Physics 121MA/Math 122PH
Fall 2001 Project 2 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, September 7.

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1. The position (on the x-axis) of a particle in one-dimensional motion is given as a function of time in the table on the other side of this sheet.

   (a) Graph the position as a function of time.

   (b) Determine the velocity as a function of time, presenting your results both graphically and in the form of a table of numerical values.

   (c) Determine the acceleration as a function of time, presenting your results both graphically and in the form of a table of numerical values.

2. Start with a circle of radius 1 centered at the origin and a smaller circle of radius 0.25 centered at $(0, 1)$ and whose center is attached to the larger circle. Focus attention on the one point of the smaller circle that is at location $(1.25, 0)$ at time $t = 0$. Suppose the larger circle (with the small circle attached) rotates counterclockwise at 1 rad/s and the smaller circle simultaneously rotates clockwise at 1 rad/s.

   (a) Use vector addition to determine a position function $\vec{r}(t)$ for that one point on the smaller circle. Explain why that point traces out an ellipse.

   (b) What radius big circle and what radius small circle will yield an ellipse that models the orbit of mars around the sun? [Hint: Let c denote the distance from the center to a focus, a the semi-major axis and b the semi-minor axis of an ellipse. Then $c = \sqrt{a^2 - b^2}$ and $\varepsilon = \frac{c}{a}$ where ε denotes the **eccentricity** of the ellipse.]