Total Number of Pages in this answer script (including the top page): 20

EXAMINATION SCRIPT

STUDENT ID.								
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DEPARTMENT:	CSE
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NAME	FAIAZ ABRAR ZAMAN PRONOY			SET	Y
COURSE NO.	CSE 250	SEMESTER	Fall -23	DATE	20/12/23
COURSE TITLE	Circuits and Electronics				

Answer Script

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Please carefully read and sign the declaration below.

On my honour, I am bearing Student ID. 22301061 hereby declare that, on this take of home assessment, I shall not misuse, in any form or method, the course materials including Lecture Notes, Reading Materials, Audio and Video Records of the lectures of this course. I shall not adopt any unfair means during the Examination and shall not receive any help or offer/ provide help to anyone, join intentionally or unintentionally any online or offline group in which answers of this assessment are posted or discussed, or engage in any behavior that would commonly be deemed to be academically unethical. I will immediately notify the invigilator of any such activity or online or offline groups that I become aware of. I shall preserve hard copy and soft copies of the answer scripts and will not expose the same to any person/party/media. I agree to accept any punitive measure taken by BRAC Authority if at any time during or after the completion of the course it is revealed/ violated otherwise. I acknowledge that I may be suspended or expelled from Brac University if I am found to have engaged in any academically unethical behavior.

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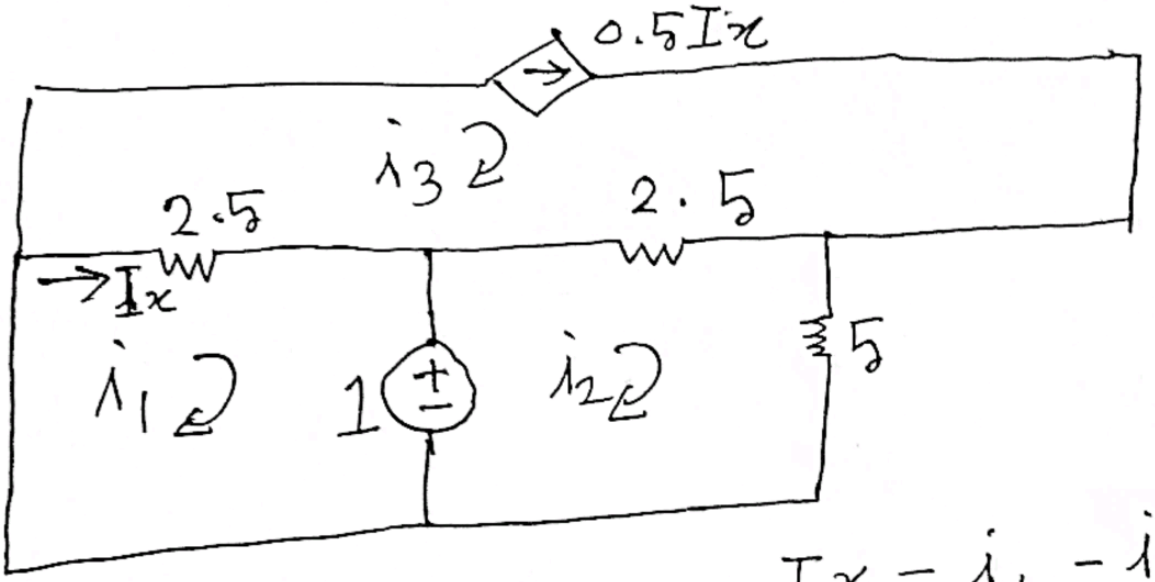
Instructions

1. Clearly enter your Student ID, Name, and Course info in the space provided. *Read the declaration and provide your signature and date.*
2. Use offset/normal white paper of A4 size for writing the answer. Use only one side of the paper for writing. On each page, clearly write your Student ID and Page numbers.
3. No washroom or any kind of break during the exam is allowed.
4. Do not leave the meeting until the invigilator says otherwise. Your exam may be disqualified if you leave the meeting.
5. If you get disconnected and join back within a few minutes, inform your invigilator. If you remain disconnected for more than 5 minutes, inform your invigilator through direct sms.
6. After completing the exam, before scanning, please write the total number of pages in this section (including the top page) on the top right corner of the top page.
7. You must submit within the designated submission time. Late submissions will not be accepted.

2

a

For R_{load}, First off all independent sources,



$I_x = i_1 - i_3$

For mesh 1,

$$2.5i_1 - 2.5i_3 + 1 = 0$$

$$\Rightarrow 2.5i_1 - 2.5i_3 = -1$$

For mesh 2,

$$-1 + 2.5i_2 - 2.5i_3 + 5i_2 = 0$$

$$\Rightarrow 7.5i_2 - 2.5i_3 = 1$$

$$i_3 = 0.5 I_x$$

$$\Rightarrow i_3 = 0.5(i_1 - i_3)$$

$$\Rightarrow i_3 - 0.5 i_1 + 0.5 i_3 = 0$$

$$\Rightarrow -0.5 i_1 + 1.5 i_3 = 0$$

$$i_1 = -0.6 \text{ mA}$$

$$i_2 = 0.067 \text{ mA}$$

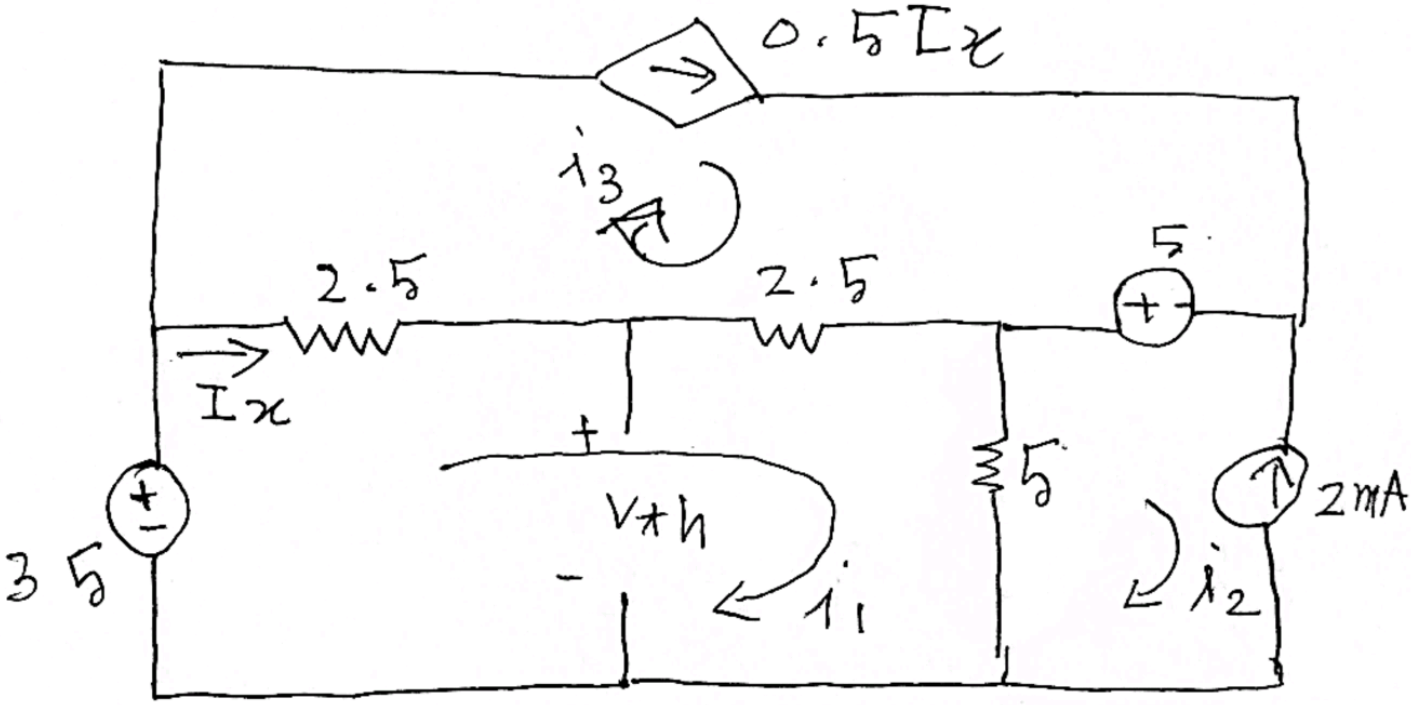
$$i_3 = -0.2 \text{ mA}$$

$$\therefore R_{th} = R_{load} = \frac{1}{i_1 - i_2}$$

$$= \left| \frac{1}{-0.6 - 0.067} \right|$$

$$= 1.5 \text{ K}\Omega$$

(b)



$$i_2 = -2 \quad \ldots (I)$$

$$I_x = i_1 - i_3$$

$$i_3 = 0.5\, I_x$$

$$\Rightarrow i_3 = 0.5\,(i_1 - i_3)$$

$$\Rightarrow -0.5\, i_1 + 1.5\, i_3 = 0 \quad \ldots (II)$$

For mesh 1,

$$-35 + 2.5(i_1 - i_3) + 2.5(i_1 - i_3) + 5i_1 - 5i_2 = 0$$

$$\Rightarrow 5(i_1 - i_3) + 5i_1 - 5 \times (-2) = 35$$

[From (I)]

$$\Rightarrow 5i_1 + 5i_1 - 5i_3 = 35 - 10$$

$$\Rightarrow 10i_1 - 5i_3 = 25 \quad \ldots \text{(III)}$$

From (II) & (III),

$$i_1 = 3$$

$$i_3 = 1$$

$$i_2 = -2$$

KVL at loop 1,

$$-35 + 2.5(i_1 - i_3) + V_{th} = 0$$

$$\therefore V_{th} = 35 - 2.5(3-1)$$

$$= 35 - 5$$

$$= 30V$$

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

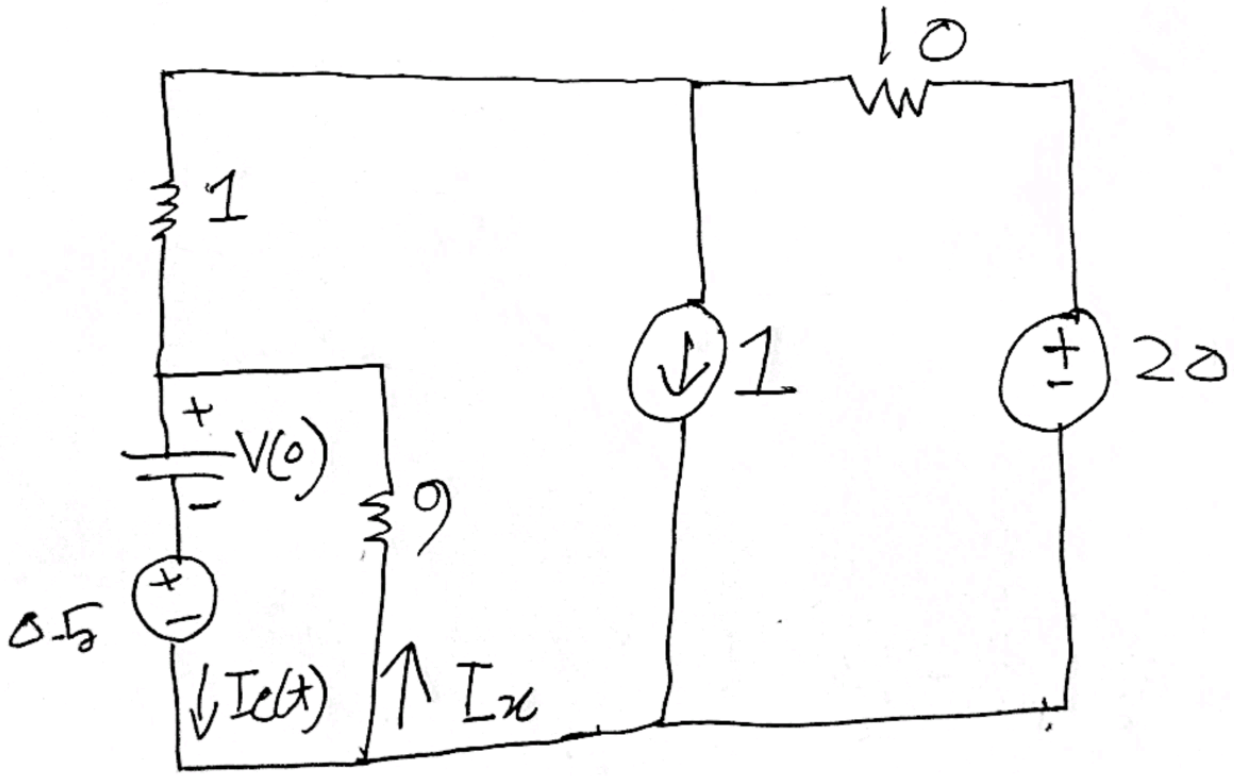
$$= \frac{30^2}{4 \times 1.5 \times 10^3}$$ [From a $R_{th} = 1.5$]

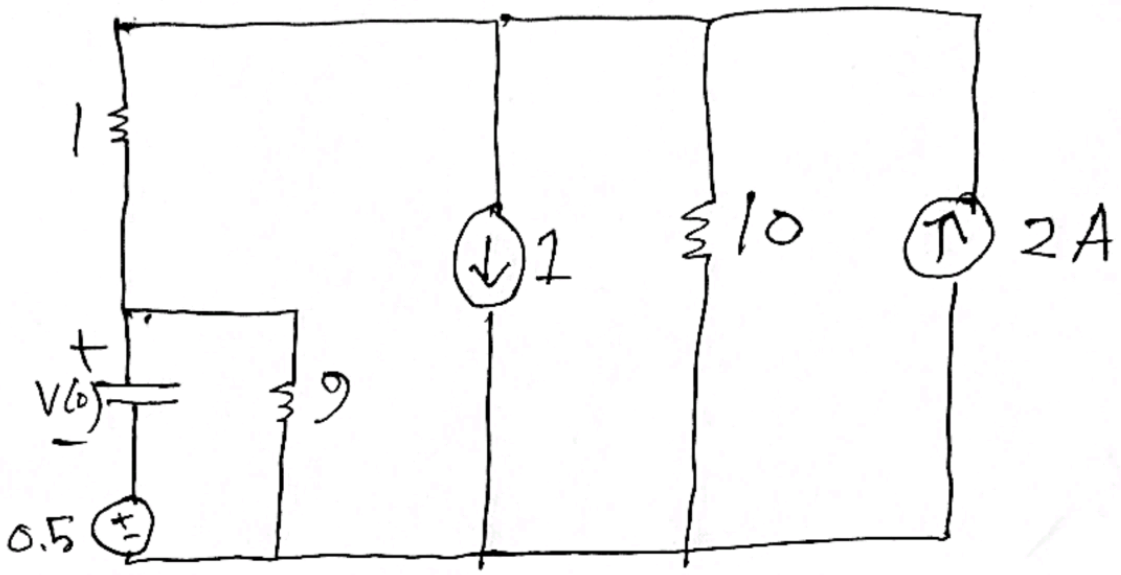
$$= 0.15 \text{ watt}$$

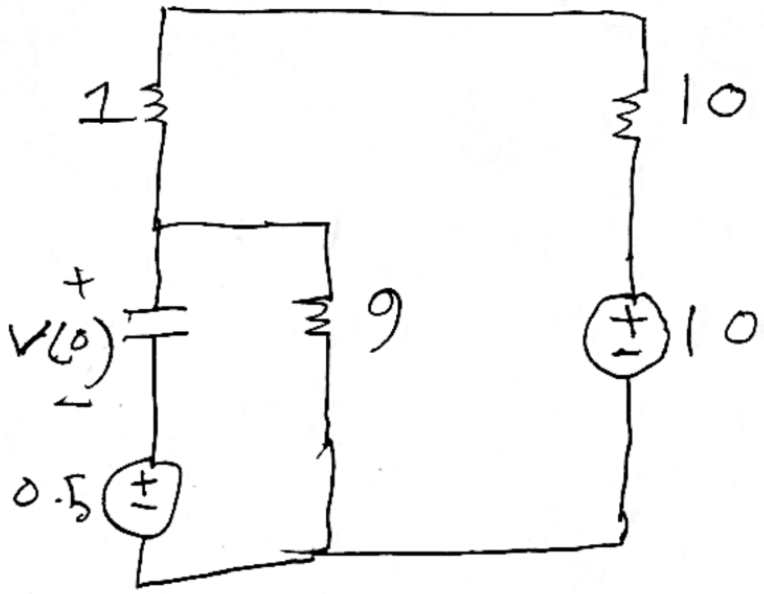
(3)

(a)

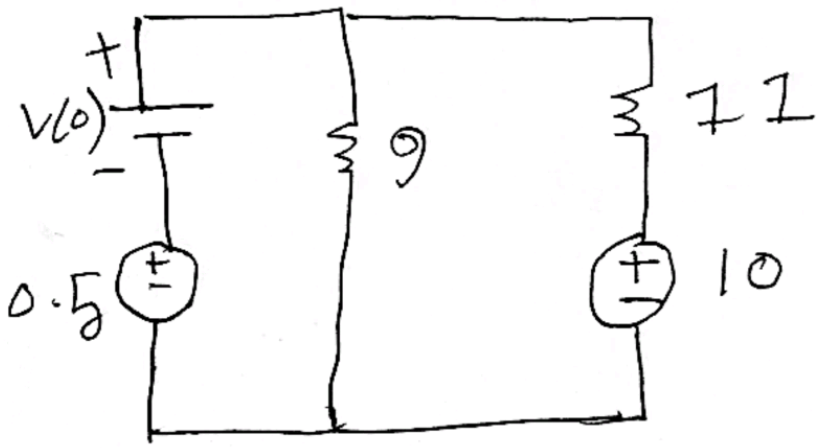
Before switching $t < 0$,

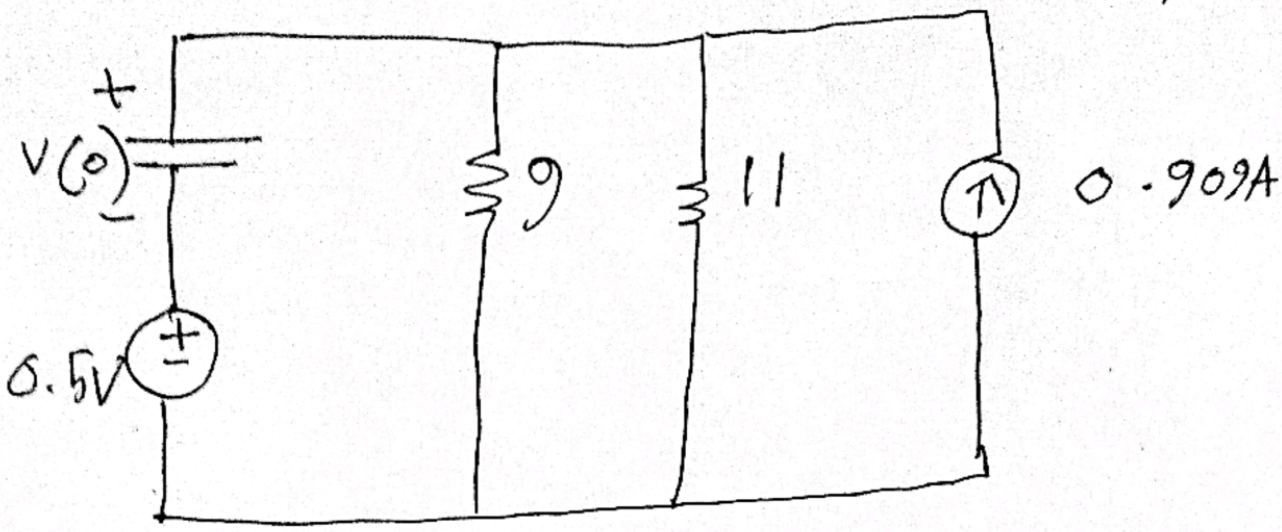


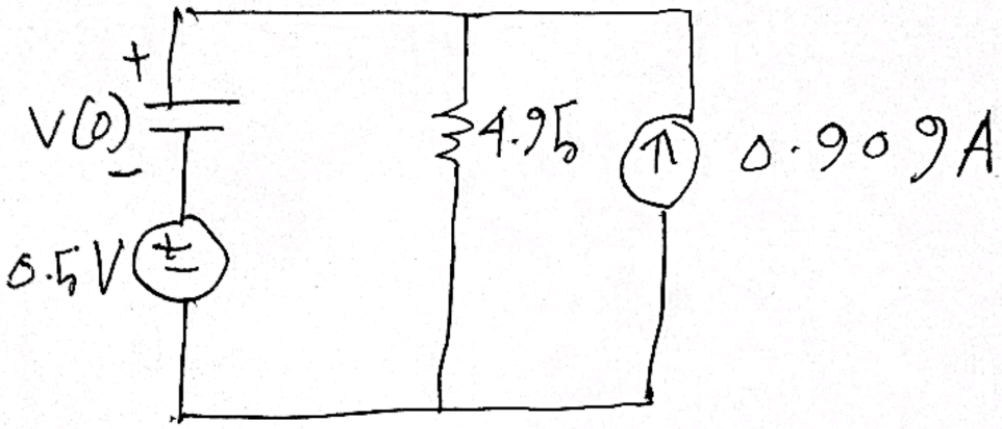


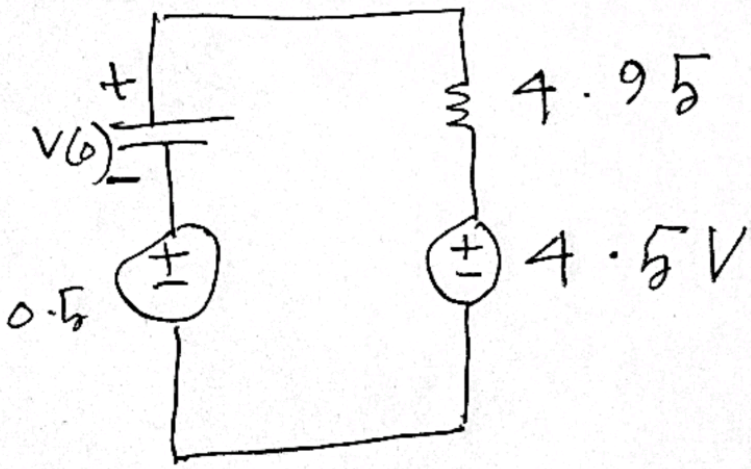


$\rightarrow (2-1) \times 10$
$= 10$





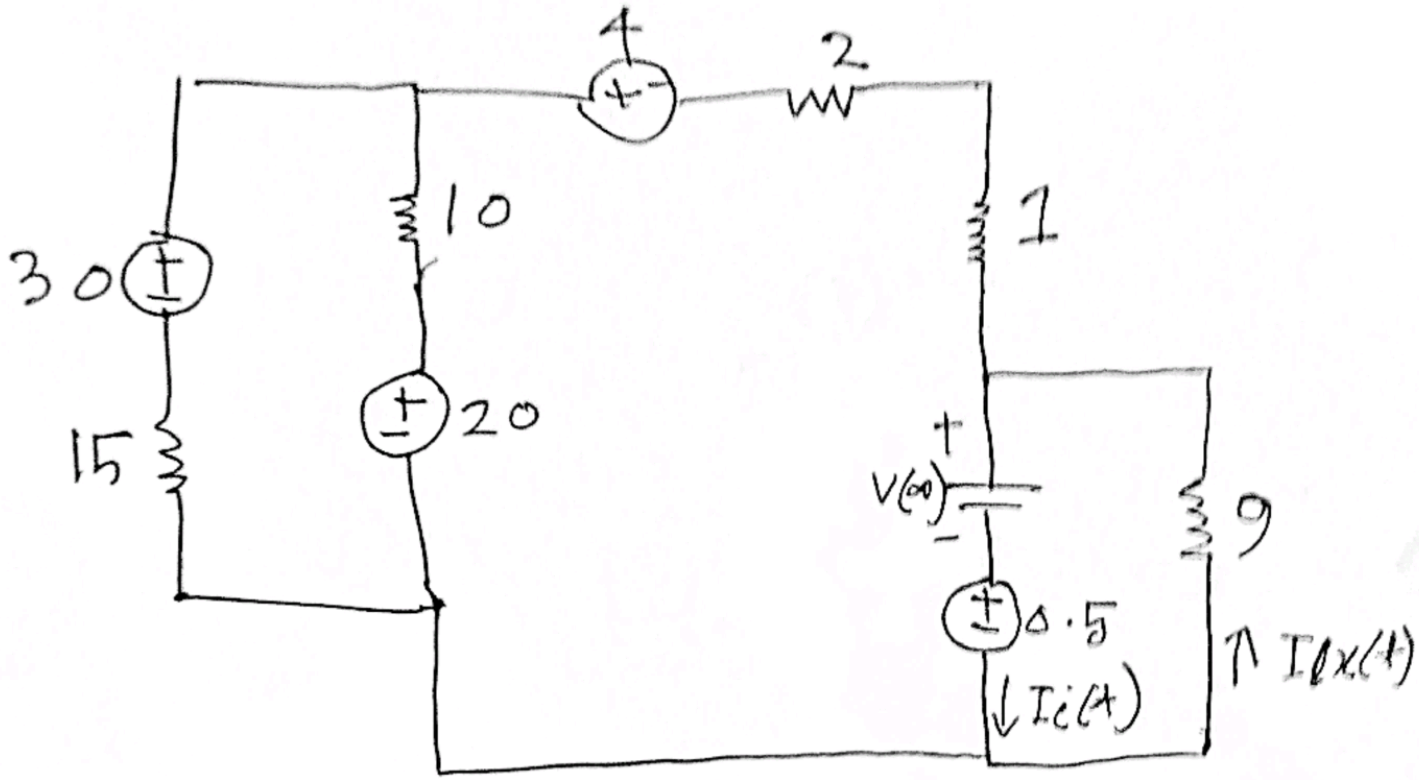


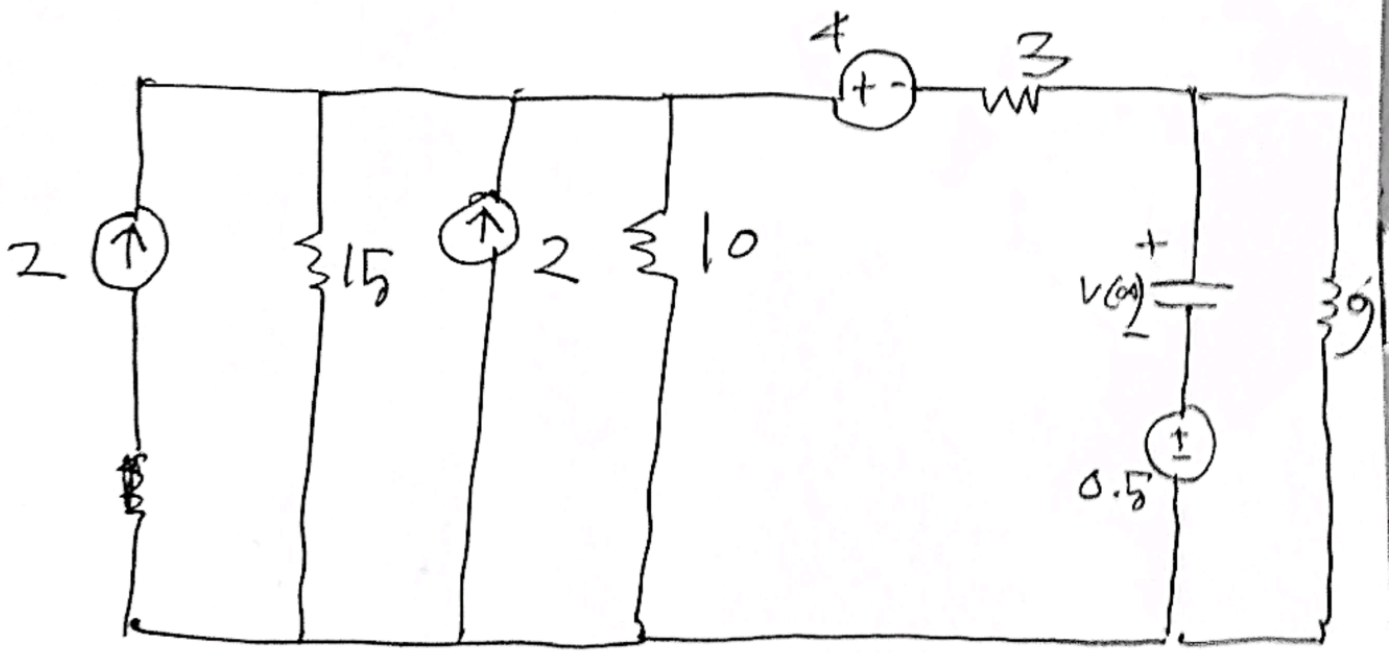


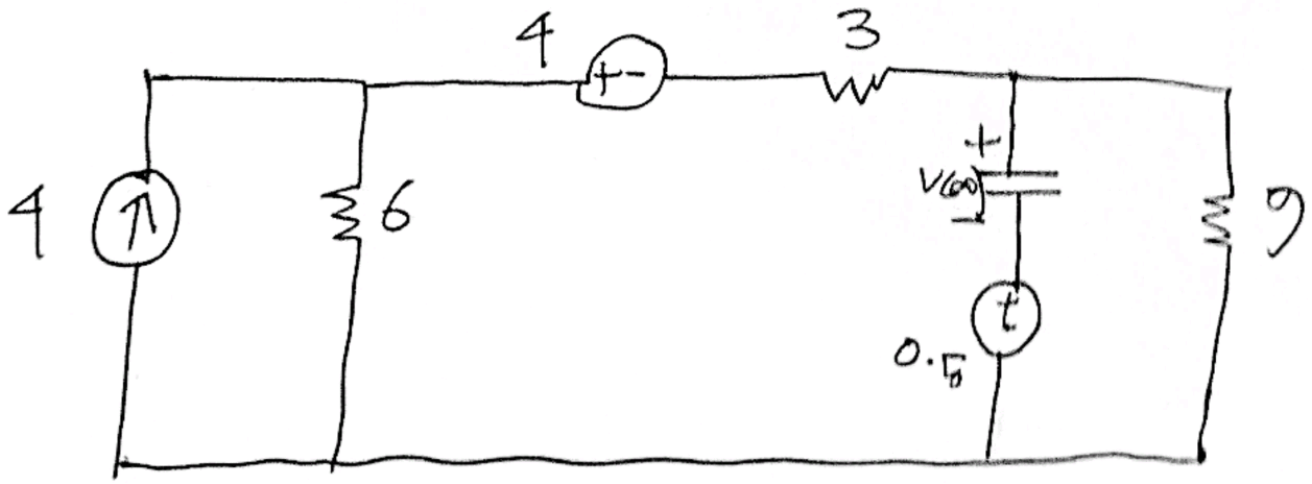
$$-0.5 + 4.5 - V(0) = 0$$

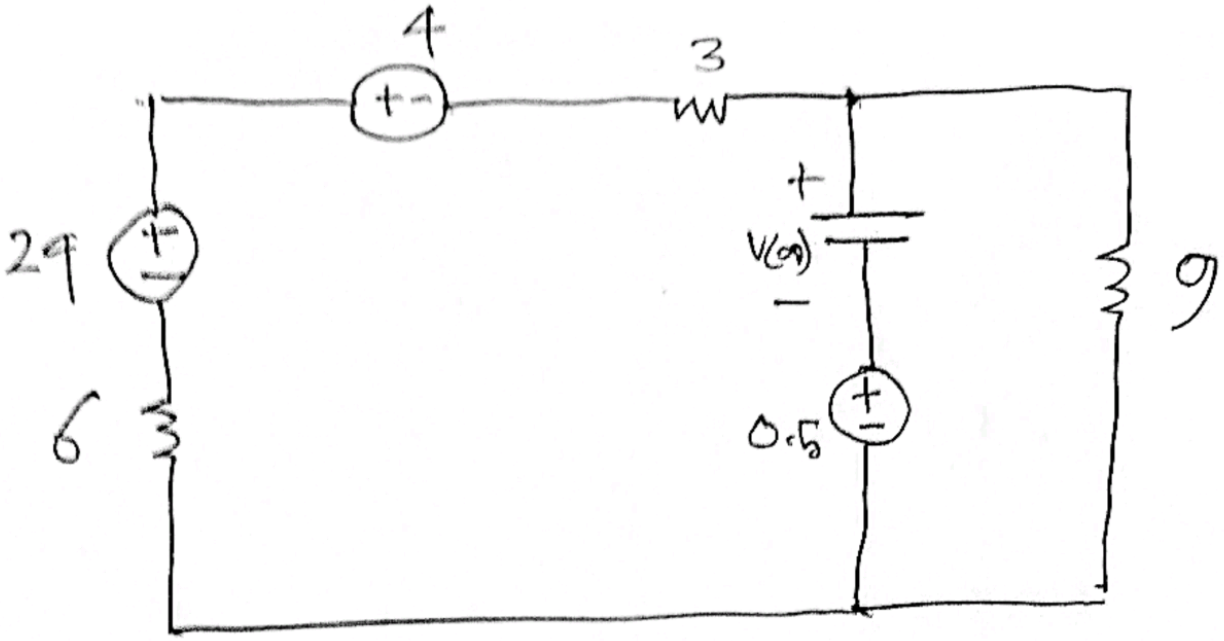
$$\Rightarrow \quad V(0) = 4V$$

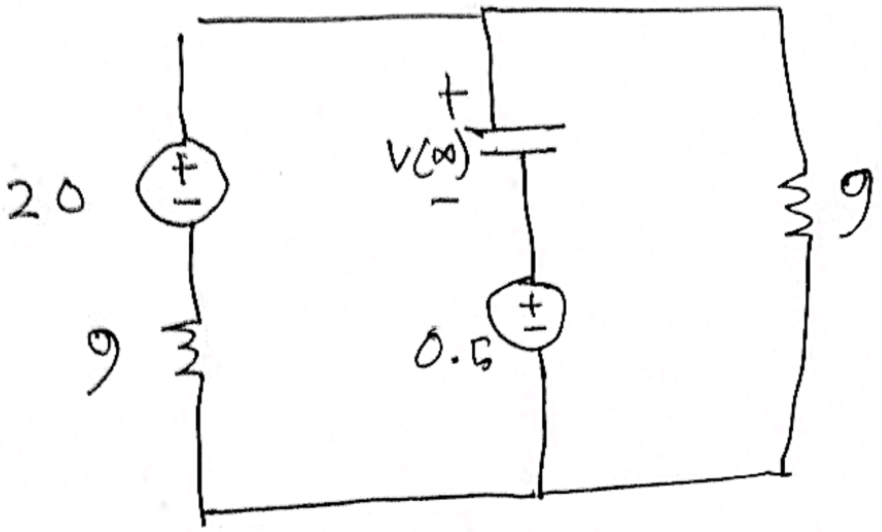
After switching $t > 0$, (8)

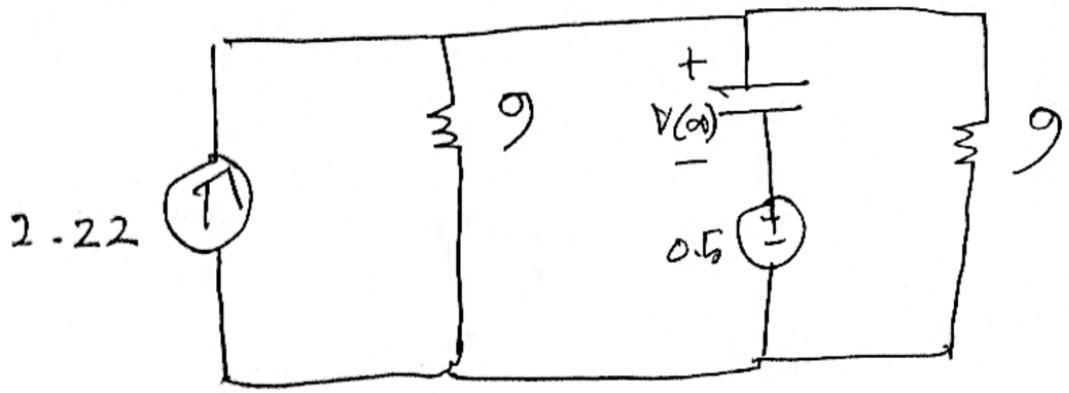


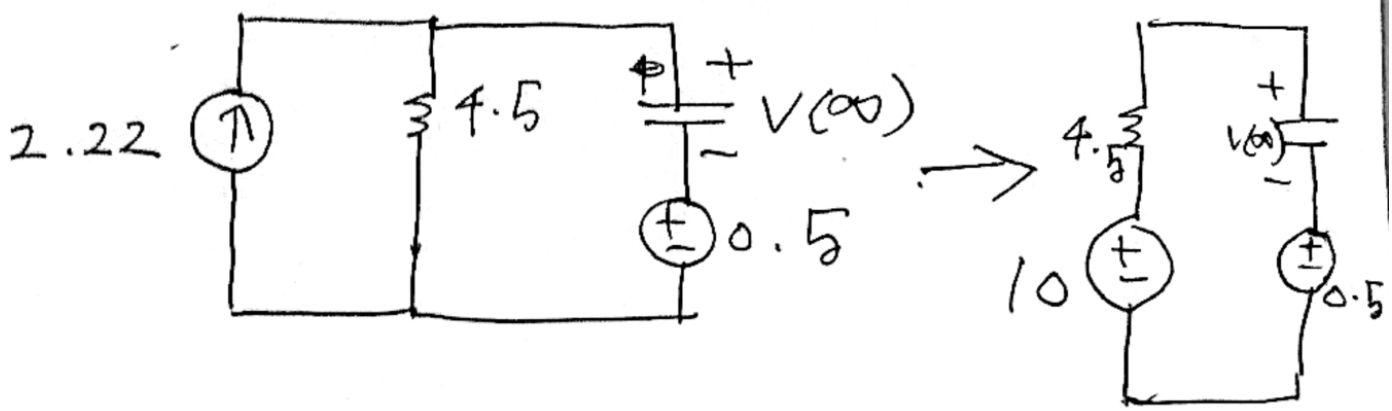





4
3
29
6
+
V(∞)
−
0.5
9


20
9
+
V(∞)
−
0.5
9

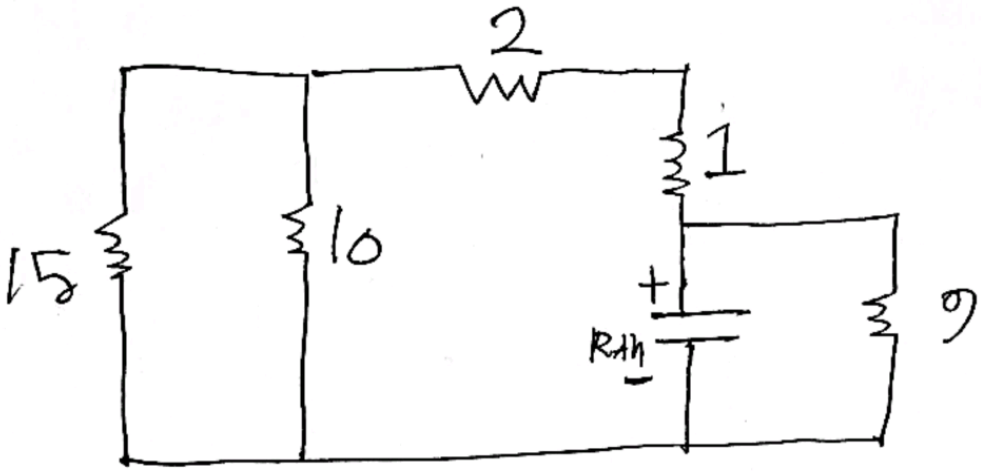

2.22
9
+
V(∞)
−
0.5
9

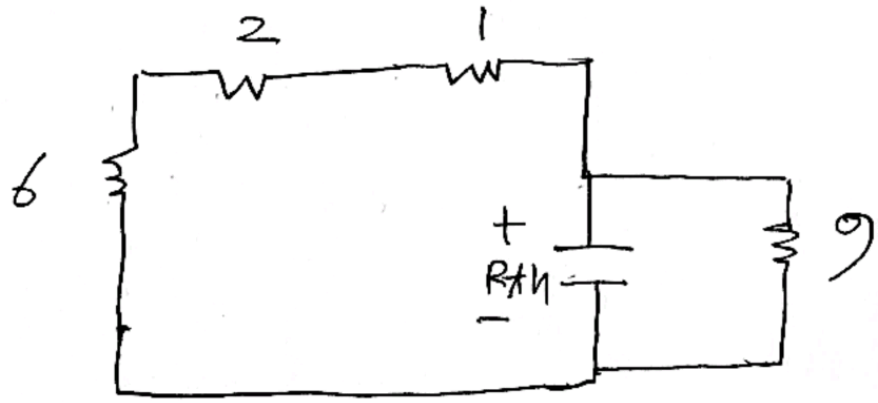

2.22
4.5
+
V(∞)
−
0.5
4.5
10
+
V(∞)
−
0.5

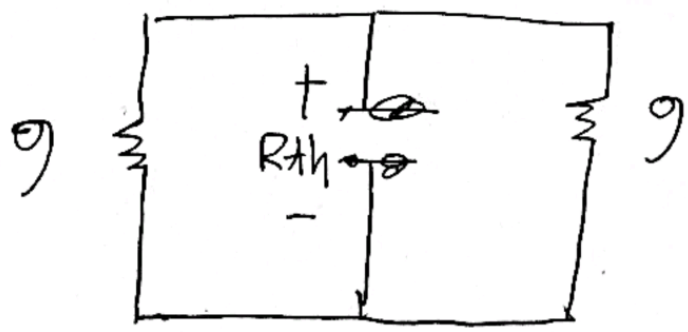
$$-10 + 0.5 + V(\infty) = 0$$

$$\Rightarrow \quad V(\infty) = 9.5\,V$$

For Rth,







$$\therefore \; R_{th} = 9 \| 9 = 4.5\,\Omega$$

$$\tau = R_{th} \times C$$

$$= 4.5 \times 8 \times 10^{-6}$$

$$= 0.0000365$$

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

$$= 9.5 + [4 - 9.5]e^{-\frac{t}{0.0000365}}$$

$$= 9.5 - 5.5e^{-27777.77t}$$

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

$$= 8 \times 10^{-6} \times -27777.77 \times -5.5e^{-27777.77t}$$

$$= 1.22e^{-27777.77t}$$

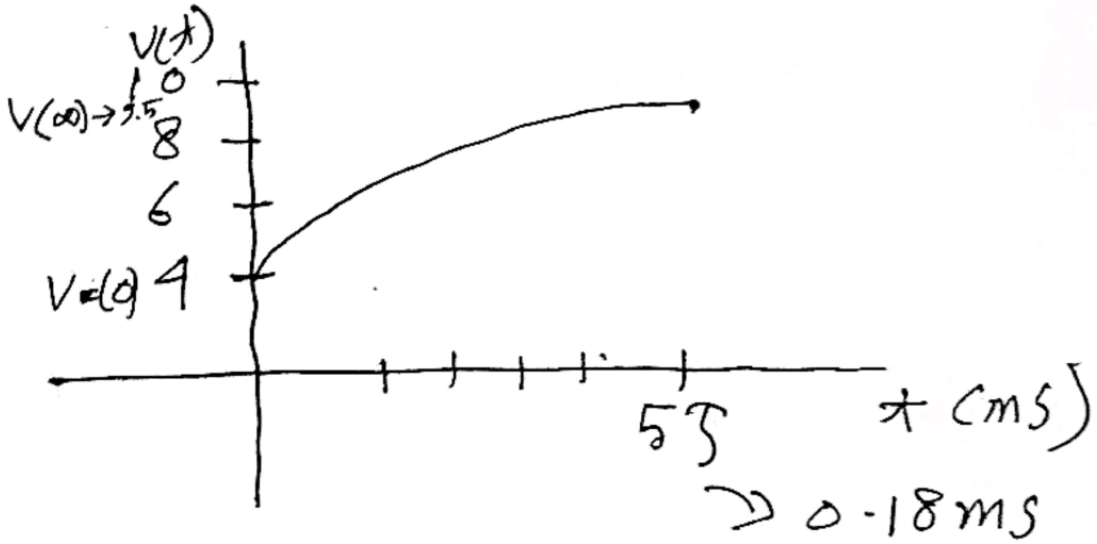
6

From a,

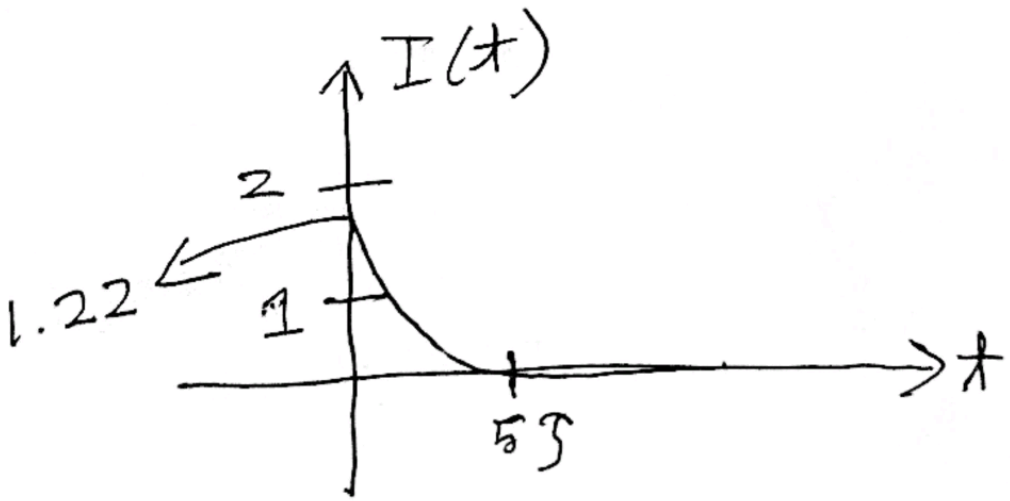
$$V(\infty) = 9.5$$

$$V(0) = 4$$

$V(\infty) > V(0)$ ∴ charging



$$i_c(t) = 1.22e^{-27777.77t}$$



c

$$I_e(t) = 1.22\, e^{-277777.77t}$$

$$\Rightarrow I_e(0.02) = 1.22\, e^{-277777.77 \times 0.02}$$

$$= 0\ A$$

$y(x) = +x$

14

1 a

a 1

V is in Phase with I

The phase difference is 0.

11 b

Impedence $Z = \frac{6\angle 50^\circ}{2\angle 50^\circ}$ $\left[\frac{V}{I}\right]$

$= 3\,\Omega$

c

(iii)

From (ii), $Z = 3\Omega$

$$C = \frac{-j}{\omega \times C} = \frac{-4j}{\omega}$$

$$L = j\omega L = j\omega \times 0.04$$

$$Z = 3 + j\omega(0.04) - \frac{4j}{\omega}$$

$$\Rightarrow 3 = 3 + (j\omega \times 0.04) - \frac{4j}{\omega}$$

$$\Rightarrow j\omega \times 0.04 = \frac{4j}{\omega}$$

$$\Rightarrow \omega^2 = \frac{4j}{0.04j}$$

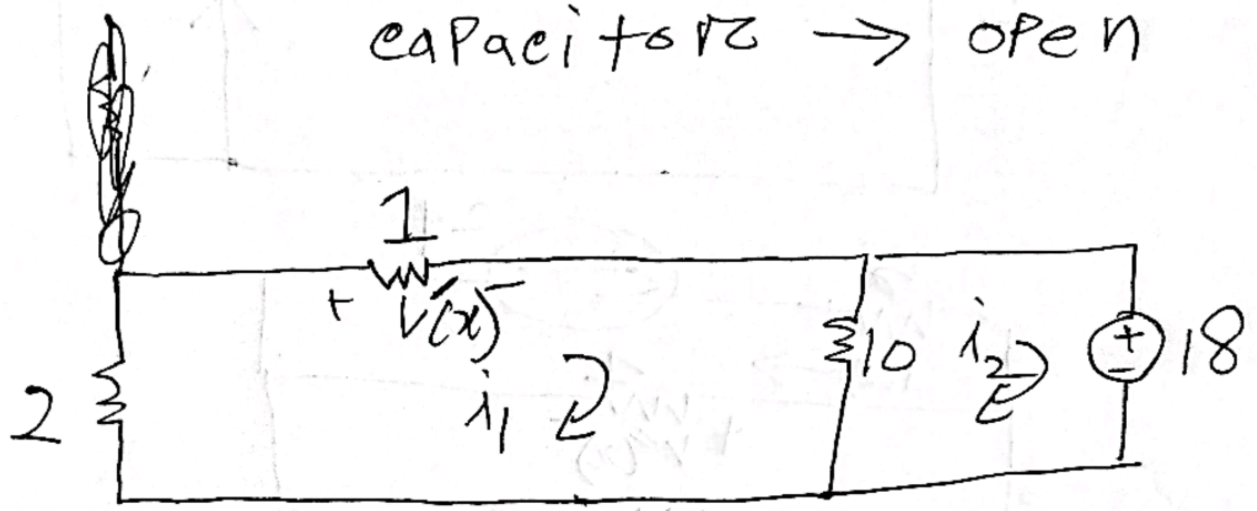
$$\Rightarrow \omega^2 = 100$$

$$\Rightarrow \omega = 10 \text{ rad s}^{-1}$$

only 18 V → DC source active

inductor → short

capacitor → open



$$(2+1)i_1 + 10i_1 - 10i_2 = 0$$

$$\Rightarrow 13i_1 - 10i_2 = 0$$

$$10i_2 - 10i_1 + 18 = 0$$

$$\Rightarrow -10i_1 + 10i_2 = -18$$

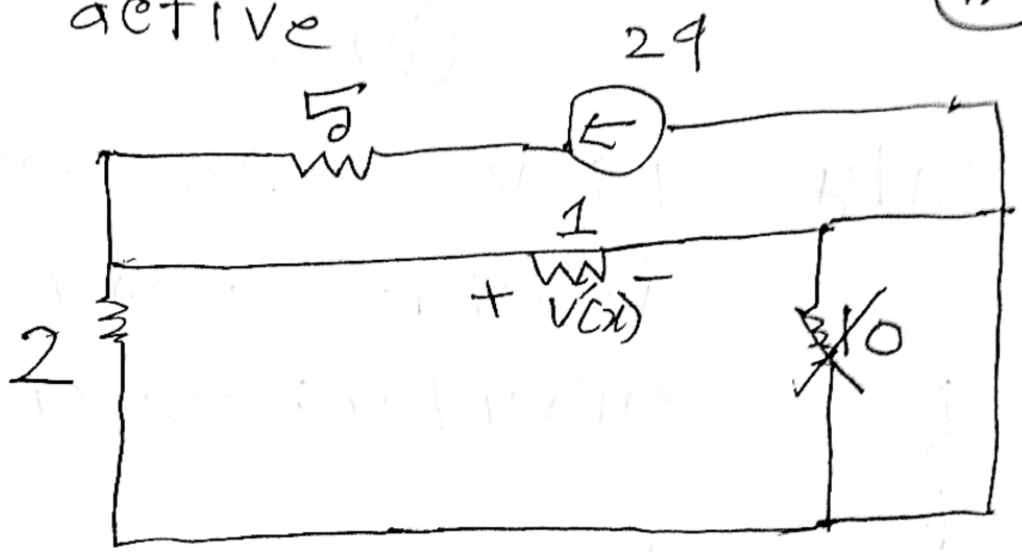
$$i_1 = -6\,A$$

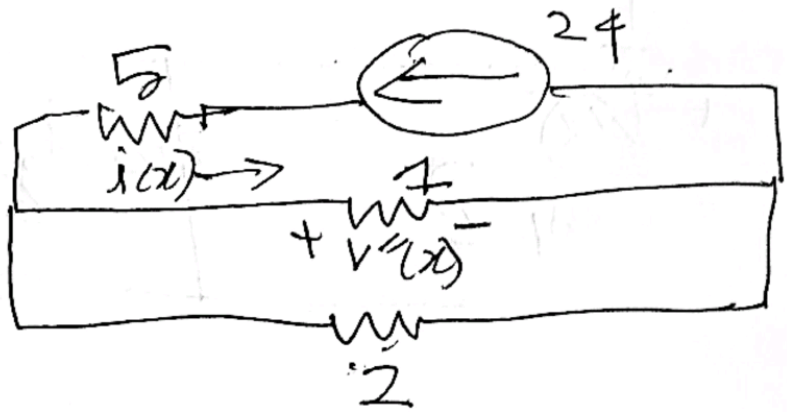
$$i_2 = -7.8\,A$$

$$\therefore V'(x) = 1 \times i_1$$

$$= -6\,V$$

24 A active





$$i(x) = \frac{1^{-1}}{5^{-1}+2^{-1}+1^{-1}} \times 24$$

$$= 14.11\,A$$

$$\therefore V''(x) = 1 \times i(x)$$

$$= 14.11\,V$$

only $9\sin(8t)$ active,

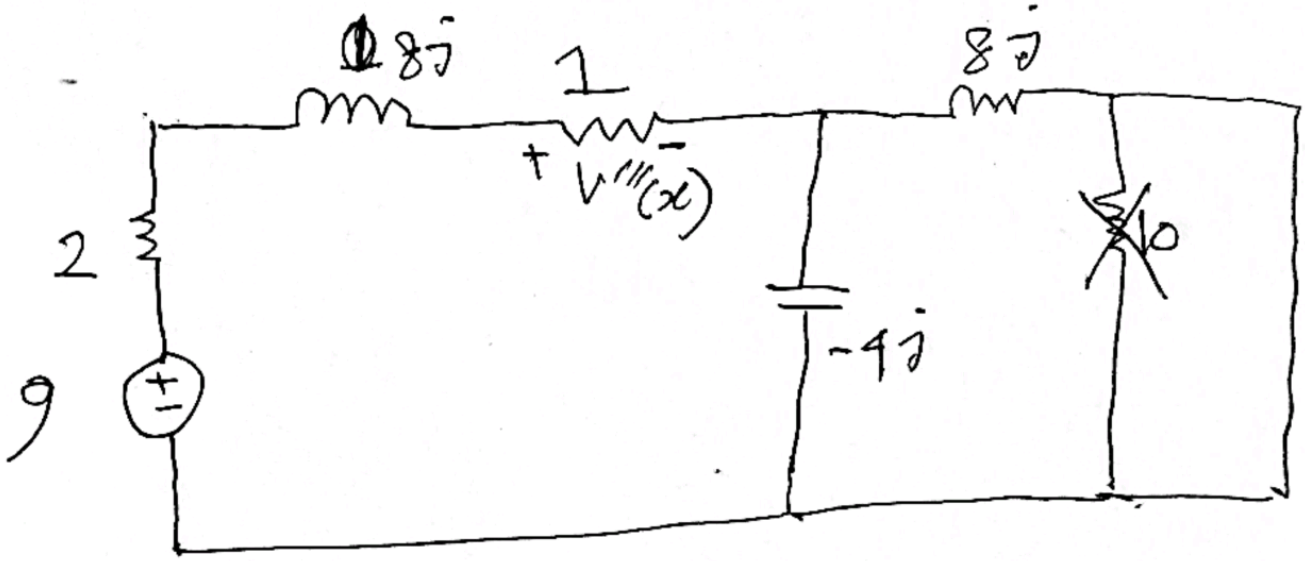
$$V = 9\angle 0^\circ = 9$$

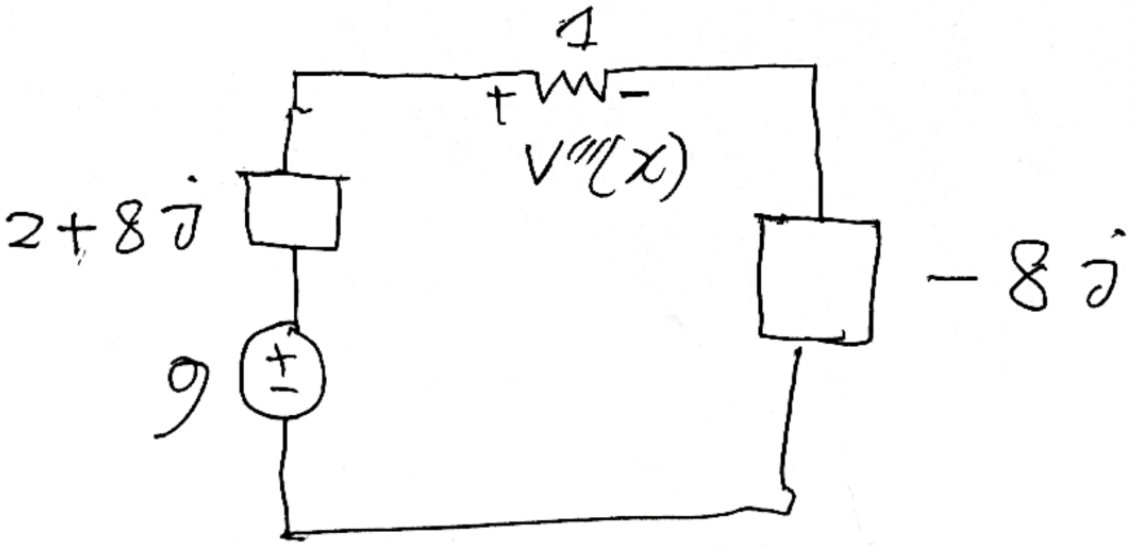
$$\omega = 8$$

$$1H \rightarrow j\omega L = j \times 8 \times 1 = 8j$$

$$\frac{1}{32}F \rightarrow \frac{1}{j\omega C} = \frac{1}{j \times 8 \times \frac{1}{32}}$$

$$= -4j$$





$$V''''(x) = \frac{1}{2+2+8j-8j}$$

$$= \frac{1}{4} V$$

$$\therefore V(x) = V'(x) + V''(x) + V'''(x)$$

$$= -6 + 14.11 + \frac{1}{4}$$

$$= 8.36 \, V$$