

Section 1

Astronomy 230

Fall 2006

Final Exam

Test Form A

1. **DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO.**
2. Write the multiple-choice answers on your test booklet.
3. Make sure to mark Test Form A and your name in your test booklet. I do not need your social security number.
4. Answer *ALL* of the questions. There is no penalty for guessing.
5. Don't get stalled on any one question.
6. Choose the **best** answer for each problem.

DO NOT FORGET TO FILL IN "TEST FORM" A

40 Multiple choice questions: (2 points each):

1. The best evidence for ETs to date is
 - A) the antikythera mechanism
 - B) there is no evidence.
 - C) the acorn spacecraft incident
 - D) the "Wow" signal at Ohio State.
 - E) the Roswell incident

2. Which Drake equation term is probably the best known value (i.e. within a factor of 10 or so)?
 - A) f_i
 - B) f_p
 - C) f_c
 - D) R^*
 - E) n_e

3. Which of the following is not a problem that will affect the lifetime of a communicating-able civilization?
 - A) Depletion of leakage signals
 - B) Overpopulation
 - C) Self annihilation (Nuclear War)
 - D) Depletion of energy resources
 - E) Natural disaster (e.g. Volcanoes, asteroids)

4. Which of the following is **not** an example of an extrasomatic storage technique?
 - A) Brain synapsis
 - B) Wikipedia
 - C) Printing press
 - D) Language
 - E) None of the above.

5. What was the main result of this class?
 - A) Even if humans are alone in the Galaxy, we will probably colonize the Galaxy.
 - B) There are only 115 advanced civilizations in our Galaxy.
 - C) Space is freaky big, so full of advanced civilizations.
 - D) ET intelligent life is possible based on scientific facts and guesses, but we do not really know.
 - E) UFOs containing aliens have never landed on Earth.

6. What does a civilization **not** need to be considered able to communicate?
 - A) Invent satellites and simple space travel
 - B) Develop agriculture
 - C) Create extrasomatic storage capabilities
 - D) Understanding of quantum mechanics (e.g. radio/radar technology)
 - E) Accept the possibility of extraterrestrial life

7. If we expect alien civilizations to be few, but transmitting bright, strong radio signals, then we should look for extraterrestrial intelligence using
- A) a radio telescope of any size.
 - B) only radio telescopes in space.
 - C) a small radio telescope (~30 meter).
 - D) a large radio telescope (~300 meter).
 - E) none of the above.
8. Which type of life probably came first?
- A) Eukaryotes
 - B) Eubacteria
 - C) Fungi
 - D) Amoebas
 - E) Archaea
9. NASA has considered inflatable space stations or modules?
- A) True
 - B) False
10. Which of the following places in our Solar System has the least likelihood for life?
- A) The surface of Titan.
 - B) The sub-surface of Europa.
 - C) The atmosphere of Venus.
 - D) The sub-surface of Io.
 - E) The sub-surface of Mars.
11. Which choice would seem most likely to have life of human intelligence or better?
- A) A planet in an intermediately spaced (~10 AU) binary star system,
 - B) A newly formed planet within the habitable zone of its star.
 - C) A large temperate moon orbiting a gas giant, which orbits a 1 solar mass star at 1 AU.
 - D) A moon orbiting a planet near a recently exploded supernova.
 - E) A planet orbiting a star near the center of our Galaxy.
12. In class, we discussed the single magic frequency that aliens would surely use to contact us.
- A) True
 - B) False
13. What is **not** evidence of ET life being abundant in the Galaxy?
- A) the class estimate of the Drake Equation (~100) suggests that it is possible.
 - B) life occurred on Earth, and there is no reason to think we are special
 - C) with so many UFO sightings, there must be some truth to ETs.
 - D) with ~300 billion stars in our galaxy there are many chances for ET life
 - E) None of the above

14. Which of the following is **NOT** a problem that we have already run into during our search for extraterrestrial life?
- A) Decoding the transmission.
 - B) Receiving government funding.
 - C) Determining at which frequency to listen.
 - D) Knowing where and when to listen.
 - E) Determining how big of channels to use.
15. The best type of life sustaining stars are
- A) Massive stars (more than 2 solar masses), as they have more mass from which to form planets.
 - B) Middle mass stars (less than 1.25 and more than 0.5 solar masses), as they live longer and don't require the planets to be too close.
 - C) Low mass stars (less than 0.5 solar masses), as life can exist nearer the star where more terrestrial planets are probably located.
 - D) Stars off the main sequence, as they have lived the longest, they are the best chance for finding intelligent life.
 - E) Binary stars, as they double the chances of life.
16. Which of the following class topics was the premise for the book/movie *Contact*?
- A) Frank Drake's radio message to M16
 - B) Leakage signals
 - C) Antimatter propulsion
 - D) Alien abductions
 - E) Crop circles
17. One idea for terraforming Mars is to use giant space mirrors to melt the polar caps.
- A) True
 - B) False
18. Why do we prefer listening for alien radio signals to sending our own signals
- A) Are technology current limits communication inside our Solar System
 - B) General relativity predicts that the gravity of our Solar System will bend spacetime
 - C) As demonstrated in class it is impossible to decode our signals
 - D) It costs more money to broadcast than receive
 - E) Extraterrestrial life does not like to listen
19. After the atmosphere had oxygen
- A) life could use more efficient metabolism and become more complex
 - B) life could live on land
 - C) life could use the Miller-Urey type of process to make more complex amino acids
 - D) both A and B
 - E) both A and C
20. In class, we did not discuss life around the first stars because
- A) The planets would have been gas giants containing only helium.
 - B) Life could never exist on the cold, rocky planets surrounding them.
 - C) The first stars didn't live long enough for life to evolve on the rocky planets surrounding them.
 - D) Life could never exist on the hot, rocky planets surrounding them.
 - E) None of the above.

21. In class, we tried to decode the Frank Drake radio signal, we found
- A) by using simple binary code, we can probably communicate with aliens.
 - B) that the frequency of the message may be the most important aspect of the transmission.
 - C) that once you realize to put it into a 23×73 square, it is easy to decode.
 - D) that the code is very difficult, if not impossible, to decode.
 - E) none of these
22. Which of the following is **not** true?
- A) There is no proof of any life besides Earth.
 - B) There is a good scientific probability of extraterrestrial intelligent life somewhere else in the Universe.
 - C) If there is extraterrestrial intelligent life somewhere else, there is a chance that it has been around for 1 billion years.
 - D) Both A and C
 - E) None of the above
23. If we assume that binary star systems **cannot** have planets with life, then which Drake term must decrease, based on class discussions?
- A) Number of stars suitable for Life (R_*)
 - B) Fraction of stars with Earth-Like planets (f_p)
 - C) Lifetime (L)
 - D) Number of Earth-Like planets per system (n_e)
 - E) Fraction of stars with planets (f_p)
24. What is the crucial accomplishment that launched mankind on the road to an advanced civilization?
- A) Agriculture
 - B) Writing
 - C) Language
 - D) The wheel
 - E) Fire
25. The Condon report discussed
- A) an improved SETI experiment.
 - B) viable spacecraft for a Mars mission.
 - C) the lack of any scientific evidence for UFOs.
 - D) the need for further scientific study of UFOs.
 - E) the famous "Wow" signal.
26. Which moon most resembles a pizza?
- A) Europa
 - B) Our Moon
 - C) Phoebe
 - D) Io
 - E) Titan

27. Which of the following was the best evidence to disprove the Ptolemaic system?
- A) Phases of the Moon.
 - B) The stars can't be that far away.
 - C) The Copernican system worked so much better.
 - D) Retrograde motion of Mars.
 - E) Phases of Venus.
28. A star, during its main sequence, does not collapse in on itself, nor does it explode violently. Why?
- A) Fermi exclusion principle.
 - B) Electromagnetic repulsion.
 - C) Newton's second law.
 - D) Law of internal pressures.
 - E) Hydrostatic equilibrium.
29. Which of the following is responsible for holding atomic nuclei together?
- A) weak nuclear
 - B) gravity
 - C) electromagnetism
 - D) dark energy
 - E) strong nuclear
30. Why is carbon important to life?
- A) It's an amino acid.
 - B) It's a solvent
 - C) It is the only element with 4 bonding sites.
 - D) It allows long molecular chains
 - E) It's a polymer
31. Spaceships traveling near the speed of light will have which adverse affect to the interstellar space travelers?
- A) the closer you go to the speed of light the more massive you get, so they get crushed by their own weight.
 - B) the distance outside the spacecraft will appear to shrink
 - C) the time required for travel will be less than they expect (on their clocks)
 - D) There are no adverse effects, only positive gains.
 - E) by the time they return to Earth their clocks and the Earth clocks could be different by millennia (everyone they know is long dead)
32. When estimating the distance to the nearest alien civilization (with a given Drake equation result), why can you assume a spherical search volume for large N (>8000)?
- A) The flatness of the Galaxy is not relevant.
 - B) The Galaxy, although disk shaped, is still very large, so a spherical approximation is always valid.
 - C) One can not do that. This is a false statement.
 - D) Because space is infinite.
 - E) None of the above.

33. Which of the following is a monomer of life?
- A) Brain Neurons
 - B) Amino acids.
 - C) Proteins.
 - D) Carbohydrates.
 - E) DNA/RNA.
34. What rocket quantity is **not** important for understanding its capability?
- A) The escape velocity.
 - B) The velocity of the exhaust.
 - C) The specific impulse.
 - D) The thrust.
 - E) The mass ratio.
35. What of the following is **not** important when addressing the fraction of stars whose properties are suitable for life to develop on one of its planets (f_p)?
- A) Fraction of wide binary systems.
 - B) Fraction of stars that have masses less than 1.25 solar masses.
 - C) Fraction of nearby stars with Jupiter-like planets.
 - D) Fraction of stars that are young (not on the main sequence).
 - E) Fraction of stars that are metal rich.
36. What is the most efficient way to get energy from mass?
- A) Fission it.
 - B) Chemically burn it.
 - C) Expel it with magnetic fields.
 - D) Fusion it.
 - E) Annihilate it.
37. The newest and most exciting SETI project to date is the Allen Telescope Array, which will
- A) resolve planets around other stars
 - B) be much more sensitive than the Arecibo single-dish telescope
 - C) 100% dedicated to SETI
 - D) be more PR than useful
 - E) resolve all the frequencies thought to be useful to ETs
38. Sex in space, or on Earth, is important because
- A) it allows the genetic material of the better organisms to survive.
 - B) mutations can only occur in sexual reproduction.
 - C) sex, although fun, also stimulates gene mutations.
 - D) it leads to greater genetic diversity and an increase of positive mutations in the offspring.
 - E) None of the above.
39. The early Universe ($t=0$) was dense, hot, and full of matter.
- A) True
 - B) False

40. In 1974, Frank Drake sent a message toward the globular cluster M13, this message was created by
- A) encoding information in a laser beam
 - B) video encoding the message (like TV) and sending it with the Arecibo radio telescope.
 - C) recording information on a gold record and shot into space.
 - D) pulsing a radio signal on/off (amplitude modulation)
 - E) periodically changing the signal frequency (frequency modulation)

Answer both of the large essay questions (40 points each):

41. Essay Question: (40 points):
(a) Write down the Drake Equation. **(b)** For each component, write down your own personal value (not necessarily the one from class). **(c)** Justify your values with facts from class. Each term must have at least one relevant fact or argument from class. Most of the credit comes from the facts of your argument. **(d)** What does your Drake equation result tell you?
42. Essay Question (40 points):
Discuss the origin of the crucial elements of life (H, O, N, and C) and what life on Earth has done with them. You must use the following terms: quarks, hydrostatic equilibrium, CNO cycle, planetsimals, panspermia, amino acids, deoxyribose sugar, hot vents, RNA world, worldview, SETI, and generation ships. Make sure to underline and briefly define each term used.

Choose only 5 of the following 6 questions and answer (10 points each):

43. Essay Question (10 points): Describe the Fermi paradox and list some reasons why our Drake's equation result can still be correct.
44. Essay Question (10 points): Discuss how the age of a fossil can be determined by carbon-14 dating. What are its limitations? Why is dating a fossil important for this class?
45. Essay Question (10 points): Briefly explain the differences between using a large radio telescope and a small radio telescope to search for extraterrestrial life. Be sure to discuss the advantages and disadvantages of each.
46. Essay Question (10 points): Using the Earth as a basis, discuss at least three necessary steps for intelligent life to create a civilization capable of communication.
47. Essay Question (10 points): There are many difficulties for interstellar travel. List and explain 3 of the main problems.
48. Essay Question (10 points): Would you expect to find homo sapiens in other solar systems? Justify your answer.