

Problem Set #1

Physics 131

24 August 2022

1. Estimate the number of beats your heart has undergone in your lifetime.
2. Nerdy sports scientists celebrate birthdays like everyone else, but some of us also celebrate our billionth second. How old will you be in years, months, and days when you pass one billion seconds since your birth? Are you likely to see your second billionth second? Third? Fourth? Fifth?
3.
 - (a) Some health experts recommend 10,000 steps per day for a healthy lifestyle. Measure the distance of your normal step and estimate how many miles one would walk with 10,000 steps.
 - (b) If a “double step,” which is two steps, is a distance roughly equivalent to a person’s height, how many double steps would you walk in a mile?
 - (c) The word “mile” comes from the Latin word “mille,” which means a thousand, because the mille was equal to the distance of a thousand double steps of a Roman soldier. If that’s true, how tall was the average Roman soldier?
4. An American football field is 100 yards from goal line to goal line and $53\frac{1}{3}$ yards wide. Each end zone is 10 yards deep.
 - (a) What is the total area of that playing surface in ft^2 ? In m^2 ?
 - (b) An *acre* (abbreviated ac) is 4840 yd^2 . How many acres in your part (a) answer?
 - (c) The SI hectare (abbreviated ha) is $10,000 \text{ m}^2$. How many hectares in your part (a) answer?
5.
 - (a) Your body is comprised of approximately 100 trillion cells. Though cells of various types come in different sizes, an average size for a cell is around $10 \mu\text{m}$ ($1 \mu\text{m} = 1 \text{ micrometer} = 10^{-6} \text{ m}$). If each cell is approximated as a sphere of diameter $10 \mu\text{m}$, how much volume do 100 trillion cells make up?
 - (b) Is your part (a) result at least in the ballpark for the volume of a human being? Use whatever means you can think of to estimate body volume.
 - (c) The unit used for atomic sizes is the ångström, abbreviated Å. The conversion is $1 \text{ Å} = 10^{-10} \text{ m}$. A hydrogen atom has a diameter of about 1 Å . Hydrogen makes up nearly two thirds of the atoms in your body; the other atoms are larger than hydrogen. Take an average diameter of 2 Å for the atoms in your cells, and further assume that the atoms are spheres (they are not!). About how many atoms should fit inside a cell (forget filling fraction and other such niceties!). Any rule of thumb you notice?

Due date: **31 August 2022** (*beginning of class*)

Rules: You are encouraged to work together and/or consult with me. Though you may get ideas for solving problems from others, the work you turn in *must* be entirely your own. Simply giving an answer or copying from another student earns you *zero* points for that problem. If you use any outside sources (books, web sites, computer software, etc), please cite your sources.