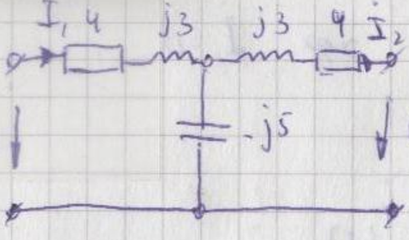


Рассчит А коэфф чет. полюс.

2-ой спос определить характер сопротив чет пол (через сопр х.х. и к.з.) через предв найденные А коэфф.

$$\begin{cases} \dot U_1 = A_{11}\dot U_2 + A_{12}\dot I_2 \\ \dot I_1 = A_{21}\dot U_2 + A_{22}\dot I_2 \end{cases}$$

прямой холостой ход $\dot I_2 = 0$

$$\dot U_{1x} = A_{11}\dot U_2 \qquad Z_{1x} = \frac{\dot U_1}{\dot I_1} = \frac{A_{11}}{A_{21}} \quad (1)$$

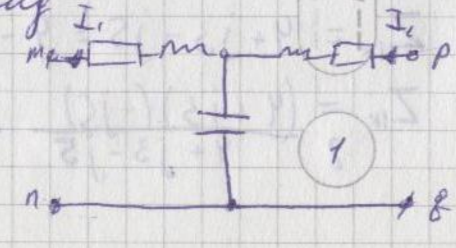
$$\dot I_{1x} = A_{21}\dot U_2$$

прямое короткое замыкание $\dot U_2 = 0$

$$\dot U_{1k} = A_{12}\dot I_2 \qquad Z_{1k} = \frac{\dot U_{1k}}{\dot I_{1k}} = \frac{A_{12}}{A_{22}} \quad (2)$$

$$\dot I_{1k} = A_{22}\cdot\dot I_2$$

Для обратной передачи энергии от зажим p, q к m, n, токи поменяют ур-е, а система примет вид



$$\begin{cases} \dot U_1 = A_{11}\dot U_2 - A_{12}\dot I_2 \\ -\dot I_1 = A_{21}\dot U_2 - A_{22}\dot I_2 \end{cases}$$

1

обратный холостой ход $\dot I_1 = 0$

$A_{21} \dot U_{2x} = A_{22} \dot I_{2x}$

$$Z_{2x} = \frac{\dot U_{2x}}{\dot I_{2x}} = \frac{A_{22}}{A_{11}} \quad (3)$$

обратное короткое замыкание $\dot U_1 = 0$

$A_{11} \dot U_{2k} = A_{12} \dot I_{2k}$

$$Z_{2k} = \frac{\dot U_{2k}}{\dot I_{2k}} = \frac{A_{12}}{A_{11}} \quad (4)$$

$$\frac{Z_{1x}}{Z_{2x} - Z_{2k}} = \frac{\frac{A_{11}}{A_{21}}}{\frac{A_{22}}{A_{21}} - \frac{A_{12}}{A_{11}}} = \frac{\frac{A_{11}}{A_{21}}}{\frac{A_{22}A_{11} - A_{12}A_{21} = 1}{A_{21}A_{11}}} =$$

$$= A_{11}^2 \Rightarrow A_{11} = \sqrt{\frac{Z_{1x}}{Z_{2x} - Z_{2k}}} \quad (5)$$

из (1) $A_{21} = \frac{A_{11}}{Z_{1x}}$ (6); из (4) $A_{12} = A_{11} Z_{2k}$ (7)

из (3) $A_{22} = A_{21} Z_{2x}$ (8)

$Z_{1x} = 4 + j3 - j5 = 4 - j2$;

$$Z_{1k} = \frac{(4+j3)(-j5)}{4+j3-j5} + 4 + j3 = 9 + j0{,}5$$

$Z_{2x} = Z_{1x} = 4 - j2$ (т.к. рассм. чет. пол. симметричный)

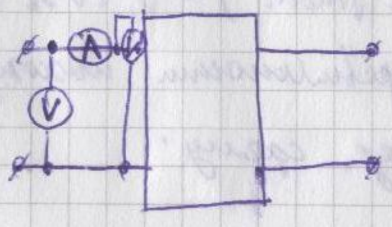
$Z_{1k} = Z_{2k} = 9 + j0{,}5$

$$A_{11} = \sqrt{\frac{(4-j2)}{(4-j2-9-j0{,}5)}} = \sqrt{\frac{4-j2}{-5-j2{,}5}} = 0{,}4 + j0{,}8$$

$$A_{21} = \frac{0{,}4+j0{,}8}{4-j2} = j0{,}2$$

$A_{12} = (0{,}4+j0{,}8)(9+j0{,}5) = 3{,}2 + j7{,}4$

$A_{22} = j0{,}2(4-j2) = 0{,}4 - j0{,}8$



$$Z_{1x} = \frac{U_1}{I_1}$$

$$Z_{1x} = Z_{1k} \cdot e^{j\varphi_{1x}}$$

$P = U_{1x} I_{1x} \cos\varphi_{1x} \to \varphi_{1x}$

Проверка

$A_{11}A_{22} - A_{12}A_{21} = 1$

Поскольку чет. пол. симметр. то он характеризуется одним характер. сопротив.

$Z_c = \sqrt{Z_{2x} Z_{2k}} = \sqrt{Z_{1x} Z_{1k}}$; $Z_c = \sqrt{\frac{A_{12}}{A_{21}}} = 6{,}22 - j1$

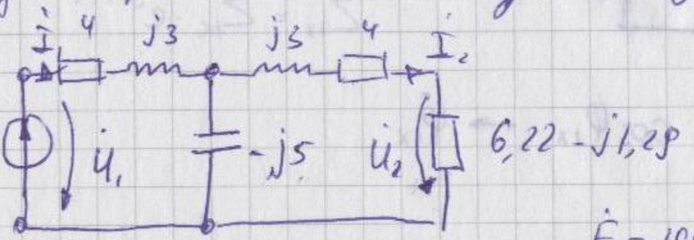
$$Z_c = \frac{(4+j3+6,22-j1,29)(-j5)}{4+j3+6,22-j1,29-j5} + 4 + j3 \approx$$

$\approx 6,22 - j1,29$

По найд. A-коэфф. определить меру передачи чет. пол.

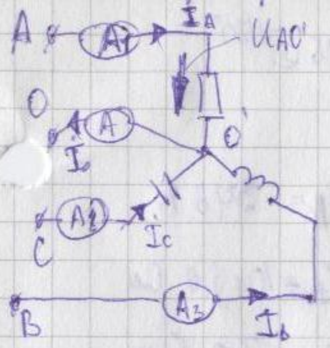
$$g = a + jb = \ln\left(\sqrt{A_{11}A_{22}} + \sqrt{A_{12}A_{21}}\right) = 0,7636 + j1,26$$

В качестве проверки правильности нахождения g – рассчитать след. схему:



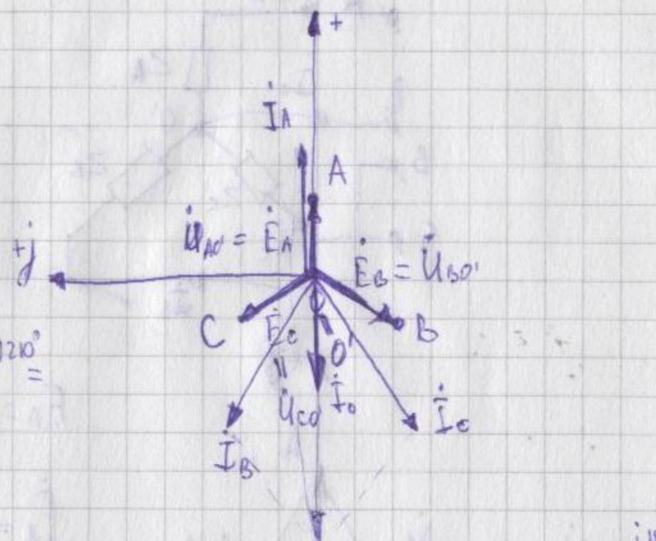
$\dot E = 100$ В

Опред. во ск-ко раз $\dot U_1$ отл. от $\dot U_2$ и $\dot I_1$ отл. от $\dot I_2$ по величине и по фазе.



$A_1 = A_2 = A_3 = 2$ A

A – ?



$\dot I_A = 2e^{j0°} = 2$

$\dot I_B = 2e^{j(-120°-90°)} = 2e^{-j210°} =$

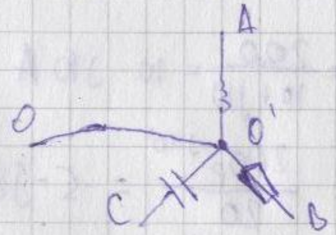
$\dot I_C = 2e^{j210°} =$

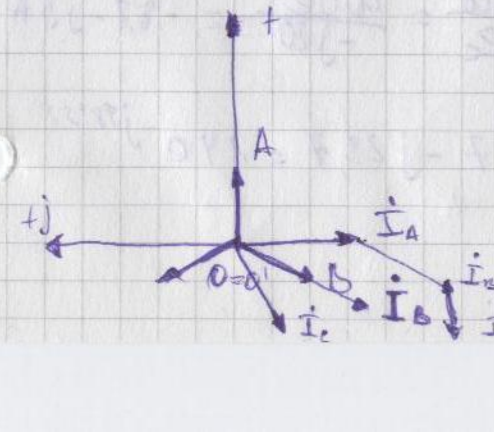
$\dot I_0 = \dot I_A + \dot I_b + \dot I_c = 2 - 1,73 + j - 1,73 - j1 = -1,46 = 1,46e^{j180}$

A = 1,46 A

$A_1 = A_2 = A_3 = 2$ A

A – ?





$\dot I_A = 2e^{-j90}$

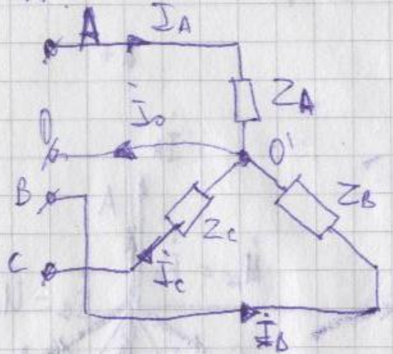
$\dot I_B = 2e^{-j120}$

$\dot I_C = 2e^{j210}$

$\dot I_0 = -j2 - 1 - j1,73 - 1,73 - j1 = -2,73 - j4,73 =$

$-(2,73+j4,73) = -5,46e^{j60^\circ} = 5,46e^{-j120^\circ}$

A = 5,46 A

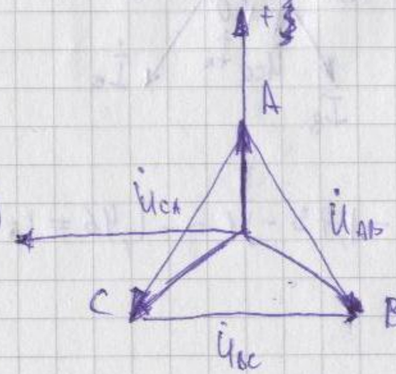


$U_A = 346$ В

$Z_A = 10+j10$ Ом

$Z_B = 20$ Ом

$Z_C = -j20$ Ом



$E_A = E_B = E_C = E_Ф = \frac{U_Л}{\sqrt{3}} = 200$ В

$\dot{E}_A = 200$

$\dot{E}_B = 200e^{-j120^\circ}$

$\dot{E}_C = 200e^{j120^\circ}$

$\dot{\varphi}_{0'} = \varphi_0$

$\dot{U}_{AO'} = \dot{E}_A$

$\dot{U}_{BO'} = \dot{E}_B$

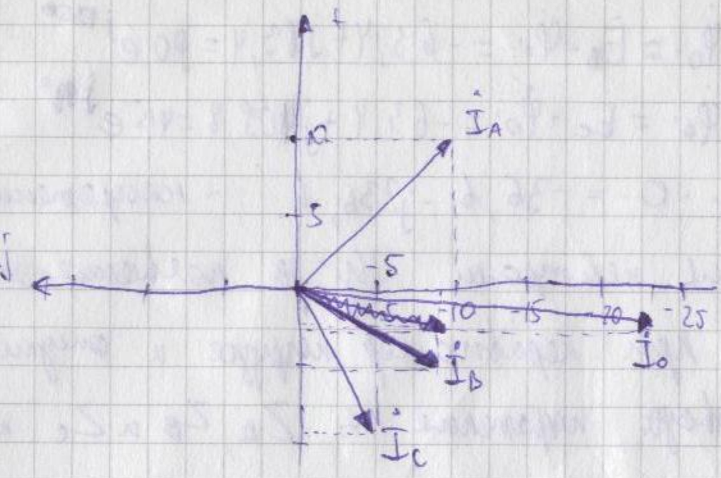
$\dot{U}_{CO'} = \dot{E}_C$

$\dot{I}_A = \frac{\dot{U}_{AO'}}{Z_A} = \frac{200}{10+j10} = 10 - j10$ A

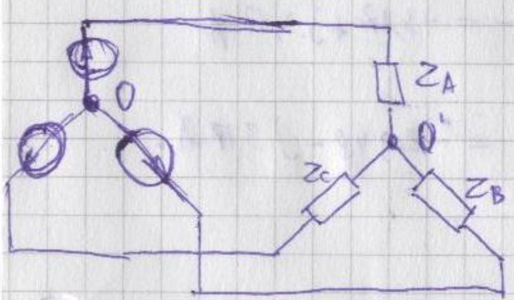
$\dot{I}_B = \frac{\dot{U}_{BO'}}{Z_B} = \frac{200e^{-j120^\circ}}{20} = -5 - j8,7$ A

$\dot{I}_C = \frac{\dot{U}_{CO'}}{Z_C} = \frac{200e^{j120^\circ}}{-j20} = -8,7 - j5$ A

$\dot{I}_0 = \dot{I}_A + \dot{I}_B + \dot{I}_C = -3,7 - j23,7 = 24e^{-j98^\circ 52'}$



Решить пред задачу для аварийного режима – обрыв нейтрального провода



$\dot{E}_B = 200 \cdot e^{-j120} = -100 - j173,2$

$\dot{E}_C = 200e^{j120} = -100 + j173,2$

Метод двух узлов

$$\dot{\varphi}_{0'} = \frac{\dot{E}_A/Z_A + \dot{E}_B/Z_B + \dot{E}_C/Z_C}{1/Z_A + 1/Z_B + 1/Z_C} = \frac{\frac{200}{10+j10} + \frac{-100-j173,2}{20} + \frac{-100+j173,2}{-j20}}{\frac{1}{10+j10} + \frac{1}{20} + \frac{1}{-j20}} = -36,6 - j236,6$$

$\dot{U}_{AO'} = \dot{\varphi}_A - \dot{\varphi}_{0'} = \dot{E}_A - \dot{\varphi}_{0'} = 236,6 + j236,6 = 334e^{j45};$

$\dot U_{BO'} = \dot\varphi_B - \dot\varphi_{O'} = \dot E_B - \dot\varphi_{O'} = -63,4 + j63,4 = 90 e^{j135°}$

$\dot U_{CO'} = \dot\varphi_C - \dot\varphi_{O'} = \dot E_C - \dot\varphi_{O'} = -63,4 + j409,8 = 415 e^{j99°}$

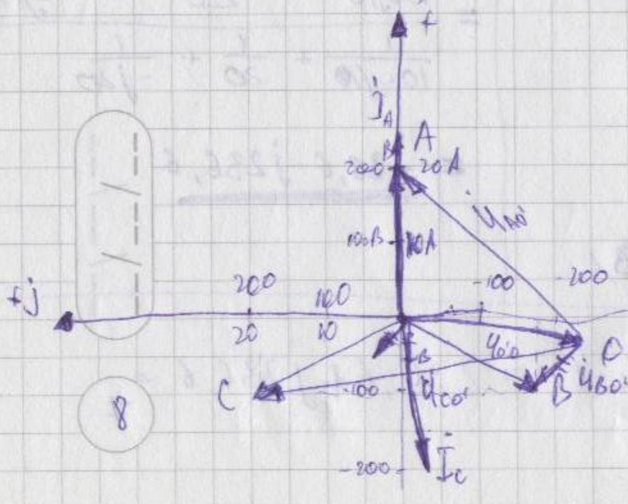
$\dot U_{O'O} = \dot\varphi_{O'} - 0 = -36,6 - j236,6$ – напряжение смещения нейтрали. Из-за появления этого напряж. при неравномер нагрузке и отсутств. нейтр. провода, напряжение на Z_A, Z_B и Z_C по величине значительно отличаются от номинальных

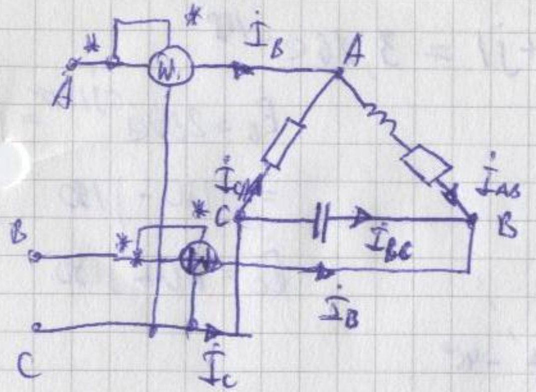
$$\dot I_A = \frac{\dot U_{AO'}}{Z_A} = \frac{236,6 + j236,6}{10 + j10} = 23,66\ A$$

$$\dot I_B = \frac{\dot U_{BO'}}{Z_B} = \frac{-63,4 + j63,4}{20} = -3,17 + j3,17\ A$$

$$\dot I_C = \frac{\dot U_{CO'}}{Z_C} = \frac{-63,4 + j409,8}{-j20} = -20,49 - j3,17\ A$$

$$(\dot I_A + \dot I_B + \dot I_C = 0)$$



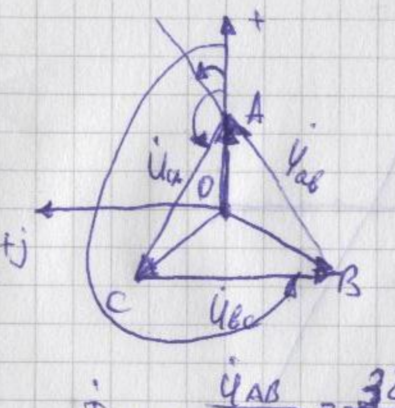


$U_1 = 380$ В

$Z_{AB} = 134,35 + j134,35$ Ом $= 190e^{j45}$

$Z_{BC} = -j190$ Ом

$Z_{CA} = 190$ Ом



$\dot U_{AB} = 380e^{j30°}$ В

$\dot U_{BC} = 380e^{-j90°}$ В

$\dot U_{CA} = 380e^{j150°}$ В

$$\dot I_{AB} = \frac{\dot U_{AB}}{Z_{AB}} = \frac{329 + j190}{134,35 + j134,35} = \frac{(329 + j190)(134,35 - j134,35)}{\ldots} = 1,93 - j0,52 = 2e^{-j15°}$$

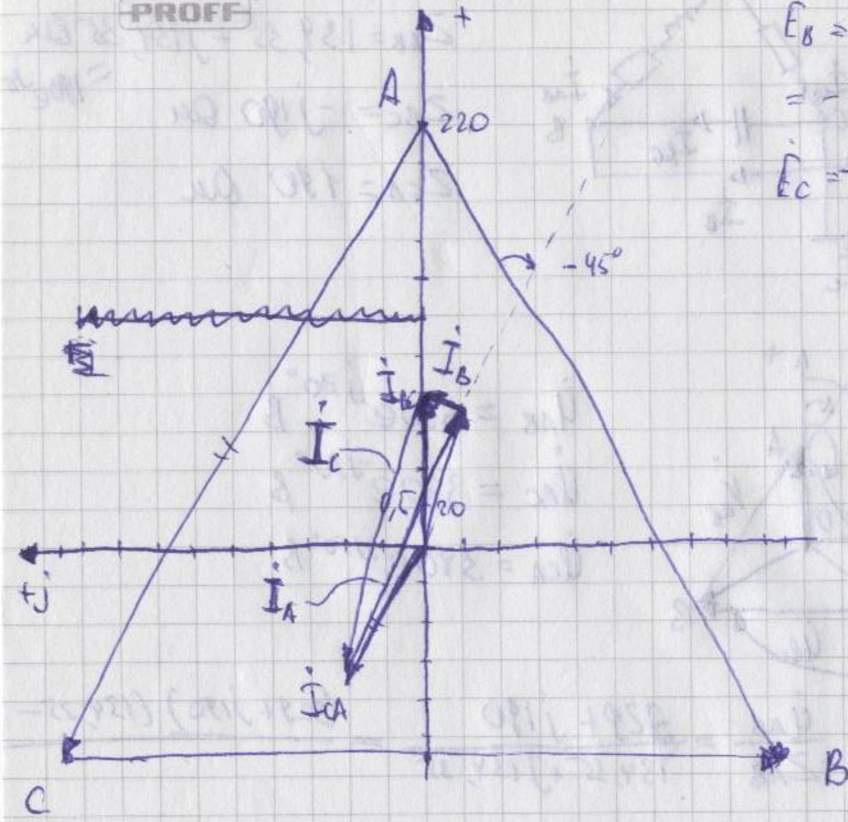
$$\dot I_{BC} = \frac{\dot U_{BC}}{Z_{BC}} = \frac{380e^{-j90°}}{190e^{-j90°}} = 2;$$

$$\dot I_{CA} = \frac{380e^{j150}}{190} = 2e^{j150°} = -1,73 + j1$$

$$\dot I_A = \dot I_{AB} - \dot I_{CA} = 1,93 - j0,52 + 1,73 - j1 = 3,66 - j1,52 = 3,96e^{-j22,55°}$$

$$\dot I_B = \dot I_{BC} - \dot I_{AB} = 0,07 + j0,52 = 0,525\, e^{j82,33°}$$

$\dot I_C = \dot I_{CA} - \dot I_{BC} = -3,73 + j1 = 3,86 e^{j108}$



$\dot E_B = 220 e^{-j120°} = -110 - j190$

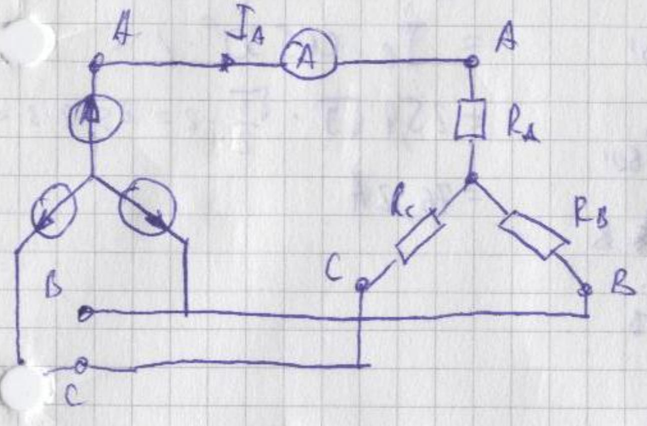
$\dot E_C = -110 + j190$

$P_1 = Re[\dot U_{AC} \overset{*}{I}_A] = Re[-380 e^{j150} \cdot 3,96 \cdot e^{j22,55°}] =$
$= Re[-1504,8 \cdot e^{j172,55°}] = Re[1493 - j195] =$
$= 1493$ Вт

$P_2 = Re[\dot U_{BC} \cdot \overset{*}{I}_B] = Re[-j380 \cdot (0,07 - j0,52)] =$
$= -198$ Вт

$P = P_1 + P_2 = 1493 - 198 = 1295$ Вт

$P = 2^2 \cdot 190 + 2^2 \cdot 134,35 = 1297,4$ Вт



$U_л = 220$ В

$R_A = R_B = R_C = 5$ Ом

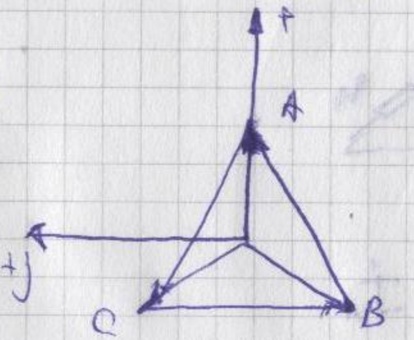
1) $U_ф$, $I_л$; P

2) КЗ ф. А

3) обрыв ф. А

Постр. вект. диагр. и опред. фазные токи и напр. в проводах при кор. замык. фазы А и при обрыве фазы А

1)



$E_A = E_B = E_C = \frac{U_л}{\sqrt{3}} = 127$ В

$\dot\varphi_0' = \varphi_0$

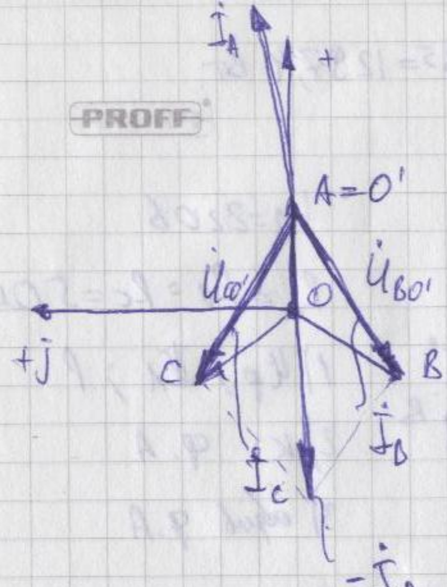
$\dot I_A = \frac{E_A}{R_A} = 25,4 \cdot e^{j0°}$

$\dot I_B = \frac{E_B}{R_B} = 25,4 \cdot e^{-j120°}$

$\dot I_C = \frac{E_C}{R_C} = 25,4 \cdot e^{+j120°}$

$P = 3 I_A^2 \cdot R_A = 9,67$ кВт

2)



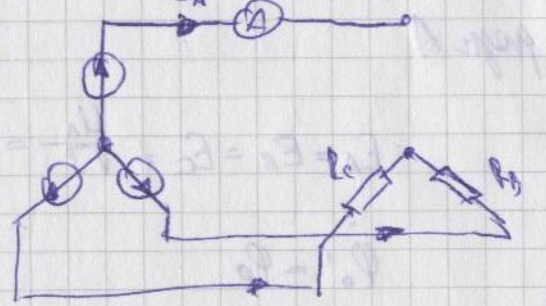
$\dot I_A = -\dot I_B - \dot I_C = -(\dot I_B + \dot I_C) =$

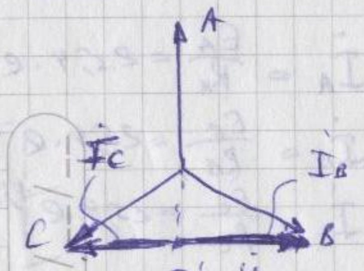
$= \dot I_B \cdot \cos 30^\circ \cdot 2 =$

$= 25{,}4\sqrt{3} \cdot \frac{\sqrt{3}}{2} \cdot 2 = 25{,}4 \cdot 3 =$

$= 76{,}2\,A$

3)



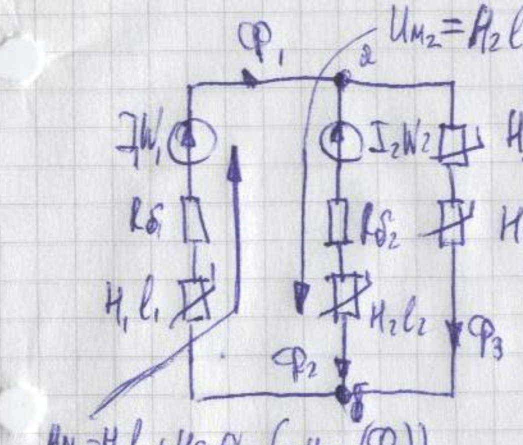


$\dot I_A$

$\dot I_B = -\dot I_C$

$I_B = I_C =$ [illegible] $= 25{,}4 \cdot \frac{\sqrt{3}}{2} =$

$= 22\,A$



$U_{M2} = H_2 l_2 + H_{\delta 2}\delta_2 \quad (= U_{M2}(\Phi_2))$

$\Phi_2(U_{M2})$

$U_{M3} = H_3' l_3' + H_3'' l_3''$

$(= U_{M3}(\Phi_3))$

$\Phi_3(U_{M3})$

Рис 2

$U_{M1} = H_1 l_1 + H_{\delta 1}\delta_1 \quad (= U_{M1}(\Phi_1))$

$\Phi_1(U_{M1})$

$$\Phi_1 = \Phi_2 + \Phi_3 \to \Phi_1[U_{Mab}] = (\Phi_2 + \Phi_3)[U_{Mab}]$$

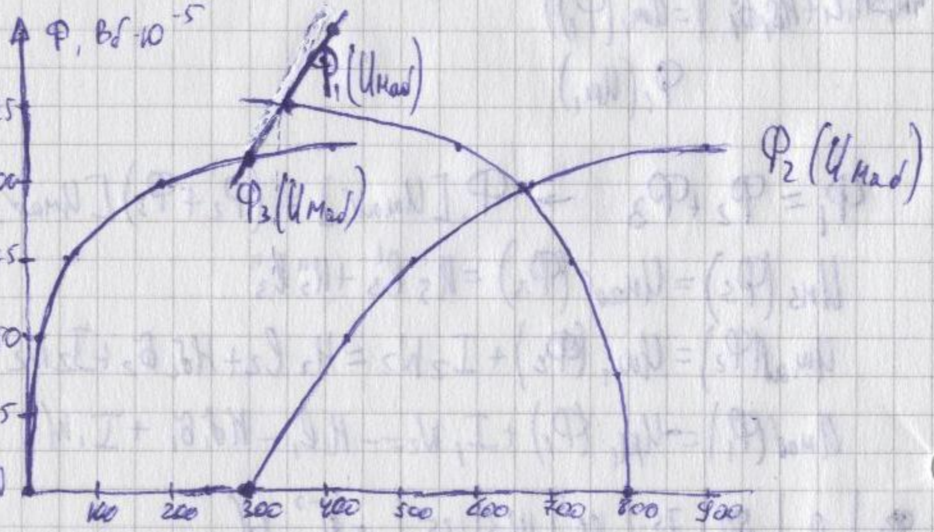
$$U_{M3}(\Phi_3) = U_{Mab}(\Phi_3) = H_3' l_3' + H_3'' l_3''$$

$$U_{Mab}(\Phi_2) = U_{M2}(\Phi_2) + I_2 W_2 = H_2 l_2 + H_{\delta 2}\delta_2 + I_2 W_2$$

$$U_{Mab}(\Phi_1) = -U_{M1}(\Phi_1) + I_1 W_2 = -H_1 l_1 - H_{\delta 1}\delta_1 + I_1 W_1$$

Φ_2	0	50	75	100	112,5	125	$\cdot 10^{-5}$ Вб
B_2	0	0,67	1	1,33	1,5		Тл
H_2	0	80	300	1000	2400		А/м (по кривой намагнич)
$H_\delta = \frac{B_2}{\mu_0}$	0	5,3	7,96	10,6	11,94		А/м
U_{M2}	0	129	217	373	599		А
$U_{Mab}(\Phi_2)$	300	429	517	673	899		А

Φ_3	0	50	75	100	112,5
$\frac{\Phi_3}{S_3'} \rightarrow B_3'$	0	0,56	0,83	1,11	1,25
H_3'	0	50	150	400	700
$\frac{\Phi_3}{S_3''} \rightarrow B_3''$	0	0,67	1	1,33	1,5
H_3''	0	90	300	1000	2400
$U_{M3}=U_{Mab}$	0	18	58	186	410



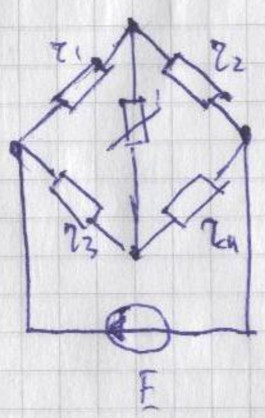
$U_{Mab} = 330$ A $\Phi_1 = 125$ Вб; $\Phi_2 = 12,5$ Вб;

$\Phi_3 = 112,5$ Вб.

14 Примечание: очевидно, что подобным образом рассчитываются эл. и электр

схема пост. тока с нелин. эл-тами, имеющая такую структуру, которая изобр. на рисунке?

Задачи на цепи пост. тока с нелин. эл-тами



$E = 70$ В

$r_1 = 6$ Ом

$r_2 = 4$ Ом

$r_3 = 2$ Ом

$r_4 = 8$ Ом

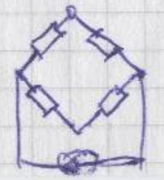
Найти: I_5 - ?

ВАХ симметр. и задана табл.

U	0	5	10	15	20	25
I	0	0,15	0,5	1,2	2	3,5

Если схема имеет одну ветвь с нелин. эл-том, то при расчете целесообразно использовать МЭГ

1)



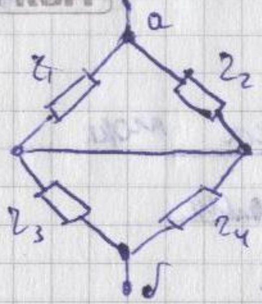
$I_{12xx} = \frac{E}{r_1 + r_2} = 7$ A

$I_{34xx} = \frac{E}{r_3 + r_4} = 7$ A

15

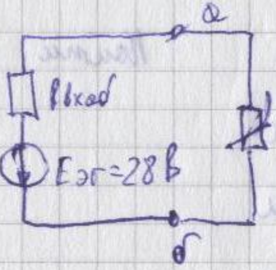
$U_{ab\,xx} = I_{12xx} \cdot r_2 = I_{34} \cdot r_4 = 7 \cdot 4 - 7 \cdot 8 = -28$ В

2)

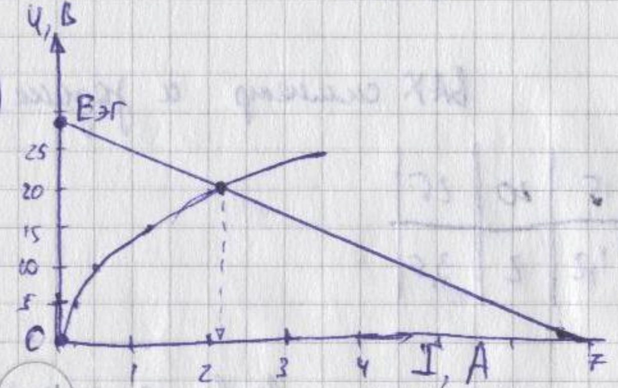


$$R_{эк} = \frac{r_1 \cdot r_2}{r_1 + r_2} + \frac{r_3 \cdot r_4}{r_3 + r_4} = 4 \text{ Ом}$$

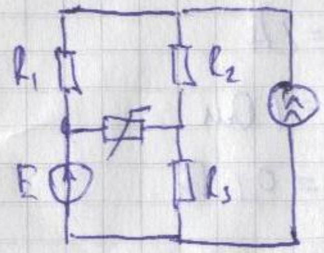
3)



4)



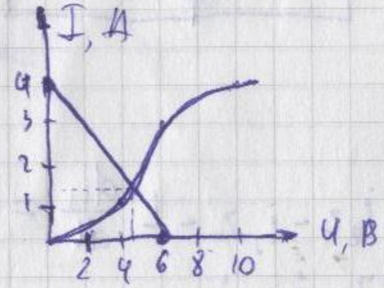
Д/з решить ту же задачу, если вместо E - J = 16 A



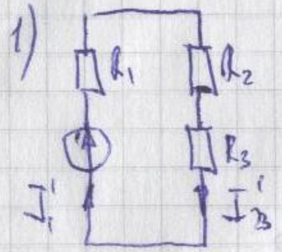
$R_1 = 1$ Ом E = 18 В

$R_2 = 2$ Ом J = 6A

$R_3 = 3$ Ом

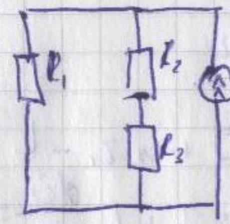


1)



$$I_1' = I_{23}' = \frac{E}{R_1 + R_2 + R_3} = 3A$$

2)



$$I_{23}'' = J \cdot \frac{R_1}{R_1 + R_2 + R_3} = 1A$$

$$I_1'' = J \cdot \frac{R_2 + R_3}{R_1 + R_2 + R_3} = 5A$$

$I_1 = I_1'' - I_1' = 2A$

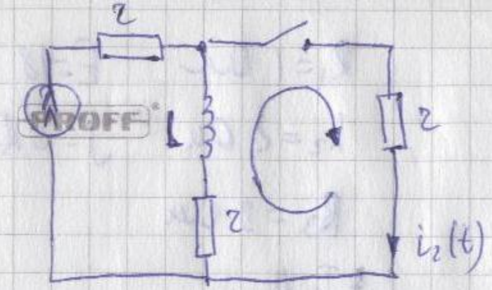
$I_{23} = I_{23}' + I_{23}'' = 4A$

$U_{об\,xx} = -I_1 R_1 + I_2 R_2 = -2 + \ldots$

$= 6$ В.

$$R_{вх\,об} = \frac{(R_1 + R_2) R_3}{R_1 + R_2 + R_3} = 1{,}5$$

$I_{нэ} = 1{,}2$ A



$J = 2A$

$r = 4$ Ом

$L = 0,1$ Гн

$i_2(t) - ?$

$i_2 r - i_1 r - L\frac{di_1}{dt} = 0,$

$J = i_1 + i_2$

$i_1 = J - i_2$

$i_2 r_2 - rJ + i_2 r_2 - L\frac{d(J - i_2)}{dt} = 0,$

$2 i_2 r_2 - rJ + L\frac{di_2}{dt} = 0$

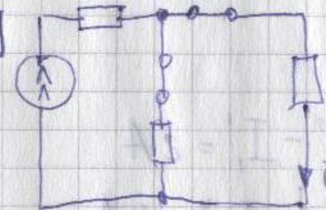
$\frac{di_2}{dt} + \frac{2r}{L} i_2 = \frac{r}{L} J$; НДУ

1] $i_2 = i_{2прин} + i_{2своб}$

$i_{2прин} = \frac{J}{2} = 1A$

$\frac{di_{2св}}{dt} + \frac{2r}{L} i_{2св} = 0$ ОДУ

2]



$i_{2пр} = J\frac{r}{r+r} = \frac{J}{2} = 1A$

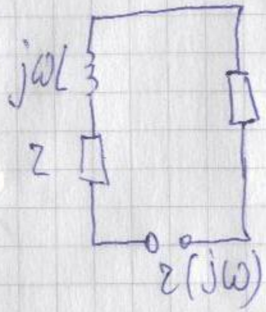
3] $i_{2св} = Ae^{pt}$

$pAe^{pt} + \frac{2r}{L}Ae^{pt} = 0$

$p + \frac{2r}{L} = 0$ характер ур

$p = -\frac{2r}{L} = -80 [c^{-1}]$

4]



$r(j\omega) = r + r + j\omega L$

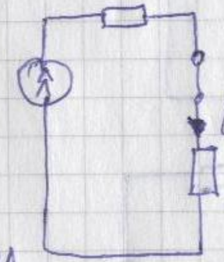
$j\omega \to p$

$2r + Lp = 0$

5] $p = -\frac{2r}{L} = -80$

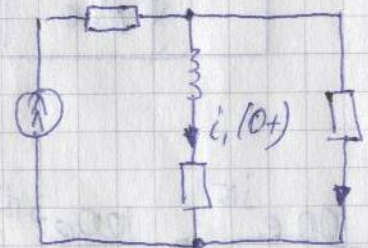
6] $i_2(0+) = i_{2пр}(0+) + i_{2св}(0+) = 1 + A = ?$

7] ННУ $i_1(0-)$



$i_1(0-) = J = 2A$

8] ЗК $i_1(0+) = i_1(0-) = 2A$

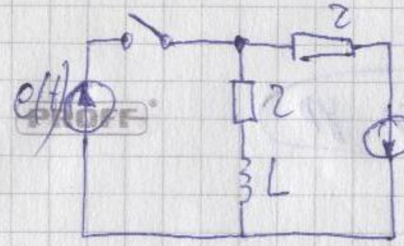


9] $i_2(0+) = ?$ ЗНУ

$i_2(0+) = J - i_1(0+) = 0$

10] $A = -1$

11] $i_2 = 1 - 1e^{-80t}$



$r = 10$ Ом

$L = 0{,}01$ Гн

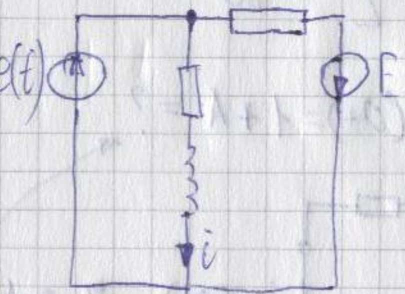
$E = 100$ В

$e = 100\sqrt{2}\sin(1000t + 15^\circ)$ В

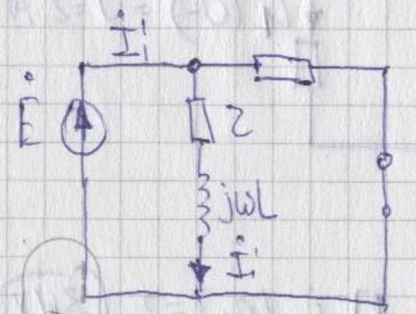
$i(t) = ?$

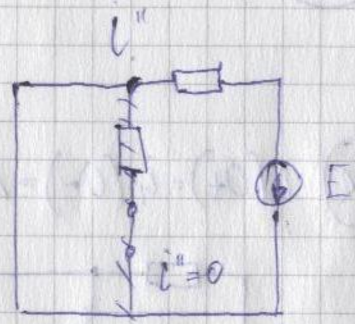
1) $i = i_{пр} + i_{св}$

2) $i_{пр} - ?$



$i = i' + i''$





$\dot{E} = \dot{I}'r + \dot{I}'j\omega L$

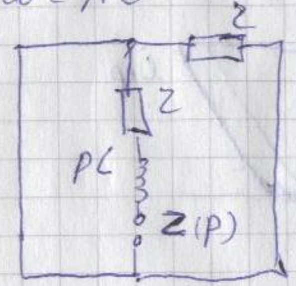
$\dot{I}' = \frac{\dot{E}}{r + j\omega L} = \frac{100e^{j15}}{10 + j10} = \frac{100e^{j15}}{10\sqrt{2}e^{j45}} =$

$= \frac{10}{\sqrt{2}}e^{-j30}$

$i' = \frac{10}{\sqrt{2}}\sqrt{2}\sin(1000t - 30^\circ)$

3) $i_{св} = Ae^{pt}$

4)



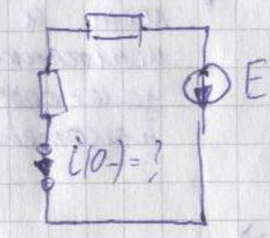
$\Rightarrow$

$Z(p) = r + pL = 0$

5) $p = -\frac{r}{L} = -1000$

6) $i(0+) = 10\sin(-30) + A = -5 + A = ?$

7) ННУ схема до коммутации

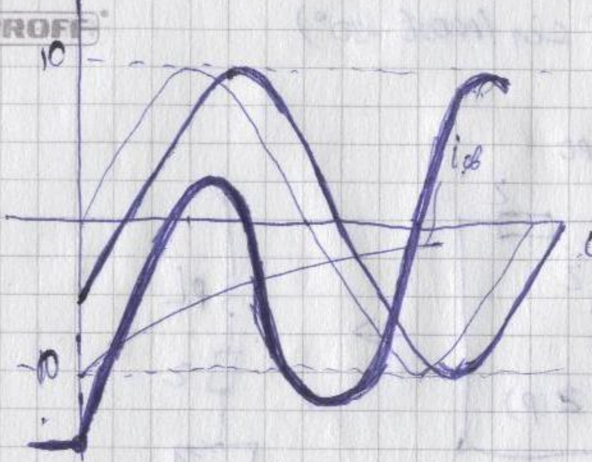


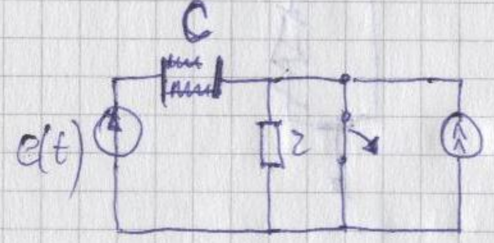
$i(0-) = \frac{-E}{r + r} = -20$ A

8) ЗК $i(0+) = i(0-) = -20$ A

10) $-5 + A = -20 \Rightarrow A = -15$

11) $i = 10 \sin(1000 - 30^\circ) - 15 e^{-1000t}$





$r = 100$ Ом

$J = 4A$

$C = 10$ мкФ

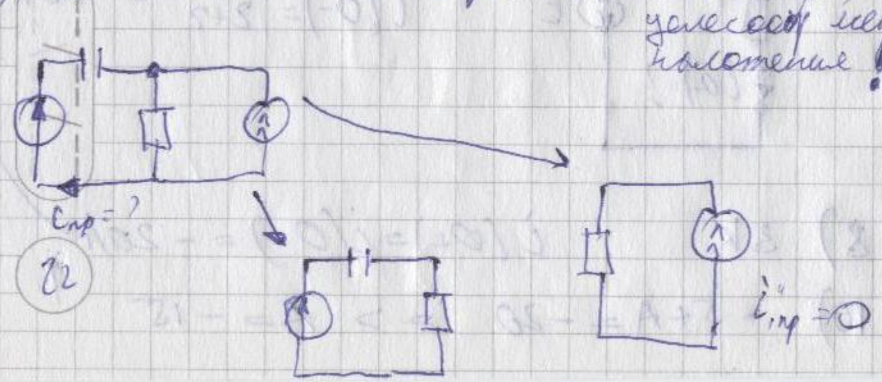
$e = 1000\sqrt{2} \sin(1000t + 45^\circ)$ В

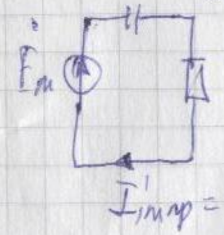
$i_1 - ?$

1) $i_1 = i_{1пр} + i_{1св}$

2) $i_{пр}$ – сх. после коммут.

! Т.к. схема содерж. конд. и синусоид. источники, то решаем усложн. методом наложения!

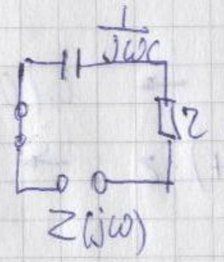


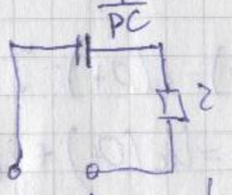


$\dot{I}'_{mпр} = \frac{\dot{E}_m}{r - j\frac{1}{\omega C}} = 10 e^{j90}$

$i'_{пр} = 10 \sin(1000t + 90^\circ) = i_{пр}$

4) $Z(p)$





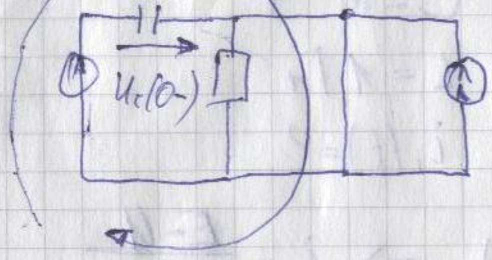
$Z(p) = r + \frac{1}{pC} = 0$

5) $rpC + 1 = 0$

$p = -\frac{1}{rC} = -1000$

6) $i_1(0+) = 10 \sin 90 + A = 10 + A = ?$

7) ННУ сх. до коммут. $u_C(0-) = ?$

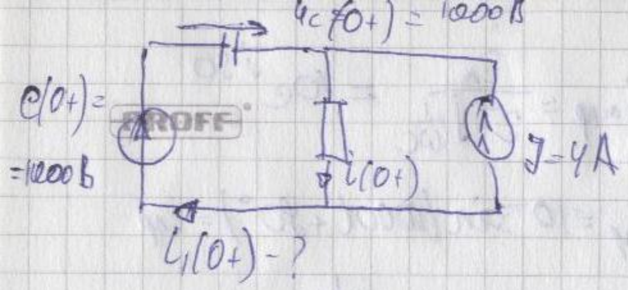


$u_C(0-) = e(0-) =$

$= 1000\sqrt{2} \sin 45 = 1000$ В

8) ЗК $u_C(0+) = 1000$ В

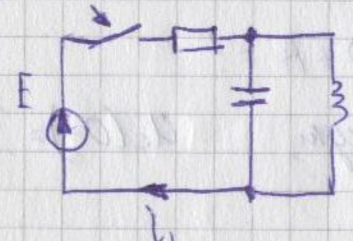
9) ЗНУ $t = 0+$



$$\begin{cases} i_1(0+) = i(0+) - J \quad \rightarrow \quad i_1(0+) = -4A \\ e(0+) = u_c(0+) + i(0+)\cdot r \quad \rightarrow \quad i(0+) = 0A \end{cases}$$

10) $10 + A = -4$; $A = -14$;

11) $i = 10 \sin \sin(1000t + 90^\circ) - 14e^{-1000t}$



$E = 100$ В

$R = 10$ Ом

$C = 10^{-3}$ Ф

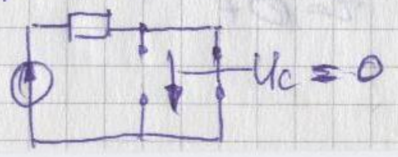
$L = 1$ Гн

$i_1(t) = ?$

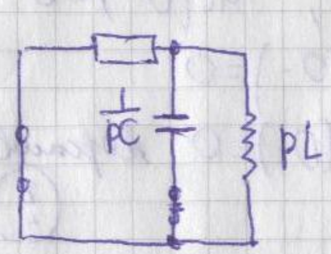
0) u_c $(E = i_1 R + u_c) \Rightarrow i_1 = \frac{E - u_c}{R}$

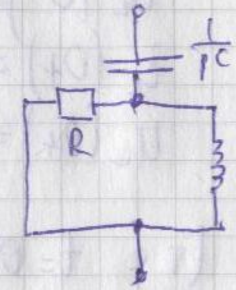
1) $u_c = u_{c пр} + u_{c св}$

2)



3) X Y





$\frac{R \cdot Lp}{R + Lp} + \frac{1}{pC} = 0$; $RLp^2C + R + Lp = 0$;

$p^2 + \frac{1}{RC}p + \frac{1}{LC} = 0$;

$p^2 + 100p + 1000 = 0$;

4) $p_{12} = -50 \pm \sqrt{2500 - 1000} = -50 \pm 38,73$;

$p_1 = -11,27$; $p_2 = -88,73$

5) $u_{c св} = A_1 e^{-11,27t} + A_2 e^{-88,73}$

6) $u_c(0+) = u_{c пр}(0+) + u_{c св}(0+) = A_1 + A_2 = ?$

$\frac{du_c}{dt} = -11,27 A_1 e^{-11,27t} - 88,73 A_2 e^{-88,73t}$

$\frac{du_c}{dt}\Big|_{0+} = -11,27 A_1 - 88,73 A_2 = ??$

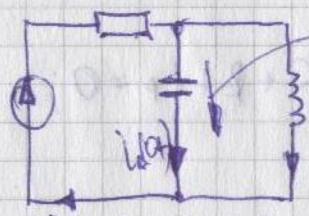
$i_c = C\frac{du_c}{dt}$ $\quad \frac{du_c}{dt}\Big|_{0+} = \frac{i_c(0+)}{C}$

7) ННУ $i_L(0-)=0$, $u_C(0-)=0$

8) ЗК $i_L(0+)=i_L(0-)=0$

$u_C(0+)=u_C(0-)=0$ Хоршов вместо (2)

9) ЗНУ (т.е. $t=0+$)



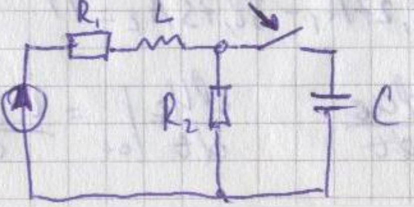
$$\begin{cases} i_1(0+)=i_C(0+)+\cancel{i_L(0+)}\to 0 \\ E=i_1(0+)\cdot R+\underbrace{u_C(0+)}_{0} \end{cases} \Rightarrow i_C(0+)=\frac{E}{R}=10\text{ A}$$

$\frac{10}{C}$ вместо (??)

10) $\begin{cases} A_1+A_2=0 \\ -11{,}27A_1-88{,}73A_2=10^4 \end{cases} \Rightarrow A_1=129,\quad A_2=-129$

11) $u_C=129e^{-11{,}27t}-129e^{-88{,}73t}$

12) $i_1=\frac{E-u_C}{10}=10-12{,}9e^{-11{,}27t}+129e^{-88{,}73t}$



$E=100$ В

$R_1=R_2=10$ Ом

$L=5$ мГн

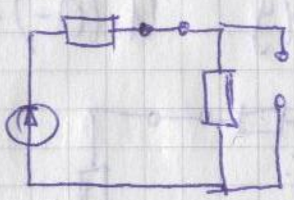
$C=10$ мкФ

$u_L(t)$

0) i_L $\left(u_L=L\frac{di_L}{dt}\right)$

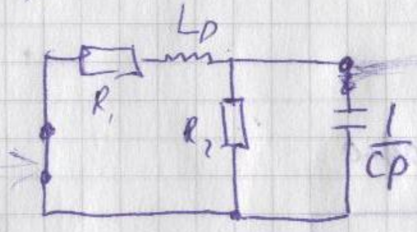
1) $i_L=i_{L пр}+i_{L св}$

2) $i_{L пр}=?$



$i_{L пр}=\frac{E}{R_1+R_2}=5$ A

3) ХУ



$$\frac{(R_1+Lp)R_2}{R_1+Lp+R_2}+\frac{1}{Cp}=0$$

4) $p_{12}=-6000\pm j2000$

5) $i_{L св}=Ae^{-6000t}\sin(2000t+\psi)$

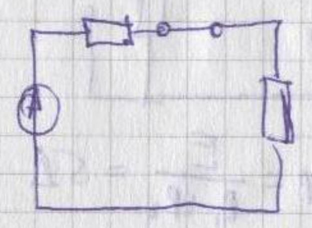
6) $i_2(0+)=5+A\sin\psi=$ (?)

$$\frac{di_L}{dt}=-6000Ae^{-6000t}\sin(2000t+\psi)+2000\cos(2000t+\psi)Ae^{-6000t}$$

$$\frac{di_L}{dt}\Big|_{0+} = -6000 A\sin\Psi + 2000 A\cos\Psi = ??$$

$$\frac{di_L}{dt}\Big|_{0+} = \frac{u_L(0+)}{L}$$

7) ННУ $u_C(0-) = 0$

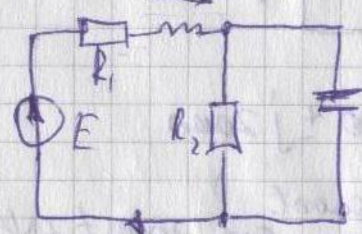


$$i_L(0-) = \frac{E}{R_1+R_2} = 5\,A$$

8) ЗК $i_L(0+) = 5\,A$ $u_C(0+) = 0$

вместо ?

9) ЗНУ



$$E = i_L(0+)\,R_1 + u_L(0+) + \underbrace{u_C(0+)}_{0}$$

$u_L(0+) = 50$ $\frac{u_L(0+)}{L}$

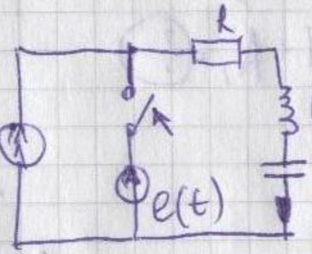
10) $\begin{cases} 5 + A\sin\Psi = 5 \\ -6000 A\sin\Psi + 2000\cos\Psi = 10000 \end{cases}$

$\begin{cases} A\sin\Psi = 0, \\ A\cos\Psi = 5 \end{cases}$ $\sin\Psi = 0$ $\cos\Psi = 1$

$A = 5$ $\Psi = 0°$

11) $i_L = 5 + 5e^{-6000t}\sin 2000t$

12) $u_L = L\frac{di_L}{dt} = \dots$



$J(t) = 2\sqrt{2}\sin(10^4 t + 135°)\,A$

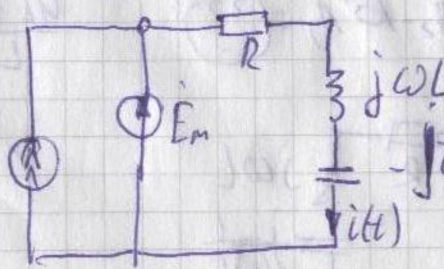
$e(t) = 100\sqrt{2}\sin(10^4 t + 45°)\,В$

$R = 100$ Ом; $L = 5$ мГн

$C = 2$ мкФ

0) —

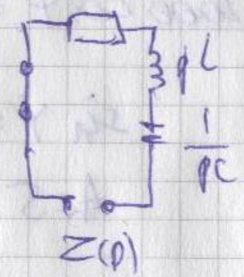
1) $i = i_{пр} + i_{св}$



$$\dot{I}_{m\,пр} = \frac{\dot{E}_m}{R + j\omega L - j\frac{1}{\omega C}} = \frac{100\sqrt{2}\,e^{j45°}}{100 + j50 - j50} = \sqrt{2}\,e^{j\pi}$$

$i_{пр} = \sqrt{2}\sin(10^4 t + 45^\circ)$ A

3) ХУ



$$Z(p) = R + pL + \frac{1}{pC} = 0$$

4) $p_{12} = -10^4$

5) $i_{св} = (A_1 + A_2 t)e^{-10^4 t}$

6) $i(0+) = i_{пр}(0+) + i_{св}(0+)$

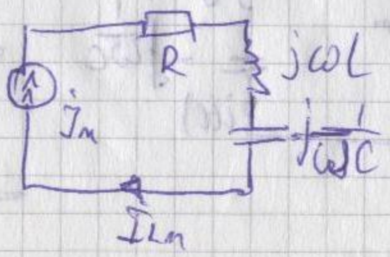
$i(0+) = \sqrt{2}\sin 45^\circ + A_1 = 1 + A_1 = ?$

$$\frac{di}{dt} = \frac{di_{пр}}{dt} + \frac{di_{св}}{dt}$$

$$\frac{di}{dt} = \sqrt{2}\cdot 10^4\cos(10^4 t + 45^\circ) + A_2 e^{-10^4 t} - 10^4(A_1 + A_2 t)e^{-10^4 t}$$

$$\left.\frac{di}{dt}\right|_{0+} = 10^4 + A_2 - 10^4 A_1 = ?? \qquad \frac{u_L(0+)}{L}$$

7) ННУ



$\dot I_{Lm} = \dot J_m = 2\sqrt{2}e^{j135^\circ}$

$\dot U_{Cm} = \dot I_{Lm}\left(-j\frac{1}{\omega C}\right) = 2\sqrt{2}e^{j135} \, 50e^{-j90^\circ} =$

$= 100\sqrt{2}e^{j45^\circ}$ В

$i_L(t) = 2\sqrt{2}\sin(10^4 t + 135^\circ)$

$u_C(t) = 100\sqrt{2}\sin(10^4 t + 45^\circ)$

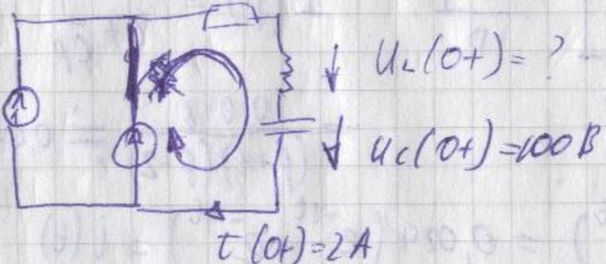
$i_L(0-) = 2\sqrt{2}\sin 135^\circ = 2\sqrt{2}\frac{\sqrt{2}}{2} = 2$ A

$u_C(0-) = 100\sqrt{2}\sin 45 = 100$ В

8) ЗК $i_L(0+) = 2$ A

$u_C(0+) = 100$ В

9) ЗНУ



$e(0+) = 100$ В

$e(0+) = i(0+)R + u_L(0+) + u_C(0+)$