

AST 309L
Review Questions for Fourth Exam
Spring 2006

This test covers Chapters 8 through 10 plus *Contact*. That means it covers the results for the Drake equation, communication, and travel. It will ask you for *your* values for N and r, and for an analysis of the consequences of your numbers.

A. Evaluation of the Drake Equation

1. Two students have evaluated their Drake Equations. Happy Feller gets $N = 2.5 \times 10^{11}$, while Mr. Average Guy gets $N = 9.4 \times 10^5$. Who will calculate the larger r? How many stars would one have to search before finding the nearest civilization, given each of their estimates for N?
2. Another student, Angela Angst, takes $L = 100$ years. Does Angela think two-way messages are possible? What does it mean if your estimate for N is less than one?
3. Given your estimate for N, would you expect your estimate for r to go up or down if the Sun were closer to the center of the galaxy?

B. Communication with Extraterrestrial Civilizations

1. Describe the spectrum of electromagnetic radiation, identifying the various wavelength regions. Indicate which are higher in frequency and shorter in wavelength.
2. Why are radio waves generally favored as the wavelength region for interstellar communication? What range of frequencies is best? What are the arguments for this range?
3. Explain three suggestions for “magic” frequencies.
4. Draw a diagram, showing how a vertically polarized electromagnetic wave can produce an alternating current in an antenna.
5. Explain how a radio telescope works.
6. Describe the problems of recognizing and decoding signals. What features should a signal have in order to make it easier to recognize and to be decoded? Describe AM, FM, analog, and digital signals.
7. Make up a message by coding a picture into a series of 1's and 0's.

8. Describe the pulsars and OH maser emission. Why don't we think these are signals from ETI?
9. Describe the methods and results of Project Ozma and Project Ozma II.
10. Describe the META and BETA projects.
11. Describe the NASA search for extraterrestrial intelligence (ETI) and its successor, Project Phoenix. Explain the differences between the all-sky survey and the discrete source search.
12. Describe the Allen Telescope Array and how it will extend the search.
13. Describe the proposed Cyclops project. What would its capabilities be?

C. Review Questions for *Contact*

1. Describe the ARGUS facility discussed in *Contact* in as much detail as you can. How many telescopes, how many frequencies, how narrow were the filters?
2. Describe the signal detected by ARGUS. What frequency was it detected at, what other frequencies did it show up at, what was the bandwidth, what was the intensity? How could the scientists in *Contact* tell it was not a terrestrial signal? How could they tell it came from Vega? What did they learn from the absence of a Doppler shift due to motion of the transmitter around Vega?
3. Describe the four levels of information coded into the signal received by ARGUS. How was each modulated and how was each decoded? What was the purpose of each level of information? What is a palimpsest?
4. When the ARGUS scientists were looking for the Primer, Ellie asked S. Hadden for advice. Describe the various suggestions he gave. Which turned out to be correct?
5. In Chapter 11 of **Contact**, various attitudes toward interstellar communication are expressed at the meeting of the World Message Consortium. Describe the various opinions and who expressed each one. Which is closest to your own attitude?
6. Describe the journey taken by the people in the machine. What is Eda's theory for how the transport system works (see Chapter 23)?

D. Travel

1. Give three motivations for interstellar travel. Use your estimates for factors in the Drake equation to compute how many habitable planets there are in the Galaxy. Assume that a planet remains habitable for 10×10^9 years.

2. In what order did the following steps occur in exploration of our own solar system: missions with astronauts, flybys, landers, colonization, orbital probes, telescopic observations? How would this sequence differ for interstellar travel? Why?
3. Describe Project Orion and Project Daedalus. Give as much detail as you can.
4. Describe two of the exotic ideas for interstellar travel. What are the problems with them?
5. Give an example of time dilation.
6. What is a Bracewell probe? What are its advantages and disadvantages for searching for ETI?
7. What are the implications of the view that colonization of the Galaxy is relatively easy for very advanced civilizations?
8. What is the Hart Hypothesis? Be sure that you can explain how this argument works and what its significance is. If you have a large estimate for N , you will have to have a good counter-argument to Hart. What are the Tipler and Zuckerman variations?
9. What are the four categories of UFO's? What is a close encounter of the third kind?

E. Broader Questions

1. Some have argued that societies that develop the capability for interstellar communication, namely sophisticated technology, will also develop the tendency toward self-destruction, either by resource depletion or by nuclear war, thus ensuring a low value for L . What do you think of this argument?
2. Compare the pace of chemical, biological, and cultural evolution. Which sets the timescale for the emergence of new technological civilizations?