R

ω_p

ω_s

$Y(\omega)$

$=$

$$\frac{1}{j\omega L + 1/j\omega C} + j\omega C_0 = \frac{j\omega C}{1 - \omega^2 LC} + j\omega C_0 = \frac{j\omega C + j\omega C_0(1 - \omega^2 LC)}{1 - \omega^2 LC}$$

$Y(\omega)$

$$\mathrm{j}\omega C + j\omega C_0(1 - \omega^2 LC) = 0$$

$$\omega^2 = \frac{C+C_0}{L(CC_0)}, \qquad \text{or} \qquad \omega = \frac{1}{\sqrt{LC_p}}$$

$$\mathrm{C}_p = C||C_0 = \frac{CC_0}{C+C_0}$$

$\omega = 1/\sqrt{LC}$

L

C_1

C_2

$v(t)$

$R_L = 100\Omega$

$\omega_0 = 1000$

$2\omega_0 = 2000$

$L = 25\,mH$

$Z(\omega)$

$$\frac{j\omega L/j\omega C_1}{j\omega L + 1/j\omega C_1} + \frac{1}{j\omega C_2} = \frac{j\omega L}{1 - \omega^2 L C_1} - \frac{j}{\omega C_2}$$

$$j\frac{\omega^2 LC_2+\omega^2 LC_1-1}{(1-\omega^2 LC_1)\omega C_2}=j\frac{\omega^2 L(C_1+C_2)-1}{(1-\omega^2 LC_1)\omega C_2}$$

$\omega^2 = 1/LC_1$

$$|Z(\omega)| = \infty$$

$$\frac{1}{\sqrt{LC_1}}=2\times10^3, \quad \text{i.e.,} \quad C_1=\frac{1}{4\times10^6\times25\times10^{-3}}=10^{-5}\,F=10\,\mu F$$

$$\omega^2 L(C_1 + C_2) = 1$$

$$|Z(\omega)| = 0$$

$C_1 + C_2$

$$\mathrm{C}_1 + C_2 = \frac{1}{\omega_0^2 L} = \frac{1}{10^6 \times 25 \times 10^{-3}} = 40 \times 10^{-6} = 40\,\mu F$$

$$\mathrm{C}_2 = 40\,\mu F - C_1 = 40\,\mu F - 10\,F = 30\,\mu F$$

$R_1 = 3\Omega$

$R_2 = 6\Omega$

$R_3 = 2\Omega$

$L = 0.5\,H$

$V_1 = 6V$

$V_2 = 3V$

$t < 0$

$i_3(t)$

R_3

$t = 0$

$$\mathrm{i}_L(0^-) = i_L(0^+) = 3/6 = 0.5\,A$$

$$\tau = L/(R_1||R_2||R_3) = 0.5/(3||6||2) = 0.5\,s$$

$i_3(\infty) = 0$

$i_3(0^+)$

V_1

$V_1 \overline{\qquad\qquad\qquad\qquad}$
$R_1 + R_2 || R_3 = \frac{6}{3+1.5} = \frac{4}{3}$

$$i'_3(0^+) = \frac{4}{3}\ \frac{2}{2+6} = \frac{4\times 6}{3\times 8} = 1 \qquad \text{(down)}$$

V_2

$$\text{i"}_3(0^+) = \frac{V_2}{R_1||R_2+R_3} = \frac{3}{2+2} = \frac{3}{4} = 0.75 \qquad \text{(down)}$$

$i_L(0^+)$

i"'$_3(0^+) = i_L(0^+)\frac{R_1||R_2}{R_3+R_1||R_2} = 0.5\frac{2}{2+2} = 0.25$ (up)

$$\mathrm{i}_3(0^+) = i_3'(0^+) + i_3''(0^+) + i_3'''(0^+) = 1 + 0.75 - 0.25 = 1.5\,A$$

$$\mathrm{i}_3(t) = 0 - (1.5 - 0)e^{-t/\tau} = 1.5e^{-2t}\,A$$

$i_L(0) = 0.5\,A$

$$\mathrm{V}_a \frac{}{R_3+\frac{V_a-V_1-V_2}{R_1}+\frac{V_a-V_2}{R_2}+i_L=\frac{V_a}{2}+\frac{V_a-9}{3}+\frac{V_a-3}{6}+0.5=0}$$

$V_a = 3\,V$

$$i_3(0^+) = V_a/R_3 = 3/2 = 1.5\,A$$