Homework 3a: ***Units, Magnitudes, and Quantities***

1. We usually measure speed as length units divided by time units. Let's adopt meters (m) as the standard unit of distance and seconds (s) as the time unit. For example, we can say that a certain object travels at a speed of 5 m/s (five meters per second). On a trip to a country in South America, you find yourself in a jungle where people do not understand this notation. Distance is measured as lengths of a standard tree (trees) with a unit length of 4.3 m, and time is measured as marks on a sundial where every interval corresponds to 3 minutes or 180 seconds. A native lets you know that she can "accelerate" at a rate of 20 trees/marks^2. What is the acceleration in m/s^2?

2. The mass of our galaxy, the Milky Way, is estimated to be around 2.06×10^{11} solar masses (1 solar mass equals the mass of our Sun). The closest star to the Sun is called Proxima Centauri.

a) Estimate the mass of the Milky Way in Proxima-Centauri masses (pc), where Proxima Centauri has a mass that is 12.5% the mass of our Sun.
b) Now, provide the answer in kg and use scientific notation.

3. Compute the following quantities using scientific notation. Make sure to show the correct number of significant figures.

a) $9.18 \times 10^5 + 0.00821$
b) 78.934×23.98
c) $8.4562 \times 10^{-5} + 1.34 \times 10^3$

4. Estimate how many orders of magnitude separate the following entities. Explain your assumptions and results:

a) An ant and a human
b) An atom and a soccer ball
c) A car and Mount Everest.

5. On a trip to New Mexico, you decide to take a trip on a hot-air balloon. As you become airborne, you start thinking about what properties of the balloon are intensive and which ones are extensive. Give two examples of each and explain your answer.

6. Create a Python program that asks for a car's speed in km/hr and converts that to miles/sec, and demonstrate its use for a car's speed of 200km/hr.
Guidelines:

- Do not define any functions (we will get to those later).
- Document your program.
- Indicate the source for your conversion factor.
- Ensure the output precision is consistent with the input.