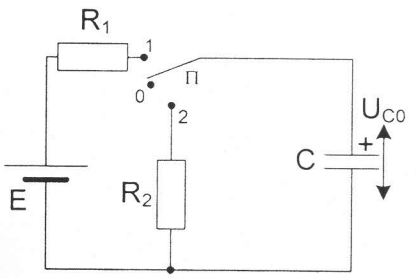
Elektrotehnika, 25.9.2014.

1. Kondenzator kapaciteta $C = 100\,\mu\text{F}$, otpornici otprnosti R_1 i R_2 i idealni naponski generator ems $E = 10\,\text{V}$ su povezani u kolo kao na slici.

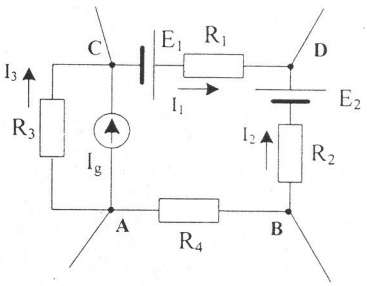
U položaju (0) prekidača Π izmeren je napon na kondenzatoru $U_{C0} = 1\,\text{V}$, zatim se prekidač prebacuje u položaj (1) u kome ostaje sve do uspostavljanja novog stacionarnog stanja.



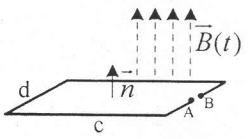
a) Izračunati koliko se promenilo opterećenje kondenzatora $\Delta Q = Q_1 - Q_0$ do uspostavljanja novog stacionarnog stanja gde je Q_0 početno naelektrisanje kondenzatora a Q_1 naelektrisanje u stacionarnom stanju pri položaju (1) prekidača.

b) Odrediti vrednost otpornosti otpornika R_1 ako je vremenska konstanta u procesu opterećivanja kodenzatora $\tau_o = 0.05\,s$.

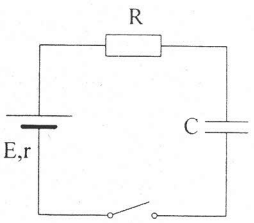
2. U delu složenog kola jednosmerne struje sa slike poznate su sve vrednosti elemenata i intenziteti struja I_1, I_2 i I_3. Odrediti izraz za napon U_{AB}.



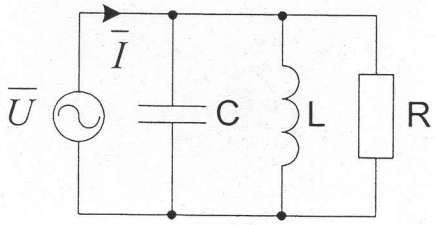
3. Kroz ravno kolo na slici magnetna indukcija se menja po zakonu $B(t) = 0.2 \cdot \sin(314t)\,\text{T}$. Odrediti izraz za magnetni fluks kroz konturu. Odrediti trenutnu vrednost indukovane elektromotorne sile između tačaka A i B. Poznato je: $d = 20\,\text{cm}$ i $c = 50\,\text{cm}$.



4. U RC kolu sa slike vremenska konstanta prelaznog procesa uključenja kondenzatora na izvor realne elektromotorne sile je $\tau = 0.01\,\text{s}$. Poznate su vrednosti $R = 97\,\Omega$ i $C = 100\,\mu\text{F}$. Izračunati unutrašnju otpornost r.

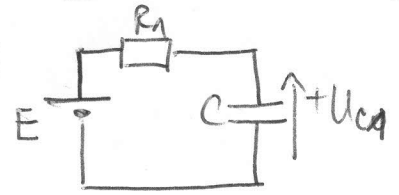


5. U kolu naizmenične struje sa slike poznato je: $\bar{U} = 100\angle -\frac{\pi}{6}\,\text{V}$, $X_L = X_C = 10\,\Omega$ i $R = 10\,\Omega$. Odrediti struju $\bar{I}$ u kompleksnom obliku.



① $t \to 0 \quad U_{C0} = 1V \Rightarrow Q_0 = U_{C0} \cdot C = 100\mu C$

a) $t \to 1$



$U_{C1} = E \Rightarrow Q_1 = U_{C1} \cdot C = 1000\mu C$

$\Delta Q = Q_1 - Q_0 = 900\mu C$

b) $\tau_0 = R_1 C \Rightarrow R_1 = \frac{\tau_0}{C} = \frac{0{,}05\,s}{100\mu F} = 500\,\Omega$

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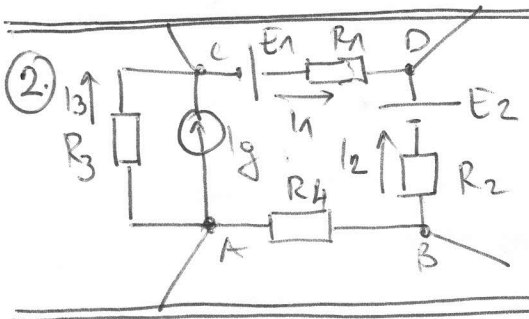
②



$U_{AB} = -R_2 I_2 + E_2 + R_1 I_1 - E_1 + R_3 I_3$

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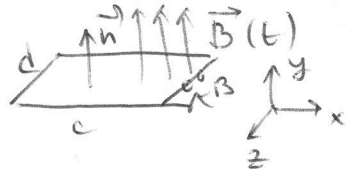
③



$\Phi = \vec{B} \cdot \vec{S} = B(t)\vec{j} \cdot cd \cdot \vec{j} = B(t) \cdot cd = 20 \cdot 10^{-2} \cdot 50 \cdot 10^{-2} \cdot 0{,}2 \sin(314t)$

$\Phi(t) = 20 \cdot 10^{-3} \sin(314t) \quad [Wb]$

$e_{ind} = -\frac{d\Phi(t)}{dt} = -20 \cdot 10^{-3} \cos(314t) \cdot 314$

$= -6{,}28 \cos(314t) \quad [V]$

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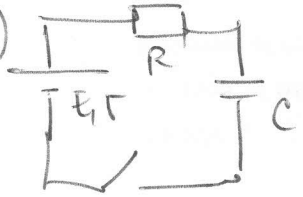
④



$\tau = C(R + r) \Rightarrow r = \frac{\tau}{C} - R = \frac{0{,}01}{100 \cdot 10^{-6}} - 97$

$r = 100 - 97 = 3\,\Omega$

$\boxed{r = 3\,\Omega}$

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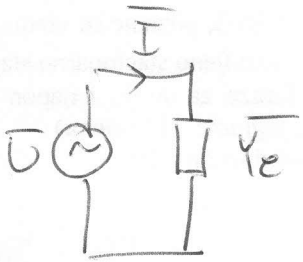
⑤ $\bar{U} = 100 e^{j\omega/6}$

$X_L = X_C = 10\,\Omega$

$R = 10\,\Omega$



$\bar{Z}_L = j X_L = j10\,\Omega \Rightarrow \bar{Y}_L = \frac{1}{j10} = -j0{,}1\,S$

$\bar{Z}_C = j X_C = -j10\,\Omega \quad \bar{Y}_C = \frac{1}{j10} = +j0{,}1\,S$

$\bar{Z}_R = 10\,\Omega \quad \bar{Y}_R = \frac{1}{10} = 0{,}1\,S$

$\bar{Y}_e = \bar{Y}_C + \bar{Y}_L + \bar{Y}_R = -j0{,}1 + j0{,}1 + 0{,}1 = 0{,}1\,S$

$\bar{I} = \frac{\bar{U}}{\bar{Z}_e} = \bar{U}\bar{Y}_e = 100 e^{j\omega/6} \cdot 0{,}1 = 10 e^{j\omega/6}\,A$