance
D) The average kinetic energy of particles in a substance

50) Why is Jupiter denser than Saturn? 50) _____

A) Scientists do not know why this is so.
B) The extra mass of Jupiter compresses its interior to a greater extent than that of Saturn.
C) It is made of a different composition than Saturn, including a higher proportion of hydrogen compounds and rocks.
D) Its core is much larger than Saturn's.
E) It has a greater proportion of helium to hydrogen compared to Saturn.

51) According to our theory of solar system formation, what three major changes occurred in the solar nebula as it shrank in size? 51) _____

A) Its gas clumped up to form the terrestrial planets, nuclear fusion produced heavy elements to make the jovian planets, and central temperatures rose to more than a trillion Kelvin.
B) It gained energy, it gained angular momentum, and it flattened into a disk.
C) Its mass, temperature, and density all increased.
D) It got hotter, its rate of rotation increased, and it flattened into a disk.

52) Suppose you look at a spectrum of visible light by looking through a prism or diffraction grating. How can you decide whether it is an emission line spectrum or an absorption line spectrum? 52) _____

A) An emission line spectrum consists of bright lines on a dark background, while an absorption line spectrum consists of dark lines on a rainbow background.
B) The only way to decide is to make a graph of the intensity of the light at every wavelength, and then analyze the graph carefully.
C) The emission line spectrum is produced by electrons jumping up in energy level, while the absorption line spectrum is produced by electrons jumping down in energy level.
D) An emission line spectrum consists of a long bright line, while an absorption line spectrum consists of a long dark line.

53) Which moon is considered likely to have a deep, subsurface ocean of liquid water? 53) _____

A) Triton B) Europa C) Miranda D) Io

54) He discovered that the orbits of planets are ellipses. 54) _____

A) Copernicus
B) Kepler
C) Tycho Brahe
D) Ptolemy
E) Galileo

55) 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? 55) _____

A) Ice has a lower melting point than rock.
B) Ice is less rigid than rock.
C) Ice is affected by tidal forces to a greater extent than rock.
D) Ice is less dense than rock.
E) Ice contains more radioactive elements than rock.

56) Why does Jupiter have several distinct cloud layers? 56) _____

A) Winds prevent clouds from forming at some altitudes, so we see clouds only at the other altitudes.
B) Different layers represent the various regions where the temperature is cool enough for liquid water to condense.
C) Different layers represent clouds made of gases that condense at different temperatures.
D) Different gases are present at different altitudes in Jupiter's atmosphere.
E) Clouds form randomly, so on average there are always several layers.

57) Which of the following best describes the composition of the particles forming Saturn's rings? 57) _____

A) Volcanic rock
B) Metallic grains
C) Water ice
D) Methane ice
E) Hydrogen and helium

58) Kepler's third law, $p^2 = a^3$, means that 58) _____

A) a planet's period does not depend on the eccentricity of its orbit.
B) all orbits with the same semimajor axis have the same period.
C) planets that are farther from the Sun move at slower average speeds than nearer planets.
D) the period of a planet does not depend on its mass.
E) All of the above are correct.

59) Which of the following statements best describes the two principle advantages of telescopes over eyes? 59) _____

A) Telescopes collect more light and are unaffected by twinkling.
B) Telescopes can collect far more light with far greater magnification.
C) Telescopes have much more magnification and better angular resolution.
D) Telescopes can collect far more light with far better angular resolution.

60) Recent evidence suggests that Mars once had a global magnetic field. Assuming this is true, which of the following could explain why Mars today lacks a global magnetic field like that of Earth? 60) _____

A) The Martian core is made of rock, while Earth's core is made of metal.
B) Mars's interior has cooled so much its molten core layer no longer undergoes convection.
C) Mars rotates much slower than the Earth.
D) Mars is too far from the Sun to have a global magnetic field.

61) According to the laws of thermal radiation, hotter objects emit photons with _____. 61) _____

A) a higher average speed
B) a lower average energy
C) a shorter average wavelength
D) a lower average frequency