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Bsee 19047

ENA- Assignment # 1

Q:- 1

(a) $f(t) = 5u(t-1)$; evaluate at $t = -3, 0, +3$.

Solve

$f(t)$ at $t = -3$: $f(-3) = 5u(-3-1) = 5u(-4) = 5(0)$ $\boxed{f(-3) = 0}$

$f(0) = 5u(0-1) = 5u(-1) = 5(0)$; $\boxed{f(0) = 0}$.

$f(3) = 5u(3-1) = 5u(2) = 5(1) = \boxed{f(3) = 5} = f(3)$

(b) $h(t) = 4u(1-t) + 2u(t+2)$; evaluate at $t = 0, +2$

$h(0) = 4u(1) + 2u(2)$ $\qquad h(0) = 4 + 2$ $\qquad \boxed{h(0) = 6}$

$h(+2) = 4u(-1) + 2u(4)$ $\qquad h(+2) = 2$ $\qquad \boxed{h(2) = 2}$

(c) $K(t) = 3u(t) - 2u(-t) + 0.8u(1-t)$

Evaluate at $t = 0.8$

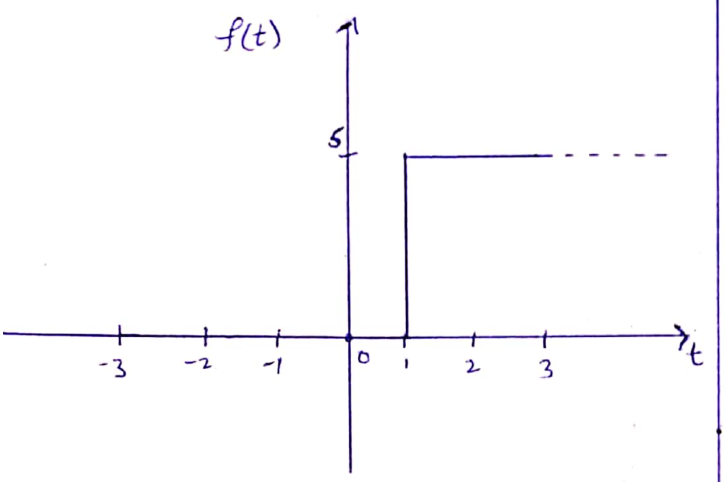
$$K(0.8) = 3u(0.8) - 2u(-0.8) + 0.8u(1-0.8)$$

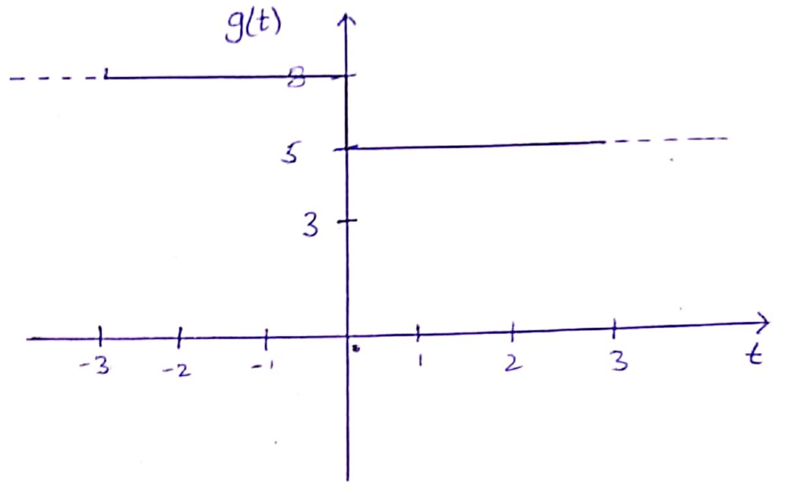
$$= 3\times1 - 2\times(0) + 0.8\times1$$

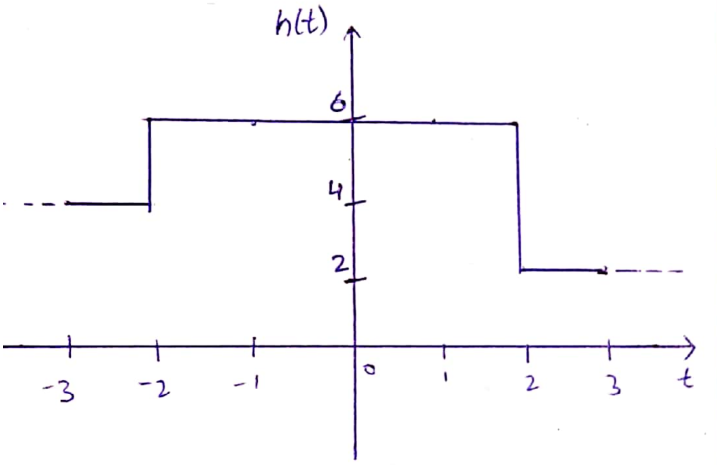
$$K(0.8) = 3 + 0.8$$

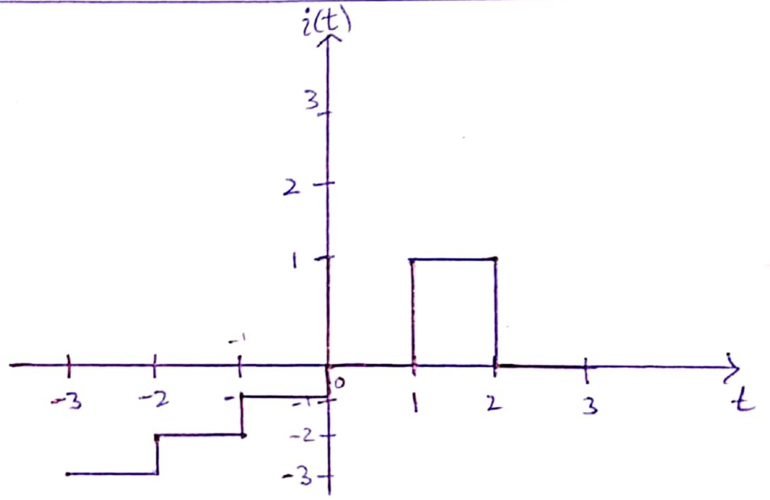
$$\boxed{K(0.8) = 3.8}$$

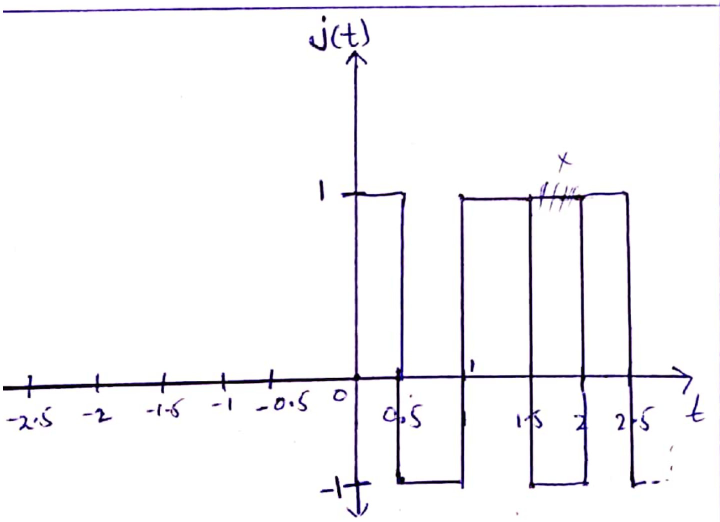
(d) sketch graph:- $-3 \le t \le 3$

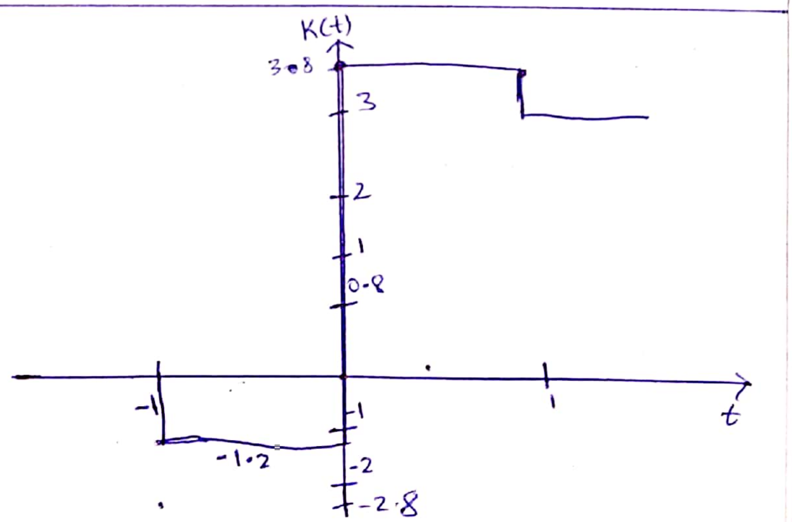


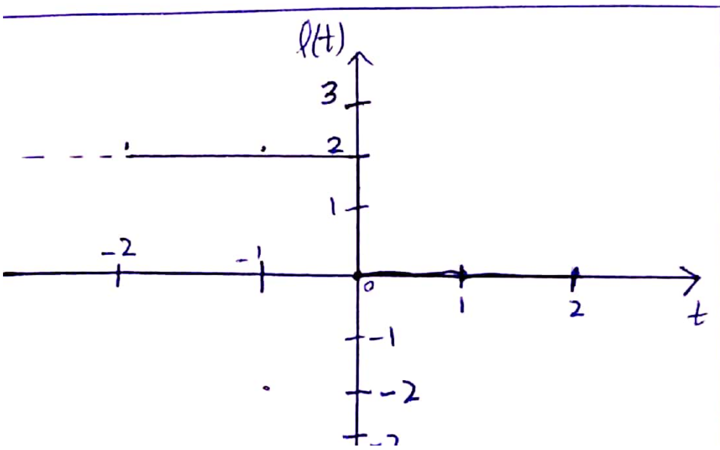


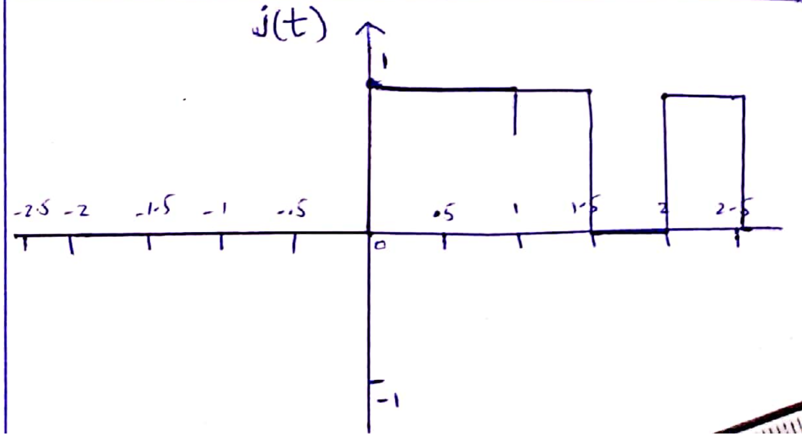






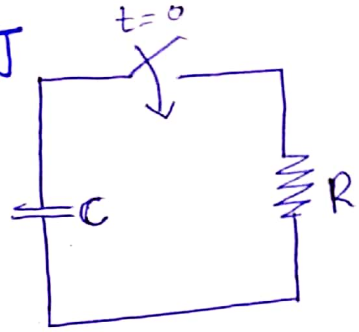






Q:- 2

(a) $C = 3.1nF$, $R = 55 M\Omega$, $W = 200mJ$



Solve

$\tau = RC = 3.1nF \times 55M\Omega$, $\tau = 170ms$ —— ①

(i) $W(0) = \frac{1}{2}CV_0^2$, $V_0 = \sqrt{\frac{2 \times W(0)}{C}} = \sqrt{\frac{2 \times 200m}{3.1nF}}$

$V_0 = 11359V$ —— ①

$V(t) = V_0 e^{-t/\tau} = \boxed{11359e^{-5.8t} V = V(t)}$

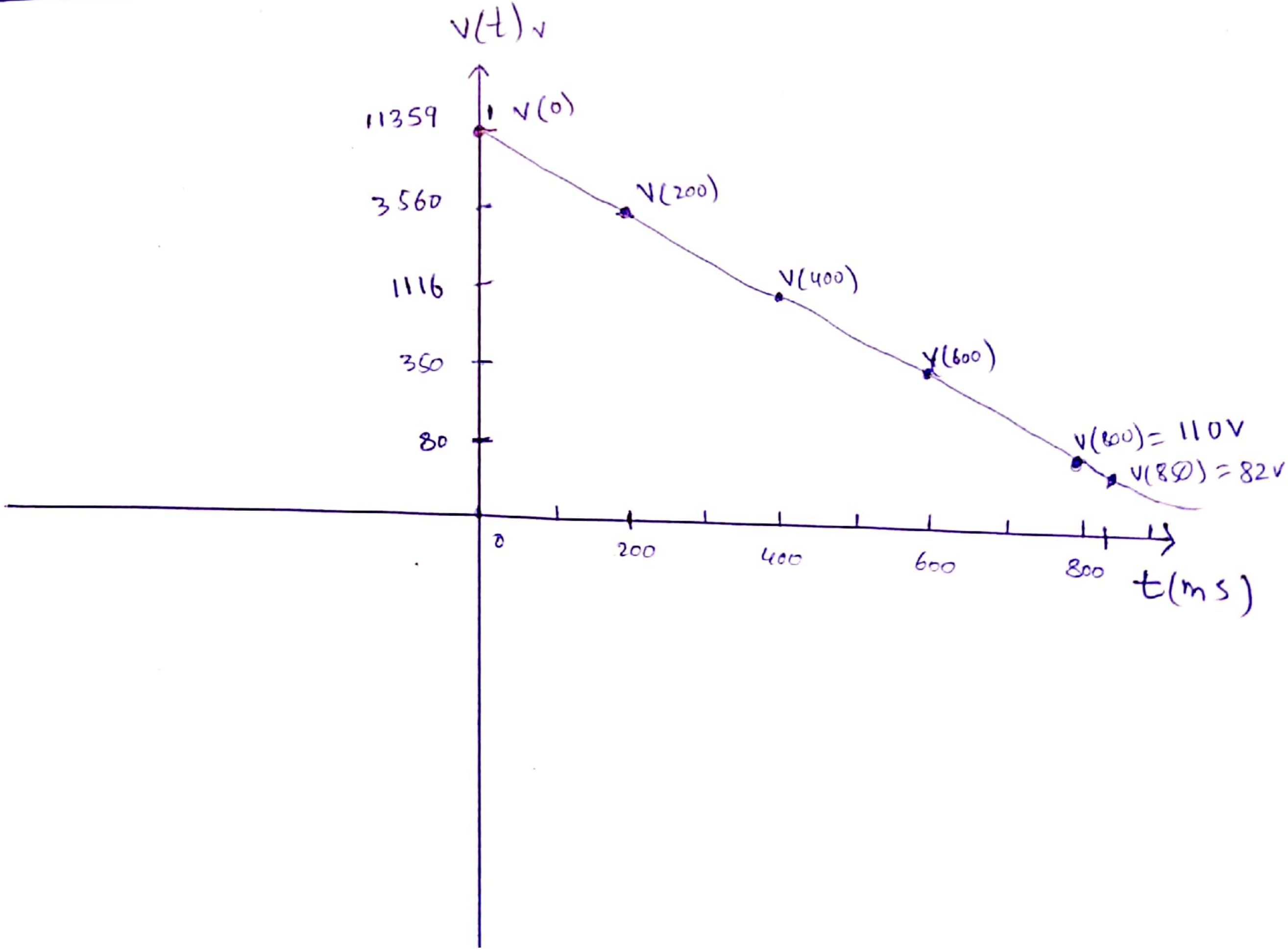
(ii) $V(170ms) = 11359e^{-1}$, $V(170ms) = 4178V$

$W(170ms) = \frac{1}{2}CV^2 = \frac{1}{2}(3.1n) \times (4178)^2$, $\boxed{W(170ms) = 27\cancel{0}mJ}$ 27mJ

(iii)

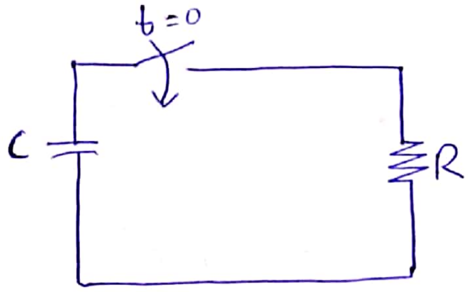
$V(2\tau) = 11359e^{-2\tau/\tau}$

$\boxed{V(2\tau) = 1537V}$



Q:-2

(b) $R = 1\Omega$, $C = 22mF$, $W = 891mJ$



Solve

$\tau = RC = 22ms$ —— ②

$V_0 = \sqrt{\frac{2\times(891m)}{22m}}$, $V_0 = 9V$ —— ①

(i) $V(t) = V_0 e^{-t/\tau}$, $= 9e^{-t/22m}$

$$\boxed{V(t) = 9e^{-45t}\,V}$$

(ii) $t = 11ms$, $33ms$. $w(t) = ?$

$V(11ms) = 9e^{-45\times 11m}$, $V(11m) = 5.4V$

$W(11ms) = \frac{1}{2}CV(11ms)$ $= \frac{1}{2}\times 22m \times 5.4$ $\boxed{W(11ms) = 594mJ}$

$V(33ms) = 9e^{-45\times 33m}$, $V(33ms) = 2V$

$W(33ms) = \frac{1}{2}CV(33m)$ $= \frac{1}{2}\times 22m \times 2$ $\boxed{W(33ms) = 220mJ}$

(ii) $R = 100k\Omega$

$\tau = RC = 22n \times 100k\Omega$, $\boxed{\tau = 2.2ms}$

$V_0(\cancel{t}) = 9V$

$\boxed{V(t) = 9e^{-455t}}$, $\boxed{V(11m) = 60mV}$, $\boxed{V(33m) = 2.7\mu V}$

, $\boxed{\cancel{w(11) = 0.66mJ}}$

$\boxed{w(11) = 39\mu J}$

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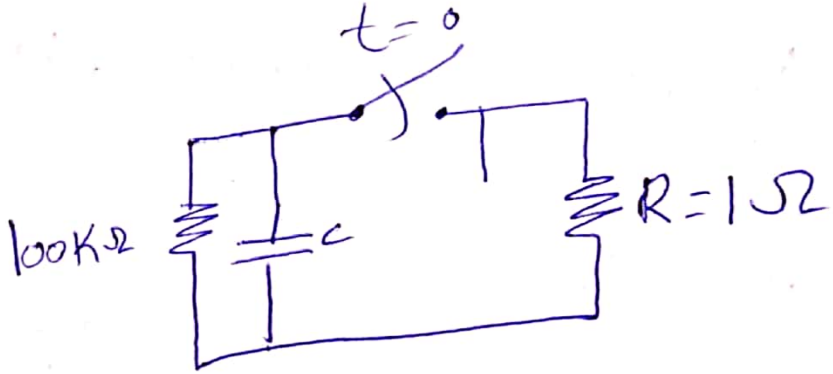
Q2

(b)

(iii)

$R_{eq} = 0.9999\,\Omega \simeq 1\,\Omega$



so ther wold be no visible change in the values.

$$\boxed{v(t) = 9e^{-45t}\ \text{V}}$$

$$\boxed{w(11m) = 594\,\text{mJ}}$$

$$\boxed{w(33m) = 220\,\text{mJ}}$$

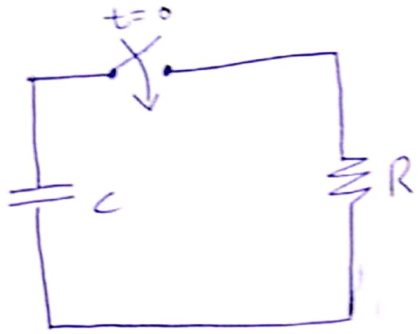
Q2

(c) $C = 10mF$,

(i) $t = ?$ $R = 1\Omega$

$\tau = RC = 1 \times 10mF$

$\boxed{\tau = 10ms}$

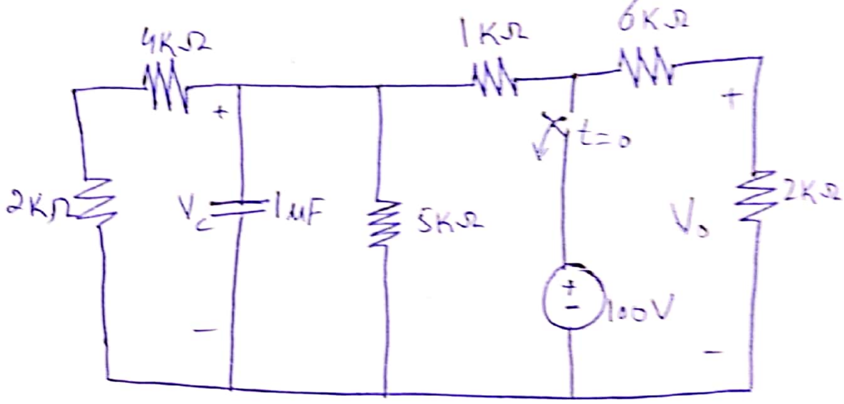


(ii) $R = 100\Omega$

$\tau = RC = 100 \times 10mF$, $\boxed{\tau = 1s}$

Q:-3

(a)

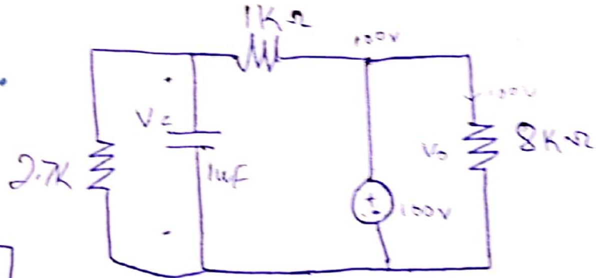


$V_c(0^-) = \frac{100 \times 2.7K}{3.7K}$

$\boxed{V_c(0^-) = 73V}$

$V_o(0^-) = \cancel{V_o(0^+)} = \frac{100 \times 2}{8}$

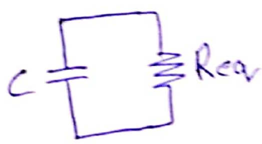
$\boxed{V_o(0^-) = 25V}$



$\cancel{V_o}$ $\boxed{V_c(0^+) = 73V}$

$V_o(0^+) = \frac{73 \times 2}{9}$, $\cancel{V_o(0^+) = 65V}$ $\boxed{V_o(0^+) = 16.2V}$

$V_c(t) = 73e^{-t/\tau}$



$\tau = R_{eq}C = 2ms$

$\boxed{V_c(t) = 73e^{-500t}}$ V

$R_{eq} = 9K \parallel 2.7K$

$R_{eq} = 2K\Omega$

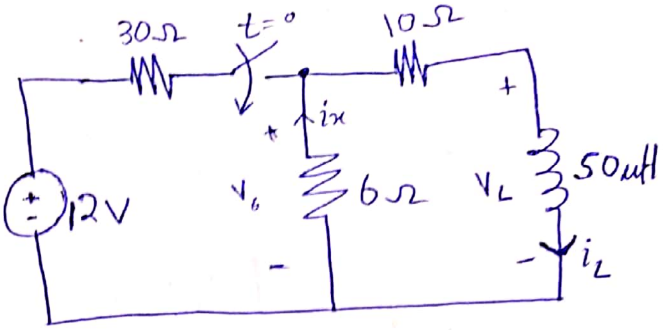
$\boxed{V_c(10m) = 491mV}$ $\boxed{V_c(12ms) = 180mV}$

$\cancel{V_o(10m) = 437mV}$ $\cancel{V_o(12ms) = 160mV}$

$\boxed{V_o(10m) = 109mV}$ $\boxed{V_o(12ms) = 40mV}$

Q3

(b)



$i_x(0^-) = i_L(0^-) = 0A$, $V_L(0^-) = 0V$

$V_6(0^+) = \frac{12\times 6}{36} = 2V$

$i_x(0^+) = -2\times 6\Omega = \boxed{i_x(0^+) = -12A}$

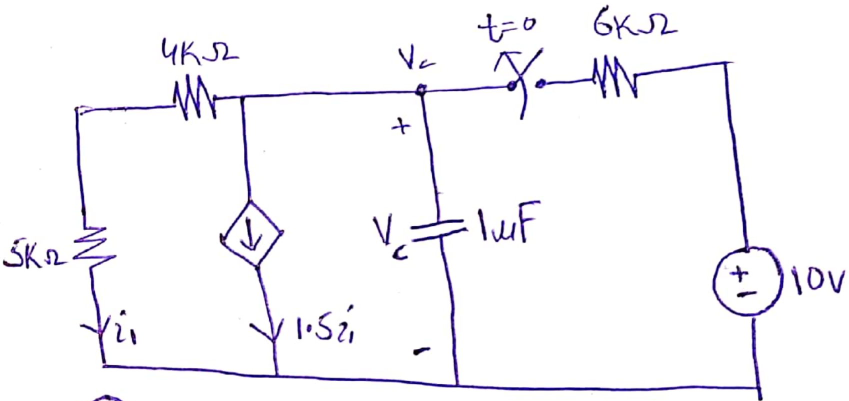
$i_L(0^+) = 2\times 10\Omega = \boxed{i_L(0^+) = 20A}$

$V_L = L\frac{di}{dt}$, $V_L(0^+) = L\times 20 =$ 50m × 20

$\boxed{V_L(0^+) = 1mV}$

Q3

(c)



using nodal analysis

$\frac{V_c-10}{6K} + \frac{V_c}{9K} + \cancel{1.7}\,1.5i_1 = 0$

$\cancel{i_1}= 3V_c - 30 + 2V_c + \cancel{24}\,27i_1 = 0$

$5V_c - 30 + \cancel{24}\,27i_1 = 0$ —— (1)

$i_1 = \frac{V_c}{9K}$ —— (2) substituting 2 in 1

$\cancel{5V_c - 30 + \frac{27V_c}{9K} = 0}$, $\cancel{45KV_c - 270K + 24V_c = 0}$ (27V_c)

$\cancel{\boxed{V_c(0^-) = 6V}}$, $\cancel{\boxed{V_c(0^+) = 6V}}$, $\tau =$

$3V_c - 30 + 2V_c + 27i_1 = 0$

$i_1 = \frac{V_c}{9K}$, $5V_c - 30 + 3V_c = 0$, $\boxed{V_c = 3.75V} = V_c(0^+) = V_c(0^-)$

$\tau = R_{eq}C$, $i_c = 2.5i_1$, $i_c = \frac{2.5\times V_c}{9K}$, $R_{eq} = \frac{V_c}{i_c} = \frac{V_c\times 9K}{2.5K\times V_c}$

$R_{eq} = 3.6K\Omega$ $\tau = (3.6K)\times(1uF)$, $\boxed{\tau = 3.6ms}$

$$V(t) = V_0 e^{-t/\tau} = 3.75\, e^{-277t} \qquad \text{(ii)}$$

$$V(3m) = 3.75\, e^{-277 \times 3m}$$

$$\boxed{V(3ms) = 1.6\,V} = 1.63\,V$$

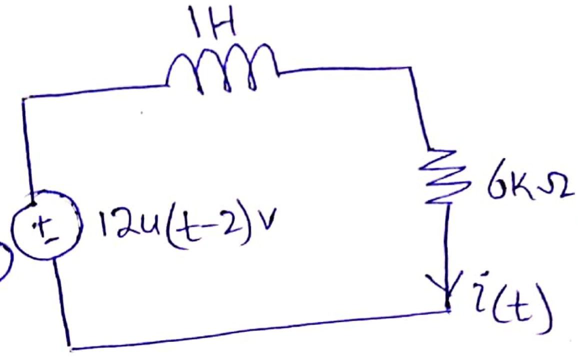
Q:-4

(a)

at $t \geq 2^+$, $v = 12V$

and before $t = 2$, $v = 0$ Hence,

$i(t) = i(0^-) = i(0^+) = i(2^-) = 0A$ — ①



$\tau = \frac{L}{R} = \frac{1}{6K\Omega}$, $\boxed{\tau = 166\mu s}$

$i(2^+) = 0A$.

Now $i(t) = i_0 - i_0 e^{-t/\tau}$: $i_0 = \frac{V_0}{R} = \frac{12}{6K} = 2mA$

$i(t) = (2m - 2me^{-t/166us}) \cancel{\times 12}\, u(t-2)$

$\cancel{i(t) = (2m - 2me^{-6t})(\cancel{12}u(t-2))}$ ——— ②

$\cancel{i(4ms) = (2m - 2me^{-0.024})(1)}$

$\boxed{\cancel{i(4ms) = 1.04mA}}$

$i(t) = (2m - 2me^{-6024t})(u(t-2))$ ——— ②

$i(4ms) = (2m - 2me^{-24})(1)$

$\boxed{i(4ms) = 2mA}$

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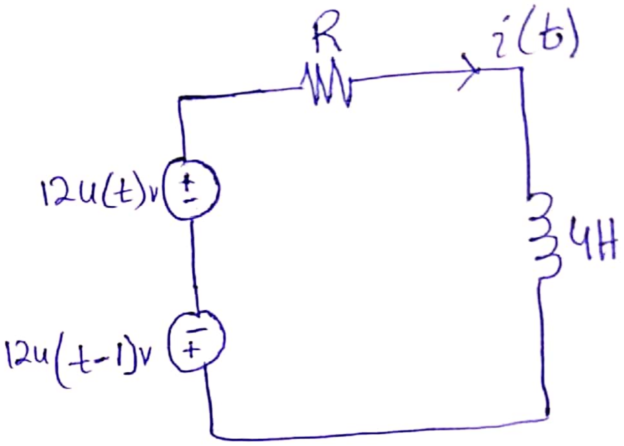
Q:- 4

(b) For $R = 10\Omega$

$\tau = 4R$, $\boxed{\tau = 400ms}$



for $t \le 0^-$, $i(t) = 0A$, $V(t) = 0V$

$V(t) = 12u(t) - 12(t-1)V$ —— (1)

at $t = 0^+$

$V(0^+) = 12V$ —— (2)

~~$i(0^+)$ for $0<t \to$~~

for $0 < t < 1$

$i(0^+) = \frac{12}{10}$, $\boxed{i(0^+) = 1.2A}$

$w(10\Omega) = \frac{1}{2}Li^2 = \frac{1}{2}(4)(1.2)^2$, $\boxed{w(10\Omega) \Rightarrow 2.88J}$

For $R = 1\Omega$

$\tau = 4s$

As the time constant with $R = 1\Omega$ is 4s and the circuite only works for less then one second.

$V(0^+) = 12V$, $i(0^+) = \frac{1}{\cancel{2}}\cancel{(4} = \frac{12}{1} = 12Amp$. then

$w(1\Omega) = \frac{1}{2}(4)(12)^2$, $\boxed{w(1\Omega) = 288J}$

The 1Ω resistor circuite will store <u>100 times</u> more energy.

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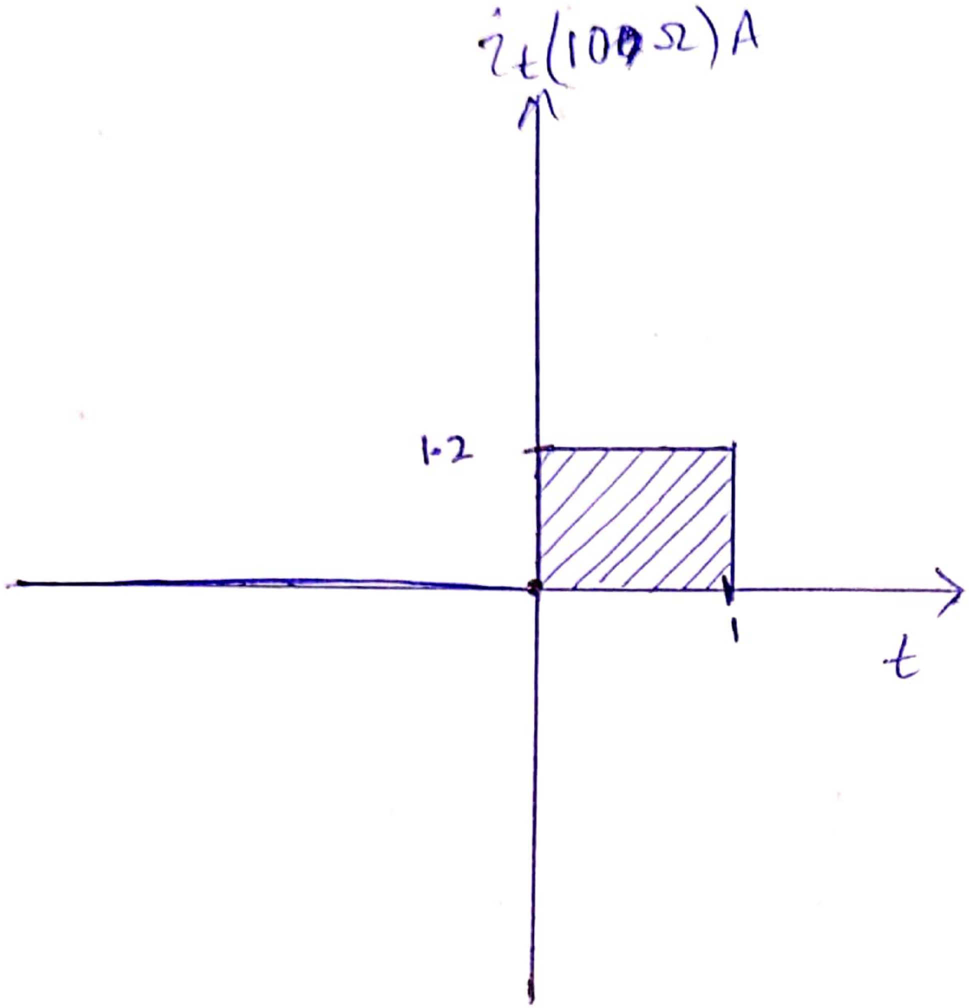
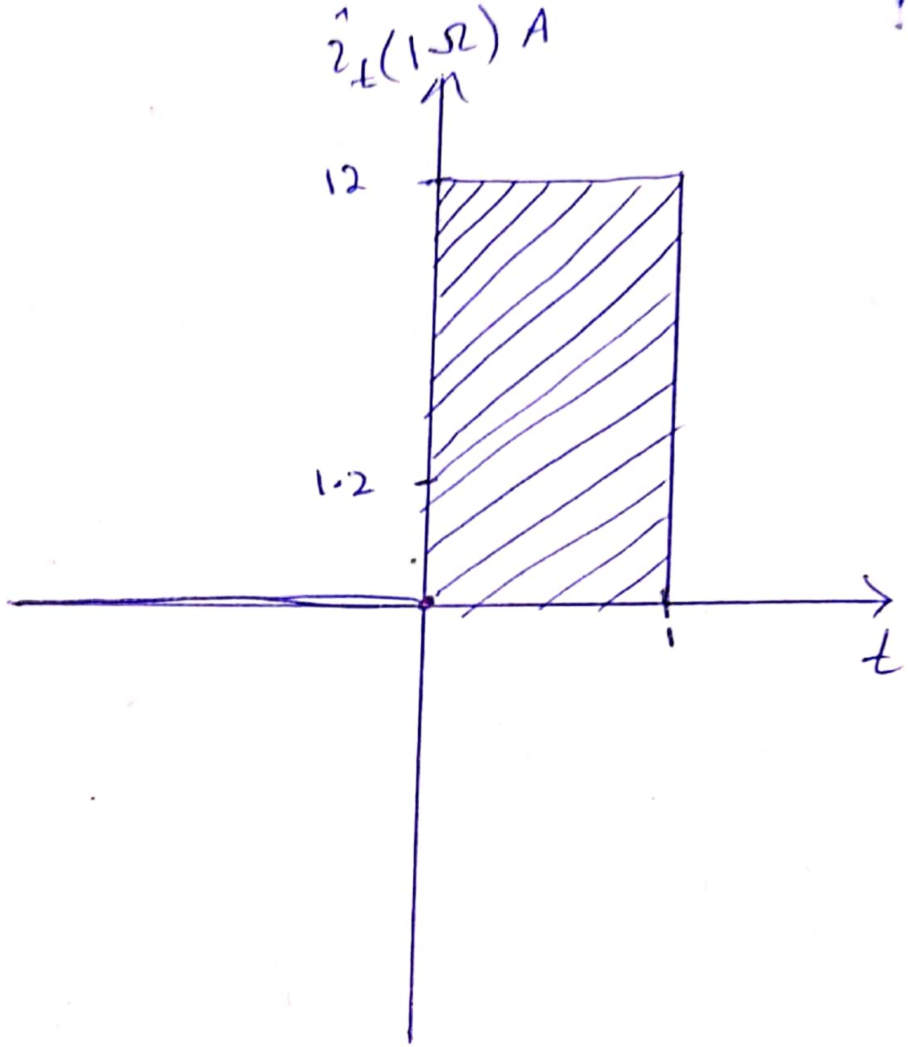
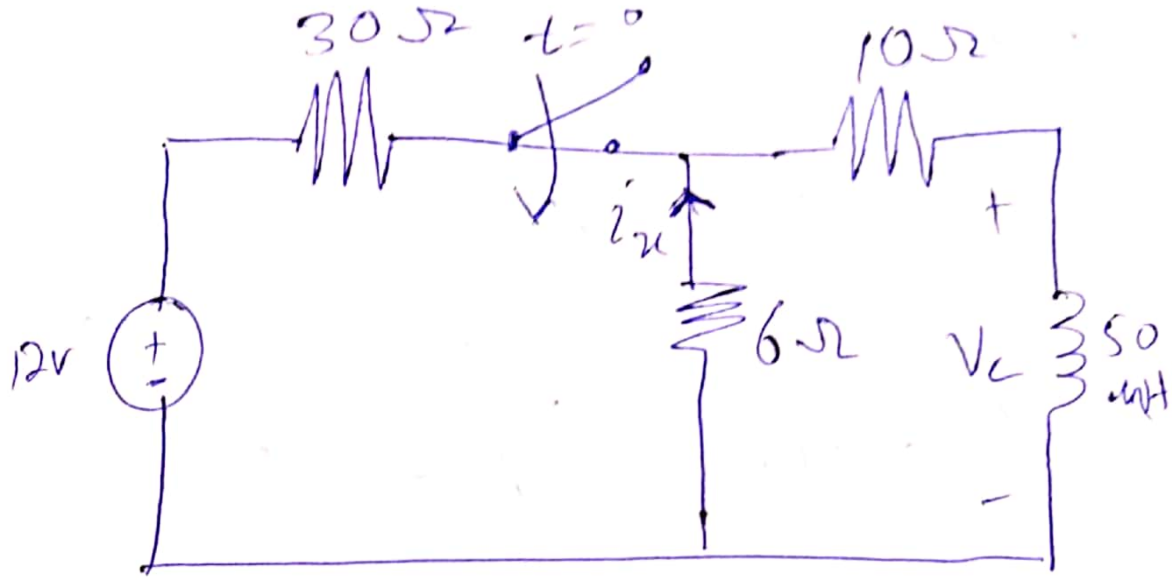




$$i(t) = (1.2e^{-2.5t})(u(t))(u(t-1))$$

$$i(t) = (12e^{-0.25t})(u(t))(u(t-1))$$

Q:- 3



(b)

$i_x(0^-) = 0A$

$i_L(0^-) = 0A$

$i_L(0^+) = 0A$

$i_x(0^+) = \frac{12}{36} = 333 mA$

$V_L(0^-) = 0V$

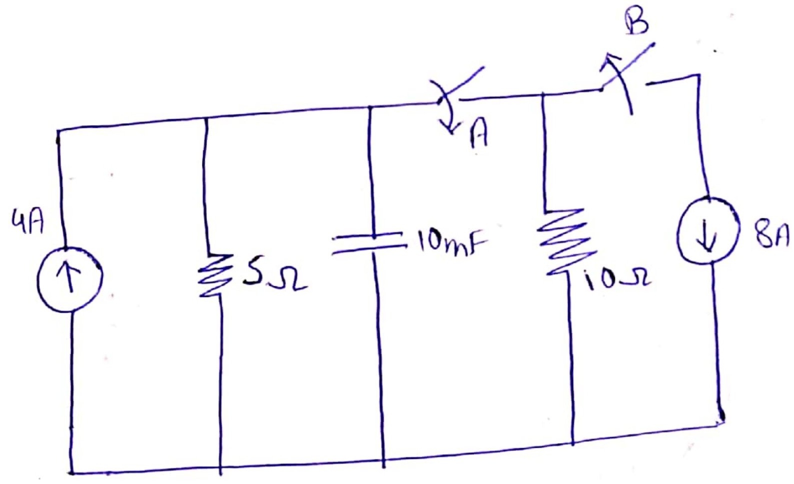
$V_L(0^+) = 0V$

Q:-5

(a)

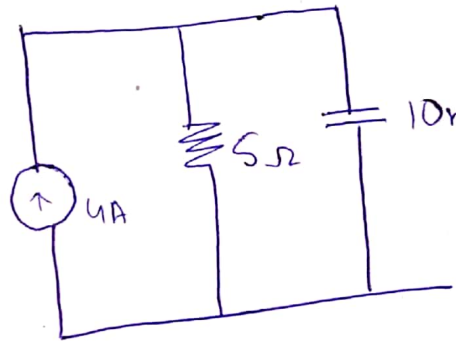
Solve:-

$\tau = RC = 50ms$



(i) $V(0^-) = 4 \times 5 = \boxed{20V}$

(ii) $V(0^+) = 4 \times 5 = \boxed{20V}$

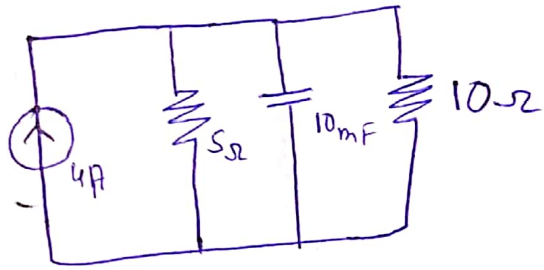


(iii) $V(40ms) = \cancel{20e}$

$20 - 20e^{-\frac{40m}{50m}}$

$V(40ms) = 20 - 8.98$

$\boxed{V(40ms) = 11V}$



(iv) $R_{eq} = 5 \| 10 = 3.33\,\Omega$

$\tau = 33.3ms$

$\boxed{V_c(40^+m) = 11V}$

(v) $t = 50ms$

$V_c(50ms) = 11 + [20-11]e^{-\frac{50m}{33m}}$

$V_c(50ms) = 11 + 17.5$

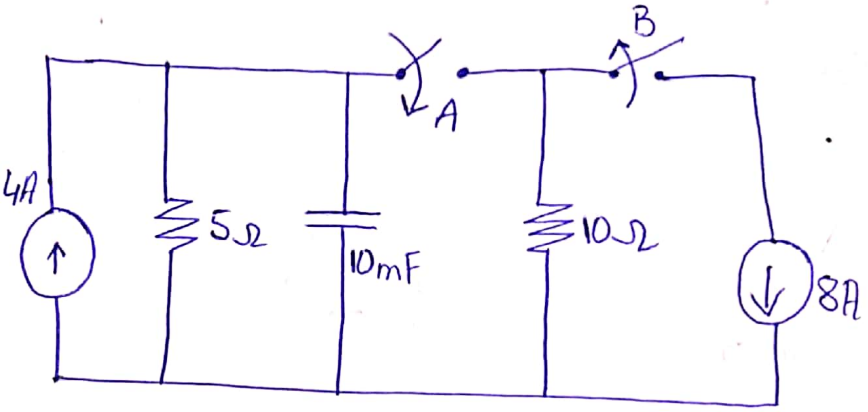
$\boxed{V_c(50ms) = 28.5V}$

Q:-5

(a)

(i) $\tau = RC = 5 \times 10m$

$\tau = 50ms$

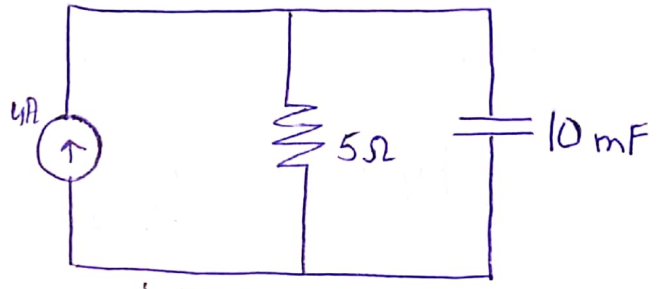


As ~~$V(0^-) = 0V$~~

~~(ii) $V(0^+) = 0V$~~

(i) $V(0^-) = ?$

$V(0^-) = 4 \times 5 = 20V$ — ①



i, ii, iii

(ii) $V(0^+) = 20V$ — ②

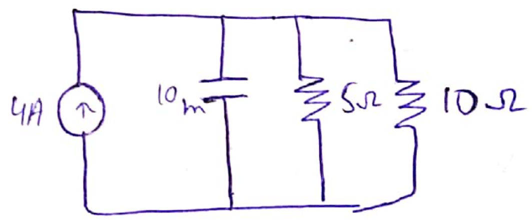
(iii) $V(40ms) = -V_0 e^{-t/\tau} + 20$

$= 20 - 20e^{-\frac{40m}{50m}}$

$\boxed{V(40ms) = 11V}$

$V(40ms) = 11 + 9e^{-\frac{40m}{50m}}$

$\boxed{V(40ms) = 15V}$



$R_{eq} = 3.3\,\Omega$

(iv) $V(40^+)$

$\boxed{V(40^+) = 15V}$

(v) $V(50ms) = ?$

$\tau = 33ms$

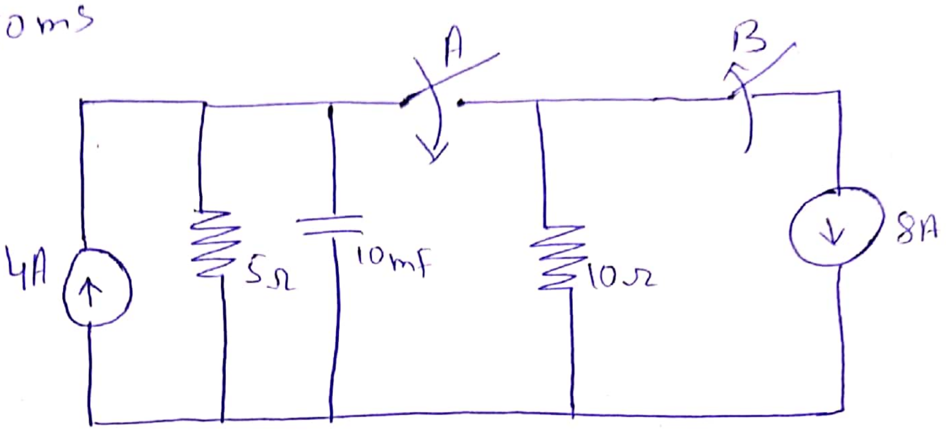
$V(t) = 15 - 15e^{-t/33ms}$

$V(50m) = 15 - 15e^{-1.5}\ V$

$\boxed{V(50m) = 11.7V}$

Q:-5

(b) $\tau = RC = 50ms$



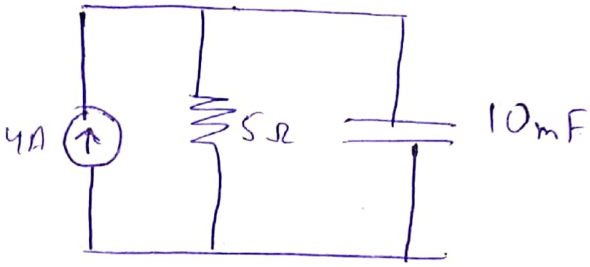
(i) $V(0^-) = 20V$

$w(0^-) = \frac{1}{2}CV^2$

$w(0^-) = \frac{(10m)(20)^2}{2}$

$\boxed{w(0^-) = 2J}$

(ii) $\boxed{w(0^+) = 2J}$



(iii) $w(200ms) = ?$

$v(200ms) = 20 - 20e^{\frac{-200m}{50m}}$

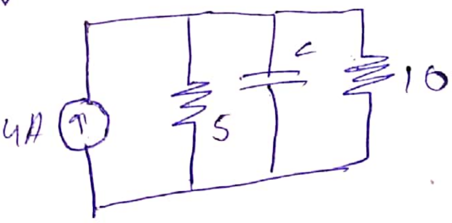
$V(200ms) = 19.6V$

$w(200ms) = \frac{10m \times (19.6)^2}{2}$, $\boxed{w(200ms) = 1.927J}$

(iv) $w(400^- ms) = ?$

$V_c(\infty) = \frac{4}{\cancel{3.3}}$, $V_c(\infty) = 13.3V$

$5||10$



$V_c(400^- ms) = 13.3 + (20-13.3)e^{-t/\tau}$

$R_{eq} = 3.3\Omega$

$\tau = 33ms$

$V_c(400^- ms) = 13.3V$

$\boxed{w(400^- ms) = 884mJ}$

(v) $\boxed{w(400^+ ms) = 884mJ}$

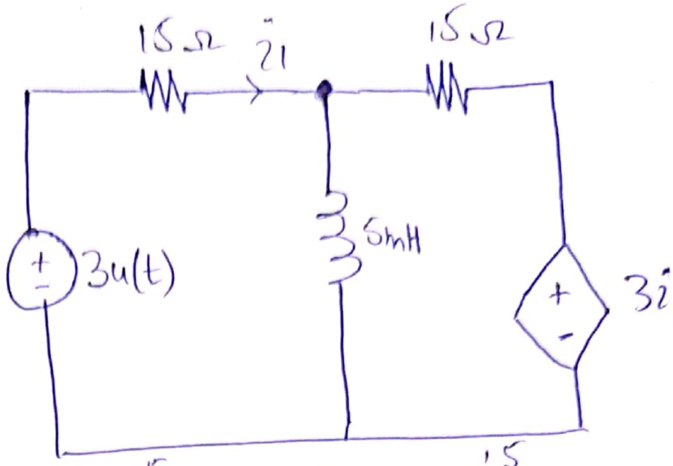
(vi) $V(700ms) = 13.3 + (20-13.3)e^{-\frac{700}{33}} = 33.3V$

$w(700ms) = \frac{10m \times (33.3^2)}{2}$

$\boxed{w(700m) = 5.54J}$

Q:-4

(c)



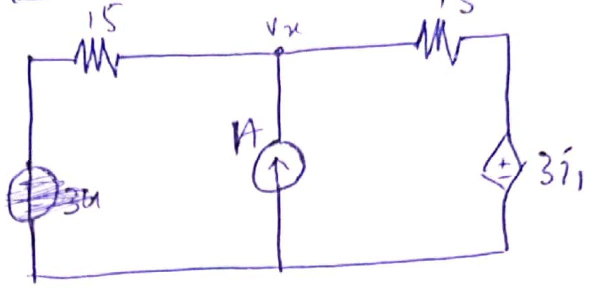
$(15+15)i_1 + 3i_1 = 3$

$33 i_1 = 3$

$i_1 = 3/33$, ~~$i_1(0) = 90.9A$~~

$\boxed{i_1(0) = 90.9mA}$

Now using nodal analysis.



$\frac{V_x}{15} + \frac{V_x - 3(90.9m)}{15} - 1 = 0$

$\frac{2V_x}{15} - 1.018 = 0$

$\boxed{V_x = 7.636V}$, ~~V_t~~ $= R_L = \frac{V_x}{1} = 7.636\,\Omega$

$\tau = L/R = \frac{5m}{7.636}$, $\boxed{\tau = 0.65ms}$

$i_1(\infty) = 3/15 = 0.2A$

$i_1(0) = 90.9mA$

$i_1(t) = i_0 e^{-t/\tau}$

$i_0 = 90.9mA - 0.2$, $i_0 = -0.1A$

$i_1(t) = -0.1e^{-t/\tau} +$ ~~$90.9mA$~~ $0.2A$

$\boxed{i_1(t) = \cancel{0.0909} - 0.1e^{-t/\tau}}$

$\boxed{i_1(t) = (200 - 100e^{-t/\tau})\,mA}$