

**ASTRONOMY 101, SECTION 004**  
**Spring, 2018**  
**First Hour Examination**

Print Your Name: \_\_\_\_\_ SID \_\_\_\_\_

Please legibly write your name and student ID on this answer sheet and print your name on your test.

Now you are ready to begin the test. For each question, select the one *best* answer and write it on your answer sheet. Ensure that the number of your answer corresponds to the number of the question.

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Feel free to mark your test, including eliminating answers, doing calculations or estimates, and especially making drawings. You must hand in your test and answer sheet before leaving the test site.

Mark the best answer A - D. Please don't hesitate to ask questions when they arise. You are on your honor as a lady or gentleman not to cheat on this test.

Numbers you should know but perhaps forgot:

Milli = $10^{-3}$	Kilo = $10^3$	There are 365 days in a year.
Micro = $10^{-6}$	Mega = $10^6$	There are 24 hours in a day.
Nano = $10^{-9}$	Giga = $10^9$	There are 360 degrees in a full circle.

The speed of light is  $3 \times 10^8$  meters/sec (Actually 299,792,458 m/s)

- Galileo's observations of the entire phase cycle of Venus proved what about Ptolemy's geocentric model?
  - That the Earth could not be the center of our solar system.
  - Orbits are actually elliptical not circular.
  - Planets rotated the wrong way in Ptolemy's model.
  - It could not be correct because they did not create stable orbits.
- There is a solar eclipse of some kind every
  - new moon.
  - few years.
  - 100 years.
  - 1000 years.
- An emission line results from
  - electrons falling from a higher to lower energy orbit around its atomic nucleus.
  - light particles (photons) colliding.
  - random thermal motion of electrons.
  - protons decaying to neutrons.
- The light-gathering ability of a telescope is most dependent on
  - how hard you squint.
  - the elevation of the observatory.
  - the concentration of water vapor in the atmosphere.
  - the diameter of its primary objective lens.

5. When observed from the ground, stars twinkle due to instabilities in the atmosphere. Planets on the other hand do not appear to twinkle when observed from the ground. Why is this?
- A) Planets appear much brighter in our night's sky.
  - B) They do twinkle, it just is a much weaker effect.
  - C) Planets are not point like objects in our sky because they are much closer than any star.
  - D) All of the above.
6. The reason for seasons on Earth is that
- A) the Earth's rotational axis is tilted ( $23.5^\circ$ ) relative to its orbital plane about the sun.
  - B) the Earth gets closer to Sun during the Summer and farther away during the winter.
  - C) the Earth is rotating like a top (precession).
  - D) Global Warming is not understood. (*it actually is VERY well understood*)
7. Newton's theory of gravity states that objects orbit each other such that
- A) the heavier object does not move and the lighter one orbits it.
  - B) both object's elliptical orbits share a common focus called the center of mass.
  - C) no circular orbits are possible.
  - D) they will collide after enough time has passed.
8. How are exoplanets discovered using the Doppler shift?
- A) The exoplanet and its parent star both orbit around a center of mass.
  - B) The star "wobbles" around the center of mass, the mass of the exoplanet increases the amount of "wobble".
  - C) This "wobble" causes the star's spectrum to be blue shifted when "wobbling" towards us and red shifted when "wobbling" away from us.
  - D) All of the above.
9. Unlike older measures of distance such as the foot, the meter
- A) was not based on a human action or body part.
  - B) is base-10 and easily converted to other larger or smaller units of length.
  - C) is now defined as the length of the path travelled by light in a vacuum in  $1/299,792,458$  second.
  - D) All of the above.
10. According to Newton's laws, an object traveling in a circle
- A) does not have a force acting on it.
  - B) has a force pushing it along the edge (circumference) of the circle.
  - C) has a force pulling it along the edge (circumference) of the circle.
  - D) has a force pulling it towards the center of the circle.
11. As a star's temperature increases,
- A) the wavelength of peak emission also decreases (gets more blue).
  - B) the total energy it radiates increases like  $T^4$  (temperature to the fourth power).
  - C) the total luminosity (brightness) increases.
  - D) All of the above.

12. Which of the following is **not** a scientific argument for why the Earth is round?
- A) Ships leaving port slip over the horizon.
  - B) The North star changes positions as you change your latitude.
  - C) Not all stars are visible in the sky.
  - D) Spheres are a perfect form, the gods created Earth to be perfect, therefore Earth should be a sphere.
13. How do we know that Earth is rotating like a top (precession) on a 26,000 year cycle?
- A) This rotation can be felt on Earth.
  - B) The north star, Polaris, is slowly moving away from being a pole star.
  - C) Because Earth is tilted at  $23.5^\circ$  relative to the ecliptic.
  - D) Retrograde orbits are explained by Earth's precession.
14. Why was Ptolemy's geocentric model of the Solar System used for ~1000 years prior to Copernicus's heliocentric model?
- A) It was created from hundreds of years of accurate data.
  - B) It was able to predict where the planets should be in the sky.
  - C) It was able to explain retrograde orbits, while previous models could not.
  - D) All of the above.
15. Within the Arctic Circle during the Summer Solstice in the Northern Hemisphere, how long does the Sun stay in the sky?
- A) 24 hours.
  - B) 12 hours.
  - C) 8 hours.
  - D) 0 hours.
16. At the North Pole, seasons are very strange. The Sun sets once per year. When does it set?
- A) The Summer Solstice.
  - B) The Winter Solstice.
  - C) The Autumn Equinox (halfway between the summer and winter solstice).
  - D) During a lunar eclipse.
17. Astronomers analyze starlight to determine a star's
- A) temperature.
  - B) composition.
  - C) motion relative to Earth.
  - D) All of the above.
18. Radio telescopes have worse resolution than optical telescopes because
- A) they have smaller apertures.
  - B) radio waves have much longer wavelengths.
  - C) the atmosphere interferes much more with radio waves.
  - D) of human radio interference.

19. How is temperature defined?
- A) How hot or cold something is compared to water.
  - B) The average speed of molecules in an object (solid, liquid, gaseous, or otherwise).
  - C) When water comes to a boil.
  - D) It is defined with respect to the speed of light, just like the meter.
20. In the law of gravity,  $F = G \frac{M_1 m_2}{r^2}$ ,  $G$  is
- A) the gravitational force specific to Earth.
  - B) a constant related to the strength of the gravitational force.
  - C) the gravitational force specific to the Solar System.
  - D) a value that differs depending on the objects that are nearby.
21. Star A and B can be considered blackbodies. The peak wavelength of star A is longer (more red) than that of star B. What conclusions can be drawn from this?
- A) A is cooler than B.
  - B) The blackbody curves of the two are identical, since both are stars.
  - C) Star B must be closer to the observer.
  - D) Emission lines seen in the spectrum of star A will be greater intensity (brighter) than those seen in B.
22. The most energetic photons (light particles) are
- A) radio.
  - B) gamma rays
  - C) ultraviolet.
  - D) visible
23. According to Copernicus, the retrograde motion for Mars must occur
- A) when Mars laps the Earth and passes between us and the Sun.
  - B) when Mars lies on the far side of the Sun.
  - C) when Mars lies exactly  $90^\circ$  East or West of the Sun.
  - D) when the Earth overtakes Mars and passes between Mars and the Sun.
24. Kepler's first law worked where Copernicus' original heliocentric model failed because Kepler described the orbits as
- A) much larger than Copernicus had envisioned.
  - B) around the Sun, not the Earth.
  - C) elliptical, not circular.
  - D) being on equants instead of epicycles.
25. During a solar eclipse, the
- Hint: sketch an Earth, Moon, Sun diagram*
- A) Moon comes between the Earth and the Sun.
  - B) Sun comes between the Earth and the Moon.
  - C) Sun goes below the horizon.
  - D) Earth comes between the Sun and the Moon.

26. What problem do refractor telescopes have that reflectors don't?
- A) refracting lenses are hard to support and significantly warp under their own weight.
  - B) chromatic aberration (focusing different colors at different points)
  - C) light loss from refracting lenses.
  - D) All of the above.
27. The common element with bright red, blue-green, and violet emission lines is
- A) helium.
  - B) carbon.
  - C) nitrogen.
  - D) hydrogen.
28. A solar eclipse can only happen during a
- A) new moon.
  - B) solstice.
  - C) first quarter moon.
  - D) full moon.
29. Warmer summertime temperatures in the Northern Hemisphere are partly due to
- A) longer days.
  - B) a lower angle in the sky of the Sun's rays.
  - C) Earth being closer to the Sun in the summer.
  - D) the Sun radiating more energy in summer.
30. You observe the full Moon just rising in the east. What time of day is it?
- A) sunrise (6:00 A.M.)
  - B) noon (12:00 P.M.)
  - C) sunset (6:00 P.M.)
  - D) midnight (12:00 A.M.)
31. Which of the following statements correctly states the significance of Galileo's observation that Jupiter has satellites (moons)?
- A) It was interesting but had no particular significance.
  - B) It showed that bodies can orbit an object other than Earth.
  - C) It showed that Jupiter must be four times the size of Earth (since Jupiter has four moons and Earth has one).
  - D) It showed that Jupiter must orbit around the Sun, not around Earth.
32. The Sun's blackbody curve peaks in the \_\_\_\_\_ portion of the spectrum.
- A) radio
  - B) infrared (IR)
  - C) visible
  - D) ultraviolet (UV)

33. Which of the following is *not* a characteristic of a wave
- A) density.
  - B) wavelength.
  - C) frequency
  - D) amplitude.
34. The force of gravity varies with the
- A) product of the two masses.
  - B) the volume of the two masses.
  - C) inverse square of the distance separating the two bodies.
  - D) Both A and C are correct.
35. A frequency of one hundred \_\_\_\_\_ means the wave is vibrating one hundred ( $10^2$ ) million ( $10^6$ ) times per second or  $10^8$  times per second; this is a typical carrier frequency for FM (frequency modulation) radio.
- A) millihertz
  - B) hertz
  - C) kilohertz
  - D) megahertz
36. A solar day is **longer** than a sidereal day because
- A) the motion of distant stars is not accounted for.
  - B) Earth is rotating and orbiting the Sun.
  - C) of the precession of Earth on its axis.
  - D) Earth is slowing down as it orbits the Sun.
37. You note that a particular star is directly overhead. It will be directly overhead again in  
*Hint: (sidereal versus solar day)*
- A) 12 hours.
  - B) 23 hours 56 minutes.
  - C) 24 hours.
  - D) 24 hours 4 minutes.
38. The time for the Moon to orbit Earth, relative to the **stars** (sidereal) is
- A) 23 hours, 56 minutes.
  - B) about 7 days.
  - C) 27.3 days.
  - D) 29.5 days.
39. The time for the Moon to orbit Earth, relative to the **Sun** (solar) is
- A) 23 hours, 56 minutes.
  - B) about 7 days.
  - C) 27.3 days.
  - D) 29.5 days.



40. In a hydrogen atom, a transition from the 2nd to the 1st excited state will produce
- A) the bright red Balmer alpha emission line.
  - B) no emission line.
  - C) a dark absorption line.
  - D) an ultra-high energy spectral line.
41. Molecules are a combination of two or more atoms and can be very structurally complex. In general, the spectral lines of molecules are
- A) more complex than those of atoms.
  - B) the same as the atoms they contain.
  - C) only absorption lines.
  - D) less complex than those of atoms.
42. What is the light-gathering power of an 8-inch telescope compared to a 4-inch telescope?
- A) 10 times better
  - B) 7 times better
  - C) 4 times better
  - D) 3 times better
43. What will occur when the **full** moon is on the ecliptic?
- A) a total lunar eclipse
  - B) a total solar eclipse
  - C) a partial solar eclipse
  - D) an annular lunar eclipse
44. The phenomenon of parallax is the
- A) change in the position of an object in the sky as a consequence of its motion.
  - B) change in apparent position of an object (like a star) as the observer moves.
  - C) apparent change in brightness of an object as it moves directly away from an observer.
  - D) change in direction of motion of a planet from retrograde to direct motion.
45. The star Wolf 1061 has a parallax of 2.34 arc seconds, while the star Ross 652 has a parallax of 1.70 arc seconds. What can you correctly conclude?
- Hint: draw a triangle for both stars.*
- A) Wolf 1061 must have a larger mass than Ross 652.
  - B) Ross 652 must have a larger mass than Wolf 1061.
  - C) Ross 652 is closer to Earth than Wolf 1061.
  - D) Wolf 1061 is closer to Earth than Ross 652.
46. If one star has a parallax ten times larger than another's, the first star is \_\_\_\_\_ than the second.
- A) seven times closer
  - B) ten times closer
  - C) four times further
  - D) ten times further

47. The Sun's observed spectrum is
- A) a continuum with no lines, as shown by the rainbow.
  - B) a continuum with emission lines.
  - C) only absorption lines on a black background.
  - D) a continuum with absorption lines.
48. The interval from new Moon to first quarter is about a(n)
- A) hour.
  - B) day.
  - C) week.
  - D) month.
49. What color does the human eye perceive infrared radiation as?
- A) Red.
  - B) Purple.
  - C) Yellow.
  - D) The human eye cannot see infrared radiation, thus it does not have a perceived color.
50. Why do we see different phases of the Moon?
- A) The motion of the Moon in its orbit around the Earth causes us to see different amounts of the Earth's shadow falling on the Moon.
  - B) The motion of the Moon in its orbit around the Earth causes us to see different amounts of the sunlit side of the Moon.
  - C) The distance of the Moon from the Earth changes because of the elliptical orbit of the Moon, causing the sunlit side of the Moon to move relative to the Earth.
  - D) The rotation of the Moon around its own axis causes us to see different amounts of the sunlit side of the Moon.
51. Violet light differs from red light in that violet light
- A) has a longer wavelength than red light.
  - B) travels more slowly (through a vacuum) than red light.
  - C) travels more quickly (through a vacuum) than red light.
  - D) has a shorter wavelength than red light.
52. A light-year is a measure of
- A) arc length along an orbit.
  - B) expansion rate of the universe.
  - C) time.
  - D) distance.
53. Electromagnetic radiation
- A) can only travel in a dense medium, like sound waves.
  - B) has only the properties of waves.
  - C) can behave both as a wave and as a particle (photon).
  - D) is the same as a sound wave.

54. When we watch the nighttime sky, we find that
- A) the stars and constellations remain fixed in our sky, not rising or setting.
  - B) stars and constellations slowly rise in the west, pass overhead, and set in the east.
  - C) all stars and constellations reach their highest point in the sky at midnight.
  - D) stars and constellations slowly rise in the east, pass overhead, and set in the west.
55. A circular orbit would have an eccentricity of
- A) 0.
  - B) between 0 and 0.5.
  - C) between 0.5 and 1.
  - D) exactly 1.0.
56. How much stronger is the gravitational pull of the Sun on an object at 1 AU (Earth's orbit) compared to an object at 10 AU (Saturn's orbit)?
- A) 5
  - B) 10
  - C) 25
  - D) 100
57. If your **mass** is 100 kilograms on Earth, then what is your **weight** on a planet where the surface gravity is half the strength of earth's surface gravity?
- Hint: the acceleration on earth is about  $10 \text{ m/s}^2$ .  $\text{Weight} = \text{mass} \times \text{acceleration}$*
- A) 50 kilograms.
  - B) 100 newtons
  - C) 500 newtons
  - D) 100 kilograms
58. The mean distance between the Earth and Sun is called
- A) the astronomical unit (AU).
  - B) the parsec(pc).
  - C) the megameter (mm).
  - D) the light-year (ly).
59. Why is the sky blue?
- A) Sun light is reflected off the blue ocean.
  - B) The atmosphere scatters blue light more than red light.
  - C) Sun light is blue.
  - D) Green plants emit blue molecules during photosynthesis.
60. What are constellations?
- A) groups of galaxies gravitationally bound and close together in the sky
  - B) groups of stars making an apparent pattern in the celestial sphere
  - C) groups of stars gravitationally bound and appearing close together in the sky
  - D) ancient story boards, useless to modern astronomers

61. Electromagnetic radiation is created in which of the following ways?
- A) Rapidly oscillating electrical charged particles.
  - B) Electron orbital transitions inside a nucleus.
  - C) A molecule slowing down its rotation.
  - D) All of the above.
62. What do the Earth constellations look like from the surface of Europa, one of Jupiter's moons?
- A) The constellations will look the same because solar distances are much smaller than the distance to the nearest star in any constellation.
  - B) Because Europa is farther away from the Sun, Earth constellations will be drastically different.
  - C) Because Europa is a moon, the constellations will be drastically different.
  - D) Europa does not have an atmosphere, thus we would not be able to see constellations.
63. Which of the following objects cannot transit (pass in front of) the Sun when viewed from Earth?
- A) Mars
  - B) Venus
  - C) the Moon
  - D) Mercury
64. Choose the correct sequence of electromagnetic radiations, in order of increasing wavelengths.
- A) radio, IR, visible, UV
  - B) UV, visible, radio, IR
  - C) UV, visible, IR, radio
  - D) visible, UV, IR, radio
65. The chemical makeup of a star's surface is obtained by
- A) measuring the chemical elements present in the stellar wind.
  - B) theoretical methods, considering the evolution of the star.
  - C) taking a sample of the surface with a space probe.
  - D) spectroscopy of the light emitted by the star, which contains absorption lines.
66. Kepler's third law allows us to find
- A) the average distance to a planet from observing its orbital period.
  - B) the gravitational force between two objects.
  - C) the mass of the heavier object as a function of its rotation on its axis.
  - D) the eccentricity of highly elliptical orbits.
67. If a **new** Moon is on the ecliptic, we will get a  
*Hint: see question 42*
- A) solar eclipse.
  - B) no eclipse.
  - C) blue moon.
  - D) total lunar solar eclipse.

68. The reason we cannot see a New Moon at night is
- A) the Sun is not illuminating the Moon, thus it appears dark.
  - B) the Moon is between the Earth and Sun, so it is on the dayside of the planet.
  - C) the Moon is too far away.
  - D) the Moon is made of cheese.
69. The distance it takes for a wave to repeat itself is the
- A) Frequency (Hertz)
  - B) Period (seconds)
  - C) Wave velocity (meters/second)
  - D) Wavelength (meters)
70. A FM radio station broadcasts at a frequency of 100 MHz (megahertz). The wavelength of its carrier wave is
- Hint:  $Wavelength = \frac{Speed\ of\ light}{Frequency}$*
- A) 3 nanometers.
  - B) 3 micrometers.
  - C) 3 millimeters.
  - D) 3 meters
71. A person orbiting Earth in the International Space Station (ISS) feels weightless because
- A) only one significant force (Earth's gravity) acts on her, but the same gravitational acceleration operates on the ISS so that the ISS does not push up on her to create the feeling of weight within it.
  - B) two forces are acting on her in opposite directions, so they cancel and produce the same effect as if no force at all were acting.
  - C) her mass is zero in space, and weight requires mass.
  - D) no forces act on her.
72. The dark absorption lines in the solar spectrum are caused by absorption
- A) of sunlight in a layer of pure hydrogen gas overlying the solar surface.
  - B) of sunlight in a cooler layer of gas overlying the hot solar surface.
  - C) entirely by atoms and molecules in Earth's cool atmosphere.
  - D) of sunlight in a hotter layer of gas overlying the cooler solar surface.
73. If CCDs (charge coupled devices) only record the intensity of the light (i.e. black and white), how do astronomers create colored images?
- A) The color we see in astronomical images is always an artist's rendition.
  - B) Different wavelength filters are used and the color image is a combination of these filtered images.
  - C) Theoretical models are used to predict the color.
  - D) Color is recorded with the human eye.

74. The biggest telescopes on Earth are:
- A) Radio telescopes
  - B) X-ray telescopes
  - C) Optical telescopes
  - D) Gamma-ray telescopes
75. Why does the Earth not fall into the Sun?
- A) The force of gravity decreases in strength by an inverse square law, thus the gravitational force from the Sun is very weak at a distance of 1 AU.
  - B) The gravity of the outer planets, especially Jupiter, help to counteract the force of the sun.
  - C) The Earth is falling into the sun! It is just taking a very long time.
  - D) The Earth is moving fast enough along its orbital path such that it can maintain its trajectory.
76. Compared to ultraviolet radiation, infrared radiation (IR) has **greater**
- A) Energy
  - B) Amplitude
  - C) Frequency
  - D) Wavelength
77. If a star is moving rapidly towards Earth, then its spectrum will be
- A) The same as if it were at rest
  - B) blue shifted.
  - C) red shifted.
  - D) much brighter than if it were at rest
78. An asteroid orbiting the Sun at a distance in between Earth and Mars will be moving:
- A) Faster than Mars but slower than the Earth
  - B) Faster than the Earth but slower than Mars
  - C) Faster or Slower than Earth depending on its mass
  - D) At the same speed as the asteroid belt
79. Suppose Newton weighs 120 lbs on his bathroom scale on Earth, how much will his scale read if he is standing on a platform 3976 miles high (doubling the distance from the Earth's surface)?
- A) 12 lbs
  - B) 30 lbs
  - C) 80 lbs
  - D) 120 lbs
80. If Earth rotated twice as fast as it currently does, but its motion around the sun stayed the same, then which of the following is true:
- A) the night would be twice as long
  - B) the year would be half as long
  - C) the night would be half as long
  - D) the year would be twice as long

81. What happens at 0 Kelvin?
- A) All molecular motion stops.
  - B) Water freezes.
  - C) Infinite pressure is created.
  - D) Everything freezes to a solid.
82. The speed of light, usually denoted by 'c,' is constant. The value of this constant velocity is very nearly  $3 \times 10^8$  km/s. This means that the speed of light derived from a galaxy moving away from us at 1000 km/s will be slower by:
- A) 0%
  - B)  $(10^3 \text{ km/s}) / (3 \times 10^8 \text{ km/s}) * 100 = 3.33\%$
  - C) 10%
  - D) 52.5%
83. What is an advantage to putting telescopes in space?
- A) Earth's atmosphere does not interfere.
  - B) It's cheaper to put a telescope in orbit.
  - C) It's easier to perform maintenance.
  - D) You don't have to pay graduate students to help operate them.
84. What is true of radio telescopes?
- A) They have poorer angular resolution than an optical reflector of the same size.
  - B) They have better angular resolution than an optical reflector.
  - C) They are the smallest, most compact telescopes.
  - D) They can only be used above the atmosphere.
85. According to Newton's laws, a force must be acting whenever
- A) an object is moving with some speed.
  - B) an object's position changes.
  - C) time passes.
  - D) the direction of an object's motion changes.