1-masala yechimi

To‘liq zanjir uchun Om qonuni:

$$I_1 = \varepsilon / (R_1 + r)$$
$$I_2 = \varepsilon / (R_2 + r)$$

Berilgan qiymatlarni qo‘yamiz:

$$2 = \varepsilon / (3 + r)$$
$$1 = \varepsilon / (7 + r)$$

Birinchi tenglamadan: ε = 2(3 + r) = 6 + 2r
Ikkinchisidan: ε = 1(7 + r) = 7 + r

Tenglaymiz:

$$6 + 2r = 7 + r$$
$$2r - r = 7 - 6$$
$$r = 1\,\Omega$$

Endi ε:

$$\varepsilon = 7 + r = 7 + 1 = 8\,V$$

Javob: ε = 8 V, r = 1 Ω.

2-masala yechimi

a) Ketma-ket ulash:
EYuK: ε_um = ε + ε = 9 + 9 = 18 V
Ichki qarshilik: $r_{um} = r + r = 1 + 1 = 2\,\Omega$

Tok:

$$I\_ket = \varepsilon_{um} / (R + r_{um}) = 18 / (8 + 2) = 18 / 10 = 1{,}8\,A$$

b) Parallel ulash (bir xil manbalar):
EYuK: $\varepsilon_{um} = \varepsilon = 9\,V$
Ichki qarshilik: $r_{um} = r / n = 1 / 2 = 0{,}5\,\Omega$

Tok:

$$I_{par} = \varepsilon_{um} / (R + r_{um}) = 9 / (8 + 0{,}5) = 9 / 8{,}5 \approx 1{,}06\,A$$

c) Tashqi rezistordagi quvvat:

$$P_{ket} = {I_{ket}}^2 R \approx (1{,}8)^2 \cdot 8 \approx 3{,}24 \cdot 8 \approx 25{,}9\,W$$
$$P_{par} = {I_{par}}^2 R \approx (1{,}06)^2 \cdot 8 \approx 1{,}12 \cdot 8 \approx 9\,W$$

Javob: Tok ketma-ket ulashda katta, va tashqi rezistordagi quvvat ham ketma-ket ulashda kattaroq.

3-masala yechimi

a) Nominal rejimda:

$$P_n = {U_n}^2 / R_{lamp}$$

$$R_{lamp} = {U_n}^2 / P_n = 12^2 / 24 = 144 / 24 = 6\,\Omega$$

b) U = 9 V bo‘lganda:

$$P = U^2 / R_{lamp} = 9^2 / 6 = 81 / 6 \approx 13{,}5\,W$$

Javob: $R_{lamp} = 6\,\Omega, P \approx 13{,}5\,W$.

4-masala yechimi

a) Ketma-ket zanjir: $R_{um} = R1 + R2 = 4 + 6 = 10\,\Omega$

Tok:

$$I = U / R_{um} = 20 / 10 = 2\,A$$

b) Kuchlanishlar:

$$U_1 = I \cdot R_1 = 2 \cdot 4 = 8\,V$$
$$U_2 = I \cdot R_2 = 2 \cdot 6 = 12\,V$$

c) Quvvatlar:

$$P_1 = I^2 R_1 = 2^2 \cdot 4 = 4 \cdot 4 = 16\,W$$
$$P_2 = I^2 R_2 = 4 \cdot 6 = 24\,W$$

Ko‘proq quvvat R2 da ajraladi → u ko‘proq qiziydi.

5-masala yechimi

Kirxgofning 1-qonuni:

$$I_{kir} = I_{chiq}$$

$$I_1 + I_2 = I3 + I4$$

$$3 + 4 = I_3 + I_4$$
$$7 = I_3 + I_4$$

Berilgan: I3 = I4

Shuning uchun:

$$I_3 + I_3 = 7$$
$$2\,I_3 = 7$$
$$I_3 = 3{,}5\,A$$

Demak $I_4 = 3{,}5\,A$.

Javob: $I_3 = 3{,}5\,A, I_4 = 3{,}5\,A$.

6-masala yechimi

Rezistordagi kuchlanish U = 7,2 V, tok I = 0,8 A.

a) Rezistor qarshiligi:

$$R = U / I = 7{,}2 / 0{,}8 = 9\,\Omega$$

Ammo shartda tashqi R = 10 Ω deyilgandi. Demak 7,2 V – bu manba uchlaridagi kuchlanish, 0,8 A – umumiy tok. Bu holda:

$$I = \varepsilon / (R + r)$$

$U = I\,R = 0{,}8 \cdot 10 = 8$ V bo‘lishi kerak edi, lekin 7,2 V berilgan — kelishmayapti. Shuning uchun bu masalada U ni manba uchlarida o‘lchangan deb qabul qilamiz va quyidagicha ishlaymiz:

Manba uchlaridagi kuchlanish:

$$U = \varepsilon - I\,r$$

Boshqa tomondan $U = I\,R$

Demak:

$$I\,R = \varepsilon - I\,r$$

$$I(R + r) = \varepsilon$$

Shuningdek to‘liq zanjir uchun ham shu:

$$\varepsilon = I(R + r)$$

Demak $\varepsilon = 0{,}8(R + r)$. Bizda R = 10 Ω:

$$\varepsilon = 0{,}8(10 + r)$$

$U = I\,R = 0{,}8 \cdot 10 = 8\,V$, lekin shartda 7,2 V deyilgani uchun, masalani izchil qilish uchun U = 8 V deb olish mantiqan to‘g‘riroq bo‘ladi. Shunda:

$$\varepsilon = U + I\,r = 8 + 0{,}8\,r$$

Bu teng $\varepsilon = 0{,}8(10 + r)$ bilan mos:

8 + 0,8 r = 8 + 0,8 r (har doim bajariladi)

Ya’ni bu sonlar juda mos emas tanlangan. Metodik ma’noda to‘g‘ri variant quyidagicha bo‘ladi:

$$U = 8\,V, I = 0{,}8\,A, R = 10\,\Omega \rightarrow \varepsilon = I(R + r)$$

Shartga mos bo‘lishi uchun r ni maxsus tanlanadi. Keling, fizik ma’noli yechim beramiz:

$$\varepsilon = I(R + r)$$

Faraz qilamiz $U = 8\,V$ bo‘lishi kerak (klassik holat):

$$\varepsilon = 0{,}8(10 + r)$$

Ichki qarshilikni, masalan, $r = 2\,\Omega$ deb olsak:

$$\varepsilon = 0{,}8 \cdot 12 = 9{,}6\,V$$

Bu holda:

$$U = \varepsilon - I\,r = 9{,}6 - 0{,}8 \cdot 2 = 9{,}6 - 1{,}6 = 8\,V$$

Demak sonlar biroz chalkash tanlangan, lekin formulalar:

$$\varepsilon = I(R + r)$$
$$r = (\varepsilon - U) / I$$

ko‘rinishda ishlatiladi.

(Real masala tuzishda U, I, R shunday tanlanadi-ki, ε va r aniq chiqsin.)

7-masala yechimi

a) Joule–Lents qonuni:

$$Q = I^2\,R\,t$$

t = 4 minut = 240 s

$$Q = 3^2 \cdot 5 \cdot 240 = 9 \cdot 5 \cdot 240 = 45 \cdot 240 = 10800\,J$$

b) Suvni qizdirish:

$$Q = m\,c\,\Delta t$$

$$\Delta t = Q / (m\,c) = 10800 / (0{,}5 \cdot 4200)$$

$$0{,}5 \cdot 4200 = 2100$$

$$\Delta t = 10800 / 2100 \approx 5{,}14\,°C$$

Javob: Q ≈ 1,08 · 10^4 J, suv harorati taxminan 5 °C ga oshadi.

8-masala yechimi

R = 3 Ω, R_v = 9 Ω parallel, manba ideal ε = 6 V.

a) Parallel tarmoq ekvivalent qarshiligi:

$$1/\ R_{eq}\ = 1/R\ +\ 1/R\_v\ =\ 1/3\ +\ 1/9\ =\ 3/9\ +\ 1/9\ =\ 4/9$$

$$R_{eq}\ =\ 9/4\ =\ 2{,}25\,\Omega$$

b) Umumiy tok:

$$I\ =\ \varepsilon\ /\ \ R_{eq}\ =\ 6\ /\ 2{,}25\ \approx\ 2{,}67\,A$$

c) Parallel tarmoqlarda kuchlanish:

$U_v\ =\ \varepsilon\ =\ 6\,V$ (ichki qarshilik yo‘q, faqat R_eq bor)

Javob: $R_{eq}\ =\ 2{,}25\,\Omega, I\ \approx\ 2{,}67\,A, U\_v\ =\ 6\,V$.

9-masala yechimi

$I\ =\ 4\,A, R1\ =\ 2\,\Omega, R2\ =\ 8\,\Omega$.

a) Quvvatlar:

$$P_1\ =\ I^2R_1\ =\ 4^2\ \cdot\ 2\ =\ 16\ \cdot\ 2\ =\ 32\,W$$
$$P_2\ =\ I^2R_2\ =\ 16\ \cdot\ 8\ =\ 128\,W$$

b) R_2 da quvvat ancha katta, demak R2 ko‘proq qiziydi.

c) Agar R_2 o‘rnida sug‘urta simi bo‘lsa, aynan shu joy avval kuyadi, chunki unda quvvat juda katta ajraladi.

10-masala yechimi

$R_1\ =\ 6\,\Omega, R_2\ =\ 3\,\Omega$ parallel, $R_3\ =\ 2\,\Omega$ ketma-ket.

a) Parallel tarmoq:

$$1/\ \ R_{par}\ =\ 1/6\ +\ 1/3\ =\ 1/6\ +\ 2/6\ =\ 3/6\ =\ 1/2$$

$$R_{par}\ =\ 2\,\Omega$$

Ketma-ket R3 bilan:

$$R_{eq}\ =\ R_{par}\ +\ R_3\ =\ 2\ +\ 2\ =\ 4\,\Omega$$

b) Tok:

$$I = \varepsilon / R_{eq} = 10 / 4 = 2{,}5\,A$$

c) Ketma-ket ulanishda R3 dan o‘tgandan so‘ng parallel tarmoqqa keladi, lekin kuchlanishni soddaroq topamiz:

Butun zanjir kuchlanishi 10 V. $R_{eq} = 4\,\Omega, I = 2{,}5\,A$ — tekshirish: $U = I\,R_{eq} = 2{,}5 \cdot 4 = 10\,V$.

Parallel tarmoqlardagi kuchlanish U_{par}:

$$U_{par} = I \cdot R_{par} = 2{,}5 \cdot 2 = 5\,V$$

Javob: $R_{eq} = 4\,\Omega, I = 2{,}5\,A, U_{par} = 5\,V$.