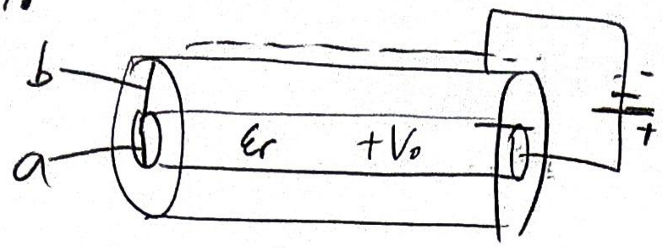
1.



$\vec{E} = ?$

$\oint \vec{D} \cdot d\vec{s} = \rho_L dl$

$D_\rho \underbrace{\int ds}_{2\pi\rho \cdot L} = \rho_L \times L$

$D_\rho = \frac{\rho_L}{2\pi\rho}$

$\vec{D} = \frac{\rho_L}{2\pi\rho} \vec{a}_\rho \; [C/m^2]$

(b) $\vec{E} = \frac{\rho_L}{2\pi\varepsilon\rho} \vec{a}_\rho \; [V/m]$

$V = -\int_b^a \frac{\rho_L}{2\pi\varepsilon\rho} \cdot d\rho$

$= \frac{\rho_L}{2\pi\varepsilon} \int_a^b \frac{1}{\rho} d\rho = \frac{\rho_L}{2\pi\varepsilon} \cdot [\ln\rho]_a^b = \frac{\rho_L}{2\pi\varepsilon} \cdot (\ln b - \ln a) = \frac{\rho_L}{2\pi\varepsilon} \cdot \left(\ln\frac{b}{a}\right) [V]$ (a)

$C = \frac{Q}{V} = \frac{\rho_L \times L}{\frac{\rho_L}{2\pi\varepsilon}\left(\ln\frac{b}{a}\right)} = \frac{2\pi\varepsilon L}{\ln\frac{b}{a}} [F]$

$C' = \frac{C}{L} = \frac{2\pi\varepsilon}{\ln\frac{b}{a}} [F/m]$ -- (c)

(d) $\rho_{ps} = \vec{P} \cdot \vec{a_n} =$

$\vec{P} = \chi_e \varepsilon_0 \vec{E} = (\varepsilon_r - 1)\varepsilon_0 \cdot \frac{\rho_L}{2\pi\varepsilon\rho} \vec{a}_\rho \; [C/m^2]$

$\left(\begin{array}{l} 1 + \chi_e = \varepsilon_r \\ \chi_e = \varepsilon_r - 1 \end{array} \right)$

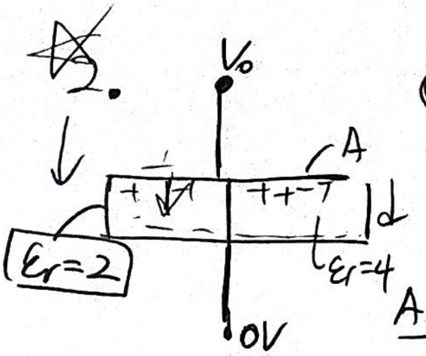
$\vec{P} = (\varepsilon - \varepsilon_0)$

$\rho_{ps} = \underbrace{(\varepsilon_r - 1)}_{\chi_e}\varepsilon_0 \cdot \frac{\rho_L}{2\pi\varepsilon\rho} \vec{a}_\rho \cdot \vec{a}_\rho \Rightarrow \boxed{\rho_{ps} = (\varepsilon_r - 1)\varepsilon_0 \cdot \frac{\rho_L}{2\pi\varepsilon\rho} [C/m^2]}$

(e) $\rho_{pv} = -\nabla \cdot \vec{P} = -\frac{1}{\rho}\frac{\partial \rho \cdot P_\rho}{\partial \rho} = -\frac{1}{\rho} \cdot \underbrace{\frac{\partial \frac{\rho_L}{2\pi\varepsilon}}{\partial \rho}}_{0} = 0$

$\boxed{\rho_{pv} = 0}$ $[C/m^3]$

~~2~~.



$A \gg d$

ⓐ $C = \frac{Q}{V} = \frac{\varepsilon A}{d} = 10 \cdot 10^{-9} [F]$

$\vec{E} =$

$\oint \vec{D} d\vec{s} = \int \rho_s ds$

$D_n \int ds = \rho_s \int ds$

$D_n = \rho_s$

$\vec{D} = \rho_s \vec{a_n}$

$\vec{E} = \frac{\rho_s}{\varepsilon} \vec{a_n}$

(b) $\vec{D} = \rho_s \vec{a_n}$

$\vec{E} = \frac{\rho_s}{\varepsilon_0 \varepsilon_r} \vec{a_n}$

$= \frac{\rho_s}{2\varepsilon_0} \vec{a_n}$

(c) $\vec{D} = \rho_s \vec{a_n}$

$\vec{E} = \frac{\rho_s}{\varepsilon_0 \varepsilon_r} \vec{a_n}$

$\vec{E} = \frac{\rho_s}{4\varepsilon_0} \vec{a_n}$

$1 + \chi_e = \varepsilon_r$

(d) $\rho_{ps} = \vec{P} \cdot \vec{a_n} = \vec{E} \cdot \chi_e \cdot \varepsilon_0 \cdot \vec{a_n} = -1 \cdot \varepsilon_0 \vec{E} = -\varepsilon_0 \vec{E} = \frac{-\rho_s}{2} [C/m^2]$

(e) $\rho_{ps} = \vec{P} \cdot \vec{a_n} = \vec{E} \cdot \chi_e \varepsilon_0 (-\vec{a_n}) = -\varepsilon_0 \vec{E} = -\frac{\rho_s}{4} [C/m^2]$

$C_1 = \frac{\varepsilon A}{d}$ $\quad$ $C_2 = \frac{\varepsilon_0 \varepsilon_r A}{d}$

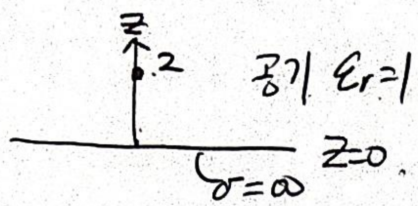
$= \frac{2\varepsilon_0 A}{d}$ $\quad$ $= \frac{4\varepsilon_0 A}{d}$

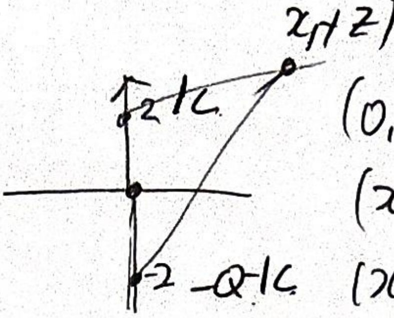
$C_1 + C_2 = \frac{6\varepsilon_0 A}{d}$

평행
병렬

2. $C = \frac{\varepsilon A}{d} = \underline{\frac{\varepsilon S}{d}}$

3.





$(0,0,2)$

$(x,y,z) - (0,0,2)$

$(x,y,z) - (0,0,-2)$

$(x, y, z-2) \quad |\vec{R_1}|^2 = x^2 + y^2 + (z-2)^2$

$(x, y, z+2) \quad |\vec{R_2}|^2 = x^2 + y^2 + (z+2)^2$

$$\vec{E} = \frac{1C}{4\pi\varepsilon_0} \cdot \left(\frac{x\vec{a}_x + y\vec{a}_y + (z-2)\vec{a}_z}{(x^2+y^2+(z-2)^2)^{\frac{3}{2}}} - \frac{x\vec{a}_x + y\vec{a}_y + (z+2)\vec{a}_z}{(x^2+y^2+(z+2)^2)^{\frac{3}{2}}} \right)$$

$$\underline{\rho_s \Rightarrow \vec{E} \cdot \vec{a}_z = \frac{1}{4\pi\varepsilon_0} \cdot \left(\frac{(z-2)}{(x^2+y^2+(z-2)^2)^{\frac{3}{2}}} - \frac{(z+2)}{(x^2+y^2+(z+2)^2)^{\frac{3}{2}}} \right)}$$

$\downarrow \times \varepsilon_0 \quad \underline{z=0}$

$$= \frac{\varepsilon_0}{4\pi\varepsilon_0} \left(\frac{-2}{(x^2+y^2+4)^{\frac{3}{2}}} - \frac{2}{(x^2+y^2+4)^{\frac{3}{2}}} \right)$$

$$= \frac{\varepsilon_0}{4\pi\varepsilon_0} \left(\frac{-4}{(x^2+y^2+4)^{\frac{3}{2}}} \right)$$

$$= \frac{-4}{4\pi} \cdot \frac{1}{(x^2+y^2+4)^{\frac{3}{2}}} \Big|_{(0,0,0)} = \frac{-1}{\pi} \times \frac{1}{(4)^{\frac{3}{2}}} =$$

$$\frac{-1}{\pi} \times \frac{1}{8} = \underline{\frac{-1}{8\pi} [C/m^2]}$$

4. $\vec{E}$

(a) $\vec{J} = \sigma \vec{E}$ (A/m^2)

(b) $\vec{E} = 0$ $-\nabla V = 0$

(c) $\oint \vec{E} d\vec{l} = 0$

5. $\nabla \times \vec{E} = 0$, $\nabla \cdot \vec{D} = \rho_v$

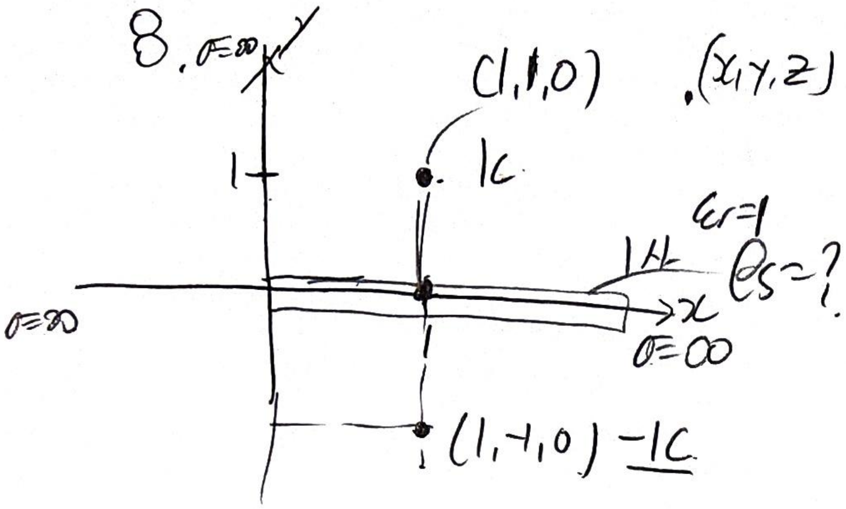
6. (a) $R = \dfrac{V}{I} = \dfrac{-\int \vec{E} d\vec{l}}{\sigma \int \vec{E} d\vec{s}}$ $[\Omega]$

(b) $C = \dfrac{Q}{V} = \dfrac{\varepsilon \int \vec{E} d\vec{s}}{-\int \vec{E} d\vec{l}}$ $[F]$

7. $\oint \vec{E} d\vec{l} = 0$

$\oint \vec{J} d\vec{s} = I_{art}$

8.



$\vec{R_1}$ $(x,y,z)-(1,1,0) \rightarrow (x-1, y-1, z)$

$\vec{R_2}$ $(x,y,z)-(1,-1,0) \rightarrow (x-1, y+1, z)$

$$\vec{E}=\frac{+1}{4\pi\varepsilon_0}\left(\frac{(x-1)\vec{a_x}+(y-1)\vec{a_y}+z\vec{a_z}}{((x-1)^2+(y-1)^2+z^2)^{\frac{3}{2}}}-\frac{(x-1)\vec{a_x}+(y+1)\vec{a_y}+z\vec{a_z}}{((x-1)^2+(y+1)^2+z^2)^{\frac{3}{2}}}\right)$$

$\rho_s=\varepsilon_0 \vec{E}|_{y=0}$

$$E_y=\frac{1}{4\pi\varepsilon_0}\left(\frac{y-1}{((x-1)^2+(y-1)^2+z^2)^{\frac{3}{2}}}-\frac{y+1}{((x-1)^2+(y+1)^2+z^2)^{\frac{3}{2}}}\right)$$

$y=0$

$$\frac{1}{4\pi\varepsilon_0}\left(\frac{-1}{((x-1)^2+1+z^2)^{\frac{3}{2}}}-\frac{1}{((x-1)^2+1+z^2)^{\frac{3}{2}}}\right)$$

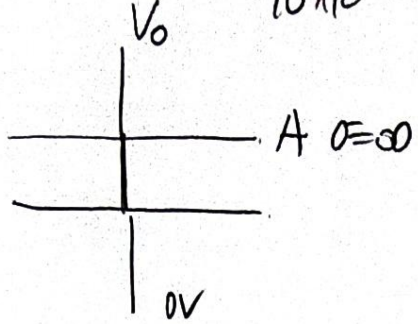
$(1,0,0)$

$$\frac{1}{4\pi\varepsilon_0}\left(\frac{-1}{(0+1+0)^{\frac{3}{2}}}-\frac{1}{(0+1+0)^{\frac{3}{2}}}\right)$$

$$\frac{-2}{4\pi\varepsilon_0}\times\varepsilon_0 \qquad \frac{-2}{4\pi}=\frac{-\pi}{2}$$

$$\boxed{\rho_s=-\frac{\pi}{2}\,[C/m^2]}$$

9.



10×10^{-9} [F]

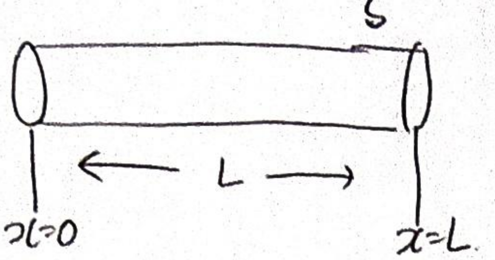
$\oint \vec{D}\, d\vec{s} = \int \rho_s\, ds$

$D_n \cdot \int ds = \rho_s \int ds$

$\underline{D_n = \rho_s}$

$\underline{\vec{D} = \rho_s \vec{a_n}}$

☆10.



$\vec{P} = ax^2 \vec{a_x}$

(a) $x=L$

$\rho_{ps} = \vec{P} \cdot \vec{a_x} = ax^2$ [C/m²]

$= aL^2$

$x=0$

$\rho_{ps} = \vec{P} \cdot -\vec{a_x} = -ax^2$ [C/m²]

$= 0$ [C/m²]

(b) $\rho_{pv} = -\nabla \cdot \vec{P}$

$= -\frac{\partial P_x}{\partial x} = -2ax$