Physics 121MA/Math 122PH

Spring 2005 Project 1 Name _____

Instructions: We encourage you to work with others in a small 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 in class on Monday, February 14.

Consider a surface charge density of the form

$$\sigma = \sigma_0 \exp\left[-\left(\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2\right)\right]$$

where σ_0, a, and b are constants while x and y are cartesian coordinates for the plane.

1. Let $a = b$. Take the charge to be distributed on a disk of radius R_0 centered at the origin.

    (a) Compute the total charge on the disk.

    (b) Compute the force exerted by this distribution of charge on a charge of size Q at the point $(0, 0, z_0)$.

2. Let $a = 0.2$ m and $b = 0.1$ m. Take the charge to be distributed on a square of side length 0.02 m centered at the origin.

    (a) Compute the total charge on the disk.

    (b) Compute the force exerted by this distribution of charge on a charge of size 10^{-6} C at the point $(0, 0, 0.4$ m$)$.