Physics 122MA/Math 221PH
Spring 2002 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 required 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 Tuesday, January 29.

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1. Ptolemy modeled the motion of the sun by assuming earth to be fixed while the sun travels around a circle of radius a at a uniform rate (where a is the same as the semimajor axis of earth's actual elliptical orbit). To account for the fact that the earth-sun distance varies, Ptolemy placed earth a distance $2ea$ from the center of the circle on which the sun travels (where e is the eccentricity of earth's actual orbit).

   (a) Write a parametrized function $\vec{r}(t)$ that describes the sun's position as a function of time in Ptolemy's model. For convenience place earth at the origin, and let $t = 0$ correspond to July 4, when earth is farthest from the sun. Let that time also be when the sun's orbit crosses the $+x$-axis.

   (b) On which date is earth closest to the sun (in this model)? Is this reasonable?

   (c) Using your function from part (a), determine the dates on which the sun crosses the $+y$-, $-x$, and $-y$-axes.

   (d) Based on your evaluation in part (c), estimate the duration of each of the four seasons. Check your results against the true seasonal leangths.

2. (a) Construct a formula that gives the distance between the point with coordinates (x_0, y_0, z_0) and the plane with equation $Ax + By + Cz + D = 0$. The formula should allow you to compute the distance using the constants x_0, y_0, z_0, A, B, C and D. Your explanation should make clear why your formula gives the correct distance.

   (b) Compute the distance between the point with coordinates $(3, -2, 5)$ and the plane with equation $6x + y - 7z + 10 = 0$.