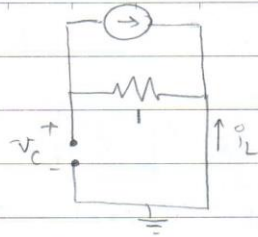


$t < 0$ :

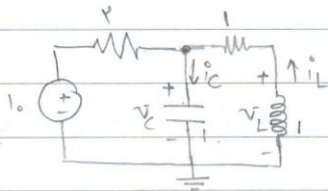


$$i_L(0^-) = i_L(0^+) = 0$$

$$v_C(0^-) = v_C(0^+) = -2$$

۴-  
(کنیت صورت سوال پایین)  
است و من از رابطه  
بالا در نظر گرفته ام)

$t > 0$ :



$$\text{KCL: } -1 + 0 + i_C = 0$$

در  $t = 0^+$  داریم:

$$\Rightarrow i_C = 1 = C \frac{dv_C(0^+)}{dt}$$

$$\Rightarrow \boxed{\frac{dv_C(0^+)}{dt} = 1}$$

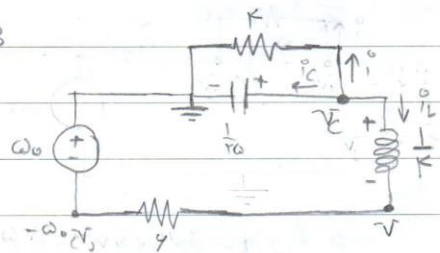
$$\text{KVL: } 0 + v_C = v_L \Rightarrow v_L = -2$$

$$v_L = -L \frac{di_L(0^+)}{dt} \Rightarrow \boxed{\frac{di_L(0^+)}{dt} = +2}$$

$$t < 0: \begin{cases} V_C(0^+) = 0 \\ i_L(0^+) = 0 \end{cases} \quad \begin{cases} V_C'(0^+) = 0 \\ i_L'(0^+) = 0 \end{cases}$$

-V

$t > 0:$



$$KCL_C: i_C + \frac{V_C}{K} + i_L = 0$$

$$KCL_V: \frac{V + \omega_0}{K} = i_L = \int (V - V_C) dt$$

$$\Rightarrow V' = KV - KV_C \Rightarrow (D-K)V = KV_C$$

$$\Rightarrow \frac{V}{K} = \frac{-V_C}{D-K}$$

$$\Rightarrow \frac{1}{\omega_0} V_C' + V_C + \frac{V + \omega_0}{K} = 0$$

$$\Rightarrow \frac{1}{\omega_0} V_C' + V_C - \frac{V_C}{D-K} + \frac{\omega_0}{K} = 0 \xrightarrow{\times \omega_0(D-K)} K(D-K)V_C' + 100(D-K)V_C - 100V_C + 2\omega_0(D-K)\omega_0 = 0$$

$$\Rightarrow KV_C'' + 1KV_C' - \omega_0\omega_0 V_C = \omega_0\omega_0 \Rightarrow V_C'' + 1KV_C' - 1\omega_0 V_C = 1\omega_0$$

$$\begin{aligned} s_1 &= \frac{-1 + \sqrt{1+4K}}{2} \\ s_2 &= \frac{-1 - \sqrt{1+4K}}{2} \end{aligned}$$

$$\Rightarrow V_C = Ae^{s_1 t} + Be^{s_2 t} + K$$

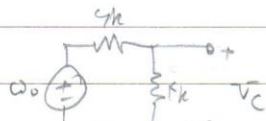
$$\begin{cases} A+B = 10 \\ s_1 A + s_2 B = 0 \end{cases}$$

$$A = \frac{\begin{vmatrix} 10 & 1 \\ 0 & s_2 \end{vmatrix}}{s_2 - s_1} = \frac{10s_2}{s_2 - s_1}$$

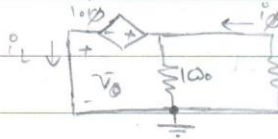
$$B = \frac{\begin{vmatrix} 1 & 10 \\ s_1 & 0 \end{vmatrix}}{s_2 - s_1} = \frac{-10s_1}{s_2 - s_1}$$

$$\Rightarrow i = \frac{V_C}{K} = \frac{\omega_0}{1(s_2 - s_1)} (s_2 e^{s_1 t} - s_1 e^{s_2 t}) - \frac{\omega_0}{1}$$

$t < 0$  :



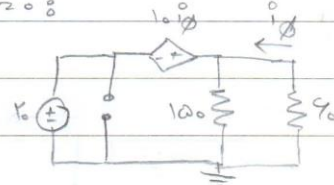
$$v_C(0^+) = v_0$$



$$i_L(0^+) = 0$$

$$i'_L(0^+) = 0$$

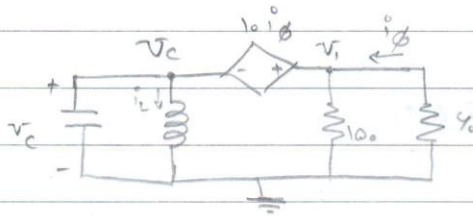
$t = 0$  :



$$\frac{10i_\phi + v_0}{1} = -i_\phi \Rightarrow i_\phi = \frac{-v_0}{11}$$

$$\frac{-v_0}{11} = 1 \times 10^{-9} \times v'_C(0^+) \Rightarrow v'_C(0^+) = \frac{-10^{-9}}{11}$$

$t > 0$  :



$$KCL: i_C + i_L + \frac{v_1}{10} + \frac{v_1}{1} = 0$$

$$v_1 - v_C = 10 \times \left(-\frac{v_1}{1}\right) \Rightarrow v_1 = 4v_C$$

$$i_C = C v'_C$$

$$i_L = \frac{1}{L} \int v_C dt$$

$$\Rightarrow C v'_C + \frac{1}{L} \int v_C dt + \frac{v_C}{\omega_0} = 0$$

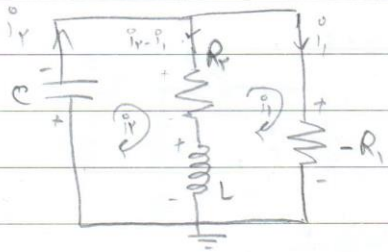
$$\Rightarrow v''_C + \frac{v'_C}{\omega_0 C} + \frac{1}{LC} v_C = 0 \Rightarrow s_{1,2} = -\frac{1}{2\omega_0 C} \pm \sqrt{\frac{1}{4\omega_0^2 C^2} - \frac{1}{LC}} \approx -12\omega_0 \pm 1.22 \times 10^9$$

$$v_0 = v_C = e^{-12\omega_0 t} (A \cos(1.22 \times 10^9 t) + B \sin(1.22 \times 10^9 t))$$

$$\rightarrow \begin{cases} v_0 = A \end{cases}$$

$$\frac{-10^{-9}}{11} = -12\omega_0 (1.22 \times 10^9 B) \Rightarrow B \approx 7.34 \times 10^{-11}$$

$$\Rightarrow v_0 = e^{-12\omega_0 t} (10 \cos(1.22 \times 10^9 t) + 7.34 \times 10^{-11} \sin(1.22 \times 10^9 t))$$



$$KVL_1: -i_1 R_1 - V_L - (i_r - i_1) R = 0$$

$$KVL_2: +V_C + (i_r - i_1) R + V_L = 0$$

$$V_L = L (i_r - i_1)' = L D i_r - L D i_1$$

$$V_C = \frac{1}{C} \int i_r dt + V_C(0^+)$$

$$(R_r - R_1 + L D) i_1 - (R_r + L D) i_r = 0$$

$$-(R_r + L D) i_1 + (R_r + \frac{D'}{C} + L D) i_r = -V_C(0^+)$$

$$i_1 = \frac{(R_r + \frac{D'}{C} + L D) i_r + V_C(0^+)}{(R_r + L D)} \Rightarrow \frac{(R_r - R_1 + L D) [(R_r + \frac{D'}{C} + L D) i_r + V_C(0^+)]}{(R_r + L D)} - (R_r + L D) i_r = 0$$

$$\Rightarrow \left[ R_r + \frac{R_r D'}{C} + R_r L D - R_1 R_r - \frac{R_1 D'}{C} - R_1 L D + R_r L D + \frac{L}{C} + L D \right] i_r + (R_r - R_1) V_C(0^+) - (R_r + L D) i_r = 0$$

در معادله درینجا ضرب جایی  $D i_r$  باید ضرب باشد پس در معادله ی بالا ضرب جایی  $i_r$  باید ضرب باشد

$$\rightarrow \frac{L}{C} - R_1 R_r = 0 \Rightarrow \boxed{R_1 = \frac{L}{R_r C}} \quad \text{شرط اول}$$

هم چنین در معادله مشخصه باید  $\Delta < 0$  باشد

$$\Delta < 0 \Rightarrow \frac{R_r^2}{C} - 4 R_r C < 0 \Rightarrow \frac{R_r}{C} - \frac{R_1}{C} < 0 \Rightarrow \boxed{R_r < R_1} \quad \text{شرط دوم}$$

و اینجای اشتراک شرط ها است.