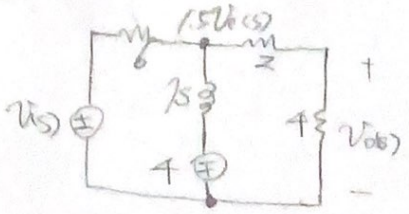
1.



$v(t) = 3[u(t) - u(t-3)] + (-7)[u(t-3) - u(t-4)]$

$= 3u(t) - 4u(t-3) + u(t-4)$

$\therefore V(s) = \frac{3}{s} - \frac{4}{s}e^{-3s} + \frac{1}{s}e^{-4s}$

$\therefore \frac{V(s) - 1.5V_o(s)}{6} = \frac{1.5V_o(s) + 4}{7s} + \frac{V_o(s)}{4}$

$\Rightarrow V_o(s)\left(\frac{1.5}{6} + \frac{1.5}{7s} + \frac{1}{4}\right) = \frac{V(s)}{6} - \frac{4}{7s}$

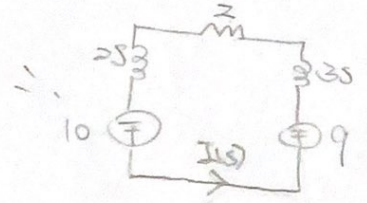
$V_o(s) = \frac{V(s)}{6} \cdot \frac{14s}{7s+3} - \frac{4}{7s} \cdot \frac{14s}{7s+3}$

$= \frac{1}{3}\left(\frac{3}{s+3/7} - \frac{4}{s+3/7}e^{-3s} + \frac{1}{s+3/7}e^{-4s}\right) - \frac{8}{7}\frac{1}{s+3/7}$

$\therefore v_o(t) = \mathcal{L}^{-1}[V_o(s)] = -\frac{1}{7}e^{-\frac{3}{7}t}u(t) - \frac{4}{3}e^{-\frac{3}{7}(t-3)}u(t-3) + \frac{1}{3}e^{-\frac{3}{7}(t-4)}u(t-4)$ (V) ★

2. $i_{2H}(0^-) = \frac{24}{2+(4\|4)} \times \frac{1}{4+4} + \frac{16}{2+(4\|4)} \times \frac{1}{4+4} = 5$ (A)

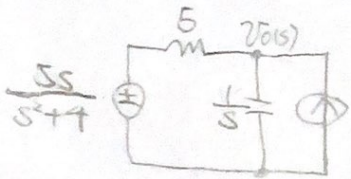
$i_{3H}(0^-) = \frac{12}{4} = 3$ (A)



$\therefore I(s) = \frac{10-9}{2+5s} = \frac{1}{2+5s}$

$\therefore i(0^+) = \lim_{s\to\infty} \frac{s}{2+5s} = \frac{1}{5}$ (A) ★

3.



$V_o(s) = \frac{1}{s}\cdot\left[e^{-s} + \frac{\frac{5s}{s^2+4} - V_o(s)}{5}\right]$

$\Rightarrow V_o(s) = \frac{5s}{5s+1}\left(\frac{e^{-s}}{s} + \frac{1}{s^2+4}\right)$

$= \frac{e^{-s}}{s+1/5} + \frac{-5/101}{s+1/5} + \frac{5}{101}\cdot\frac{s+20}{s^2+4}$

$\therefore v_o(t) = e^{-\frac{t-1}{5}}u(t-1) + \left[\frac{-5}{101}e^{-\frac{t}{5}} + \frac{5}{101}(\cos 2t + 10\sin 2t)\right]u(t)$ (V) ★

4.

$G(j\omega) = \frac{9\cdot\left(\frac{j\omega}{200}+1\right)^2}{j\omega\left[\left(\frac{j\omega}{20}\right)^2 + \frac{j\omega}{100} + 1\right]\left(\frac{j\omega}{900}+1\right)^2}$ ★

$20 = 20\log[G(j0.9)]$

$\therefore G(j0.9) = 10$

$\Rightarrow k_0 = 9$

5. (a) ∵ parallel, critically system ∴ $\alpha = \frac{1}{2RC}$, $\omega_0 = \frac{1}{\sqrt{LC}}$

$\alpha^2 - \omega_0^2 = 0 \Rightarrow R = \pm\sqrt{\frac{L}{4C}} = \pm 2000$ (取正)

∴ $R = 2000\ (\Omega)$ ★

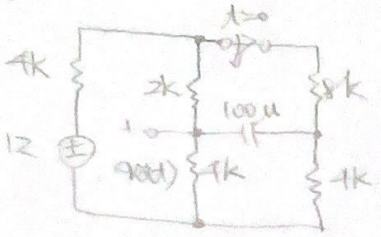
(b) $\omega_0 = \frac{1}{\sqrt{LC}} = 10^3\ (\text{rad/s})$ ★ $\alpha = \omega_0 RC = 0.5$ (單位) ★

$B_W = 2\alpha = 2000\ (\text{rad/s})$ ★

$\omega_H = \alpha + \sqrt{\alpha^2 + \omega_0^2} = 500 + 500\sqrt{5} = 2414.214\ (\text{rad/s})$ ★

$\omega_L = -\alpha + \sqrt{\alpha^2 + \omega_0^2} = -500 + 500\sqrt{5} = 414.214\ (\text{rad/s})$ ★

6.



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

$v_o(\infty) = 12 \cdot \frac{4k}{10k} = 4.8\ (V)$

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

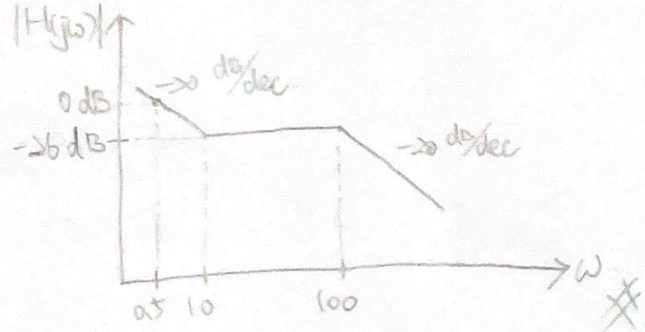
$\therefore \frac{12 - v(0^+)}{6k} = \frac{v(0^+)}{4k} + \frac{v(0^+) - 2}{4k}$

$v(0^+) = \frac{15}{4} = 3.75\ (V)$

$\tau = \frac{1}{[4k + (6k \parallel 4k)] \cdot 100\mu} = \frac{16}{25}$

$\therefore v_o(t) = \left(4.8 - 1.05\, e^{-\frac{25}{16}t}\right) u(t)\ (V)$ ★

7.



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