AE – 2015 09 09

① $v_C(t) = \frac{1}{C}\int_0^t i_C(t)\,dt$;

$T = \frac{1}{f} = 2ms$; $\frac{T}{2} = 1ms$; $\int_0^{T/2} i_C(t)\,dt = \frac{I_m \cdot \frac{T}{2}}{2} = \frac{5\cdot 10^{-3}}{2} = 2,5mC.$

a) $t_1 = \frac{T}{2} = 1ms$; $v_C(t_1) = \frac{1}{C}\int_0^{t_1} i_C(t)dt = \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} = \underline{208,3V}$

$W_1 = \frac{1}{2}\,12\cdot 10^{-6}\cdot 208,3^2 = \underline{0,26J}$

b) $t_2 = T = 2ms$;

$v_C(t_2) = \frac{1}{C}\int_0^{t_1} i_C(t)\,dt + \frac{1}{C}\int_{t_1}^{t_2} i_C(t)\,dt$

$v_C(t_2) = \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} - \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} = \underline{0}$; $\underline{W_2 = 0}$

c) $t_3 = \frac{3T}{2} = 3ms$;

$v_C(t_3) = \frac{1}{C}\int_0^{t_1} i_C(t)\,dt + \frac{1}{C}\int_{t_1}^{t_2} i_C(t)\,dt + \frac{1}{C}\int_{t_2}^{t_3} i_C(t)\,dt$

$v_C(t_3) = \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} - \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} + \frac{2,5\cdot 10^{-3}}{12\cdot 10^{-6}} = \underline{208,3V}$; $\underline{W_3 = W_1}$.

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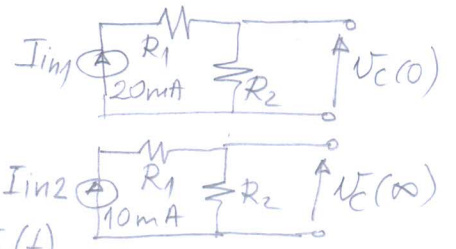
② $v_C(t) = v_C(\infty) + [v_C(0) - v_C(\infty)]e^{-t/\tau}$;



$v_C(0) = R_2 I_{in1} = 2,2\cdot 10^3 \cdot 20\cdot 10^{-3} = \underline{44V}$;

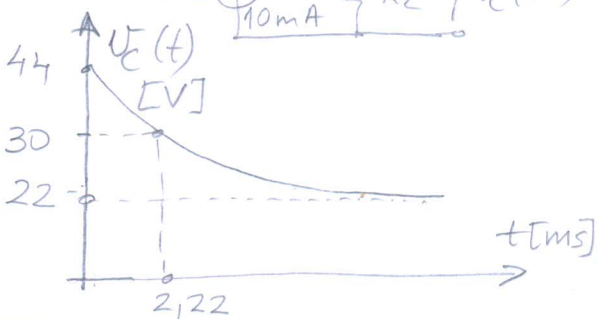
$v_C(\infty) = R_2 I_{in2} = 2,2\cdot 10^3 \cdot 10\cdot 10^{-3} = \underline{22V}$

$\tau = R_2 C = 2,2\cdot 10^3 \cdot 10^{-6} = \underline{22ms}.$

$30 = 22 + [44 - 22]e^{-t_1/\tau}$

$8 = 22\cdot e^{-t_1/\tau}$

$t_1 = \tau \cdot \ln\frac{22}{8} = 2,22ms$



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③ $V_o = -V_S\frac{R_x}{R_i} + V_{ref}\left(1+\frac{R_x}{R_i}\right)$

$V_S(0) = 0,6V$

$V_S(100) = 0,6 - 100\cdot 2\cdot 10^{-3} = \underline{0,4V}$

$0 = -0,6\frac{R_x}{R_i} + V_{ref}\left(1+\frac{R_x}{R_i}\right)$ >—

$5 = -0,4\frac{R_x}{R_i} + V_{ref}\left(1+\frac{R_x}{R_i}\right)$

$5 = 0,2\cdot\frac{R_x}{R_i} \Rightarrow \frac{R_x}{R_i} = 25$; $R_x = 25R_i = \underline{250k\Omega}$

$V_{ref}\left(1+\frac{R_x}{R_i}\right) = 0,6\frac{R_x}{R_i}$; $V_{ref}\cdot 26 = 0,6\cdot 50$

$V_{ref} = \frac{0,6\cdot 25}{26} = \underline{577mV}$