

## Extraterrestrial Life: Problem Set #1

Due, in class, Thursday January 31<sup>st</sup>

- 1) Explain briefly how the *terrestrial* planets (such as the Earth) differ from the *giant* planets (such as Jupiter). Describe how these differences are thought to arise as a consequence of the theory of the formation of the Solar System.
- 2) It is possible (although unproven by observations so far) that planetary systems may exist around high mass stars as well as around low mass stars. Why are planetary systems around high mass stars unpromising locations to search for life?
- 3) Suppose that a single supernova explosion results in the ejection of 10 Solar masses of heavy elements (all those elements other than hydrogen and helium) back into space. If the  $10^{11}$  stars in the Galaxy have an average heavy element content that is 1% of their mass, how many supernovae must have exploded during the lifetime of the Galaxy to create those heavy elements? [assume that the average stellar mass is 1 Solar mass for the purposes of this question]
- 4) The distance to the nearest star system, Alpha Centauri, is 4.4 light years. How fast would a spacecraft need to go (in km per second) to reach Alpha Centauri in 1000 years?
- 5) Suppose that the average density of stars in a region of the Galaxy is 1 star per cubic light year (i.e. a cube, one light year on a side, contains on average one star). Write down an expression for the number of stars within a sphere of radius  $r$ . If only 1 in a million stars are surrounded by planets that harbor life, how far away would you expect the nearest life-bearing planet to be?