первое число - порядковый номер эл-та

вторые два - узлы

для источников напряжения отсчет узлов от + к -
для источников тока по направлению тока

ветви - наибольшее из первых чисел

узлы - наибольшее из двоек чисел

№ 1.1.1 № 11

Сдано ✓

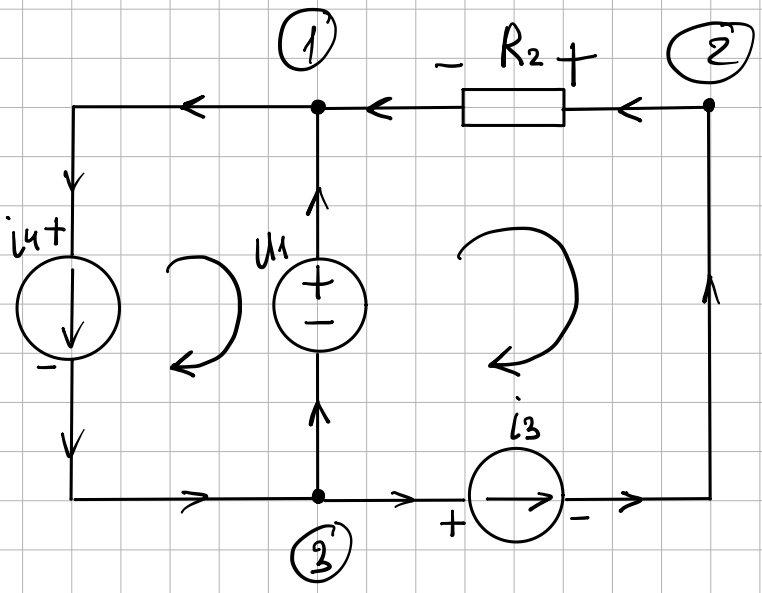
Цепь:

113 - ИН $u_1 = 2$

212 $R_2 = 2$

332 ИТ $i_3 = 5$

413 ИТ $i_4 = 2$



ток i_1 - произвольное направление

I З.К.

$i_1 + i_3 - i_4 = 0 \rightarrow i_1 = -3$

$i_2 = i_3 = 5$ (послед. соедин) $u_2 = i_2 R_2 = 5 \cdot 2 = 10$

II З.К.

$$\begin{cases} u_1 - u_4 = 0 \rightarrow u_4 = 2 \\ -u_2 - u_3 - u_1 = 0 \rightarrow u_3 = -12 \end{cases}$$

$p_1 = 6$ $p_3 = -60$

$p_2 = 50$ $p_4 = 4$

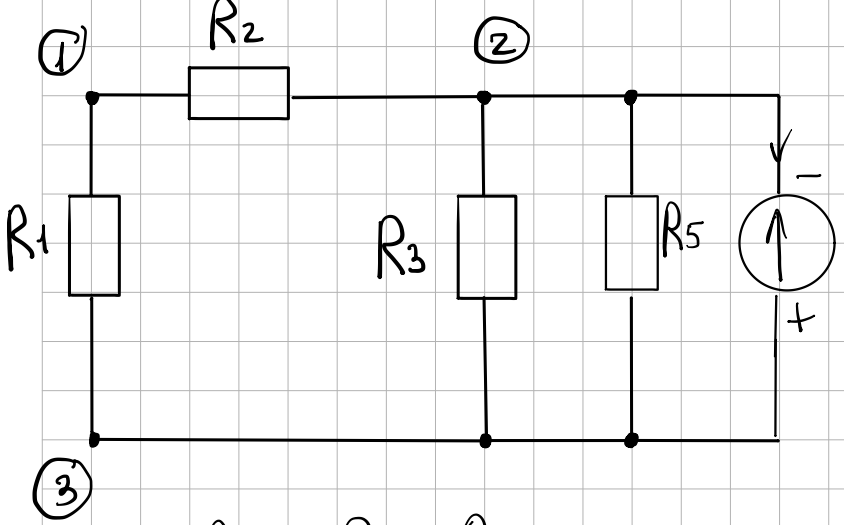
Ответ: $i_1 = 3$, $i_2 = 5$; $U_2 = 10$, $U_3 = -12$, $U_4 = 2$;
$p_1 = 6$, $p_2 = 50$, $p_3 = -60$, $p_4 = 4$

№ 1.1.2 № 11

Сдано V

Цепь:
113 – R_1;
212 – R_2
323 – R_3
432 – ИТ $i_4 = 5$
523 – R_5

$R_к = 2$
$i_к$ по ~~ОДУ~~ – ?
$R_{вх}$ – ?



$$R_{12} = R_1 + R_2 = 2 + 2 = 4$$

$$i_5 = i_4 \frac{1}{R_5\left(\frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{R_5}\right)} = 5 \frac{1}{2\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{2}\right)} = 2$$

$$i_3 = i_4 \frac{1}{R_3\left(\frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{R_5}\right)} = 5 \frac{1}{2\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{2}\right)} = 2$$

$$i_{12} = i_4 \frac{1}{R_{12}\left(\frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{R_5}\right)} = 5 \cdot \frac{1}{4\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{2}\right)} = 1$$

$$\frac{1}{R_{вх}} = \frac{1}{R_5} + \frac{1}{R_3} + \frac{1}{R_{12}} = \frac{1}{2} + \frac{1}{2} + \frac{1}{4} = \frac{5}{4}$$

$$R_{вх} = \frac{4}{5} = 0{,}8$$

№ 1.1.3 № 11 Метод наложения

Сдано ✓

Цепь:

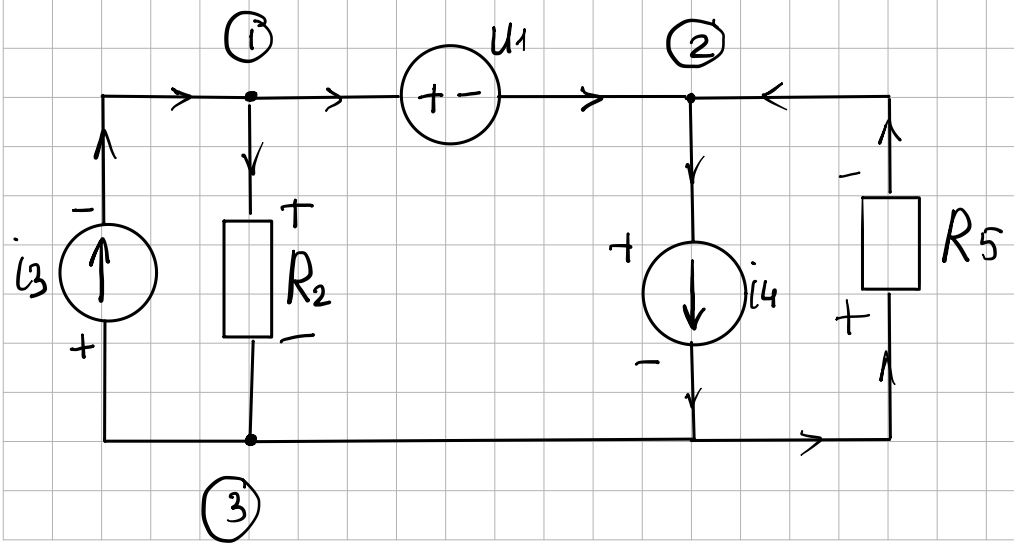
112 - ИН $u_1 = 10$ $u_3, u_4 - ?$

213 - $R_2 = 2$

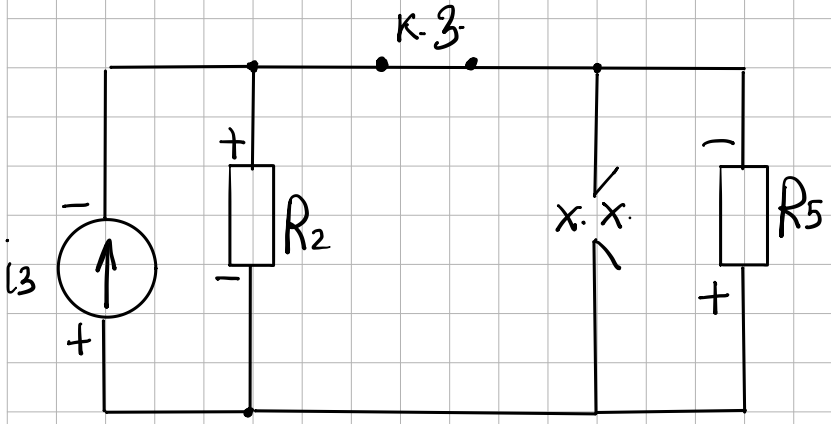
331 - ИТ $i_3 = 5$

423 - ИТ $i_4 = 5$

523 - $R_5 = 3$



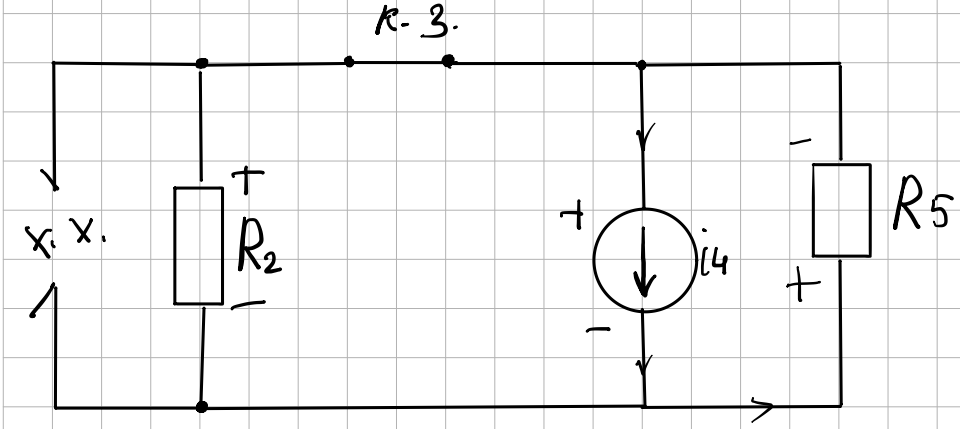
1 Действие от источника $\dot{i}_3$

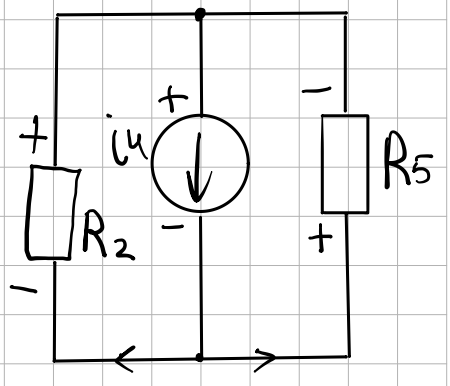


$$\dot{i}_2^{\,I} + \dot{i}_5^{\,I} = \dot{i}_3 = 5$$

$$\frac{\dot{i}_2^{\,I}}{\dot{i}_5^{\,I}} = \frac{R_5}{R_2} = \frac{3}{2} \Rightarrow \dot{i}_2^{\,I} = 3;\ \dot{i}_5^{\,I} = -2$$ (т.к. не совп. направление с полярностью)

2 Действие от источника $\dot{i}_4$

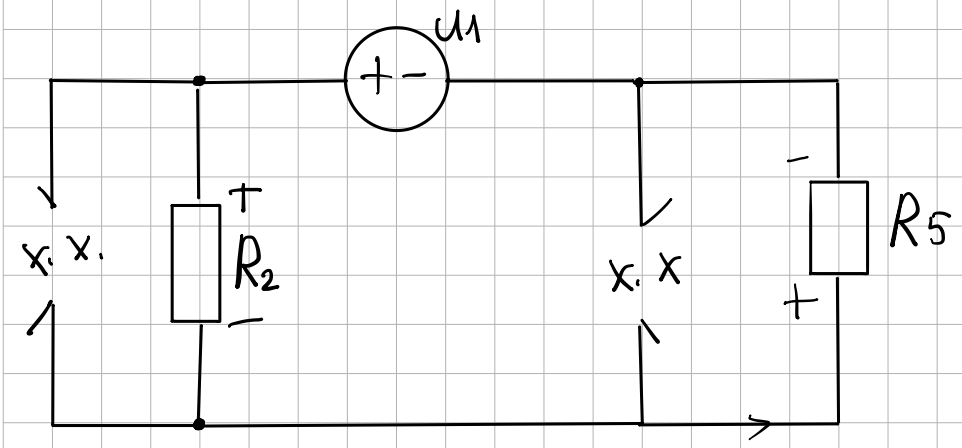


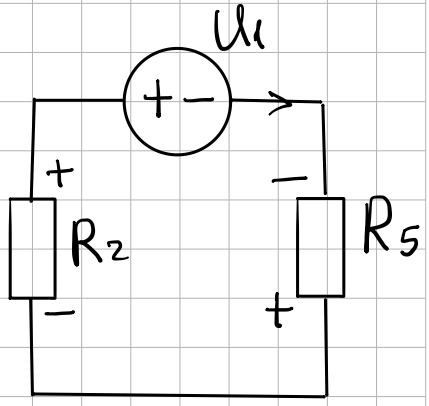


$$\dot{i}_2^{\,II} + \dot{i}_5^{\,II} = \dot{i}_4 = 5$$

$$\frac{\dot{i}_2^{\,II}}{\dot{i}_5^{\,II}} = \frac{R_5}{R_2} = \frac{3}{2} \Rightarrow \dot{i}_2^{\,II} = -3$$ (т.к. не совп. направление с полярностью); $\dot{i}_5^{\,II} = 2$

③ Действие от источника U_1





$U_{вх} = U_1 = 10$

$R_{вх} = R_2 + R_5 = 5$

$i_2^{III} = i_5^{III} = \frac{U_{вх}}{R_{вх}} = \frac{10}{5} = 2$

$i_2 = i_2^{I} + i_2^{II} + i_2^{III} = 3 - 3 + 2 = 2$

$i_5 = i_5^{I} + i_5^{II} + i_5^{III} = -2 + 2 + 2 = 2$

$U_2 = i_2 R_2 = 2 \cdot 2 = 4$

$U_5 = i_5 R_5 = 2 \cdot 3 = 6$

II З. К.

$$\begin{cases} -U_2 + U_1 + U_4 = 0 \\ -U_4 + U_5 = 0 \\ U_3 + U_2 = 0 \end{cases} \qquad \begin{cases} U_4 = 6 \\ U_3 = -4 \end{cases}$$

Ответ: $U_4 = 6$; $U_3 = -4$

№ 1.1.4 № 11 Сдано ✓

Метод пропорциональных величин (МПВ)

Цепь:

114 – ИН $U_1 = 120$

212 – $R_2 = 4$

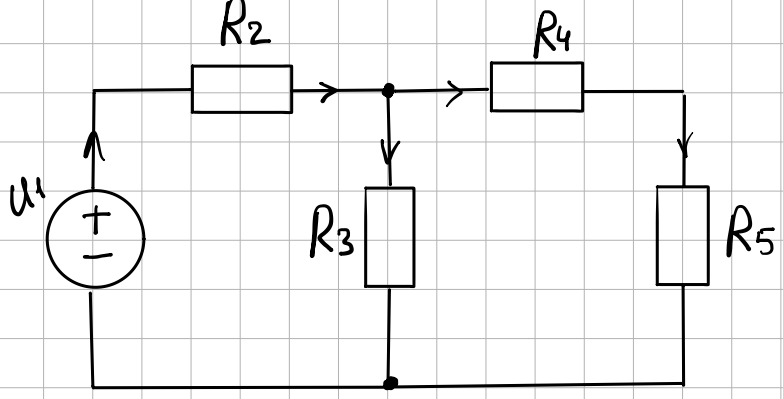
324 – $R_3 = 4$

423 – $R_4 = 2$

534 – $R_5 = 2$

i_5, U_3 – ?

$G_{вх}, G_{5\text{-}1}, H_{U3\text{-}1}$ – ?



Пусть, $i_5' = 1 \Rightarrow U_5' = i_5' \cdot R_5 = 1 \cdot 2 = 2$

$i_4' = i_5' = 1 \Rightarrow U_4' = i_4' \cdot R_4 = 1 \cdot 2 = 2$

$U_{45}' = U_5' + U_4' = 2 + 2 = 4$

$U_3' = U_{45}' = 4$

$i_3'' = \frac{U_3'}{R_3} = \frac{4}{4} = 1$

$i_2' = i_3'' + i_4' = 1 + 1 = 2$

$U_2' = i_2'' \cdot R_2 = 2 \cdot 4 = 8$

$U_1' = U_2' + U_3' = 8 + 4 = 12$

$$k = \frac{U_1}{U_1'} = \frac{120}{12} = 10$$

$$i_5 = i_5' \cdot k = 1 \cdot 10 = 10$$

$$U_3 = U_3' \cdot k = 4 \cdot 10 = 40$$

$$G_{вх} = \frac{i_2}{U_1} = \frac{i_2' \cdot k}{U_1} = \frac{2 \cdot 10}{120} = \frac{20}{120} = \frac{1}{6}$$

$$G_{51} = \frac{i_5}{U_1} = \frac{10}{120} = \frac{1}{12}$$

$$H_{u31} = \frac{U_3}{U_1} = \frac{40}{120} = \frac{1}{3}$$

Ответ: $i_5 = 10$; $U_3 = 40$; $G_{вх} = 1/6$; $G_{51} = 1/12$; $H_{u31} = 1/3$

№ 1.1.5 Сдано ✓ № 11 Ур-ния Кирхгофа

Цепь:

113 - ИТ $i_1 = 1$

231 - $R_2 = 5$

321 - ИН $U_3 = 5$

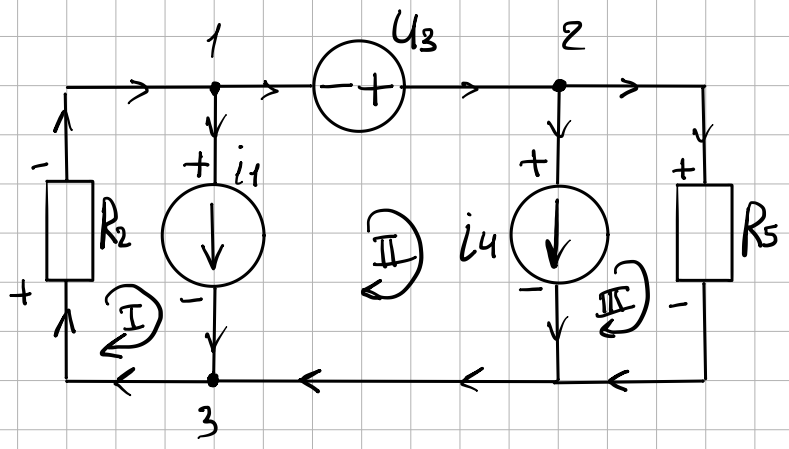
423 - ИТ $i_4 = 5$

523 - $R_5 = 5$

Найти токи ИН и R-эл-тов, напряжения ИТ

i_2, i_3, i_5 - ?

U_1, U_4 - ?



I. З.К.

узел 1: $-i_2 + i_1 + i_3 = 0$

узел 2: $-i_3 + i_4 + i_5 = 0$

II З.К.

I) $\begin{cases} U_1 + U_2 = 0 \\ -U_1 - U_3 + U_4 = 0 \\ -U_4 + U_5 = 0 \end{cases}$

$$\begin{cases} -i_2 + i_1 + i_3 = 0 \\ -i_3 + i_4 + i_5 = 0 \\ U_1 + U_2 = 0 \\ -U_1 - U_3 + U_4 = 0 \\ -U_4 + U_5 = 0 \end{cases}$$

$$\begin{cases} -i_2 + 1 + i_3 = 0 \\ -i_3 + 5 + i_5 = 0 \\ U_1 + 5i_2 = 0 \\ -U_1 - 5 + U_4 = 0 \\ -U_4 + 5i_5 = 0 \end{cases}$$

$$\begin{cases} i_3 - i_2 = -1 \\ i_5 - i_3 = -5 \\ u_1 + 5i_2 = 0 \\ u_4 - u_1 = 5 \\ 5i_5 - u_4 = 0 \end{cases}$$

$u_1 \quad u_4 \quad i_2 \quad i_3 \quad i_5$

$$\left(\begin{array}{ccccc|c} 0 & 0 & -1 & 1 & 0 & -1 \\ 0 & 0 & 0 & -1 & 1 & -5 \\ 1 & 0 & 5 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 5 \\ 0 & -1 & 0 & 0 & 5 & 0 \end{array}\right)$$

$u_1 = -35/2 = -17,5$

$u_4 = -25/2 = -12,5$

$i_2 = 7/2 = 3,5$

$i_3 = 5/2 = 2,5$

$i_5 = -5/2 = -2,5$

Ответ: $u_1 = -17,5$; $u_4 = -12,5$; $i_2 = 3,5$;

$i_3 = 2,5$; $i_5 = 2,5$

№ 1.1.6 № 11 Сдано

Метод контурных токов

Цепь:

115 – R_1

213 – R_2

312 – ИТ $i_3 = 1$

452 – ИТ $i_4 = 1$

525 – R_5

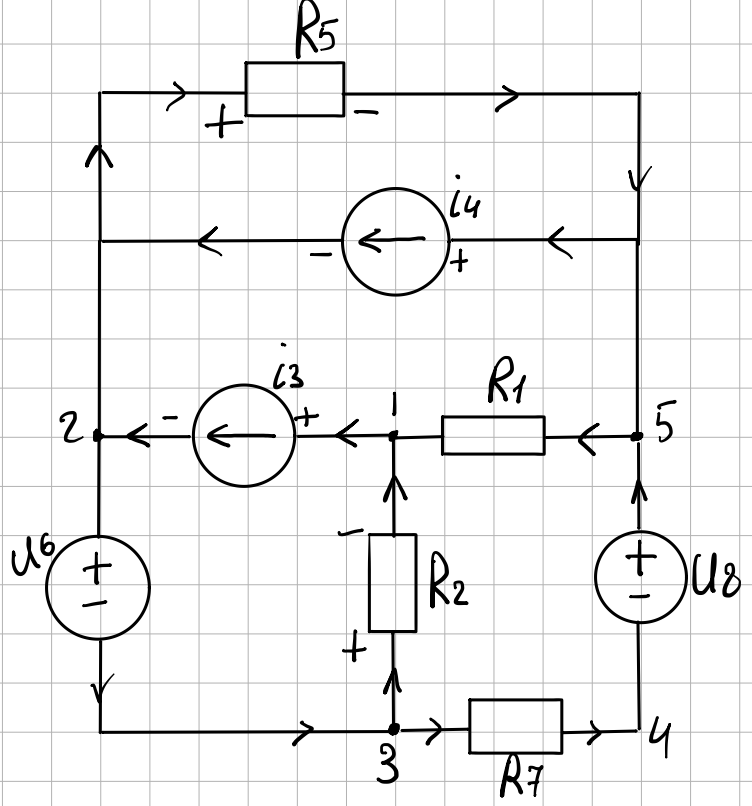
623 – ИН $u_6 = 2$

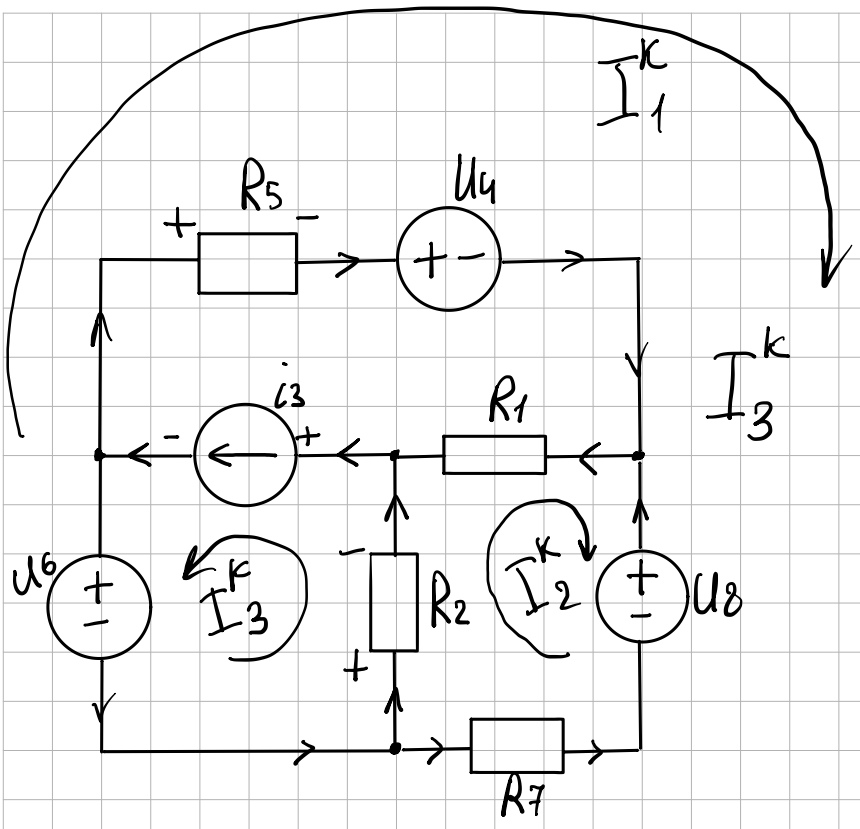
734 – R_7

854 – ИН $u_8 = 2$

$R_к = 2$

i_7 – ?





$$U_4 = i_4 R_4 = 1 \cdot 2 = 2$$

$$R_{11} = R_5 + R_7 = 2 + 2 = 4$$

$$R_{22} = R_7 + R_2 + R_1 = 2 + 2 + 2 = 6$$

$$R_{12} = R_{21} = R_7 = 2$$

$$R_{13} = R_{31} = 0$$

$$R_{23} = R_{32} = R_2 = 2$$

$$I_3^K = i_3 = 1$$

$$U_1^0 = U_6 - U_4 - U_8 = 2 - 2 - 2 = -2$$

$$U_2^0 = -U_8 = -2$$

$$\begin{vmatrix} R_{11} & R_{12} \\ R_{21} & R_{22} \end{vmatrix} \cdot \begin{vmatrix} I_1^к \\ I_2^к \end{vmatrix} = \begin{vmatrix} U_1^0 - R_{13} I_3^к \\ U_2^0 - R_{23} I_3^к \end{vmatrix}$$

$$\begin{vmatrix} 4 & 2 \\ 2 & 6 \end{vmatrix} \cdot \begin{vmatrix} I_1^к \\ I_2^к \end{vmatrix} = \begin{vmatrix} -2 - 0 \cdot 1 \\ -2 - 2 \cdot 1 \end{vmatrix}$$

$$\begin{vmatrix} 4 & 2 \\ 2 & 6 \end{vmatrix} \cdot \begin{vmatrix} I_1^к \\ I_2^к \end{vmatrix} = \begin{vmatrix} -2 \\ -4 \end{vmatrix}$$

$$\Delta = 4 \cdot 6 - 2 \cdot 2 = 20$$

$$\Delta_1 = \begin{vmatrix} -2 & 2 \\ -4 & 6 \end{vmatrix} = -2 \cdot 6 - 2 \cdot (-4) = -12 + 8 = -4$$

$$\Delta_2 = \begin{vmatrix} 4 & -2 \\ 2 & -4 \end{vmatrix} = 4 \cdot (-4) - 2 \cdot (-2) = -16 + 4 = -12$$

$$I_1^к = \frac{\Delta_1}{\Delta} = \frac{-4}{20} = -\frac{1}{5} = -0{,}2$$

$$I_2^к = \frac{\Delta_2}{\Delta} = \frac{-12}{20} = -\frac{6}{10} = -\frac{3}{5} = -0{,}6$$

$$i_7 = I_2^к + I_1^к = -0{,}6 - 0{,}2 = -0{,}8$$

Цепь:

Метод узловых напряжений

i_7 - ?

115 - R_1

213 - R_2

312 - ИТ $i_3 = 1$

452 - ИТ $i_4 = 1$

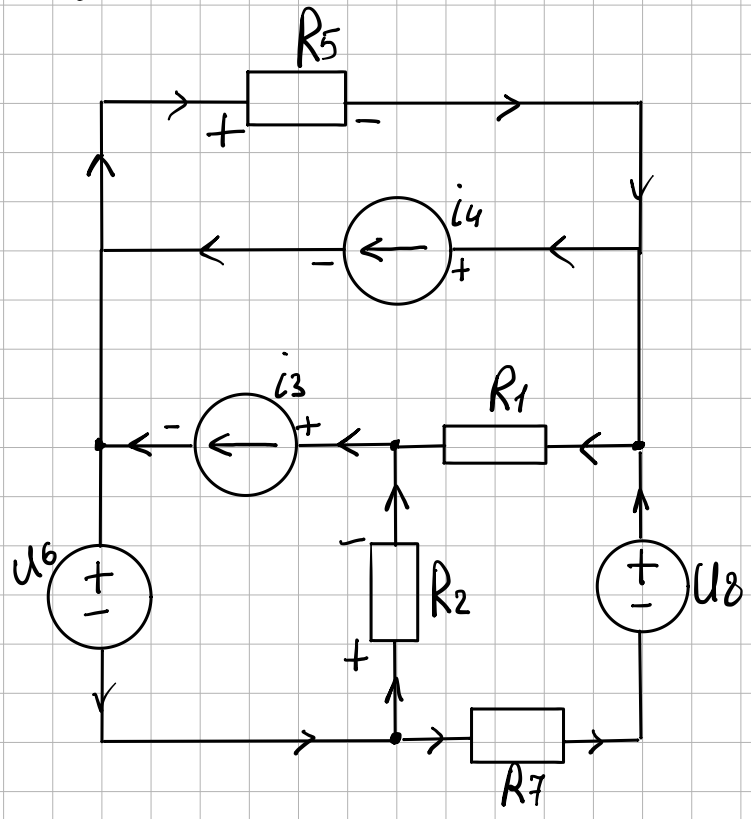
525 - R_5

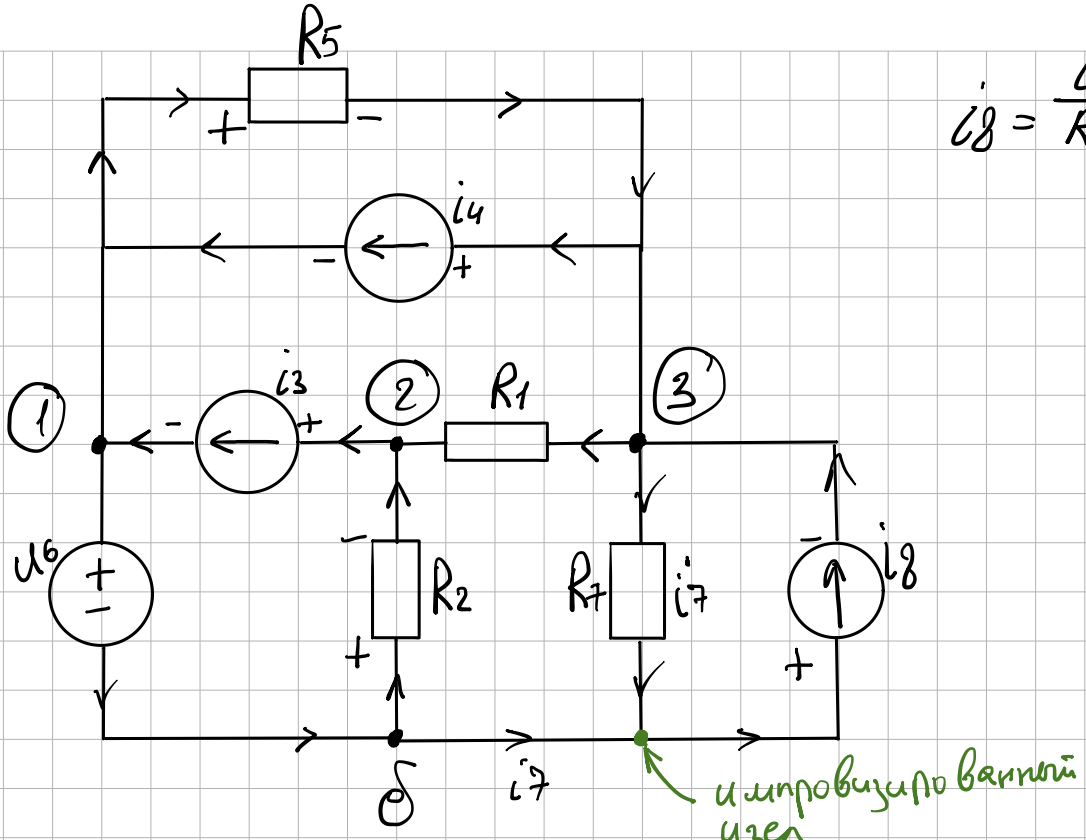
623 - ИН $u_6 = 2$

734 - R_7

854 - ИН $u_8 = 2$

$R_к = 2$





$$i_8 = \frac{u_8}{R_8} = \frac{2}{2} = 1$$

$$\begin{cases} u_1^y = u_6 = 2 \\ (G_2 + G_1) u_2^y - G_1 u_3^y = -i_3 \\ (G_1 + G_7 + G_5) u_3^y - G_1 u_2^y - G_5 u_1^y = i_8 - i_4 \end{cases}$$

$$\begin{cases} \left(\frac{1}{2} + \frac{1}{2}\right) u_2^y - \frac{1}{2} u_3^y = -1 \\ \left(\frac{1}{2} + \frac{1}{2} + \frac{1}{2}\right) u_3^y - \frac{1}{2} u_2^y = 0 \end{cases}$$

$$\begin{cases} u_2^y - \frac{1}{2} u_3^y = -1 \\ \frac{3}{2} u_3^y - \frac{1}{2} u_2^y = 0 \end{cases} \rightarrow u_2^y = -1 + \frac{1}{2} u_3^y$$

$$\frac{3}{2} u_3^y - \frac{1}{2}\left(-1 + \frac{1}{2} u_3^y\right) = 0$$

$$\frac{3}{2} u_3^y + \frac{1}{2} - \frac{1}{4} u_3^y = 0$$

$$\frac{5}{4} U_3^y = -\frac{1}{2}$$

$$U_3^y = -\frac{2}{5}$$

$$U_2^y = -1 + \frac{1}{2} U_3^y = -1 + \frac{1}{2} \cdot \left(-\frac{2}{5}\right) = -\frac{6}{5}$$

$$i_7' = \left(U_3^y - U_5^y\right) G_7 = -\frac{1}{5}$$

$$-i_7 - i_8 + i_7' = 0$$

$$i_7 = i_7' - i_8$$

$$i_7 = \frac{1}{5} - 1 = -\frac{4}{5} = -0{,}8$$

№ 1.1.7 № 11 Сдано ✓

Метод эквивалентного источника напряжения (МЭИН)

Цепь:

114 - ИН $u_1 = 4$

212 - $R_2 = 2$

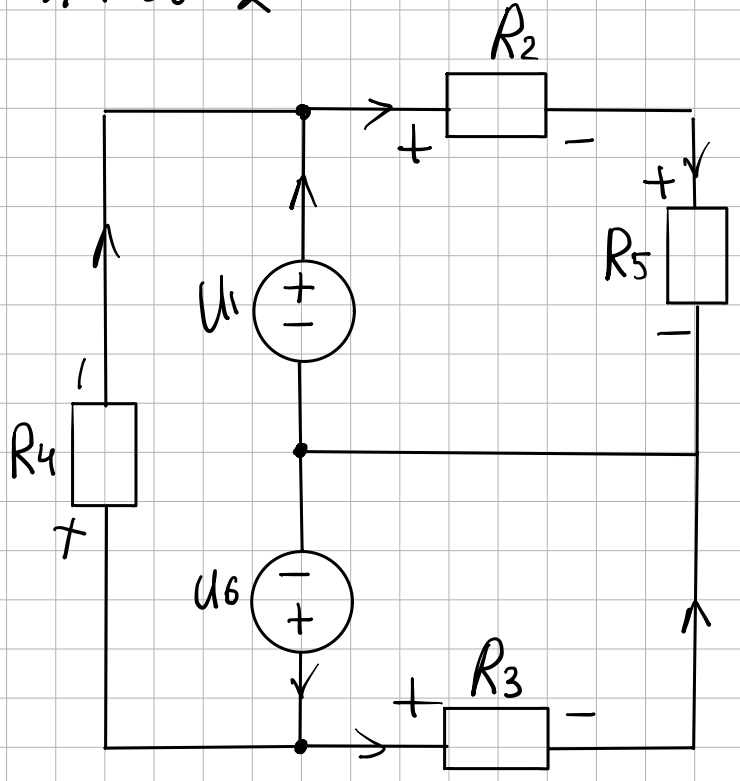
323 - $R_3 = 2$

413 - $R_4 = 2$

524 - $R_5 = 2$

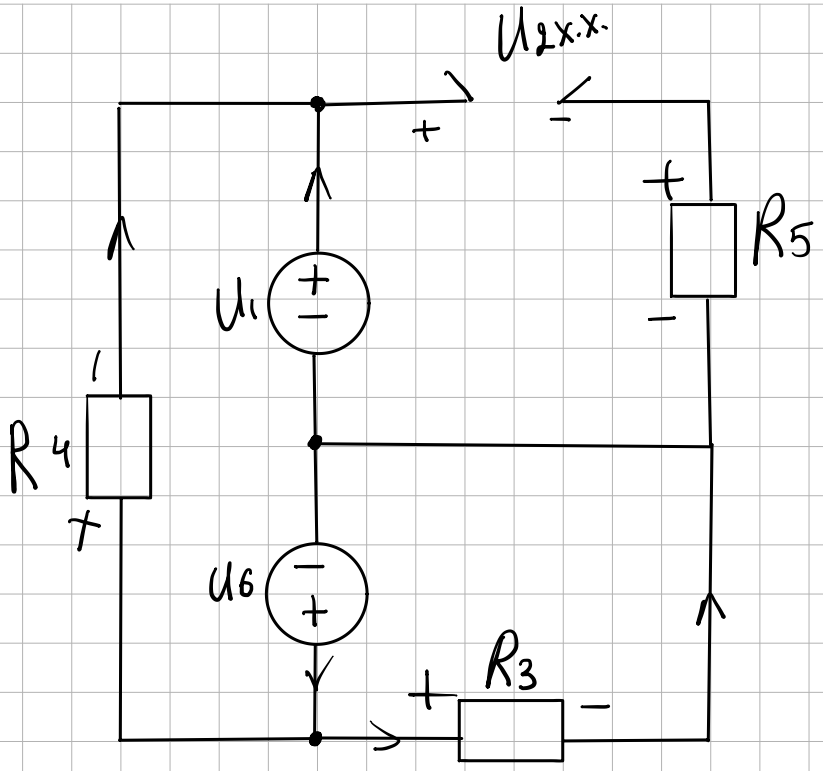
634 - ИН $u_6 = 2$

$i_2 - ?$

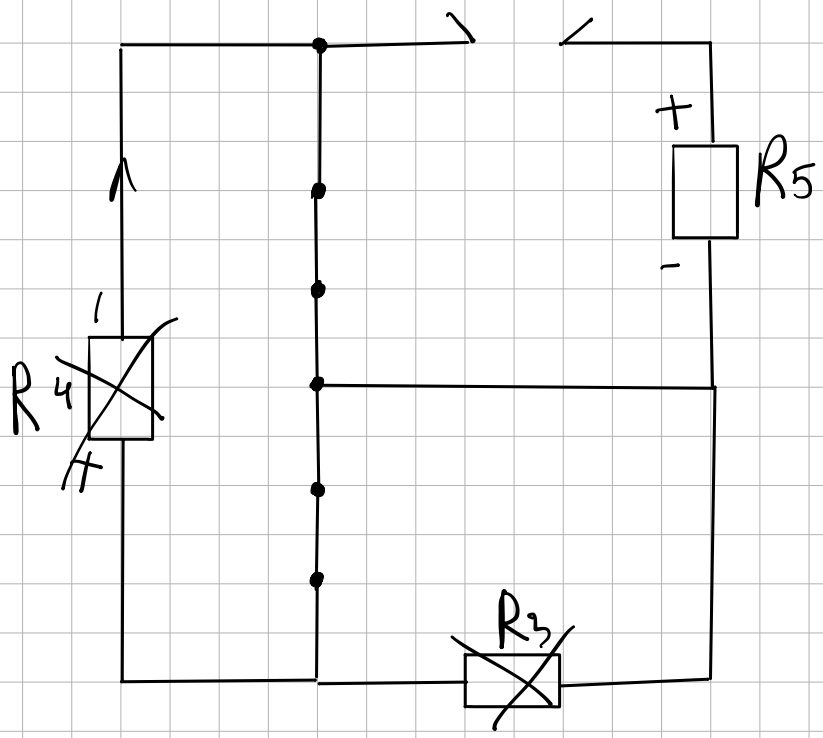


$$\left.\begin{array}{l} i_{R_2} = i_{R_5} \\ R_2 = R_5 \end{array}\right\} \Rightarrow u_2 = u_5$$

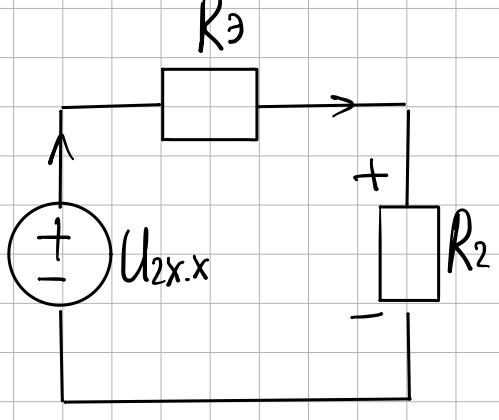
МЭИН



$U_{2x.x} = U_1 = 4$

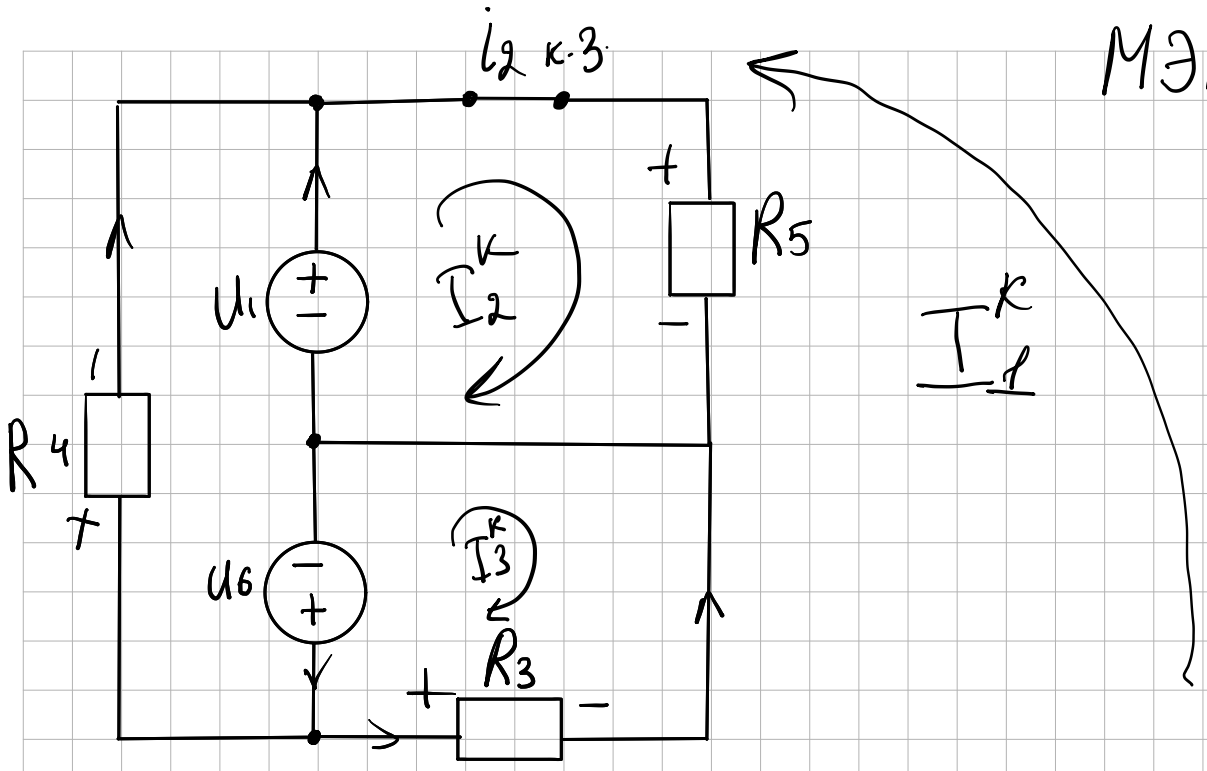


$R_э = R_5 = 2$



$$i_2 = \frac{U_{2xx.}}{R_э + R_2} = \frac{4}{2+2} = 1$$

МЭИТ



$$\begin{cases} (R_5+R_3+R_4)\underline{I}_1^к - R_5\underline{I}_2^к - R_3\underline{I}_3^к = 0 \\ R_5\cdot\underline{I}_2^к - R_5\underline{I}_1^к = U_1 \\ R_3\cdot\underline{I}_3^к - R_3\underline{I}_1^к = -U_6 \end{cases}$$

$$\begin{cases} 6\underline{I}_1^к - 2\underline{I}_2^к - 2\underline{I}_3^к = 0 \\ 2\underline{I}_2^к - 2\underline{I}_1^к = 4 \rightarrow 2\underline{I}_2^к = 4 + 2\underline{I}_1^к \\ 2\underline{I}_3^к - 2\underline{I}_1^к = -2 \rightarrow 2\underline{I}_3^к = -2 + 2\underline{I}_1^к \end{cases}$$

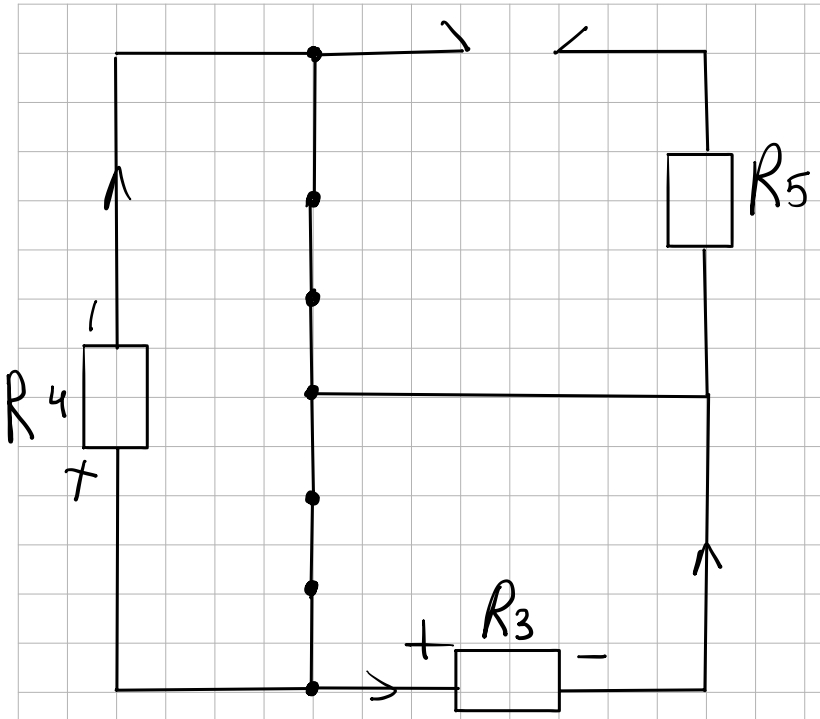
$$6\underline{I}_1^к - 4 - 2\underline{I}_1^к + 2 - 2\underline{I}_1^к = 0$$

$$2\underline{I}_1^к = 2 \rightarrow \underline{I}_1^к = 1$$

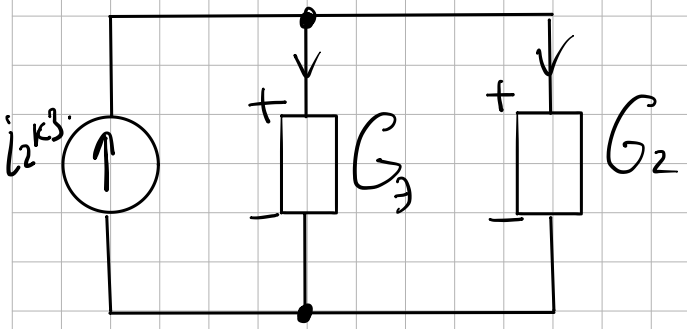
$$2\underline{I}_2^к = 4 + 2\cdot 1 = 6 \rightarrow \underline{I}_2^к = 3$$

$$2\underline{I}_3^к = -2 + 2\cdot 1 = 0$$

$$i_{2\,к.з.} = 3 - 1 = 2$$

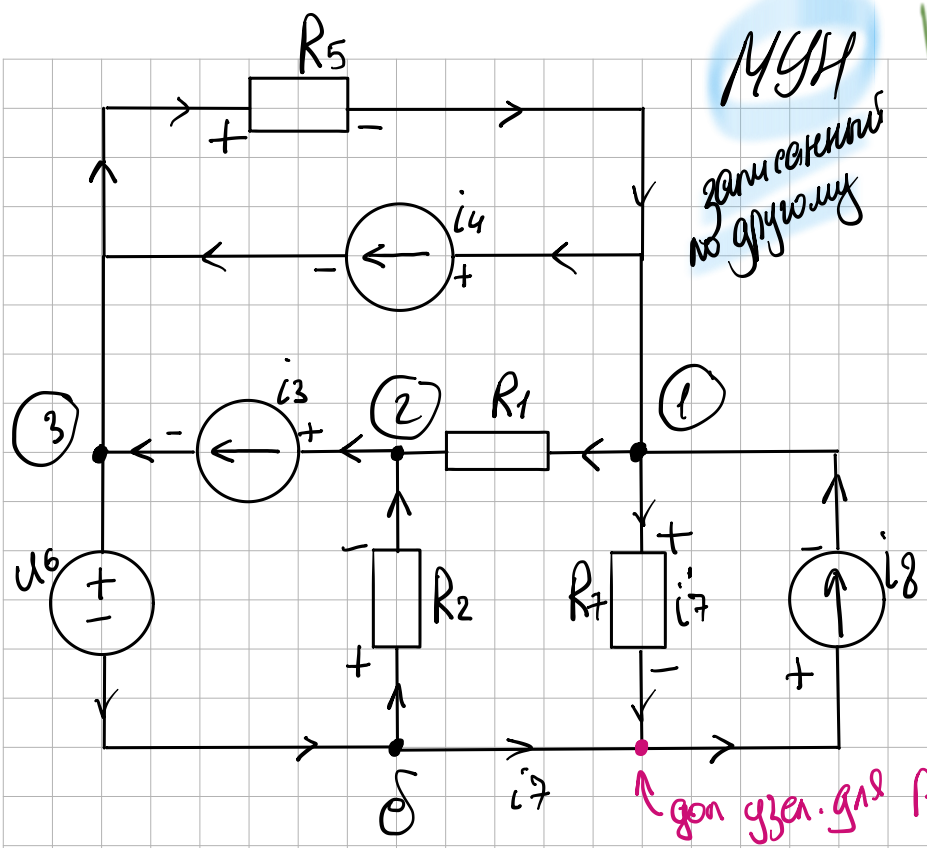


$$R_3 = R_5 = 2$$



$$U_2 = \frac{i_2^{K3}}{G_3 + G_2} = \frac{2}{\frac{1}{2} + \frac{1}{2}} = 2$$

$$i_2 = \frac{U_2}{R_2} = \frac{2}{2} = 1$$



МУН
записанный по другому

$$i_8 = \frac{U_8}{R_8} = \frac{2}{2} = 1$$

$$U_3^y = U_6 = 2$$

$$G_{11} = G_7 + G_1 + G_5 = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{3}{2}$$

$$G_{12} = G_{21} = G_1 = -\frac{1}{2}$$

$$G_{22} = G_1 + G_2 = \frac{1}{2} + \frac{1}{2} = 1$$

$$G_{13} = G_5 = -\frac{1}{2}$$

$$G_{23} = 0$$

$$I_1^0 = -i_4 + i_8 = -1 + 1 = 0$$

$$I_2^0 = -i_3 = -1$$

$$\begin{vmatrix} \frac{3}{2} & -\frac{1}{2} \\ -\frac{1}{2} & 1 \end{vmatrix} \cdot \begin{vmatrix} U_1^y \\ U_2^y \end{vmatrix} = \begin{vmatrix} 0 - (-\frac{1}{2}) \cdot 2 \\ -1 - 0 \cdot 2 \end{vmatrix}$$

$$\begin{vmatrix} \frac{3}{2} & -\frac{1}{2} \\ -\frac{1}{2} & 1 \end{vmatrix} \cdot \begin{vmatrix} U_1^y \\ U_2^y \end{vmatrix} = \begin{vmatrix} 1 \\ -1 \end{vmatrix}$$

$$\Delta = \frac{3}{2} \cdot 1 - \left(-\frac{1}{2}\right) \cdot \left(-\frac{1}{2}\right) = \frac{3}{2} - \frac{1}{4} = \frac{6}{4} - \frac{1}{4} = \frac{5}{4}$$

$$\Delta_1 = \begin{vmatrix} 1 & -\frac{1}{2} \\ -1 & 1 \end{vmatrix} = 1 \cdot 1 - \left(-\frac{1}{2}\right) \cdot (-1) = \frac{1}{2}$$

$$\Delta_2 = \begin{vmatrix} \frac{3}{2} & 1 \\ -\frac{1}{2} & -1 \end{vmatrix} = \frac{3}{2} \cdot (-1) - 1 \cdot \left(-\frac{1}{2}\right) = -1$$

$$U_1^y = \frac{\Delta_1}{\Delta} = \frac{1}{2} \cdot \frac{4}{5} = \frac{2}{5}$$

$$U_2^y = \frac{\Delta_2}{\Delta} = -\frac{4}{5}$$

$$i_7'' = (U_1^y - U_5) \cdot G_7 = \frac{2}{5} \cdot \frac{1}{2} = \frac{1}{5}$$

$$-i_7 - i_7' + i_8 = 0$$

$$i_8 - i_7' = i_7$$

$$i_7' = 1 - \frac{1}{5} = \frac{4}{5} = 0{,}8$$

№ 1.2.1

№ 11

Сдано ✓

Цепь:

115 - ИН $u_1 = 24$

212 - К зам.

323 - R_3

435 - R_4

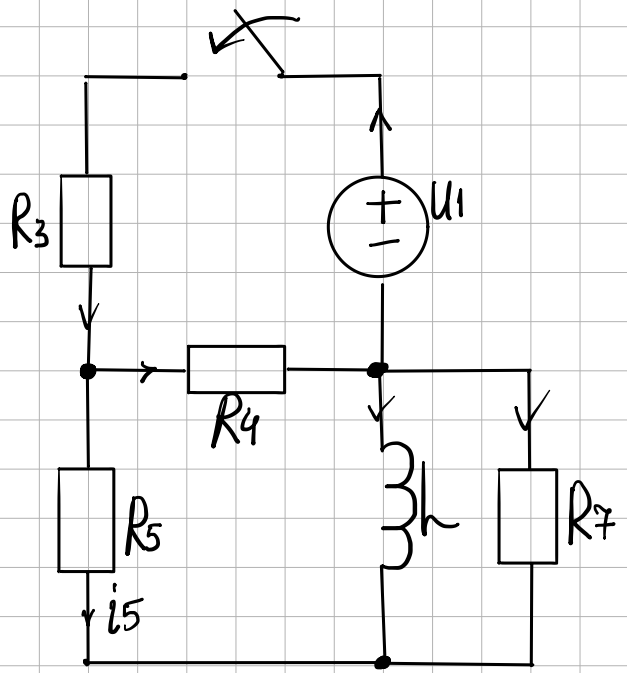
534 - R_5

645 - $L_6 = 6$

745 - R_7

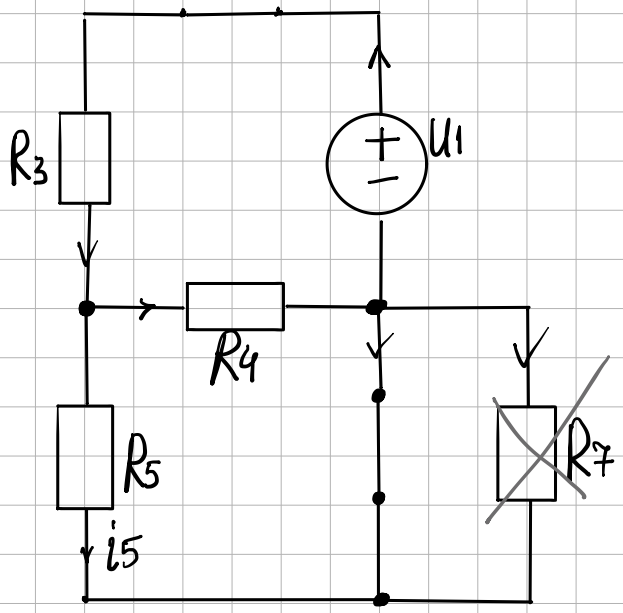
$R_k = 2$

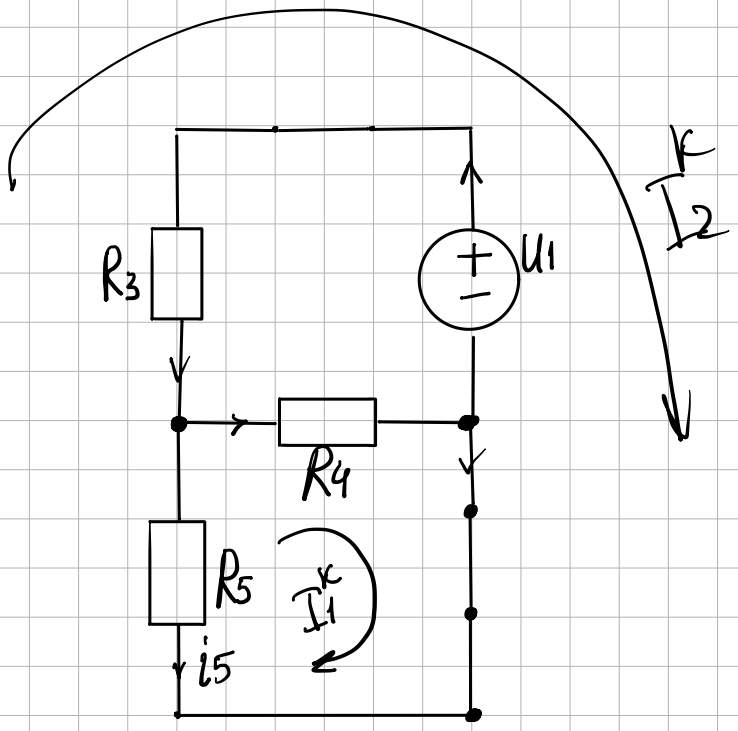
$i_5 - ?$



1) $i_5(t) = Ae^{-t/\tau} + i_{5\,уст}$

2) $t \to \infty$





$$R_{11} = R_5 + R_4 = 2 + 2 = 4$$

$$R_{22} = R_5 + R_3 = 2 + 2 = 4$$

$$R_{12} = R_{21} = R_5 = 2$$

$$U_1^0 = 0; \quad U_2^0 = -U_1 = -24$$

$$\begin{vmatrix} 4 & 2 \\ 2 & 4 \end{vmatrix} \cdot \begin{vmatrix} I_1^к \\ I_2^к \end{vmatrix} = \begin{vmatrix} 0 \\ -24 \end{vmatrix}$$

$$\Delta = 4 \cdot 4 - 2 \cdot 2 = 16 - 4 = 12$$

$$\Delta_1 = \begin{vmatrix} 0 & 2 \\ -24 & 4 \end{vmatrix} = -(-24) \cdot (2) = 48$$

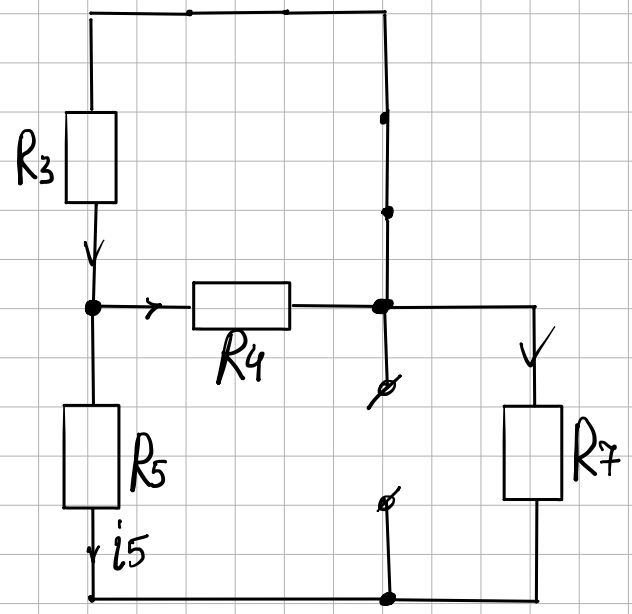
$$\Delta_2 = \begin{vmatrix} 4 & 0 \\ 2 & -24 \end{vmatrix} = 4 \cdot (-24) = -96$$

$$I_1^к = \frac{\Delta_1}{\Delta} = \frac{48}{12} = 4$$

$$I_2^к = \frac{\Delta 2}{\Delta} = -\frac{96}{12} = -8$$

$$i_{5\,уст} = I_1^к + I_2^к = 4 - 8 = -4$$

3) $$\tau = \frac{L}{R_э}$$



$$R_{34} = \frac{2 \cdot 2}{2+2} = 1$$

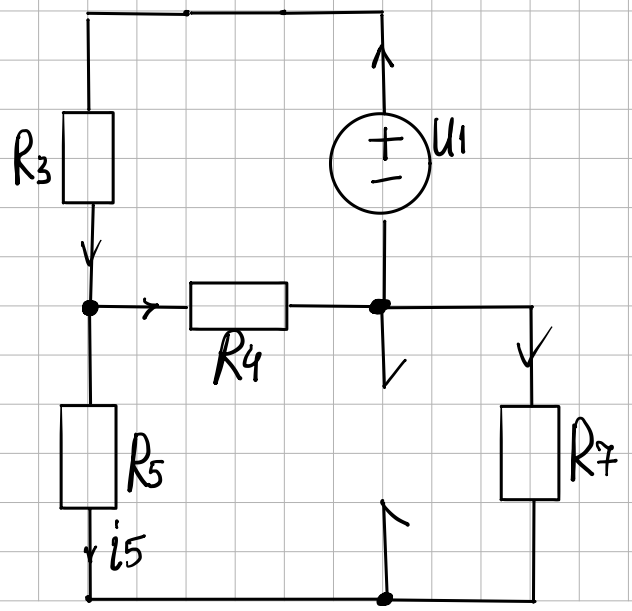
$$R_{345} = 1 + 2 = 3$$

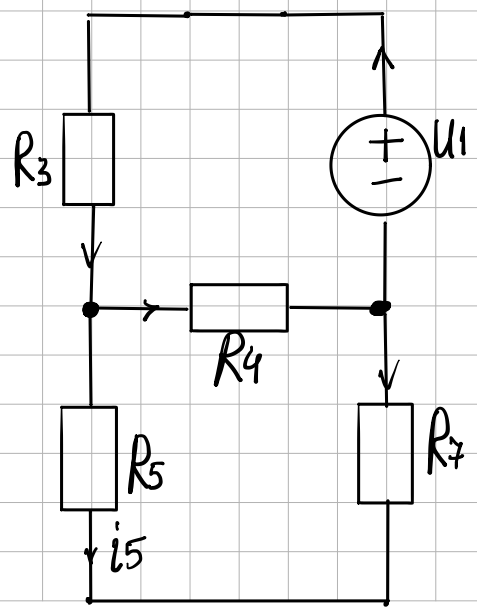
$$R_э = \frac{R_{345} \cdot R_7}{R_{345} + R_7} = \frac{3 \cdot 2}{3+2} = \frac{6}{5}$$

$$\tau = 6 \cdot \frac{5}{6} = 5$$

4) а) $i_L(0-) = 0$ (по условию)

б) $i_L(0+) = i_L(0-) = 0$





$$R_{57} = R_5 + R_7 = 2+2 = 4$$

$$R_{457} = \frac{R_4 \cdot R_{57}}{R_4 + R_{57}} = \frac{4 \cdot 2}{4+2} = \frac{8}{6} = \frac{4}{3}$$

$$R_{6x} = \frac{2 \cdot \frac{4}{3}}{2 + \frac{4}{3}} = \frac{\frac{8}{3}}{\frac{10}{3}} = \frac{8}{10}$$

$$i_{6x} = \frac{24 \cdot 10}{8} = 30$$

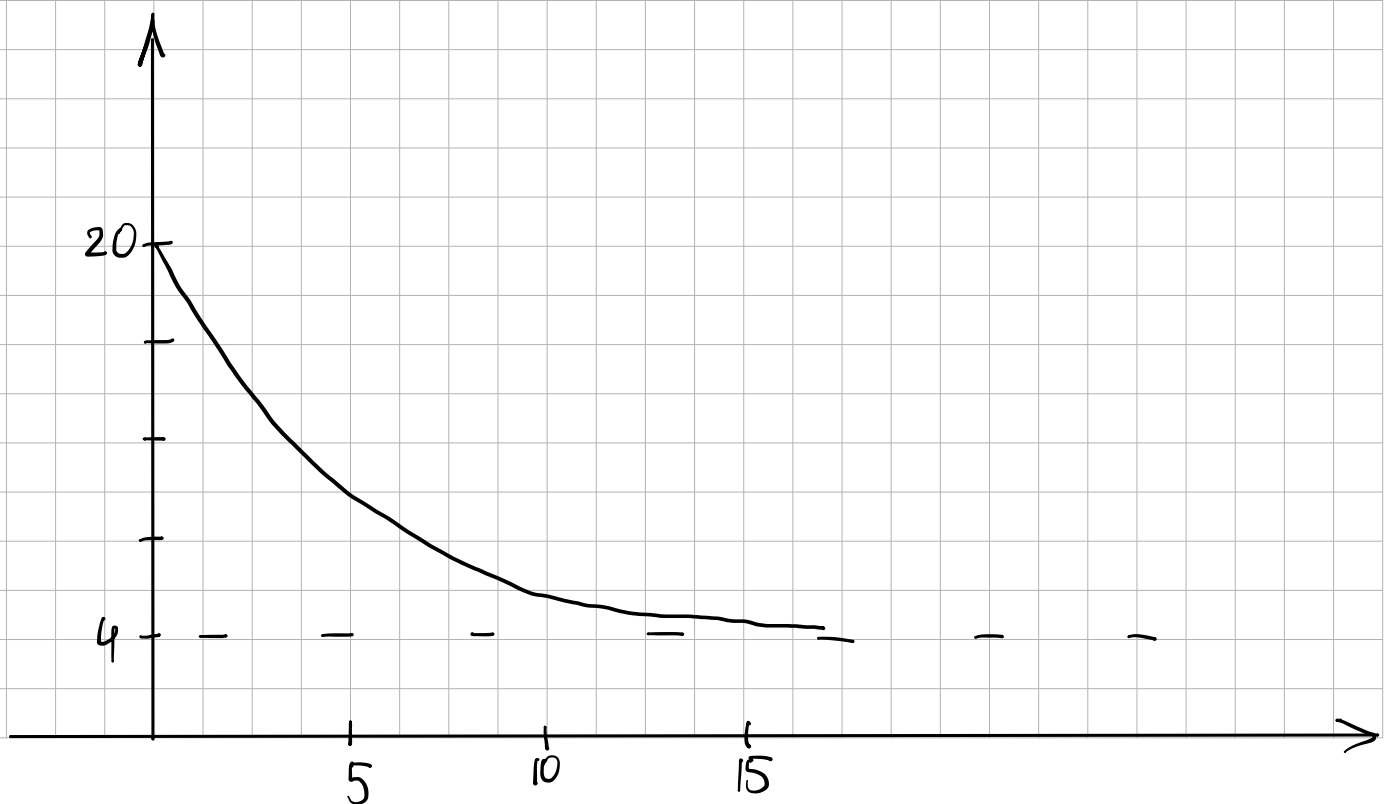
$$i_{5(0+)} = 30 \cdot \frac{1}{R_5\left(\frac{1}{R_{57}} + \frac{1}{R_4}\right)} = \frac{30}{2\left(\frac{1}{4} + \frac{1}{2}\right)} = \frac{30}{\frac{3}{2}} = \frac{30 \cdot 2}{3} = 20$$

$$20 = A + 4 \Rightarrow A = 16$$

$$i_5(t) = 16e^{-t/5} + 4$$

$t = 0 \quad 20$

$t \to \infty \quad 4$



№ 1.2.3 № 11

Цепь:

115 – ИН $U_1 = 4$

212 – $R_2 = 1$

312 – к, зам-ся

423 – $R_4 = 0{,}5$

553 – ИТ $i_5 = 4$

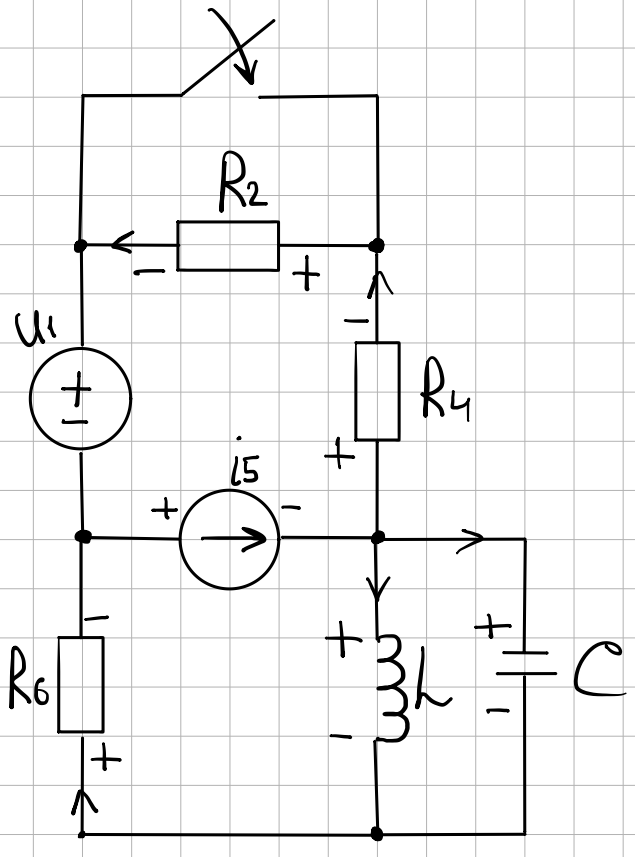
654 – $R_6 = 0{,}5$

734 – $L = 1$

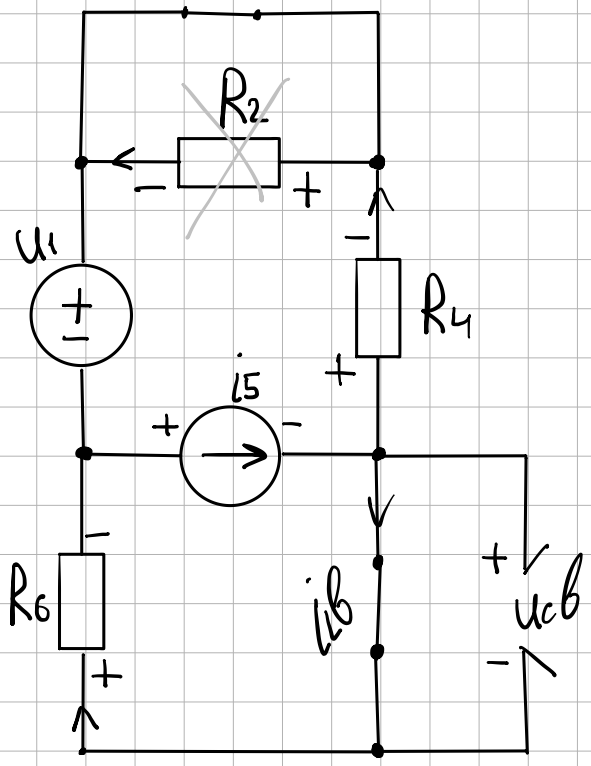
834 – $C = 0{,}5$

Нужно найти

$u_C(t)$, $i_L(t)$



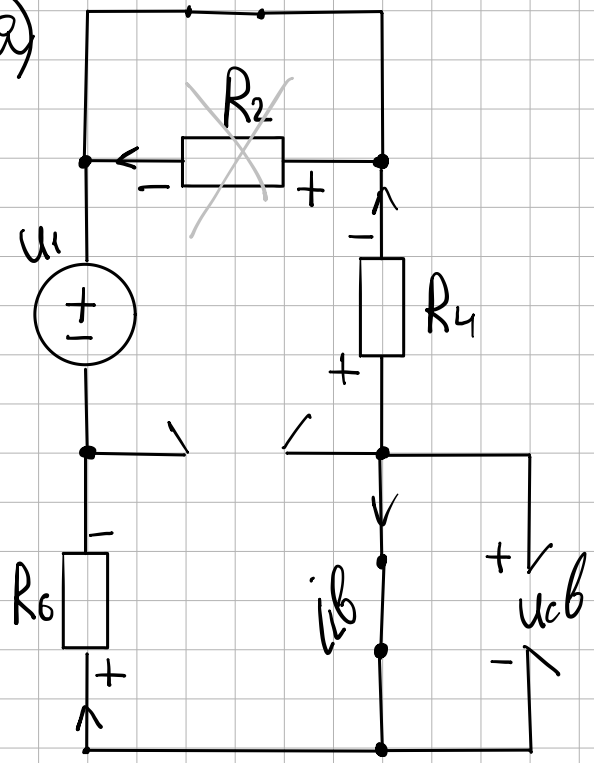
1) $t \to \infty$ L = к.з. C = х.х.



$u_{св} = 0$

Методом наложения найдём $i_в$

а)

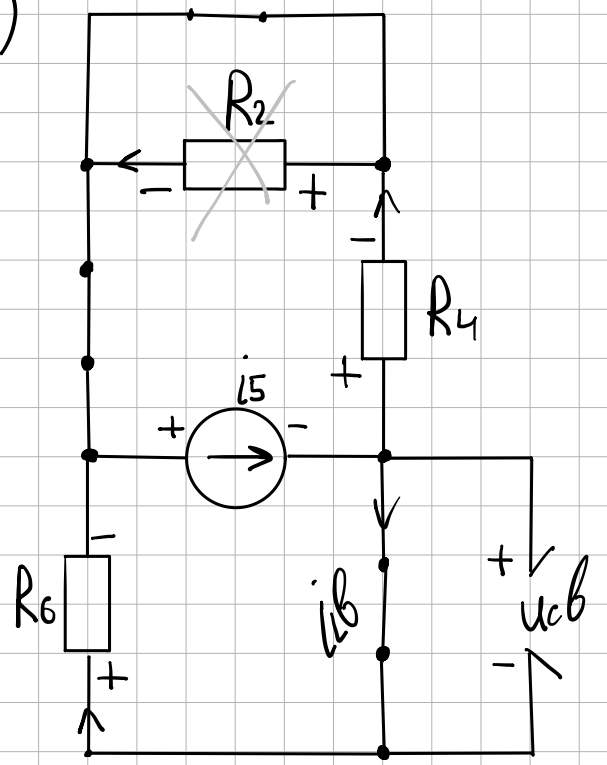


$R_{вх} = R_4 + R_6 = 0{,}5 + 0{,}5 = 1$

$i_{вх} = u_1 / R_{вх} = 4/1 = 4$

$i'_в = i_{вх} = 4$

8)

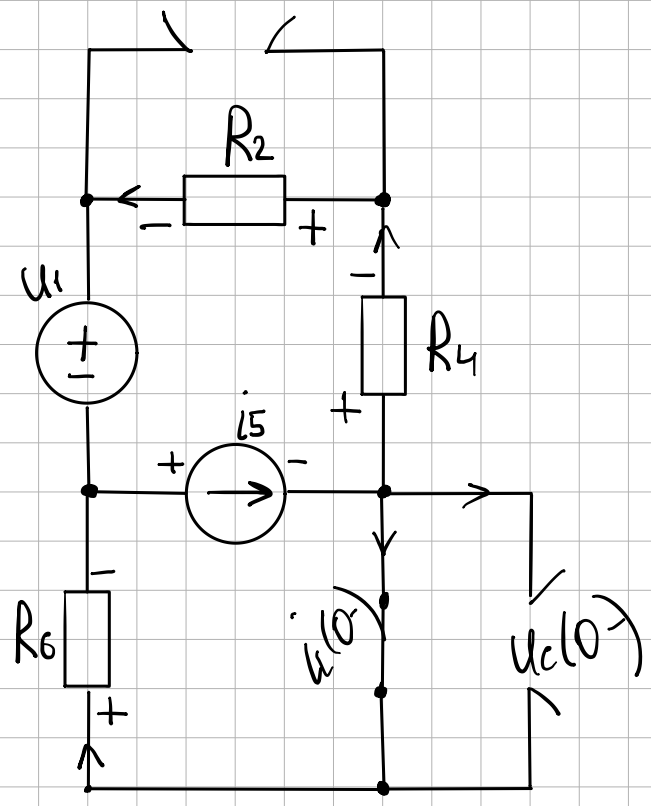


$$i''_{Lв} = \frac{i_5}{2} = \frac{4}{2} = 2$$

$$i_{Lв} = i'_{Lв} + i''_{Lв} = 4 + 2 = 6$$

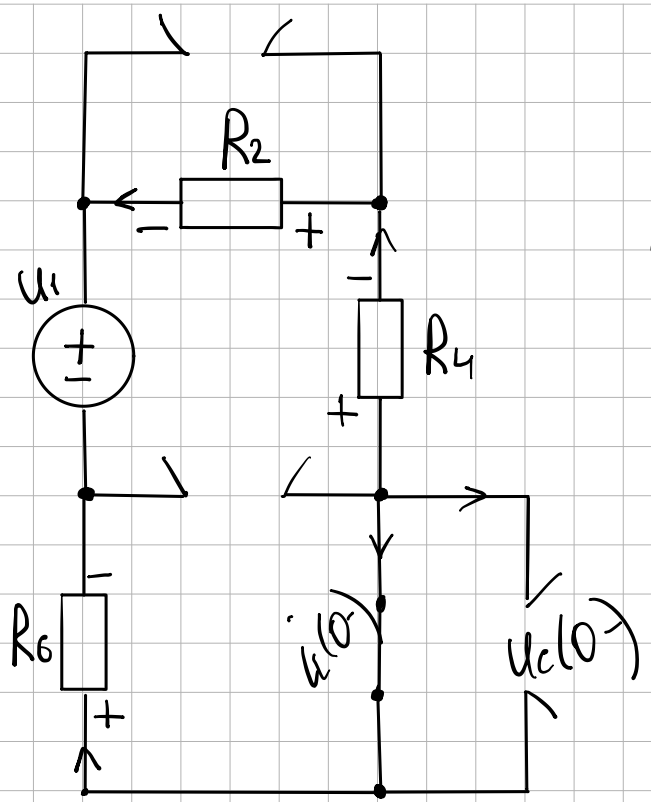
$$\boxed{\begin{aligned} i_{Lв} &= 6 \\ u_{Cв} &= 0 \end{aligned}}$$

2) $t = 0-$ $\quad C = $ х.х. $\quad L = $ к.з



$$u_C(0-) = 0$$

Методом наложения найдём $i_L(0)$

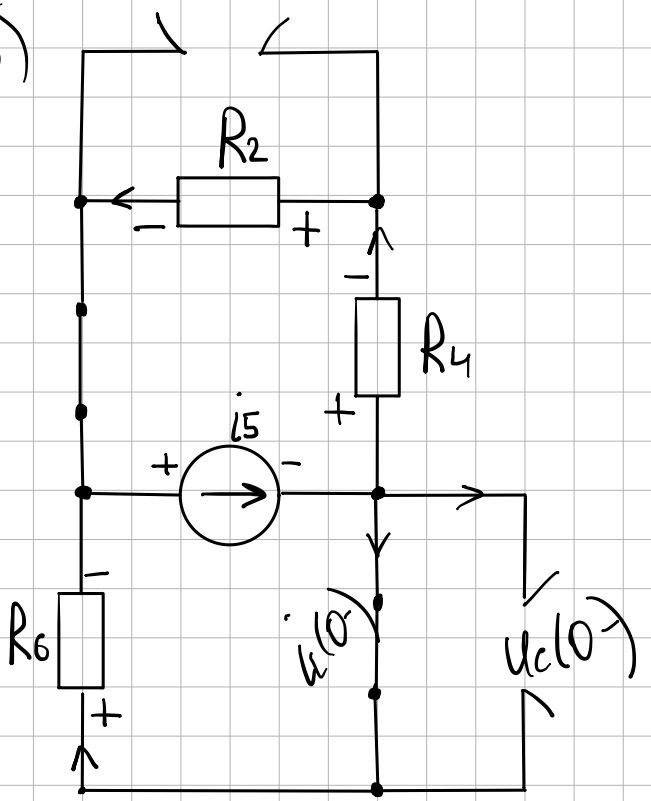


$$R_{вх} = R_2 + R_4 + R_6 = 1 + 0{,}5 + 0{,}5 = 2$$

$$i_{вх} = U_1 / R_{вх} = 4/2 = 2$$

$$i_L'(0-) = i_{вх} = 2$$

б)



$$R_{24} = R_2 + R_4 = 1 + 0{,}5 = 1{,}5$$

$$i_L''(0-) = i_5 \cdot \frac{R_{24}}{R_{24} + R_6} =$$

$$= 4 \cdot \frac{1{,}5}{1{,}5 + 0{,}5} = 3$$

$$i_L(0-) = i_L'(0-) + i_L''(0-) =$$

$$= 2 + 3 = 5$$

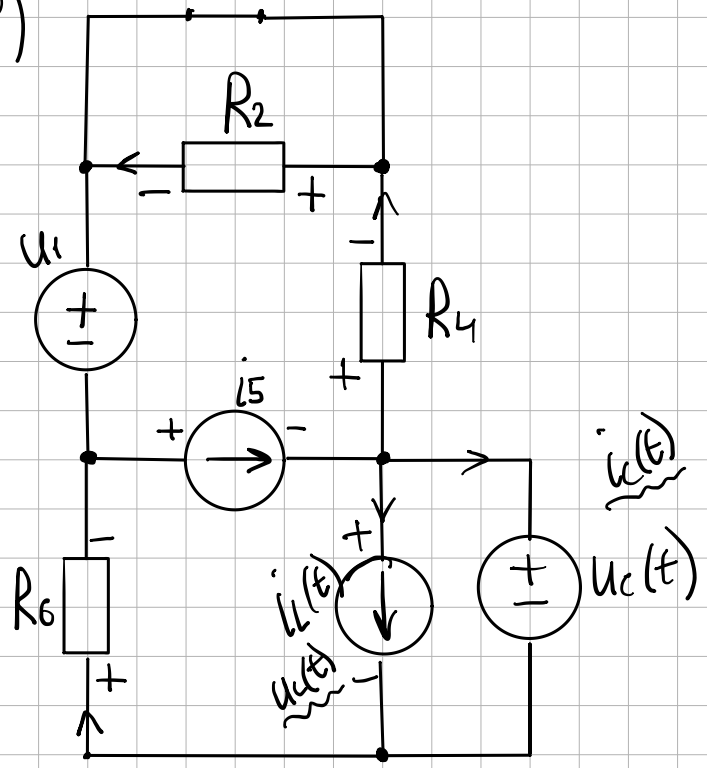
$$u_c(0-) = 0$$

$$i_L(0-) = 5$$

3) $t = 0+$

$$\begin{cases} u_C(0+) = u_C(0-) = 0 \\ i_L(0+) = i_L(0-) = 5 \end{cases}$$

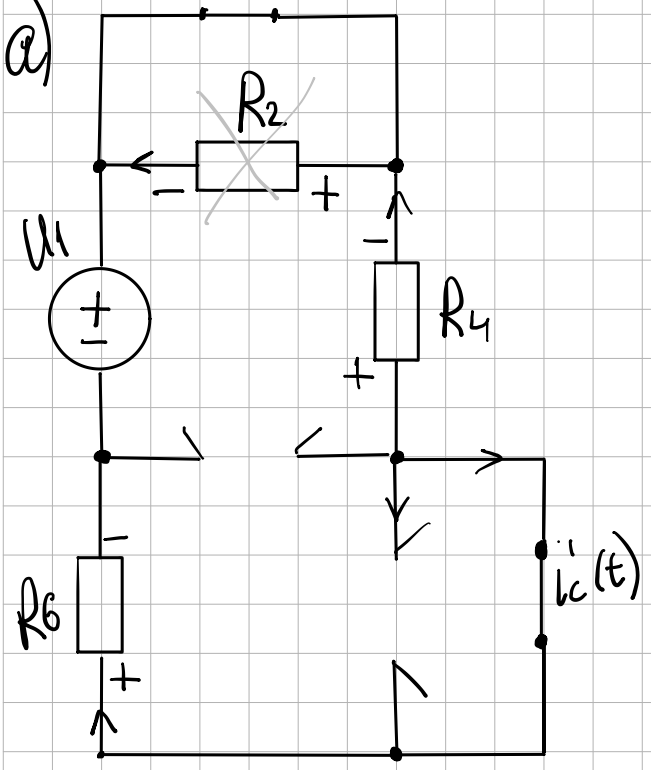
4)



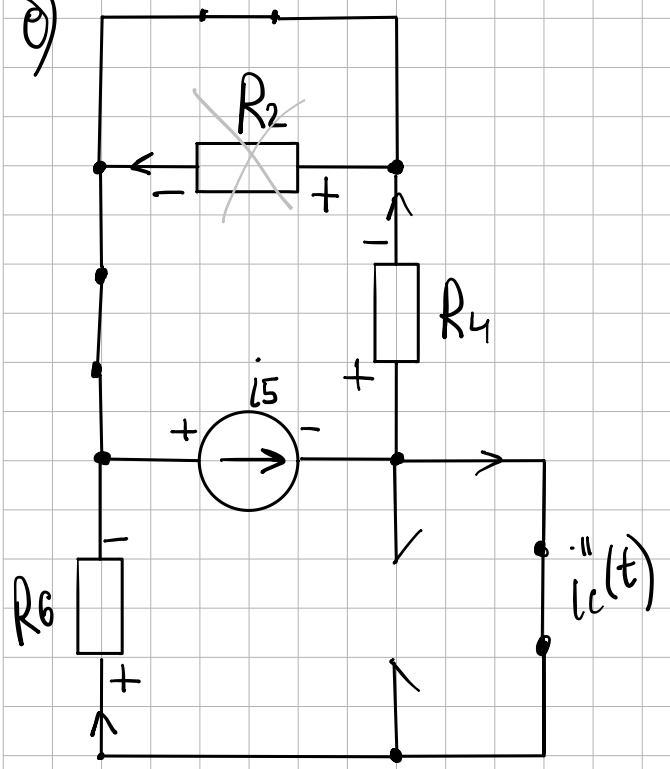
$$u_L(t) = u_C(t)$$

Методом наложения найдем $i_C(t)$

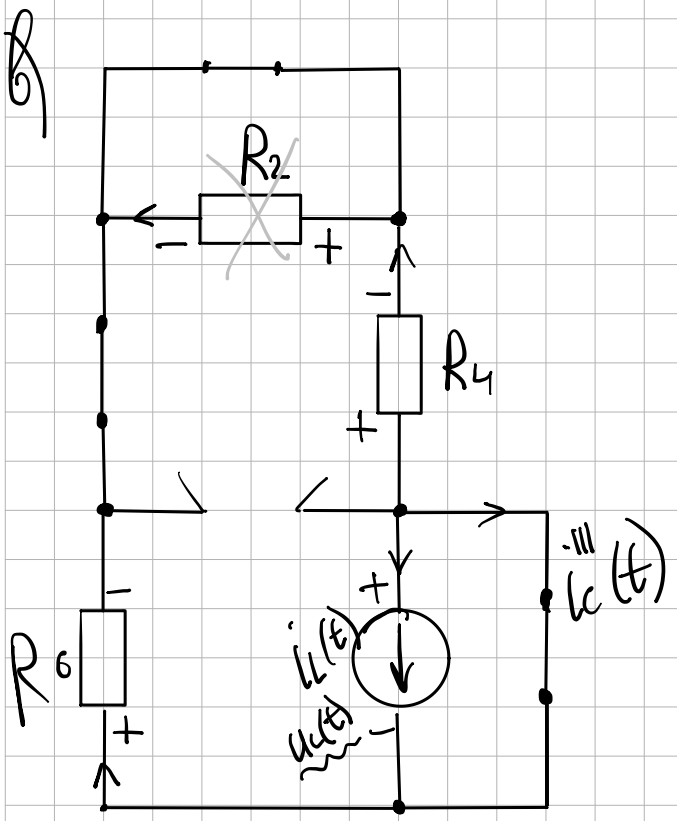
а)



$$i'_C(t) = \frac{u_1}{R_4 + R_6} = u_1$$

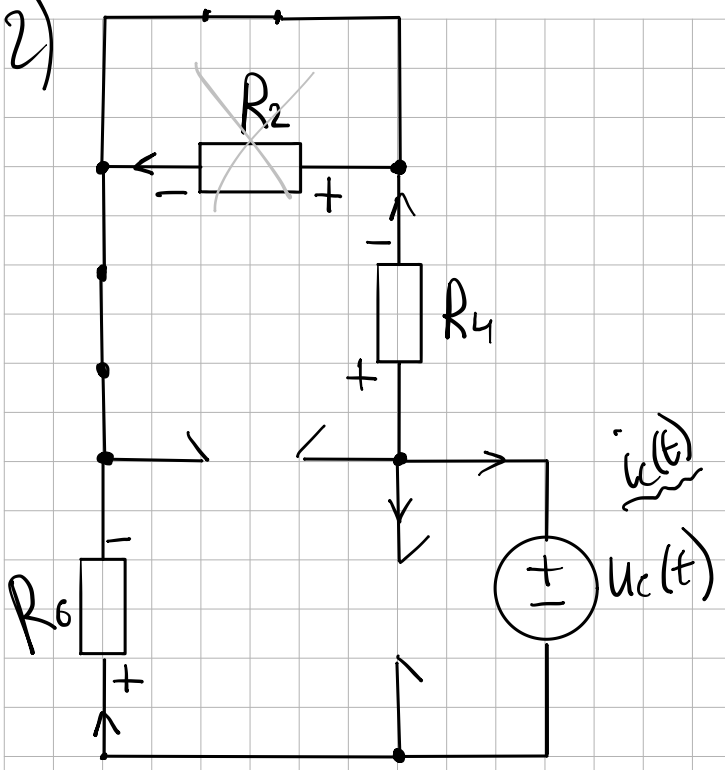


$$i''_c(t) = \frac{i_5}{2}$$



$$i'''_c(t) = -i_L(t)$$

2)



$$i_L^{IV}(t) = \frac{u_c(t)}{R_6 + R_4} = -u_c(t)$$

$$u_L(t) = u_c(t)$$

$$i_c(t) = -u_c(t) - i_L(t) + u_1 + \frac{i_5}{2}$$

$$\begin{bmatrix} \frac{du_c(t)}{dt} \\ \frac{di_L(t)}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{1}{C} & -\frac{1}{C} \\ \frac{1}{L} & \frac{0}{L} \end{bmatrix} \begin{bmatrix} u_c(t) \\ i_L(t) \end{bmatrix} +$$

$$+ \begin{bmatrix} \frac{1}{C} & \frac{1}{2C} \\ \frac{0}{L} & \frac{0}{L} \end{bmatrix} \begin{bmatrix} u_1 \\ i_5 \end{bmatrix} =$$

$$= \underbrace{\begin{bmatrix} -2 & -2 \\ 1 & 0 \end{bmatrix}}_{[A]} \begin{bmatrix} u_c(t) \\ i_L(t) \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} u_1 \\ i_5 \end{bmatrix}$$

$$\det\left([A] - \begin{bmatrix} p & 0 \\ 0 & p \end{bmatrix}\right) = \begin{bmatrix} -2 & -2 \\ 1 & 0 \end{bmatrix} - \begin{bmatrix} p & 0 \\ 0 & p \end{bmatrix} =$$

$$= \begin{bmatrix} -2-p & -2 \\ 1 & -p \end{bmatrix} = -p(-2-p) + 2 = 2p + p^2 + 2 =$$

$$= p^2 + 2p + 2 \qquad p_{1,2} = -1 \pm j$$

$$u_c' = -u_c(t) - i_L(t) + u_1 + \frac{i_5}{2}$$

$$i_L' = u_c(t)$$

$$\begin{bmatrix} -2 & -2 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} u_c(0+) \\ 0 \\ 5 \\ i_L(0+) \end{bmatrix} + \begin{bmatrix} 2 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} u_1 \\ 4 \\ 4 \\ i_5 \end{bmatrix} = \begin{bmatrix} -10 \\ 0 \end{bmatrix} + \begin{bmatrix} 12 \\ 0 \end{bmatrix} =$$

$$= \begin{bmatrix} 2 \\ 0 \end{bmatrix} \begin{matrix} \rightarrow u_c'(0+) = 2 \\ \rightarrow i_L'(0+) = 0 \end{matrix}$$

$$i_L(t) = A_1 e^{-t}\cos t + A_2 e^{-t}\sin t + i_{LB}$$
$$i_L'(t) = -A_1 e^{-t}\cos t - A_1 e^{-t}\sin t - A_2 e^{-t}\sin t + A_2 e^{-t}\cos t + 0$$

$$\begin{cases} i_L(0+) = A_1 e^0 \cos 0 + A_2 e^0 \sin 0 + 6 = 5 \\ i_L'(0+) = -A_1 e^0 \cos 0 - A_1 e^0 \sin 0 - A_2 e^0 \sin 0 + A_2 e^0 \cos 0 = 0 \end{cases}$$

$$A_1 + 6 = 5 \Rightarrow A_1 = -1$$
$$-A_1 + A_2 = 0 \Rightarrow A_2 = -1$$

$$i_L(t) = -e^{-t}\cos t - e^{-t}\sin t + 6$$

$$u_C(t) = A_1 e^{-t}\cos t + A_2 e^{-t}\sin t + u_{CB}$$
$$u_C'(t) = -A_1 e^{-t}\cos t - A_1 e^{-t}\sin t - A_2 e^{-t}\sin t + A_2 e^{-t}\cos t + 0$$

$$u_C(0+) = A_1 e^0 \cos 0 + A_2 e^0 \sin 0 + 0 = 0$$
$$u_C'(0+) = -A_1 e^0 \cos 0 - A_1 e^0 \sin 0 - A_2 e^0 \sin 0 + A_2 e^0 \cos 0 = 2$$

$$A_1 + 0 = 0 \Rightarrow A_1 = 0$$
$$-A_1 + A_2 = 2 \Rightarrow A_2 = 2$$

$$u_C(t) = 2e^{-t}\sin t$$

$$u_L = u_C(t) = 2e^{-t}\sin t$$

$$i_C = -u_C(t) - i_L(t) + u_1 + \frac{i_5}{2} =$$

$$= -2e^{-t}\sin t + e^{-t}\cos t + e^{-t}\sin t - 6 + 4 + 2 =$$

$$= e^{-t}\cos t - e^{-t}\sin t$$

№ 1.2.2. № 11

Цепь:

114 - ИН $u_1 = 9$

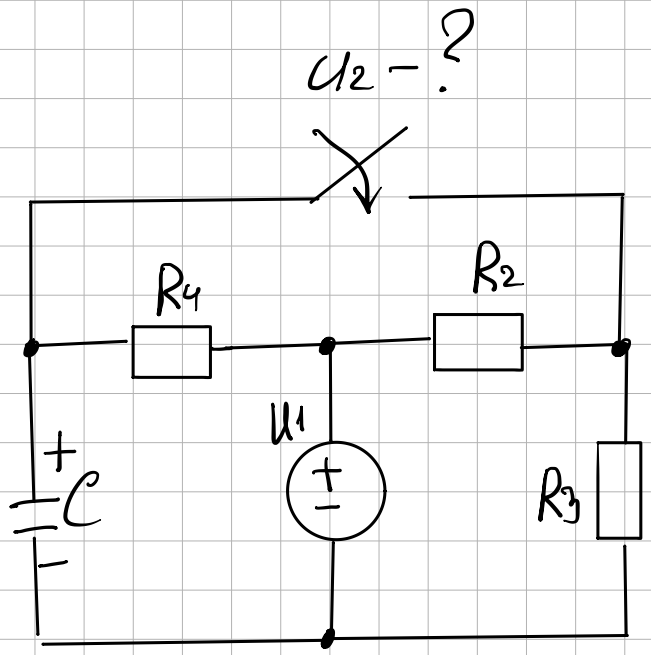
212 - $R_2 = 1$

324 - $R_3 = 1$

413 - $R_4 = 1$

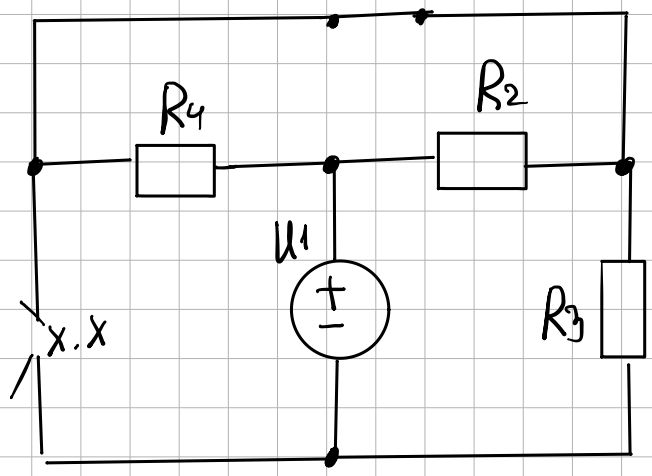
534 - $C_5 = 0{,}5$

623 - К-зам



1) $u_2(t) = Ae^{-t/\tau} + u_{2\text{вын}}$

2) $t \to \infty$ C = Х.Х.



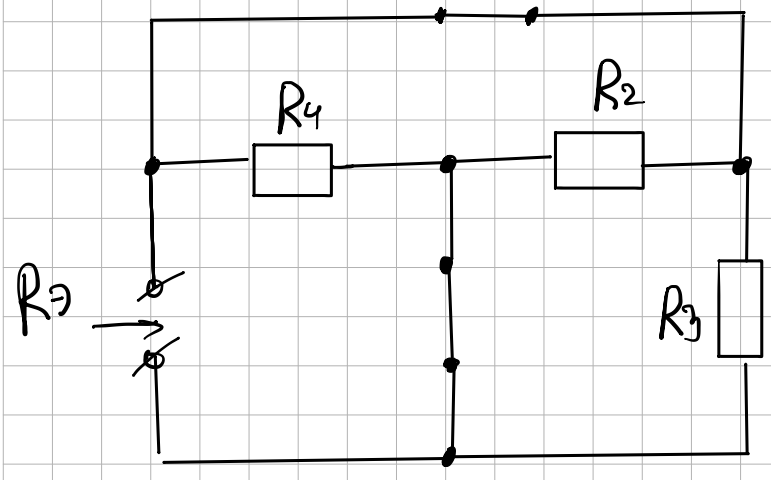
$$R_{24} = \frac{1 \cdot 1}{1+1} = \frac{1}{2}$$

$$i_3 = \frac{U_1}{R_{24} + R_3} = \frac{9}{\frac{1}{2} + 1} = 6$$

$$i_2 = i_4 = \frac{i_3}{2} = \frac{6}{2} = 3$$

$$U_{2вых} = i_2 \cdot R_2 = 3 \cdot 1 = 3$$

3) $\tau = C \cdot R_э$



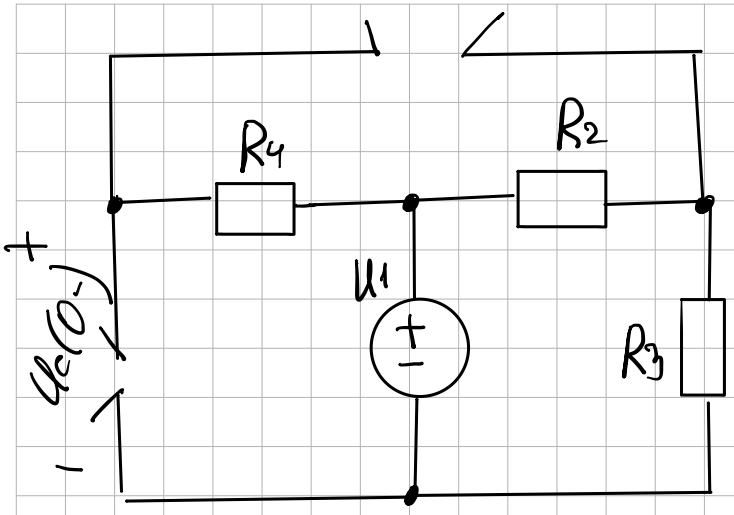
$$\frac{1}{R_э} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} =$$

$$= \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = 3$$

$$\frac{1}{R_э} = 3 \Rightarrow R_э = \frac{1}{3}$$

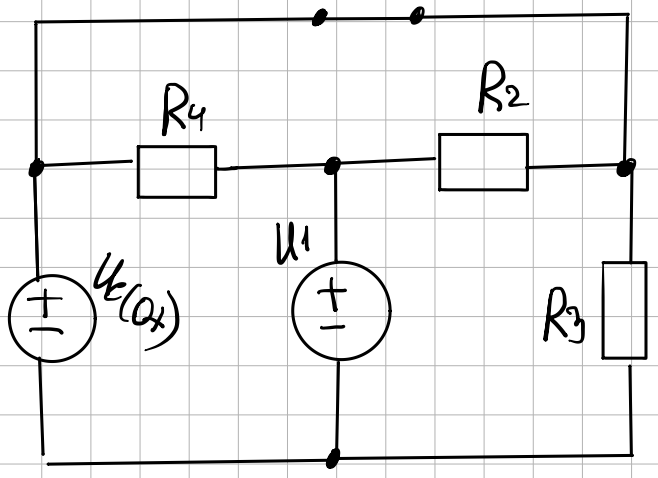
$$\tau = 0{,}5 \cdot \frac{1}{3} = \frac{1}{6}$$

4) а) $t = 0-$

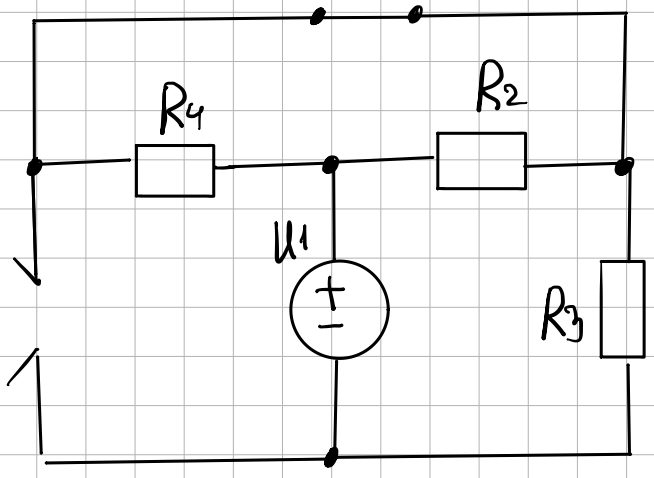


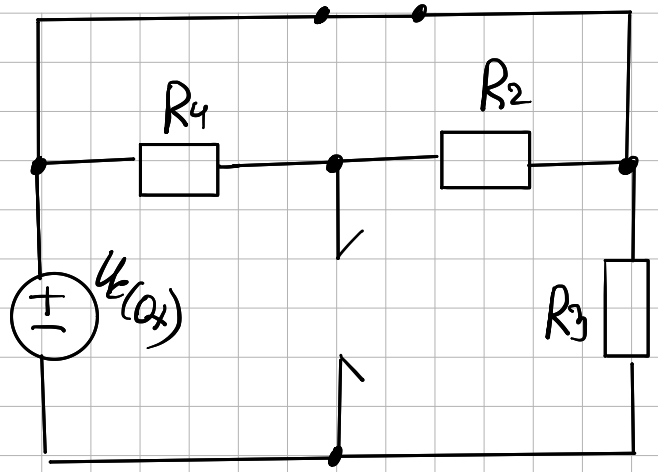
б) $U_C(0+) = U_C(0-) = 9$

$t = 0+$



Метод напряжений





$$i_2 = \frac{u_c(0+)}{R_4+R_2+R_3} = \frac{9}{3} = 3$$

$$u_2'' = i_2 R_2 = 3 \cdot 1 = 3$$

$$u_2(0+) = 3 + 4{,}5 = 7{,}5$$

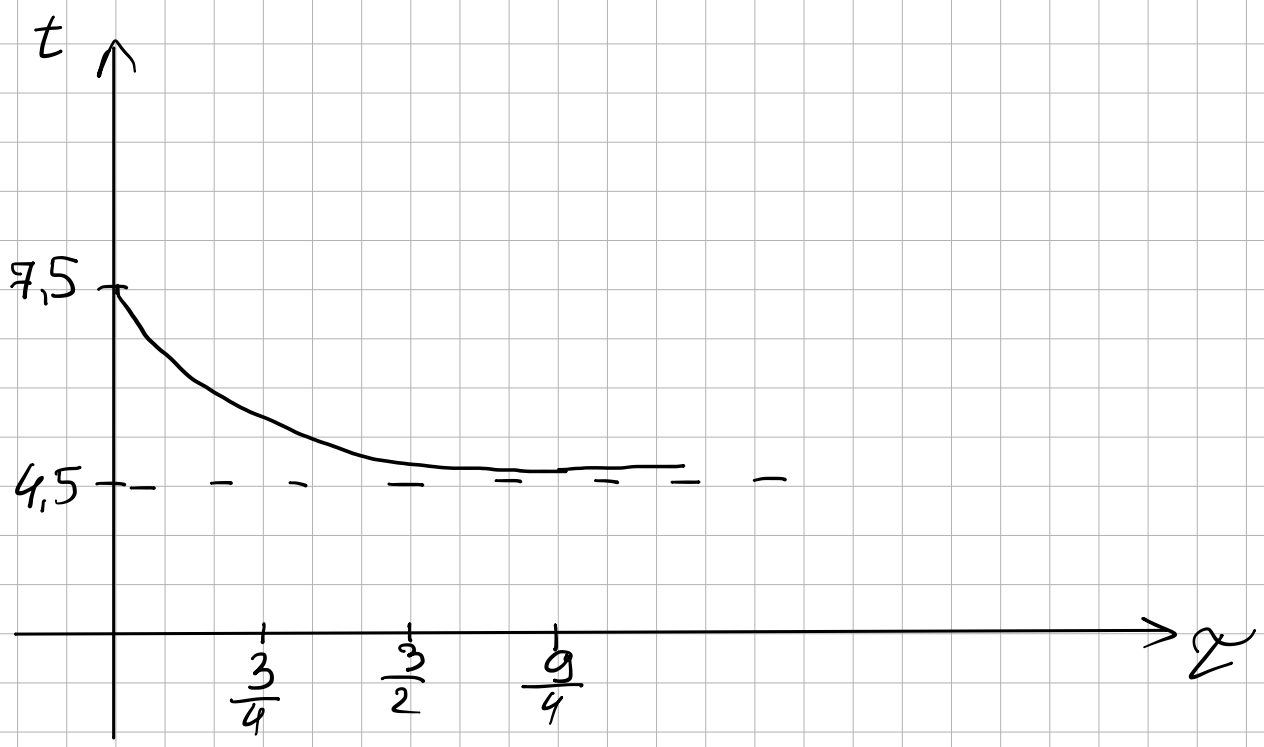
б) $7{,}5 = Ae^0 + 4{,}5$

$7{,}5 - 4{,}5 = A$

$A = 3$

$$u_2(t) = 3e^{-\frac{4}{3}t} + 4{,}5$$

$t = 0$: $7{,}5$ $\quad$ $t \to \infty$ $4{,}5$



№ 1.2.4 Часть 1 № 11

Дано:

114 - ИН u_1

212 - R_2

324 - R_3

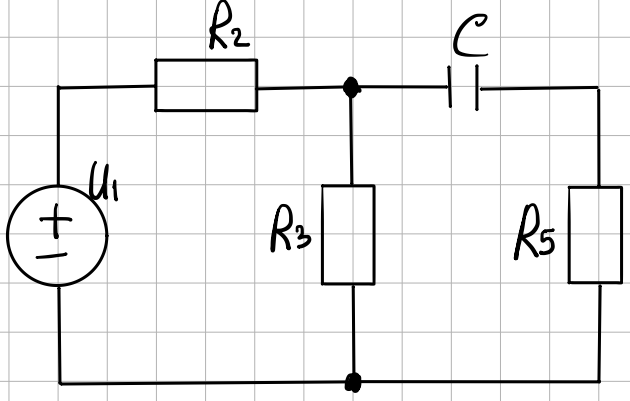
423 - $C_4 = 1$

534 - R_5

$R_k = 1$

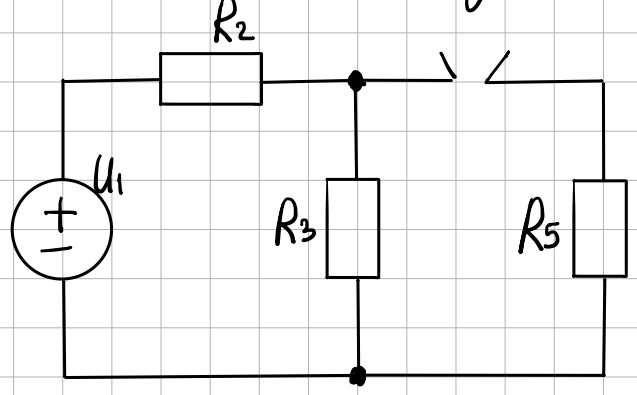
$h_1(t)$, $h(t)$, $h_2(t)$

для i_3 - ?



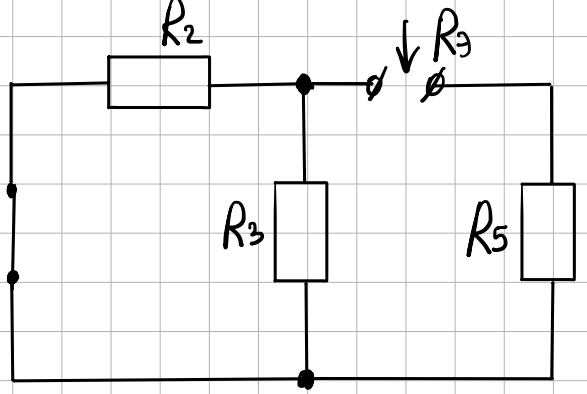
1) $i_3(t) = Ae^{-t/\tau} + i_{3\,уст}$

2) $t \to \infty$ $i_{3\,уст}$ - ? $C = x.x.$



$$i_{3\,уст} = \frac{u_1}{R_2 + R_3} = \frac{1}{1+1} = \frac{1}{2}$$

3) $\tau = C \cdot R_э$



$$R_э = \frac{R_2 \cdot R_3}{R_2 + R_3} + R_5 =$$

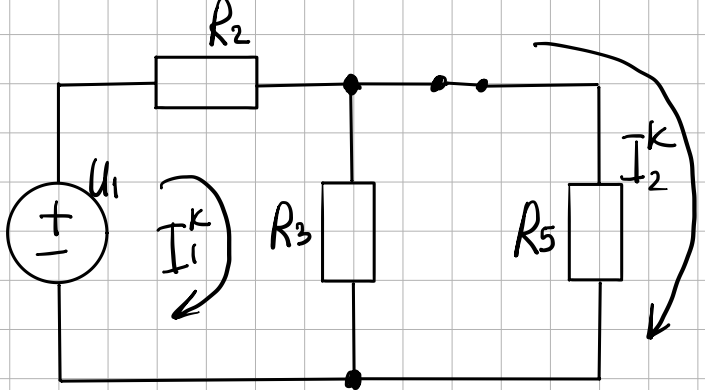
$$= \frac{1 \cdot 1}{1+1} + 1 = \frac{1}{2} + 1 = \frac{3}{2}$$

$$\tau = C \cdot R_э = 1 \cdot \frac{3}{2} = \frac{3}{2}$$

4) а) $u_c(0-) = 0$

$u_c(0+) = u_c(0-) = 0$

б) ЗНУ $t = 0+$



$R_{11} = R_2 + R_3 = 1+1 = 2$

$R_{22} = R_2 + R_5 = 1+1 = 2$

$R_{12} = R_2 = 1$

$$\begin{cases} R_{11} I_1^к + R_{12} \cdot I_2^к = u_1 \\ R_{22} I_2^к + R_{12} \cdot I_1^к = u_1 \end{cases} \qquad \begin{cases} 2I_1^к + I_2^к = 1 \\ 2I_2^к + I_1^к = 1 \end{cases}$$

$I_2^к = 1 - 2I_1^к$

$2(1 - 2I_1^к) + I_1^к = 1$

$2 - 4I_1^к + I_1^к = 1$

$-3I_1^к = -1$

$I_1^к = \frac{1}{3}$ $\qquad i_3(0+) = I_1^к = \frac{1}{3}$

в) $A - ?$

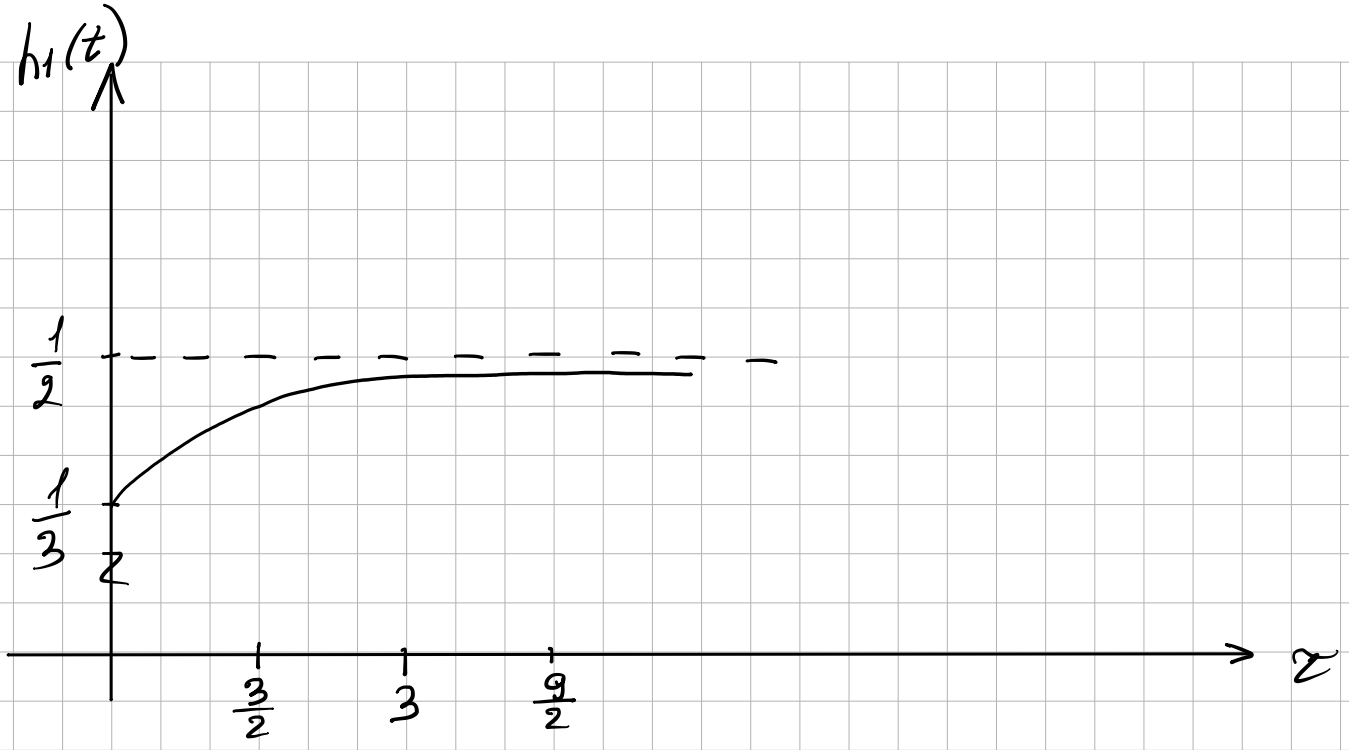
$Ae^0 + \frac{1}{2} = \frac{1}{3}$

$A = \frac{1}{3} - \frac{1}{2} = -\frac{1}{6}$

$u_2(t) = \left(-\frac{1}{6} e^{-\frac{2}{3}t} + \frac{1}{2}\right) 1(t) = h_1(t)$

$t = 0: \ \frac{1}{3}$

$t \to \infty: \ \frac{1}{2}$



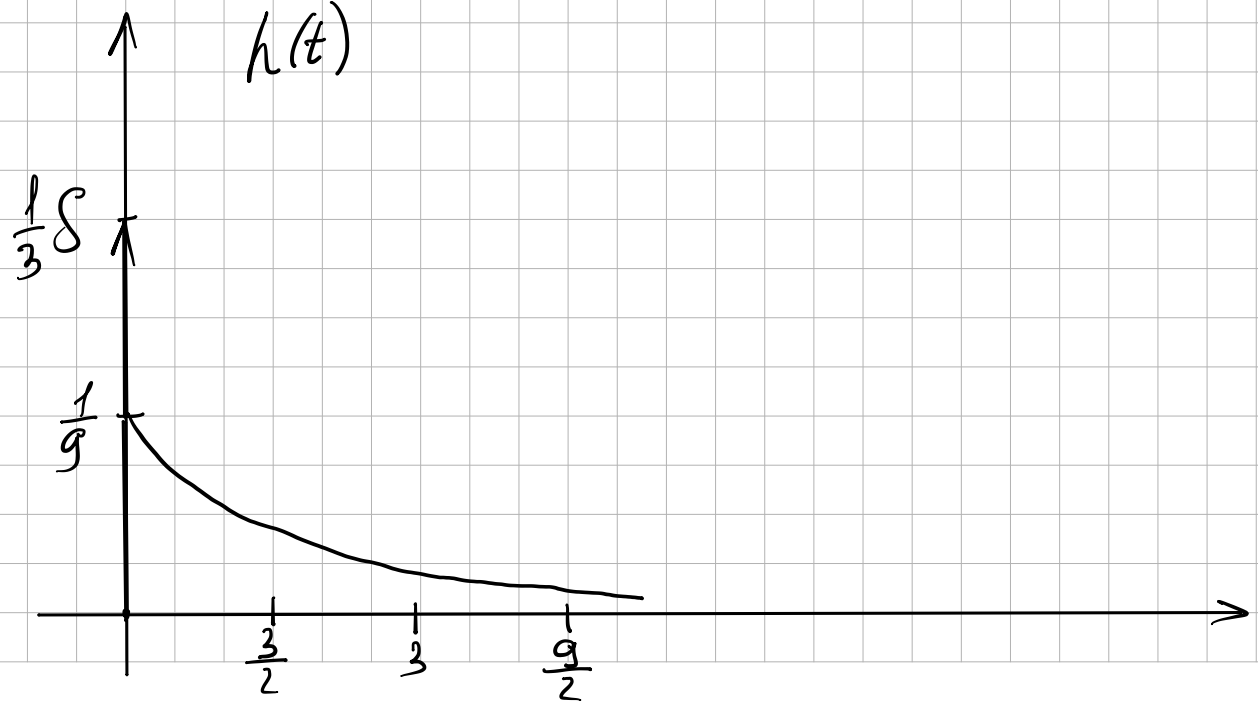
$$h(t) = h_1'(t) = \left[\left(-\frac{1}{6}e^{-\frac{2}{3}t} + \frac{1}{2}\right)\delta_1(t)\right]' =$$

$$= -\frac{1}{6}\cdot\left(-\frac{2}{3}\right)e^{-\frac{2}{3}t}\cdot\delta_1(t) + \left(-\frac{1}{6}e^{-\frac{2}{3}t} + \frac{1}{2}\right)\delta(t) =$$

$$= \frac{1}{9}e^{-\frac{2}{3}t}\cdot\delta_1(t) + \frac{1}{3}\delta(t)$$

$t = 0$: $\frac{1}{9}$

$t \to \infty$: 0

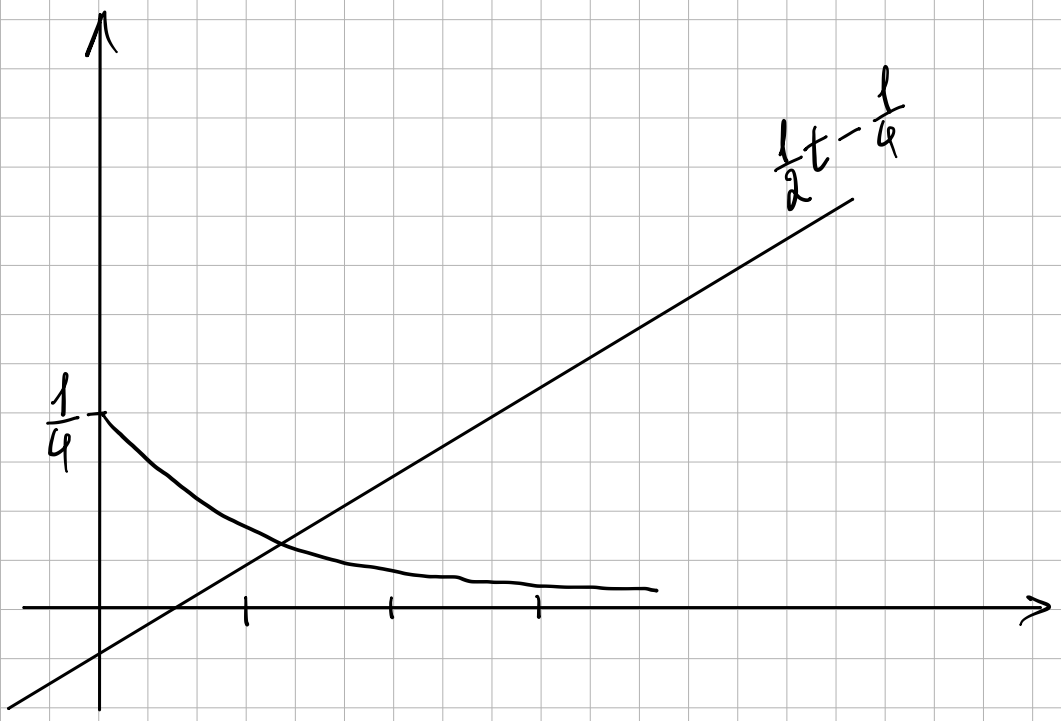


$$h_2(t) = \int h_1(t)\,dt$$

$$h_2(t) = \int_0^t \left(-\frac{1}{6}e^{-\frac{2}{3}t} + \frac{1}{2}\right) dt =$$

$$= \left(\frac{1}{4}e^{-\frac{2}{3}t} + \frac{1}{2}t\right)\Big|_0^t = \left(\frac{1}{4}e^{-\frac{2}{3}t} + \frac{1}{2}t - \frac{1}{4}\right)\sigma_1(t)$$

$t = 0$: $\frac{1}{4}$ $\quad t \to \infty$: 0



Подготовка к КР по ТОЭ.

№ 1.24 № 25

Цепь:

114 - ИН U_1

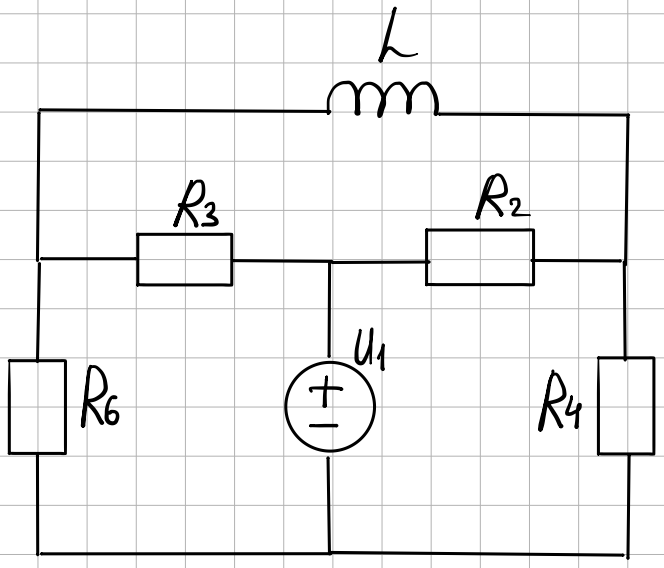
212 - $R_2 = 1$

313 - $R_3 = 3$

424 - $R_4 = 3$

523 - $L_5 = 1{,}5$

634 - $R_6 = 1$

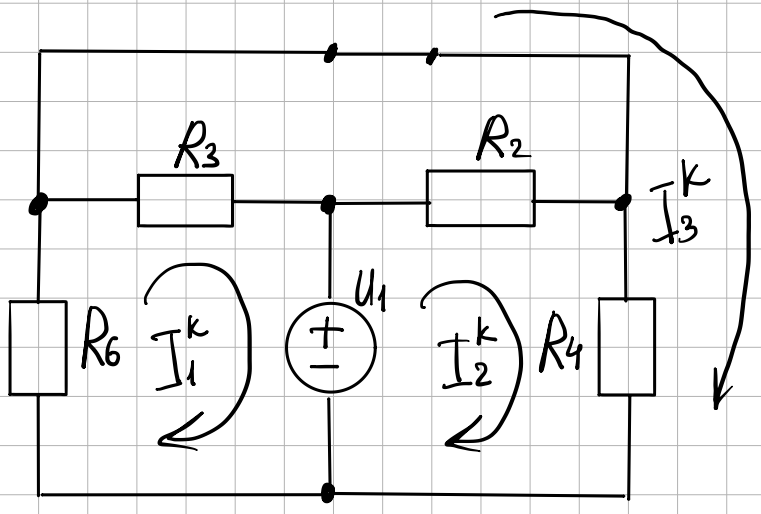


$h_1(t)$, $h(t)$, $h_2(t)$

для i_3 - ?

1) $i_3(t) = Ae^{-t/\tau} + i_{3\,уст}$

2) $t \to \infty$, $i_{3\,уст}$ - ? L = к.з.



$R_{11} = R_6 + R_3 = 1 + 3 = 4$

$R_{22} = R_2 + R_4 = 1 + 3 = 4$

$R_{33} = R_4 + R_6 = 3 + 1 = 4$

$R_{12} = 0$

$R_{13} = R_6 = 1$

$R_{23} = R_4 = 3$

$$\begin{cases} R_{11} I_1^к + R_{12} I_2^к + R_{13} I_3^к = -U_1 \\ R_{22} I_2^к + R_{21} I_1^к + R_{23} I_3^к = U_1 \\ R_{33} I_3^к + R_{31} I_1^к + R_{32} I_2^к = 0 \end{cases}$$

$$\begin{cases} 4\bar{I}_1^к + \bar{I}_3^к = -1 \longrightarrow \bar{I}_1^к = \dfrac{-1-\bar{I}_3^к}{4} \\ 4\bar{I}_2^к + 3\bar{I}_3^к = 1 \longrightarrow \bar{I}_2^к = \dfrac{1-3\bar{I}_3^к}{4} \\ 4\bar{I}_3^к + \bar{I}_1^к + 3\bar{I}_2^к = 0 \end{cases}$$

$$4\bar{I}_3^к + \frac{-1-\bar{I}_3^к}{4} + \frac{3-9\bar{I}_3^к}{4} = 0$$

$$16\bar{I}_3^к - 1 - \bar{I}_3^к + 3 - 9\bar{I}_3^к = 0$$

$$6\bar{I}_3^к = -2$$

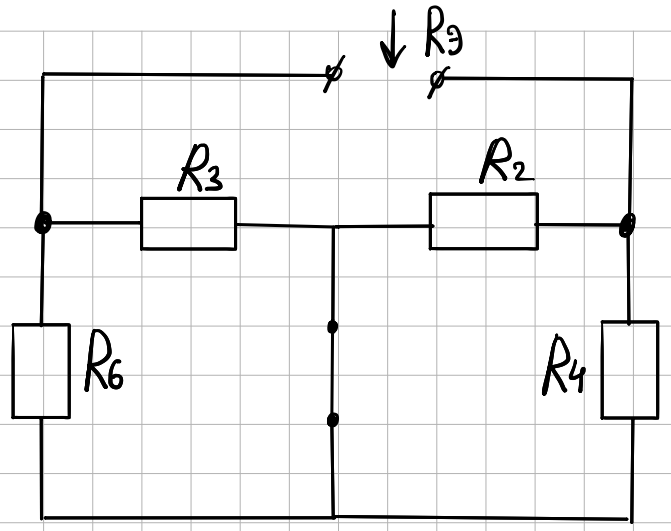
$$\bar{I}_3^к = -\frac{1}{3}$$

$$\bar{I}_1^к = \frac{-1+\frac{1}{3}}{4} = -\frac{1}{6}$$

$$\bar{I}_2^к = \frac{1+\frac{1}{3}\cdot 3}{4} = 1$$

$$i_{3\,уст} = \bar{I}_3^к = -\frac{1}{3}$$

3) $\tau = \dfrac{L}{R_э}$



$$R_{36} = \frac{R_3 \cdot R_6}{R_3 + R_6} = \frac{3 \cdot 1}{3+1} = \frac{3}{4}$$

$$R_{24} = \frac{R_2 \cdot R_4}{R_2 + R_4} = \frac{1 \cdot 3}{1+3} = \frac{3}{4}$$

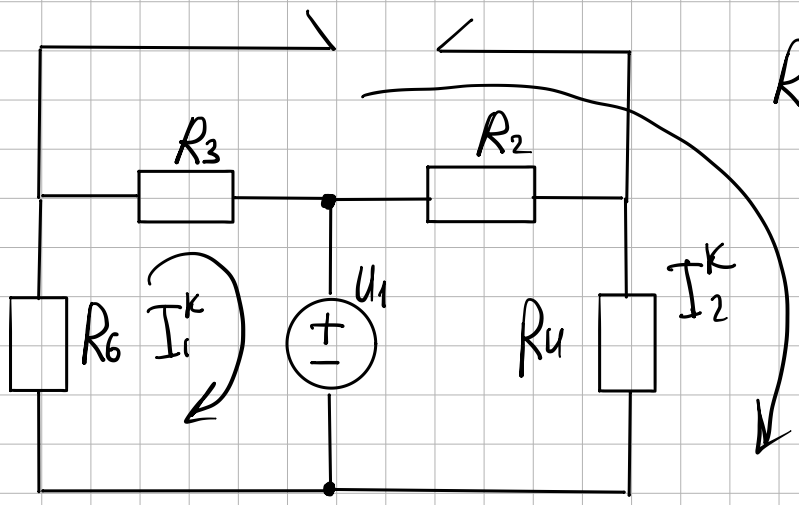
$$R_э = R_{36} + R_{24} = \frac{3}{4} + \frac{3}{4} = \frac{6}{4} = \frac{3}{2}$$

$$I = \frac{1,5}{1,5} = 1$$

4) а) $i_L(0-) = 0$

$i_L(0+) = i_L(0-) = 0$

б) $t = 0+$ $\quad$ $L = x.x.$



$$R_{11} = R_3 + R_6 = 3 + 1 = 4$$

$$R_{22} = R_3 + R_2 + R_4 + R_6 = 3 + 1 + 3 + 1 = 8$$

$$R_{12} = R_6 + R_3 = 1 + 3 = 4$$

$$\begin{cases} 4I_1^к + 4I_2^к = -1 \\ 8I_2^к + 4I_1^к = 0 \end{cases}$$

$$I_1^к = \frac{-1 - 4I_2^к}{4}$$

$$8I_2^к - 1 - 4I_2^к = 0$$

$$4I_2^к = 1 \rightarrow I_2^к = \frac{1}{4}$$

$$I_1^к = \frac{-1 - 4 \cdot \frac{1}{4}}{4} = -\frac{1}{2}$$

$$i_3(0+) = I_1^к + I_2^к = -\frac{1}{2} + \frac{1}{4} = -\frac{1}{4}$$

б) $A - ?$

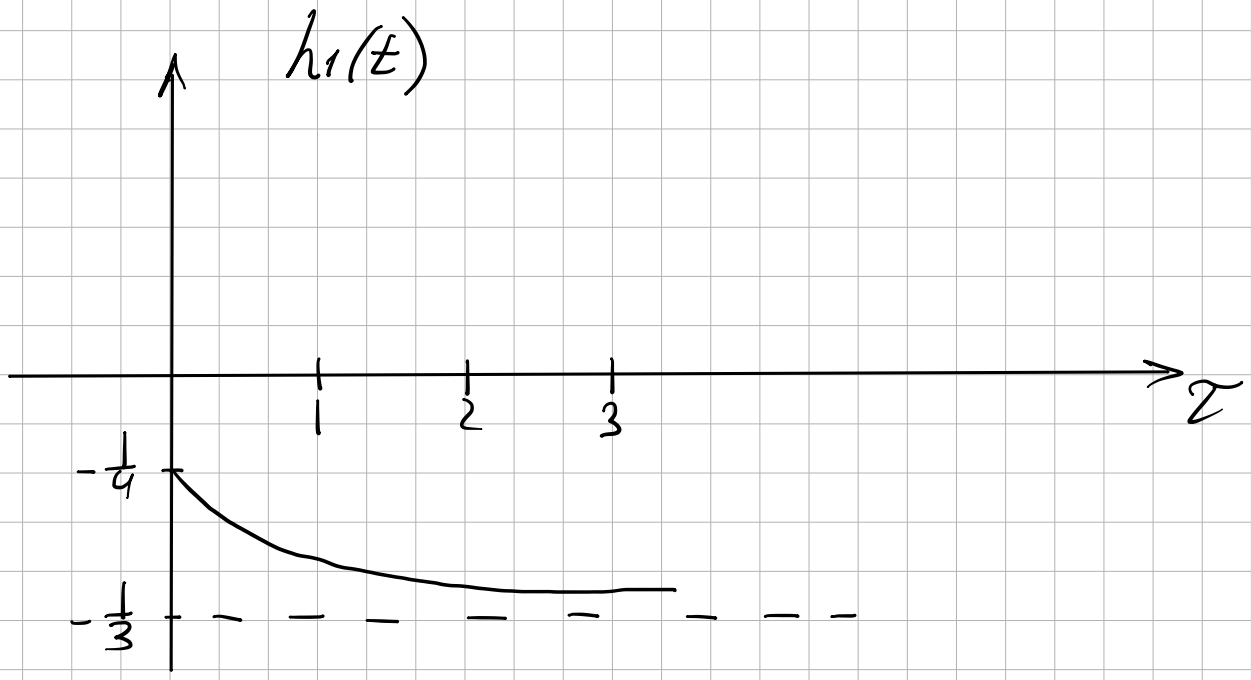
$$Ae^0 - \frac{1}{3} = -\frac{1}{4}$$

$$A = -\frac{1}{4} + \frac{1}{3} = \frac{1}{12}$$

$$i_3(t) = \left(\frac{1}{12}e^{-t} - \frac{1}{3}\right)\delta_1(t) = h_1(t)$$

$t = 0$: $-\frac{1}{4}$

$t \to \infty$: $-\frac{1}{3}$

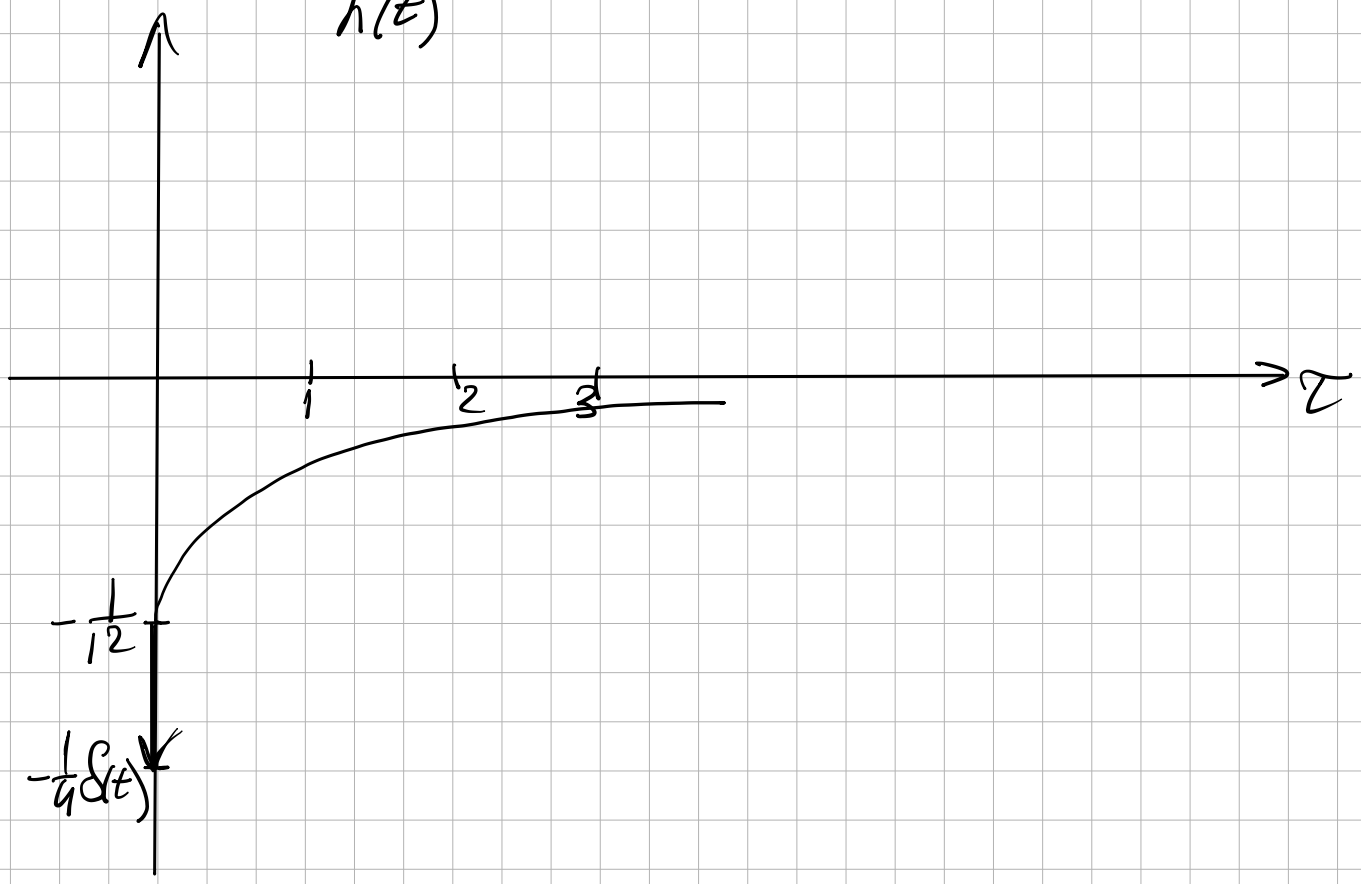


$$h(t) = h_1'(t) = \left[\left(\frac{1}{12}e^{-t} - \frac{1}{3}\right)\delta_1(t)\right]' =$$

$$= -\frac{1}{12}e^{-t}\cdot\delta_1(t) + \left(\frac{1}{12}e^{-t} - \frac{1}{3}\right)\delta(t) =$$

$$= -\frac{1}{12}e^{-t}\delta_1(t) - \frac{1}{4}\delta(t)$$

$t=0: -\frac{1}{12}$ $\quad t \to \infty : 0$



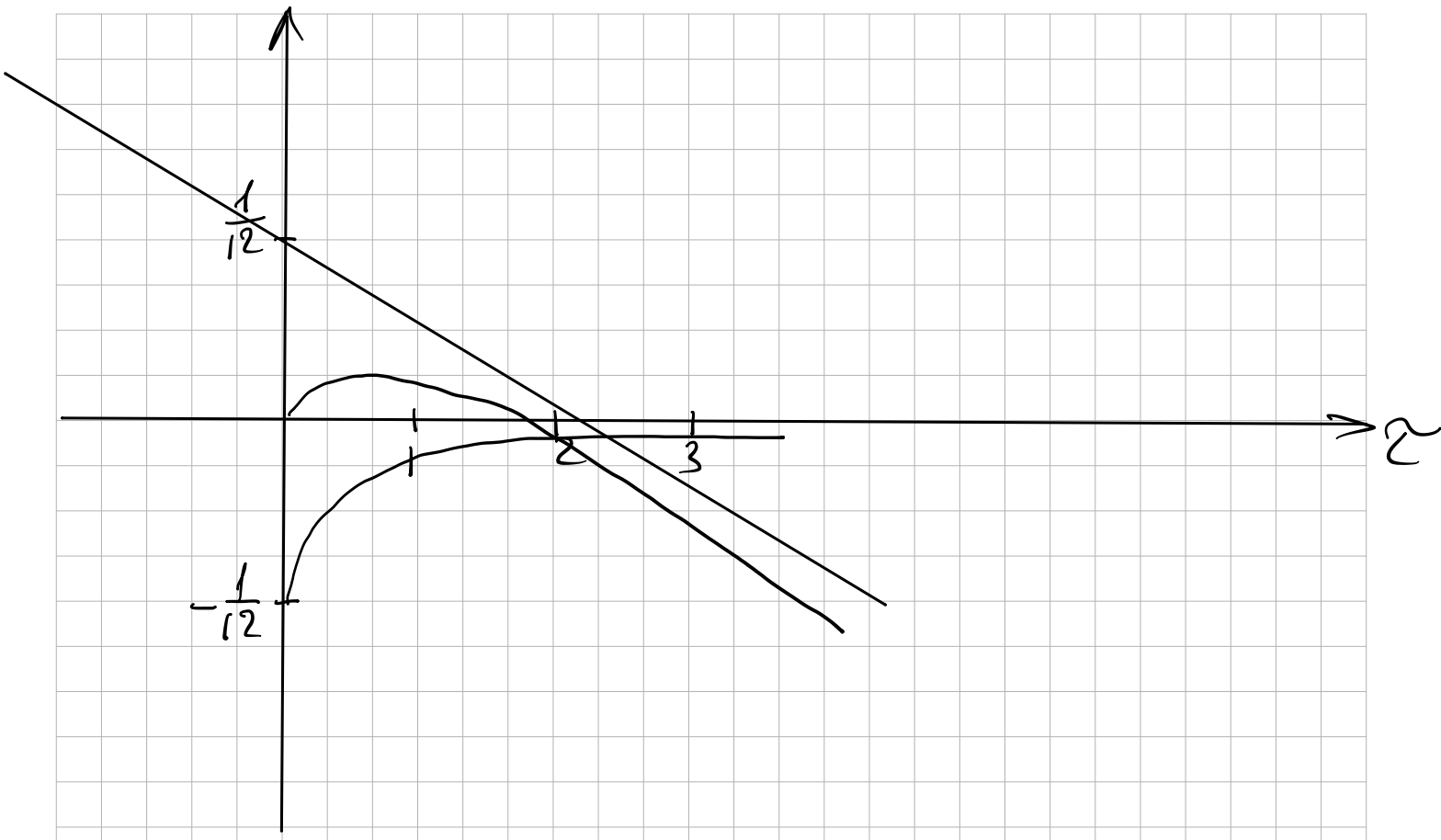
$$h_2(t) = \int h_1(t)\,dt$$

$$h_2(t) = \int_0^t \left(\frac{1}{12}e^{-t} - \frac{1}{3}\right)dt = -\frac{1}{12}e^{-t} - \frac{1}{3}t \Big|_0^t =$$

$$-\frac{1}{12}e^{-t} - \frac{1}{3}t - \left(-\frac{1}{12}e^{0} - \frac{1}{3}\cdot 0\right) =$$

$$= \left(-\frac{1}{12}e^{-t} - \frac{1}{3}t + \frac{1}{12}\right)\delta_1(t)$$

1) $t=0: -\frac{1}{12}$ $\quad t \to \infty : 0$


$\frac{1}{12}$
$-\frac{1}{12}$
1
1
2
3
z

№ 1.3.1 Вариант 11

Дано:

При заданных условиях для пассивного ДП

$u = 10\sqrt{2}(\cos 2t + 90)$

$\dot{I} = -5$

Найти: $\alpha_i, i, \dot{U}_m, \dot{U}, U_m, U, \omega, f, T, \varphi, \underline{Z}$, построить ВА и график $u(t)$

Решение.

$\omega = 2$

$T = \frac{2\pi}{\omega} = \frac{2\pi}{2} = \pi$

$f = \frac{1}{T} = \frac{1}{\pi}$

$U_m = 10\sqrt{2}$

$\dot{U}_m = U_m e^{j\alpha_u} = 10\sqrt{2} e^{j90} = 10\sqrt{2} j$

$U = \frac{U_m}{\sqrt{2}} = \frac{10\sqrt{2}}{\sqrt{2}} = 10$

$\dot{I} = \frac{\dot{I}_m}{\sqrt{2}} \Rightarrow$

$\Rightarrow \dot{I}_m = \dot{I} \cdot \sqrt{2} = -5\sqrt{2}$

$$Z = \frac{\dot{U}_m}{\dot{I}_m} = \frac{10\sqrt{2}\,j}{-5\sqrt{2}} = \frac{10\sqrt{2}\,j \cdot (-5\sqrt{2})}{(-5\sqrt{2})\cdot(-5\sqrt{2})} = \frac{-100j}{50} =$$

$$= -2j = \sqrt{0^2 + (-2)^2} \cdot e^{j \operatorname{arctg} \frac{-2}{0}} = 2e^{-j90}$$

$\varphi = -90^\circ$

$\varphi = \alpha_u - \alpha_i$; $\quad \alpha_i = \alpha_u - \varphi$

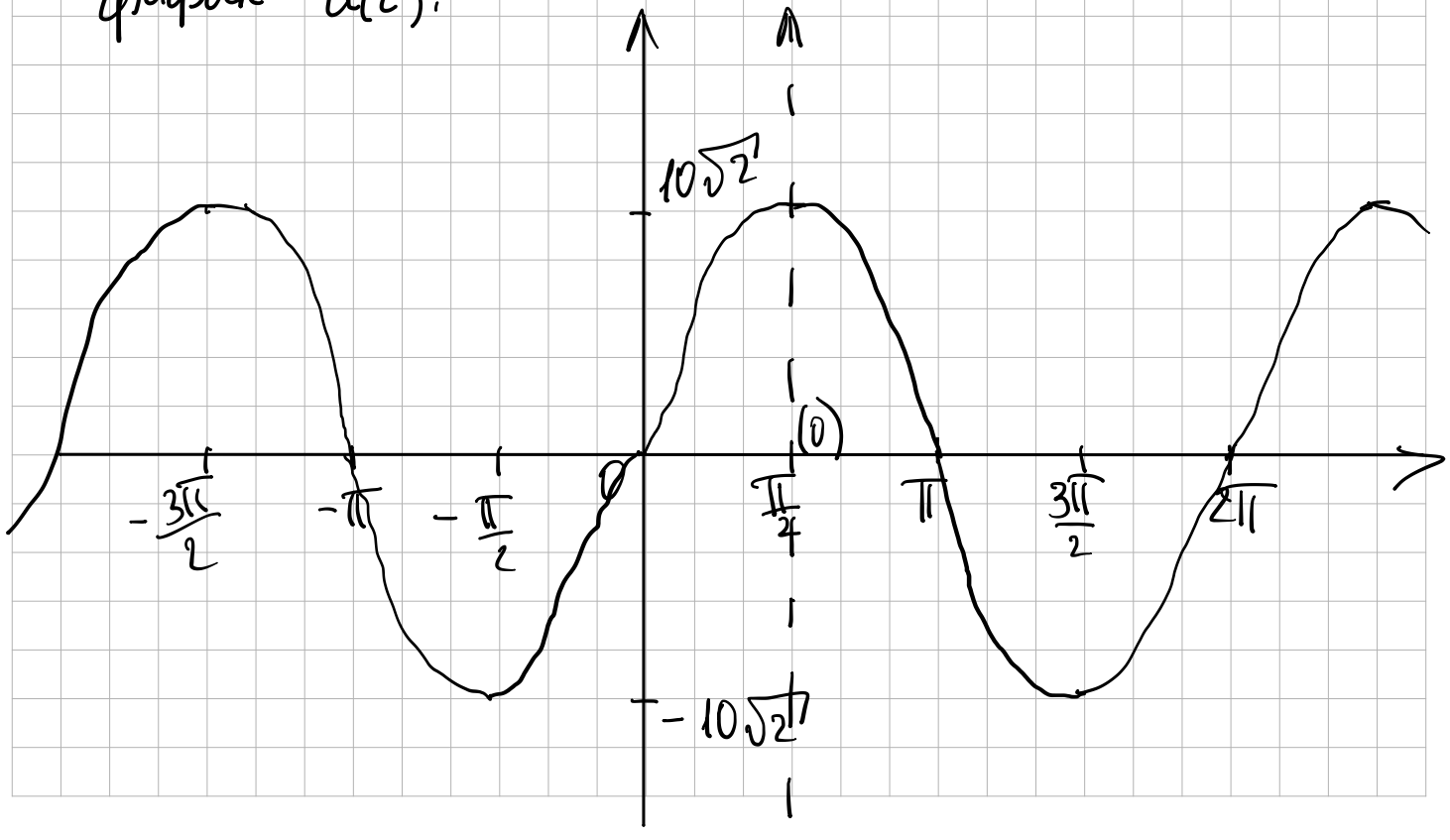
$\alpha_i = 90^\circ - (-90^\circ) = 180^\circ$

$i = -5\sqrt{2}(\cos 2t + 180^\circ)$

ВД:

$\dot{I}_{mR} \longrightarrow \dot{U}_{mR}$

График $u(t)$:



№ 1.3.3 Вариант 11

Дано:

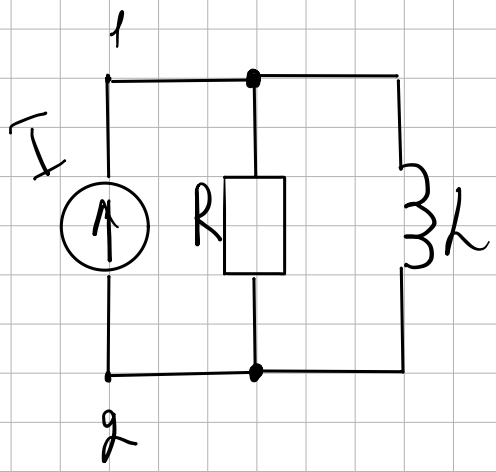
121 – НТ

212 – R

312 – L

$\omega = 2$

$Z_{вх} = 2 + 2j$



Найти: $|Y_{вх}|$, Y, L, R

$$Z_{вх} = \frac{Z_R \cdot Z_L}{Z_R + Z_L} = 2 + 2j$$

$$Z_R = R \qquad Z_L = j\omega L = 2jL$$

$$Z_{вх} = \frac{R \cdot 2jL}{R + 2jL} = 2 + 2j$$

$$\frac{(R \cdot 2jL)(R - 2jL)}{R^2 + 4L^2} = \frac{2jLR^2 + 4RL^2}{R^2 + 4L^2} =$$

$$= \frac{4RL^2}{R^2 + 4L^2} + \frac{2jLR^2}{R^2 + 4L^2}$$

$$\begin{cases} \dfrac{4RL^2}{R^2+4L^2} = 2 \\ \dfrac{2LR^2}{R^2+4L^2} = 2 \end{cases}$$

$$4RL^2 = 2(R^2+4L^2)$$

$$2LR^2 = 2(R^2+4L^2)$$

$$\Rightarrow \quad 4RL^2 = 2LR^2$$

$$2RL^2 = LR^2$$

$$2RL = R^2$$

$$2RL - R^2 = 0$$

$$R(2L-R) = 0$$

$$R = 0 \qquad 2L - R = 0$$

$$2L = R$$

$$L = \frac{R}{2}$$

$$\frac{2\cdot\left(\frac{R}{2}\right)\cdot R^2}{R^2+4\left(\frac{R}{2}\right)^2} = 2$$

$$\frac{R^3}{2R^2} = 2 \qquad \frac{R}{2} = 2 \Rightarrow R = 4$$

$$L = \frac{R}{2} = \frac{4}{2} = 2$$

Проверка $Z_{вх}$

$$Z_{вх} = \frac{Z_R \cdot Z_L}{Z_R + Z_L} = \frac{4 \cdot 4j}{4 + 4j} = \frac{16j(4 - 4j)}{32} =$$

$$= \frac{j(4 - 4j)}{2} = \frac{4j + 4}{2} = 2 + 2j \quad V$$

$$Y_{вх} = \frac{1}{Z_{вх}} = \frac{1}{2 + 2j} = \frac{2 - 2j}{8} = \frac{1}{4} - \frac{1}{4}j$$

$$|Y_{вх}| = \sqrt{\left(\frac{1}{4}\right)^2 + \left(-\frac{1}{4}\right)^2} = \frac{\sqrt{2}}{4}$$

$$\varphi = \operatorname{arctg}\left(-\frac{1}{4} / \frac{1}{4}\right) = -45^\circ$$

$$\psi = -\varphi = 45^\circ$$

$$Y_{вх} = \frac{\sqrt{2}}{4} e^{-j45^\circ}$$

№ 1.3.5 Вариант 11

Дано:

113 – $u_1 = 100\cos(2t - 90°)$

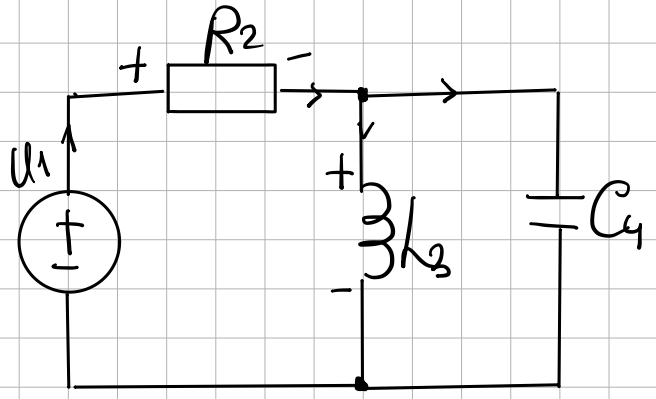
212 – $R_2 = 10$

323 – $L_3 = 2{,}5$

423 – $C_4 = 0{,}05$

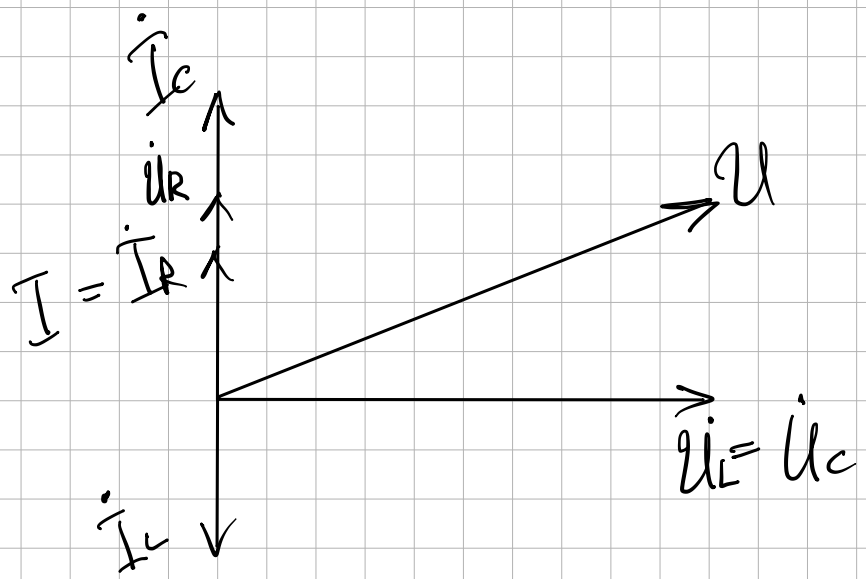
Найти: $u_3(t) - ?$

(то есть $u_L - ?$)



Цепь

ВД:



$$\underline{Z}_L = j\omega L = j \cdot 2 \cdot 2{,}5 = 5j$$

$$\underline{Z}_C = -j\frac{1}{\omega C} = -j\frac{1}{2 \cdot 0{,}05} = -10j$$

$$\underline{Z}_{bx} = \underline{Z}_R + \frac{\underline{Z}_L \cdot \underline{Z}_C}{\underline{Z}_L + \underline{Z}_C} = 10 + \frac{5j \cdot (-10j)}{5j - 10j} =$$

$$= 10 + 10j$$

$$\dot{U}_{1m} = 100(\cos(-90°) + j\sin(-90°)) =$$

$$= -100j$$

$$\dot{I}_{mbx} = \frac{\dot{U}_{1m}}{\underline{Z}_{bx}} = \frac{-100j}{10 + 10j} = -5 - 5j$$

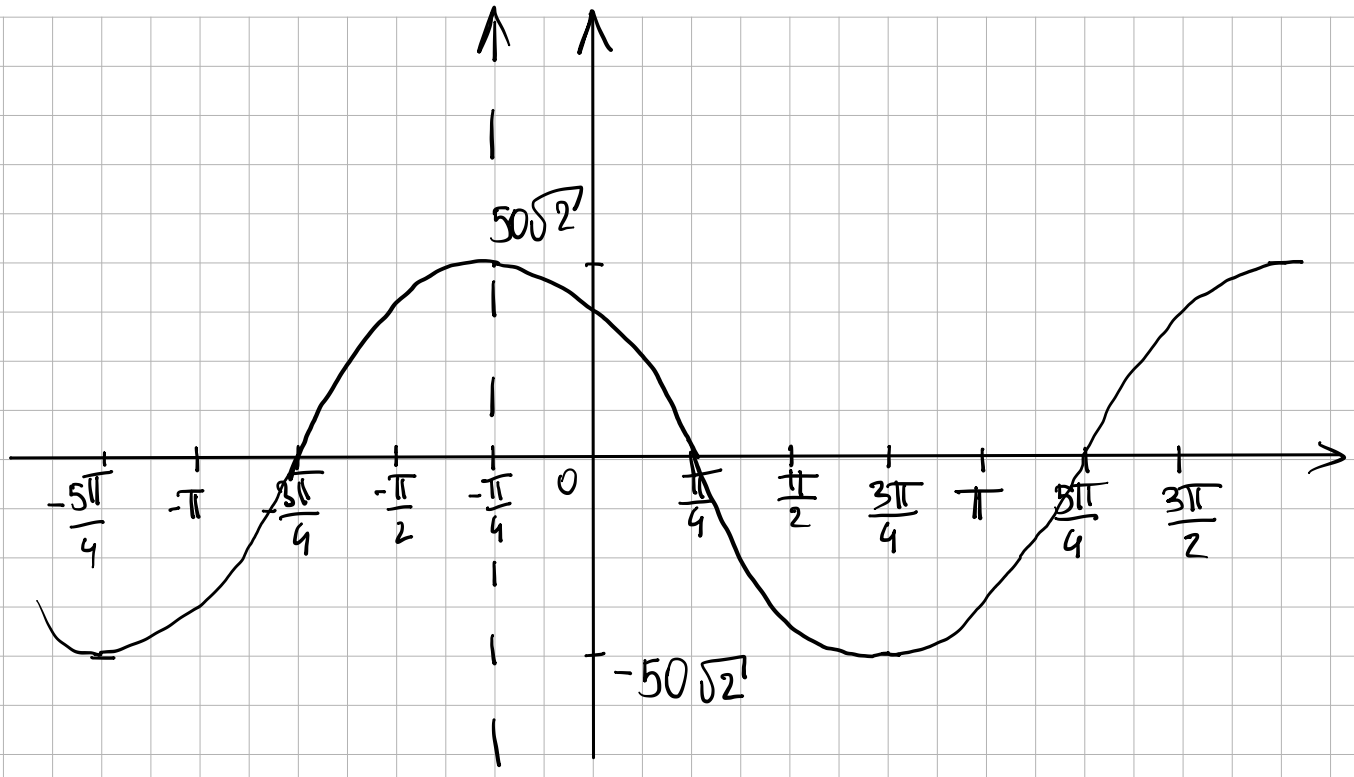
$$\dot{I}_{mL} = \dot{I}_{mbx} \cdot \frac{\underline{Z}_C}{\underline{Z}_C + \underline{Z}_L} = -5 - 5j \cdot \frac{-10j}{-10j + 5j} =$$

$$= -10 - 10j$$

$$\dot{U}_{mL} = \dot{I}_{mL} \cdot \underline{Z}_L = (-10 - 10j) \cdot 5j = 50 - 50j =$$

$$= \sqrt{50^2 + 50^2}\, e^{\operatorname{arctg}\left(\frac{-50}{50}\right)j} = 50\sqrt{2}\, e^{-45j}$$

$$u_3(t) = 50\sqrt{2}\,(2t - 45°)$$


$50\sqrt{2}$
$-50\sqrt{2}$
$-\frac{5\pi}{4}$
$-\pi$
$-\frac{3\pi}{4}$
$-\frac{\pi}{2}$
$-\frac{\pi}{4}$
0
$\frac{\pi}{4}$
$\frac{\pi}{2}$
$\frac{3\pi}{4}$
π
$\frac{5\pi}{4}$
$\frac{3\pi}{2}$

№ 1.3.6 Вариант 11

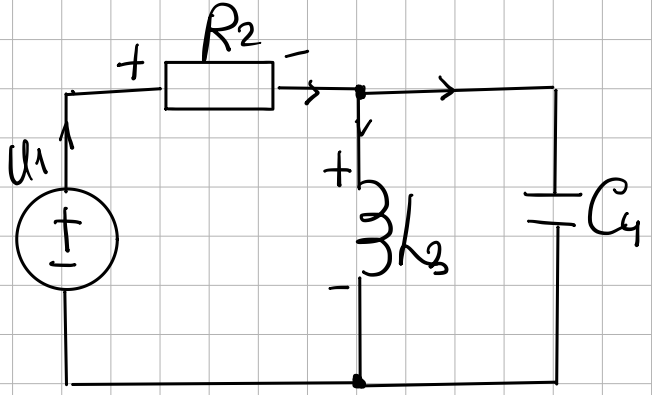
Дано:

113 – ИН $u_1 = 100\cos(2t - 90°)$

212 – $R_2 = 10$

323 – $L_3 = 2{,}5$

423 – $C_4 = 0{,}05$



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1) Найти токи и напряжения по МПВ

2) P, P_Q, P_S, $\tilde{P}_S$

Решение

$u_1 = 100\cos(2t - 90°)$

$\omega = 2$

$Z_C = -j\frac{1}{\omega C} = -j\frac{1}{2 \cdot 0{,}05} = -10j$

$Z_L = j\omega L = j \cdot 2 \cdot 2{,}5 = 5j$

$\dot{U}_{1m} = 100e^{-90j} = 100(\cos(-90°) + j\sin(-90°)) =$

$= -100j$

$Z_{R_2} = R_2 = 10$

$\dot{I}'_{mc} = 1 \Leftrightarrow \dot{U}'_{mc} = \dot{I}'_{mc} \cdot Z_c = 1 \cdot (-10j) = -10j$

$\dot{U}'_{mc} = \dot{U}'_{mL} = -10j$

$\dot{I}'_{mL} = \frac{\dot{U}'_{mL}}{Z_L} = \frac{-10j}{5j} = -2$

$\dot{I}'_{mR_2} = \dot{I}'_m = \dot{I}'_{mc} + \dot{I}'_{mL} = -10j - 2 =$

$= -2 - 10j$

$\dot{U}'_{mR_2} = \dot{I}'_{mR_2} \cdot Z_R = (-2 - 10j) \cdot 10 =$

$= -20 - 100j$

$\dot{U}'_{mR_2} + \dot{U}'_{1m} = -10j$

$-20 - 100j + \dot{U}'_{1m} = -10j$

$\dot{U}'_{1m} = -10j + 20 + 100j$

$\dot{U}'_{1m} = 20 + 90j$

$K = \frac{\dot{U}_{1m}}{\dot{U}'_{1m}} = \frac{-100j}{20+90j} = -\frac{18}{17} - \frac{4}{17}j$

$\dot{I}_{mc} = \dot{I}'_{mc} \cdot K = -\frac{18}{17} - \frac{4}{17}j = \frac{2\sqrt{85}}{17} e^{j13^\circ}$

$\dot{U}_{mc} = -10j \cdot \left(-\frac{18}{17} - \frac{4}{17}j\right) = -\frac{40}{17} + \frac{180}{17}j =$

$$= \frac{4\sqrt{101}}{17} e^{-j77^\circ}$$

$$\dot{U}_{mL} = \dot{U}_{mC} = \frac{4\sqrt{101}}{17} \cdot e^{-j77^\circ}$$

$$\dot{I}_{mL} = -2 \cdot \left(-\frac{18}{17} - \frac{4}{17}j\right) = \frac{36}{17} + \frac{8}{17}j =$$

$$= \frac{4\sqrt{85}}{17} e^{j13^\circ}$$

$$\dot{I}_{mR_2} = (-2-10j) \cdot \left(-\frac{18}{17} - \frac{4}{17}j\right) =$$

$$= -\frac{4}{17} + \frac{188}{17}j = \frac{4\sqrt{2210}}{17} e^{-j89^\circ}$$

$$\dot{I}_m = \dot{I}_{mR_2} = \frac{4\sqrt{2210}}{17} e^{-j89^\circ}$$