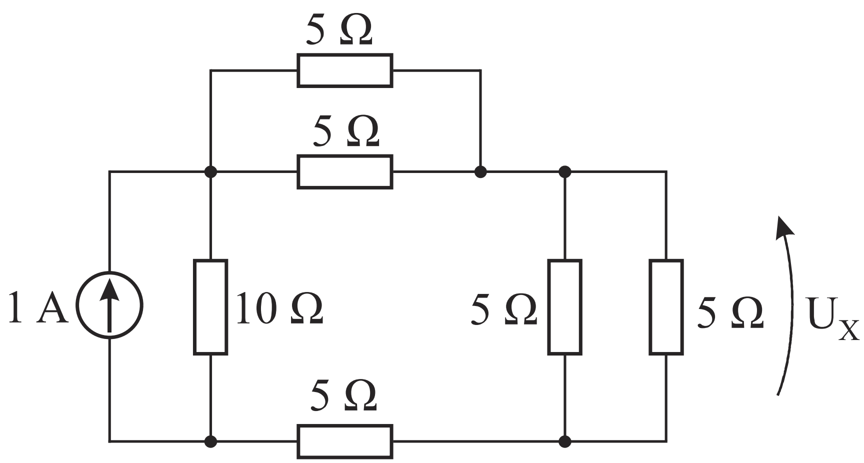
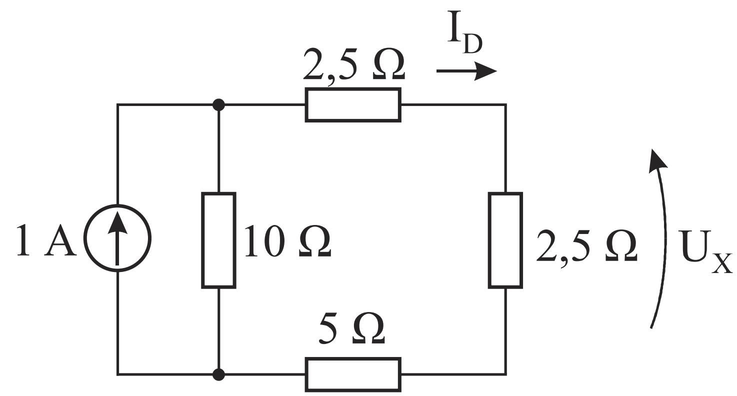
Ponedeljak, 13.12.2021.
Sreda, 15.12.2021.

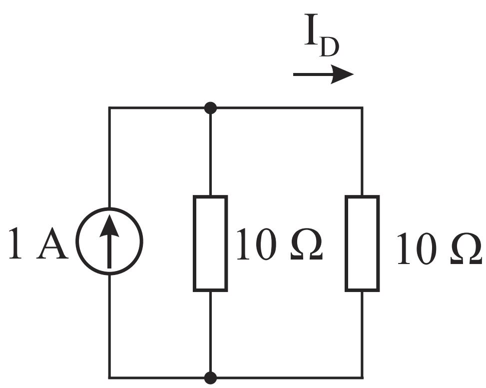
Vežbe 19

Vremenski konstantne električne struje

Zadatak 1. U električnom kolu sa slike izračunati napon U_X, koristeći relacije strujnog razdelnika.



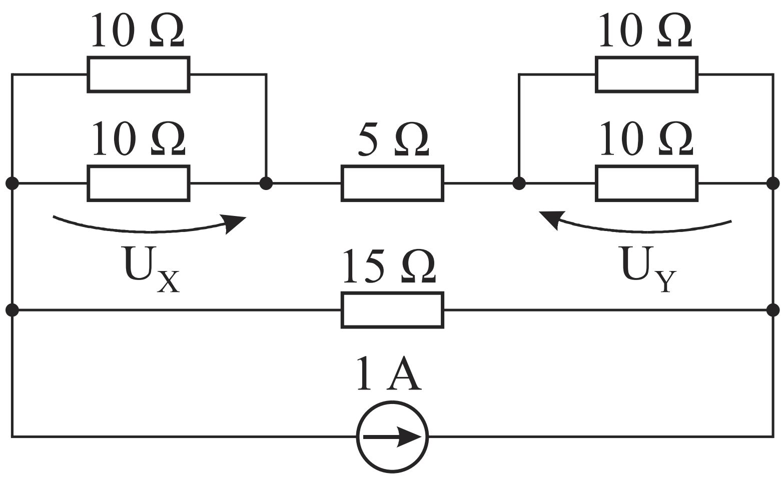


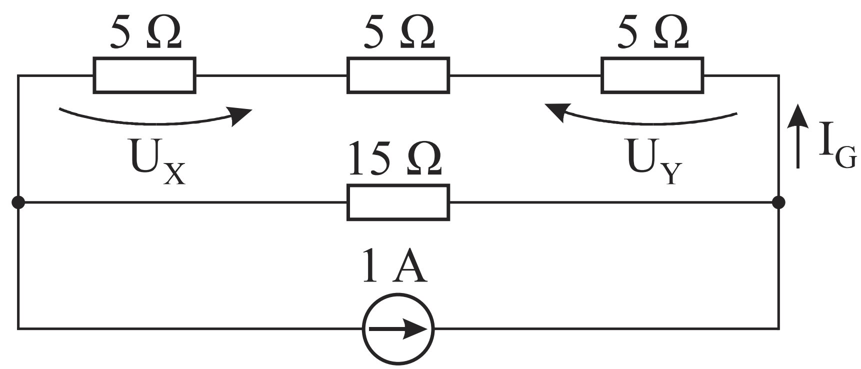


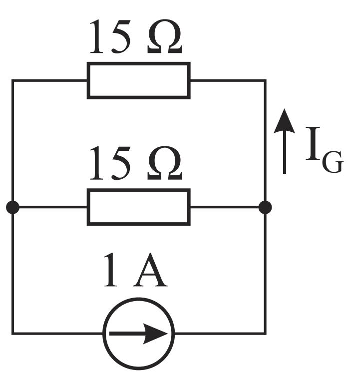
$$I_D = \frac{10}{10+10} \cdot 1 = 0,5\ A$$

$$\boxed{U_X = 2,5 \cdot I_D = 1,25\ V}$$

Zadatak 2. Koristeći relacije strujnog razdelnika, u električnom kolu sa slike, izračunati napone U_X i U_Y.





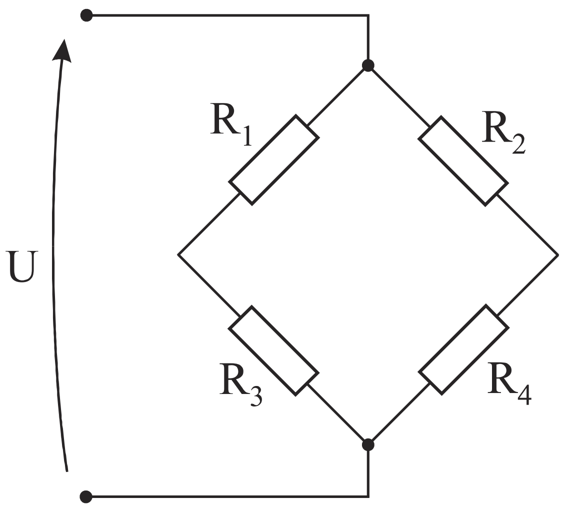


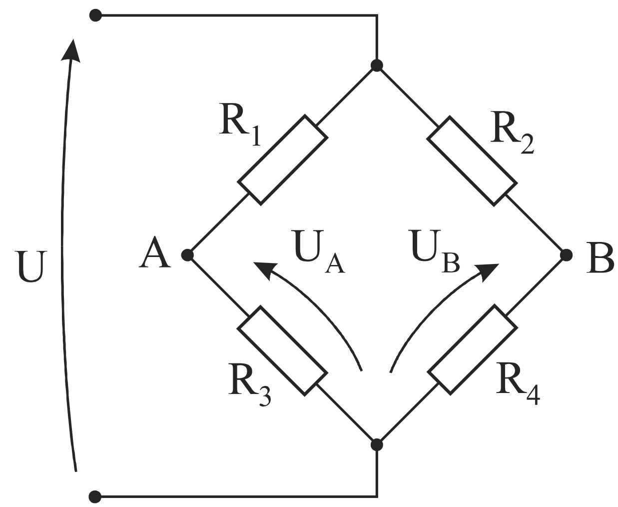
$$I_G = \frac{15}{15+15} \cdot 1 = 0,5\ A$$

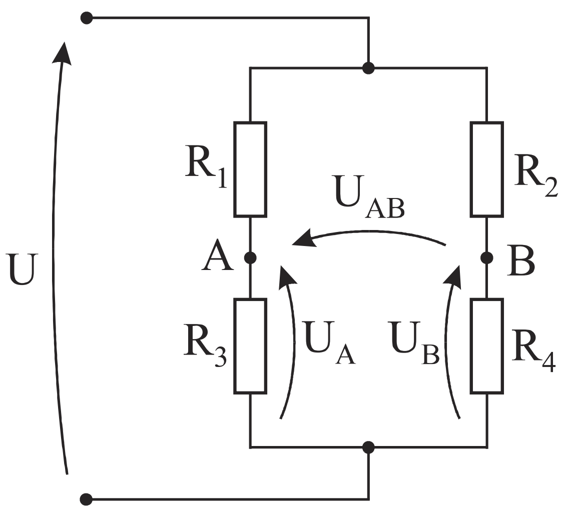
$$\boxed{U_X = 5 \cdot I_G = 2,5\ V}$$

$$\boxed{U_Y = -5 \cdot I_G = -2,5\ V}$$

Zadatak 3. Na slici je prikazana mreža koja se naziva Vitstonov most. Koristeći relacije razdelnika napona, izraziti vrednosti napona U_A i U_B u funkciji napona U.



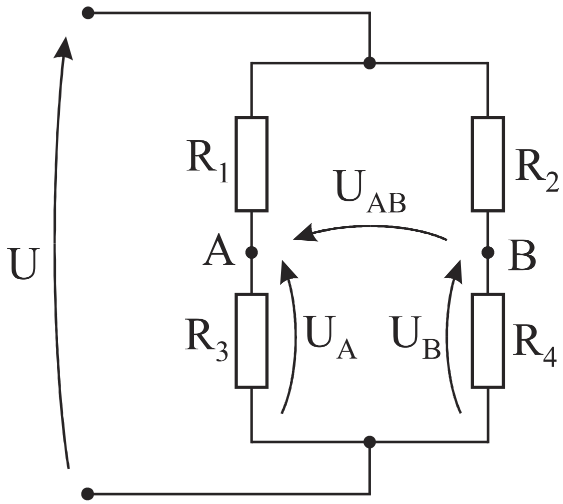




$$\boxed{U_A = \frac{R_3}{R_3 + R_1} \cdot U}$$

$$\boxed{U_B = \frac{R_4}{R_4 + R_2} \cdot U}$$

Zadatak 4. Na osnovu rešenja prethodnog zadatka, izraziti vrednost napona U_{AB} u funkciji napona U, a zatim izvesti uslov ravnoteže Vitstonovog mosta (tj. odrediti odnos otpornosti otpornika tako da je $U_{AB}=0$ za $U\neq0$).



$$\boxed{U_A = \frac{R_3}{R_3+R_1}\cdot U}$$

$$\boxed{U_B = \frac{R_4}{R_4+R_2}\cdot U}$$

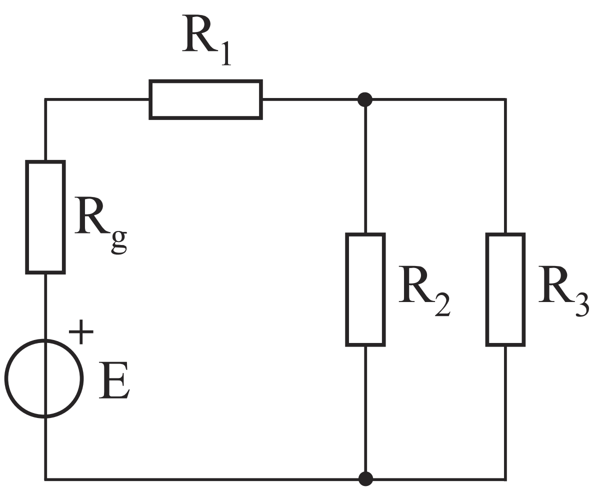
$$U_{AB} = U_A - U_B = \frac{R_3}{R_3+R_1}\cdot U - \frac{R_4}{R_4+R_2}\cdot U = \left(\frac{R_3}{R_3+R_1} - \frac{R_4}{R_4+R_2}\right)\cdot U$$

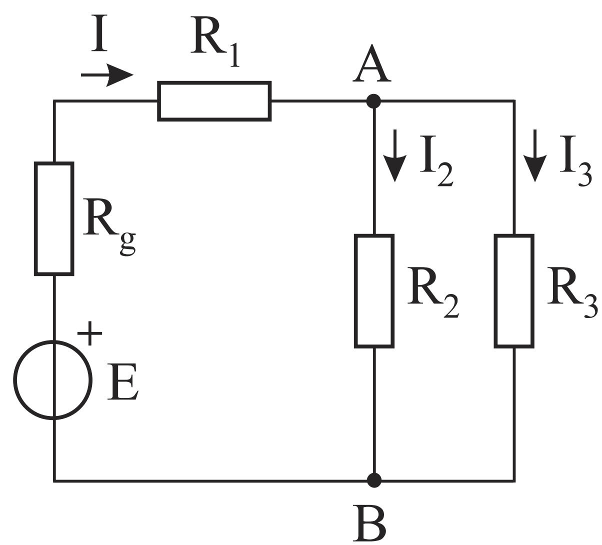
$$U_{AB} = 0 \qquad \text{za} \qquad \frac{R_3}{R_3+R_1} = \frac{R_4}{R_4+R_2}$$

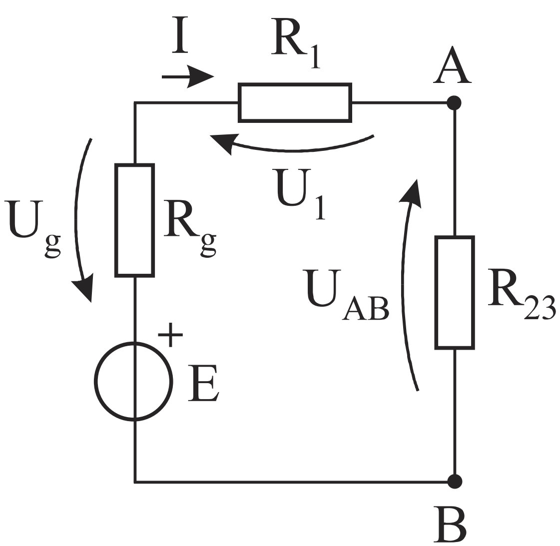
$$R_3\cdot R_4 + R_3\cdot R_2 = R_4\cdot R_3 + R_4\cdot R_1$$

$$\boxed{R_2\cdot R_3 = R_1\cdot R_4} \qquad \boxed{\frac{R_1}{R_2} = \frac{R_3}{R_4}}$$

Zadatak 5. Odrediti jačinu struje kroz kolo prikazano na slici, kao i napone između priključaka sva tri otpornika, ako je E=6 V, R_g=0,01 Ω, R_1=0,15 Ω, R_2=0,2 Ω, R_3=0,4 Ω.



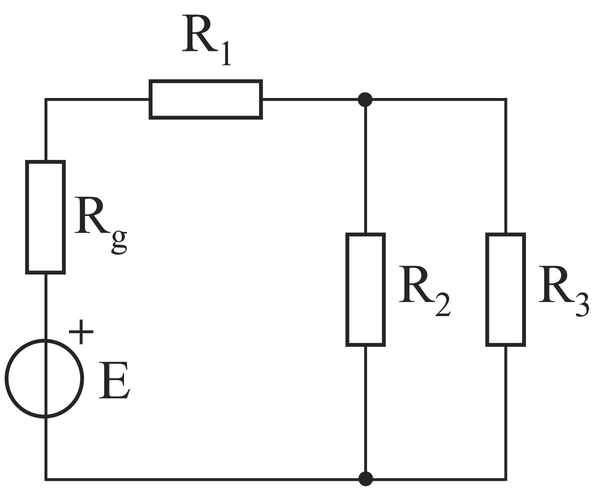


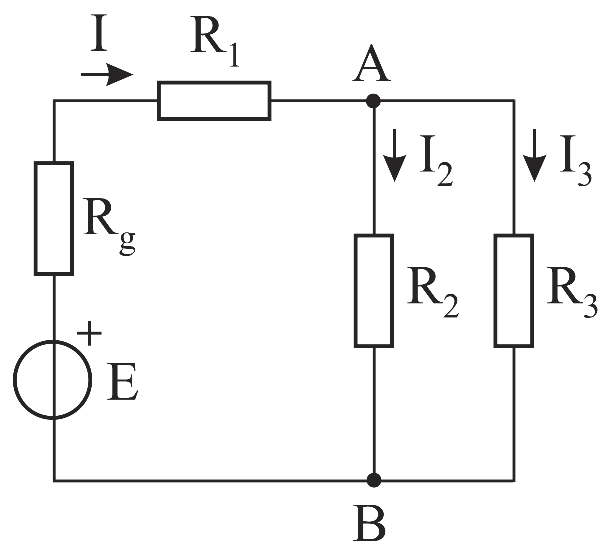


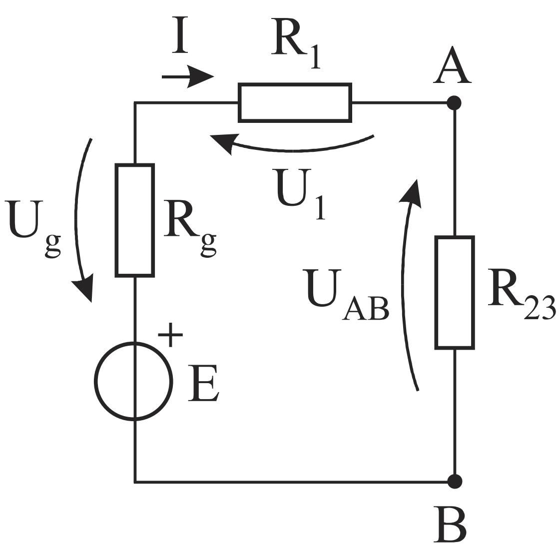
$$R_{23} = R_2 \,||\, R_3 = \frac{0,2 \cdot 0,4}{0,2 + 0,4} = 0,133\,\Omega$$

$$R_1 \cdot I + R_{23} \cdot I - E + R_g \cdot I = 0$$

$$\boxed{I = \frac{E}{R_g + R_1 + R_{23}} = 20,48\ A}$$







$$\boxed{U_1 = R_1 \cdot I = 3{,}07\ V}$$

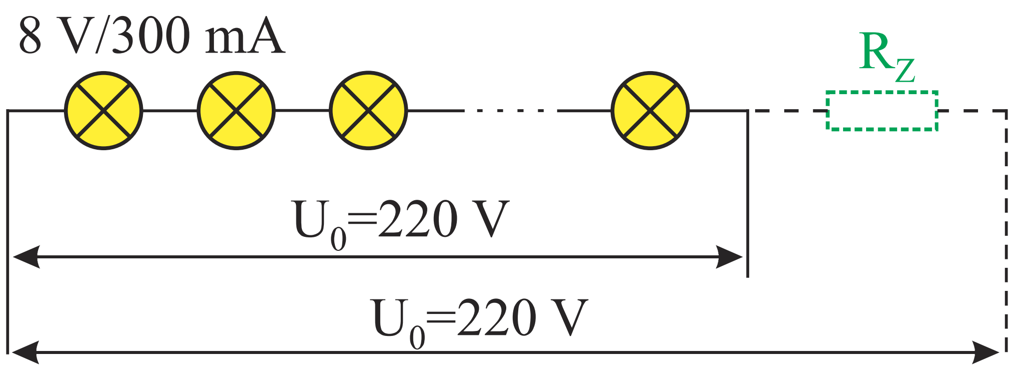
$$\boxed{U_{AB} = R_{23} \cdot I = 2{,}73\ V}$$

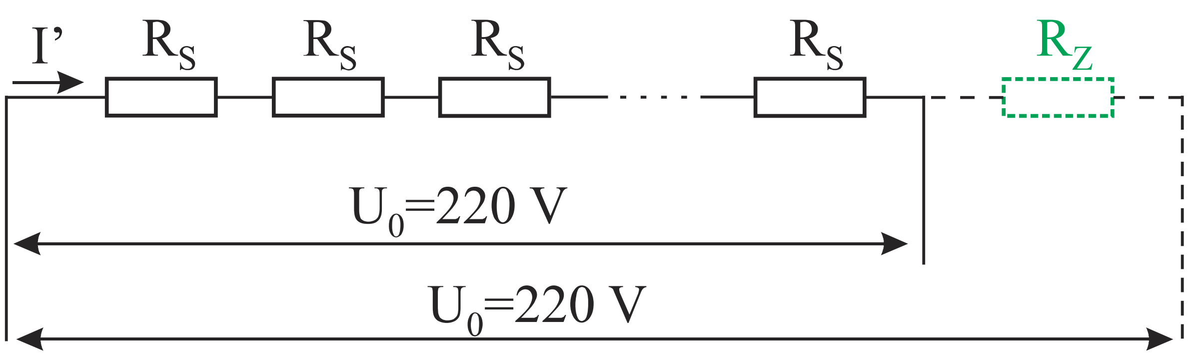
$$\boxed{U_g = R_g \cdot I = 0{,}2\ V}$$

$$\boxed{I_2 = \frac{U_{AB}}{R_2} = 13{,}65\ A}$$

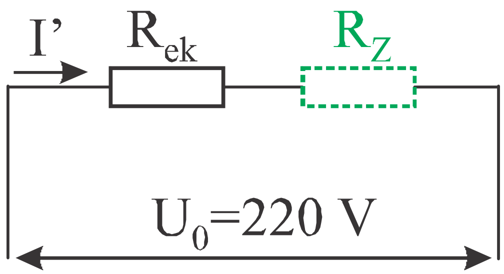
$$\boxed{I_3 = \frac{U_{AB}}{R_3} = 6{,}83\ A}$$

Zadatak 6. Za osvetljenje novogodišnje jelke imamo na raspolaganju 20 sijalica (vezanih redno) na kojima piše 8 V/300 mA. Odrediti vrednost otpornika R_Z, koji mora da se upotrebi, da bi cela rasveta mogla da se priključi na mrežni napon U_0=220 V.





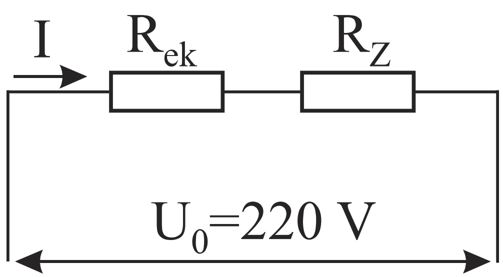
$$R_S = \frac{8\,V}{300\,mA} = 26,67\,\Omega$$



$$R_{ek} = 20 \cdot R_S = 533{,}4\,\Omega$$

$$I' = \frac{U_0}{R_{ek}} = \frac{220\,V}{533{,}4\,\Omega} = 412\,mA$$

$$I' = 412\,mA > 300\,mA \quad \Rightarrow \quad \text{mora se dodati } R_Z$$

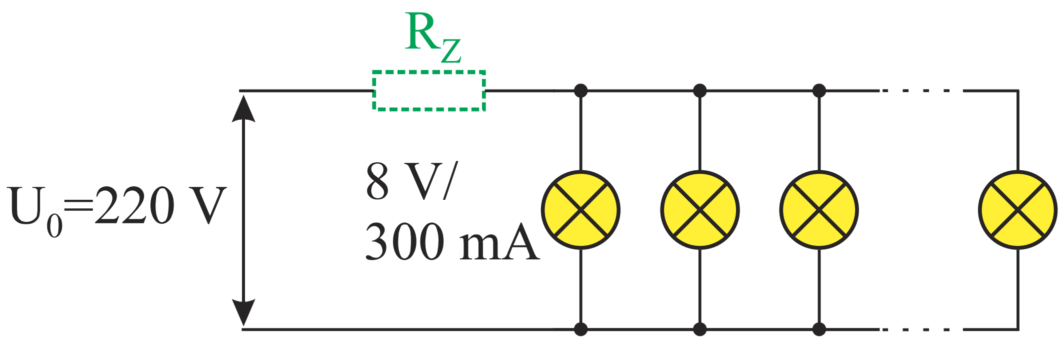


$$I = \frac{U_0}{R_{ek} + R_Z} \le \mathrm{I}_{\max} \qquad (\mathrm{I}_{\max} = 300\,mA)$$

$$R_Z \ge \frac{U_0}{\mathrm{I}_{\max}} - R_{ek} = \frac{220\,V}{300\,mA} - 533{,}4\,\Omega$$

$$\boxed{R_Z \ge 199{,}9\,\Omega}$$

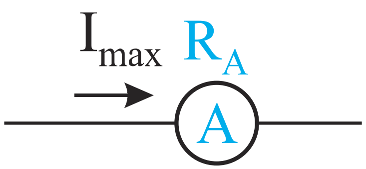
Zadatak 7. – DOMAĆI Za osvetljenje novogodišnje jelke imamo na raspolaganju 20 sijalica (vezanih paralelno) na kojima piše 8 V/300 mA. Odrediti vrednost otpornika R_Z, koji mora da se upotrebi, da bi cela rasveta mogla da se priključi na mrežni napon U_0=220 V.

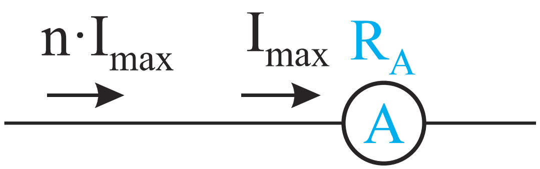


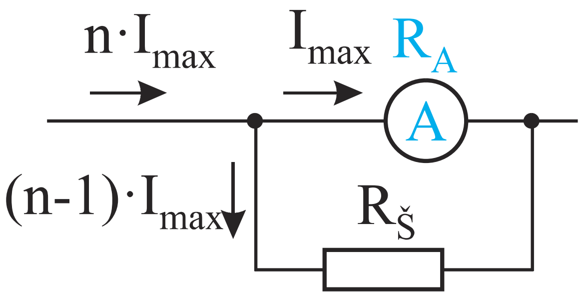
$$\boxed{R_Z \geq 35{,}34\,\Omega}$$

Zadatak 8. Proširivanje mernog opsega.

a) Ampermetar.







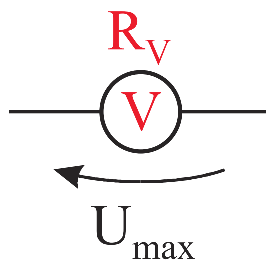
$$I_{\max} = \frac{R_Š}{R_A + R_Š} \cdot n \cdot I_{\max}$$

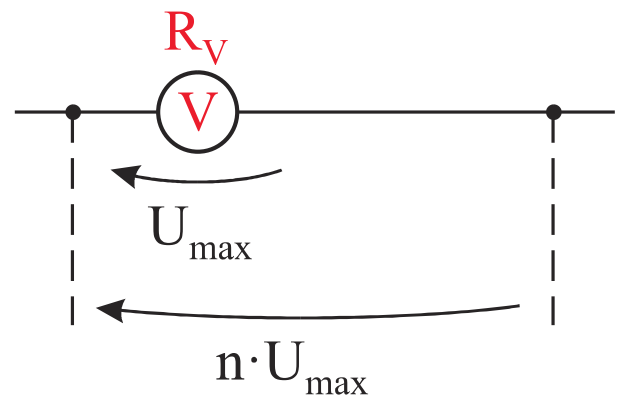
$$\left(R_A + R_Š\right) \cdot I_{\max} = R_Š \cdot n \cdot I_{\max}$$

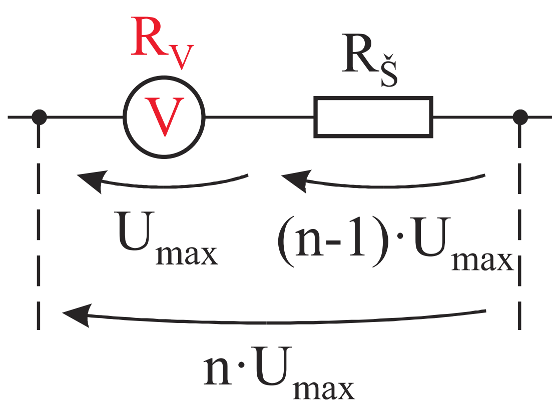
$$R_A \cdot I_{\max} = R_Š \cdot \left(n \cdot I_{\max} - I_{\max}\right) = R_Š \cdot (n-1) \cdot I_{\max}$$

$$\boxed{R_Š = \frac{R_A}{n-1}}$$

b) Voltmetar.







$$U_{\max} = \frac{R_V}{R_V + R_Š} \cdot n \cdot U_{\max}$$

$$\left(R_V + R_Š\right) \cdot U_{\max} = R_V \cdot n \cdot U_{\max}$$

$$R_Š \cdot U_{\max} = R_V \cdot \left(n \cdot U_{\max} - U_{\max}\right) = R_V \cdot \left(n-1\right) \cdot U_{\max}$$

$$\boxed{R_Š = \left(n-1\right) \cdot R_V}$$