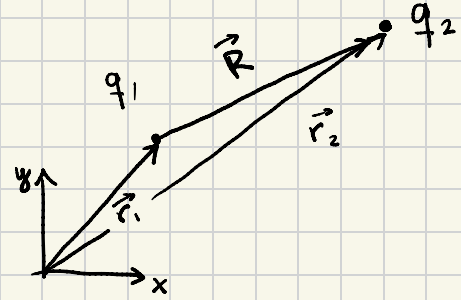
Coulombs lov

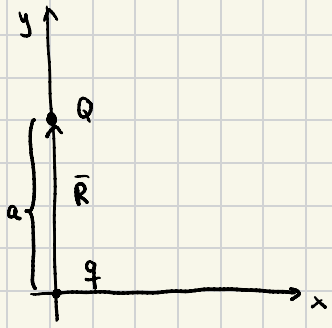
$$\vec{F}_{\text{på 2 fra 1}} = \frac{q_1 q_2}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$$

$\hat{R}$ — enhetsvektor

$$\vec{F}_g = -G \frac{m_1 m_2}{R^2} \hat{R}$$



Oppgave



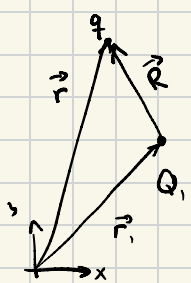
$$\vec{F} = \frac{qQ}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}, \quad \hat{R} = (0,1), \quad R = a^2$$

$$= \frac{qQ}{4\pi\epsilon_0 a^2} \underbrace{(0,1)}_{\hat{y}}$$

Elektrisk felt

Coulombs lov gir kraft: $\vec{F} = \frac{qQ_1}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$

$$= q \underbrace{\frac{Q_1}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}}_{\vec{E}(\vec{r})}$$

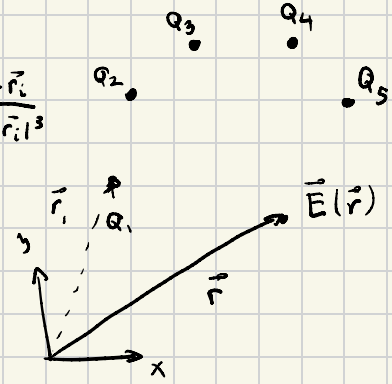


Elektrisk felt:

$$\vec{E}(\vec{r}) = \frac{Q_1}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}, \quad \vec{R} = \vec{r} - \vec{r}_1, \quad R = |\vec{R}| \quad \hat{R} = \frac{\vec{R}}{|\vec{R}|}$$

$$\vec{E}(\vec{r}) = \sum_{i=1}^{N} \frac{Q_i}{4\pi\epsilon_0} \frac{\hat{R}_i}{R_i^2} = \sum_{i=1}^{N} \frac{Q_i}{4\pi\epsilon_0} \frac{\vec{r} - \vec{r}_i}{|\vec{r} - \vec{r}_i|^3}$$

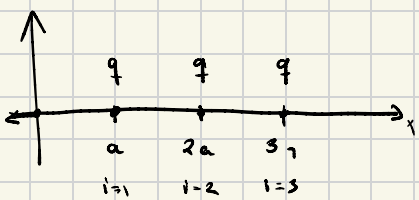
$$\vec{R}_i = \vec{r} - \vec{r}_i$$



Eksempel

$$\vec{E}(0) = \sum_{i=1}^{\infty} \frac{q}{4\pi\epsilon_0} \frac{(-1,0)}{(i\cdot a)^2}$$

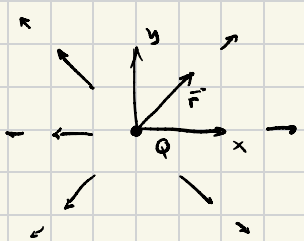
$$= \frac{q}{4\pi\epsilon_0 a}(-1,0) \sum_{i=1}^{\infty} \frac{1}{i^2}$$



Eksempel

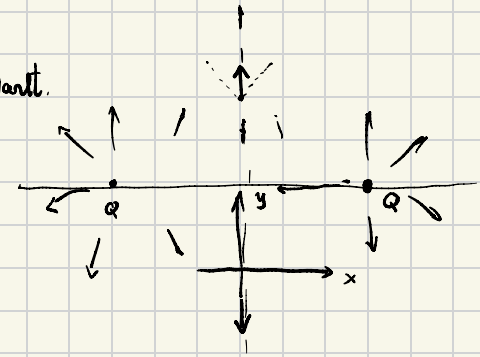
$$\vec{E}(\vec{r}) = \frac{Q}{4\pi\epsilon_0} \frac{\hat{r}}{r^2}$$

$$\vec{R} = \vec{r} - \vec{r}_1 \overset{\vec{r}_1 = \vec{0}}{=} \vec{r}$$

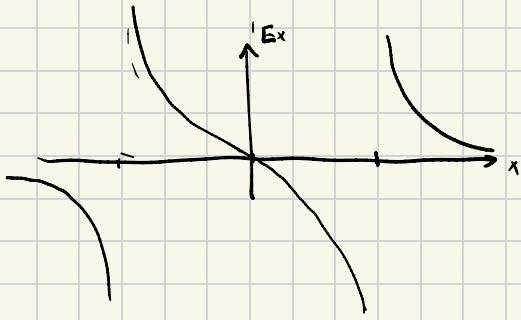


Eksempel

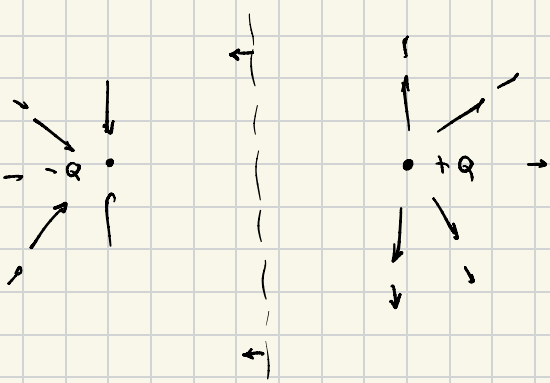
Skisser det elektriske feltet i xy-planet.



Finn $E_x(x)$ langs x-aksen



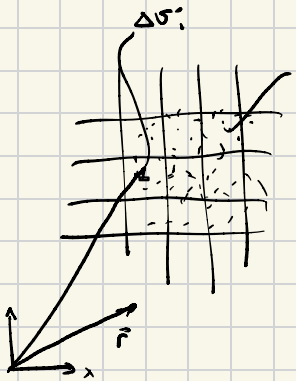
Eksempel



Kontinuerlige ladningsfordelinger

$$\vec{E} = \sum_i \frac{Q_i}{4\pi\epsilon_0} \frac{\vec{R}_i}{R_i^3}$$

Q_i: ladning i boks; $\vec{R}_i$: posisjon til boks.



$$N_i q = \frac{N_i}{V} V q$$

$$= \frac{N_i q}{V} V$$

$$= \rho_v V$$

ρ_v: romladningstetthet

$$Q_i = \rho_v(\vec{r}_i)\,\Delta v_i$$

$$\vec{E} = \sum_i \frac{\rho_v(\vec{r}_i)\,\Delta v_i}{4\pi\epsilon_0} \frac{\vec{R}_i}{R_i^3} \rightarrow \iiint_v \frac{\rho_v(\vec{r}_i)}{4\pi\epsilon_0} \frac{\vec{R}_i}{R_i^3}\, dv$$

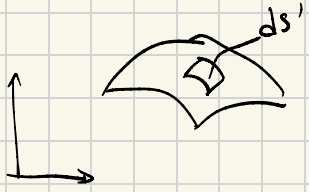
Synliggjør at integralet ikke er over $\vec{r}$!

$$\vec{E}(\vec{r}) = \iiint \frac{\rho(\vec{r}')}{4\pi\epsilon_0} \frac{\vec{r}-\vec{r}'}{|\vec{r}-\vec{r}'|^3}\, dv'$$

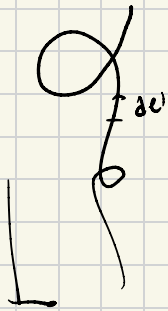
$dv' = dx'\,dy'\,dz'$



$$\iiint_v \frac{\rho(\vec{r}')\,dv'}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$$



$$\iint_S \frac{\rho_s(\vec{r}')\,ds'}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$$



$$\int_C \frac{\rho_l(\vec{r})\,dl'\,\hat{R}}{4\pi\epsilon_0 R^2}$$