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Day

Time : Date : / /

Name: Tanjim Reza

Student ID: 20101065

Course: CSE250

Section: CSE06

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Ans: to the que no: 01

Superposition Theorem: The Superposition theorem states that if a circuit has multiple voltage or current sources then it is the same to the sum of the simplified circuit when only one of the sources is alive. More specifically, If more than one source acts simultaneously in an electric circuit then the current through any of the branches of the circuit is the summation of currents which would flow through the branch for each source while keeping all the other sources dead.

Firstly, we look into the equations of voltage, current and power. (sum)

$$V_1 + V_2 = V_{total}$$

$$I_1 + I_2 = I_{total}$$

$$I^2R + I^2R \neq I^2R_{total}$$

For voltage and current we have linear equations thus we can add them up directly but as $(a+b)^2 \neq a^2+b^2$ we can not do this for I^2R or $\frac{V^2}{R}$. That's why it works for voltage and current but not for power.

Ans: to the que no: 02

From the superposition theorem, we know we have to enable one source and kill every other source at a time so that we can calculate everything as if that enabled source is the only one working.

Noteworthy:

Voltage Source → Short circuit
Current Source → Open circuit

So,
Step: 01 Mark all the sources (independent)

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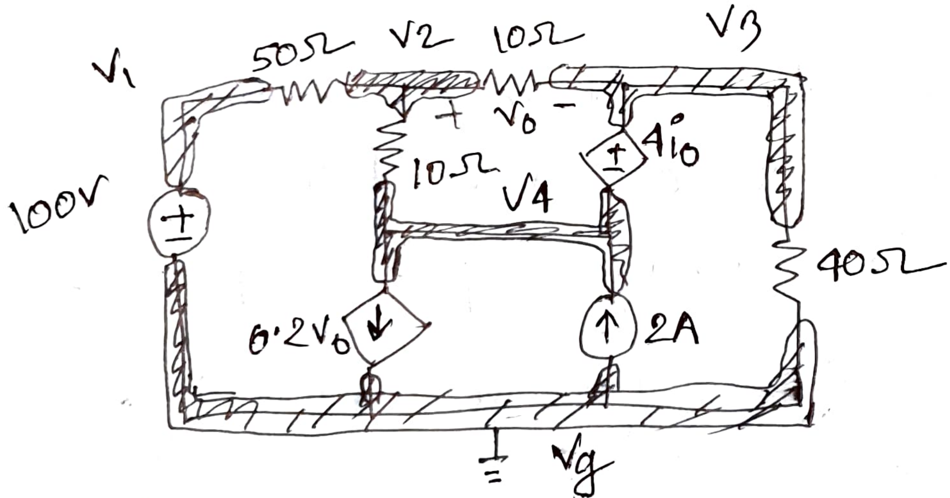
Step 02: Keep one alive, kill rest (sources of course)

Step 03: Perform our noteworthy operation

Step 04: Nodal Analysis / Calculate results

Step 05: Repeat until all independent sources are done one by one.

Ans: to the que no: 03



Already have on V_0 so keeping ground node as V_g

$$V_g = 0$$

$$\therefore V_1 = 100\,V$$

$$V_0 = V_2 - V_3$$

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$$V_2\left(\frac{1}{50}+\frac{1}{10}+\frac{1}{10}\right)-\frac{V_1}{50}-\frac{V_4}{10}-\frac{V_3}{10}=0$$

$$V_3\left(\frac{1}{10}+\frac{1}{40}\right)+V_4\left(\frac{1}{10}\right)-\frac{2V_2}{10}-\frac{V_g}{40}-0.2V_0=0$$

For $4i_0$

$$V_3-V_4=4i_0$$

$$\Rightarrow V_3-V_4=4\left(\frac{V_2-V_4}{10}\right)$$

$$\Rightarrow 5V_3-2V_2-3V_4=0$$

Solving the equations.

$V_1=100$

$V_2=21.5686$

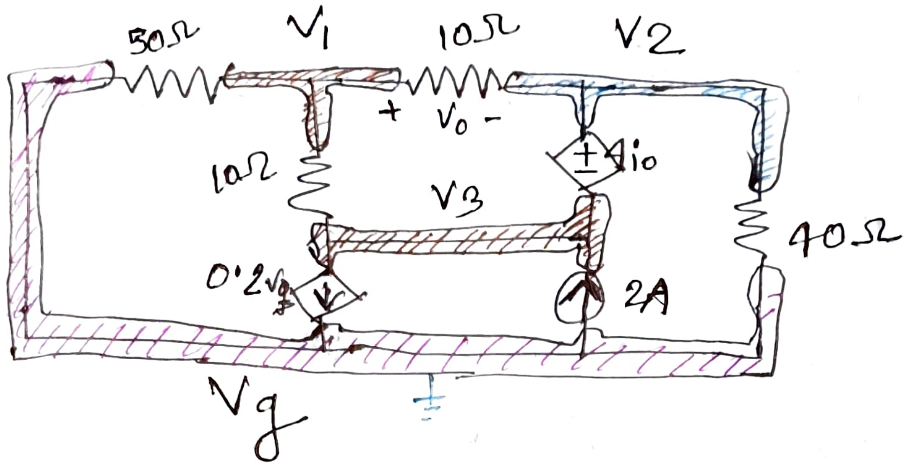
$V_3=15.686$

$V_4=11.7647$

$V_0=21.5686-15.686$

$=5.88$

Ans: to the que no:04



$$V_1\left(\frac{1}{50}+\frac{1}{10}+\frac{1}{10}\right)-\frac{V_g}{50}-\frac{V_3}{10}-\frac{V_2}{10}=0$$

$$V_2\left(\frac{1}{10}+\frac{1}{40}\right)+V_3\left(\frac{1}{10}\right)-\frac{V_1}{10}-\frac{0}{40}-\frac{V_1}{10}+0{\cdot}2V_o-2=0$$

$$V_1-V_2=V_o$$

For 4io

$\cancel{5V_3}$ $V_2-V_3=4i_o$

$$\Rightarrow V_2-V_3=4\left(\frac{V_1-V_3}{10}\right)$$

$$\Rightarrow 5V_2-3V_3-2V_1=0$$

Solving the equations

$V_1 = 62{\cdot}74$

$V_2 = 67{\cdot}45$

$V_3 = 70{\cdot}58$

$V_0 = -4{\cdot}71$

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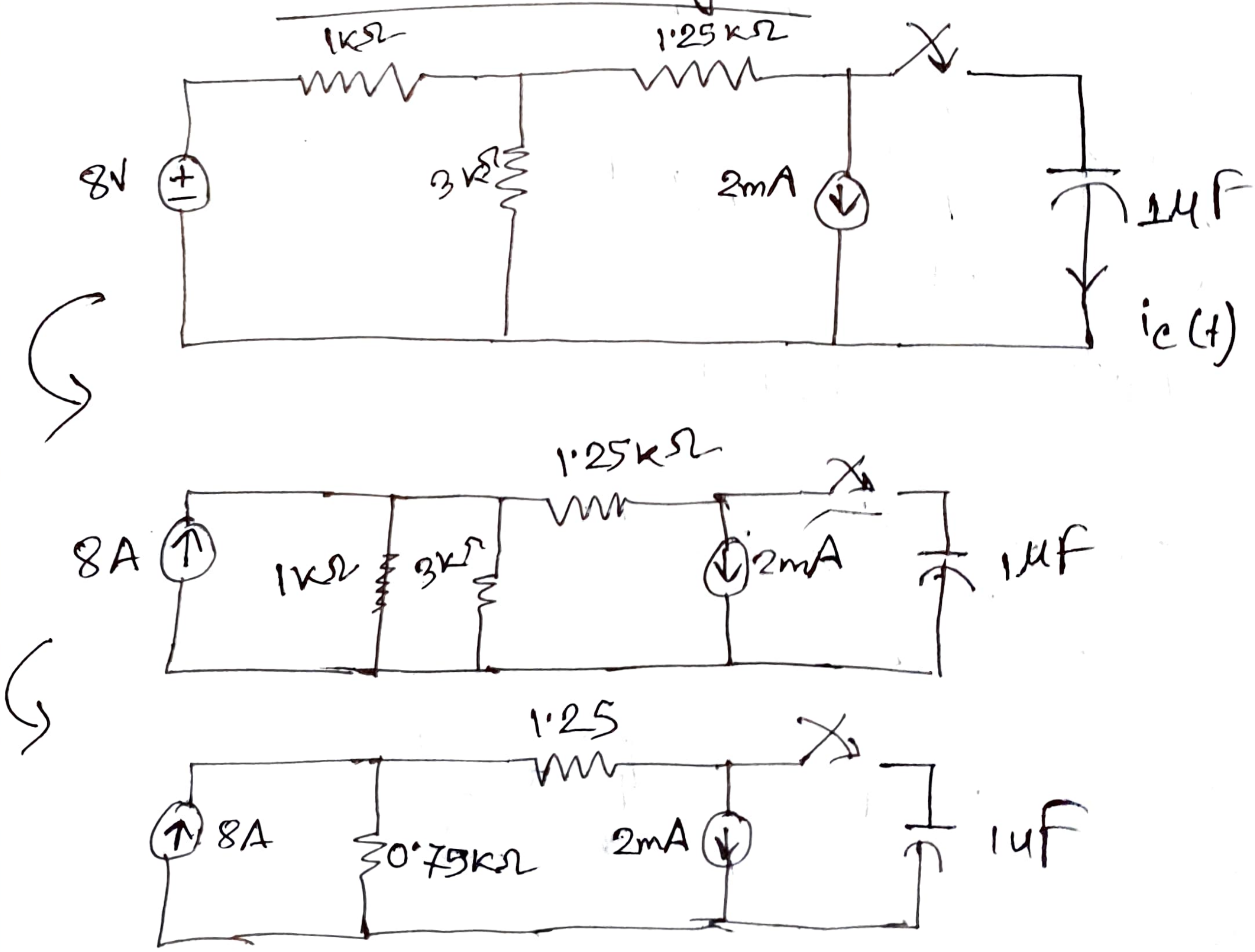
Ans: to the que no:05

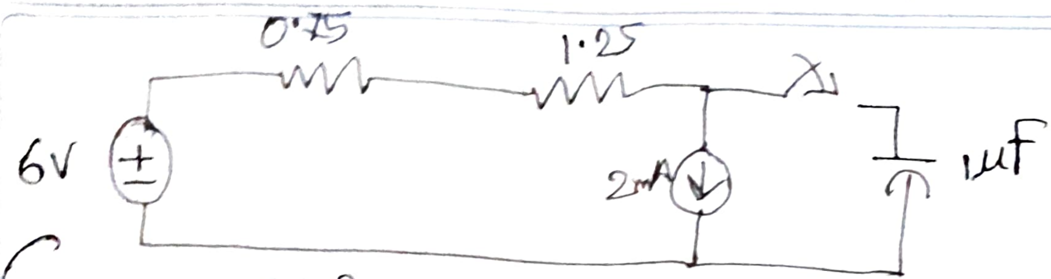
$$V = V_o' + V_o''$$

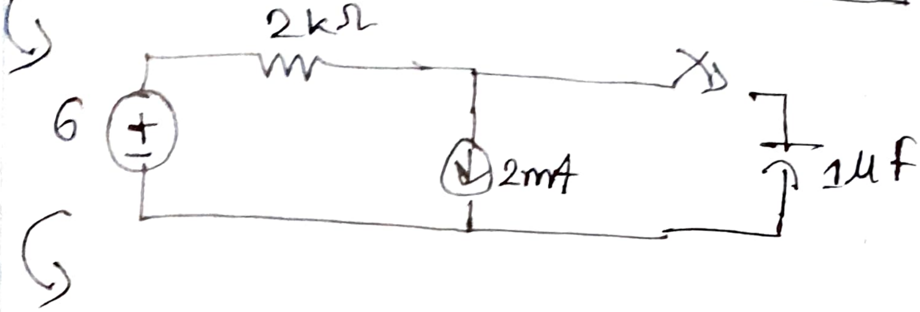
$$= 5.88 + (-4.71)$$

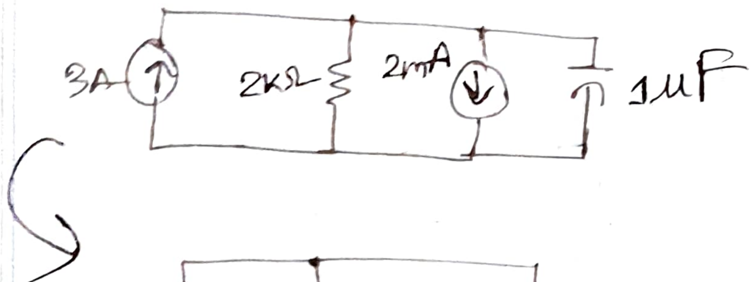
$$= 1.17 \text{ Ans}$$

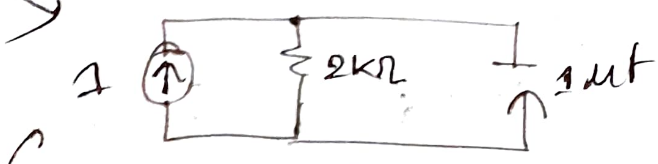
Transient Analysis







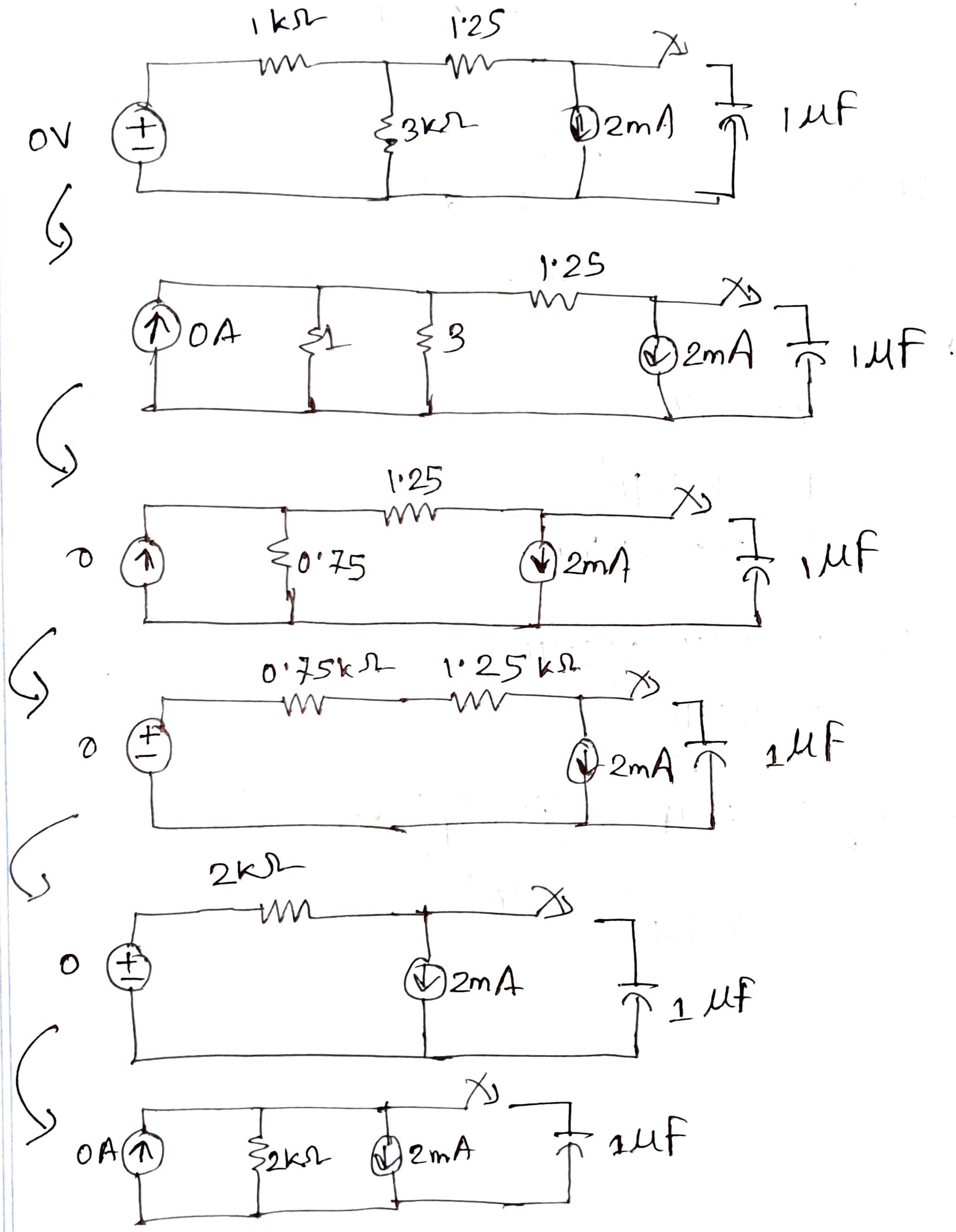




$$\tau = (2\times10^{3})\times(1\times10^{-3})$$
$$= 2\times10^{-3}$$

$$\therefore\ i(t) = i_f + (i_i - i_f)\times e^{-t/\tau}$$
$$= 0 + \left(1\times e^{-t/2\times10^{-3}}\right)$$
$$= e^{-t/2\times10^{-3}}$$

2


1kΩ
1·25
3kΩ
2mA
1μF
0V
1·25
0A
1
3
2mA
1μF
1·25
0
0·75
2mA
1μF
0·75kΩ
1·25kΩ
0
2mA
1μF
2kΩ
0
2mA
1μF
0A
2kΩ
2mA
1μF

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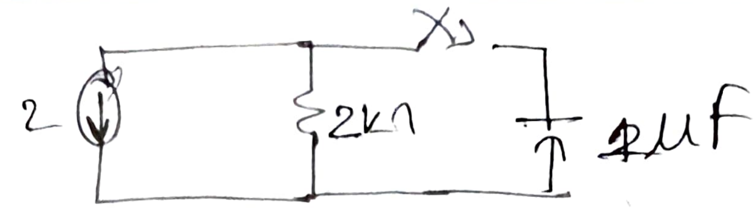

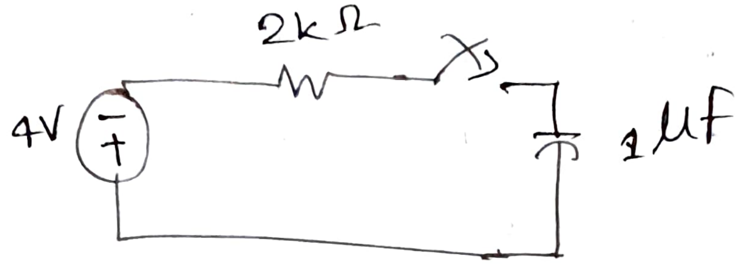

Here

$V = -4V$

$R = 2 \times 10^3$

$I = -2\,mA$

$\tau = 2 \times 10^3 \times 1 \times 10^{-6}$

$= 2 \times 10^{-3}$

$\therefore i_c(t) = i_f + (i_i - i_f) \times e^{-t/\tau}$

$= -2 e^{-t/2 \times 10^{-3}}$

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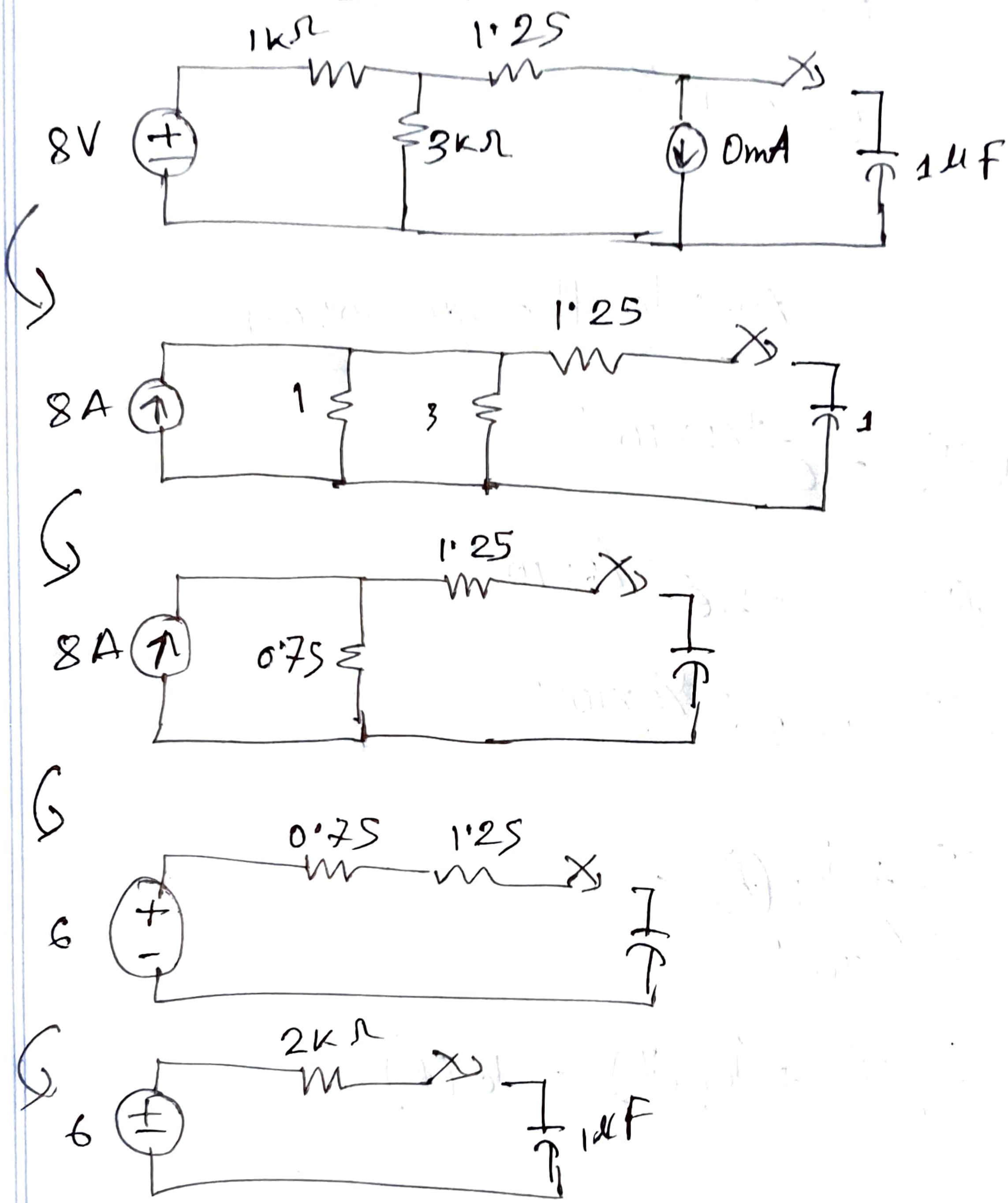

$V = 6$

$R = 2 \times 10^3$

$I = 3 \times 10^{3}$

$\tau = RC$

$= 2 \times 10^3 \times 10^{-6}$

$= 2 \times 10^{-3}$

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$$i_{c_2}(t) = 0 + 3e^{-t/2\times10^{-3}}$$
$$= 3e^{-t/2\times10^{-3}}$$

Ans: to the que no: 04

$$i_c(t) = e^{-t/2\times10^{-3}}$$

$$i_{c_1}(t) = -2e^{-t/2\times10^{-3}}$$

$$i_{c_2}(t) = 3e^{-t/2\times10^{-3}}$$

$$i_{c_1}(t) + i_{c_2}(t)$$
$$= e^{-t/2\times10^{-3}}$$

$$\therefore \; i_{c_1}(t) + i_{c_2}(t) = i_c(t)$$

Letting, $t = 10s$

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$$\left(-2\times e^{-\frac{10}{2\times10^{-3}}}\right) + 3e^{-\frac{10}{2\times10^{-3}}} = e^{-\frac{10}{2\times10^{-3}}}$$

$$\Rightarrow 0 + 0 = 0$$

$\therefore$ Superposition works