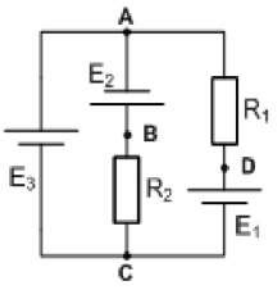
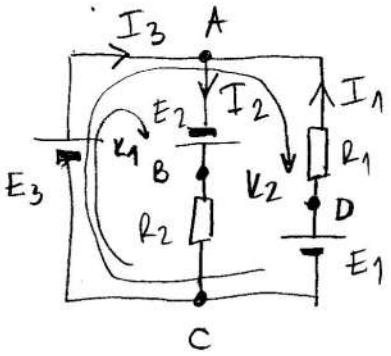
1. U kolu na slici 1, primenom Kirhofovih zakona (metod struja u granama) odrediti intenzitete struja u svim granama, potencijale tačaka A, B, C i D, napon U_{BD}, kao i snage svih elemenata u kolu. Poznato je: $E_1 = 6\,\mathrm{V}$, $E_2 = 2\,\mathrm{V}$, $E_3 = 10\,\mathrm{V}$, $R_1 = 10\,\Omega$ i $R_2 = 20\,\Omega$.





- ОЗНАЧИТИ РЕФ. СМЕРОВЕ СТРУЈА!

* I K3 : $n_č - 1 = 1$: 3×3 I_1, I_2, I_3

Ⓐ $I_3 + I_1 = I_2$, ИЛИ $-I_3 - I_1 + I_2 = 0$ ... (1)

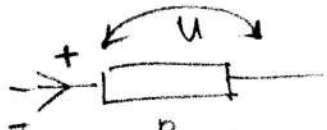
[Ⓒ: $I_2 = I_3 + I_1$]

* II K3 :

(K1) $E_3 + E_2 - R_2 I_2 = 0$ (2)

(K2) $E_3 + R_1 I_1 - E_1 = 0$ (3)

ОМОВ ЗАКОН:



$U = RI$

УСКЛАЂЕНИ РЕФ. СМЕРОВИ!

$I_2 = \frac{E_3 + E_2}{R_2} = 0{,}6\,\mathrm{A}$

$I_1 = \frac{E_1 - E_3}{R_1} = -0{,}4\,\mathrm{A}$

$I_3 = I_2 - I_1 = 1\,\mathrm{A}$

Ⓐ $U_{BD} = -R_1 I_1 + E_2 = -E_1 + R_2 I_2 = -E_1 + E_3 + E_2 = 6\,\mathrm{V}$

Ⓐ ПОТЕНЦИЈАЛ: РЕФ. ТАЧКА - ПРОИЗВОЉНО

1° $C = 0$ ($V_C = 0$)

$V_A = E_3 = 10\,\mathrm{V}$, $V_B = R_2 I_2 = 12\,\mathrm{V}$, $V_D = E_1 = 6\,\mathrm{V}$

($V_A = U_{AC}$)

$U_{BD} = V_B - V_D = 6\,\mathrm{V}$!

2° $A = 0$

$V_B = E_2 = 2\,\mathrm{V}$, $V_C = -E_3 = -10\,\mathrm{V}$, $V_D = R_1 I_1 = -4\,\mathrm{V}$

3°, 4° ...

Ⓐ $P_{E1} = E_1 I_1 = -2{,}4\,\mathrm{W}$

$P_{E2} = E_2 I_2 = 1{,}2\,\mathrm{W}$

$P_{E3} = E_3 I_3 = 10\,\mathrm{W}$

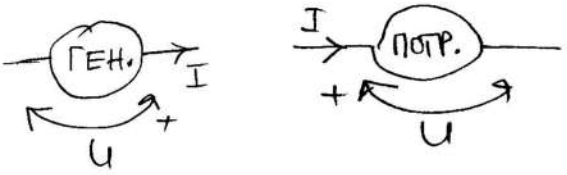
$P_{R1} = R_1 I_1^2 = 1{,}6\,\mathrm{W}$

$P_{R2} = R_2 I_2^2 = 7{,}2\,\mathrm{W}$

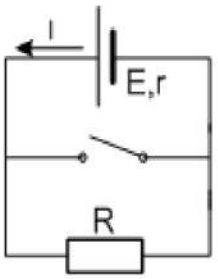
$\Sigma P_E = \Sigma P_R$

СНАГА У ЕЛ. КОЛУ:

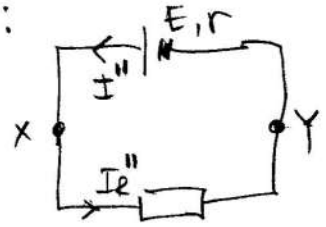
$P = U \cdot I$



2. U kolu na slici 4, pri zatvorenom prekidaču, izmerena je struja u grani sa generatorom $I'=2A$. Kada se prekidač otvori, kroz generator teče struja $I''=1A$. Poznata je otpornost $R=20\Omega$. Odrediti parametre naponskog generatora E i r.

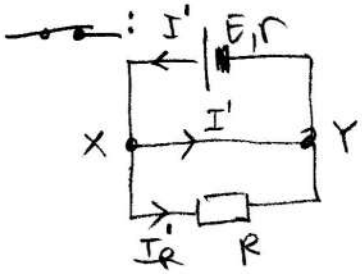


Rešenje:



$I''=I_R''=\frac{E}{R+r}$ R

$\left(U_{XY}''=RI''=R\frac{E}{R+r}\right)$



$U_{XY}'=0 \quad (V_X=V_Y)$

$I_R'=0 \quad \left(=\frac{U_{XY}}{R}\right)$

$\Downarrow$

$I'=\frac{E}{r}$

$E=(R+r)I''=rI'$

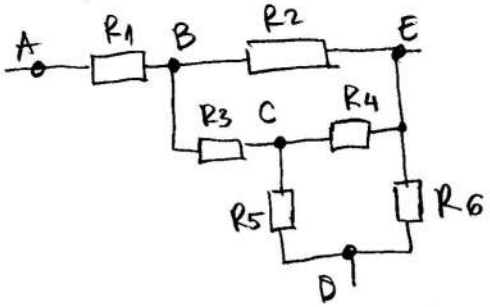
$RI''=r(I'-I'')$

$r=R\frac{I''}{I'-I''}=20\,\Omega$

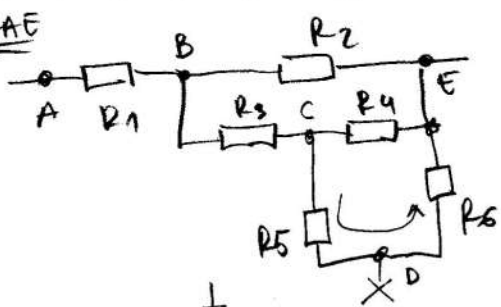
$E=rI'=40\,V$

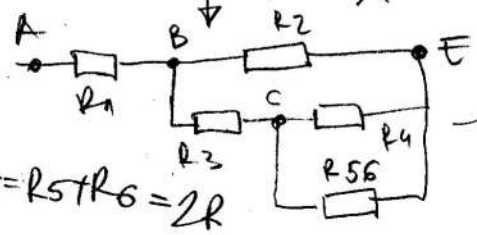
---

③ У КОЛУ НА СЛИЦИ, ОДРЕДИТИ ЕКВИВАЛЕНТНУ ОТПОРНОСТ ИЗМЕЂУ СЛЕДЕЋИХ ТАЧАКА: R_{AE}, R_{DE}, R_{CE}! $R_1=R_2=R_3=R_4=R_5=R_6=R=16\,\Omega$

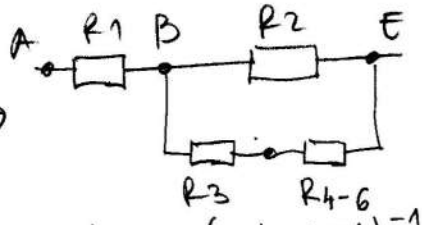


R_{AE}





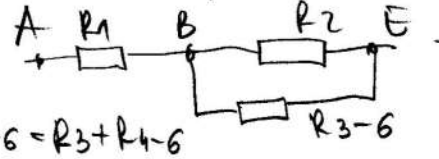
$R_{56}=R_5+R_6=2R$



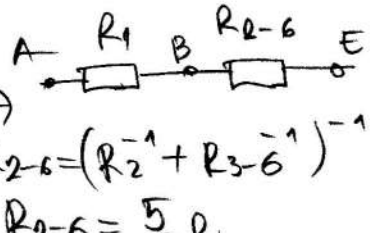
$R_{4-6}=\left(R_4^{-1}+R_{56}^{-1}\right)^{-1}$

$R_{4-6}=\frac{2R}{3}$

$\Downarrow$



$R_{3-6}=R_3+R_{4-6}$



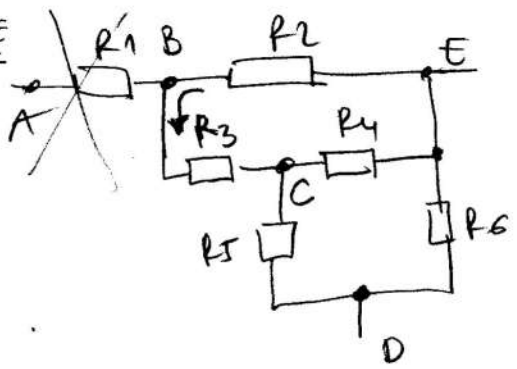
$R_{2-6}=\left(R_2^{-1}+R_{3-6}^{-1}\right)^{-1}$

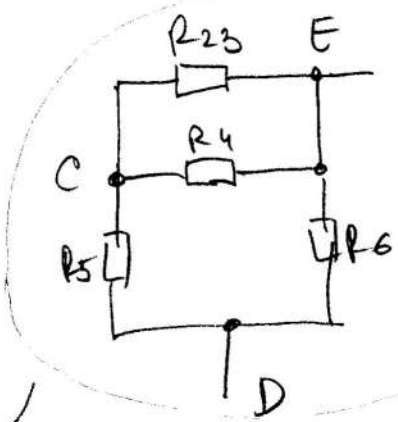
$R_{2-6}=\frac{5}{8}R$

$\Downarrow$

$R_{AE}=R_1+R_{2-6}=\frac{13}{8}R=26\,\Omega$

R_{DE}

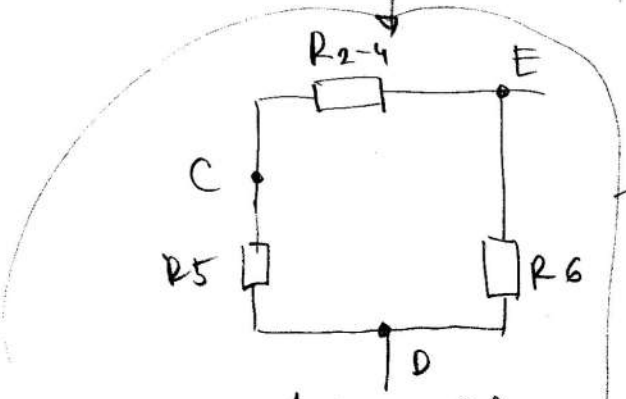




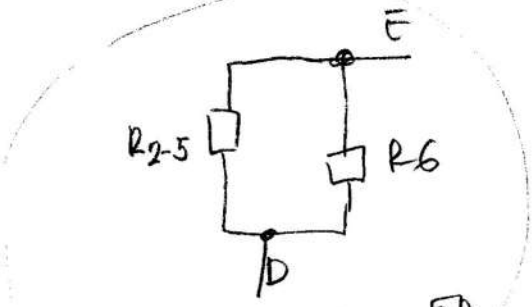
$R_{23} = R_2 + R_3 =$

$= 2R$

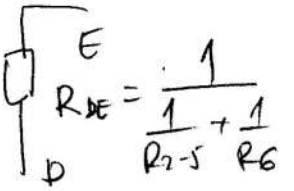
$R_2 — R_3$: ~~РЕАЛНА ВЕЗА~~!



$$R_{2-4} = \frac{1}{\frac{1}{R_{23}} + \frac{1}{R_4}} = \frac{2R}{3}$$



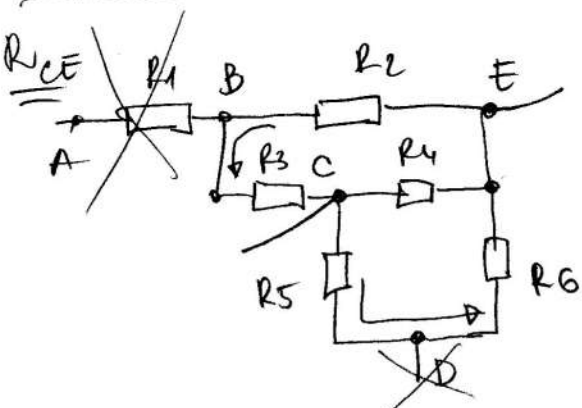
$$R_{2-5} = R_{2-4} + R_5 = \frac{5R}{3}$$



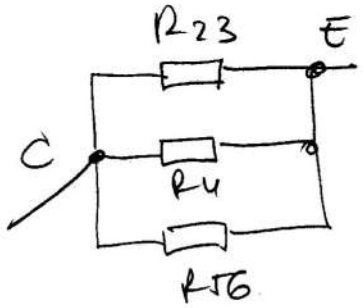
$$R_{DE} = \frac{1}{\frac{1}{R_{2-5}} + \frac{1}{R_6}}$$

$$R_{DE} = \frac{5}{8}R = 10\,\Omega$$

R_{CE}



$R_2 — R_3$ и $R_5 — R_6$ — ~~РЕАЛНА ВЕЗА~~

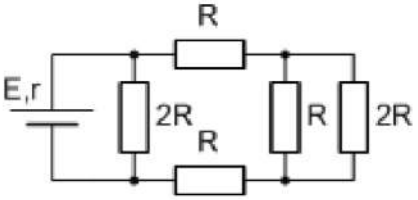


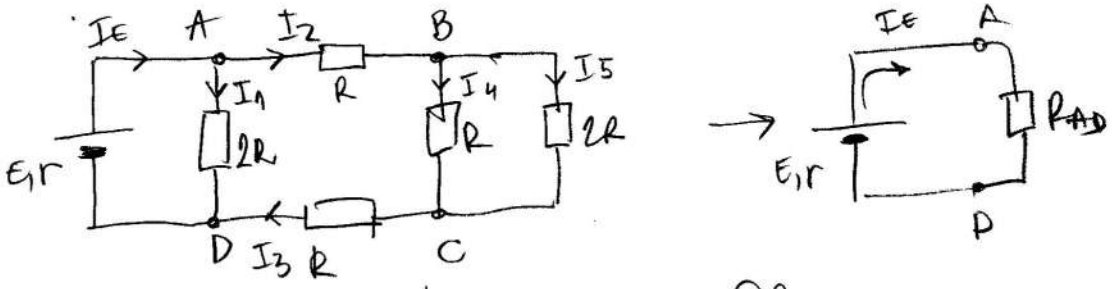
$R_{23} = R_2 + R_3 = 2R$

$R_{56} = R_5 + R_6 = 2R$

$$R_{CE} = \frac{1}{\frac{1}{R_{23}} + \frac{1}{R_4} + \frac{1}{R_{56}}} = \frac{R}{2} = 8\,\Omega$$

3. Odrediti struje u svim granama kola prikazanog na Slici 1. Poznato je: $E=4\,\mathrm{V}$, $r=0.4\,\Omega$, $R=1.4\Omega$.





$$R_{AD}=\frac{1}{\frac{1}{2R}+\frac{1}{R+R+\frac{1}{\frac{1}{R}+\frac{1}{2R}}}}=\frac{8R}{7}=1,6\,\Omega$$

$$I_E=\frac{E}{r+R_{AD}}=2\,\mathrm{A}$$

$$U_{AD}=E-rI=3,2\,\mathrm{V}$$

0.3. $\rightarrow$ $I_1=\frac{U_{AD}}{2R}=\frac{3,2\,\mathrm{V}}{2,8\,\Omega}=\frac{8}{7}\,\mathrm{A}$

I K3 $\rightarrow$ $I_2=I_3=I_E-I_1=\frac{6}{7}\,\mathrm{A}$

I_4, I_5 ? $\Rightarrow$ U_{BC} = ?

$$U_{BC}=I_2\cdot R_{BC}=I_2\cdot\frac{R\cdot 2R}{R+2R}=\frac{6}{7}\mathrm{A}\cdot\frac{2}{3}\cdot 1,4\,\Omega=0,8\,\mathrm{V}$$

[$U_{BC}=E-rI_E-RI_2-RI_3=\ldots$]

0.3. $I_4=\frac{U_{BC}}{R}=\frac{0,8\,\mathrm{V}}{1,4\,\Omega}=\frac{4}{7}\,\mathrm{A}$

0.3. $I_5=\frac{U_{BC}}{2R}=\frac{0,8\,\mathrm{V}}{2,8\,\Omega}=\frac{2}{7}\,\mathrm{A}$

PROVERA: I K3 $\rightarrow$ $I_2=I_4+I_5$ ✓ . . .