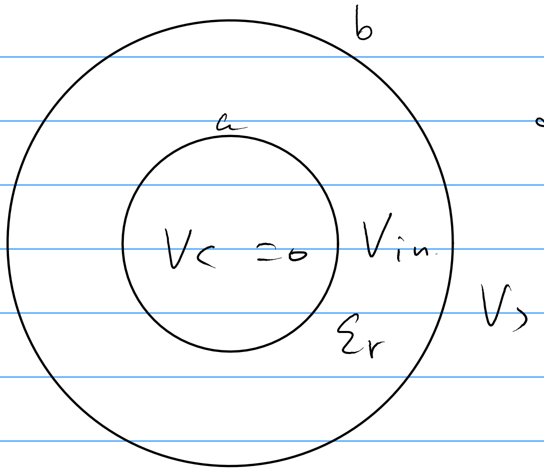
Correction to 4.24 soln.

I treated the $r<a$ region as vacuum, while it should be a conductor. Here's the corrected soln:



Since the only angular dependent boundary condition is

$$V(r\to\infty) = -Er\cos\theta,$$

we'll propose that

$$V_s = \left(-Er + \frac{B}{r^2}\right)\cos\theta$$

$$V_{in} = \left(Ar + \frac{C}{r^2}\right)\cos\theta.$$

b.c.: @ $r=b$:

$$V_s(b) = V_{in}(b)$$

$$\Rightarrow \frac{B}{b^3} - E = \frac{C}{b^3} + A. \quad ①$$

$$D_{s\perp}(b) = D_{in\perp}(a)$$

$$\Rightarrow \varepsilon_r\left(A - \frac{2C}{b^3}\right) = -E - \frac{2B}{b^3} \quad ②$$

@ $r=a$: $V_{in}(a)=0 \Rightarrow A + \frac{C}{a^3} = 0 \quad ③$

$$③ \Rightarrow C = -Aa^3$$

$$①\,\&\,③ \Rightarrow E = B\left(\frac{1}{b^3}\right) + A\left(\frac{a^3}{b^3} - 1\right) \quad ④$$

$$② \Rightarrow E = -\varepsilon_r\left(1+\frac{2a^3}{b^3}\right)A - \frac{2B}{b^3} \quad ⑤$$

$$④ - ⑤ \Rightarrow 0 = 3B + \left[a^3(1+2\varepsilon_r) + b^3(\varepsilon_r - 1)\right]A$$

$$\Rightarrow B = -\frac{1}{3}\left[\varepsilon_r(2a^3+b^3) + (a^3-b^3)\right]A.$$

$2 \times ④ + ⑤$

$$\Rightarrow 3b^3E_0 = \left[2(a^3-b^3) - \varepsilon_r(b^3+2a^3)\right]A$$

$$\Rightarrow A = \frac{3b^3E_0}{2(a^3-b^3) - \varepsilon_r(b^3+2a^3)}$$

$$\Rightarrow V_{in} = A\left(r - \frac{a^3}{r^2}\right)\cos\theta$$