Physics 122MA/Math 221PH
Spring 2001 Quiz 3 Name _____

Instructions: We encourage you to work with others in your assigned group on this quiz. 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 quiz is due at the beginning of class on Monday, February 21.

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1. Consider a thin charged rod that lies from $x = 1$ m to $x = 2$ m on the x-axis. the rod has a uniform charge density $\lambda = 1.0 \times 10^{-6}$ C/m. We are interested in computing the value of the electric field at the point (3m, 3m).

   (a) Do a numerical estimate of the electric field by breaking the rod into 20 equal pieces, computing the approximate electric field at (3m, 3m) due to each piece, and then summing. A spreadsheet would be extremely helpful. (3 points)

   (b) Express the electric field at (3m, 3m) in terms of definite integrals by taking the limit as the number of intervals becomes infinite. (1 point)

   (c) Evaluate the definite integrals you found in part (b). You may use a computer to perform the evaluation. If you do so, please provide a hard copy of the program's output and specify which software you used. (3 points)

   (d) Now change to a *non-uniform charge density* $\lambda(x) = (x^2 + 1.0) \times 10^{-6}$ with outputs in C/m for inputs in m. Repeat part (a) for this situation. (3 points)

2. Use a calculator or spreadsheet and the Midpoint rule with 64 squares of equal size, to estimate the following double integral where $R = [0, 1] \times [0, 1]$.

$$\iint_R e^{-x^2-y^2}\, dA$$