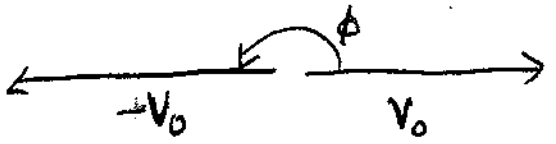
Spring 2004 #9 (p 1 of 1)

Consider the infinite two-dimensional conducting plane depicted in the figure. The right half is maintained at electrostatic potential V_0 while the left half is maintained at potential $-V_0$. What is the potential above the plane?



(see Fall 2003 #10, Spring 2003 #9, Spring 2005 #8)

since ϕ is restricted (does not range to 2π), the general solution to the potential is given by

$$\Phi(r,\phi) = (a_0 + b_0 \ln r)(c_0 + d_0 \phi)$$

Now, apply the boundary conditions

- $\Phi(r, \phi = 0) = V_0 = (a_0 + b_0 \ln r) c_0$

  since $V_0 \neq V_0(r)$, $b_0 = 0$

  Thus, $V_0 = a_0 c_0$

- $\Phi(r, \phi = \pi) = -V_0 = a_0 c_0 + a_0 d_0 \pi = V_0 + a_0 d_0 \pi$

$$\Rightarrow \quad a_0 d_0 = \frac{-2V_0}{\pi}$$

Thus, the potential is

$$\boxed{\Phi(r,\phi) = V_0 - \frac{2V_0}{\pi}\phi = V_0\left(1 - \frac{2}{\pi}\phi\right)}$$