Order-of-Magnitude Physics – Lab 2

Guidelines:

- Break up into groups of 1, 2, or 3 people.
- At any given moment, there should be ≤ 1 "scribe" (person with marker/pen).
- The scribe has complete control over what to write down (and what not to write down).
- Please change scribes when switching to another problem, but not within a given problem.
- When you have an answer, write it down on the "Answer Board" where everyone's answers will be collected.
- If you are done, feel free to leave, or you can observe other groups.

Problem 1. "The Word for World is —".[1]

The atmospheric mixing ratio of CO_2 is the northern hemisphere has been measured for several decades. It displays an annual oscillation with peak-to-peak amplitude of about 5 ppmv. See Figure 1, next page.

Provide a quantitative explanation for this effect. On the "Answer Board," you can write down your own estimate for the peak-to-peak amplitude.

[1] After the novel by Ursula K. Le Guin. Google this only if desperate.

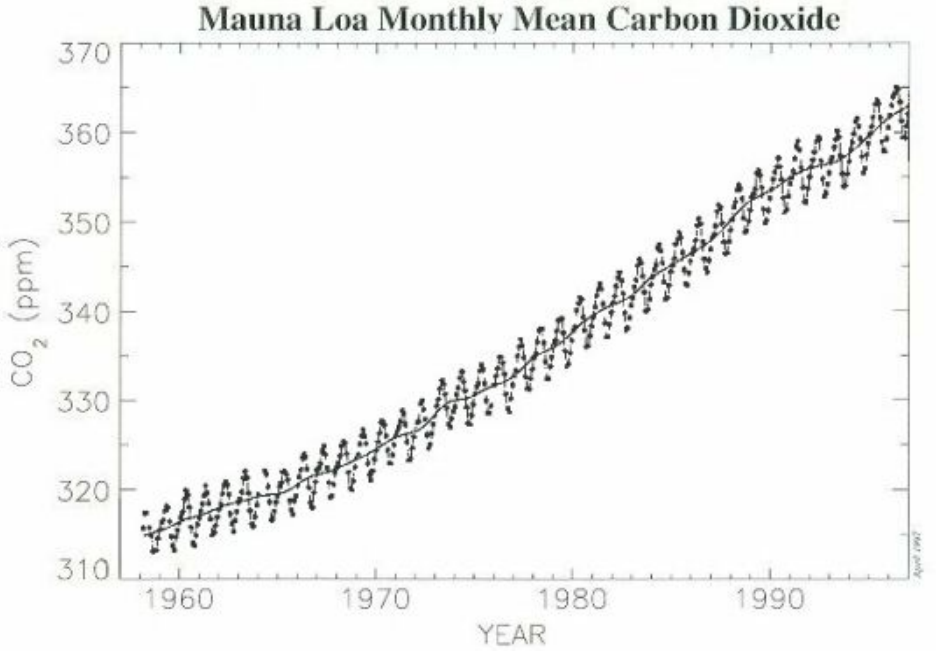

Figure 1: Time variation of CO_2 volume mixing ratio as measured at Mauna Loa, Hawaii, latitude 19.5 deg N.

Problem 2. How Round is "Nearly Round"?[2]

How large must an asteroid be before self-gravity makes it round? You can give the radius in km.

[2]On 24 August 2006, the 26th General Assembly of the International Astronomical Union resolved that a "solar system planet" is a "celestial body that (a) is in orbit about the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a nearly round shape, and (c) has cleared the neighbourhood around its orbit." According to this definition, there are only eight planets in our solar system.

Problem 3. Great Pacific Garbage Patch

Plastic dumped into the Pacific Ocean collects in the "Great Pacific Garbage Patch": an area ranging in size from 0.7–15 million square km (wikipedia).

Captain Charles J. Moore is usually credited with discovering and popularizing the Great Pacific Garbage Patch. He is reported to have said that a clean-up effort "would bankrupt any country."

Consider a "conventional" clean-up project that relies on shipping/industrial vessels fitted with nets or other extraction equipment that can collect millimeter-sized and larger bits of garbage. Would Captain Moore's pessimistic assessment be correct for such a conventional effort?