$\underline{m=1}$ $A_1 a = B_1/a - E_0 a$

So $A_1 a = -E_0 a - \frac{\varepsilon}{\varepsilon_0} a A_1 - E_0 a = -2E_0 a - \frac{\varepsilon}{\varepsilon_0} a A_1$

$A_1 (1 + \frac{\varepsilon}{\varepsilon_0}) = -2E_0 \Rightarrow A_1 = -2E_0 \frac{\varepsilon_0}{\varepsilon + \varepsilon_0}$

and $B_1 = (A_1 + E_0) a^2 \Rightarrow B_1 = \frac{\varepsilon - \varepsilon_0}{\varepsilon + \varepsilon_0} a^2 E_0$

$\underline{m>1}$ $A_m a^m = B_m a^{-m}$

$= -\frac{\varepsilon}{\varepsilon_0} a^{2m} a^{-m} A_m \Rightarrow$

$A_m = -\frac{\varepsilon}{\varepsilon_0} A_m$! Can only be true if $\underline{A_m = 0}$!

So, at last, the suspense was killing me...

$$\underline{\phi_{in} = -2E_0 \frac{\varepsilon_0}{\varepsilon + \varepsilon_0} \rho \cos\varphi}$$

$$\underline{\phi_{out} = -E_0 \rho \cos\varphi + E_0 a^2 \frac{\varepsilon - \varepsilon_0}{\varepsilon + \varepsilon_0} \frac{1}{\rho} \cos\varphi}$$

$$\vec{E}_{in} = -\frac{\partial}{\partial x}\left(-2E_0 \frac{\varepsilon_0}{\varepsilon + \varepsilon_0} x\right)\hat{x} = 2\frac{\varepsilon_0}{\varepsilon + \varepsilon_0} E_0 \hat{x}$$

$$\vec{E}_{in} = \frac{2}{K_e + 1} E_0 \hat{x}$$

$$\vec{P}_{in} = \chi \varepsilon_0 \vec{E}_{in} = (K_e - 1)\varepsilon_0 \vec{E}_{in} = \frac{2(K_e - 1)}{K_e + 1} \varepsilon_0 E_0 \hat{x}$$

depolarizing factor????

$$\vec{E}_{loc} = \vec{E}_{in} - \vec{E}_0 = \left(\frac{2}{K_e + 1} - 1\right) E_0 \hat{x} = -\frac{K_e - 1}{K_e + 1} E_0 \hat{x}$$

$$\Rightarrow \vec{E}_{loc} = -\frac{1}{2\varepsilon_0} \vec{P} \Rightarrow \underline{N = 1/2}$$