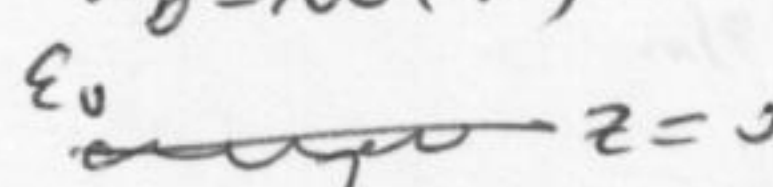


# Quiz (Exercises)

1)  $E_0 = 100 \text{ (V)}$   
 $\epsilon_0$    $z=0$   
 $\rho_s = -5 \cdot 10^{-10} \text{ (C/m}^2\text{)}$   
 $E_1 = ?$   
 $\epsilon_1 = 2\epsilon_0$

$$D_{N1} - D_{N0} = \rho_s$$

$$D_{N1} = \rho_s + D_{N0}$$

$$2\epsilon_0 E_1 = \rho_s + \epsilon_0 E_0$$

$$E_1 = \frac{\epsilon_0 E_0 + \rho_s}{2\epsilon_0} = \frac{100\epsilon_0 + (-5 \cdot 10^{-10})}{2\epsilon_0} = 25 \text{ (V/m)}$$

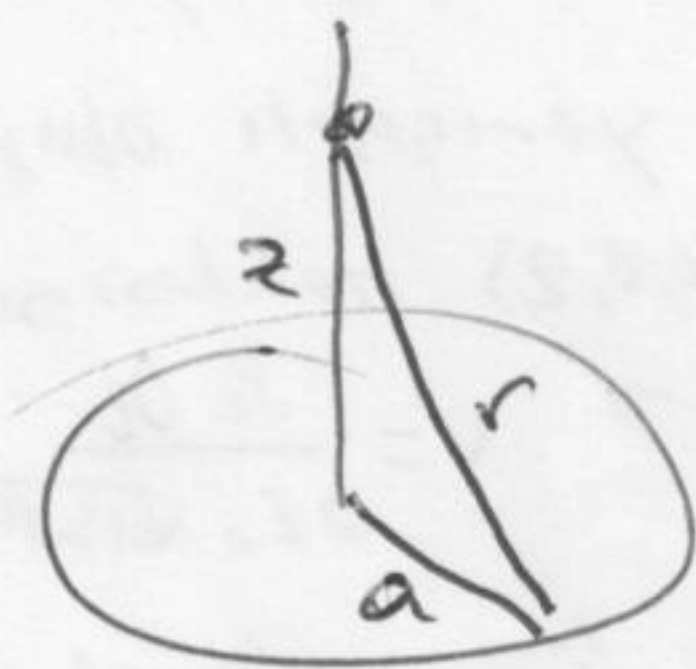
2)  $|\vec{D}| = \epsilon_0 \epsilon_r |\vec{E}| = 8.85 \cdot 10^{-12} \cdot 225 \cdot 10^4 = 2.257 \cdot 10^{-5} \text{ (C/m}^2\text{)}$

$$\kappa_e = \epsilon_r - 1 = 254$$

$$|\vec{P}| = \kappa_e \epsilon_0 |\vec{E}| = 254 \cdot 8.85 \cdot 10^{-12} \cdot 10^4 = 2.25 \cdot 10^{-5} \text{ (C/m}^2\text{)}$$

$$V = |\vec{E}| \cdot d = 10^4 \cdot 10^{-3} \cdot 1.5 = 15 \text{ (V)}$$

3)



$$r = \sqrt{z^2 + a^2}$$

$$V = \int \frac{\rho_L d\ell}{4\pi\epsilon_0 \sqrt{a^2 + z^2}}$$

$$d\ell = a d\phi$$

$$V = \frac{q\epsilon_0}{4\pi\epsilon_0 \sqrt{a^2 + z^2}} \int_0^{2\pi} d\phi = \frac{q\epsilon_0}{2\epsilon_0 \sqrt{a^2 + z^2}}$$

$$\vec{E} = -\vec{\nabla} V = -\vec{a}_z \frac{\partial}{\partial z} \left[ \frac{q\epsilon_0}{2\epsilon_0 \sqrt{a^2 + z^2}} \right] = -\vec{a}_z \frac{q\epsilon_0}{2\epsilon_0} \frac{\partial}{\partial z} (a^2 + z^2)^{-1/2} =$$

$$\vec{E} = -\vec{a}_z \frac{q\epsilon_0}{2\epsilon_0} \left(-\frac{1}{2}\right) (a^2 + z^2)^{-3/2} \cdot 2z = +\vec{a}_z \frac{q\epsilon_0}{2\epsilon_0} \frac{z}{(a^2 + z^2)^{3/2}}$$

$$\vec{E}|_{z=a} = \vec{a}_z \frac{q\epsilon_0 a^2}{2\epsilon_0} \frac{4a}{17^{3/2} a^3} = \vec{a}_z \frac{2a}{(17)^{3/2}} \text{ (N/m)}$$

$\rho_L = \epsilon_0 a^2$