Electromagnetic Theory HW4

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1 Problem 2.13

a) For a long cylinder with surface potentials independent of z the solution should have no z-dependence. The standard separation of Laplace's equation in polar coordinates produces the general series solution:

$$\begin{aligned}\Phi(\rho,\phi) =& A_0 + B\ln\rho + \sum_{n=1}^{\infty}\rho^n\left(A_n\cos n\phi + B_n\sin n\phi\right)\\ &+ \sum_{n=-1}^{-\infty}\rho^n\left(C_n\cos n\phi + D_n\sin n\phi\right)\end{aligned} \tag{1.1}$$

We need a solution that is regular at the origin and single-valued, so the negative series and the logarithmic term coefficients must be 0.

$$\Phi(\rho,\phi) = A_0 + \sum_{n=1}^{\infty}\rho^n\left(A_n\cos n\phi + B_n\sin n\phi\right) \tag{1.2}$$

We first solve for the A_0 coefficient using the provided boundary conditions on the cylinder inner surface.

$= \mathrm{V}_1, 0 \le \phi \le \pi$
V_2

2 Problem 2.15