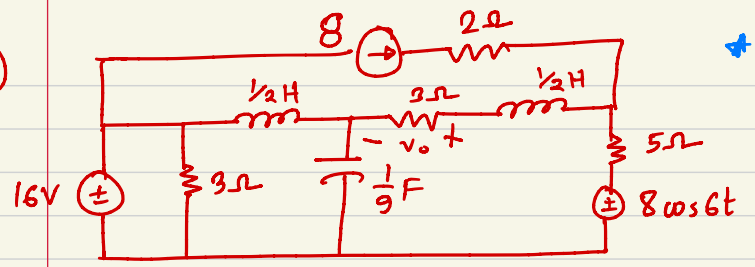
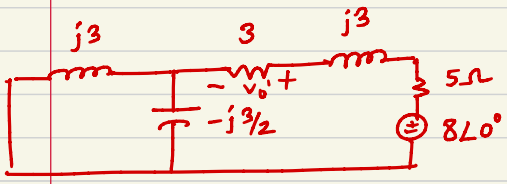
Q



* Set-1

① v_o'



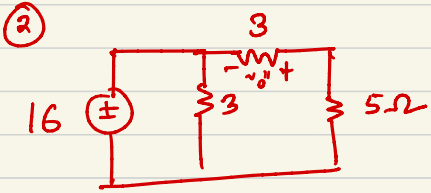
$j3 \parallel -j1.5 = -j3$

$$v_o' = \frac{3}{8+j3-j3} 8\angle 0^\circ$$

$$= 3\angle 0^\circ$$

$$v_o' = 3\cos 6t$$

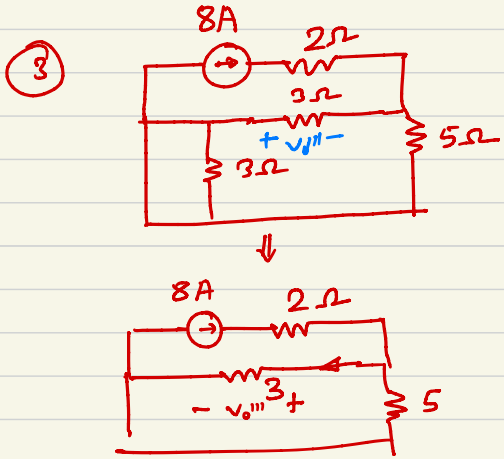
② v_o''



$$v_o'' = \frac{-3}{3+5} \times 16$$

$$= -6V$$

③



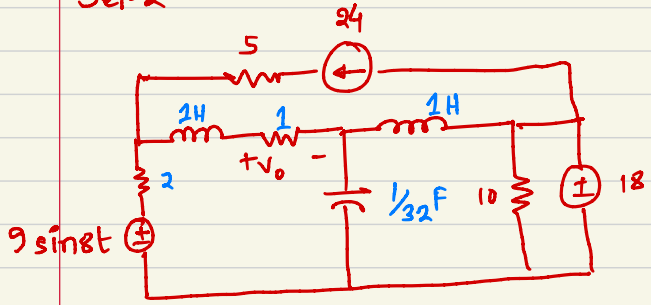
current through $3\Omega = \frac{5}{5+3} \times 8$

$$= 5A$$

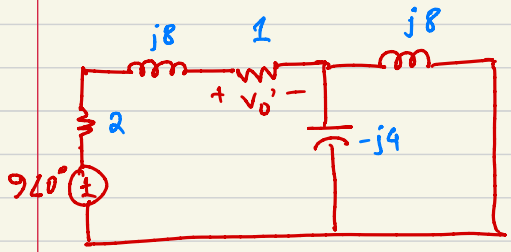
$v_o''' = +15V$

Ans: $9 + 3\cos 6t$ V

Set-2



①



$-j4 \| j8 = -j8$

$$v_o' = \frac{1}{3+j8-j8} \, 9\angle 0^\circ$$

$$= 3\angle 0^\circ$$

$$v_o' = 3\sin 8t$$

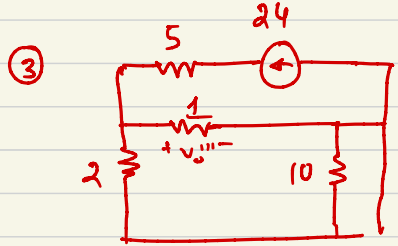
②

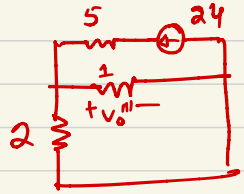
$$v_o' = -\frac{1}{2+1} \times 18$$

$$= -6V$$

Ans: $3\sin 8t + 10V$

③





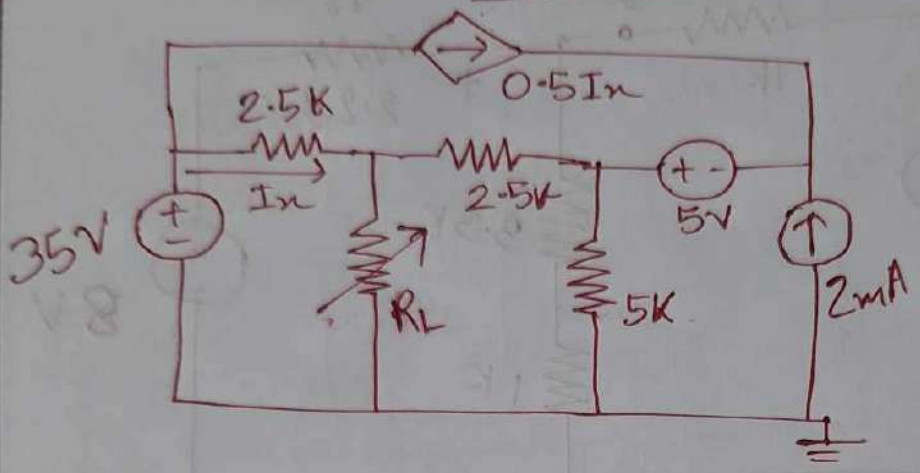
current through $1\Omega = \frac{2}{2+1} \times 24$

$= 16A$

$v_o''' = 16V$

Final, Fall'23

Set-A



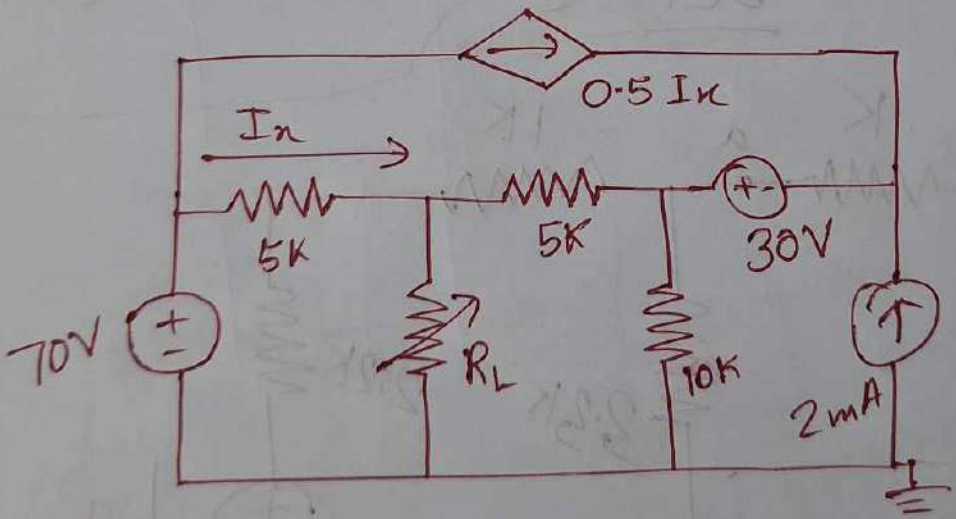
i) $R_L = ?$ [for max power.]

ii) $P_{max} = ?$

Ans→

V_{oc}	I_{sc}	R_{th}	P_{max}
30V	20mA	1.5K	150mW

Set-B



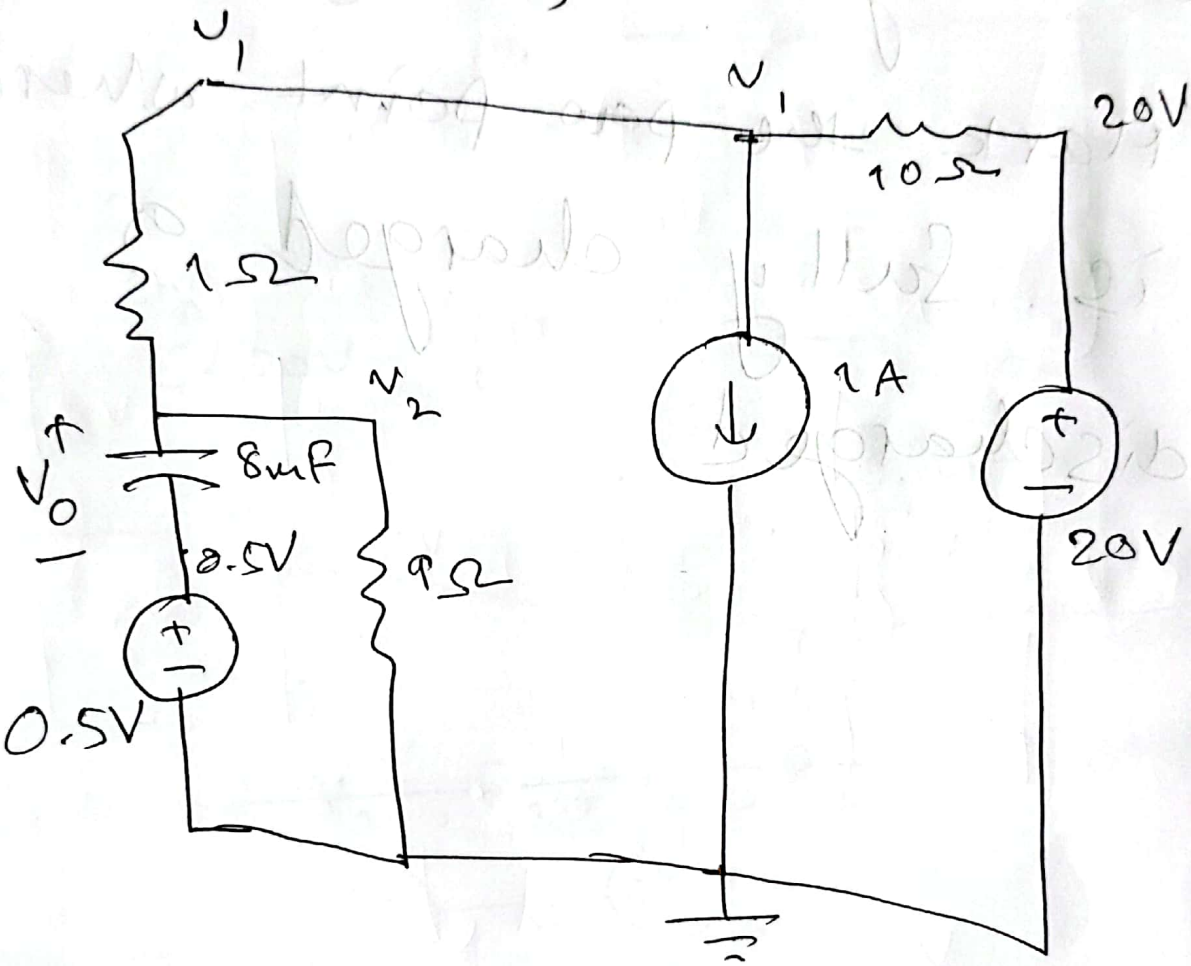
i) $R_L = ?$ [for max power]

ii) $P_{max} = ?$

Ans→

V_{oc}	I_{sc}	R_{th}	P_{max}
60V	20mA	3KΩ	300mW

(a) For $t < 0$,



$$\frac{v_1}{10} + 1 + \frac{v_1 - 20}{10} = 0$$

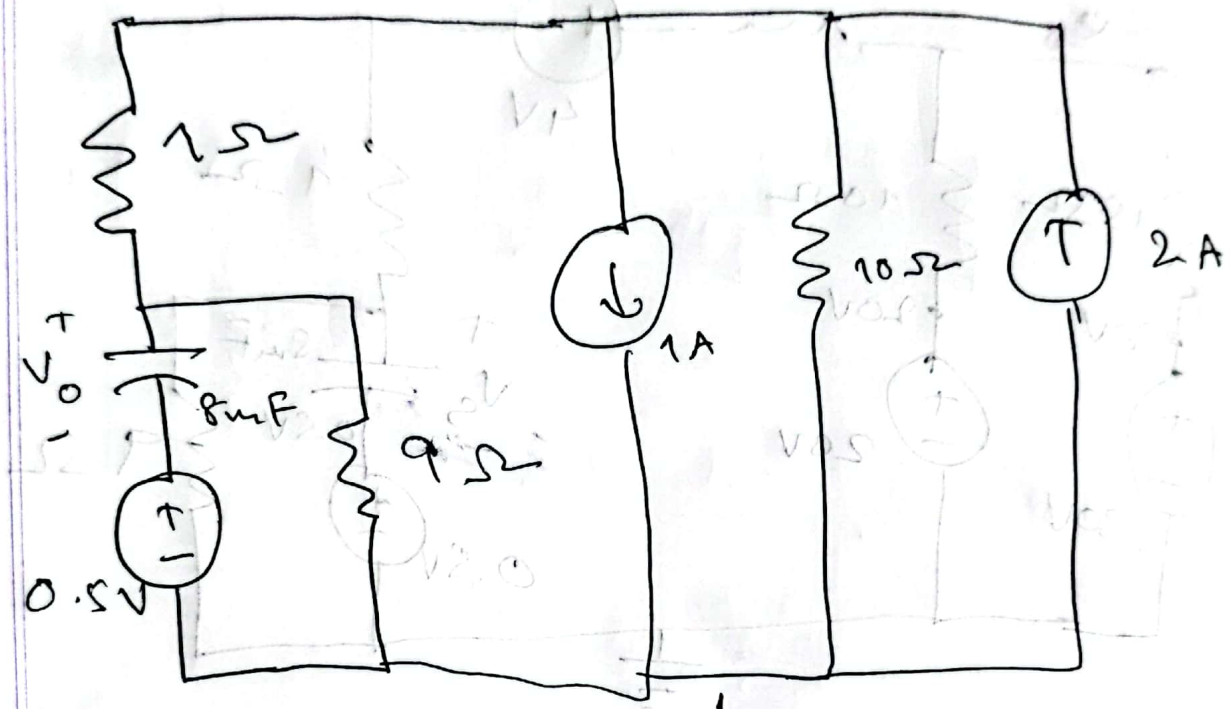
or, $v_1 = 5V$

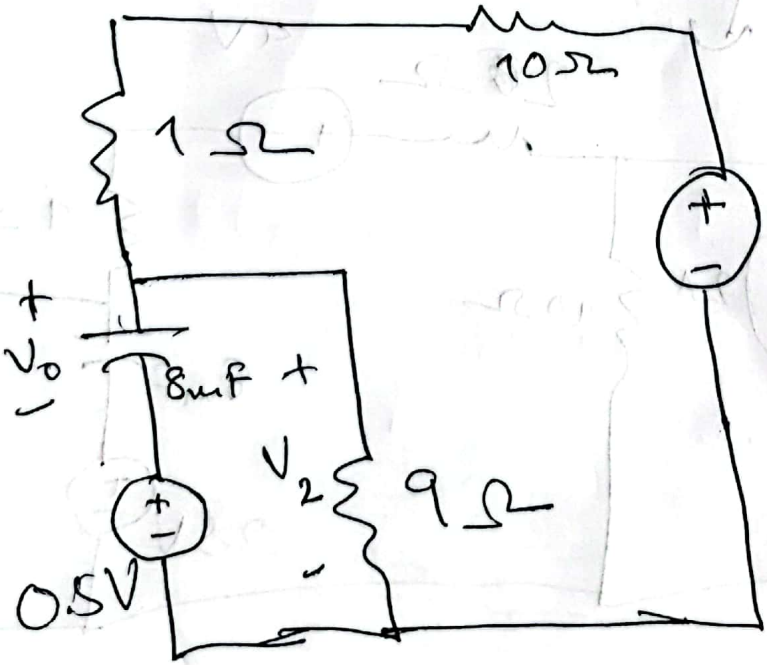
$$v_2 = \frac{9}{1+9} \times 5 = 4.5V$$

$\therefore V_o = 4.5V - 0.5V = 4V$

$i_c(0) = 0A$

Using source transformation,





$$V_2 = \frac{9}{10+1+9} \times 10$$

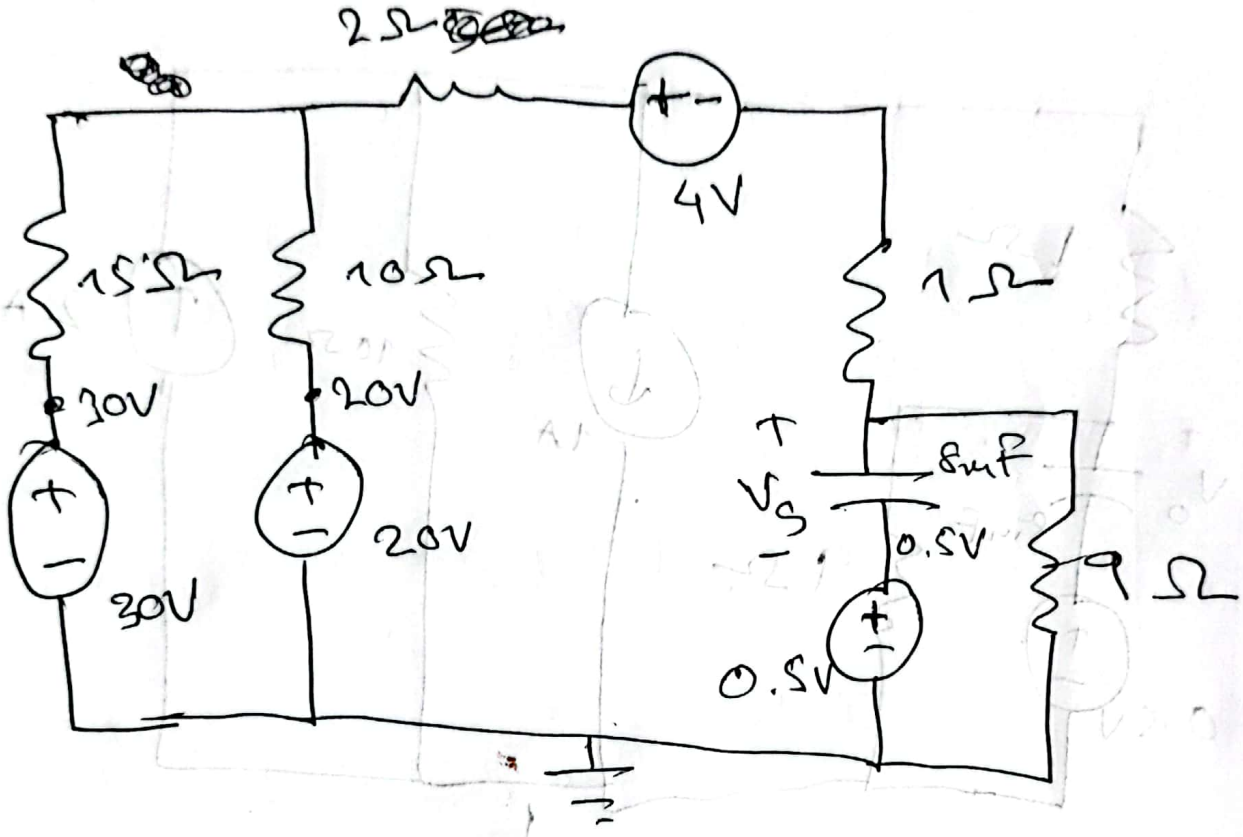
$$= 4.5V$$

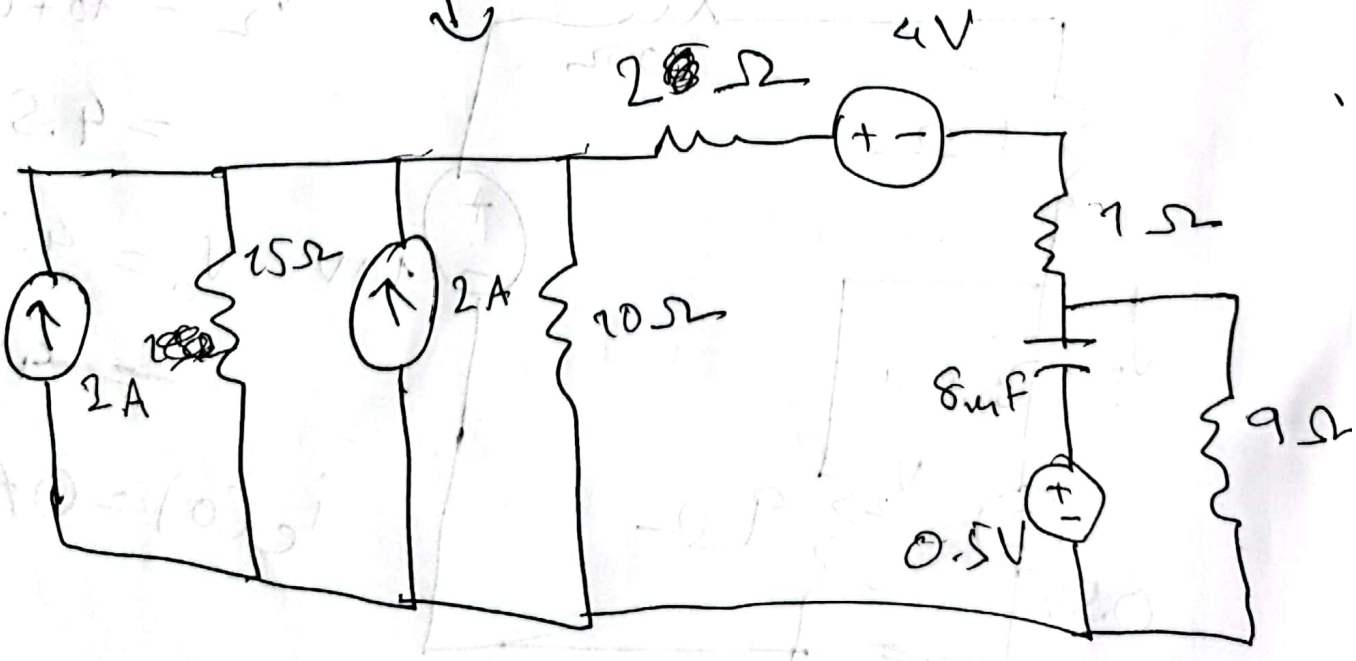
$$V_o = 4.5 - 0.5$$

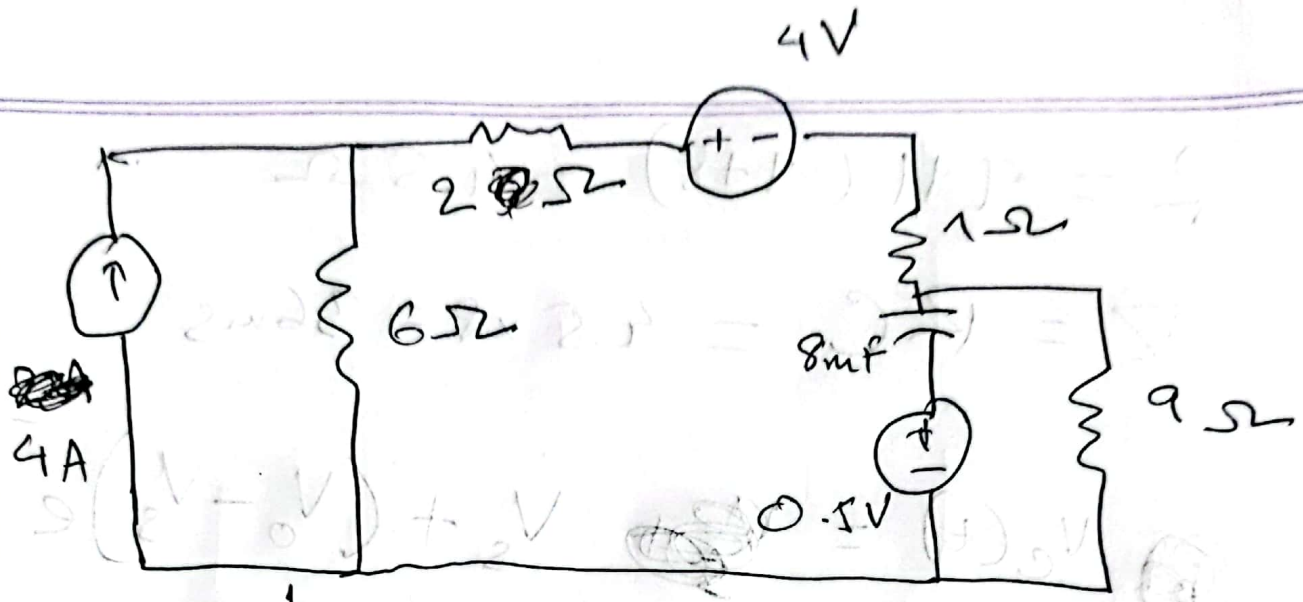
$$= 4V$$

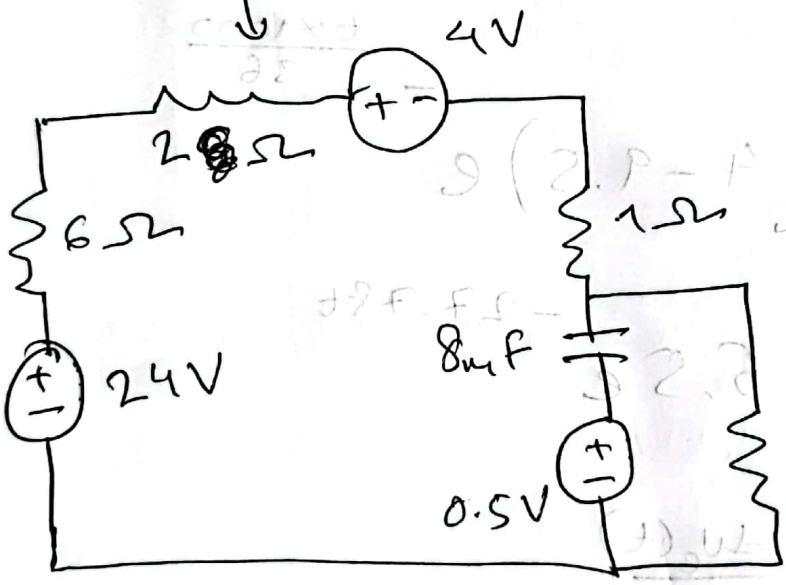
$$i_c(0) = 0A$$

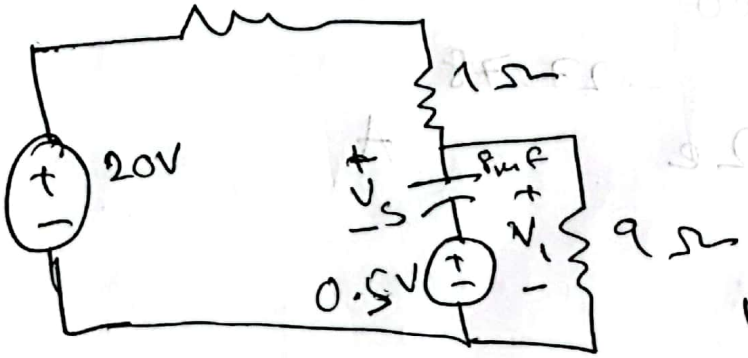
For $t > 0$,


2Ω
4V
15Ω
10Ω
1Ω
30V
20V
20V
30V
8mF
V_S
0.5V
9Ω
0.5V


4V
2Ω
15Ω
2A
2A
10Ω
1Ω
8mF
9Ω
0.5V







$$V_1 = \frac{9}{9+1+8} \times 20$$

~~8.57V~~

$= 10V$

$V_s = 10 - 0.5$

$= 9.5V$

$$R = 9 \,||\, (1+8) = 4.5\,\Omega$$

$$\tau = RC = 4.5 \times 8 = 36\text{ms}$$

$$v_c(t) = V_s + (V_0 - V_s)e^{-\frac{t}{\tau}}$$

$$= 9.5 + (4 - 9.5)e^{-\frac{t \times 1000}{36}}$$

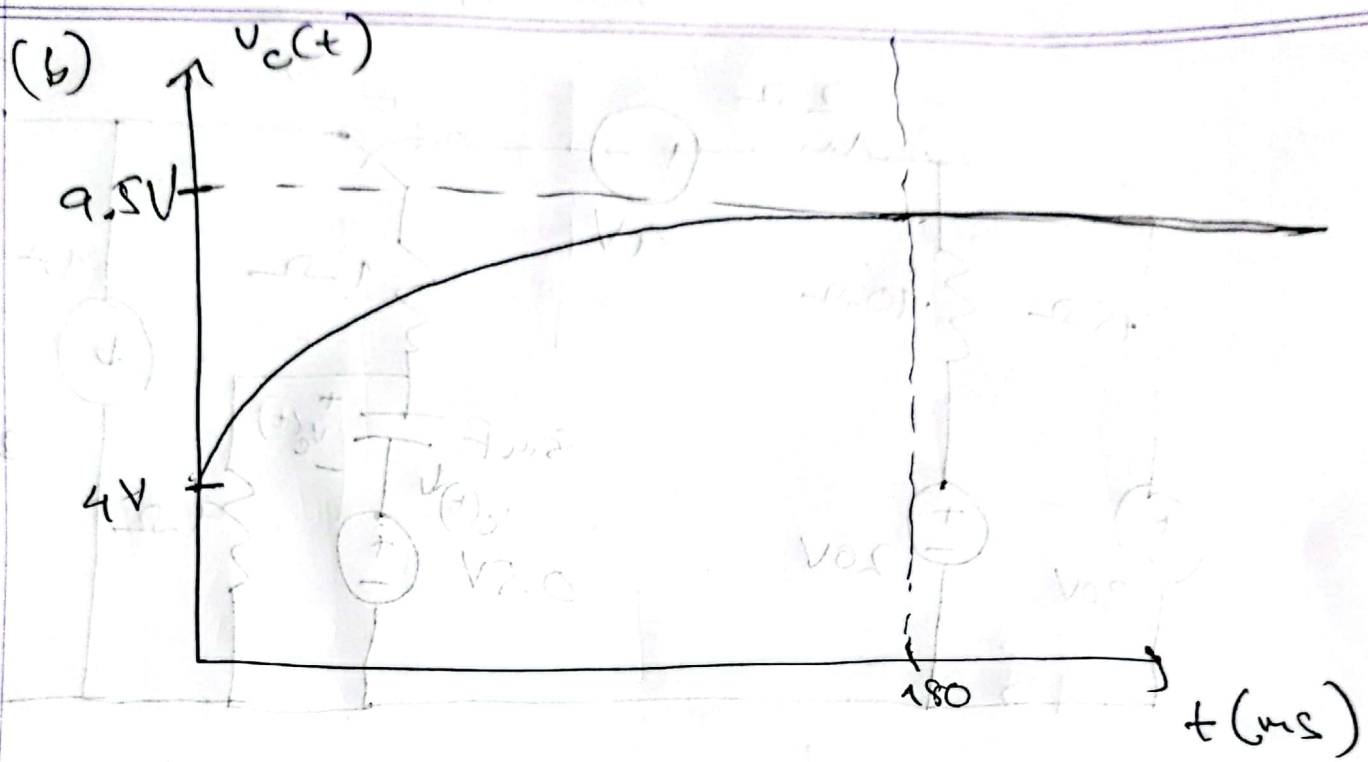
$$= 9.5 - 5.5e^{-27.78t}$$

$$i_c(t) = C\frac{dv_c(t)}{dt}$$

$$= \frac{8}{1000} \times (-5.5)(-27.78)e^{-27.78t}$$

$$= 1.22e^{-27.78t}\ A$$

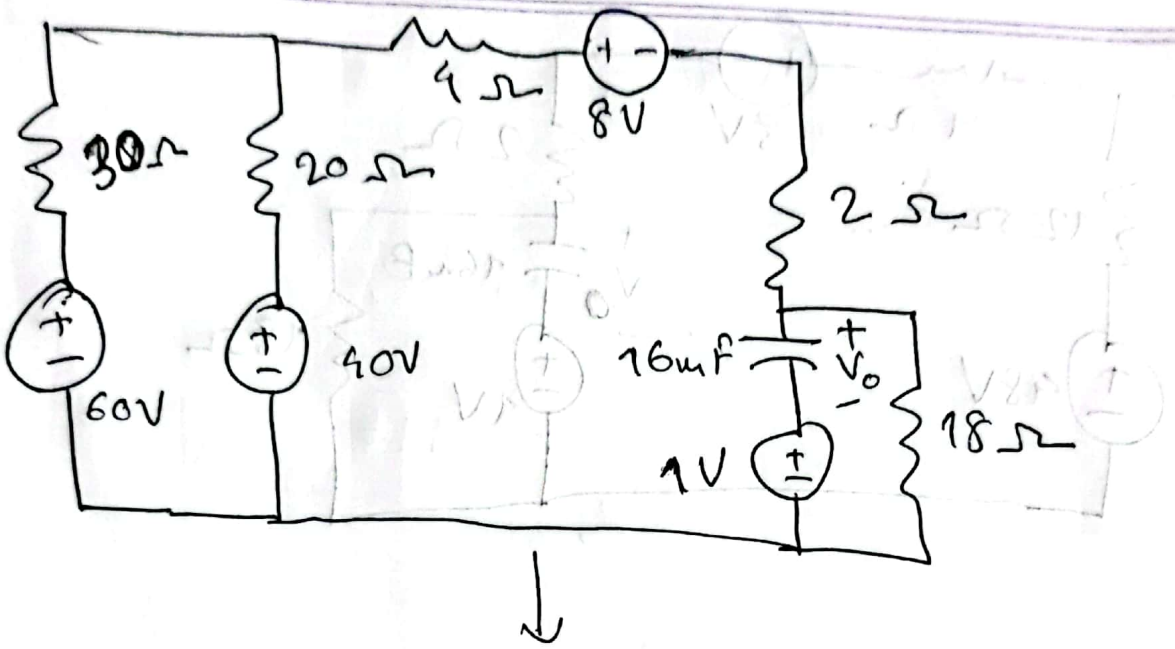
(b)

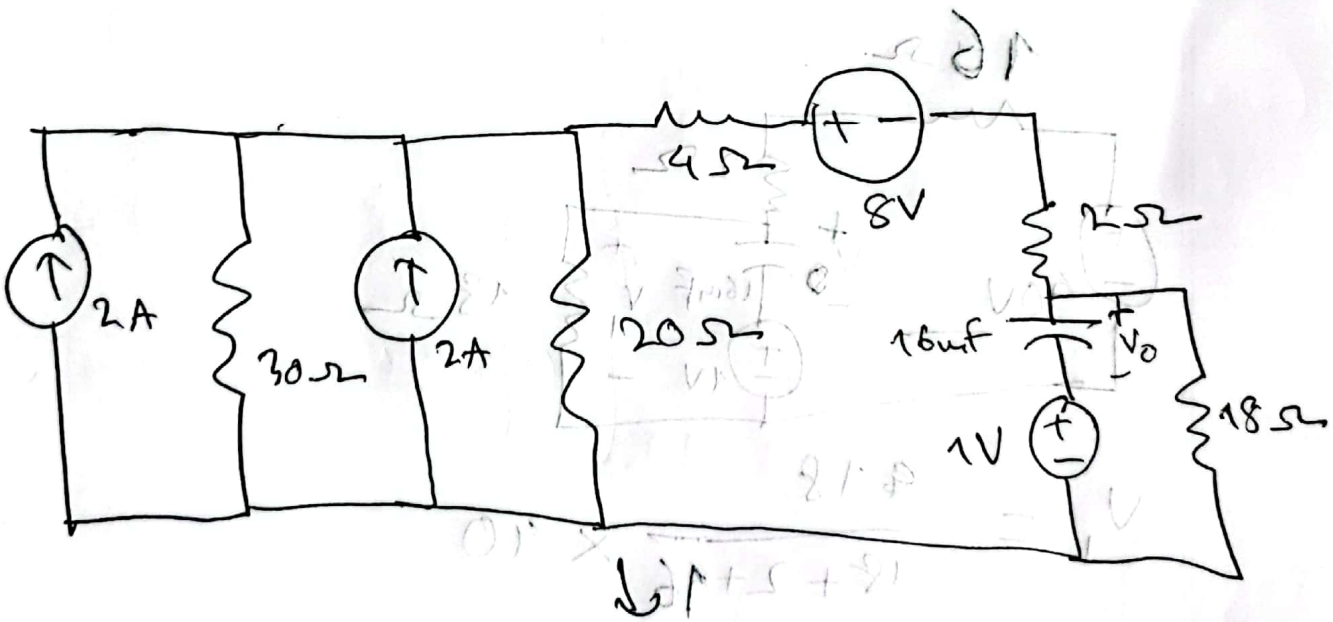


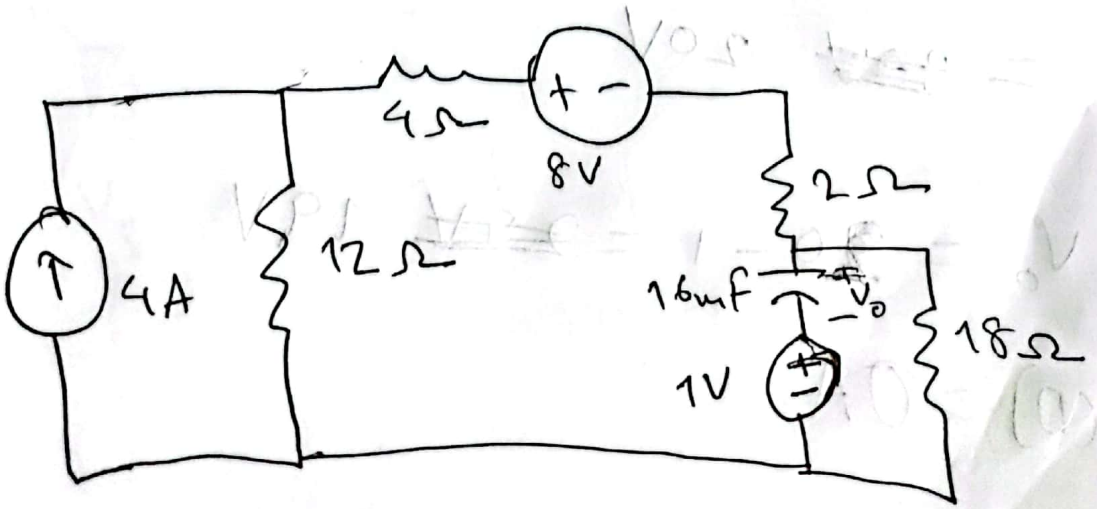
$5\tau = 180ms$

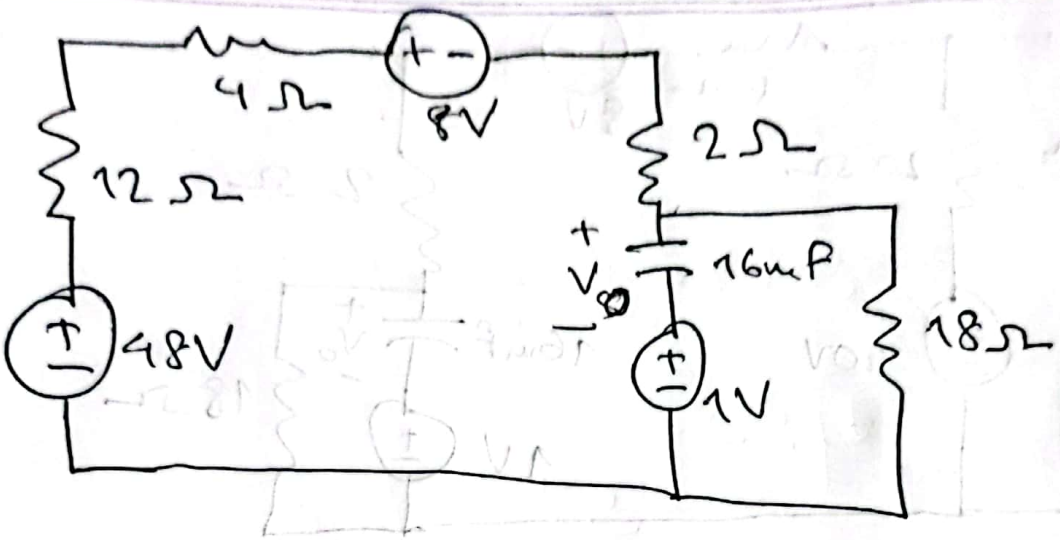
C is charging

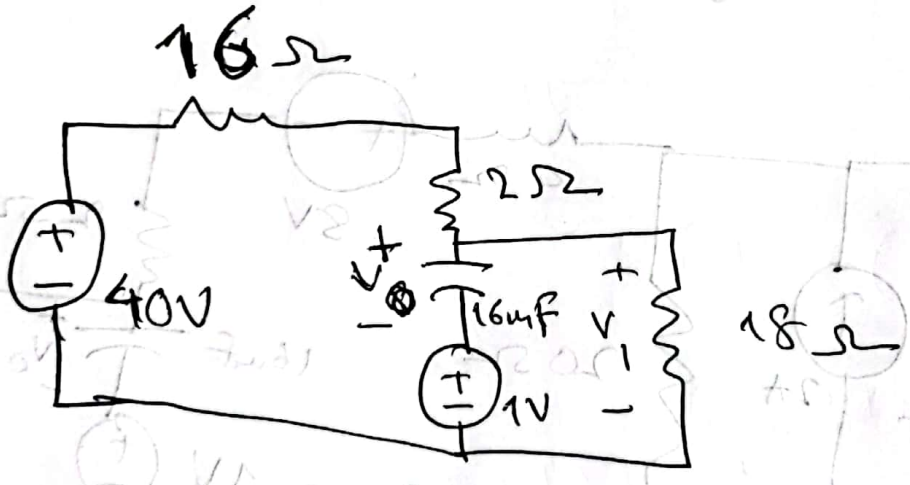
For $t < 0$,


4Ω
8V
30Ω
20Ω
2Ω
60V
40V
16mF
V_o
18Ω
1V


4Ω
8V
2Ω
2A
30Ω
2A
20Ω
16mF
V_o
1V
18Ω


4Ω
8V
2Ω
4A
12Ω
16mF
V_o
18Ω
1V





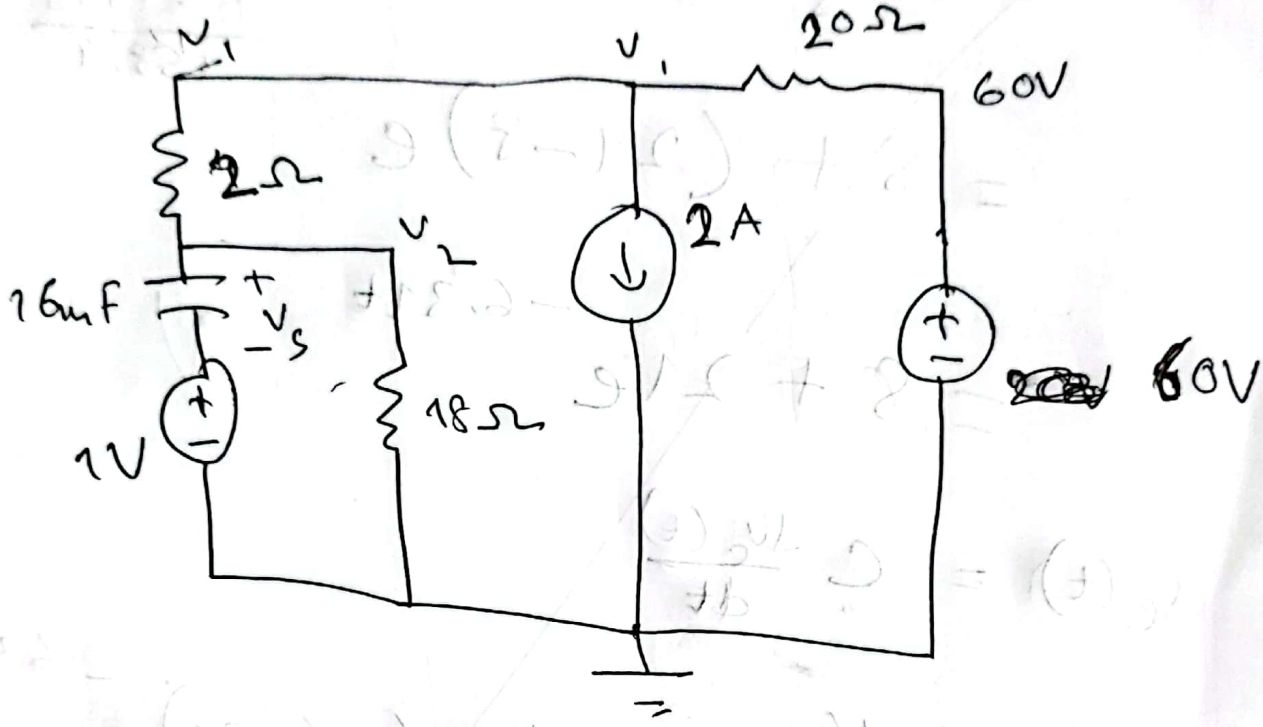
$$V_1 = \frac{18}{18+2+16} \times 40$$

$$= 20V$$

$$\therefore V_o = 20 - 1 = 19V$$

$$i_c(0) = 0A$$

For $t < 0$,



$$\frac{v_1}{2+18} + 2 + \frac{v_1 - 60}{20} = 0$$

or, $v_1 = 10V$

$$v_2 = \frac{18}{18+2} \times 10 = 9V$$

$\therefore v_s = 9 - 1 = 8V$

$R = 18 \| (2+20) = 9.9\Omega$

$\tau = RC = 9.9 \times 16 = 158.4ms$

$$v_c(t) = V_s + (V_0 - V_s)\, e^{-\frac{t}{\tau}}$$

$$= 8 + (19 - 8)\, e^{-\frac{t \times 1000}{158.4}}$$

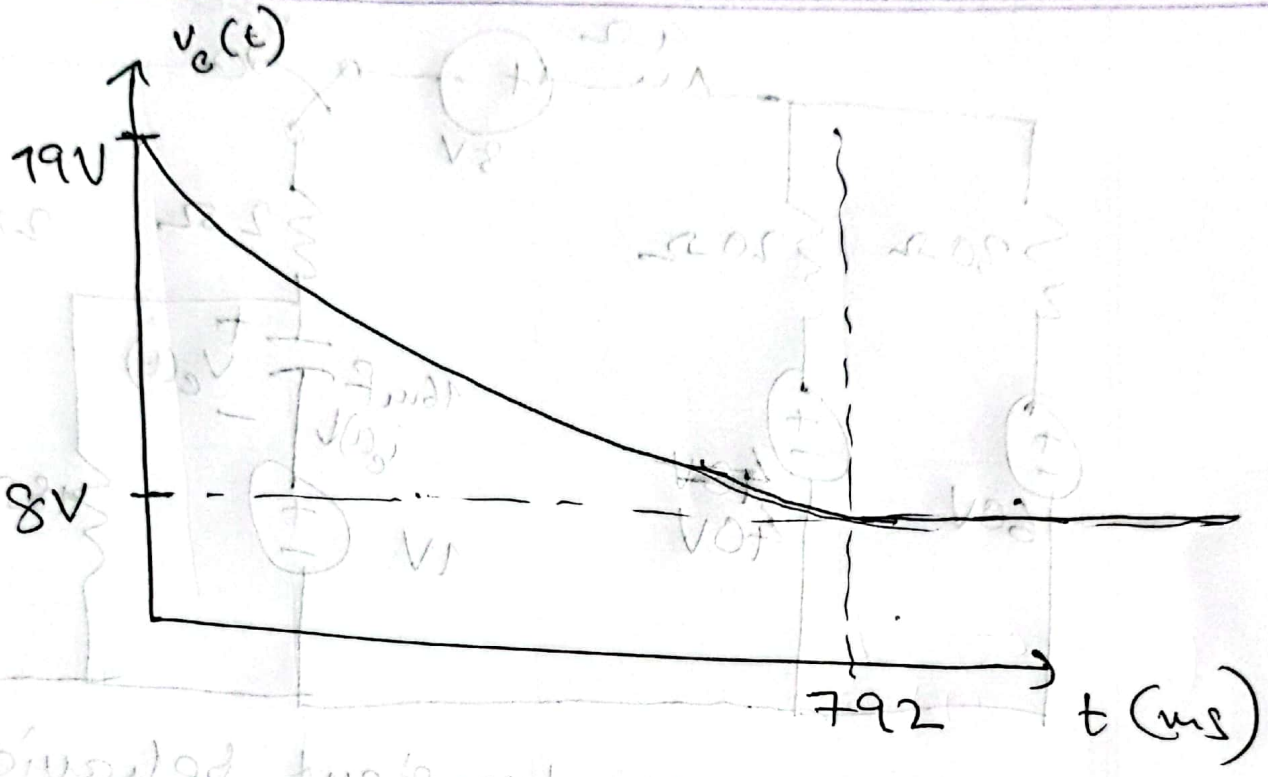
$$= 8 + 11\, e^{-6.31t} \quad V$$

$$i_c(t) = C \frac{dv_c(t)}{dt}$$

$$= \frac{16}{1000} \times 11 \times (-6.31)\, e^{-6.31t}$$

$$= -1.11\, e^{-6.31t} \quad A$$

(b)



$5\tau = 792ms$

Capaciter is discharging