№ 124

$U_1 = 4e^{-4t}\delta(t)$

$R_4 = 1$

$C_3 = 1$

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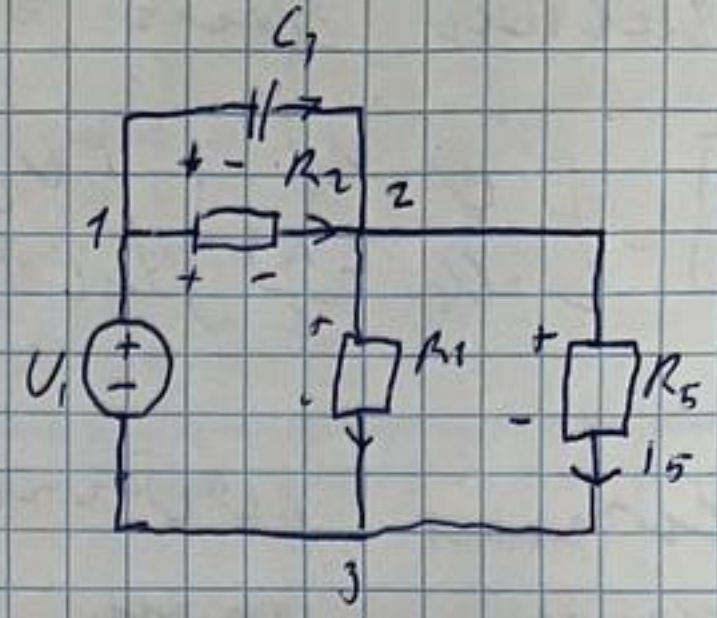
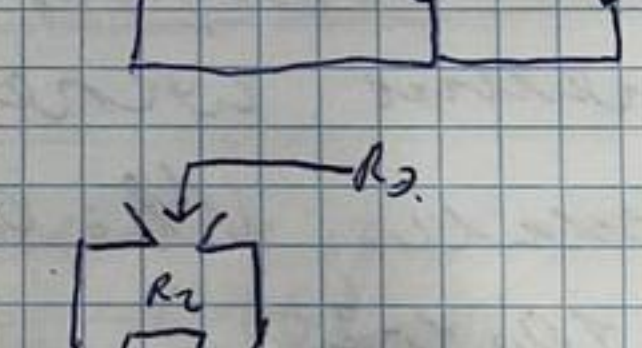
i_5



1) $t = 0$ $\quad U_C(0-) = 0$

2) $t = 0+$ $\quad U_C(0+) = U_C(0-) = 0$

$i_5(0+) = \frac{U_1}{R_5} = \frac{1}{1} = 1$

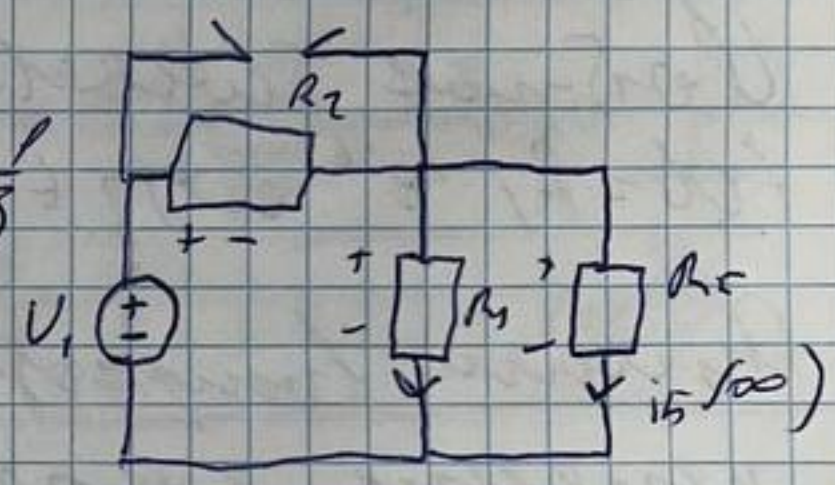


3) $t \to \infty$

$R_{45} = \frac{R_4 R_5}{R_4 + R_5} = \frac{1}{2}$

$U_5 = U_{45} = \frac{R_{45}}{R_0 + R_{45}} U_1 = \frac{\frac{1}{2}}{\frac{3}{2}} \cdot 1 = \frac{1}{3}$

$i_5(\infty) = U_5 / R_5 = \frac{1}{3}$



4) τ?

$G_3 = G_2 + G_4 + G_5 = 3 \Rightarrow$

$\Rightarrow R_3 = \frac{1}{G_3} = \frac{1}{3}$

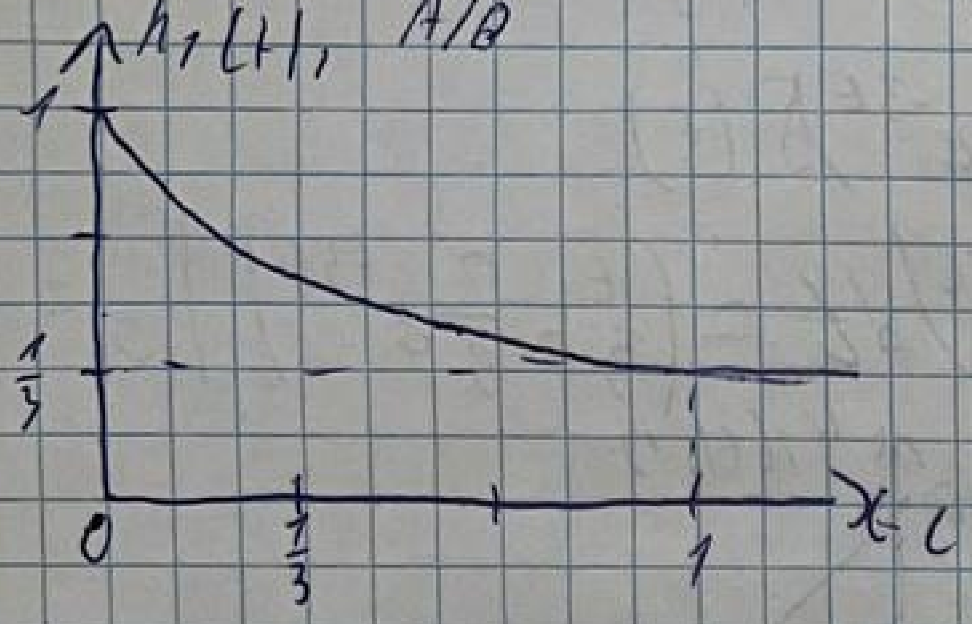
$\tau = C R_3 = \frac{1}{3}$

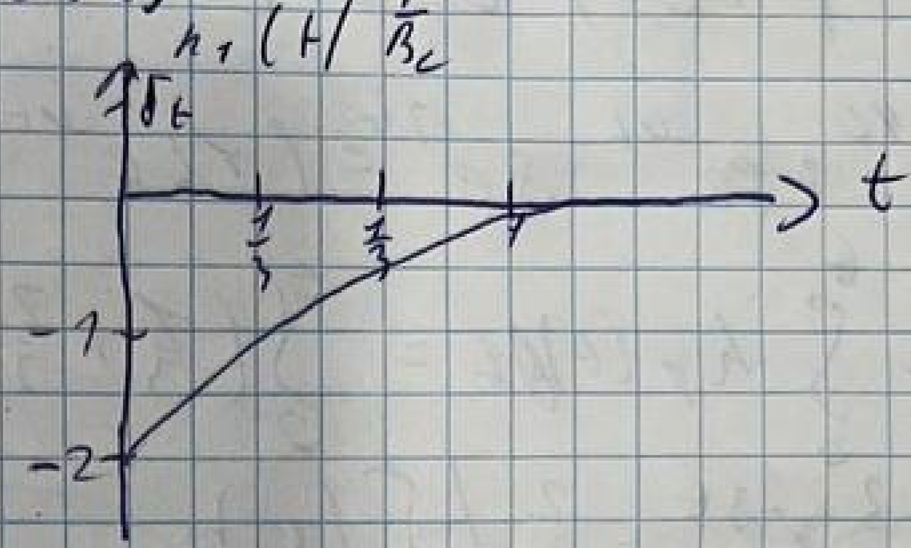
5) $h_1(t) = (i_5(\infty) + Ae^{-3t})\delta(t)$

$A = i_5(0+) - i_5(\infty) = 1 - \frac{1}{3} = \frac{2}{3}$ $\Rightarrow h_1(t) = \frac{1}{3} + \frac{2}{3}e^{-3t}\delta_1(t)$

$$h(t) = \frac{d h_1(t)}{dt}\,\delta_1(t) + h_1(0+)\,\delta(t)$$

$$h(t) = -2e^{-3t}\delta_1(t) + \delta(t)$$





$$i_5(t) = f_1(0+)h_1(t) + \int_0^t f_1'(\tau)h_1(t-\tau)\,d\tau = 4\left(\frac{1}{3} + \frac{2}{3}e^{-3t}\right) +$$

$$+ \int_0^t -16e^{-4\tau}\left(\frac{1}{3} + \frac{2}{3}e^{-3t}e^{3\tau}\right)d\tau = \frac{4}{3} + \frac{8}{3}e^{-3t} +$$

$$+ \frac{4}{3}e^{-4\tau}\Big|_0^t + \frac{32}{3}e^{-3t}e^{-\tau}\Big|_0^t = \frac{4}{3} + \frac{8}{3}e^{-3t} + \frac{4}{3}e^{-4t} - \frac{4}{3} +$$

$$+ \frac{32}{3}e^{-4t} - \frac{32}{3}e^{-3t} = \left(-8e^{-3t} + 12e^{-4t}\right)\delta(t)$$

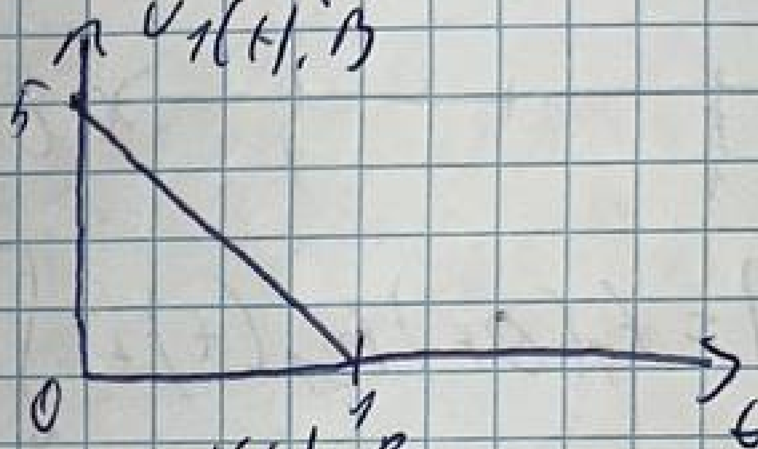
$i_5(t) = h_1(0+) f_1(t) + \int_0^t f(\tau) h_0(t-\tau) d\tau = 4e^{-4t} +$

$+ \int_0^t 4e^{-4t}(+2e^{-3t}) e^{3\tau} d\tau = 4e^{-4t} + 8e^{-3t} e^{\tau}\Big|_0^t =$

$= 4e^{-4t} + 8e^{-4t} - 8e^{-3t} = (12e^{-4t} - 8e^{-3t})\delta(t)$

$h_2(t) = \int_0^t h_1(t) dt = \int_0^t \left(\frac{1}{3} + \frac{2}{3}e^{-3t}\right) dt = \left(\frac{t}{3} - \frac{2}{9}e^{-3t}\right)\Big|_0^t =$

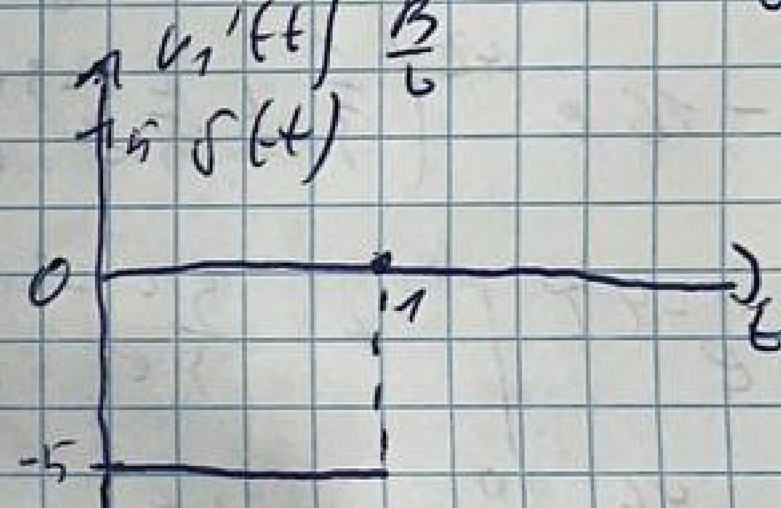
$= \left(\frac{t}{3} - \frac{2}{9}e^{-3t} + \frac{2}{9}\right)\delta(t)$



$u_1'' = -5\delta(t) + 5\delta'(t) + 5\delta(t-1)$

$u_1(t) = \int_{-\infty}^{t} \int (u_1''(t) dt) dt = -5\delta_2(t) +$

$5\delta_1(t) + 5\delta_2(t-1)$

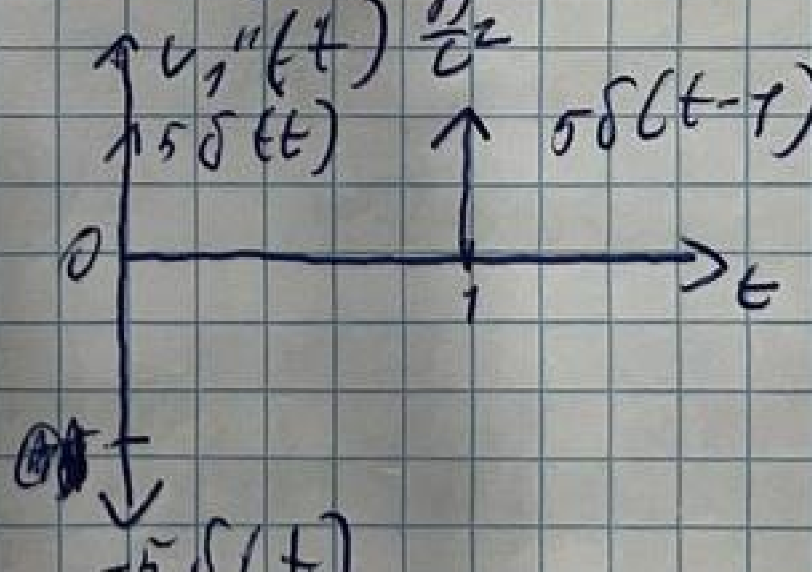


Тогда:

$i_5(t) = -5h_2(t) + 5h_1(t) + 5h_2(t-1) =$

$= 5\left(\frac{1}{3} + \frac{2}{3}e^{-3t}\right)\delta(t) - 5\left(\frac{t}{3} - \frac{2}{9}e^{-3t} + \frac{2}{9}\right) *$

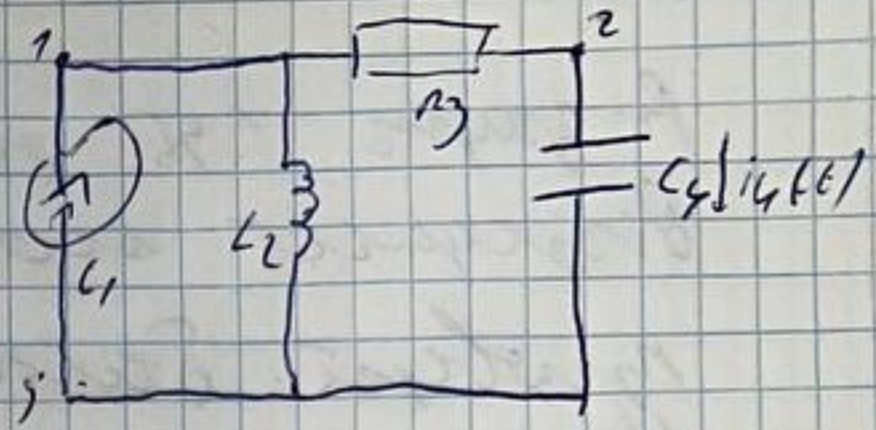
$* \delta_1(t) + 5\left(\frac{t-1}{3} - \frac{2}{9}e^{-3(t-1)} + \frac{2}{9}\right)\delta(t-1)$



$L_2 = 10$ Гн
$R_3 = 5$ Ом
$C_4 = 0{,}2$ Ф
$131 - U(t) = 10\cos(t + 180°)$
$231 - L2 = 10$
$312 - R_3 = 5$
$423 - C4 = 0{,}2$ $\omega = 1$

Найти $i_4(t)$ - ?

№ 135



1) Комплексное сопротивление

$Z_{L2} = j\omega L = j10$ Ом

$Z_{R3} = R_3 = 5$ Ом

$Z_{C4} = 1/j\omega C = -j5$ Ом

$Z_{R_C} = R_3 + 1/j\omega C =$
$= 5 - j5 = 5\sqrt{2} \cdot e^{-45°}$

$$Z_{23} = \frac{j\omega C \cdot (R_3 + 1/j\omega C)}{j\omega C + (R_3 + 1/j\omega C)} = \frac{j10(5 - j5)}{j10 + 5 - j5} =$$

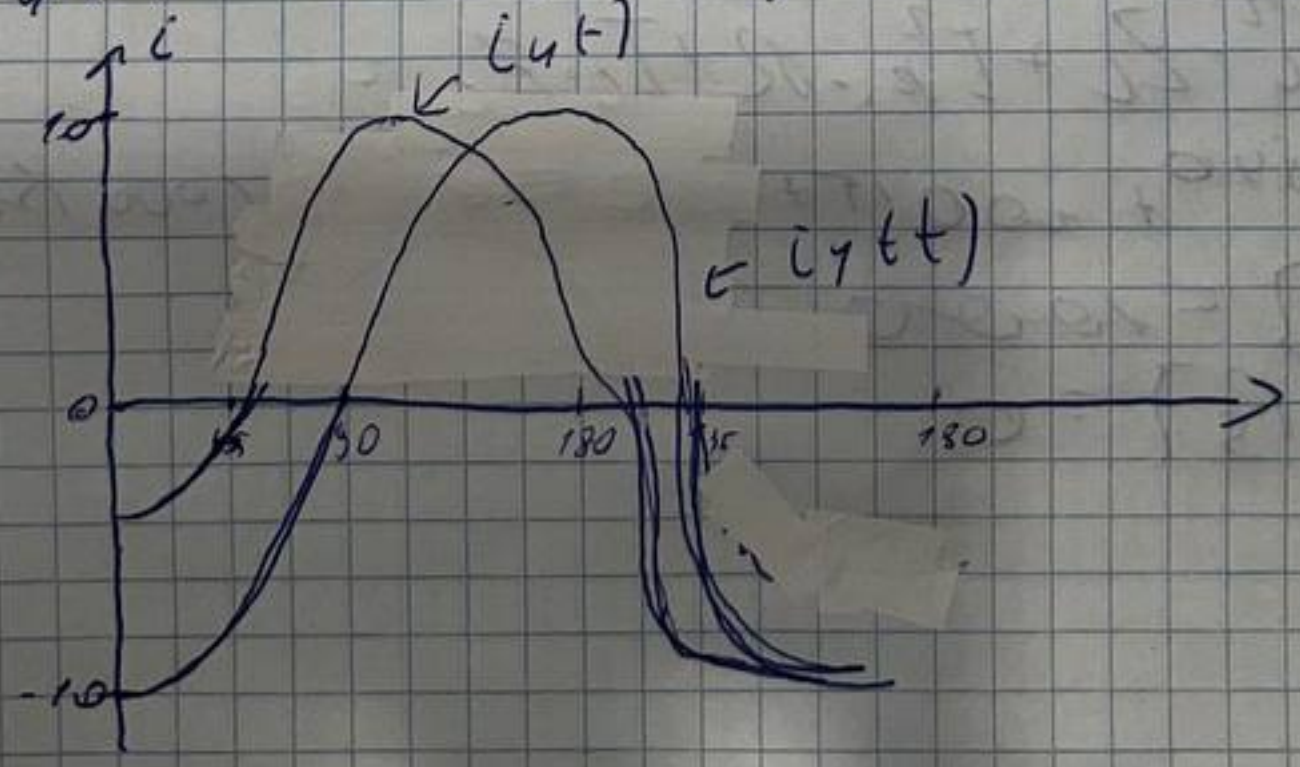
$$= \frac{50 + j50}{5 + j5} = 10 \text{ Ом} = 10 \cdot e^{j0°}$$

$\dot{U}_{23} = \dot{I}_1 \cdot Z_{23} = 10 \cdot e^{j180°} \cdot 10 \cdot e^{j0} = -100 \cdot e^{j0°}$ В

$\dot{I}_4 = \dot{U}_{23} / (R_3 + 1/j\omega C) = 100 \cdot e^{j0°} / 5\sqrt{2} \cdot e^{j45°} =$

$= -10\sqrt{2} \cdot e^{j45°} \Rightarrow$

$\Rightarrow i_4(t) = -10 \cdot \cos(t + 45°)$



№136

В-вариант 1.36. найти токи и напряжения. Определить мощности P, P_Q, P_S, P_Z и проверить баланс мощностей

Найдем ток и напряжение на каждом элементе цепи

L-индуктивность:

$\dot{U}_L = \dot{U}_{13}$; $\dot{I}_L = \dot{U}_{13}/Z_L = -100e^{j0}/10e^{j90} =$

$= -10 \cdot e^{-j90}$; $\dot{U}_L = -100\, e^{j0}$

C-конденсатор

$\dot{I}_C = \dot{I}_4 = -10\sqrt{2} \cdot e^{j45}$

$\dot{U}_C = \dot{I}_C \cdot Z_C = -10\sqrt{2} e^{j45} \cdot (-j5) = 50\sqrt{2}\, e^{-j45}$

R резистор

$\dot{I}_R = \dot{I}_4 = -10\sqrt{2} \cdot e^{j45^\circ}$

$\dot{U}_R = \dot{I}_R \cdot R = -50\sqrt{2} e^{j45^\circ}$

Баланс мощностей

$\dot{U}_{C1} \cdot P_S = \dot{U}_L^* = -100 \cdot e^{j0} \cdot (-10) e^{j0} = 1000$ ВА

$P_{in} \cdot P_S = I_C^2 \cdot Z_L + I_R^2 \cdot R + I_C \cdot Z_C =$

$= 100 \cdot 10 e^{j90} + 200 \cdot 5 + 200 \cdot 5 \cdot e^{-j90} = 1000$ Вт

$P = Re\{P_S\} = 1000$

$R_Q = Im\{P_S\} = 0$