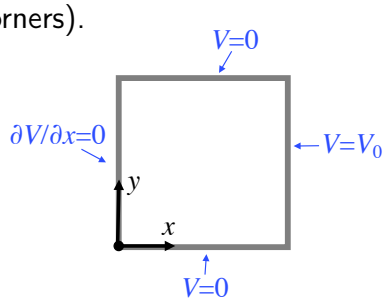
Homework 5

Due Date: All homework submitted by Sunday **10/04** 11:59pm will be graded together. Homework submitted past that time may be graded late. Submit your homework through Canvas as a single pdf file. Do not use solution sets from previous years. You are encouraged to discuss homework assignments with each other, the TAs or myself, but the solutions have to be executed and submitted individually.

Problem A. The Pipe [50%]. A square rectangular pipe (sides of length a) runs parallel to the z-axis (from $-\infty$ to $+\infty$) The 4 sides are maintained with boundary conditions given in the figure (Each of the 4 sides is insulated from the others at the corners).

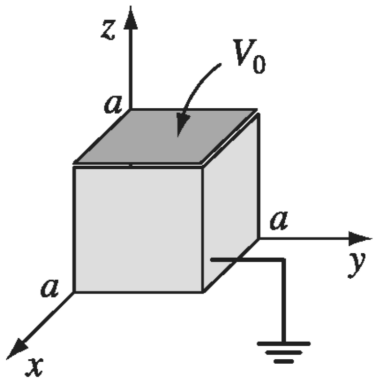


(1) Find the potential $V(x, y)$ at all points across the section of this pipe.

(2) Sketch the $\mathbf{E}$-field lines and equipotential contours inside the pipe. (Also, state in words what the boundary condition on the left wall means - what does it tell you? Is the left wall a conductor?)

(3) Find the charge density $\sigma(x, y = 0)$ everywhere on the bottom conducting wall ($y = 0$).

Problem B. The Box [50%]. A cubical box (sides of length a) consists of five metal plates, which are welded together and grounded (see below). The top is made of a separate sheet of metal, insulated from the others, and held at a constant potential V_0.



(1) Find the potential $V(x, y, z)$ inside the box.

(2) What should the potential at the center $(a/2, a/2, a/2)$ be? Check numerically that your formula is consistent with this value.