Assignment 4; Phys 191 Name ________________

1. (50 points) Calculate the electric field of a solid flat disk of radius R with uniform *surface* charge density σ, as measured at a height z above the center of the disk. (For a bit of surface area dA, the bit of charge is $dq = \sigma dA$.) *Hint:* Divide up the disk into infinitesimally thin rings and integrating up the electric field of the rings, using the ring result we obtained in class.

Take the limit $R \to \infty$ and verify that you get the result for an infinite plane, which is $\vec{E} = \pm\sigma/2\epsilon_0\,\hat{\mathbf{z}}$. ($\pm$ depending on whether you're above or below the plane.)

Note: The integrals you have to perform will be doable by hand, and not too difficult, but it's legitimate to look up results in integral tables or use software such as Wolfram Alpha.

2. (50 points) Calculate the electric field of a solid flat square of side length b with uniform *surface* charge density σ, as measured at a height z above the center of the square. (For a bit of surface area dA, the bit of charge is $dq = \sigma dA$.) *Hint:* Divide up the disk into thin strips (lines) along the x-axis and integrating up the electric field of the lines, using the line result we obtained in class.

Take the limit $b \to \infty$ and verify that you get the result for an infinite plane, which is $\vec{E} = \pm\sigma/2\epsilon_0\,\hat{\mathbf{z}}$. ($\pm$ depending on whether you're above or below the plane.)

Note: The integrals you have to perform will be doable by hand, but very difficult, and the results will be seriously ugly. It will be best to look up results in integral tables or use software such as Wolfram Alpha.