(1) Homogener Kugel

$$\rho(\vec{x}) = \begin{cases} \rho_0 \left(1 - \frac{r}{R}\right) & \text{für } r \leq R \\ 0 & \text{für } r > R \end{cases}$$

mit $\rho_0 = \frac{3Q}{4\pi R^3}$

a) Gesamtladung?

$$Q_T = \int dq = \int_0^{2\pi} d\varphi \int_0^{\pi} \sin\theta \, d\theta \int_0^{R} r^2 dr \, \rho(\vec{x})$$

$$= 4\pi \int_0^{R} r^2 dr \, \rho(\vec{x}) = 4\pi\rho_0 \int_0^{R} r^2 \left(1 - \frac{r}{R}\right) dr$$

$$= 4\pi\rho_0 \left\{ \frac{R^3}{3} - \frac{R^4}{4R} \right\}$$

$$= 4\pi\rho_0 R^3 \frac{1}{12} = \pi\rho_0 R^3 \frac{1}{3}$$

$$= \frac{\pi}{3} R^3 \frac{3Q}{4\pi R^3} = Q$$

$\rightarrow$ Gesamtladung $Q_T = Q$

b) Sýna að $\bar{E}$ utan kúlu sé eins og fyr punktlaga kúlu í $r=0$.

Gauß-lögmál $\oint \bar{E} \cdot d\bar{s} = \frac{Q_{enc}}{\epsilon_0}$

Kúlan er ólaðað kerni (en ekki r)
$\bar{E}$ er því það sama utan $\rho(\bar{x})$ et fjarlægðin er sú sama fyr $r=0 \leftrightarrow$ kúrusamhverfa

$\hookrightarrow$ Gauß $\rightarrow$ $E(4\pi r^2) = \frac{Q}{\epsilon_0}$

$\rightarrow E = \frac{Q}{4\pi r^2 \epsilon_0}$

með skilyrði fyr gildsbundinn et $\rho_0 > 0$

c) Finna $\overline{E}$ innan dreifi.

Notum Gauß-lögmál -> reiknum út heildun innan Gauß-yfirborðs

$$Q_{enc}(r) = \int_0^r 4\pi (r')^2 dr' \rho_0 \left(1 - \frac{r'}{R}\right)$$

$$= Q\left(\frac{r^3}{R^3}\right)\left\{4 - \frac{3r}{R}\right\}$$

þar sem eg veit að $\rho_0 = \frac{3Q}{4\pi R^3}$

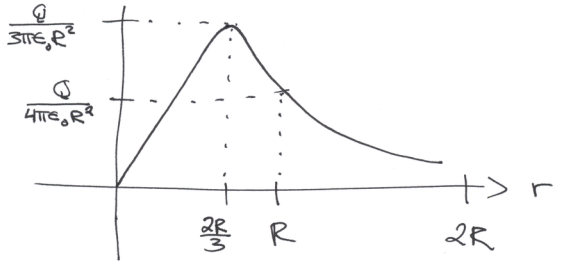
-> Gauß-lögmál gefur

$$E(4\pi r^2) = Q\left(\frac{r^3}{R^3}\right)\left\{4 - \frac{3r}{R}\right\}\frac{1}{\epsilon_0}$$

$$\Rightarrow E = \frac{Qr}{4\pi\epsilon_0 R^3}\left\{4 - \frac{3r}{R}\right\} \text{ ef } r \leq R$$

Stefnir „radial" út á við

d)



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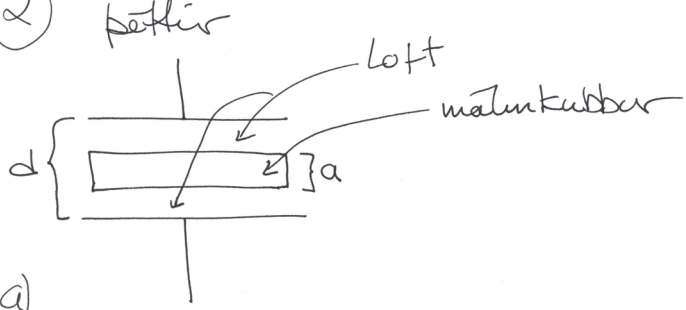
(2)



a)

Samasem Tveir ~~röð~~ tengdir þéttar

$$C_T = \left\{ \frac{1}{C_1} + \frac{1}{C_2} \right\}^{-1} = \left\{ \frac{1}{C_1} + \frac{1}{C_1} \right\}^{-1}$$

$$= \frac{C_1}{2} = \frac{1}{2} \frac{\epsilon_0 A}{(d-a)\frac{1}{2}} = \frac{\epsilon_0 A}{d-a}$$

b) án málmkubbs er rýmdin C_0

$$C_0 = \frac{\epsilon_0 A}{d}$$

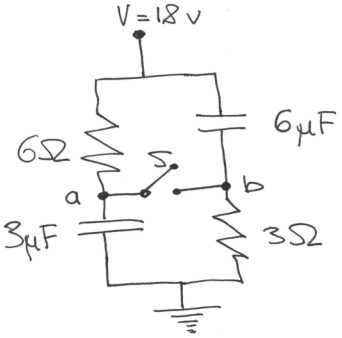
$$\rightarrow C_T = \frac{\epsilon_0 A}{d-a} = C_0 \frac{d}{d-a}$$

c) <u>Markgildið $a \rightarrow 0$</u>

$$C_T = C_0 \frac{d}{d-a} \xrightarrow[a \to 0]{} C_0$$

Markgildið $a \rightarrow d$

$$C_T \rightarrow \infty$$



a) Spennumunur a og b þegar S er opin

$V_{ab} = 18\,V$ (Engin straumur flýtur)

b) a er með hærri spennu en b

c) Lóta spennu b m.v. jörð þ.s. er lóðað ur

þá er <u>sama spennufall</u> yfir

* 6Ω - viðnámið og 6μF - þéttirnn

og

* 3Ω - viðnámið og 3μF - þétt

Straumurin er þá

$$18\,V = I \cdot (6\Omega + 3\Omega)$$

$$\rightarrow I = 2A$$

$$\rightarrow V_b = 2A \cdot 3\Omega = 6V$$

d) Hve mikið breytist hleðsla þéttanna þ. 5 er lokað

Áður

$$Q_3^i = CV = (3 \cdot 10^{-6} F)(18V) = 5.4 \cdot 10^{-5} C$$

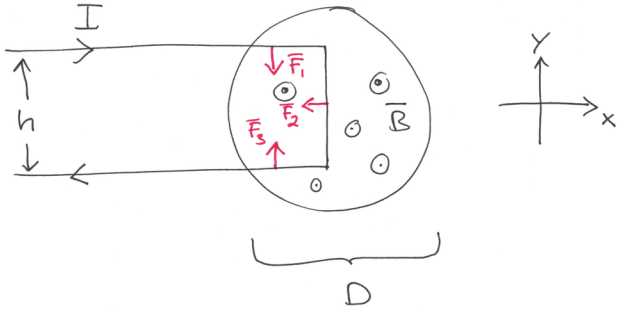
$$Q_6^i = (6 \cdot 10^{-6} F)(18V) = 1.08 \cdot 10^{-4} C$$

Eftir

$$Q_3^f = (3 \cdot 10^{-6} F)(18V - 12V) = 1.8 \cdot 10^{-5} C$$

$$Q_6^f = (6 \cdot 10^{-6} F)(18V - 6V) = 7.2 \cdot 10^{-5} C$$

Báðir tapa $3.6 \cdot 10^{-5}$ C



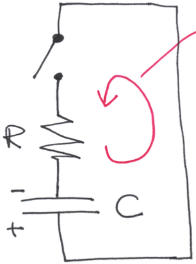
Finn heldarkraften á leiðaran

$$\bar{F} = I\bar{l} \times \bar{B}$$

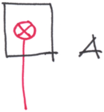
$\bar{F}_1$ og $\bar{F}_3$ skyttast út

$$\bar{F}_2 = -\hat{x}\, I h B$$

5



Straumur þegar S er lokað

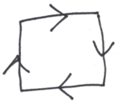


segulsviðið vegna stóru lykkjunnar

þéttirinn hefur endanlega rýmd
→ straumurinn deyr út

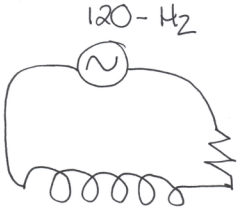
litla lykkjan reynir að viðhalda þessu sviði

↓



réttsælis spanaður straumur

(6) (b)



fyrir þessa tíðni er

$X_L = 250\,\Omega$ spanviðnám

a) Finna L spólu

$$X_L = \omega L \rightarrow L = \frac{X_L}{\omega} = \frac{X_L}{2\pi f}$$

$$= \frac{250\,\Omega}{2\pi\,(120\,Hz)} \approx 0{,}332\ H$$

b) Hver er V_{rms} fyr. spennugjafann t.p.a. spólan eyði 800 W

Samviðnám

$$Z = \sqrt{R^2 + X_L^2}$$

$$P_{ave} = \frac{V_{rms}^2}{Z} \cos\phi$$

þar $P_{ave} = V_{rms} \cdot I_{rms} \cdot \cos\phi$

og $\cos\phi = \frac{R}{Z}$

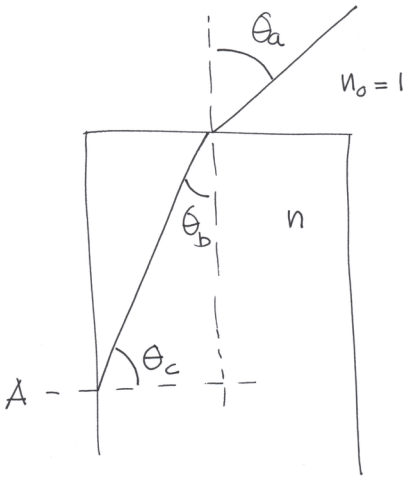
$$\hookrightarrow P_{ave} = \frac{V_{rms}^2 R}{Z^2}$$

$$\rightarrow V_{rms} = Z\sqrt{\frac{P_{ave}}{R}}$$

$$= \sqrt{R^2 + X_L^2}\sqrt{\frac{P_{ave}}{R}}$$

~ 668 V

↑ þessi jafna nægir



$$\theta_b = \frac{\pi}{2} - \theta_c \qquad \sin\theta_c = \frac{n_0}{n}\sin\left(\frac{\pi}{2}\right)$$

$$\theta_c = \arcsin\left(\frac{1}{n}\right)$$

$$\theta_b = \frac{\pi}{2} - \arcsin\left(\frac{1}{n}\right)$$

Snell

$$n_0 \sin\theta_a = n \sin\theta_b$$

$$\sin\theta_a = n \sin\theta_b$$

$$\sin\theta_a = n \sin\left\{\frac{\pi}{2} - \arcsin\left(\frac{1}{n}\right)\right\}$$

$$\theta_a = \arcsin\left[n \sin\left\{\frac{\pi}{2} - \arcsin\left(\frac{1}{n}\right)\right\}\right]$$

Sem mais cálculos meu

$$\sin(x+y) = \sin x \cos y + \cos x \sin y$$

. . . .