General Make-up Solutions

Q-1 $X_L = j\omega L = j \times 2 \times 0.5 = j\,\Omega$

(a) $X_C = \dfrac{1}{j\omega C} = \dfrac{1}{j \times 2 \times \frac{1}{2}} = -j\,\Omega$

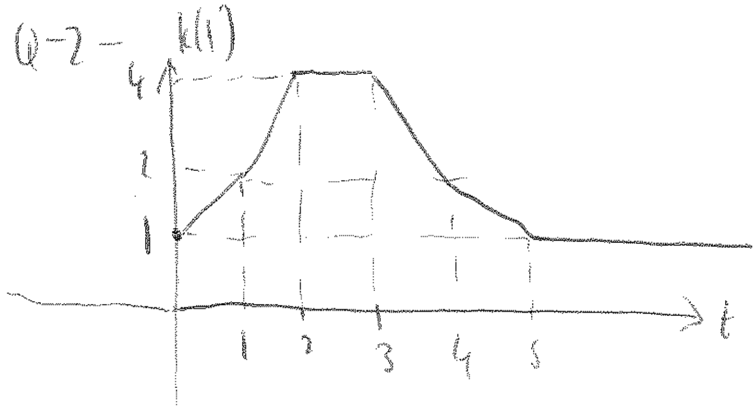
$X_R = 2\,\Omega$

$V_{sp} = e^{j\theta} = e^{j \times 0^\circ} = e^0 = 1$ Volt

(b) $I_{cp} = \dfrac{V_{sp}}{X_R + X_L + X_C} = \dfrac{1}{2 + j - j} = \dfrac{1}{2}$ Ampere

(c) $I_c(t) = \frac{1}{2}\cos(2t)$ Ampere

Q-2 —



Q-3 —

$\dfrac{d^4 I_L}{dt^4} - I_L = \sin(2t)$

char-equ $= s^4 - 1 = 0 \quad (s^2-1)(s^2+1) = 0$

$s_1 = 1 \quad s_2 = -1 \quad s_3 = j \quad s_4 = -j$

$\omega = 2$ rad/sec

$j\omega \neq s_i \quad i = 1, 2, 3, 4$ hence $I_{cp} = K_1 \sin(2t) + K_2 \cos(2t)$

$\dfrac{dI_{cp}}{dt} = 2K_1\cos(2t) - 2K_2\sin(2t)$

$\dfrac{d^3 I_c}{dt^3} = -8K_1\cos(2t) + 8K_2\sin(2t)$

$\dfrac{d^2 I_{cp}}{dt^2} = -4K_1\sin(2t) - 4K_2\cos(2t)$

$\dfrac{d^4 I_c}{dt^4} = 16K_1\sin(2t) - 16K_2\cos(2t)$

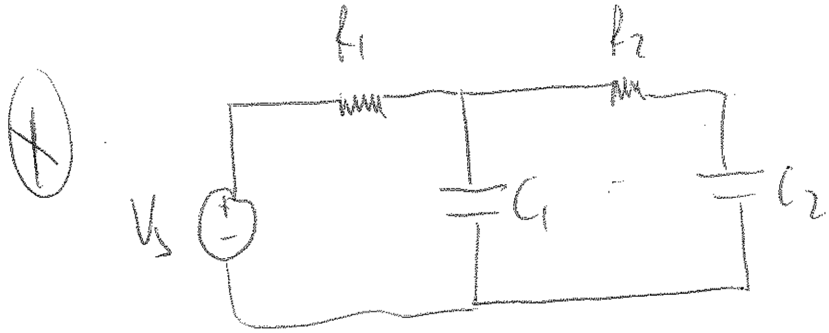
$$\frac{d^4 I_{cp}}{dt^4} - I_{cp} = \sin(2t)$$

$$16 K_1 \sin(2t) + 16 K_2 \cos(2t) - \left[K_1 \sin(2t) + K_2 \cos(2t)\right] = \sin(2t)$$

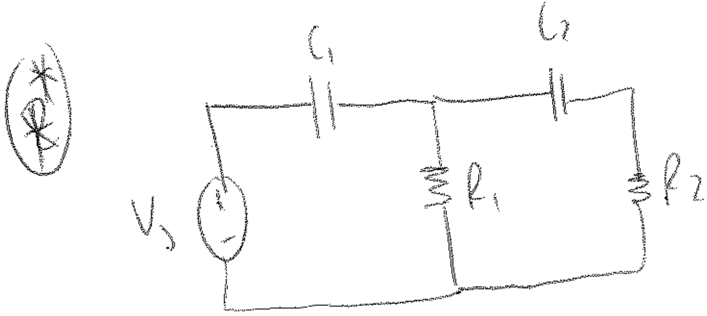
$$K_1 = \frac{1}{15} \qquad K_2 = 0$$

$$I_{cp} = \frac{1}{15}\sin(2t)$$

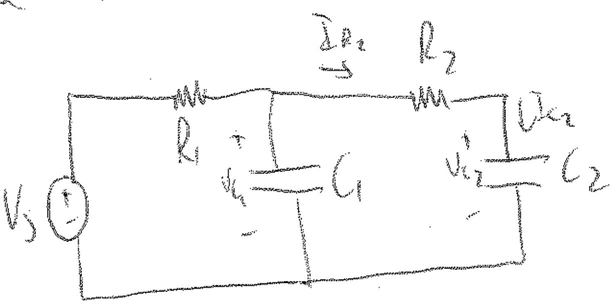
Q4 - We have a voltage source so the circuit configuration can be



or



Use *



$V_s = V_{R_1} + V_{C_1}$

$I_{R_2} = I_{C_2} = C_2 \frac{dV_{C_2}}{dt}$

$V_{C_1} = V_{R_2} + V_{C_2}$

$V_{C_1} = R_2\left[C_2 \frac{dV_{C_2}}{dt}\right] + V_{C_2}$

$$\boxed{\frac{dV_{C_2}}{dt} = \frac{1}{R_2C_2}V_{C_1} - \frac{1}{R_2C_2}V_{C_2}}$$

Hence $\frac{1}{R_2C_2} = 0.5$

$V_s = V_{R_1} + V_{C_1}$ $\quad V_s = R_1\left[I_{C_1} + I_{C_2}\right] + V_{C_1}$

$$V_s = R_1\left[C_1\frac{dV_{C_1}}{dt} + C_2\frac{dV_{C_2}}{dt}\right] + V_{C_1}$$

$$V_s = R_1\left[C_1\frac{dV_{C_1}}{dt} + C_2\left(\frac{V_{C_1}}{R_2C_2} - \frac{V_{C_2}}{R_2C_2}\right)\right] + V_{C_1}$$

$$V_s = R_1C_1\frac{dV_{C_1}}{dt} + \left(\frac{R_1}{R_2} + 1\right)V_{C_1} + \frac{R_1}{R_2}V_{C_2}$$

$$\boxed{\frac{dV_{C_1}}{dt} = \frac{V_s}{R_1C_1} + \frac{1}{C_1R_2}V_{C_2} - \frac{R_1+R_2}{R_1C_1R_2}V_{C_1}}$$

Hence

$$\frac{1}{R_1C_1} = 1 \qquad \frac{1}{C_1R_2} = 1 \qquad \frac{R_1+R_2}{R_1C_1R_2} = 2$$

$$\frac{1}{R_2C_2} = 0.5 \qquad \begin{matrix} R_1 = 1 & R_2 = 1 \\ C_1 = 1 & C_2 = 2 \end{matrix} \Rightarrow \text{All conditions are satisfied}$$

<u>Hence circuit</u>