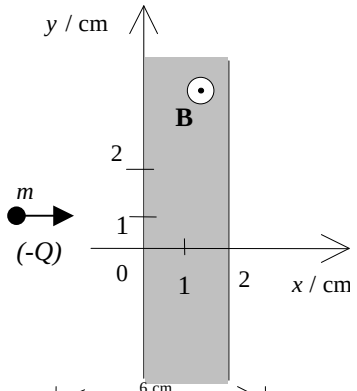
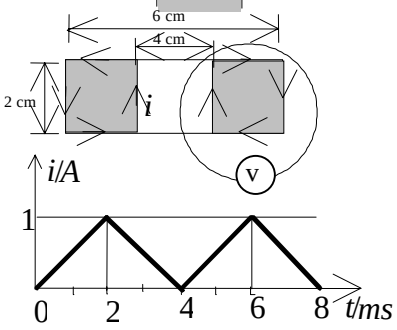
OSNOVE ELEKTROTEHNIKE II (UNI)

Izpit 07. 09. 1999

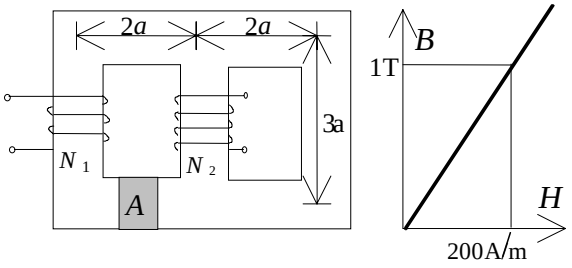
1. V dva centimetra {irok pas magnetnega polja gostote 0.5 mT prileti elektron s hitrostjo10^6 m/s. Dolo~ite koordinati *x* in *y*, kjer elektron »zapusti« magnetno polje! (*m* = 9,11·10^{-31} kg, *Q* = 1.6·10^{-19}C)



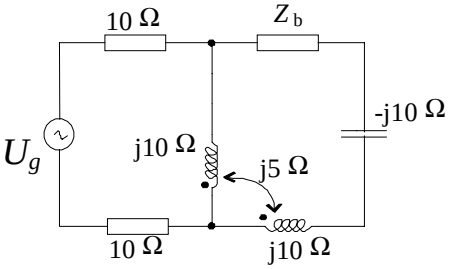
2. Kolik{no efektivno napetost meri idealni voltmeter v zanki, ki objema toroidno tuljavo na železnem jedru z μ_r = 10000 in *N* = 200 ovoji ter tokom narisane žagaste ~asovne oblike? ($\mu_0 = 4\pi \cdot 10^{-7}$ H/m)



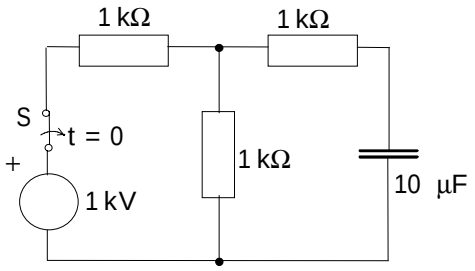
3. Dano je magnetno jedro z linearno magnetilno krivuljo, N_1 = 250, N_2 = 300, *a* = 10 cm, *A* = 10 cm^2. Izra~unajte medsebojno induktivnost navitij.



4. Dolo~ite kompleksno upornost $\underline{Z}_b$ pasivnega vezja tako, da bo na njej najve~ja delovna mo~!



5. Koliko toplote se sprosti na uporih v vezju 20 ms po izklopu stikala!



REZULTATI IZPITA OSNOVE ELEKTROTEHNIKE II (UNI) 7.9.1999

1)

$$\frac{m.v^2}{R} = Q.v.B \Rightarrow R = \frac{m.v}{Q.B} = 0{,}0114\ \text{m}\ ,\ \text{kar je} < 2\ \text{cm}$$

$$\Rightarrow x = 0,\ y = 1 + 2.1{,}14\ \text{cm} = 3{,}28\ \text{cm}$$

Ker je radij elektrona v polju manjši od širine pasu, bo elektron v polju naredil cel polkrog!

2)

$$U_v = U_i = -\frac{d\Phi}{dt},\quad d\Phi = B.dA = B.2\ \text{cm}.dr$$

$$\frac{B}{\mu}\oint dl = N.i \Rightarrow B = \frac{N.i.\mu}{2\pi r}$$

$$\Phi = 2cm.\int_{r_1}^{r_2}\frac{N.i.\mu}{2\pi}.\frac{dr}{r} = 2cm.\frac{N.i.\mu}{2\pi}.\ln\frac{r_2}{r_1} = M.i = 3{,}2.10^{-3}.i$$

$$U_v(t) = -M.\frac{di}{dt} = \left\{\begin{array}{r} -M.\dfrac{1A}{(2-0)\text{ms}} = -1{,}62\ \text{V}\ ;\ \text{t} < 2\ \text{ms} \\ +1{,}62\ \text{V};\ 2\ \text{ms} > \text{t} < 4\ \text{ms} \end{array}\right\}$$

$$U_{ef} = \sqrt{\frac{1}{4\text{ms}}.\int_0^{4ms}(1{,}62)^2.dt} = 1{,}62\ \text{V}$$

3)

$$L_{12} = \frac{N_1.\Phi_{12}}{I_2}$$

"Odstranimo" navitje 1 in dobimo simetrično jedro, kjer velja

$$R = \frac{2.2a + 3a}{\mu.A};\quad \mu = \frac{B}{H} = 5.10^{-3}\ \text{H/m}$$

$$N_2.I_2 = 2.\Phi_{12}.\left(\frac{R}{2} + \frac{3a}{\mu.A}\right) = \Phi_{12}.\left(\frac{13a}{\mu.A}\right)$$

$$L_{12} = N_1.N_2.\frac{\mu.A}{13a} = 0{,}29\ \text{H}$$

4) Med sponkama bremenskega upora poiščemo nadomestno Theveninovo upornost:

$$\underline{I}_1(10+10) + (\underline{I}_1 - \underline{I}_2).j10 + \underline{I}_2.j5 = 0$$

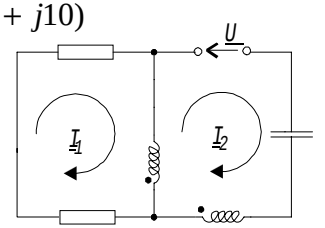
$$\underline{I}_2(-j10 + j10) + (\underline{I}_2 - \underline{I}_1).j10 - \underline{I}_2.j5 - (\underline{I}_2 - \underline{I}_1).j5 = \underline{U}$$

$$\underline{I}_1(20 + j10) - \underline{I}_2.j5 = 0 \Rightarrow \underline{I}_1 = \frac{\underline{I}_2.j5}{(20 + j10)}$$

$$\underline{I}_1(-j5) + \underline{I}_2.0 = \underline{U} \quad \Rightarrow \quad \underline{U} = -j\frac{1}{5}\underline{I}_1 = -j\frac{1}{5}.\frac{\underline{I}_2.j5}{(20 + j10)}$$

$$\underline{Z}_{vh} = \frac{\underline{U}}{\underline{I}_2} = \frac{25}{(20 + j10)} = (1 - j0{,}5)\ \Omega$$

$$\underline{Z}_b = \underline{Z}_{vh}^* = (1 + j0{,}5)\Omega$$



5) Pred preklopom ne teče tok skozi kondenzator, zato je napetost na njem enaka polovici napetosti generatorja $Uc(t=0) = 500\text{V}$.

Po preklopu se kondenzator prazni prek dveh uporov 1kΩ (R=2kΩ) in velja

$$U_R + U_c = 0,\quad i.R + \frac{1}{C}.\int i.dt = 0$$

$$\frac{1}{C}.i + R.\frac{di}{dt} = 0 \Rightarrow \quad i = A.e^{-t/RC} = \frac{500}{2000}.e^{-50t} = 0{,}25.e^{-50t}$$

$$W = \int_0^{20ms} i^2(t).R.dt = 0{,}25^2.2000.\frac{1}{2.50}.e^{-2.50t}\Big|_0^{20ms} = -2{,}5.(0{,}13 - 1) = 1{,}08\ \text{J}$$