Astronomy 101 12 December, 2016
Introduction to Astronomy: The Solar System

Final exam

Practice questions for Unit V

Name (written legibly): ______________________________________

Honor Pledge: ***On my honor, I have neither given nor received unauthorized aid on this examination.***

Signature: ___________________________________ Student PID: ______________________

Instructions:

On the scannable answer sheet:
- Fill in your name (last name, then first name) and ID number and sign in the blank above.
- Identify the form number in the *last column* of the sequence number block.
- Answer all 40 questions using a number 2 pencil.

In addition:
- Do not open your exam until instructed to do so.
- Be sure to also answer each question in the blanks provided on this exam form.
- The exam ends at 3:00.
- When done, raise your hand and we will collect both this form and your answer sheet..

And of course:
- You may not use any notes, texts, calculators or communications devices.
- All work must be your own.

Score: _______ out of 72.

The final will have approximately 72 questions. Of those, about 24 will be based on material from Unit V. The following 24 questions should provide a guide to what kind of questions to expect.

Useful equations:

$p^2 = (4\pi^2/GM)\, a^3$

$F = m\, a$

$F = G\, m_1\, m_2 / r^2$

$v = \lambda\upsilon$ (for light, v=c)

$E = h\upsilon$ (h = Planck's constant.)

$\theta_R \sim \lambda/D$ (The constant of proportionality depends on the units of λ and D.)

λ_{peak} (μm) = 2880 / T (K)

$L = 4\pi\, r^2\, \sigma T^4$ (σ = the Stefan-Boltzmann constant.)

$\Delta\lambda/\lambda = v/c$

$T = T_{ref} / R^{1/2}$ (If R is in AU, then T_{ref} = 300 K.)

Constants (which you probably won't need):

$G = 6.674\times10^{-11}$ N m^2 kg^{-2}

$c = 2.998 \times 10^8$ m/s

$h = 6.626 \times 10^{-34}$ J/s

$\sigma = 6.570 \times 10^{-8}$ W m^{-2} K^{-4}

Pick the best answer to each question.

_____ 1. Which of the following elements are not necessary for life as we understand it?

a. Hydrogen.
b. Carbon.
c. Nitrogen.
d. Oxygen.
e. All of the above are necessary for life as we understand it.

_____ 2. The carbon, nitrogen, and oxygen found in the Solar System formed in ...

a. the Big Bang at the beginning of the Universe.
b. supernova explosions.
c. black holes.
d. evolved stars like red giants and supergiants.
e. in main-sequence stars like the Sun.

_____ 3. Where did life on Earth originate?

a. It formed locally on Earth, on the dry land soon after the crust solidified.
b. It formed locally on Earth, in shallow sea pools at the edge of the ocean.
c. It formed locally on Earth, deep below the ocean surface.
d. Life on Earth was seeded from impacts bringing it from another world or outer space.
e. We don't know.

_____ 4. The more massive a star is ...

a. the more fuel for fusion reactions it has and the longer its lifetime.
b. the more quickly it burns through its fuel and the shorter its lifetime.
c. the cooler its effective temperature when on the main sequence.
d. the fainter its luminosity when on the main sequence.
e. the smaller its radius when on the main sequence.

_____ 5. The habitable zone around a star is defined to be the range of distances at which ...

a. a planet or moon can hold down an atmosphere.
b. the equilibrium temperature is between the freezing and evaporation temperatures of water.
c. the orbital period is between 0.5 and 2.0 years.
d. orbital resonances with the largest planet in the system are impossible.
e. high quality stereo radio reception is possible.

_____ 6. Why would we not expect to see complex life around a star half the mass of the Sun and believed to be one of the oldest stars in the Galaxy?

a. Its habitable zone is too small.
b. Its lifetime is too short.
c. It wouldn't have enough of the elements heavier than hydrogen needed for life.
d. Stars of this mass are unlikely to have planets.
e. Its magnetic field would be too weak.

_____ 7. The transit method to detect exoplanets is most sensitive to ...

a. large exoplanets in orbits close to the central star.
b. large exoplanets in orbits far from the central star.
c. small exoplanets in orbits close to the central star.
d. small exoplanets in orbits far from the central star.
e. None of the above.

_____ 8. The radial velocity method to detect exoplanets is most sensitive to ...

a. large exoplanets in orbits close to the central star.
b. large exoplanets in orbits far from the central star.
c. small exoplanets in orbits close to the central star.
d. small exoplanets in orbits far from the central star.
e. None of the above.

_____ 9. Which of the following methods has not yet successfully detected an exoplanet?

a. The radial velocity method.
b. Direct imaging, usually with a coronograph to block light from the central star.
c. Observing transits when the planet passes in front of the star.
d. Speckle interferometry.
e. Microlensing.

____ 10. The radial velocity method to detect exoplanets measures the ...

a. Doppler shift of the planet as it moves around its host star.
b. reflex motion of the star as it and a planet orbit their common center of mass.
c. change in brightness from a star when a planet crosses in front of it.
d. light scattered from a planet's point-spread function.
e. light scattered from dust and other debris typically found in planetary systems.

_____ 11. The astrometric method to detect exoplanets measures the ...

a. wobble in a star's proper motion as it and a planet orbit their common center of mass.
b. radial velocity of the star as it and a planet orbit their common center of mass.
c. light scattered from a planet's point-spread function.
d. light scattered from dust and other debris typically found in planetary systems.
e. change in brightness from a star when a planet crosses in front of it.

______ 12. The radial velocity method determines all of the following, **EXCEPT** ...

a. the period of an exoplanet's orbit.
b. the eccentricity of an exoplanet's orbit.
c. the inclination of an exoplanet's orbit.
d. the lower limit of an exoplanet's mass.
e. The radial velocity method determines all of the above.

_____ 13. If a system is observed pole-on, exoplanets ...

a. can be detected with the radial velocity method, but not with transits.
b. can be detected with the transit method, but not with radial velocities.
c. can be detected with both the transit and radial velocity methods.
d. cannot be detected with either transits or radial velocities.
e. cannot be detected with tranits, radial velocities, or the astrometric method.

_____ 14. Barnard's star has the highest proper motion of any star in the sky. It is also known for the ...

a. detection of a planet in its habitable zone using the radial velocity method.
b. detection of a planet orbiting it with the direct imaging method.
c. detection of a planet in its habitable zone using the transit method.
d. false detection of a planet orbiting it using the astrometric method.
e. detection of a planet orbiting it using the microlensing method.

_____ 15. The closest exoplanet to the Sun is ...

a. 51 Peg b.
b. HD 189733 b
c. Proxima Centauri b.
d. Kepler-69b
e. Kepler-452b

_____ 16. Brown dwarfs ...

a. have masses roughly 13 to 70 times that of Jupiter
b. do not have enough mass to undergo fusion of hydrogen to helium
c. have enough mass for fusion reactions involving deuterium
d. have been detected among nearby stars
e. All of the above.

______ 17. How have winds been detected in exoplanetary atmospheres?

a. Imaging that allows the tracking of cloud features on the disks of exoplanets.
b. The broadening of spectral lines due to the Doppler shifts from the winds.
c. Infrared emission as a hot Jupiter orbits its star showing that the warmest part of the atmosphere is not directly below the star.
d. The spectroscopic detection of changes in chemical composition caused by the winds.
e. Changes in the radial velocity of the star most consistent with planetary winds.

_____ 18. The Kepler mission has discovered ...

a. many hot Jupiters.
b. exoplanets in the habitable zone of their star.
c. exoplanets that have masses similar to Earth.
d. All of the above.
e. None of the above.

_____ 19. Hot Jupiters most likely ...

a. formed very close to the star they orbit.
b. migrated into their current orbit after forming further out.
c. were captured by the star they orbit after forming in deep space.
d. formed after a collision ejected material from the star they now orbit.
e. accreted enough mass to become a brown dwarf.

_____ 20. The Drake Equation predicts the existence of roughly how many civilizations in the Galaxy?

a. 1.
b. 100.
c. 10,000.
d. one million.
e. Any of the above, depending on assumed values for the terms in the equation.

_____ 21. What question does Fermi's paradox ask?

a. Why have aliens visited the Earth?
b. How can gravity bend light?
c. Why do aliens love reruns of Gilligan's Island?
d. Can faster-than-light space travel possible?
e. Where are the aliens?

_____ 22. If we could study an Earth-like world with a spatial resolution of only 100 km per pixel, what would be the best means of searching for signs of life?

a. Scanning the images for signs of civilization like crops or roads.
b. Obtaining spectra to look for ozone and other products of biology.
c. Studying the cloud patterns to search for shifts in global circulation.
d. All of the above would be equally effective.
e. None of the above would work at a spatial resolution of 100 km.

_____ 23. Which of the following statements is **FALSE**? (Answer "e" if "a" through "d" are true.)

a. A scientific theory must be consistent with the current data.
b. A scientific theory must be modified or rejected if it does not agree with future data.
c. Science does not prove anything true.
d. A scientific theory becomes a law after passing repeated tests.
e. All of the above are true.

_____ 24. The last slide of the last lecture suggested that we ...

a. be as objective as we can and brave enough to follow the data.
b. vote for politicians eager to fund science.
c. should take more science classes, no matter our major.
d. all complete our course evaluations.
e. watch more science fiction movies.