

# Physics 103b

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Order of Magnitude Physics

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## Problem Set 1

Due at *beginning* of class 14 January 1997

In some problems data is specified quite precisely. However, your answer should be in the spirit of order of magnitude.

1. The "Planck mass" is defined as  $(\frac{\hbar c}{G})^{\frac{1}{2}}$ . As energy, what is this worth in gallons of gasoline?
2. Cooking dishes are composed of special glasses that have low coefficients of expansion. For example, the linear coefficient of thermal expansion  $\alpha$ , in units of inverse centigrade degree, is  $1 \times 10^{-5}$  for commercial glass,  $3 \times 10^{-6}$  for pyrex, and  $8 \times 10^{-7}$  for vycor. Why is ordinary glass inappropriate for cooking vessels? Be quantitative.
3. Benjamin Franklin noticed that a given amount of oil dropped on a lake's surface could not be induced to spread beyond a certain area. How much oil would be required to cover Millikan pond?
4. Diffusion of perfume
  - a) Estimate the time required for perfume to diffuse across a room of size comparable to the one in which our class is held. Is this timescale in accord with your experience?
  - b) How does perfume usually spread in air?
5. My teacup is impervious to nucleons.
  - a) At absolute zero, how many neutrons can I put in the cup before my cup runneth over?
  - b) How many protons?
6. Invent a problem of your own.