Kvantumfizika

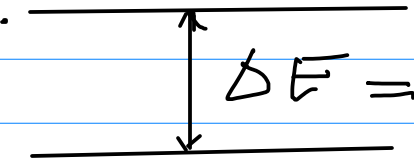
Kvantum = energiacsomag

Planck állandó:

$$h = 6{,}63 \cdot 10^{-34}\ Js$$

$$\hbar = \frac{h}{2\pi} = 1{,}05 \cdot 10^{-34}\ Js$$

Energiaszintek és elnyelés:



$\Delta E = h \cdot f$ ← foton energia

Hullám - részecske

de Broglie összefüggések:

energia:

$$E = h \cdot f = \frac{h}{T} = \hbar \cdot \omega \quad ; \quad \omega = 2\pi \cdot f = \frac{2\pi}{T}$$

impulzus:

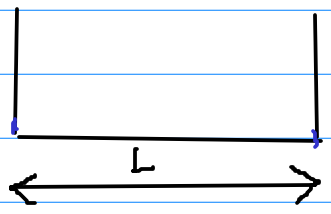
$$p = m \cdot v = \frac{h}{\lambda} = \hbar \cdot k \quad ; \quad k = \frac{2\pi}{\lambda}$$

Dobozba zárt elektron (állóhullám)

$$\lambda = \frac{2L}{n} \qquad (n = 1, 2, 3, \dots)$$

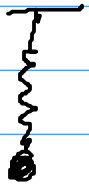
$$p = \frac{h}{\lambda} = \frac{h}{2L} \cdot n$$

$$E_n = \frac{1}{2} m v^2 = \frac{p^2}{2m} = \frac{h^2}{8L^2 m} n^2$$



Harmónikus oszcillátor

Kvantum harmonikus oszcillátor



$k = n - 1$

$$E_k = \hbar f \left(k + \frac{1}{2}\right)$$

kvantumszám kétféleképpen:

$n = 1, 2, \ldots$ Hány fél nulladmúlos?

$k = n - 1 = 0, 1, 2, \ldots$ Hány csomópont?

(Ez a k nem ugyanaz, mint a hullámszám k-ja az előző lapon!)

Atomi elektronszerkezet

csomóhelyek: $k = l + g$

- csomósík l
- csomógömb g

főkvantumszám $n = k + 1 = l + g + 1$

Pályakvantumszám:

mellék kvantumszám: l

$g = n - 1 - l$

$n \geq 1$

$0 \leq l \leq n - 1$

$0 \leq g$

	l
s	0
p	1
d	2
f	3

Pauli elv: 1 pályán max 2 elektron

mágneses kvantumszám: m

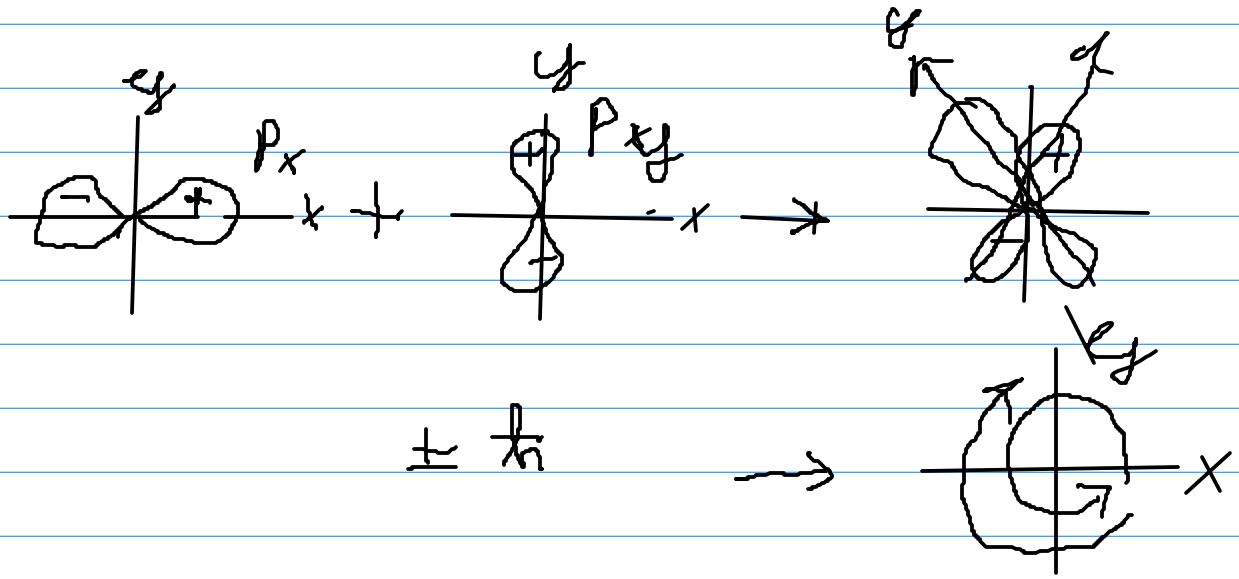
pályairányultság $-l \leq m \leq l$ $2l+1$ db.

Spinkvantumszám: $s = \pm\frac{1}{2}$

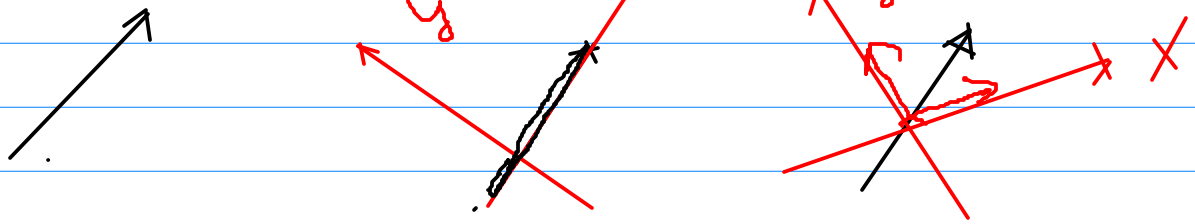
Pauli elv: 1 állapotban max 1 elektron lehet

2 különböző spinnel!

Szuperpozíció



$m = -1, 0, +1$

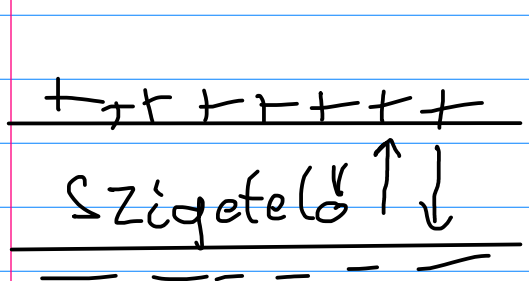


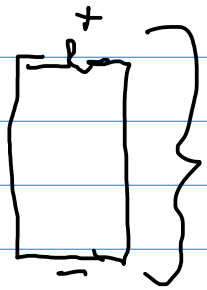
Spin

$\pm \frac{1}{2}\hbar$

Elektromosság

Kondenzátor



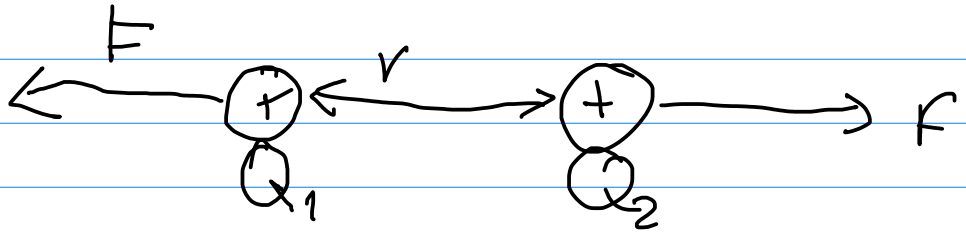


töltés Coulomb C

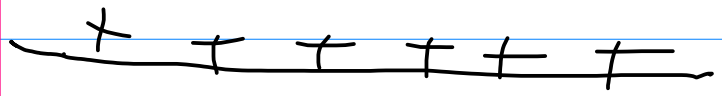
$C = A \cdot s$ ← Amper

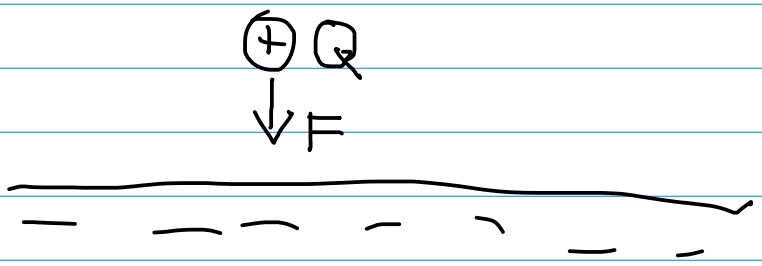
Potenciál(-különbség ~ feszültség

$V = \frac{1}{C}$ (Volt)



$$F = k \cdot \frac{Q_1 \cdot Q_2}{r^2}$$





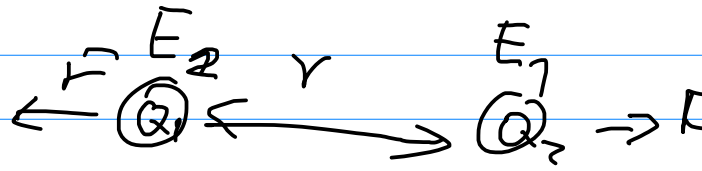
$$F = E \cdot Q$$

N C

$$E = \frac{N}{C}$$

Coulomb törvénye

$$F = k \frac{Q_1 Q_2}{r^2}$$



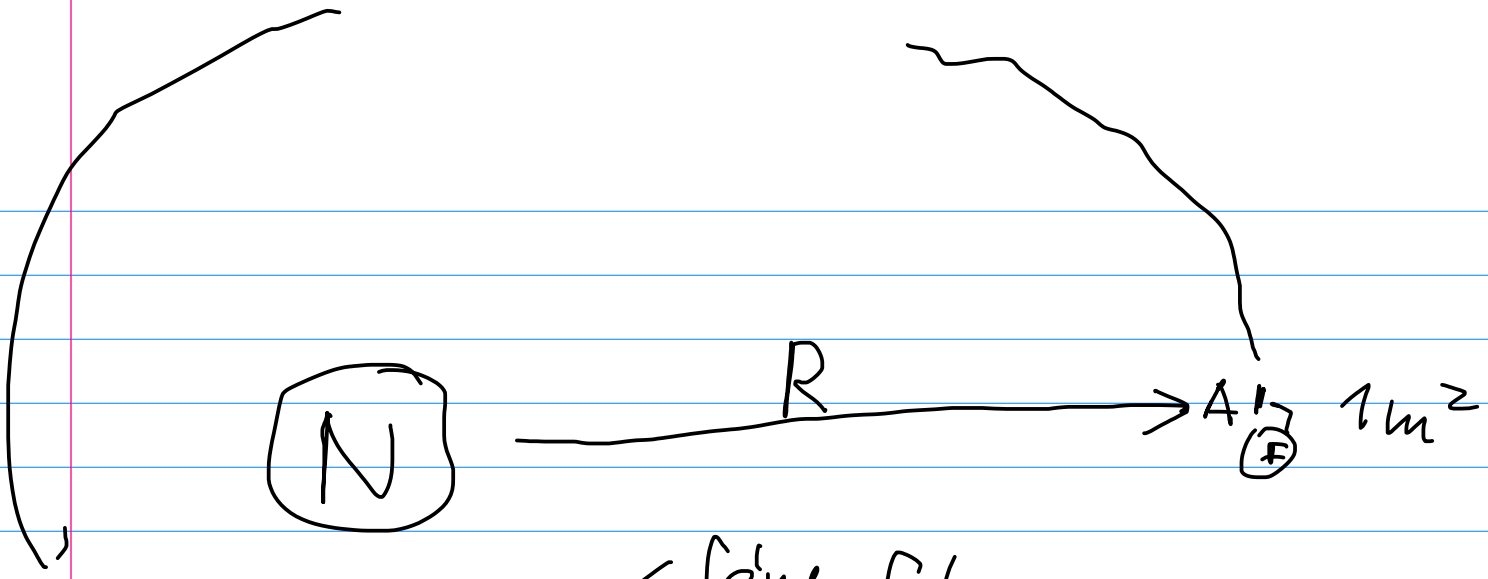
gravitációs törvény

$$F = G \frac{M_1 M_2}{r^2}$$

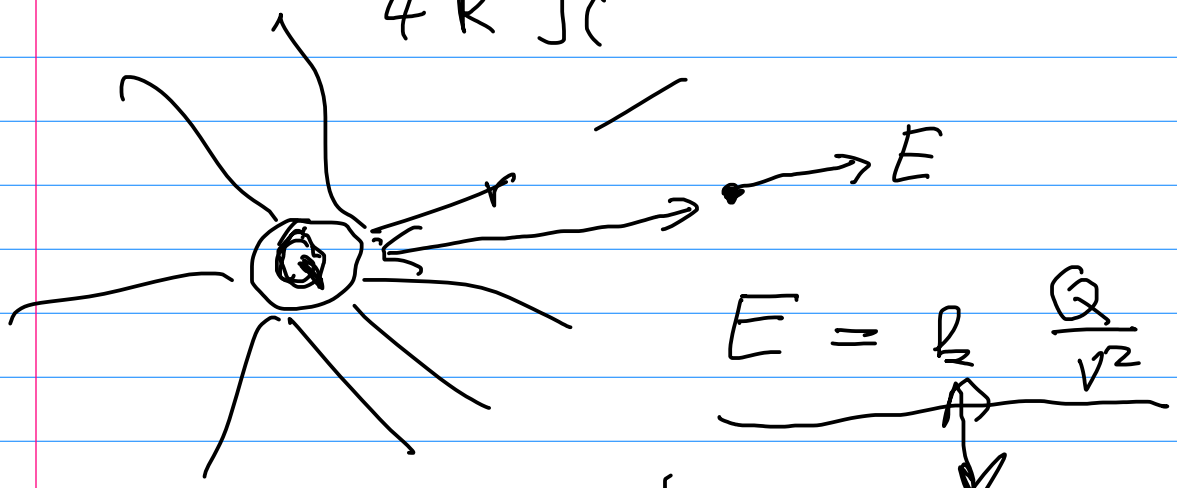
$$k = 9 \cdot 10^9 \cdot \frac{Nm^2}{C^2}$$

$$\rightarrow = Q_1 \cdot E_2 = Q_2 \cdot E_1$$

$$E_2 = k \cdot \frac{Q_2}{r^2} \qquad E_1 = k \cdot \frac{Q_1}{r^2}$$



$$P = \frac{\Phi \cdot A}{4R^2\pi}$$ ← fény fluxus



$$E = k \frac{Q}{r^2}$$

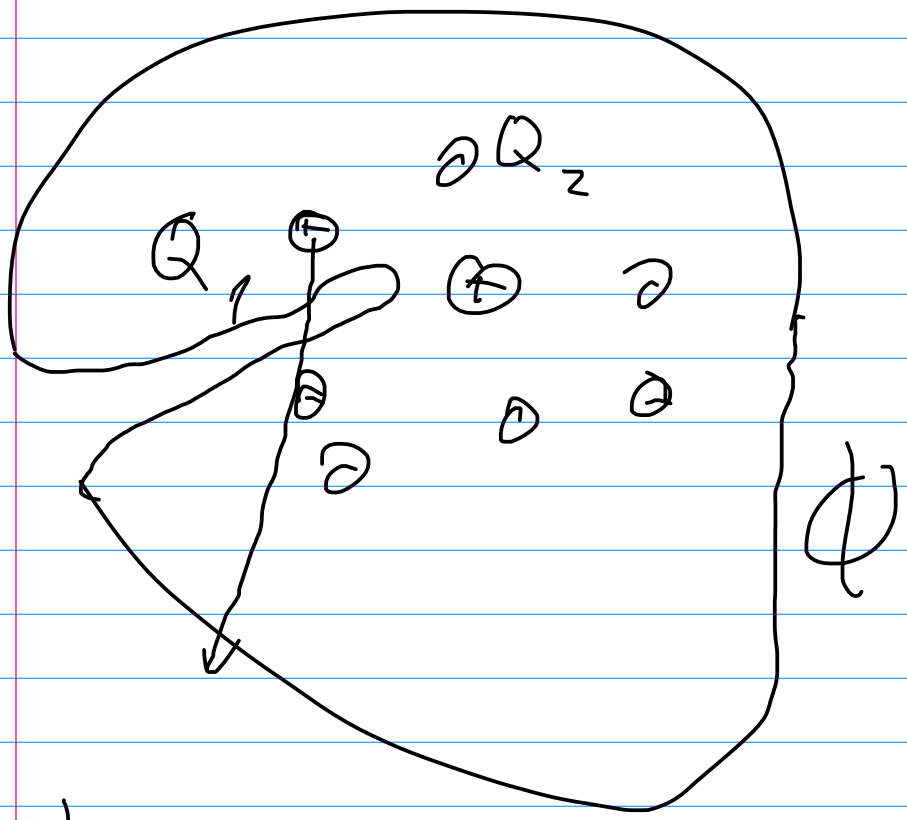
$$E = \frac{\Phi}{4r^2\pi} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r^2}$$

elektromos fluxus

$$\Phi = \frac{Q}{\varepsilon_0}$$

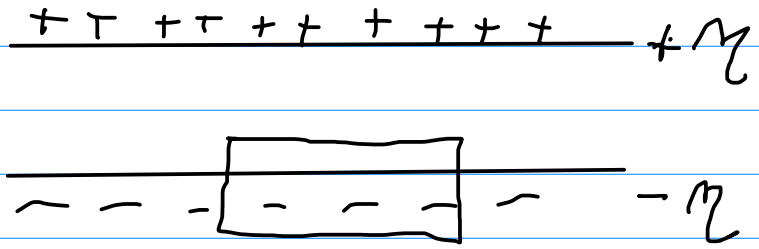
$$\varepsilon_0 \approx 8{,}86 \cdot 10^{-12} \frac{C^2}{N m^2}$$

vákuum dielektromos állandója



Gauss tình e'ng

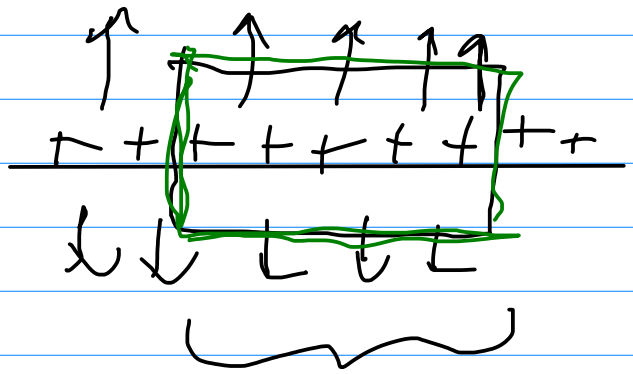
$$\phi = \frac{\sum_i Q_i}{\varepsilon_0}$$



$+\eta$

$-\eta$

$$[\eta] = \frac{C}{m^2}$$



η

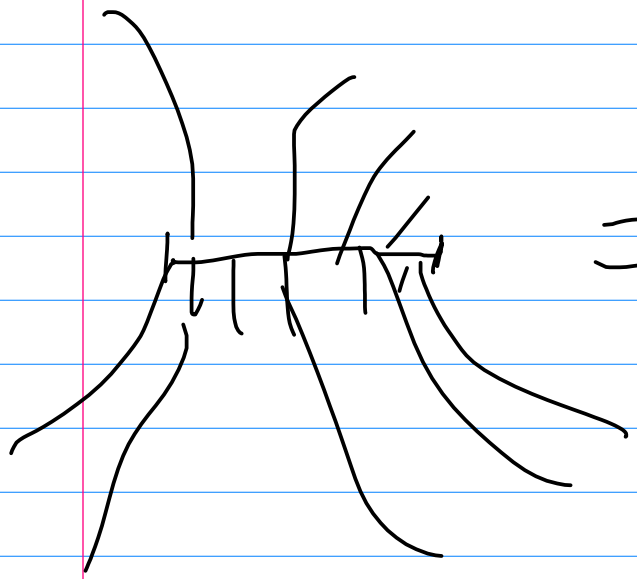
Veqtelen tätfläk

A

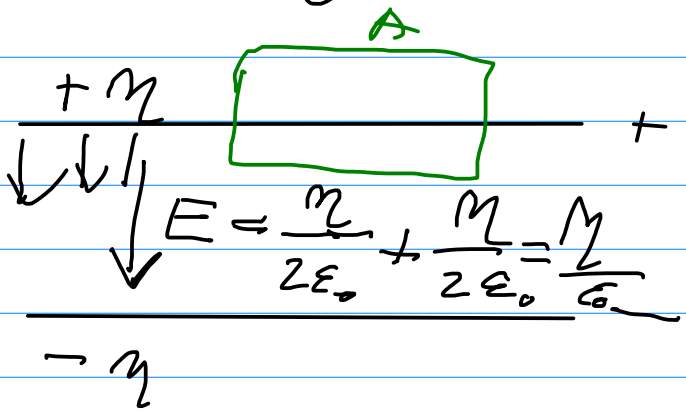
$$Q = \eta \cdot A$$

$$\Phi = \frac{\eta \cdot A}{\varepsilon_0}$$

$$E = \frac{\Phi}{2A} = \frac{\eta}{2\varepsilon_0}$$



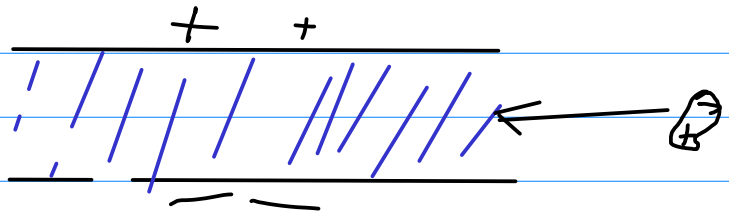
$E = 0$

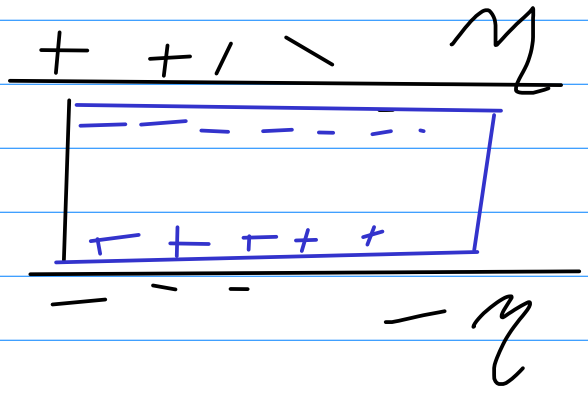


$$\Phi = \frac{\eta A}{\varepsilon_0}$$

$$E = \frac{\eta}{\varepsilon_0} = \frac{\Phi}{A}$$

$E = 0$





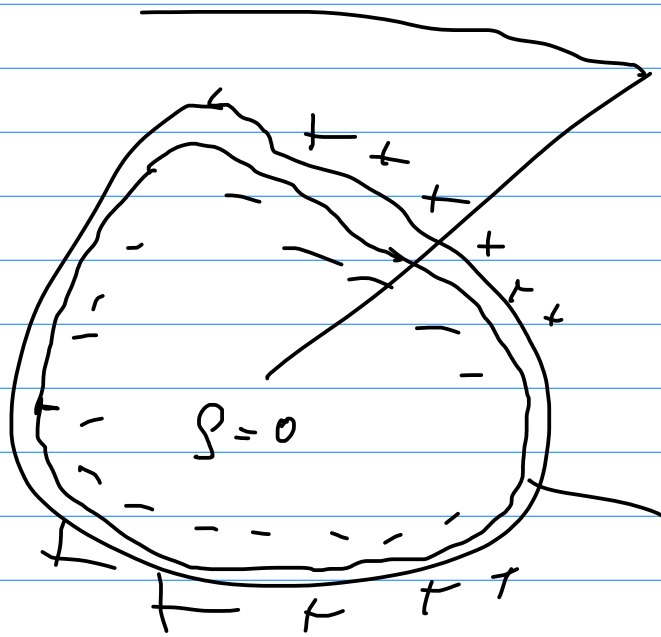
vákuum dielektrikum

$$E = \frac{\eta}{\varepsilon_0 \cdot \varepsilon_r}$$

$0 < \varepsilon_r < 1$

dielektromos áll

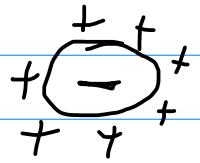
E

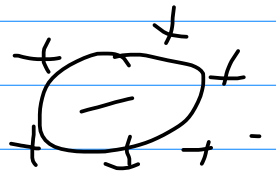


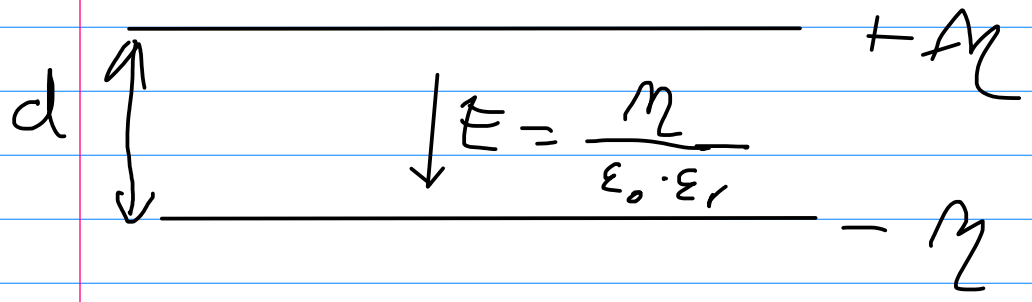
vízes
oldat
vezeto"

szigetelő

$\rho = 0$ ⟵ töltéscsökkenés





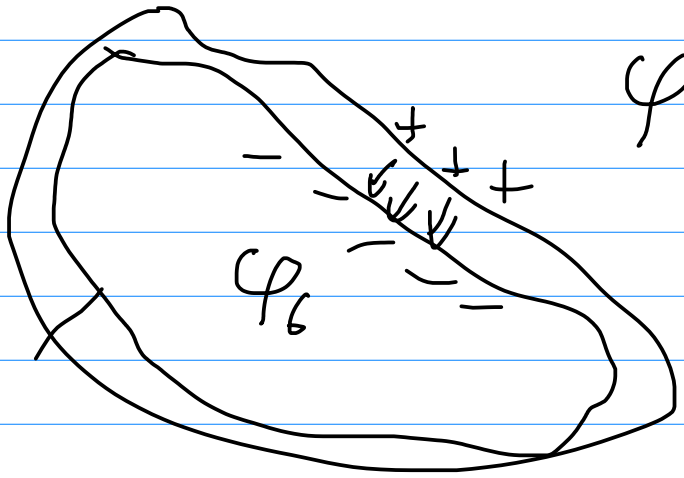


$$\Delta W = F \cdot d = E \cdot Q d = Q \cdot \underbrace{Ed}$$

feszültség = potenciál(-különbség) $\rightarrow \Delta \varphi$

mértékegység: $[\varphi] = Volt$

$$\Delta \varphi = E \cdot d = \frac{M d}{\varepsilon_0 \varepsilon_r}$$



$\varphi_k \ (=0)$

$$\Delta \varphi = \varphi_k - \varphi_a = \frac{M d}{\varepsilon_G \varepsilon_r}$$