

Physics 341
Spring 2007
Homework #1
Due - Thursday, January 25, 2007

Reading: Innumeracy

My Notes: Chapter 1 & Chapter 2

1. The ratio of the size of the atom to the size of the nucleus of the atom is 10^5 . Consider our lecture hall. What of your body parts is in the same as that ratio to the size of the lecture hall? Better said, would a basketball represent the nucleus if the lecture hall was the atom? A tennis ball? A golf ball? A typical Texas tree roach? A fly?
2. A DNA molecule contains 220 million base pairs. If you made a model of a DNA molecule using ping pong ball size spheres for the atoms, estimate the length of the model.
3. How tall is the tower? How tall is Belmont? Will the Tower fit inside the Stadium? In your estimates include the precision that you are obtaining. Find some way to measure these heights to within an accuracy of 5%.
4. How many people are born in the United States in a year? How many are born in Texas? How many die from heart disease? Make an order of magnitude estimate. Comment on how you arrived at each of these estimates.
5. How many hairs are there on top of your head? Describe the method that you used to estimate it. How fast does it grow in miles per hour? How fast does it grow in body heights per year?
6.
 - (a) What is the height of the National Debt in pennies stacked on top of each other.
 - (b) Suppose these pennies were distributed uniformly across the land area of the contiguous 48 states. What distance would separate each penny from its nearest neighbor?
 - (c) How many tons of copper would be required to make these pennies?
 - (d) Suppose they were distributed by dropping them from the sky. If you were standing outside, how many pennies would hit your head, on average?
 - (e) If you stuck your finger straight up, what is the probability that a penny would land on it? and stick? Explain your estimates.

7. I am sitting in my kitchen and I watch a squirrel jump from a tree to the ground. The squirrel was about 2 meters, 10 times her height, off the ground when she jumped. This seemed to be effortless on the part of the squirrel. If I tried to jump to the ground out of a tree 20 meters high, 10 times my height, I would break something, probably everything, How does the squirrel do that? Suppose that I jumped from 2 meters. Would it be the same as for the squirrel? What does that sentence mean? Suppose the squirrel jumped from 20 meters. Do you think that it will get hurt? Explain. What is the ratio of the squirrel's terminal speed to mine?
8. One of the methods proposed to cut down on gasoline consumption is to reduce the speed limits on cars and trucks. Estimate how much gasoline is consumed by cars and trucks. Using dimensional arguments, estimate what fraction of the gasoline that is consumed by cars and trucks will be saved by reducing the speed limits from $70 \frac{\text{mi}}{\text{hr}}$ to $55 \frac{\text{mi}}{\text{hr}}$.

Home Experiment 1. You were given two pieces of paper and a string. Using the string as your unit of length, measure the perimeter of the two pieces of paper and the distance between the two corners indicated as A and B in the following figure. Do this with a precision of at least 10%. For each sheet of paper, take the ratio of the length of the perimeter to the distance between A and B. What is the ratio of the areas of the two pieces of paper? Discuss these results in terms of dimensional variables and scaling. Discuss the use of your string as a candidate for the international standard of length.

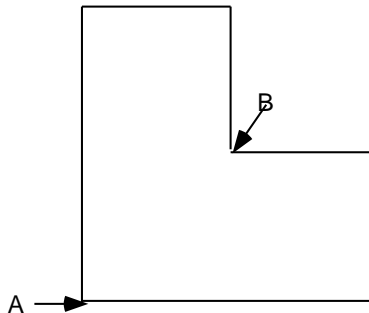


Figure 1: Figure for Home Experiment # 1