Alan Teorisi

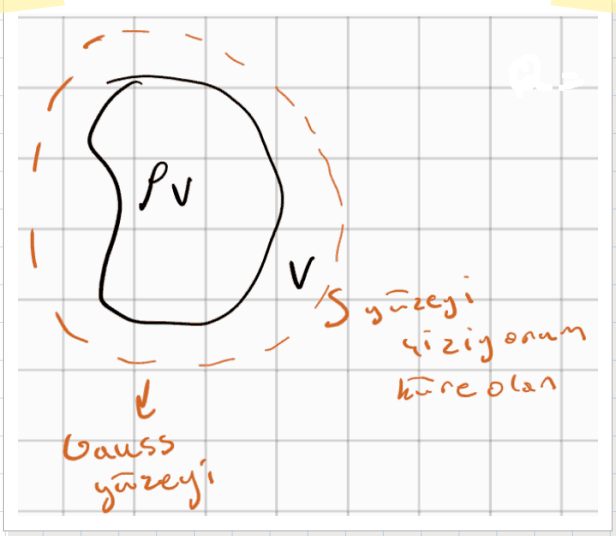
Gauss yasası uygulamaları: küre ve silindir

Orijinal not: Ugulama6.pdf

UYARI Bu belge, el yazısı ders notlarından Claude (Anthropic) yardımıyla dijitale aktarılmıştır. Yardımcı kaynak olarak hazırlanmıştır; hata veya eksik içerebilir. Lütfen orijinal notları ve ders kaynaklarını esas alın.

NOTICE *This document was transcribed from handwritten lecture notes with the help of Claude (Anthropic). It is meant as a supplementary resource and may contain errors or omissions. Always check against the original notes and official course material.*

orj. s. 1



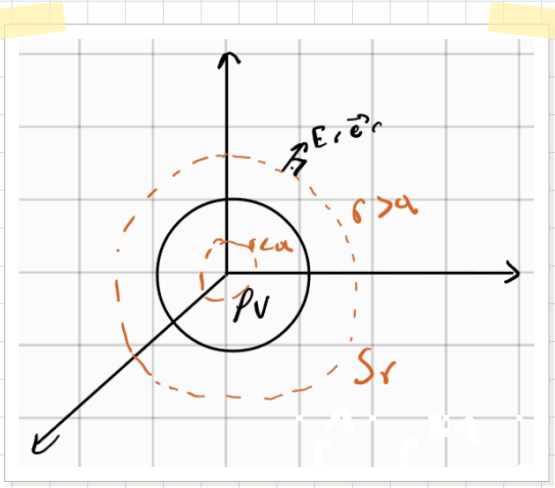
orijinal çizim, s. 1

$$Q = \int_V \rho_v \, dV \qquad \vec{D} = \varepsilon_0 \vec{E}$$

$$\oint_S \vec{D} \cdot d\vec{s} = Q$$

S32 Pr.1

S17 Pr.1'i : gauss ile çözünüz



orijinal çizim, s. 1

$$\oint_{S_r} \varepsilon_0 \vec{E} \cdot d\vec{s} = Q$$

$\vec{E} = E_r \vec{e}_r + \cancel{E_\theta \vec{e}_\theta} + \cancel{E_\phi \vec{e}_\phi}$ sadece yarıçapa bağlı

$$\vec{E} = E_r(r)\,\vec{e}_r$$

$$d\vec{s} = r^2 \sin\theta \, d\theta \, d\phi \, \vec{e}_r$$

$$\int_{\theta=0}^{\pi} \int_{\phi=0}^{2\pi} \varepsilon_0 E_r(r)\,\vec{e}_r\, r^2 \sin\theta \, d\theta \, d\phi \, \vec{e}_r = Q$$

$$4\pi\varepsilon_0 r^2 E_r(r) = Q \Rightarrow E_r(r) = \frac{Q}{4\pi\varepsilon_0 r^2}$$

$$\boxed{\vec{E} = \frac{Q}{4\pi\varepsilon_0}\frac{\vec{e}_r}{r^2}}$$

$r < a$

$$Q = \int_V \rho_v \, dV$$

$$= \int_{r'=0}^{r} \int_{\theta'=0}^{\pi} \int_{\phi'=0}^{2\pi} \rho_v r'^2 \sin\theta' \, dr' \, d\phi' \, d\theta'$$

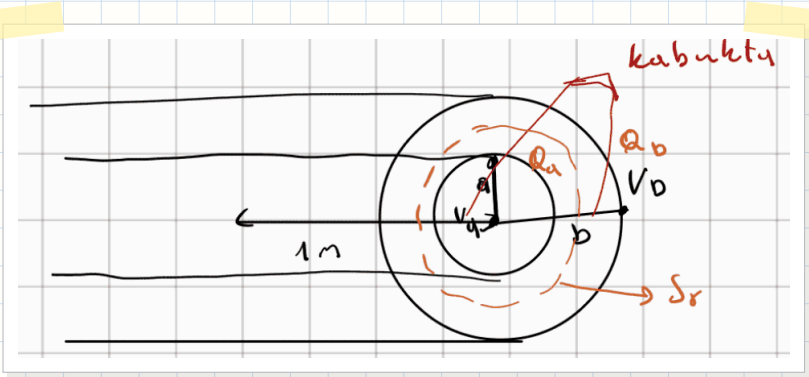
$$= \frac{4\pi r^3}{3}\rho_v$$

orj. s. 2

Sayfa 32 Pr.2

S26 Pr.5'i gauss ile çözünüz. $V(\infty) = 0$ halinde içteki ve dıştaki silindirin birim yükseklikteki kısmında bulunan yükü V_a ve V_b cinsinden yazınız.

iç içe iki silindir



orijinal çizim, s. 2

$$\vec{E} = E_\rho \vec{e}_\rho + E_\phi \vec{e}_\phi + E_z \vec{e}_z$$

$$\vec{E} = E_\rho(\rho)\vec{e}_\rho \qquad d\vec{s} = \rho\, d\phi\, dz\, \vec{e}_\rho$$

$a < \rho < b$

$$\oint_{S_r} \vec{D} \cdot d\vec{s} = Q_a \Rightarrow \int_{z=0}^{1}\int_{\phi=0}^{2\pi} \varepsilon_0 E_\rho(\rho)\, \rho\, d\phi\, dz = Q_a \text{ olur}$$

$$2\pi\rho\, \varepsilon_0 E_\rho(\rho) = Q_a \text{ olur}$$

$$\vec{E} = E_\rho(\rho)\vec{e}_\rho = \frac{Q_a}{2\pi\varepsilon_0\rho}\vec{e}_\rho$$

$$\vec{E} = -\text{grad}\, V$$

$$\frac{Q_a}{2\pi\varepsilon_0\rho}\vec{e}_\rho = -\frac{\partial V}{\partial \rho}\vec{e}_\rho$$

$$a < \rho < b \qquad V(\rho) = \frac{Q_a}{2\pi\varepsilon_0}\ln\left(\frac{1}{\rho}\right) + C$$

$$\rho = a \Rightarrow V_a = \frac{Q_a}{2\pi\varepsilon_0}\ln\left(\frac{1}{a}\right) + C$$

$$\rho = b \Rightarrow V_b = \frac{Q_a}{2\pi\varepsilon_0}\ln\left(\frac{1}{b}\right) + C$$

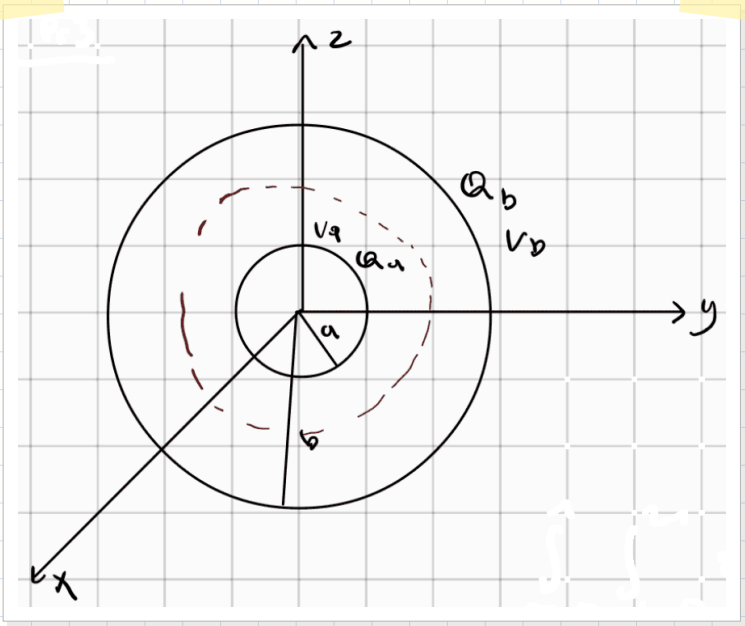
$$\rho > b \qquad \oint_S \vec{D} \cdot d\vec{s} = Q_a + Q_b$$

$$\vec{E} = \frac{Q_a + Q_b}{2\pi\varepsilon_0\rho}\vec{e}_\rho$$

orj. s. 3

$$V(\rho) = \frac{Q_a + Q_b}{2\pi\varepsilon_0}\ln\left(\frac{1}{\rho}\right) + D$$

S.32 Pr.3



orijinal çizim, s. 3

ispatla

$$\boxed{\frac{1}{a}Q_a + \frac{1}{b}Q_b = 4\pi\varepsilon_0 V_0}$$

olduğunu gösteriniz

$$a < r < b \qquad \oint_{S_r} \vec{D}\cdot d\vec{s} = Q_a$$

$$\vec{E} = E_r(r)\,\vec{e}_r, \qquad d\vec{s} = r^2 \sin\theta\, d\phi\, d\theta\, \vec{e}_r$$

$$\int_{\theta=0}^{\pi}\int_{\phi=0}^{2\pi} \varepsilon_0 E_r r^2 \sin\theta\, d\theta\, d\phi = Q_a$$

$$4\pi\varepsilon_0 r^2 E_r = Q_a$$

$$E_r = \frac{Q_a \vec{e}_r}{4\pi\varepsilon_0 r^2}, \qquad \vec{E} = -\operatorname{grad} V$$

$$\frac{Q_a \vec{e}_r}{4\pi\varepsilon_0 r^2} = -\frac{\partial V}{\partial r}\vec{e}_r$$

$$\boxed{V(r) = \frac{Q_a}{4\pi\varepsilon_0 r} + C}$$

$$V_a = \frac{Q_a}{4\pi\varepsilon_0 a} + C$$

$$-V_b = \frac{Q_b}{4\pi\varepsilon_0 b} + C$$

$$\boxed{V_a - V_b = \frac{Q_a}{4\pi\varepsilon_0}\left(\frac{1}{a} - \frac{1}{b}\right)}$$

[1] Claude notu: muhtemelen Q_a olmalı (sonuçtaki ifade Q_a içeriyor).

orj. s. 4

$$Q_a = \frac{(V_a - V_b)\,4\pi\varepsilon_0}{\left(\frac{1}{a} - \frac{1}{b}\right)}$$

$$r > b \qquad \oint_{S_r} \vec{D} \cdot d\vec{s} = Q_a + Q_b$$

$$\boxed{\vec{E} = \frac{Q_a + Q_b}{4\pi\varepsilon_0 r^2}\,\vec{e}_r}$$

Burdan $\vec{E} = -\text{grad}\,V \Rightarrow V(r) = \frac{Q_a + Q_b}{4\pi\varepsilon_0 r} + D$

$$V(\infty) = 0 \Rightarrow D = 0$$

$$V_b = \frac{Q_a + Q_b}{4\pi\varepsilon_0 b}$$

$$+\ V_a - V_b = \frac{Q_a}{4\pi\varepsilon_0}\left(\frac{1}{a} - \frac{1}{b}\right)$$

$$4\pi\varepsilon_0 V_a = \frac{Q_{\not a}}{\not b} + \frac{Q_b}{b} + \frac{Q_a}{a} - \frac{Q_{\not a}}{\not b}$$

$$\left(\frac{Q_a}{a} + \frac{Q_b}{b} = 4\pi\varepsilon_0 V_a\right)$$

⚠ Dikkat!

Önemli yerler

- Kolomb kanunu
- süperposition
- Enerji
- $\Delta V = 0$ sorusu gelebilir
- $\Delta V = -\frac{\rho}{\varepsilon_0}$: Poisson denklemi