

ALGORITAM RJEŠAVANJA

- 1) nacrtati shemu u „kanonskom“ obliku
- 2) označiti sve STRUJE (i izvore i otpornike, ako nisu reći)
- 3) napisati sve jednačbe I. k. z. (struje u čvorovima)
- 4) napisati sve jednačbe II. k. z. (naponi u petljama)
- 5) izračunati ukupni otpor i struju (ako se može)
- 6) dalje kako znaš i umiješ...
↳ jednačbe iz 3. & 4. koraka + Ohmov zakon za svaki otpornik/trosilo ... (+ $P = U \cdot I$ ako se traže snage)

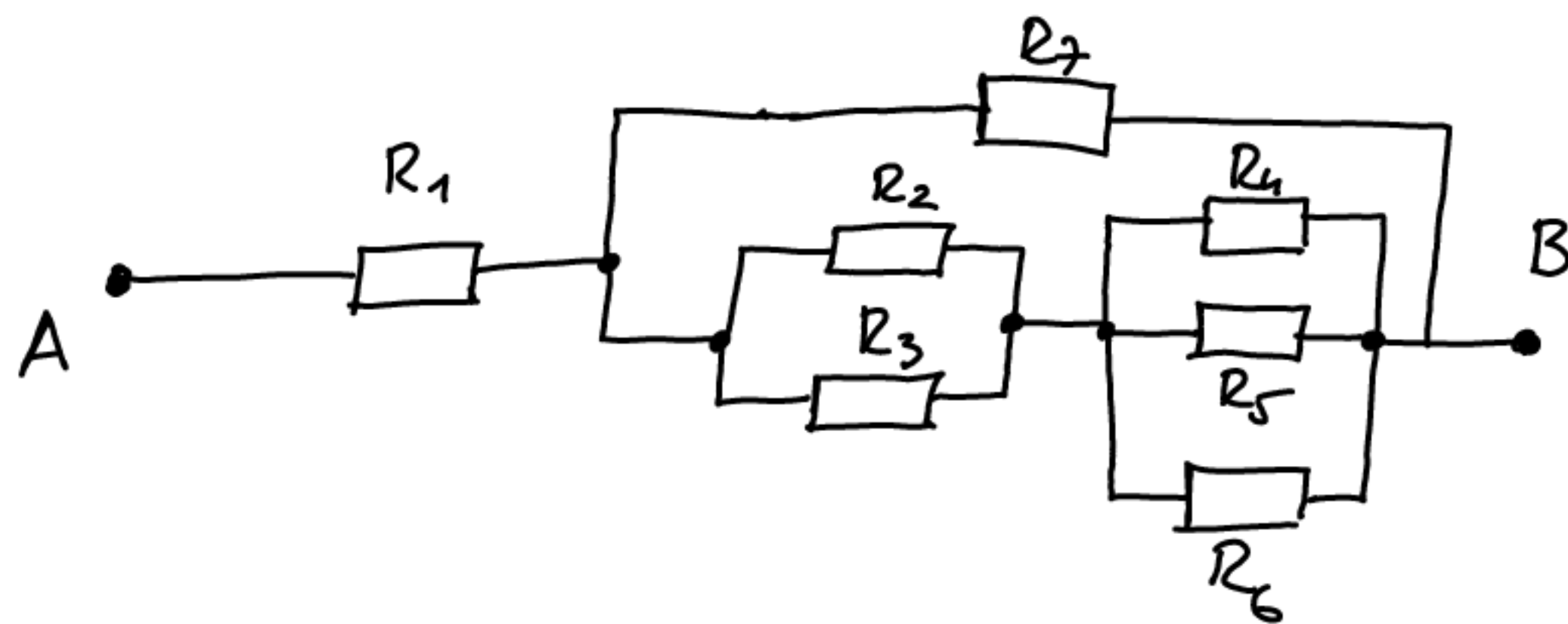
Tipovi zadataka:

- 1) Kanonski oblik i ekvivalentni otpor ...
- 2) Mješoviti spoj s 1 izvorom i svim poznatim otpornicima
- 3) Mješoviti spoj s ampermetrom i voltmetrom
- 4) Mješoviti spoj – slučajevi (ako/ako)

Kanoniski oblik i ekvivalentni otpor (*gledano na satru)

Knjiga str. 117., zadaci: 1-12, posebno: 1, 5*, 11 + 20, 23 & 24

① (knjiga str. 117., zad 1)



$$R_{uc} = R_1 + R_{234567} = 10 + 7.5 = \underline{\underline{17.5 \Omega}}$$

$$R_{234567} = \frac{R_7 \cdot R_{23456}}{R_7 + R_{23456}} = \frac{15 \cdot 15}{15 + 15} = 7.5 \Omega$$

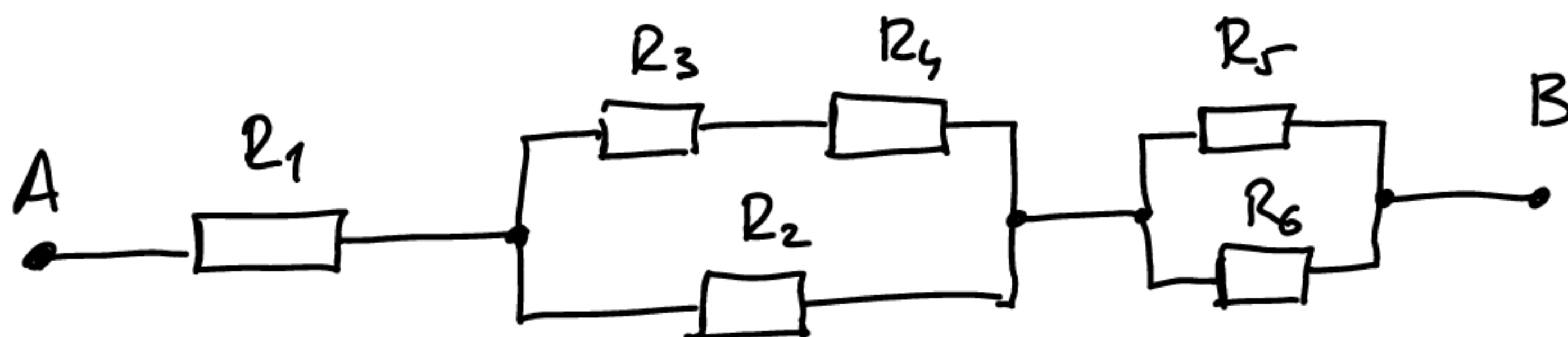
$$R_{23456} = R_{23} + R_{456} = 10 + 5 = 15 \Omega$$

$$R_{23} = \frac{R_2 \cdot R_3}{R_2 + R_3} = \frac{20 \cdot 20}{20 + 20} = 10 \Omega$$

$$\frac{1}{R_{456}} = \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{20} + \frac{1}{20} + \frac{1}{10} = \frac{4}{20} = \frac{1}{5}$$

$$\rightarrow R_{456} = \frac{5}{1} = 5 \Omega$$

② (izjiga str. 118., zad. 11)

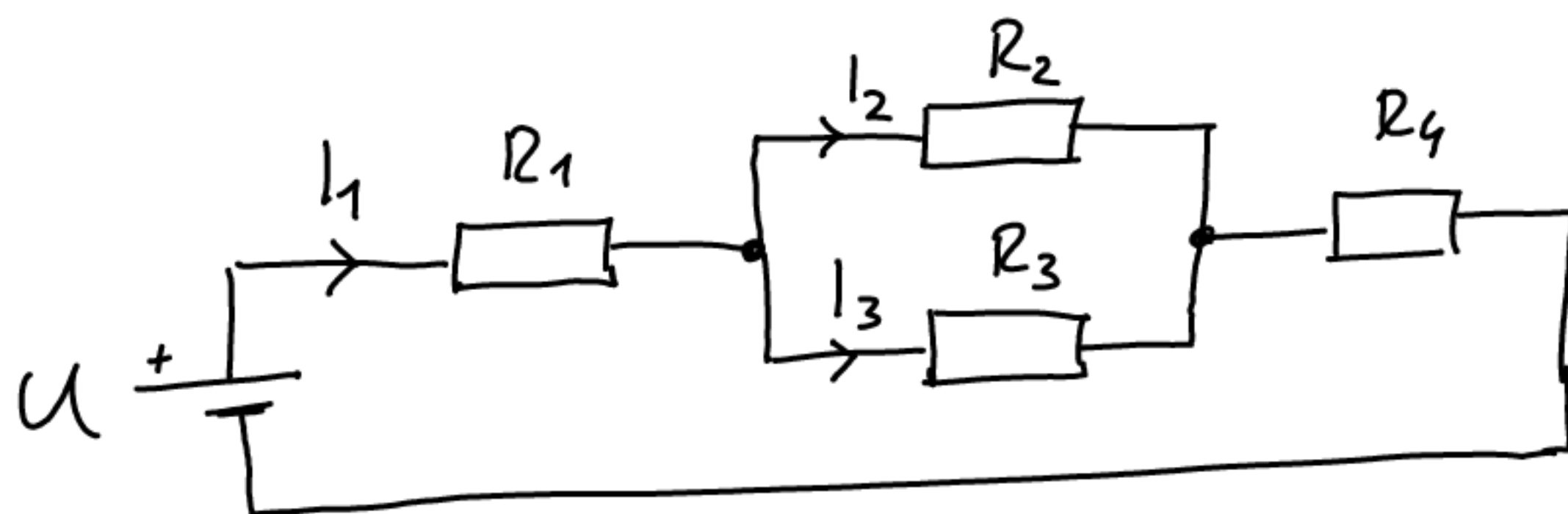


$$R_{uk} = R_1 + R_{234} + R_{56} = 15 + 28 + 0.64 = \underline{\underline{43.64 \text{ k}\Omega}}$$

$$R_{234} = \frac{R_{34} \cdot R_2}{R_2 + R_{34}} = \frac{56 \text{ k}\Omega \cdot 56 \text{ k}\Omega}{56 \text{ k}\Omega + 56 \text{ k}\Omega} = 28 \text{ k}\Omega$$

$$R_{56} = \frac{R_5 \cdot R_6}{R_5 + R_6} = \frac{1.28 \text{ k}\Omega}{2} = 0.64 \text{ k}\Omega$$

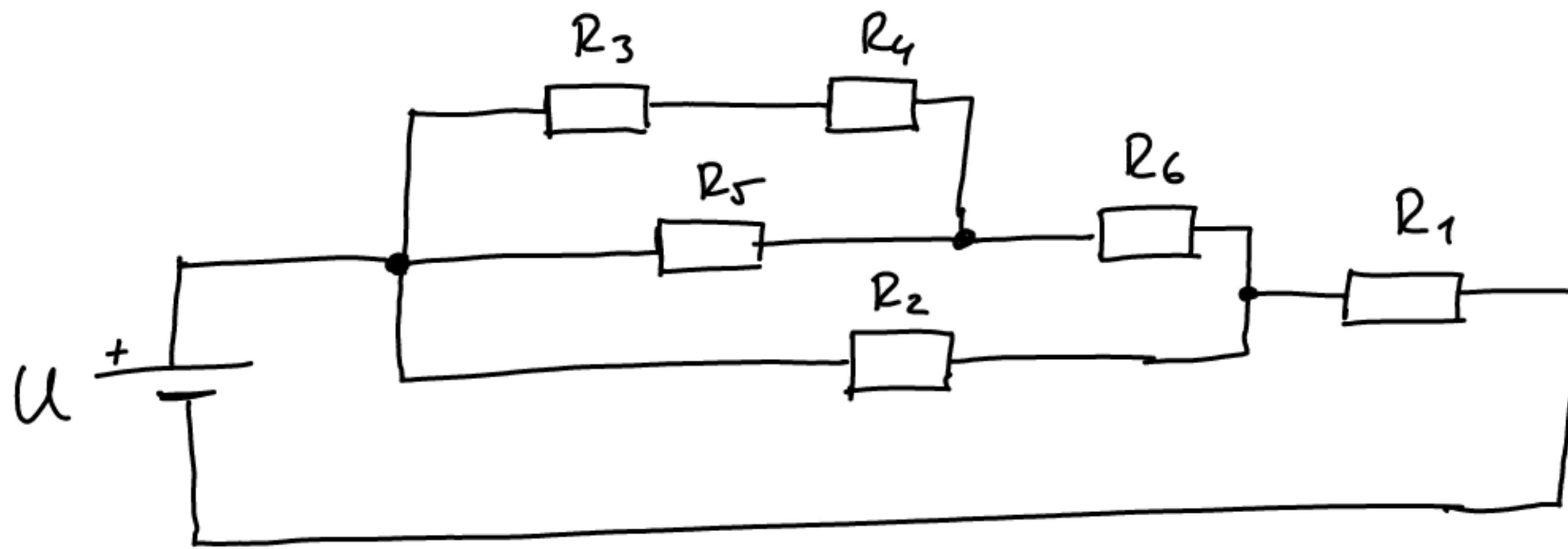
③ (izjiga str. 120., zad. 20)



$$R_{uk} = R_1 + R_{23} + R_4 = 1 + 2.4 + 1.6 = \underline{\underline{5 \Omega}}$$

$$R_{23} = \frac{6 \cdot 4}{6 + 4} = \frac{24}{10} = 2.4 \Omega$$

9. (kyjiga str. 120., zad 23)



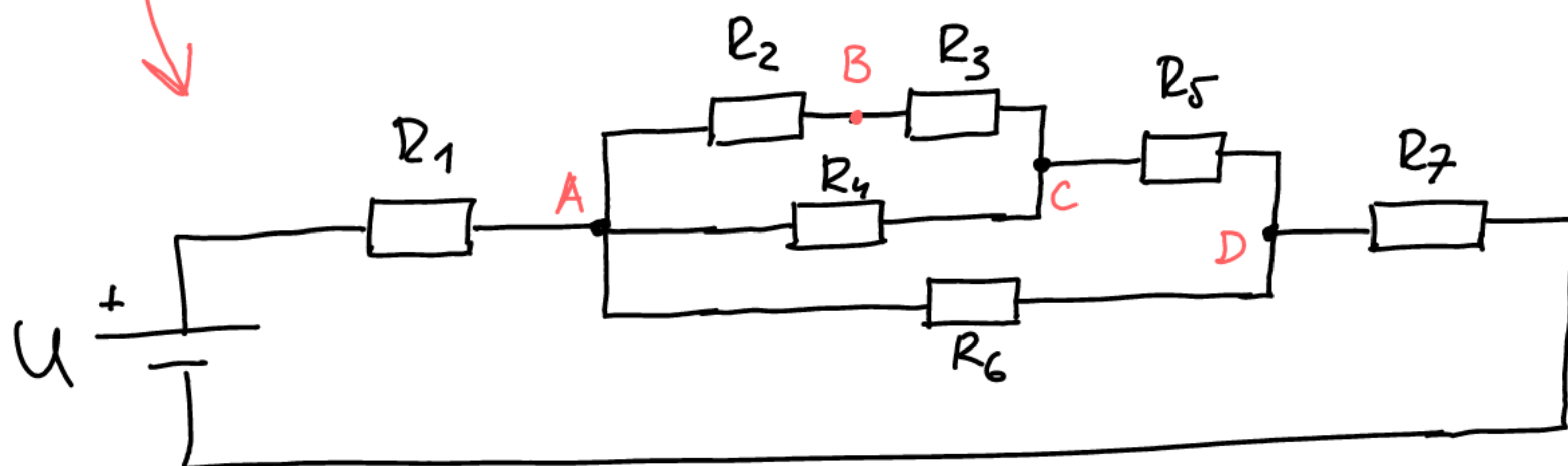
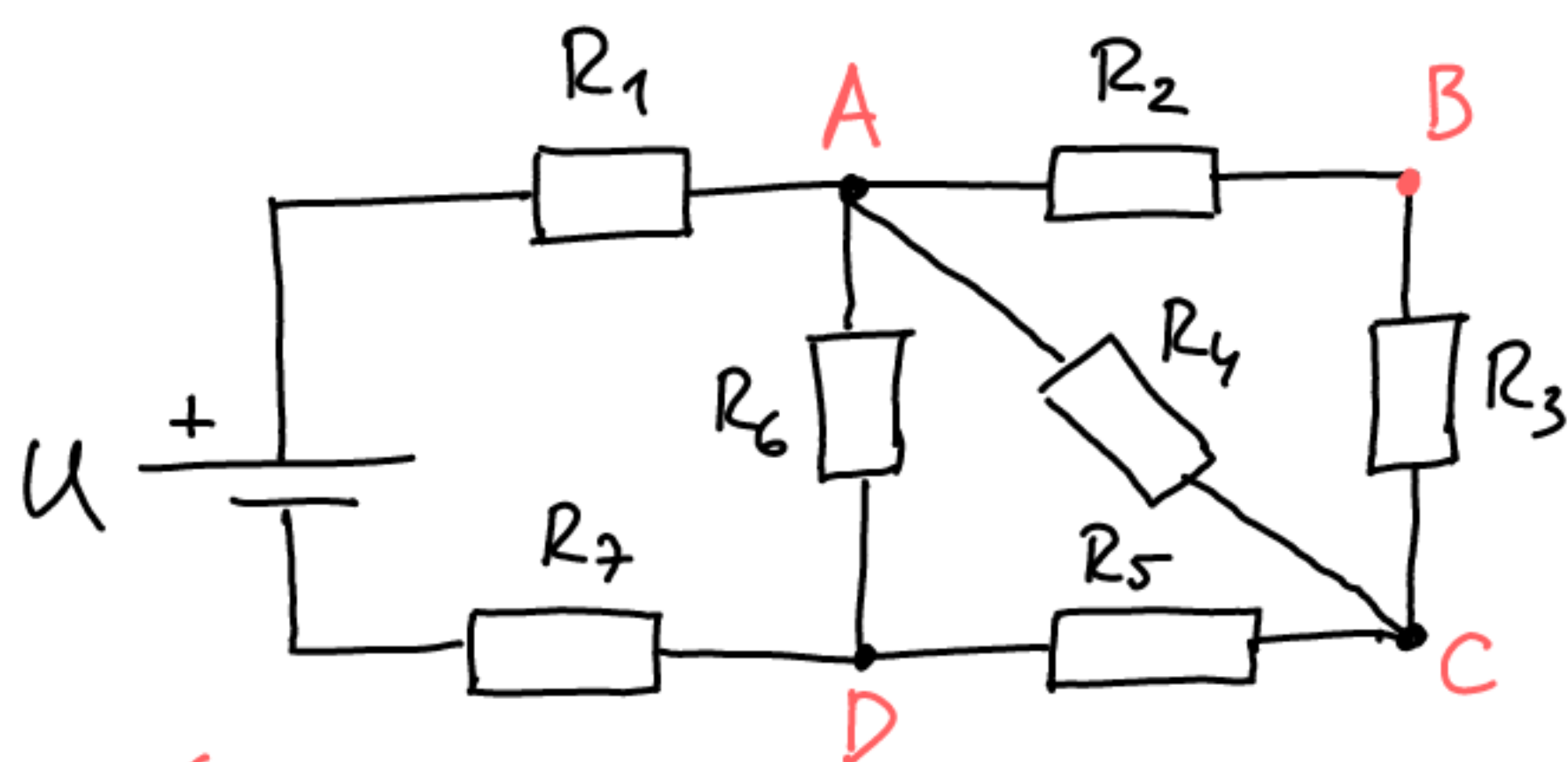
$$R_{uk} = R_1 + R_{23456} = 2 + 10 = \underline{\underline{12 \Omega}}$$

$$R_{23456} = \frac{R_2 \cdot R_{3456}}{R_2 + R_{3456}} = \frac{20 \cdot 20}{20 + 20} = 10 \Omega$$

$$R_{3456} = R_{345} + R_6 = 6 + 14 = 20 \Omega$$

$$R_{345} = \frac{(R_3 + R_4) \cdot R_5}{(R_3 + R_4) + R_5} = \frac{15 \cdot 10}{25} = \frac{150}{25} = 6 \Omega$$

5.



$$R_{uk} = R_1 + R_{23456} + R_7 = 10 + 32.8 + 70 = \underline{\underline{112.8 \Omega}}$$

$$R_{23456} = \frac{R_{2345} \cdot R_6}{R_{2345} + R_6} = \frac{72.2 \cdot 60}{72.2 + 60} = \frac{4332}{132.2} = 32.8 \Omega$$

$$R_{2345} = R_{234} + R_5 = 22.2 + 50 = 72.2 \Omega$$

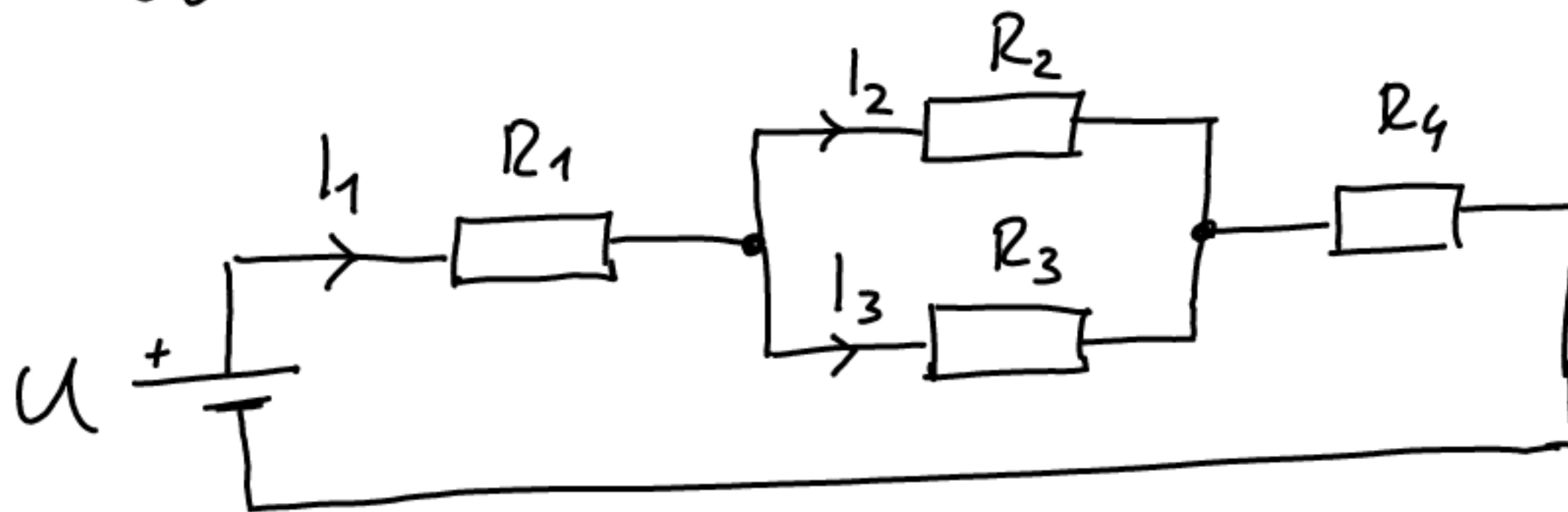
$$R_{234} = \frac{R_{23} \cdot R_4}{R_{23} + R_4} = \frac{50 \cdot 40}{50 + 40} = \frac{2000}{90} = 22.2 \Omega$$

$$R_{23} = R_2 + R_3 = 20 + 30 = 50 \Omega$$

Mješoviti spoj sa svin otpornika

Knjiga str. 119., zadaci: 13-24, posebno: 20, 23, 24 (+ još 35-38)

6. (knjiga str. 120, zad. 20)



$$\begin{aligned}U &= 40 \text{ V} \\R_1 &= 1 \, \Omega \\R_2 &= 6 \, \Omega \\R_3 &= 4 \, \Omega \\R_4 &= 1.6 \, \Omega\end{aligned}$$

$$R_{uk} = 5 \, \Omega$$

$$I_1 = \frac{U}{R_{uk}} = \frac{40}{5} = 8 \text{ A} \quad ; \quad \underline{I_1 = I_2 + I_3}$$

$$U = U_1 + U_{23} + U_4 \rightarrow U_{23} = U - U_1 - U_4 = \underline{\underline{19.2 \text{ V}}}$$

$$U_1 = I_1 \cdot R_1 = 8 \cdot 1 = 8 \text{ V}$$

$$U_4 = I_1 \cdot R_4 = 8 \cdot 1.6 = 12.8 \text{ V}$$

$$I_2 = \frac{U_{23}}{R_2} = \frac{19.2}{6} = 3.2 \text{ A}$$

$$I_3 = \frac{U_{23}}{R_3} = \frac{19.2}{4} = 4.8 \text{ A}$$

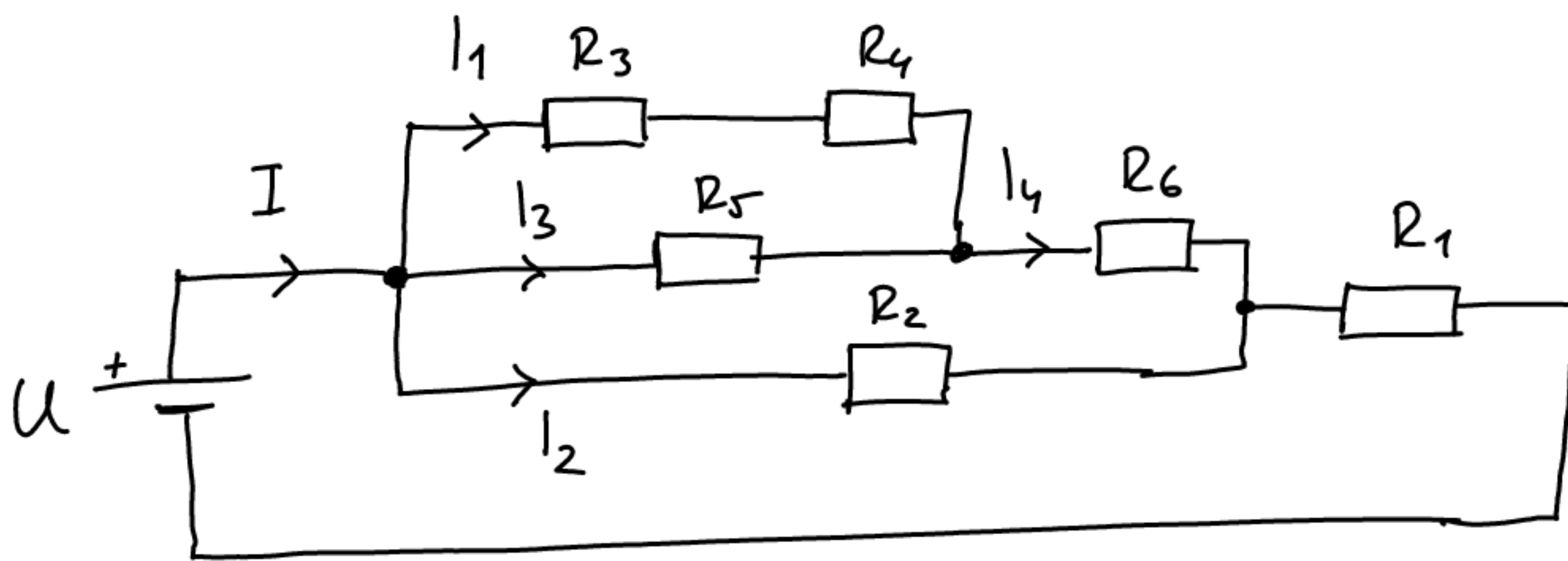
$$\left. \begin{array}{l} I_2 = 3.2 \text{ A} \\ I_3 = 4.8 \text{ A} \end{array} \right\} + = 8 \text{ A} = I_1 \checkmark$$

$$P_1 = U_1 \cdot I_1 = 8 \cdot 8 = 64 \text{ W} \quad ; \quad P_2 = U_{23} \cdot I_2 = 61.44 \text{ W}$$

$$P_4 = U_4 \cdot I_1 = 102.4 \text{ W} \quad ; \quad P_3 = U_{23} \cdot I_3 = 92.16 \text{ W}$$

$$P_{uk} = U \cdot I = 40 \cdot 8 = 320 \text{ W} = P_1 + P_2 + P_3 + P_4 \checkmark$$

7. (kyjica str. 120, zad 23)



$$R_1 = 2 \Omega$$

$$R_2 = 20 \Omega$$

$$R_3 = 5 \Omega$$

$$R_4 = 10 \Omega$$

$$R_5 = 10 \Omega$$

$$R_6 = 14 \Omega$$

$$U = 24 V$$

$$R_{uk} = 12 \Omega \quad (\text{iz 4. zadatka})$$

$$U = U_2 + U_1 \quad I = I_1 + I_2 + I_3$$

$$U_2 = U_5 + U_6 \quad ; \quad I_4 = I_1 + I_3$$

$$U_5 = U_3 + U_4$$

$$I = \frac{U}{R_{uk}} = \frac{24}{12} = 2 A$$

$$U_1 = I \cdot R_1 = 2 \cdot 2 = 4 V$$

$$U_2 = U - U_1 = 24 - 4 = 20 V$$

$$I_2 = \frac{U_2}{R_2} = \frac{20}{20} = 1 A$$

$$I_4 = I - I_2 = 2 - 1 = 1 A$$

$$U_6 = I_4 \cdot R_6 = 1 \cdot 14 = 14 V$$

$$U_5 = U_2 - U_6 = 20 - 14 = 6 V$$

$$I_3 = \frac{U_5}{R_5} = \frac{6}{10} = 0.6 A$$

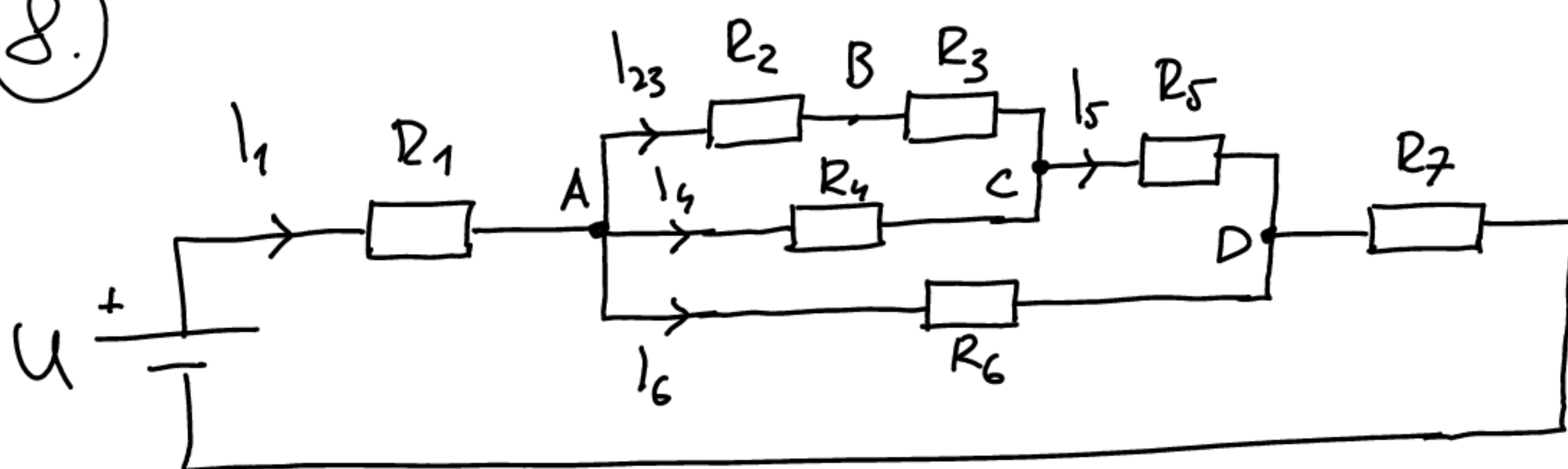
$$I_1 = I_4 - I_3 = 1 - 0.6 = 0.4 A$$

$$U_3 = I_1 \cdot R_3 = 0.4 \cdot 5 = 2 V$$

$$U_4 = I_1 \cdot R_4 = 0.4 \cdot 10 = 4 V$$

$$U_3 + U_4 = 6 V = U_5 \quad \checkmark$$

8.



$$\begin{aligned} U &= 10 \text{ V} \\ R_1 &= 10 \Omega \\ R_2 &= 20 \Omega \\ &\vdots \\ R_7 &= 70 \Omega \end{aligned}$$

$$R_{\text{uk}} = 112.8 \Omega \quad (\text{iz 5. zadatka})$$

$$I_1 = \frac{U}{R_{\text{uk}}} = \frac{10}{112.8} = 0.08865 = 88.65 \text{ mA}$$

$$I_1 = I_{23} + I_4 + I_6 = I_5 + I_6$$

$$I_{23} + I_4 = I_5$$

$$U = U_1 + U_6 + U_7$$

$$U_4 + U_5 = U_6$$

$$U_2 + U_3 = U_4$$

$$\Rightarrow U_1 = I_1 \cdot R_1 = 0.89 \text{ V}$$

$$U_7 = I_1 \cdot R_7 = 6.21 \text{ V}$$

$$U_6 = U - U_1 - U_7 = 2.91 \text{ V}$$

$$I_6 = \frac{U_6}{R_6} = 0.0485 = 48.5 \text{ mA}$$

$$I_5 = I_1 - I_6 = 0.0402 \text{ A} = 40.2 \text{ mA}$$

$$U_5 = I_5 \cdot R_5 = 2.01 \text{ V}$$

$$U_4 = U_6 - U_5 = 0.90 \text{ V}$$

$$I_4 = \frac{U_4}{R_4} = 0.0224 \text{ A} = 22.4 \text{ mA}$$

$$I_{23} = I_5 - I_4 = 0.0178 \text{ A} = 17.8 \text{ mA}$$

$$U_2 = I_{23} \cdot R_2 = 0.36 \text{ V}$$

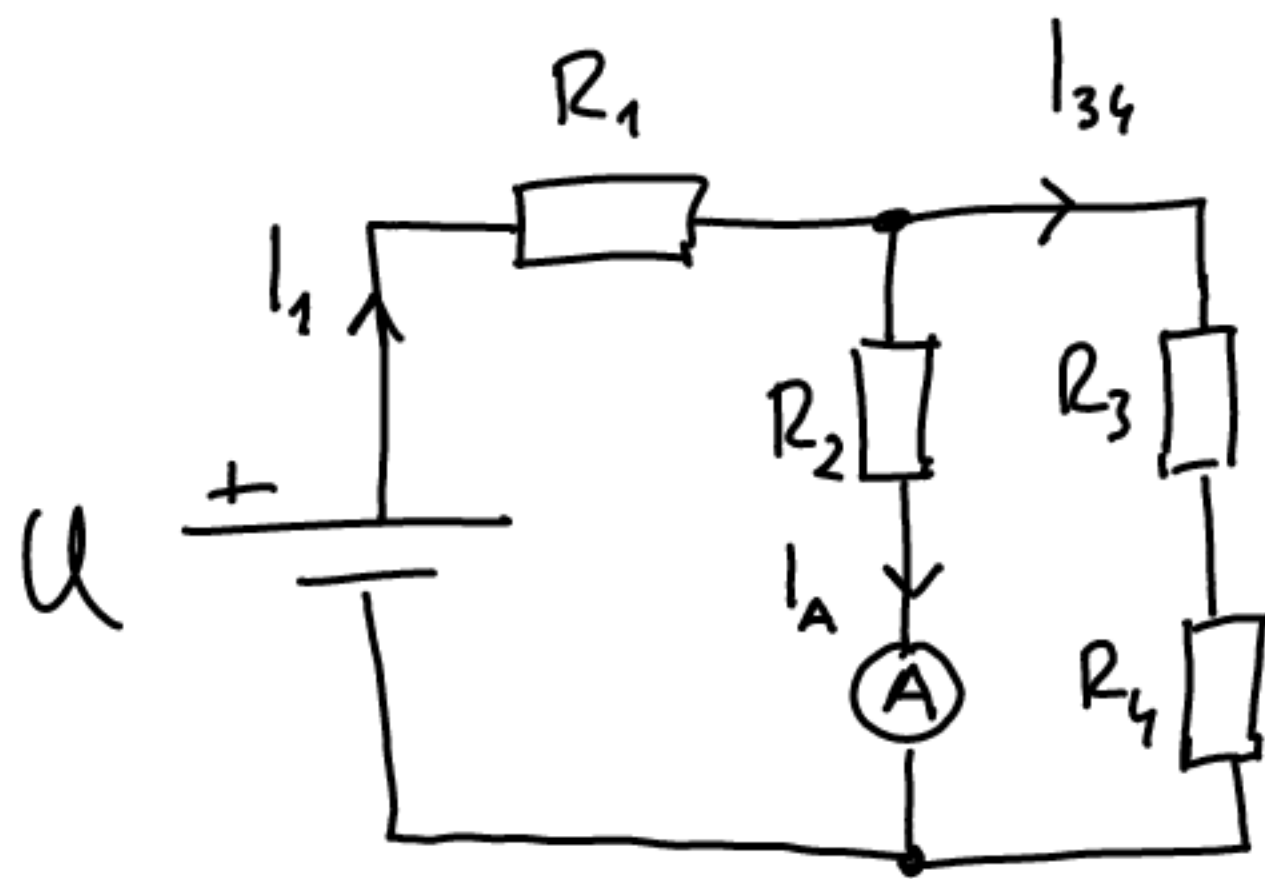
$$U_3 = I_{23} \cdot R_3 = 0.53 \text{ V}$$



Mješoviti spoj s voltmetrom / ampermetrom

Knjiga str. 121., zadaci: 28. - 32., posebno 28. i 32.

9. (knjiga str. 121., zad. 28)



$$U = 42 \text{ V}$$

$$R_1 = ?$$

$$R_2 = 10 \Omega$$

$$R_3 = 20 \Omega$$

$$R_4 = 30 \Omega$$

$$I_A = 1.5 \text{ A}$$

$$I_1 = I_A + I_{34}$$

$$U = U_1 + U_2$$

$$U_2 = U_{34}$$

$$U_2 = I_A \cdot R_2 = 1.5 \cdot 10 = 15 \text{ V}$$

$$U_{34} = 15 \text{ V}$$

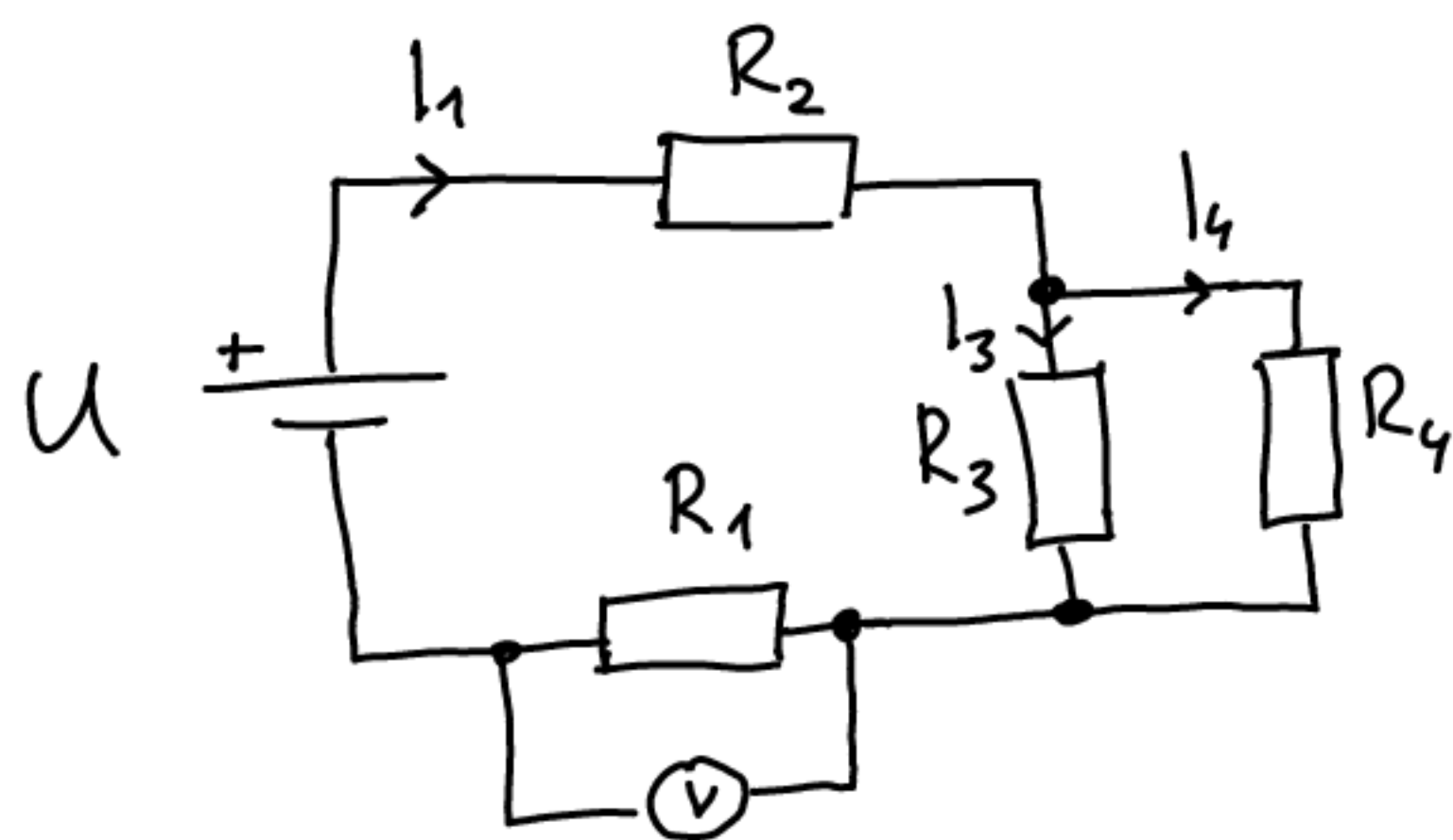
$$I_{34} = \frac{U_{34}}{R_{34}} = \frac{15}{(20+30)} = 0.3 \text{ A}$$

$$I_1 = I_A + I_{34} = 1.5 + 0.3 = 1.8 \text{ A}$$

$$U_1 = U - U_2 = 42 - 15 = 27 \text{ V}$$

$$R_1 = \frac{U_1}{I_1} = \frac{27}{1.8} = \underline{\underline{15 \Omega}}$$

10. (kyjiga str. 121, zad. 32)



$$R_1 = 20 \Omega$$

$$U_V = 5V$$

$$R_2 = 6.25 \Omega$$

$$R_3 = 5 \Omega$$

$$U = ?$$

$$R_4 = 15 \Omega$$

$$U_V = U_1$$

$$U = U_2 + U_{34} + U_1$$

$$I_1 = I_3 + I_4$$

$$I_1 = \frac{U_1}{R_1} = \frac{5V}{20 \Omega} = 0.25 A$$

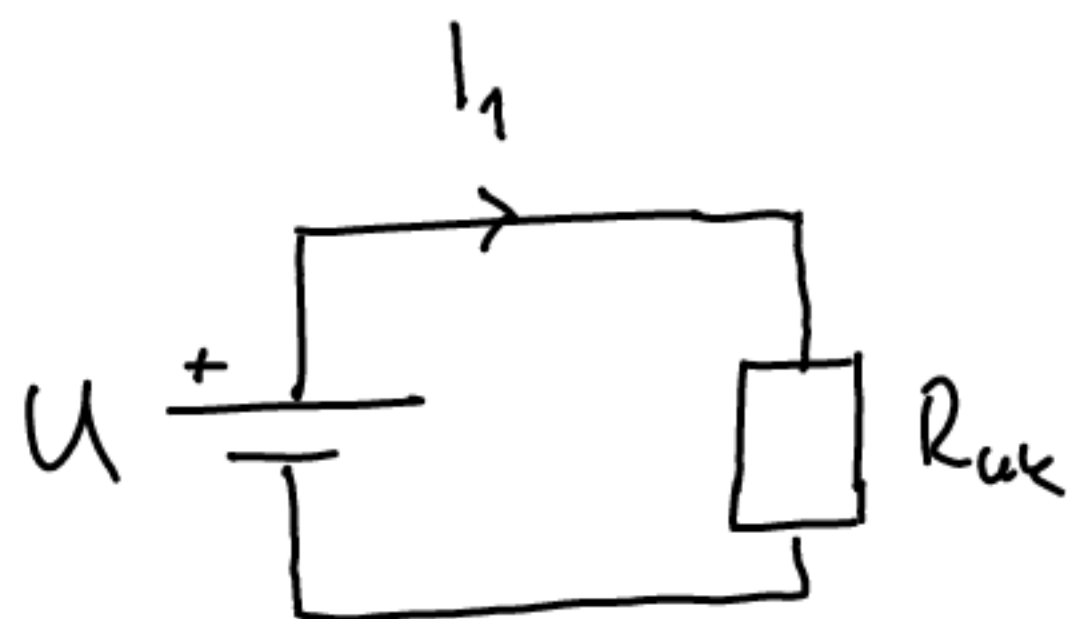
$$R_{uk} = R_2 + \frac{R_3 \cdot R_4}{R_3 + R_4} + R_1 =$$

$$= 6.25 + \frac{5 \cdot 15}{5 + 15} + 20 =$$

$$= 6.25 + \frac{75}{20} + 20 =$$

$$= 6.25 + 3.75 + 20 =$$

$$R_{uk} = 30 \Omega$$



$$\Rightarrow U = I_1 \cdot R_{uk} =$$

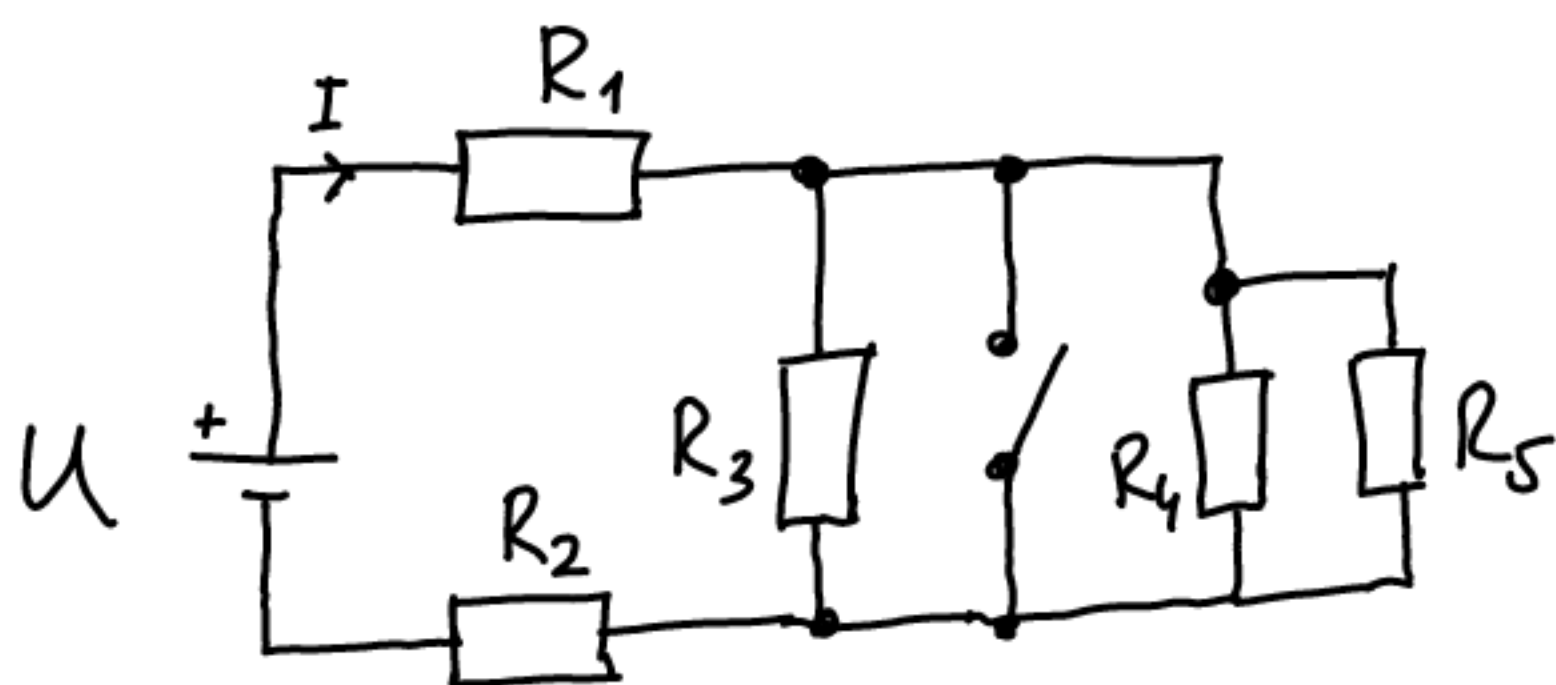
$$= 0.25 \cdot 30 =$$

$$= \underline{\underline{7.5 V}}$$

Mješoviti spoj s prekidačem

Knjiga str. 121., zadaci: 33, 34, 40, 44, 45, 46; posebno: 34, 40, 46

11. (knjiga str. 121, zad. 34)



$$R_1 = 10 \Omega$$

$$R_2 = 15 \Omega$$

$$R_4 = 100 \Omega$$

$$R_5 = 100 \Omega$$

$$R_{45} = \underline{\underline{50 \Omega}}$$

$$U = ?$$

$$R_3 = ?$$

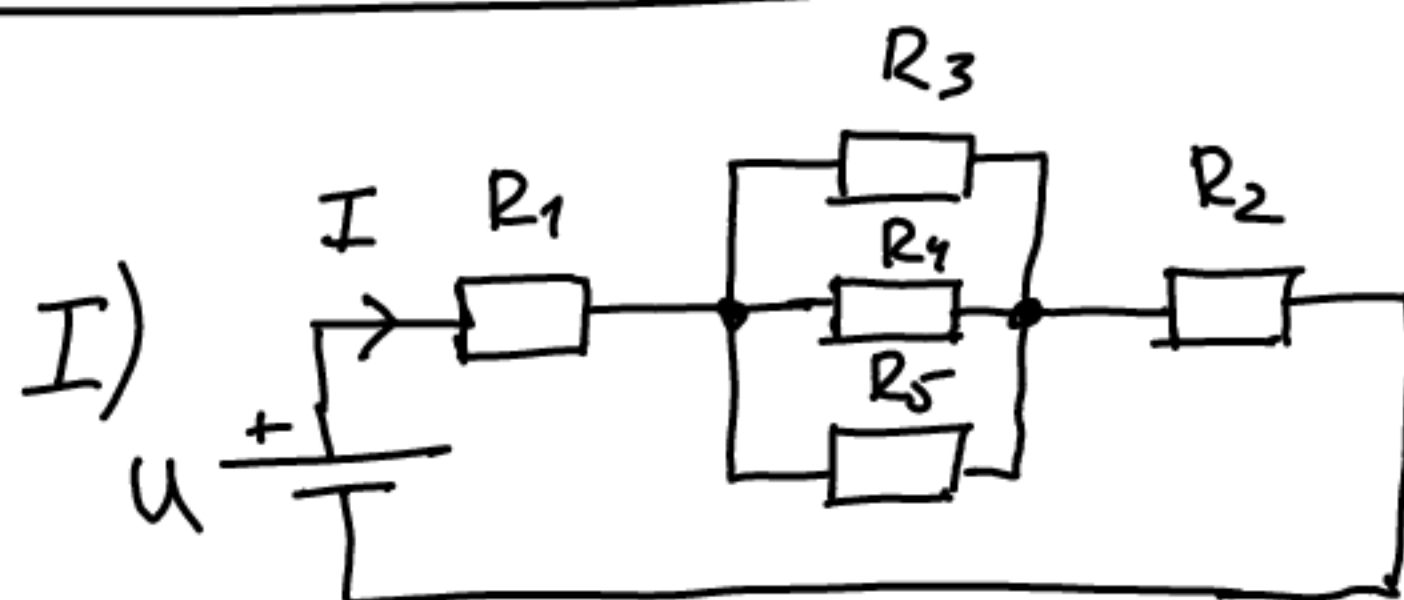
$$\text{iz II) } U = I \cdot R_{12} = \\ = 0.4 \cdot 25 =$$

$$\boxed{U = 10 \text{ V}}$$

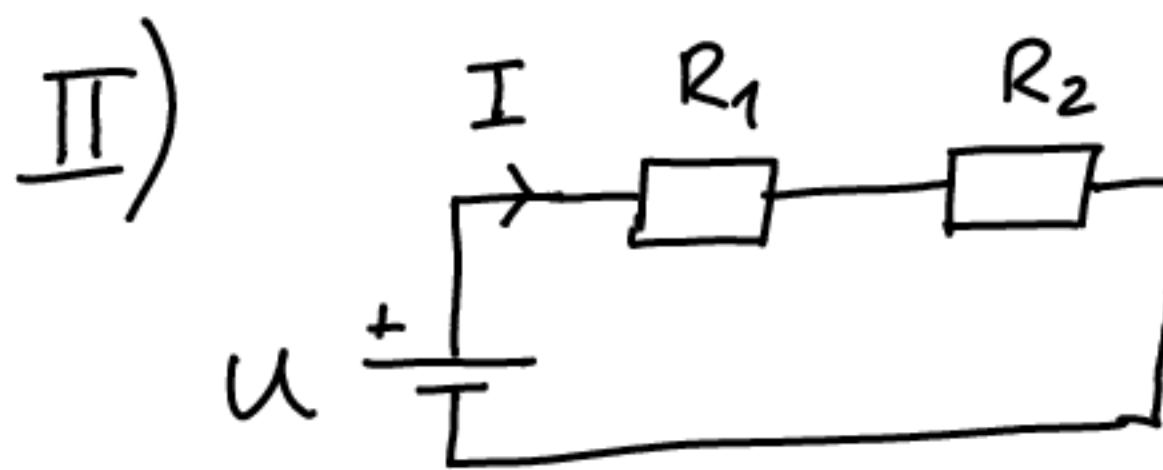
$$\text{iz I) } R_{uk} = \frac{U}{I} = \frac{10}{0.2} = \underline{\underline{50 \Omega}}$$

$$R_{uk} = R_1 + R_2 + R_{345} \rightarrow R_{345} = 50 - 10 - 15 = 25 \Omega$$

$$R_{345} = \frac{R_3 \cdot R_{45}}{R_3 + R_{45}} \rightarrow 25 = \frac{R_3 \cdot 50}{R_3 + 50} \xrightarrow{\text{matem.}} \dots \rightarrow \boxed{R_3 = 50 \Omega}$$



$$I = 0.2 \text{ A}$$



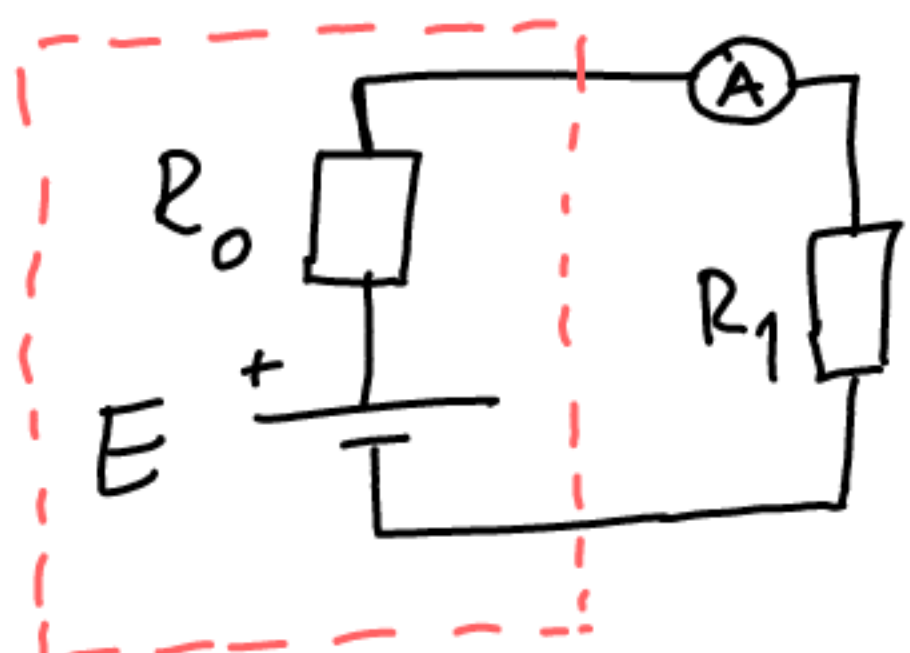
$$I = 0.4 \text{ A}$$

Jer, ako je sklopka zatvorena
onda kratki spoj u paraleli,
a $R_{ks} = 0$.

$$\text{Matematika kaže: } \frac{0 \cdot x}{0 + x} = \frac{0}{x} = \underline{\underline{0!}}$$

12.) (kujiga str. 122, zad. 40)

I)



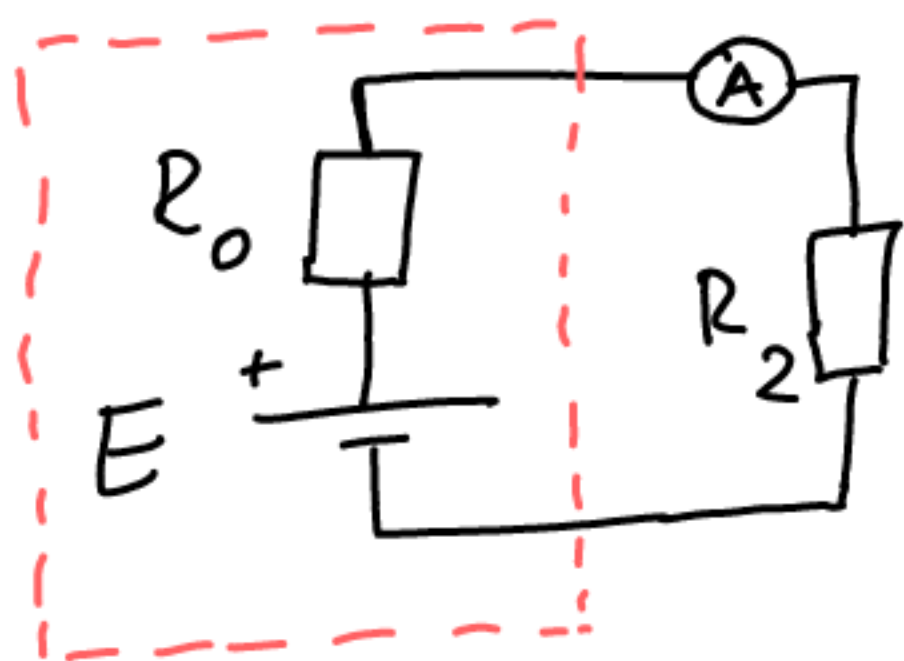
$$\begin{aligned} I_A &= 0.5 \text{ A} \\ R_1 &= 20 \Omega \end{aligned}$$

$$\left. \begin{aligned} I_A &= 0.5 \text{ A} \\ R_1 &= 20 \Omega \end{aligned} \right\} I_A = \frac{E}{R_{uk}} = \frac{E}{R_1 + R_0}$$

$$\Rightarrow (20 + R_0) \cdot 0.5 = E$$

Realni izvor

II)



$$\begin{aligned} I_A &= 0.25 \text{ A} \\ R_2 &= 44 \Omega \end{aligned}$$

$$\left. \begin{aligned} I_A &= 0.25 \text{ A} \\ R_2 &= 44 \Omega \end{aligned} \right\} I_A = \frac{E}{R_2 + R_0}$$

$$\Rightarrow (44 + R_0) \cdot 0.25 = E$$

$$\Rightarrow (20 + R_0) \cdot 0.5 = (44 + R_0) \cdot 0.25$$

$$\rightarrow 10 + 0.5 R_0 = 11 + 0.25 R_0$$

$$\rightarrow (0.5 - 0.25) R_0 = 11 - 10$$

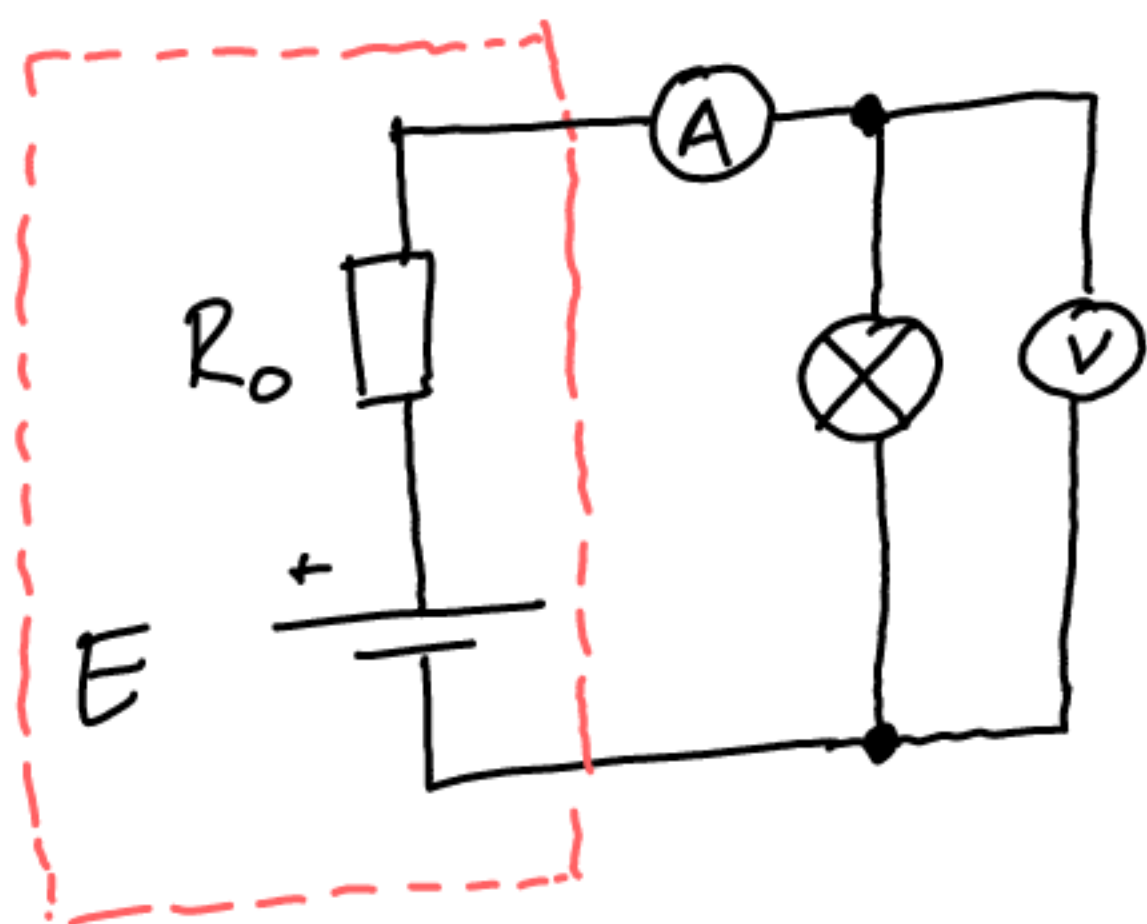
$$\rightarrow R_0 = \frac{1}{0.25} = \underline{\underline{4 \Omega}}$$

$$\rightarrow E = (20 + 4) \cdot 0.5 = \underline{\underline{12 \text{ V}}}$$

provjera:

$$E = (44 + 4) \cdot 0.25 = 12 \text{ V} \checkmark$$

13. (kujiga str. 123, zad. 46)



$$\text{I) } U_v = 25 \text{ V}, I_A = 5 \text{ A}$$

$$E = I_A \cdot R_0 + U_v = \underline{\underline{5 \cdot R_0 + 25}}$$

$$\text{II) } U_v = 28 \text{ V}, I_A = 2 \text{ A}$$

$$E = I_A \cdot R_0 + U_v = \underline{\underline{2 \cdot R_0 + 28}}$$

$$\Rightarrow 5 \cdot R_0 + 25 = 2 \cdot R_0 + 28$$

$$\rightarrow 3 \cdot R_0 = 3$$

$$\boxed{R_0 = 1 \Omega}$$

$$\rightarrow \boxed{E = 5 \cdot 1 + 25 = 30 \text{ V}}$$

provjera: $E = 2 \cdot 1 + 28 = 30 \text{ V}$ ✓