Coulombs lov

$$\vec{E} = \frac{Q}{4\pi\epsilon_0}\frac{\hat{R}}{R^2}$$

Gauss lov

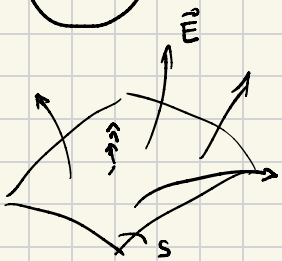
$$\oint_S \vec{E}\cdot d\vec{S} = \frac{Q}{\epsilon_0}$$

Q netto ladning innenfor S



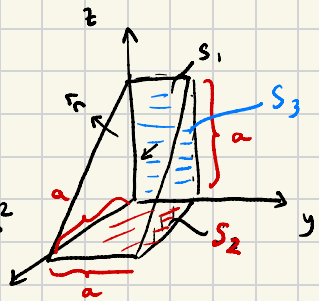
Fluks $\int_S \vec{E}\cdot d\vec{S}$

Uniform $\vec{E}$ plans $\Big\}$ $\vec{E}\cdot\vec{S}$



TEST

$$\vec{E} = E_0\hat{x}$$



$$\phi_1 = \int_{S_1}\vec{E}\cdot d\vec{S} = \vec{E}\cdot\vec{S}_1 = E_0 a^2$$

$$\phi_2 = \vec{E}\cdot\vec{S}_2 = 0$$

$$\phi_3 = \vec{E}\cdot\vec{S}_3 = E_0\hat{x}\cdot S_3\hat{x} = E_0 S_3 = E_0 a^2$$

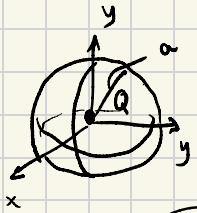
Gauss lov

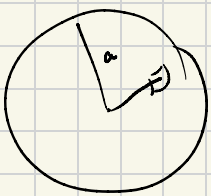
$$\oint_S \vec{E} \cdot d\vec{S} = \frac{Q}{\epsilon_0}$$

$$\vec{E} = \frac{Q}{4\pi\epsilon_0} \frac{\hat{R}}{R^2} = \frac{Q}{4\pi\epsilon_0} \frac{\hat{r}}{r^2}$$

$$\vec{R} = \vec{r} - \vec{r}\,' = \vec{r}$$

($\vec{r}\,' = \vec{0}$, $\hat{r}\, dS = d\vec{S}$)





$$\oint_S \vec{E} \cdot d\vec{S} = \oint_S \frac{Q}{4\pi\epsilon_0} \frac{\hat{r}}{r^2} \cdot d\hat{S}$$

$$= \frac{Q}{4\pi\epsilon_0} \frac{1}{a^2} \underbrace{\oint_S dS}_{4\pi a^2}$$

$$= \frac{Q}{4\pi\epsilon_0} \frac{4\pi a^2}{a^2} = \frac{Q}{\epsilon_0}$$

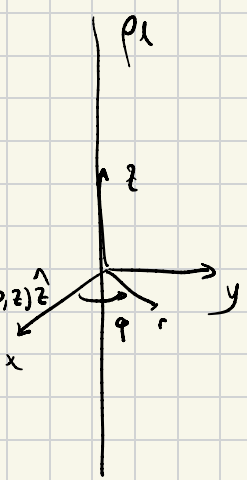
Hvordan finne $\vec{E}$ med Gauss lov?

$$\oint_S \underbrace{\vec{E} \cdot d\vec{S}}_{} = \frac{Q}{\epsilon_0}$$

$$\vec{E} = \vec{E}(r, \varphi, z)$$

$$= E_r(r,\varphi,z)\hat{r} + E_\varphi(r,\varphi,z)\hat{\varphi} + E_z(r,\varphi,z)\hat{z}$$

$$= E_r(r)\hat{r} + E_\varphi(r)\hat{\varphi} + E_z(r)\hat{z}$$



Argument: $\oint_C \vec{E} \cdot d\vec{r} = 0$ C: konstant r

$\Rightarrow E_\varphi = 0$

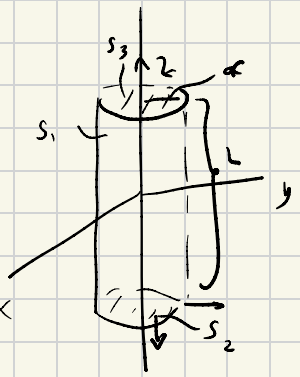
$$\oint_S \vec{E} \cdot d\vec{S} = \frac{Q}{\epsilon_0}$$

$$\oint_S E_r(r)\hat{r} \cdot d\vec{S} = \frac{Q}{\epsilon_0}$$

$$\oint_{S_1} E_r(r)\hat{r} \cdot \underbrace{d\vec{S}}_{\hat{r}\,dS} + \underbrace{\int_{S_2} E_r(r)\hat{r} \cdot d\vec{S}}_{0} + \underbrace{\int_{S_3} E_r(r)\hat{r} \cdot d\vec{S}}_{0}$$

$$\int_{S_1} E_r(r) \underbrace{\hat{r} \cdot \hat{r}}_{=1} dS = E_r(r) \int_{S_1} dS = E_r(r)\, 2\pi r L = \frac{Q}{\epsilon_0}$$

$$\boxed{E_r(r) = \frac{Q/L}{2\pi\epsilon_0 r}}$$



Metode Finn $\vec{E}(\vec{r})$ med Gauss lov

(1) Finn symmetrien $\vec{E}(\vec{r}) = E_r(r)\hat{r}$

(2) Velger en overflate, S, slik at $\vec{E} \cdot \hat{n}$ = konstant på overflaten

(3) Finn $\oint_S \vec{E} \cdot d\vec{S}$ (Husk S må være lukket)

(4) Setter E utenfor integralet

(5) Finn integralet og løs likningen for E

TEST

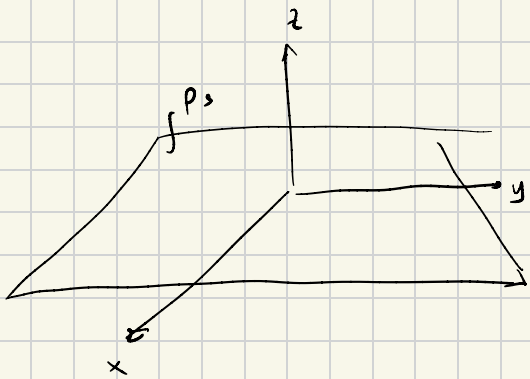
Kuleskall



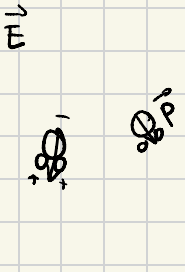
$$\vec{E}(\vec{r}) = \overset{?}{\cdot} = E_r(r)\hat{r}$$

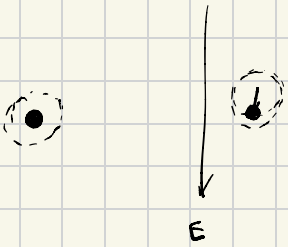
Kulekoordinater

$\vec{E}(\vec{r}) = ? = E_z(z)$



Polarisasjon



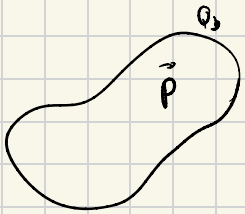


$$\vec{P} = \chi_e \epsilon \vec{E}$$



$$\vec{P} = \frac{1}{\Delta v} \sum \vec{p}_i$$

$$Q_b = -\int_S \vec{P} \cdot d\vec{S}$$



$$\vec{D} = \epsilon_0 \vec{E} + \vec{P} \quad , \left(\vec{P} = \chi_e \epsilon_0 \vec{E}\right)$$

Gauss lov

$$\oint_S \vec{D} \cdot d\vec{S} = Q_{fri} \quad ; \quad \vec{D} = \epsilon \vec{E}$$