

Extraterrestrial Life: Problem Set #2

Due, in class, Thursday February 14th

- 1) Discuss the evidence that suggests that the water on the Earth originated from impacts with bodies originally situated in the outer asteroid belt. Why are comets not thought to have dominated the delivery of the Earth's water?
- 2) Some stars' luminosity varies markedly due to periodic stellar pulsations. Suppose (hypothetically, since this does not happen for stars like the Sun) that the Sun's luminosity oscillated by 50% on a timescale of (a) 1 hour or (b) 1000 years. How do you think these oscillations would affect the habitability of the Earth?
- 3) Describe how feedback processes operating over long time periods maintain the stability of the Earth's climate.
- 4) Describe, in non-mathematical terms, how we can determine the age of rocks. Be careful to explain what is meant by 'age' in this sense.
- 5) Imagine an extrasolar planet whose surface is 75% covered by ocean and 25% covered by land. If the ocean has an albedo of $A = 0.1$ and the land an albedo of $A = 0.5$, what is the average albedo of the planet? If all the land is in the form of a single continent close to the equator on one hemisphere of the planet, sketch how the brightness of the planet (seen by a distant observer) would vary with time as the planet rotated.
- 6) In daylight, Earth's surface absorbs about 400 watts per square meter of Solar energy. The total power from radioactive decay within the Earth is 3 trillion watts (3×10^{12} watts), which leaks out through the entire surface area of the Earth. If the radius of the Earth is 6400km, calculate the internal heat flow (watts per square meter) averaged over the surface. By what factor is the Solar flux larger than the internal flux?