Physics 121MA/Math 122PH
Fall 2001 Project 1 Name _____

Instructions: We encourage you to work with others in your assigned group on this project. You should write your solution neatly using complete sentences that incorporate all symbolic mathematical expressions into the grammatical structure. Include enough detail to allow a fellow student to reconstruct your work, but you need not show every algebraic or arithmetic step. It is important that you do your own writing, even if you have worked out the details with other people. All graphs should be done carefully on graph paper or drawn by a computer. This project is due at the beginning of class on Friday, August 31.

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1. This problem concerns measurement, estimation, and units.

   (a) Astronomers use the term *astronomical unit* (abbreviated AU) for measuring large distances. It is defined as the mean distance from Earth to the Sun and has a value of 1.496×10^{11} m (rounded to four digits). For larger distances, the *parsec* is used. The parsec (short for "parallax second") is defined as the distance at which 1 AU subtends an angle of 1" (i.e., 1/3600 of a degree).Express the parsec in astronomical units and in meters.

   (b) During the summer, one of your professors spread a large amount of topsoil. Unfortunately, topsoil suppliers use the cubic yard as a unit of measure. What is the *approximate* mass, in kilograms, of one cubic yard of topsoil? Carefully justify any assumptions or estimates that you make.

2. In a previous math course, you probably learned how the graph of a function is related to the graph of the corresponding inverse function: one graph is the reflection of the other through the line $y = x$.

   (a) Give an argument or explanation to support the following fact: If the point (a, b) is on the graph of the function f, then the point (b, a) is on the graph of the inverse function f^{-1}.

   (b) Use the fact in (a) to explain why the graph of a function f and the graph of the inverse function f^{-1} are reflections of each other through the line $y = x$.

   (c) Consider the tangent function $f(x) = \tan x$ with domain $(-\pi/2, \pi/2)$. Use the reflection idea to construct the graph of the inverse tangent function. It may be useful to consider how the vertical asymptotes of the tangent function are reflected across the line $y = x$.