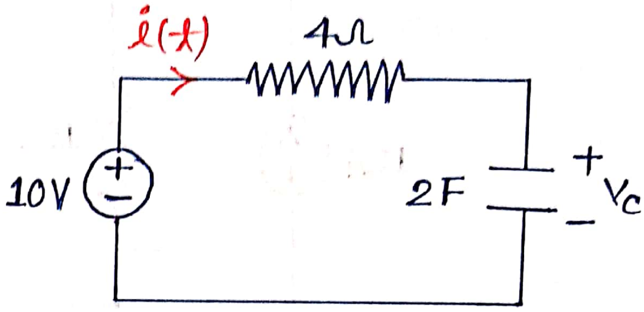
BE QUIZ-2
SOLUTION

SOL (1):



$V_c(0^-) = 6\,V$ (Given)

$\therefore V_c(0^+) = V_c(0^-) = 6\,V$ (Capacitor does't allow sudden change of voltage)

$\therefore V_c(\infty) = 10\,V$

$\therefore V_c(t) = [V_c(0^+) - V_c(\infty)]\,e^{-t/RC} + V_c(\infty)$

Time constant $= \tau = RC = 4\times 2 = 8$ Sec

$\therefore V_c(t) = (6-10)\,e^{-t/8} + (+10) = (+10 - 4e^{-t/8})\,V$

$$\therefore i(t) = C\,\frac{dV_c(t)}{dt} = 2\cdot\frac{d}{dt}\left\{+10 - 4e^{-t/8}\right\}$$

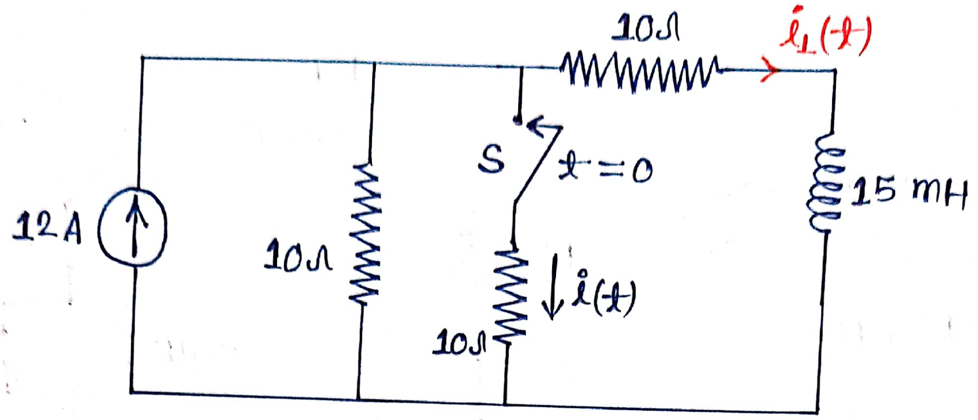
$$= 2\times(-4)\times\left(-\frac{1}{8}\right)e^{-t/8} = e^{-t/8}$$ → (4 POINT)

$\therefore$ Energy absorbed by 4Ω resistor in $0<t<\infty$,

$$E = \int_0^\infty i^2(t)\times R\,dt = \int_0^\infty 4\cdot e^{-t/4}\,dt = 4\left[\frac{e^{-t/4}}{-1/4}\right]_0^\infty$$

$$= -16\left[e^{-t/4}\right]_0^\infty = 16 \text{ Joule}$$ → (2 POINT)

SOL(2):



$i_L(0^+) = i_L(0^-) = \frac{12}{2} = 6A$

$\therefore i(0^+) = \frac{6}{2} = 3A$ → (0.5 POINT)

$\therefore i(\infty) = \frac{12}{3} = 4A$ → (0.5 POINT)

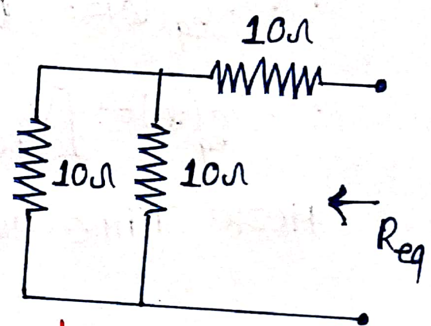
$\therefore i(t) = [i(0^+) - i(\infty)]e^{-t/\tau} + i(\infty)$

Here, Time constant $(\tau) = \frac{L}{R_{eq}}$

$= \left(\frac{15 \times 10^{-3}}{15}\right)$

$= 1\ msec$

→ (0.5 POINT)



$R_{eq} = 10 + (10 \| 10)$

$= 15Ω$

$\therefore i(t) = (3-4)e^{-t/10^{-3}} + 4$

$= (4 - e^{-1000t})A$ → (2.5 POINT)

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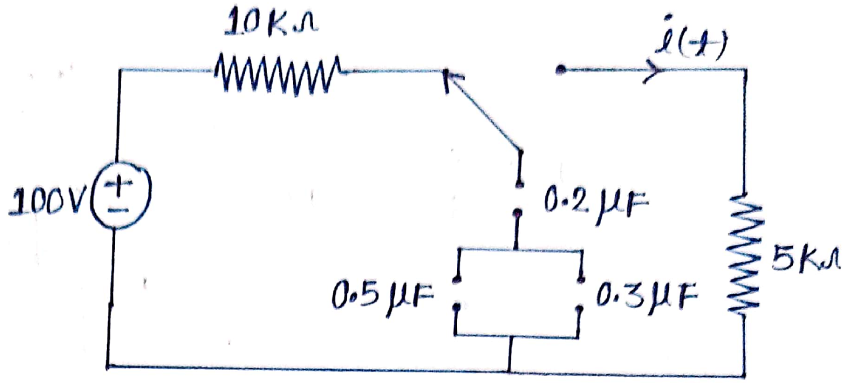
SOL(3):

at $t = 0^-$



$$C_{eq} = \frac{0.2 \times (0.5+0.3)}{0.2+0.5+0.3}$$

$$= 0.16\ \mu F$$

$$V_{C_{eq}}(0^+) = V_{C_{eq}}(0^-)$$

(Capacitor doesn't allow sudden change of voltage)

Here, $V_{C_{eq}}(0^-) = 100\ V$

$\therefore V_{C_{eq}}(0^+) = 100\ V$ → (0.5 POINT)

$\therefore V_{C_{eq}}(\infty) = 0$ → (0.5 POINT)

$$\therefore V_{C_{eq}}(t) = [V_{C_{eq}}(0^+) - V_{C_{eq}}(\infty)]e^{-t/\tau} + V_{C_{eq}}(\infty)$$

Here Time constant $(\tau) = RC_{eq} = 5 \times 10^3 \times 0.16 \times 10^{-6}$

$= 0.8\ msec$ → (1 POINT)

$$V_{C_{eq}}(t) = (100-0)e^{-t/(0.8\times 10^{-3})} + 0$$

$$= 100\, e^{-\frac{10000}{8}t}$$

$$\therefore i(t) = -C_{eq} \cdot \frac{d\, V_{C_{eq}}(t)}{dt} = (0.16\times 10^{-6}) \cdot \frac{d}{dt}\left\{100\, e^{-10^4 t/8}\right\}$$

$$= -0.16 \times 10^{-6} \times 100 \times \left(\frac{-10^4}{8}\right) e^{-1250t}$$

$$= 20\, e^{-1250t}\ mA$$ → (4 POINT)

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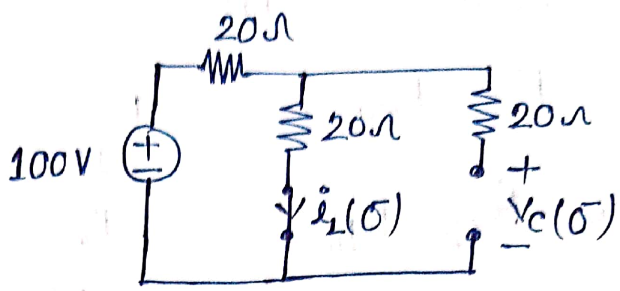
SOL (4) :

Step (I) at $t = 0^-$



$\therefore i_L(0^-) = \left(\frac{100}{20+20}\right) = 2.5A$

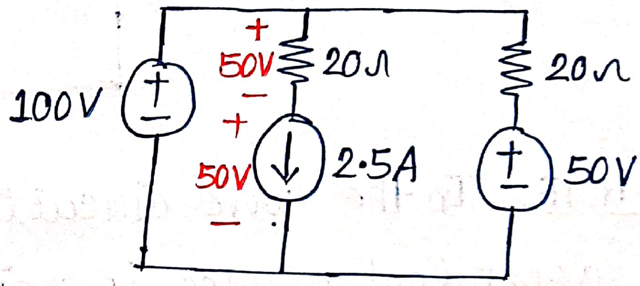
$\therefore V_c(0^-) = 20 \times 2.5 = 50V$

Step (II) at $t = 0^+$

$\therefore i_L(0^+) = i_L(0^-) = 2.5A$ → (0.5 POINT)

$\therefore V_c(0^+) = V_c(0^-) = 50V$ → (0.5 POINT)

Step (III)



$$V_L = L \frac{di}{dt}$$

$$50 = 1 \times \frac{di}{dt}(0^+)$$

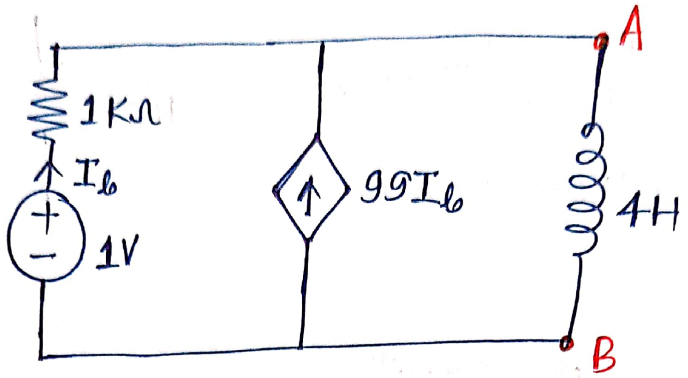
$$\therefore \frac{di(0^+)}{dt} = 50 \ A/sec$$ → (3 POINT)

SOL(5):-

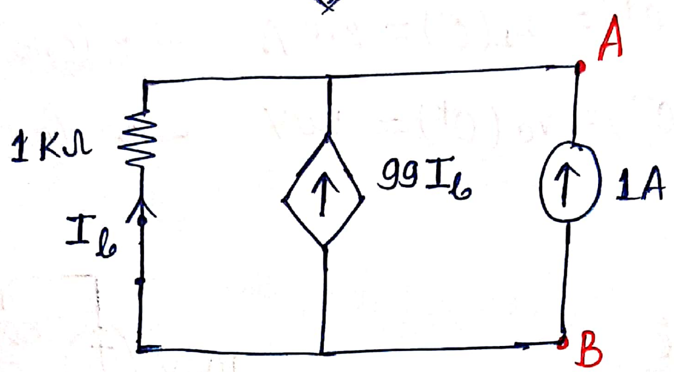
Here, $L = 4H$

For R_{eq} –

$R_{eq} = R_{AB} = R_{th}$



NOTE: 1A external current source is connected across terminal A–B.



NOTE: In the above circuit while finding time constant, dependent source is neither replaced by open circuit or short circuit.

$$I_b + 99I_b + 1 = 0$$

$$I_b = \left(-1/100\right)$$

$$I_b = \frac{-V_A}{1 \times 10^3}$$

$$\therefore V_A = 10\ V = V_{AB}$$

$$\therefore R_{th} = \frac{V_{AB}}{1} = 10\Omega = R_{eq}$$ → (3 POINT)

$$\therefore \text{Time Constant} = \frac{L}{R_{eq}} = \frac{4}{10} = 0.4\ \text{Sec}$$ → (1 POINT)