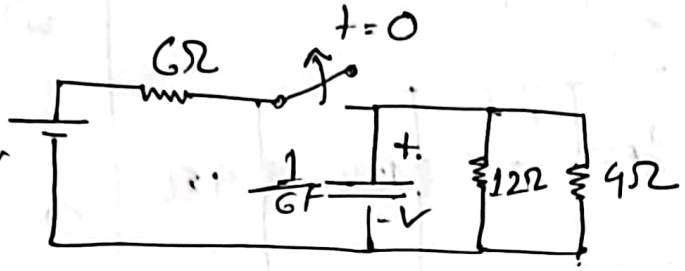
MD. Sohanur Rahman Shimul

Assignment: 03

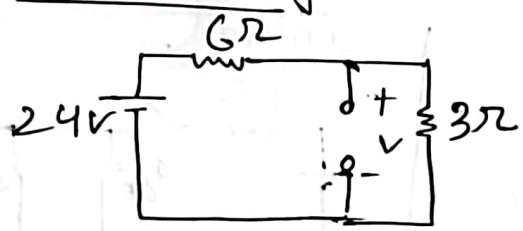
CSE250 Sec: 02

2229079

Q#1



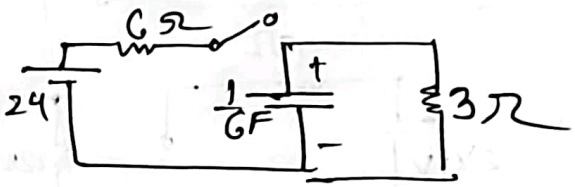

before switching




$$V_o(0) = \frac{3}{3+6} \times 24$$

$$= 8V$$

initial




$$R_{eq} = 3\Omega$$

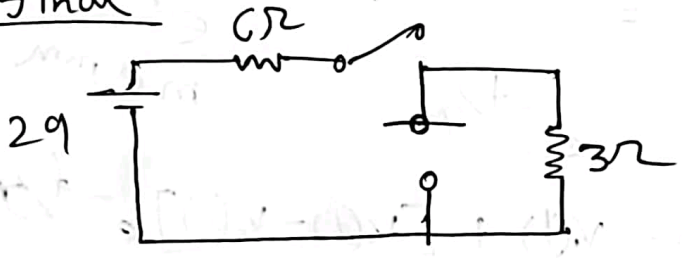
$$C_{eq} = \frac{1}{6}F$$

$$\tau = R_{eq} \cdot C_{eq}$$

$$= 3 \times \frac{1}{6}$$

$$= \frac{1}{2}s$$

final




$$V_o(\infty) = 0\ V$$

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

$$= 0 + (8 - 0)\, e^{-t/1/2}$$

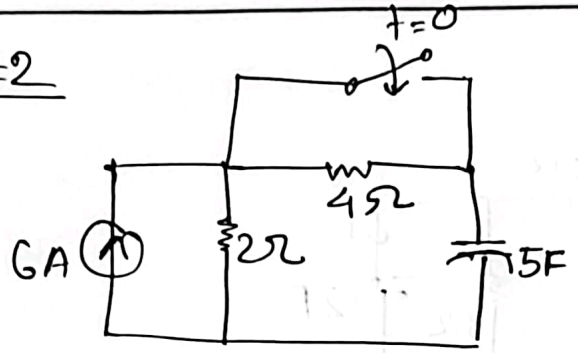
$$= 8e^{-2t}\ V$$

$$W_C(0) = \frac{1}{2} \cdot C \cdot V^2$$

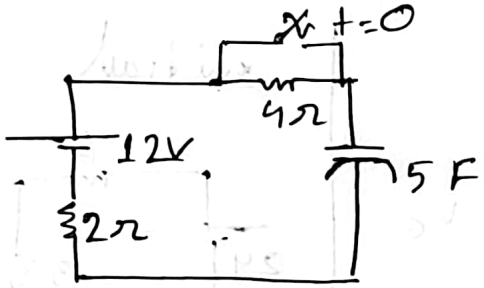
$$= \frac{1}{2} \times \frac{1}{6} \times 8^2$$

$$= 5.33J \quad \text{(Ans)}$$

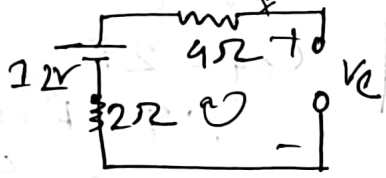
Q#2




after using source transformation:

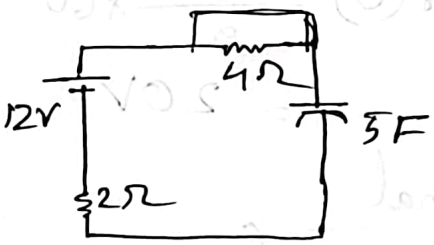



before switching:




$V_0(0) = 12V$

initial



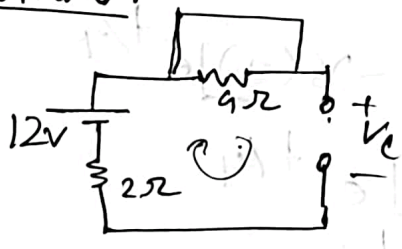

$R_{eq} = 2\Omega$

$C_{eq} = 5F$

$\therefore \tau = R_{eq} \cdot C_{eq}$

$= 10s$

final:



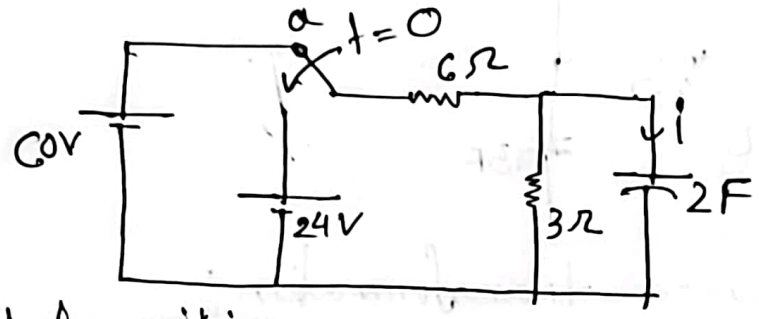

$V_0(\infty) = 12V$

$\therefore V_0(t) = V_0(\infty) + [V_0(0) - V_0(\infty)]e^{-t/\tau}$

$= 12 + (12-12)e^{-t/10}$

$= 12V$ (Ans)

Q#3

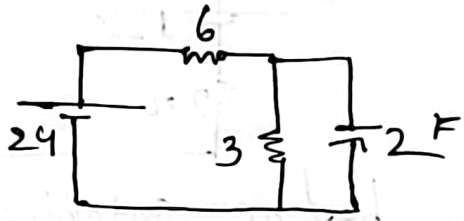



before switching ~~initial~~ stage:


$$V_c(0) = \frac{3}{9} \times 60$$

$$= 20V$$

initial



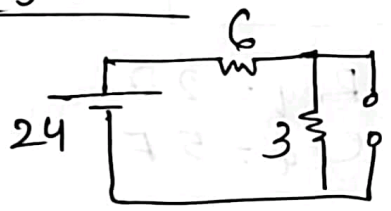

$$Req = (6 \| 3) = 2\Omega$$

$$Ceq = 2F$$

$$\therefore \tau = Req \cdot Ceq$$

$$= 4 sec$$

final




$$V_c(\infty) = \frac{3}{6+3} \times 24$$

$$= 8V$$

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

$$= 8 + [20 - 8] e^{-t/4}$$

$$= 8 + (12) e^{-t/4}$$

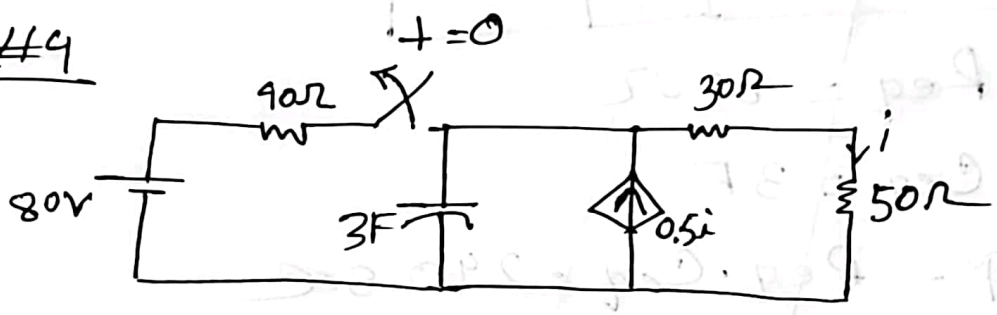
$$i_c(t) = C \cdot \frac{d}{dt}(V_c(t))$$

$$= 2 \cdot \frac{d}{dt}(8 + 12e^{-t/4})$$

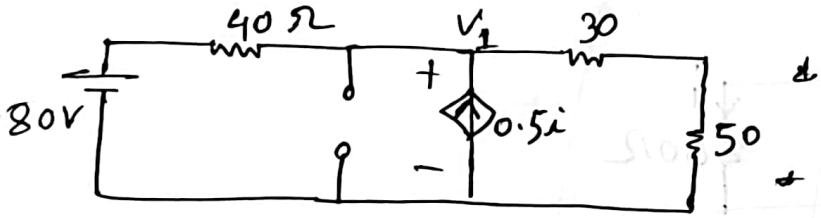
$$i_L(t) = 2\left[0 + \left(-\frac{1}{4}\right) \cdot \frac{3}{2} e^{-t/4}\right]$$

$$= -6e^{-t/4} \text{ A} \quad \text{(Ans)}$$

Q#4




before switching




$$i = \frac{V_1}{80}$$

$$\frac{V_1 - 80}{40} - 0.5i + \frac{V_1}{80} = 0$$

$$\frac{V_1}{40} - 2 - 0.5\frac{V_1}{80} + \frac{V_1}{80} = 0$$

$$V_1\left(\frac{1}{40} - \frac{0.5}{80} + \frac{1}{80}\right) = 2$$

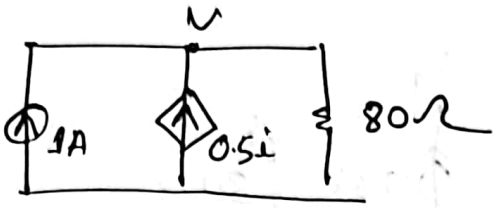
$$\therefore V_1 = 64 \text{ V}$$

$$\therefore V_0(0) = V_1 = 64 \text{ V}$$

$$\therefore i = \frac{64}{80} = 0.8 \text{ A}$$

(Ans)

initial




$$-1 - 0.5\frac{V}{80} + \frac{V}{80} = 0$$

$$\therefore \frac{V}{160} = 1$$

$$\therefore V = 160$$

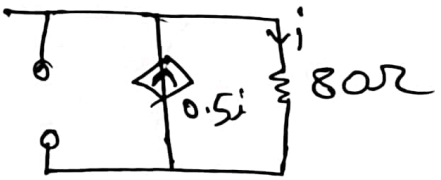
$$R_{th} = \frac{160}{1} = 1$$

$$C_{eq} = 3F$$

$$\therefore \tau = R_{th} \cdot C_{eq}$$

$$= 480 \text{ sec}$$

final




$$V_o(\infty) = 0\,V$$

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

$$= 0\,[64]\,e^{-t/480}$$

$$= 64e^{-t/480}$$

$$i_o(t) = C\frac{d}{dt}(V_o(t))$$

$$= 3\frac{d}{dt}(64e^{-t/480})$$

$$= 3\left[64\, e^{-t/480} \cdot \left(\frac{1}{-480}\right)\right]$$

$$= 0.4\, e^{-t/480}\ A$$

$$\therefore i(t) = \frac{V}{R}$$

$$= 64\, e^{-t/480}$$

$$i_0(t) = C\frac{d}{dt}(dx/t)$$

$$= 3\frac{d}{dt}\left[64\, e^{-t/480}\right)$$

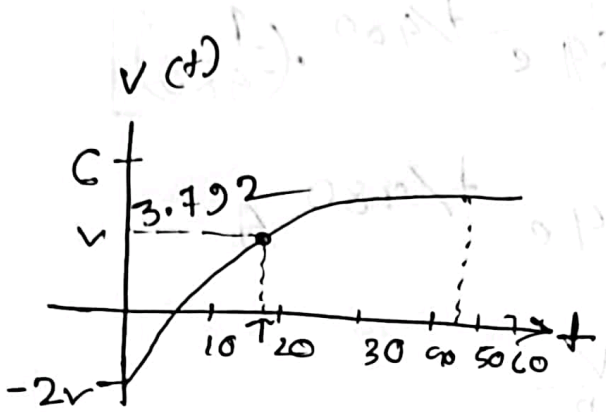
$$= 3\left(64\, e^{-t/480} \times \left(-\frac{1}{480}\right)\right)$$

$$= -0.4\, e^{-t/480}\ A$$

(Ans)

Q#5

a)




$0.632 \times 6 = 3.792$

b) here,

$5\tau = 45$

$\therefore \tau = 9\ ms$

$= 9 \times 10^{-3}\ s$ (Ans)

(b)

$V_o(0) = -2\ V$

$V_o(\infty) = 6\ V$

$\tau = 9 \times 10^{-3}\ s$

$\therefore V_o(t) = 6 + (-8)e^{-t/9\times10^{-3}}$

$= 6 - 8e^{-t/9\times10^{-3}}\ V$

(Ans)

c) from 'a' $\tau = 9 \times 10^{-3}$ sec

$\therefore \tau = R_{eq} \cdot C_{eq}$

$9 \times 10^{-3} = 4 C$

$\therefore C = 2.25$ F

d) from 'a' $\tau = 9 \times 10^{-3}$ sec

$\tau = R_{eq} \cdot C_{eq}$

$\therefore 9 \times 10^{-3} = 4 \times 10^{3} C_{eq}$

$\therefore C_{eq} = 2.25$ μF

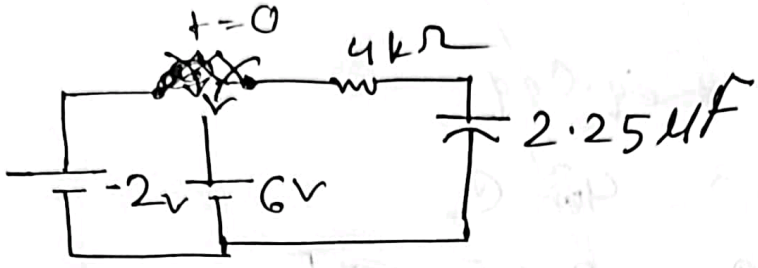
$= 2.25 \times 10^{-6}$ F

$w = C \times \frac{1}{2} \times V_c(0)^2$

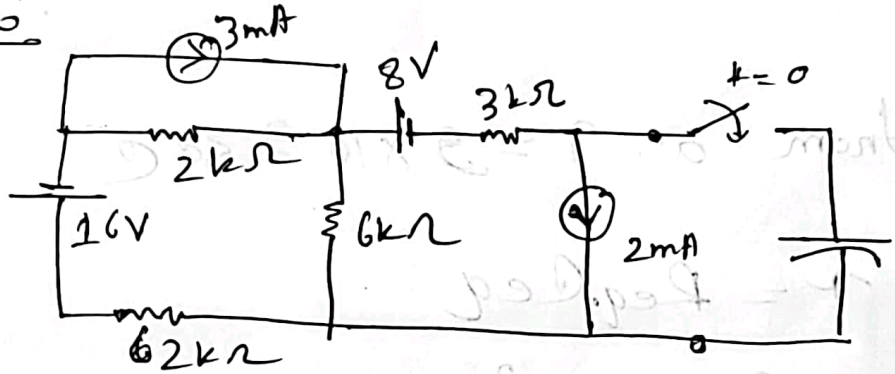
$= 2.25 \times 10^{-6} \times 9 \times 10^{-3} \times (-2)^2 \times \frac{1}{2}$

$= 4.5 \times 10^{-6}$ J (Ans)

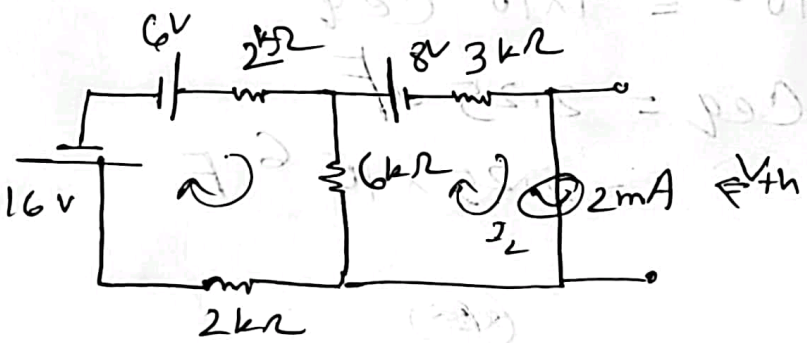
c)




Q#6



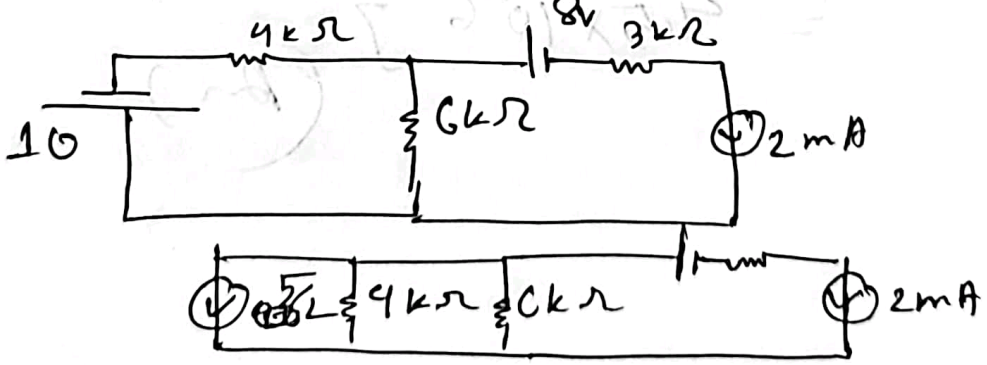

$V_{th}$

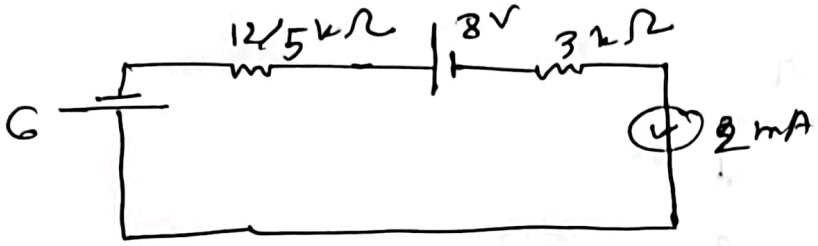


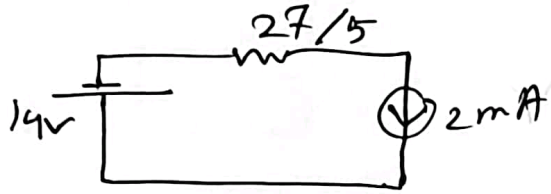

$I_2 = 2mA$

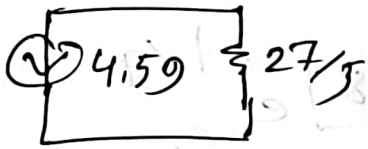
~~$-6 + 2I_1 + 6I_1 - 6I_2 + 2I_1 = -16$~~

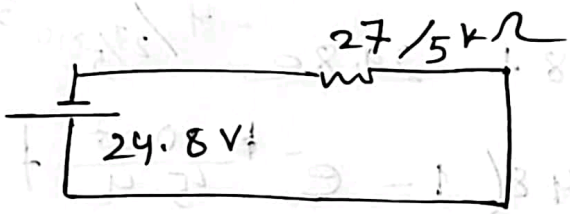
~~$\therefore I_1 = 0.2mA$~~



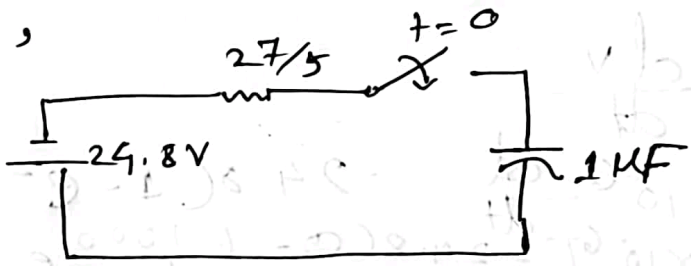


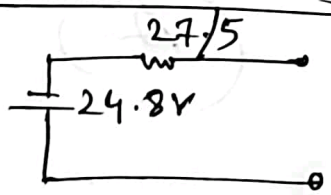




Now,

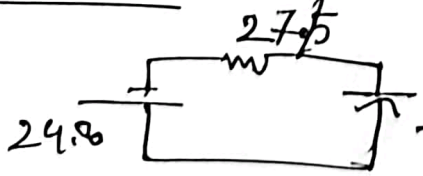



before switching




$V_0(0) = 0V$

initial

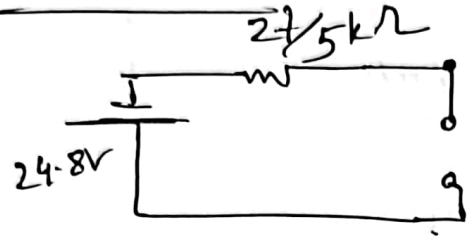



$R_{eq} = 27/5 \times 10^{3}\ \Omega$

$C_{eq} = 1 \times 10^{-6}\ F$

$\therefore \tau = \frac{27}{5} \times 10^{-3}\ sec$

final




$V_0(\infty) = -24.8V$

~~$\therefore V_0(t) = -24.8(1$~~

$V_0(t) = -24.8 + [24.8]e^{-t/\tau}$

$= -24.8 + 24.8e^{-t/2.7/5 \times 10^{-3}}$

$= -24.8\left(1 - e^{-\frac{1000}{5.4}t}\right)$ V

$\therefore i_c = C\frac{dv}{dt}$

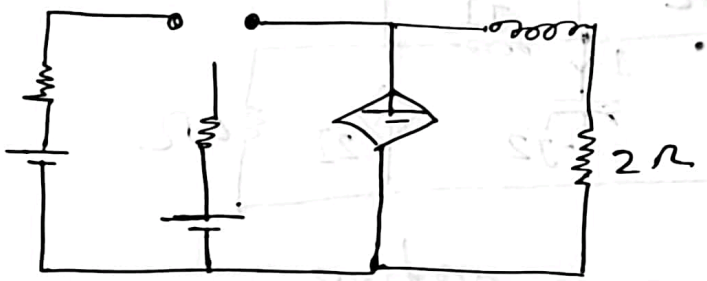
$= 1\times10^{-6}\cdot\frac{d}{dt}\left(-24.8\left(1 - e^{-\frac{1000}{5.4}t}\right)\right)$

$= 1\times10^{-6}\left[-24.8\left(0 - \left(-\frac{1000}{5.4}e^{-\frac{1000}{5.4}t}\right)\right)\right]$

$= -4.59e^{-\frac{1000}{5.4}}$ A

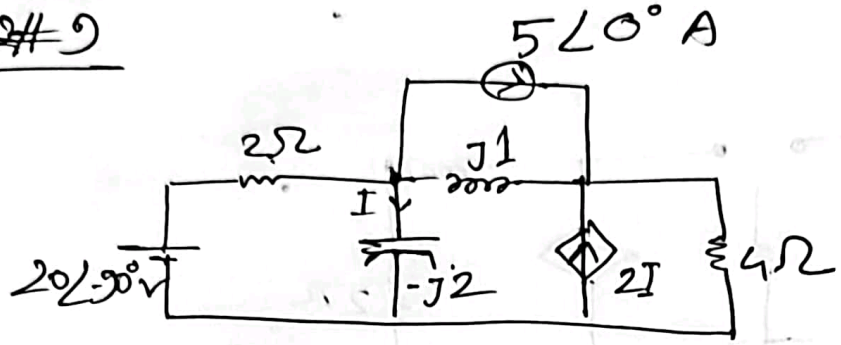
(Ans)

Q#7

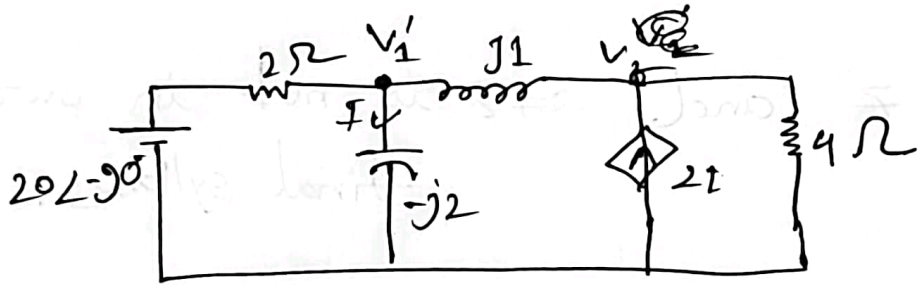



Q#7 and Q#8 is not in our final syllabus.

Q#9




when $20\angle 90$ is active:




Node 1

$$\frac{V_1 - 20\angle -90}{2} + \frac{V_1}{-j2} + \frac{V_1 - V_2}{j1} = 0$$

$$\frac{V_1}{2} - \frac{20\angle -90}{2} + \frac{V_1}{-j2} + \frac{V_1}{j1} - \frac{V_2}{j1} = 0$$

$$V_1\left(\frac{1}{2} + \frac{1}{-j2} + \frac{1}{j1}\right) + V_2\left(\frac{1}{-j1}\right) = \frac{20\angle -90}{2} \quad -(i)$$

Node 2

$$I = \frac{V_1}{-j2}$$

$$\frac{V_2 - V_1}{j1} - 2I + \frac{V_2}{4} = 0$$

$$\frac{V_2}{j1} - \frac{V_1}{j1} - 2\frac{V_1}{-j2} + \frac{V_2}{4} = 0$$

$$V_1\left(\frac{1}{-j1} - \frac{2}{-j2}\right) + V_2\left(\frac{1}{j1} + \frac{1}{4}\right) = 0 \quad -(ii)$$

$$\Delta V = \begin{bmatrix} \frac{1}{2} + \frac{1}{-j2} + \frac{1}{j1} & \frac{1}{-j1} \\ \frac{1}{-j1} - \frac{2}{-j2} & \frac{1}{j1} + \frac{1}{4} \end{bmatrix}$$

$$= \left(\frac{1}{2} + \frac{1}{-j2} + \frac{1}{j1}\right)\left(\frac{1}{j1} + \frac{1}{4}\right) - \left(\frac{1}{-j1}\right)\left(\frac{1}{-j1} - \frac{2}{-j2}\right)$$

$$= \frac{1}{8} - \frac{5}{8}j$$

$$\Delta V_1 = \begin{bmatrix} \frac{20\angle -90^\circ}{2} & \frac{1}{-j1} \\ 0 & \frac{1}{j1} + \frac{1}{4} \end{bmatrix}$$

$$= \frac{20\angle -90}{2} \times \left(\frac{1}{j1} + \frac{1}{4}\right)$$

$$= -10 - \frac{5}{2}j$$

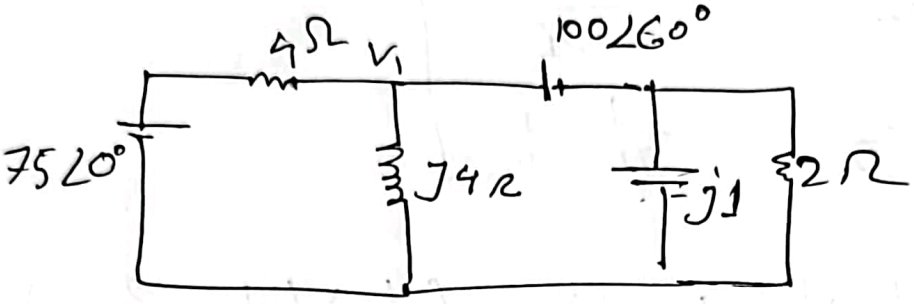
$$\therefore V_1 = \frac{\Delta V}{\Delta V_1}$$

$$= \frac{1/8 - 5/8\,j}{-10 - 5/2\,j}$$

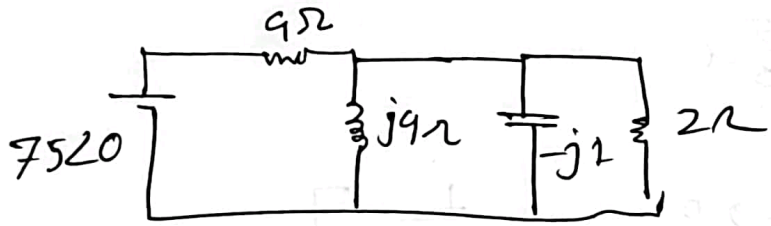
$$= 0.06\angle 87.27^\circ$$

$$\therefore I = \frac{V_1}{-j2} = 7.906\angle 43.49\ A \quad (\text{Ans})$$

Q#10




when 75∠0° is active



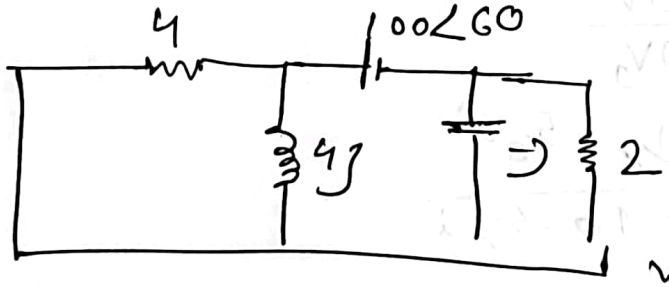

$$Z_1 = 4j \,||\, (-j) \,||\, 2$$

$$= 1.11 \angle -56.3°$$

$$V_1' = V_2 = \frac{Z_1}{Z_1 + 4} \times 75 \angle 0$$

$$= 17.68 \angle -35°$$

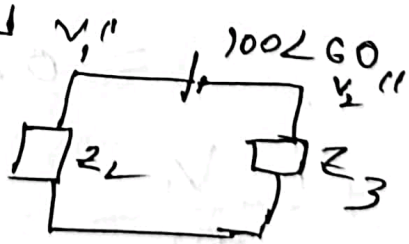
when $100\angle 60°$ is active;




$$Z_2 = 4j \,||\, 4$$

$$Z_3 = -j \,||\, 2$$

$\Rightarrow$



$$V_1'' = \frac{Z_2}{Z_2 + Z_3} \times 100\angle 60$$

$$= 105.41 \angle 78.43^\circ$$

$$V_2'' = 100\angle 60^\circ - V_1''$$

$$= 33.33 \angle -30^\circ$$

$$\therefore V_1 = V_1' + V_1''$$

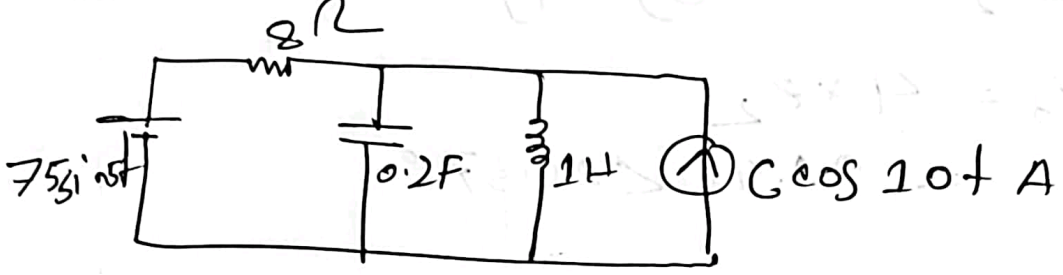
$$= 96.8 \angle 69.7^\circ \text{ V}$$

$$V_2 = V_2' + V_2''$$

$$= 16.88 \angle 165.72^\circ \text{ V}$$

(Ans)

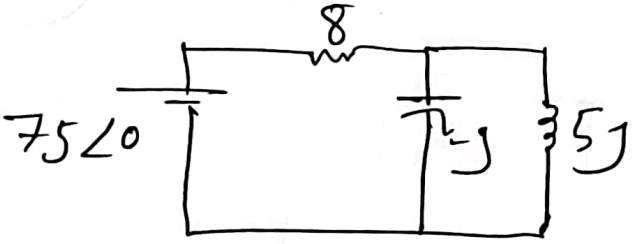
~~Q#12~~




when $75\sin 5t$ is active:

$$\omega = 5$$

$$C_1 = -j \qquad L_1 = 5j$$




$$Z_1 = (-j \,||\, 5j)$$

$$= -5/4\, j$$

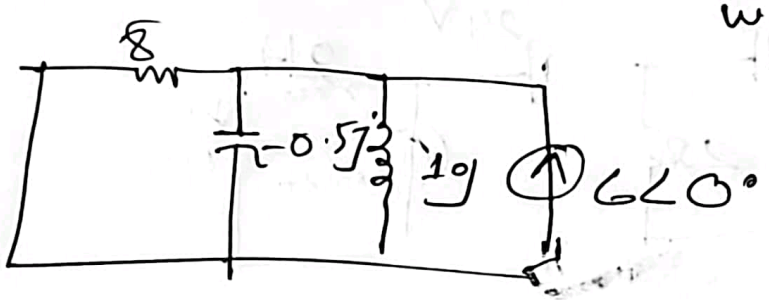
$$V_{o1} = \frac{Z_1}{Z_1 + 8} \times 75\angle 0$$

$$= 11.58\angle -81.12^\circ$$

$$v_{o1} = 11.58 \sin(5t - 81.12^\circ)$$

when $6\cos 10t$ is active

$\omega = 10$ $\quad C_2 = -0.5j$ $\quad L_2 = 10j$




$$Z_{eq} = 8 \| 10j \| (-0.5j)$$

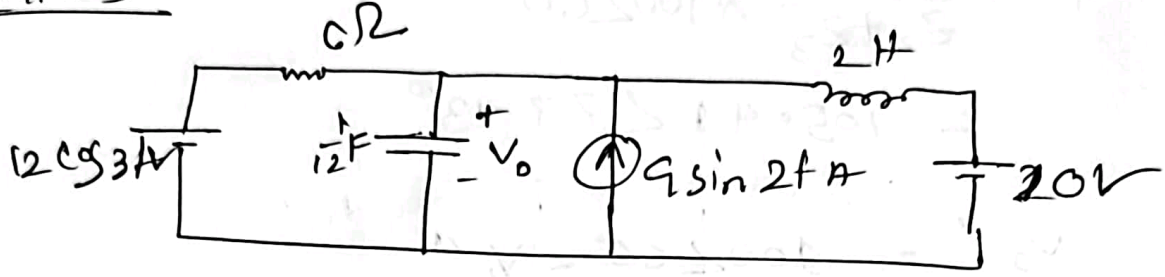
$$V_{o2} = Z_{eq} \times 6\angle 0$$

$$= 3.125\angle -86.24°$$

$$\therefore V_o = V_{o1} + V_{o2} = 11.50\sin(5t - 81.12°) + 3.125\cos(10t - 86.24°)$$

(Ans)

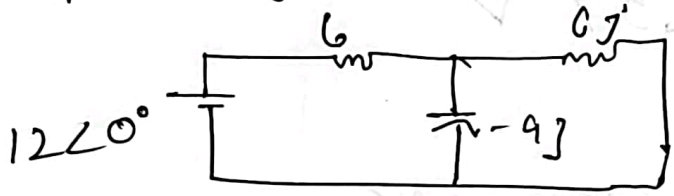
Q#13




when 12cos3t is active

$$w = 3$$

$$Z_1 = -4jΩ \qquad L_1 = 6j$$



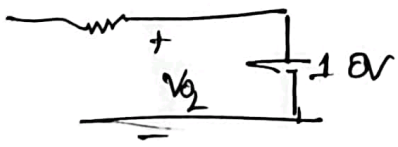

$$Z_1 = 6j \,||\, (-4j)$$

$$= -12j$$

$$V_o = \frac{Z_1}{Z_1 + 6} \times 12\angle 0$$

$$= 10.73\angle -26.57$$

when 10V is active



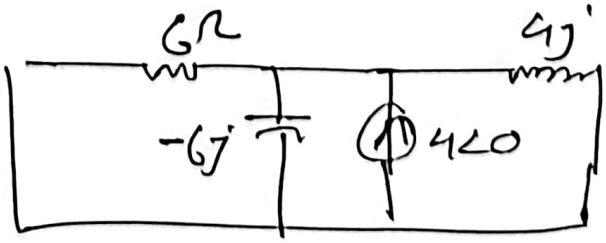

$$V = 10V$$

when 4sin 2t A is active

$$w = 2$$

$$C_2 = \frac{1}{12} = -6j$$

$$L_2 = 4j$$



$$Z_2 = 6 \| (-6j) \| 4j$$

$$V_3 = 4 \times Z_2$$

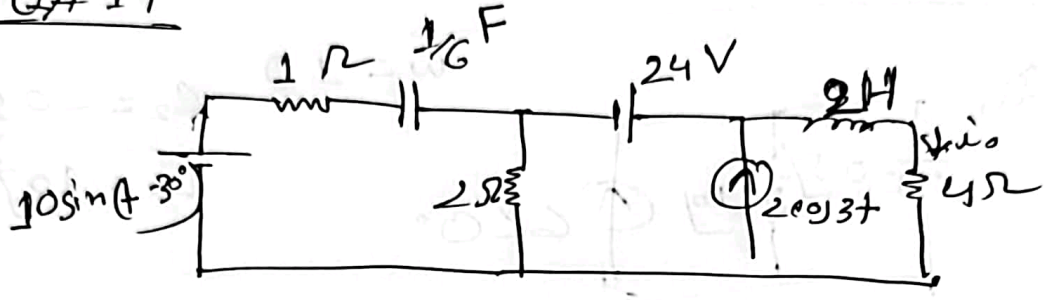
$$= 21.46 \angle 26.57°$$

$$\therefore V_o = V_1 + V_2 + V_3$$

$$= 10\sqrt{3} \cos(3t - 26.57°) + 10 + 21.46 \sin(2t + 26.57°)$$

(Ans)

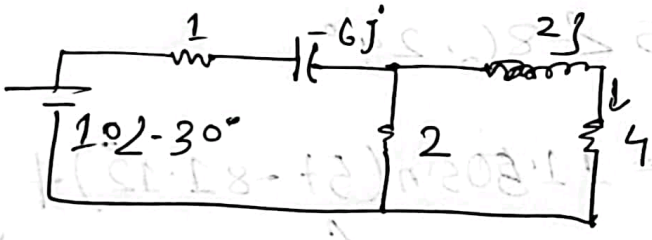
Q#14




when $10\sin(t-30°)$ is active

$$\omega = 1$$

$$C_1 = -6j \qquad L_1 = 2j$$



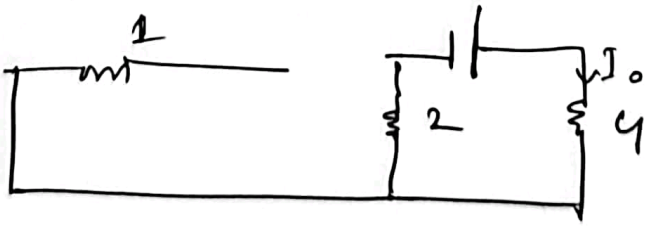

$$Z_1 = 2 \,||\, (2j+4)$$

$$V_1 = \frac{Z_1}{Z_1 + 1 - 6j} \times 10\angle -30$$

$$i_{o_1} = \frac{V}{2j+4}$$

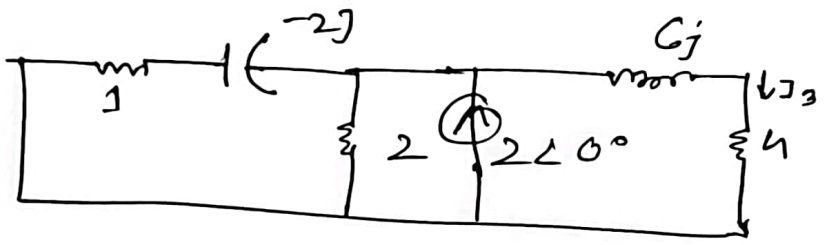
$$= 0.504\angle 19.09°$$

when 24V is active




$$i_{o_2} = \frac{24}{6} = 4$$

when $2\cos 3t$ is active:




$$\omega = 3$$

$$C_2 = -2j$$

$$L_2 = 6j$$

$$\therefore i_{o_3} = \frac{(6j+4)^{-1}}{(6j+4)^{-1} + 2^{-1} + (1-2j)^{-1}}$$

$$= 0.3352 \angle -76.43^\circ$$

$$\therefore i = i_{o_1} + i_{o_2} + i_{o_3}$$

$$= 0.504\sin(t+19.1^\circ) + 4 + 0.3352\cos(3t-76.43^\circ)$$

(Ans)