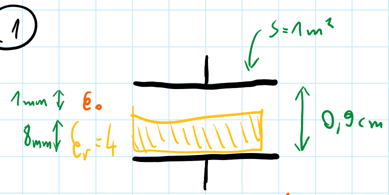
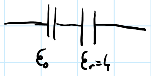
(1)



$E = ?$ $U = 18\,kV$ $E_{max} = 30\,\frac{kV}{cm}$

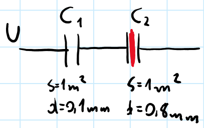
$C = \frac{Q}{U} = \varepsilon \frac{S}{d} \rightarrow Q = U \varepsilon_0 \varepsilon_r \frac{S}{d}$



$C = 4 \cdot 8{,}85 \cdot 10^{-12} \cdot \frac{1}{0{,}009} = 3{,}93 \cdot 10^{-9}\,F$

$E = \frac{U}{d} = \frac{18000\,V}{0{,}9\,cm} = \frac{\cancel{18}000}{0{,}\cancel{9}} = 20\,\frac{kV}{cm}$

$C = 3{,}93 \cdot 10^{-9}\,F$



$C_1 = \varepsilon_0 \frac{S}{d_1} = 8{,}85 \cdot 10^{-12} \cdot \frac{1}{0{,}001} = 8{,}85 \cdot 10^{-9}$

$C_2 = \varepsilon_0 \varepsilon_r \frac{S}{d_1} = 8{,}85 \cdot 10^{-12} \cdot \frac{1}{0{,}008} = 4{,}43 \cdot 10^{-9}$

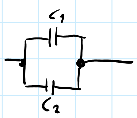
$U_1 = U \frac{C_2}{C_1 + C_2} = 18 \cdot \frac{4{,}43 \cdot 10^{-9}}{(8{,}85 + 4{,}53)(10^{-9})} = 6\,kV$

$U_2 = U \frac{C_1}{C_1 + C_2} = 18 \cdot \frac{8{,}85 \cdot 10^{-9}}{(8{,}85 + 4{,}53)10^{-9}} = 12\,kV$

$E_1 = \frac{U_1}{d_1} = \frac{6}{0{,}1} = 60\,\frac{kV}{cm}$

$E_2 = \frac{U_2}{d_2} = \frac{12}{0{,}8} = 15\,\frac{kV}{cm}$

(2) $t = 2\,ms$ $W = ?$ $P = ?$



$C_1 = C_2 = 660 \cdot 10^{-6}\,F$

$U = 480\,V$

$C_z = \frac{Q_1}{U} + \frac{Q_2}{U} = C_1 + C_2$

$C_z = 1{,}32 \cdot 10^{-3}$

$W = \frac{CU^2}{2} = \frac{1{,}32 \cdot 10^{-3} \cdot 480^2}{2} = 152\,J$ $P = \frac{152}{0{,}002} =$

(3) $C = 20\,\mu F$

$U = 24\,kV$

$l = 20\,mm$

$d = 0{,}3\,mm$

$\Delta T = ?$ $T_R = 20°C$

$l = 20\,mm$
$d = 0{,}3\,mm$
$\Delta T = ? \quad T_R = 20°C$
$\Delta t = 0{,}4\,ms$
$\rho_{cu} = 1{,}78 \cdot 10^{-8}\ \Omega m \quad / \gamma = 8{,}75 \frac{g}{cm^3}$
$c = 0{,}092 \frac{cal}{g°C}$

$C = \frac{Q}{U} \qquad Q = CU$

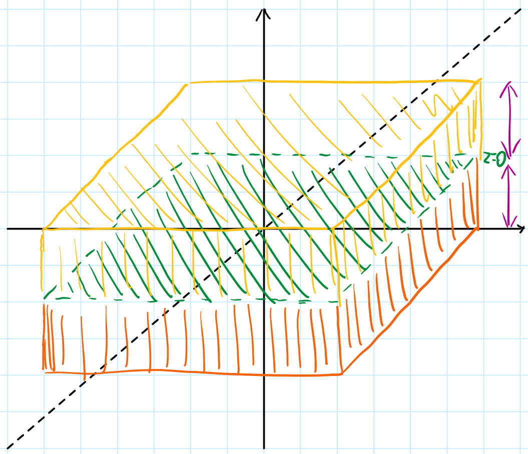
$W = \frac{CU^2}{2} = \frac{20 \cdot \cancel{10^{-6}} \cdot 2 \cdot 2 \cdot \cancel{10^{6}}}{2} = 80J = 9{,}55\ cal$

$V = \left(\frac{1}{2}d\right)^2 \pi \cdot l$

$m = V \cdot \gamma$

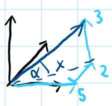
$\Delta T = \frac{W}{mc} = \frac{9{,}55\ cal}{(\frac{1}{2}d)^2 \pi l c \gamma} = \frac{9{,}55}{0{,}5 \cdot 0{,}015^2 \cdot 3{,}14 \cdot 2 \cdot 0{,}92 \cdot 8{,}75}$

④ $\varepsilon_r = 4 \qquad z \leq 0 \qquad z \geq 0$
$\qquad\qquad\qquad 1 \qquad\quad 2$



$\varepsilon_r = 3 \quad E_2 = (5, -2, 4)$

$\varepsilon_r = 4 \quad E_1 = (5, -2, 3)\ \frac{kV}{m}$



$x = \sqrt{5^2 + 2^2} = \sqrt{29}$

$\varepsilon_1 E_{1z} = \varepsilon_2 E_{2z} \rightarrow E_{2z} = 4k$

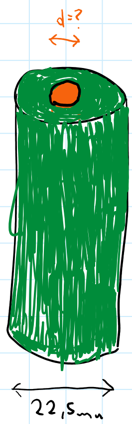
$tg\alpha = \frac{3}{\sqrt{29}} \quad \alpha =$

$arctg \frac{3}{\sqrt{29}} \approx 29°$

$W = \frac{1}{2} \varepsilon E^2 V = \frac{1}{2} \cdot 4 \cdot 38 \cdot 2^3 = 606$

$arctg \frac{4}{\sqrt{29}} \approx 36{,}6°$

⑤



$\varepsilon = 3{,}5$

U_{max}
$U(E) = ?$

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

$\oint = \oint_{P_1} + \int_{P_2} + \int_{P_3} = D(r) \cdot S_b$

$Q = D(r) \cdot S_B = \varepsilon_r \varepsilon_0 \cdot E \cdot 2\pi r l$

$U = \int_{r_1}^{r_2} E\,dr = \int_{r_1}^{r_2} \frac{Q}{\varepsilon_0 \varepsilon_r 2\pi r l} dr = \frac{Q}{\varepsilon_0 \varepsilon_r 2\pi l} \int_{r_1}^{r_2} \frac{1}{r} dr = \frac{Q}{\varepsilon_0 \varepsilon_r 2\pi l} \ln\left(\frac{r_2}{r_1}\right)$

$E_{max} = 10 \frac{kV}{cm}$

$\boxed{E = \frac{Q}{\varepsilon_0 \varepsilon_r 2\pi r l}}$

$E(U) = \frac{U}{\ldots}$

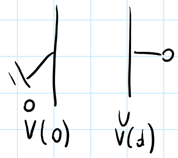
$$E_{max} = 10\,\frac{kV}{cm} \qquad \boxed{E = \frac{Q}{\varepsilon_0 \varepsilon_r 2\pi r l}}$$

$$E(U) = \frac{U}{\ln\frac{r_2}{r_1}\cdot r}$$

$$\frac{d}{dr}E(U) = \frac{U}{(\ln r_2 - \ln r_1) r} \quad \frac{d}{dr} = -\frac{1}{r_1}\cdot r_1 + (\ln r_2 - \ln r_1) = -1 + \ln\left(\frac{r_2}{r_1}\right)$$

$$\frac{d}{dr}E(U) = 0 \rightarrow \ln\frac{r_2}{r_1} = 1 \qquad r_1 = \frac{r_2}{e} = 4{,}1\,mm$$

6



$$\oint \vec{D}\circ d\vec{s} = \int_V Q_v\, dV$$

$$\operatorname{div}\vec{D} = Q_v$$

$$\oint \vec{D}\circ d\vec{s} = \int \operatorname{div}\vec{D}\, dV$$

$$\vec{D} = \varepsilon\vec{E}$$

$$\operatorname{div}\vec{E} = \frac{Q_v}{\varepsilon}$$

prawo Gaussa

$$\operatorname{div}\vec{D} = \lim_{S(\Delta V)\to 0} \frac{1}{\Delta V}\int_{S(\Delta V)} \vec{D}\circ d\vec{s}$$

$$\operatorname{div}\vec{D} = \nabla\circ\vec{D}$$

$$\nabla = \frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}$$

$$\operatorname{div}\vec{D} = \frac{\partial}{\partial x}D_x + \frac{\partial}{\partial y}D_y + \frac{\partial}{\partial z}D_z$$

$$\oint_L \vec{E}\circ d\vec{l} = 0$$

$$\vec{E} = -\operatorname{grad} V = -\nabla V = -\left(\frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}\right)$$

$$\operatorname{div}\vec{E} = \frac{Q_v}{\varepsilon}$$

$$-\operatorname{div}\operatorname{grad} V = \frac{Q_v}{C}$$

$$-\nabla\circ\nabla V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = \Delta V$$

$$\Delta V = \frac{-Q_v}{\varepsilon}$$

a) $Q_v = 0 \rightarrow \Delta V = 0$

$$\frac{\partial^2 V}{\partial x^2} = 0$$