0538 645 50 46

ELEKTRİK ALANLAR

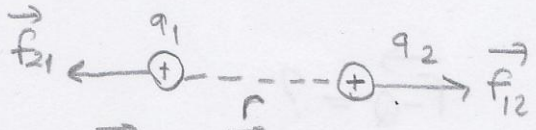
* $q = N \cdot |e|$
  - Toplam Yük
  - Yük Sayısı
  - 1 elektron (ya da proton) yükü

* $|e| = 1,6 \cdot 10^{-19} C$

1 C → kaç elektrik yükü dur?

$1 C = N \cdot 1,6 \cdot 10^{-19} C$

$N \cong 10^{18}$



$\vec{f}_{12} + \vec{f}_{21} = 0$

$\vec{F}_{12} = -\vec{f}_{21}$ (zıt yönde)

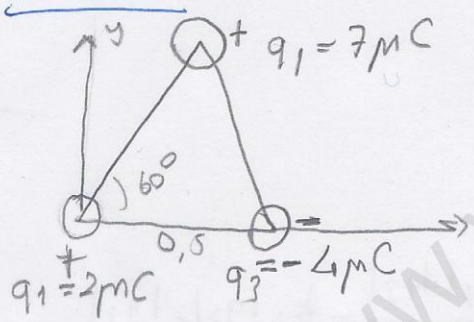
* $F_{12} = f_{21} = f = k \cdot \frac{|q_1| \cdot |q_2|}{r^2}$

Coulomb Yasası

* $k = \frac{1}{4\pi \cdot \varepsilon_0} = 8,89 \cdot 10^{-9} \frac{N \cdot m^2}{C^2} \cong 9 \cdot 10^9 \frac{N \cdot m^2}{C^2}$ = Coulomb Sabiti

* $\varepsilon_0 = 8,85 \cdot 10^{-12} \frac{C^2}{N \cdot m^2}$ → Boş uzayın elektriksel geçirgenliği

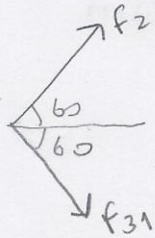
Örnek:



q_1 üzerine etkiyen elektriksel kuvvet nedir?

$F_{21} = \frac{k \cdot |q_1| \cdot |q_2|}{r^2} = \frac{9 \cdot 10^9 \cdot 7 \cdot 10^{-6} \cdot 2 \cdot 10^{-6}}{(5 \cdot 10^{-1})^2} = 0,504 N$

$F_{31} = \frac{k \cdot |q_1| \cdot |q_3|}{r^2} = \frac{9 \cdot 10^9 \cdot 7 \cdot 10^{-6} \cdot 4 \cdot 10^{-6}}{(5 \cdot 10^{-1})^2} = 1,008 N$



$\vec{f}_{21} = f_{21x} \cdot \vec{i} + f_{21y} \cdot \vec{j}$

$= (f_{21} \cdot \cos 60)\, i + (f_{21} \cdot \sin 60)\, j = (0,504 \cdot \frac{1}{2})\vec{i} + (0,504 \cdot \frac{\sqrt{3}}{2})\vec{j}$

$= (0,252\, i + 0,436\, j)\ N$

$f_{31} = f_{31x} \cdot i + f_{31y}(-j)$

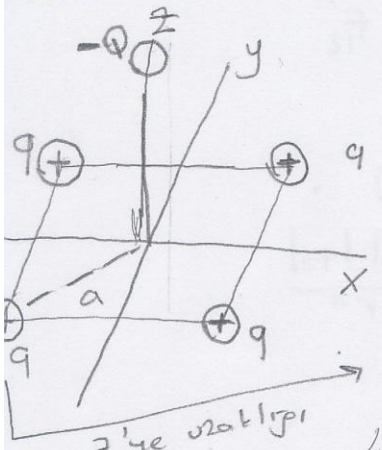
$= (f_{31} \cdot \cos 60)\, i - (f_{31} \sin 60)\, j$

$= (1,008 \cdot \frac{1}{2})\, i - (1,008 \cdot \frac{\sqrt{3}}{2})\, j = 0,504\, i - 0,873\, j$

$F_{21} + f_{31} = (0,756\, i - 0,437\, j)\ N$ $\quad f_1 = |f_1| = \sqrt{0,756^2 + (0,437)^2} = 0,873$

$\tan\theta = \frac{f_{1y}}{f_{1x}} = \frac{-0,437}{0,756} = \dots = \theta \Rightarrow \dots$

Örnek=



$\vec{F}_{-Q} = ?$

Kenar uzunluğu = L

$a = \frac{\sqrt{2}}{2} L$

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

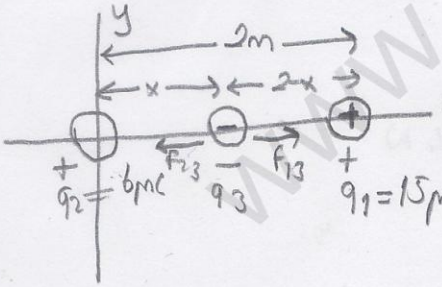
4 yükün 2 bileşeni kalır.

$\vec{F}_{-Q} = 4\vec{f}_z = 4F_1 \cdot \cos\theta \cdot (-\vec{k}) = 4 \cdot k\left(\frac{|q||Q|}{r^2}\right) \cdot \left(\frac{z}{r}\right) \cdot (-\vec{k})$ $\left(\begin{smallmatrix}2\\3\\4\end{smallmatrix}\right)$

$\vec{f}_{-Q} = 4k \cdot \frac{|q| \cdot |Q|}{(a^2+z^2)^{\frac{3}{2}}} \cdot (-\vec{k})$

$\vec{F}_{-Q} = 4k \cdot \frac{|q| \cdot |Q| \cdot z}{\left[\left(\frac{\sqrt{2}L}{2}\right)^2 + z^2\right]^{3/2}} \cdot (-\vec{k})$ (N)

Örnek= Bileşke kuvvet nerede sıfırdır?



$\vec{F}_{13} + \vec{f}_{23} = 0$

$\vec{F}_{13} = -\vec{F}_{23}$

$f_{13} = f_{23}$

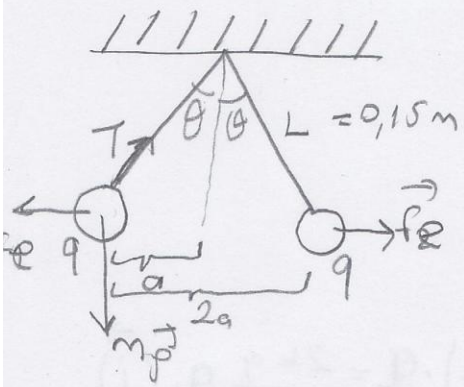
$\frac{k \cdot |q_1| \cdot |q_3|}{(2-x)^2} = k \cdot \frac{|q_2| \cdot |q_3|}{x^2}$

$\frac{15 \cdot 10^{-6} C}{4 - 4x + x^2} = \frac{6 \cdot 10^{-6} C}{x^2}$

$3x^2 + 8x - 8 = 0$

$x = 0,773 m$

Örnek:



Kütleleri $m = 3.10^{-2}$ kg, q yüklü, eşdeş iki küçük küre ipler ile asıldığında $\theta = 5°$'de dengede kalıyorlar. $q = ?$

$\Sigma f_x = 0$ $\quad$ $\Sigma f_y = 0$

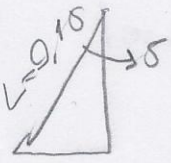
$T\sin\theta - fe = 0$ $\quad$ $T\cos\theta - mg = 0$

$T.\sin\theta = fe$ $\quad$ $T\cos\theta = mg$

$$\frac{T\sin\theta}{T.\cos\theta} = \frac{fe}{mg}$$

$$\tan\theta = \frac{k.\frac{|q|.|q|}{r^2}}{mg}$$

$$q^2 = \frac{m.g.\tan\theta.r^2}{k}$$



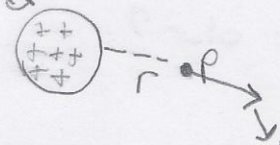
$a = 0{,}013$ m

$r = 2a = 0{,}026$ m

$$q^2 = \frac{3.10^{-2}.9{,}8.\tan 5.(0{,}026)^2}{9.10^9} =$$

$q = 4{,}4.10^{-8}$ C

ELEKTRİK ALANI



$$\vec{E} = \left(\frac{k.Q}{r^2}\right).\hat{r}$$

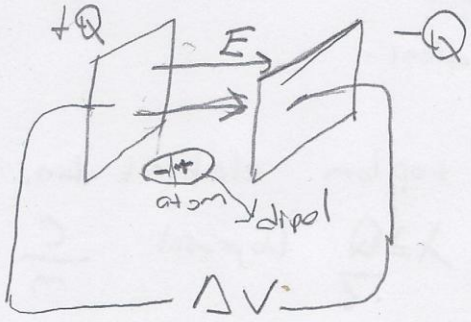
($\hat{r}$: birim vektör)

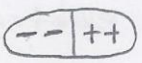
Elektrik alanı bulmak istediğimiz noktada + yük varsayarız.

P noktasına koyulan bir yüke (q_0 olsun) etkiyen kuvvet;

$$\vec{f} = \vec{E}.q_0$$

Bir Dipolün Elektrik Alanı

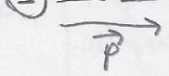


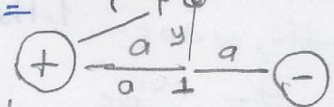


$p = 2aq$

↳ elektrik dipol moment

↳ Yönü −'den +'ya doğrudur.

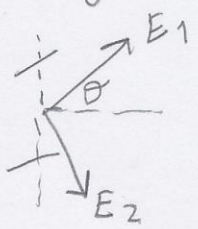




$E_p = ?$

P'de + yük varmış gibi

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



$E_1 = E_2 = k \cdot \frac{q}{r^2}$

$\Sigma Y = 0$

$2\vec{E}_x = \vec{E}_p = 2 \cdot E_1 \cdot \cos\theta = 2 \cdot \left(k \cdot \frac{q}{r^2}\right) \cdot \frac{a}{r} = \frac{2kq}{r^3} a \cdot (\vec{i})$

$E_p = 2k \cdot \frac{q \cdot a}{(a^2+y^2)^{3/2}} \cdot (\vec{i}) \cdot N/C$

P noktasına $q_3 = 4q$'luk yük koyalım. Buna etkiyen elektriksel kuvvet = ?

$F_3 = q_3 \cdot \vec{E_p} = \frac{4 \cdot 2k \cdot q \cdot q}{(a^2+y^2)^{3/2}} \cdot (\vec{i})$ (N)

c) P noktası dipolden çok uzakta ise E_p ne olur?

Sürekli Bir Yük Dağılımının Elektrik Alanı

$\Delta E = k \cdot \frac{\Delta q}{r^2}$ Δq yükünün r uzaklığında P noktasındaki elektrik alanı.

$E_p = \Sigma \Delta E = k \Sigma \frac{\Delta q_i}{r_i^2}$ P noktasındaki toplam elektrik alan.

$\Delta q_i \to 0$ seçelim

$E_p = \lim_{\Delta q_i \to 0} k \Sigma \frac{\Delta q_i}{r_i^2} = k \int \frac{dq}{r^2}$

$\vec{E_p} = \left(k \int \frac{dq}{r^2}\right) \hat{r}$ birim vektör.

Yük dağılım düzgün değilse:

$\frac{dq}{d\ell}$	$\lambda = \frac{Q}{\ell}$	Doğrusal	$\frac{C}{m}$
$\frac{dq}{dA}$	$\sigma = \frac{Q}{A}$	Yüzeysel	$\frac{C}{m^2}$
$\frac{dq}{dv}$	$\rho = \frac{Q}{V}$ = Hacimsel yük yoğunluğu		$\frac{C}{m^3}$