Vježbe F,

STRUJNI KRUGOVI

jakost struje $I = \frac{\Delta Q}{\Delta t}$

Ohmov zakon $U = R \cdot I$ $\quad I = \frac{U}{R}$

Snaga $P = U \cdot I = I^2 R = \frac{U^2}{R}$

otpor i otpornost $R = \rho \cdot \frac{\ell}{S}$

provodnost (vodljivost) $\sigma = \frac{1}{\rho}$ $\left(\Omega^{-1} m^{-1}\right)$

gustoća struje $\vec{j} = \sigma \vec{E}$, $j = \frac{I}{S}$

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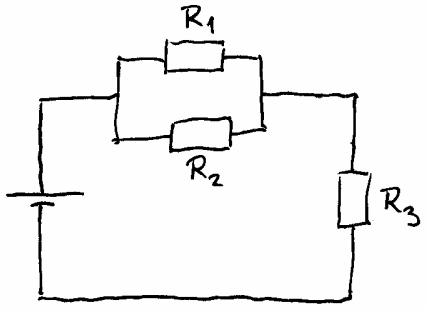
(25) Kroz otpornik R_2 na shemi teče struja 0.4A. Odredite napon izvora, snagu koju troši svaki od tri otpornika i ukupnu snagu u strujnom krugu. $R_1 = 1\Omega$, $R_2 = 2\Omega$, $R_3 = 3\Omega$.



$U_2 = I_2 R_2 = 0.8\,V$

$I_1 = \frac{U_2}{R_1} = 0.8\,A$

$I_3 = I_1 + I_2 = 1.2\,A$

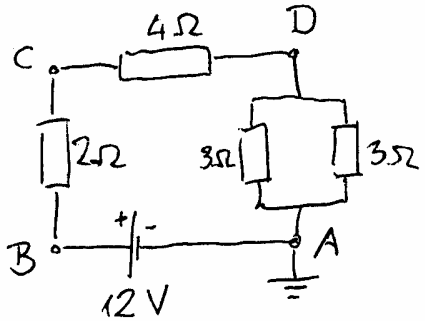
$U_3 = I_3 R_3 = 3.6\,V$

$U = U_2 + U_3 = 4.4\,V$

$P_1 = I_1 U_1 = 0.64\,W$
$P_2 = I_2 U_2 = 0.32\,W$
$P_3 = I_3 U_3 = 4.32\,W$

$P = P_1 + P_2 + P_3 = U \cdot I_3 = 5.28\,W$

(26) U strujnom krugu na slici odredite potencijale točaka ABCD i napon između B i D



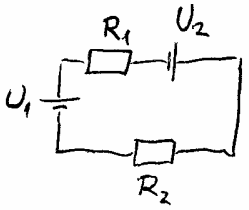
$R_{uk} = 2\Omega + 4\Omega + 1.5\Omega = 7.5\,\Omega$

$I = \frac{U}{R} = \frac{12}{7.5} = 1.6\,A$

$V_A = 0$
$V_B = 12\,V$
$V_C = 8.8\,V$
$V_D = 2.4\,V$

$U_{BD} = 9.6\,V$

(27) Napon izvora U_2 na shemi je 65% viši od napona U_1. Odredite oba napona ako je ukupna snaga na otpornicima 17 W. $R_1 = 10\Omega$, $R_2 = 15\Omega$



$P = U \cdot I = I^2 R$, $R = R_1 + R_2 = 25\Omega$

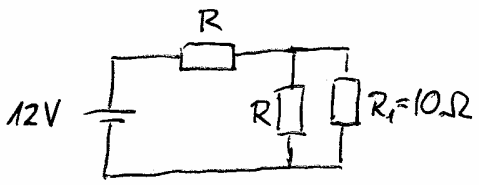
$17 = I^2 \cdot 25$, $I = \sqrt{0.68} = 0.82462\ A$

$U = I \cdot R = 20.6155\ V = 1.65\ U_1$

$U_1 = 7.7794\ V$

$U_2 = 12.8361\ V$

(28) Odredite otpor R (dva otpornika na shemi) ako kroz otpornik R_1 teče struja 0.5 A



$U_1 = R_1 I_1 = 10 \cdot 0.5 = 5\ V$

$U_2 = U_1 = 5\ V$

$U_3 = 12\ V - U_1 = 7\ V$

$R = \frac{7V}{I} = \frac{5V}{I - 0.5A}$

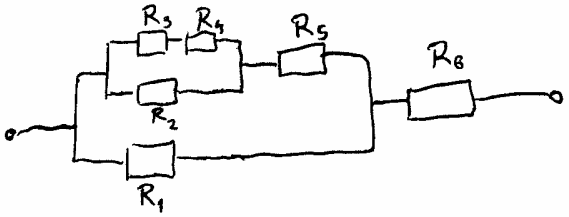
$7I - 3.5 = 5I$

$2I = 3.5$

$I = 1.75\ A$

$\Rightarrow R = \frac{7V}{1.75A} = \frac{5V}{1.25A} = 4\Omega$

(29) Odredite ukupan otpor sklopa otpornika na slici



$R_1 = 10\Omega$

$R_2 = 14\Omega$

$R_3 = 3.75\Omega$

$R_4 = 3.25\Omega$

$R_5 = 2\Omega$

$R_6 = 9\Omega$

$R_{34} = R_3 + R_4 = 7\Omega$

$R_{234} = \frac{R_2 \cdot R_{34}}{R_2 + R_{34}} = \frac{14 \cdot 7}{14 + 7} = \frac{14}{3}\Omega$

$R_{2345} = R_5 + R_{234} = \frac{14}{3}\Omega + \frac{6}{3}\Omega = \frac{20}{3}\Omega$

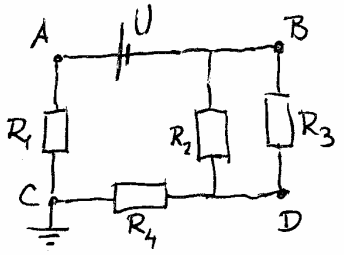
$\frac{1}{R_{1\text{-}5}} = \frac{1}{R_1} + \frac{1}{R_{2\text{-}5}} = \frac{1}{10} + \frac{3}{20} = \frac{5}{20}\ \Omega^{-1}$

$R_{1\text{-}5} = 4\Omega$

$R_{UK} = R_{1\text{-}5} + R_6 = 4\Omega + 9\Omega = 13\Omega$

(30) Odredite potencijale točaka A B C i D na shemi.
Kolika struja teče kroz otpornik R_3?

$U = 18.18\,V$
$R_1 = R_2 = 14.4\,\Omega$
$R_3 = R_4 = 18\,\Omega$



$$R_{UK} = R_1 + R_4 + \frac{R_2 R_3}{R_2 + R_3} = 14.4 + 18 + \frac{14.4 \cdot 18}{14.4 + 18} = 40.4\,\Omega$$

$$I = \frac{U}{R_{UK}} = \frac{18.18\,V}{40.4\,\Omega} = 0.45\,A$$

potencijali: $U_C = 0\,V$ (uzemljeno)

$$U_A = U_C + U_{R_1} = 0 + 0.45 \cdot 14.4 = 6.48\,V$$

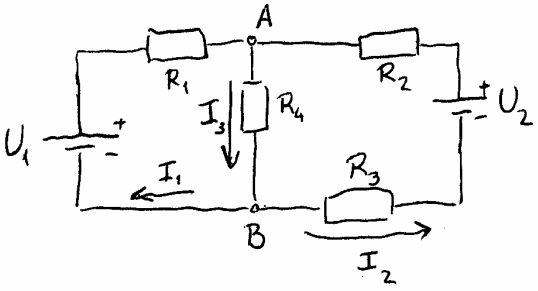
$$U_B = U_A - U = -11.7\,V = 6.48 - 18.18$$

$$U_D = U_C - U_{R_4} = 0 - I R_4 = -0.45 \cdot 18 = -8.1\,V$$

$$I_3 = \frac{U_3}{R_3} = \frac{U_D - U_B}{R_3} = \frac{-8.1 + 11.7}{18} = 0.2\,A$$

(31) Odredite jakost električnih struja u granama mreže na slici.
Koliki je napon U_{AB}?

$U_1 = 4\,V$
$U_2 = 6\,V$
$R_1 = 1\,\Omega$
$R_2 = 2\,\Omega$
$R_3 = 4\,\Omega$
$R_4 = 4\,\Omega$



Kirchoffovi zakoni

$$U_1 = I_1 R_1 + I_3 R_4$$
$$U_2 = I_2 (R_2 + R_3) + I_3 R_4$$
$$I_3 = I_1 + I_2$$

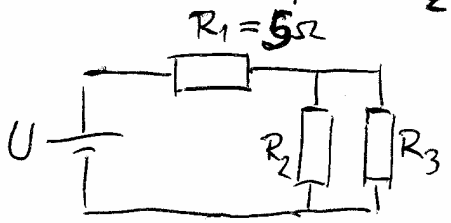
$$4 = 1 I_1 + 4 (I_1 + I_2)$$
$$6 = 6 I_2 + 4 (I_1 + I_2)$$

$$4 = 5 I_1 + 4 I_2 \quad / \cdot 5$$
$$6 = 4 I_1 + 10 I_2 \quad / \cdot (-2)$$

$$20 = 25 I_1 + 20 I_2$$
$$-12 = -8 I_1 - 20 I_2$$

$$8 = 17 I_1$$
$$I_1 = \frac{8}{17} = 0.47\,A$$
$$I_2 = 1 - \frac{5}{4} I_1 = 1 - \frac{5}{4} \cdot \frac{8}{17} = \frac{7}{17} = 0.41\,A$$
$$I_3 = \frac{15}{17} = 0.88\,A$$
$$U_{AB} = I_3 R_4 = \frac{60}{17} = 3.53\,V$$

(32) Na otporniku $R_3 = 10\,\Omega$ napon iznosi 64% napona izvora, a joulova toplina ima snagu 6.4W. Odredite napon izvora, struju kroz R_1 i ukupnu snagu koju troši strujni krug. Koliki je otpor R_2?



$P_3 = U_3 I_3 = \frac{U_3^2}{R_3}$

$U_3 = \sqrt{P_3 R_3} = 8\,V$

$U = \frac{U_3}{0.64} = 12.5\,V$

$U_1 = U - U_3 = 4.5\,V$

$I_1 = 0.9\,A$

$I_3 = 0.8\,A$

$I_2 = I_1 - I_3 = 0.1\,A$

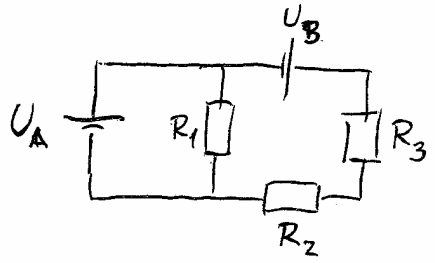
$R_2 = \frac{U_3}{I_2} = \frac{8}{0.1} = 80\,\Omega$

$P = U \cdot I_1 = 11.25\,W$

(33) (3/9.6.2017.)

Odredite struju kroz R_2 i napon na R_2 na shemi.

$U_A = 7V$, $U_B = 14\,V$, $R_1 = 7\,\Omega$, $R_2 = 7\,\Omega$, $R_3 = 8\,\Omega$



$U_1 = U_A = 7V$, $I_1 = \frac{U_1}{R_1} = 1\,A$

$U_2 + U_3 = I_2 (R_2 + R_3) = 14 + 7 = 21\,V$

$I_2 = \frac{21}{15} = 1.4\,A$

$U_2 = I_2 R_2 = 9.8\,V$

- struktura atoma, jezgra
- radioaktivnost (raspadi) i nukl. reakcije (nastanak svih jezgri, stabilnih i radioaktivnih)
- izotopi (~ 1930, nakon otkrića neutrona)
- statistički karakter raspada: idealan sat, atomi ne stare
- defekt mase, E vezanja

atomi su identični

$$N = N_0 \cdot 2^{-\frac{t}{T}}$$

N: broj atoma nakon t; N_0: br. at. u $t=0$; T: vrijeme poluraspada

$$2^x = e^{(\ln 2)x} = e^{x \ln 2}$$

$$\frac{dN}{dt} = N_0 \cdot 2^{-\frac{t}{T}} \cdot \frac{-\ln 2}{T} = -\frac{N}{T} \ln 2$$

$A = \left|\frac{dN}{dt}\right|$, $[A] = Bq$ (bekerel, raspad u sekundi)

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(34) Odredite atomsku težinu magnezija iz učestalosti i masa izotopa:

^{24}Mg	78.99%	23.98504	
^{25}Mg	10.00%	24.98584	
^{26}Mg	11.01%	25.98260	(tbl. 24.305)
24.3202		24.30505	

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(35) Odredite udjele dvaju prirodnih izotopa klora, ^{35}Cl i ^{37}Cl, ako je atomska masa 35.453

približno: $35.453 = p \cdot 35 + (1-p) \cdot 37$

$\Rightarrow p = 77.35\%$ ^{35}Cl

22.65% ^{37}Cl

točnije

$35.453 = p \cdot 34.96885 + (1-p) \cdot 36.96950$

$1.5165 = p \cdot 2.00065$

75.80% ^{35}

24.20% ^{37}

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(36) Koliki se postotak ^{14}C raspadne 1000 godina nakon nastanka?

$T = 5730$ Y

$$\frac{N}{N_0} = 2^{-\frac{1000}{5730}} = 0.886$$

88.6% ostane ^{14}C

11.4% se raspadne u ^{14}N

(37) Odredite masu i množinu radioaktivnog izvora ^{241}Am, aktivnosti 70 kBq. $T = 432.2\,Y$

$$70\,000 = \frac{N \ln 2}{432.2 \cdot 365.25 \cdot 24 \cdot 3600} \Rightarrow N = 1.3774 \cdot 10^{15} \text{ atoma}$$

$$n = \frac{N}{N_A} = 2.2873 \cdot 10^{-9} \text{ mol}, \quad m = nM = 5.51 \cdot 10^{-7} g = 0.551 \mu g$$

b) Kolika će biti aktivnost nakon 30 godina?

$$A = A_0 \, 2^{-\frac{t}{T}} = 70 \text{ kBq} \cdot 2^{-\frac{30}{432.2}} = 66.71 \text{ kBq}$$

c) Kolika nakon 3000 godina?

$$A = 70\,000 \cdot 2^{-\frac{3000}{432.2}} = 570 \text{ Bq}$$