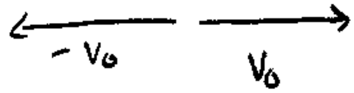
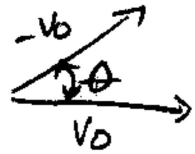
Spring 2003 # 9 (p 1 of 1)

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?



we can approach this problem the same way we would this problem



with $\theta = \pi$

Since the angle is restricted (That is, θ does not range to 2π), the general solution to the potential is

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

Now, apply boundary conditions.

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

  the only way to satisfy that the rhs equals a constant is for $b_0 = 0$.

  $$\Rightarrow V_0 = a_0 c_0$$

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

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

Thus,

$$\Phi(r,\theta) = a_0 c_0 + a_0 d_0 \theta = V_0 - \frac{2V_0}{\pi}\theta = \boxed{V_0\left(1 - \frac{2\theta}{\pi}\right)}$$

$\rightarrow$ verify that this potential satisfies boundary conditions!