Astronomical Measurements

[**No calculators. No internet.**]

1. Define the following astronomical distance units.
   a) AU (astronomical unit)
   b) ly (light year)
   c) pc (parsec)
   Estimate the magnitude of the above units, in terms of cgs / mks length unit, from the following information.
   a) c = 3×10^{10} cm/s
   b) Earth - Sun distance $\simeq$ 8 light-minute

2. Let us define a *'regular conversation'* to be a process in which, after saying something a person receives a reply within 10 minutes.
   a) What is the farthest place (it has to be a real location) you can travel to from where you can have a 'regular conversation' with your family? (Mars / Venus)
   b) Is it possible to have such a 'regular conversation', from this place, all the time? (only nearest approach)
   [Distance (from the Earth) to (at the most 3) solar system objects would be provided if asked for.]

3. What are the masses of the following astronomical objects? – a) Earth b) Jupiter c) Sun.
   [If you know them, fine. If not make a wild guess. 😉]

   The angular size of the Sun (seen from the Earth) is $\sim 0.5°$. What is the average density of the Sun? Make an estimate for the mass of our entire solar system. Find the average density of the solar system from this estimate [you can ask for the value of only one quantity, (radius of Pluto's orbit)], and compare this with - a) the density of the Sun, b) the average density of the terrestrial planets [You should be able to make a reasonable guess for (b), given that you live on one such planet.].

4. The reason we can see total solar eclipses from the Earth is the fact that the Sun and the Moon have the same apparent size in the sky, as seen from the Earth. Ask for the value of only one quantity, (Earth-Moon distance $\simeq$ 1.3 light-second), and estimate the volume of the Moon. There is a suggestion that the Pacific Ocean was created when a chunk was pulled out of the Earth (by a passing object), and that chunk subsequently became the Moon. Is this a plausible theory, considering the volumes involved? [The surface area of the Pacific Ocean is $\sim 2 \times 10^{18}$ cm^2. And if we tried to submerge Mt. Everest at the deepest point of the ocean, the water surface would be above the top of the mountain by a km or so.]

5. The units we use for long time intervals are intimately related to three celestial cycles. Identify these cycles and the corresponding temporal units. [Which is an extremely important temporal unit that is NOT related to any natural cycle?] The calendars in use today are mainly of three types - solar, lunar and luni-solar. Every one of these need to insert an extra day / month here and there to keep the calendars in synch with the celestial cycles. Numerically demonstrate why that should be so.

Teaching Assistants
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