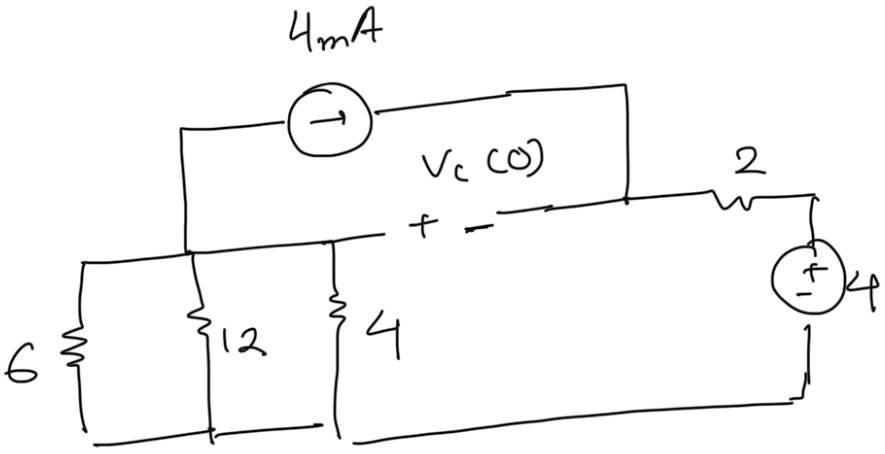
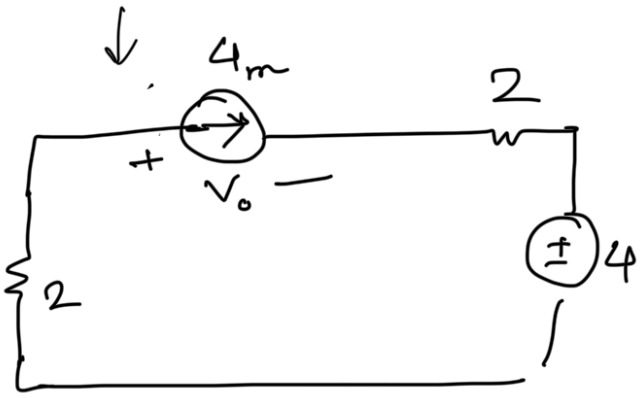
SET B

(1)

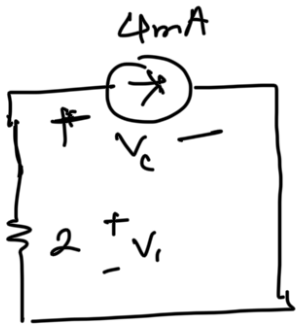




(a) $V_c(0) = -2 \times 4 - 4 - 2 \times 4 = -20\,V$

[3]

(b)



[3]

$V_c(\infty) = -8V$

So, $\tau = 0.2\,s$

(c) $R_{eq} = 2k\Omega$

[3]

$C_{eq} = 100\mu F$ So, $5\tau = 1s$

(d) for $t<0$ $V_c(t) = 4V$

[3]

for $t>0$ $V_c(t) = -8 + (-20+8)e^{-t/0.2}$

$= -8 - 12e^{-t/0.2}$

(e) $I_c(t) = 0$ for $t<0$

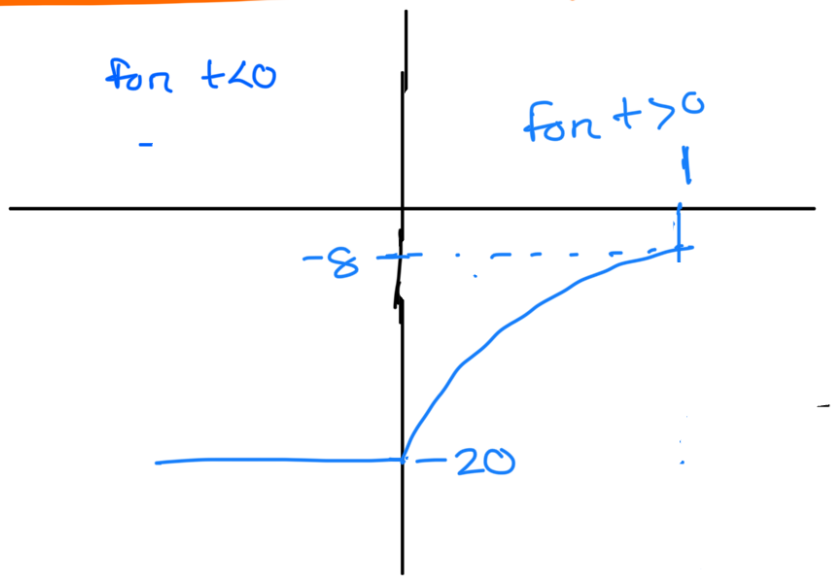
[2]

$I_c(t) = 100\times10^{-6}(-12e^{-t/0.2}) \times \left(-\frac{1}{0.2}\right)$

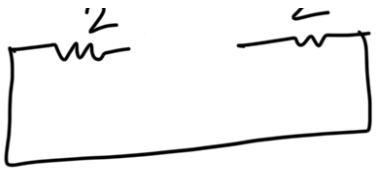
$I_c(t) = 6\times10^{-3}e^{-t/0.2}$

(f)

[3]



(g) [3]



$R_{eq} = 4k$

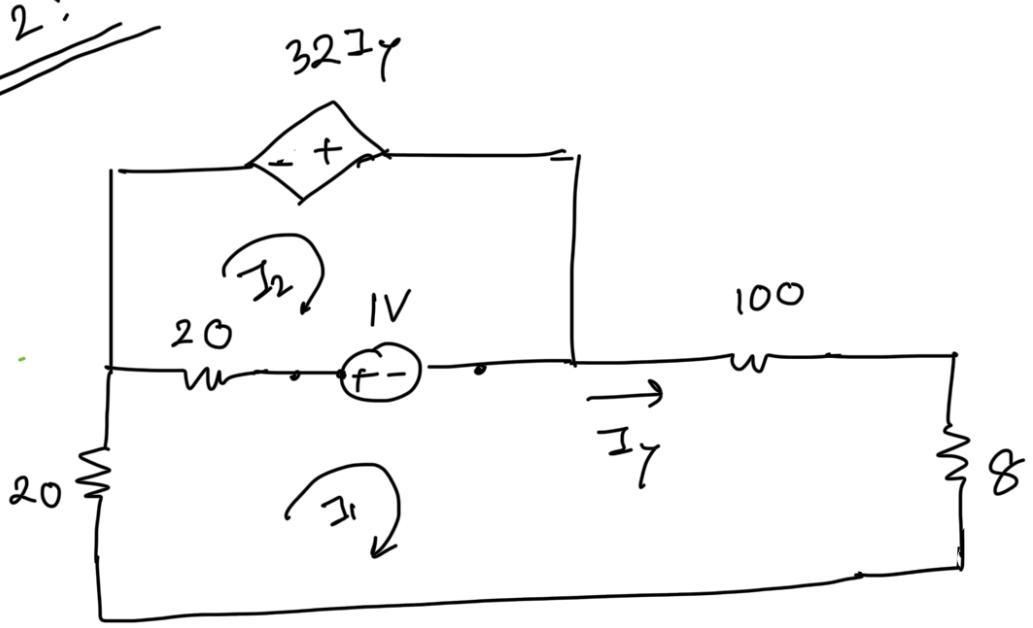
$C_{eq} = 100\mu F$

$\tau = 0.4s$

$\therefore 5\tau = 2s$

Ques 2:

(a) [7]



$I_y = I_1$

$148 I_1 - 20 I_2 + 1 = 0$

$148 I_1 - 20 I_2 = -1$

$20 I_2 - 20 I_1 - 1 - 32 I_y = 0$

$20 I_2 - 20 I_1 - 1 - 32 I_1 = 0$

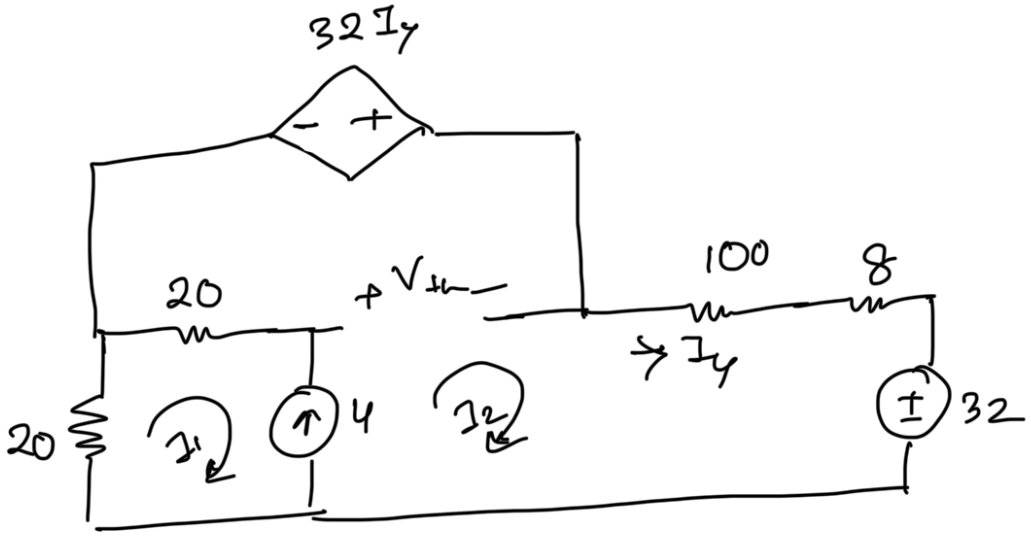
$-52 I_1 + 20 I_2 = 1$

$I_1 = 0 \quad , \quad I_2 = \frac{1}{20}$

$$R_{th} = \frac{1}{I_2 - I_1} = 20.52$$

(b) [8]

V_{th}



$I_y = I_2$

$I_2 - I_1 = 4$

$20I_1 - 32I_y + 108I_2 + 32 = 0$

$20I_1 - 32I_2 + 108I_2 = -32$

$20I_1 + 76I_2 = -32$

$I_1 = -3.5\ mA$, $I_2 = 0.5\ mA$

$-32I_y - V_{th} + 20(I_2 - I_1) = 0$

$\therefore V_{th} = -32I_2 + 20(I_2 - I_1)$

$$V_{th} = 64V$$

$$P_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{64^2}{4 \times 20}$$

$$P_{max} = 51.2\ \omega$$

Ques 3:

(i) [4]

$$\frac{4 \times 10^3}{4 \times 10^3 + Z} \times 0\angle 55 = 3\angle 125.5$$

$$Z = 5.682 - 11311.698j$$

$$= 11311.7\angle -89.97^\circ k\Omega$$

[1] (ii) R, C

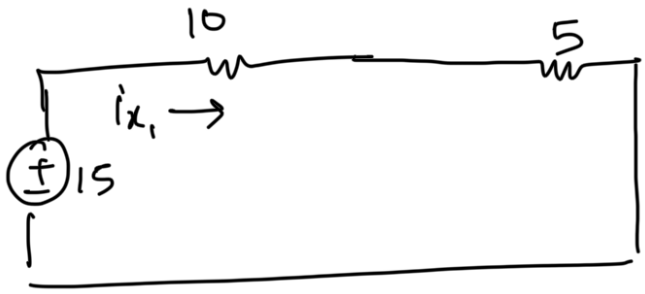
[1] (iii)

$$\frac{1}{\omega C} = 11311.698$$

$$C = 1.77\ \mu F$$

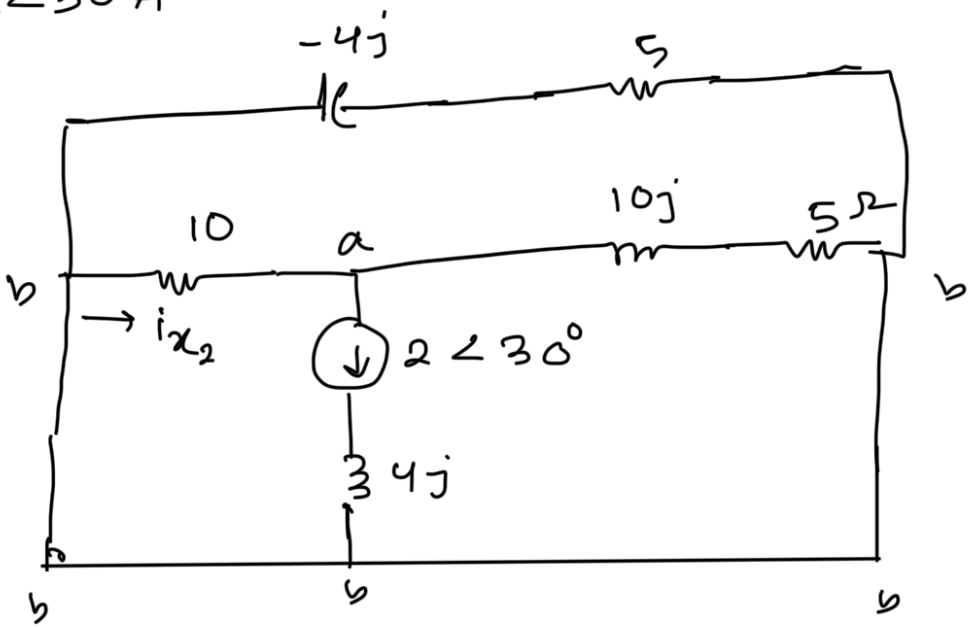
(b) 15V active:

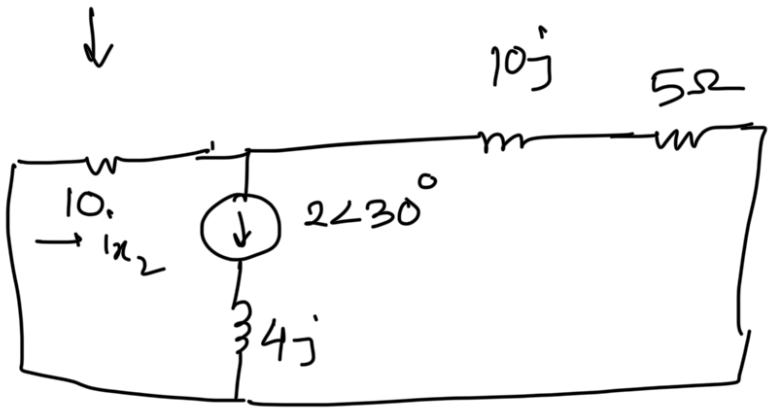
[14]



$$i_{x_1} = \frac{15}{15} = 1$$

$2\angle 30^\circ A$ active



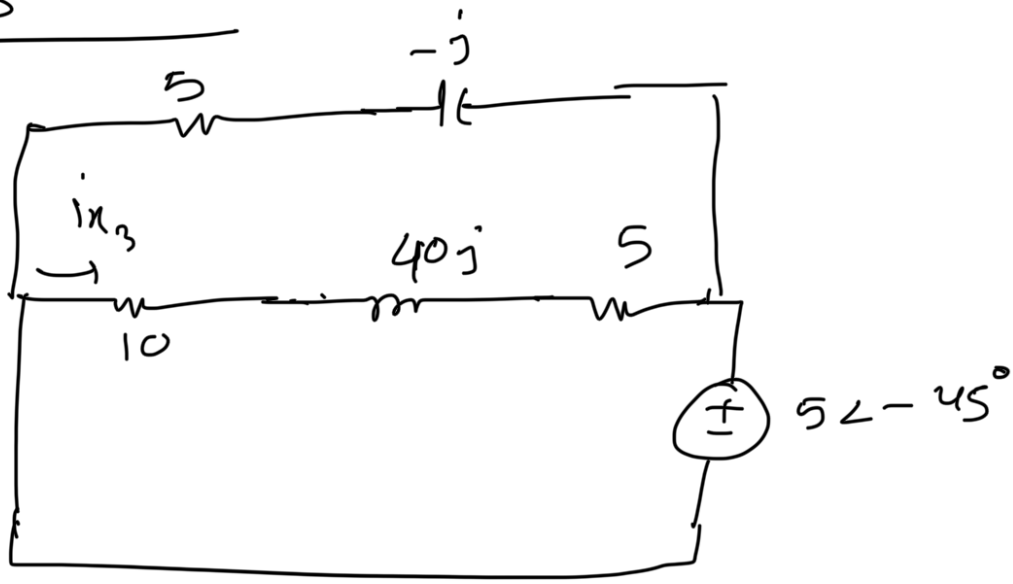


$$\therefore i_{x_2} = \frac{10^{-1}}{10^{-1} + (5+10j)^{-1}} \times 2\angle 30^\circ$$

$$= 1.24 \angle 59.74^\circ$$

$$\therefore i_{x_2} = 1.24 \sin(2t + 59.74^\circ)$$

$5\angle -45^\circ$ active:



$$\text{So, } i_{x_3} = -\frac{5\angle -45^\circ}{10 + 40j + 5}$$

$$= 0.11 \angle -114.44^\circ$$

$$i_{x_3} = 0.11 \cos(8t - 114.44)$$

So, $i_x = i_{x_1} + i_{x_2} + i_{x_3}$

$$= 1 + 1.24 \sin(2t + 59.74^\circ) + 0.11 \cos(8t - 114.44^\circ)$$