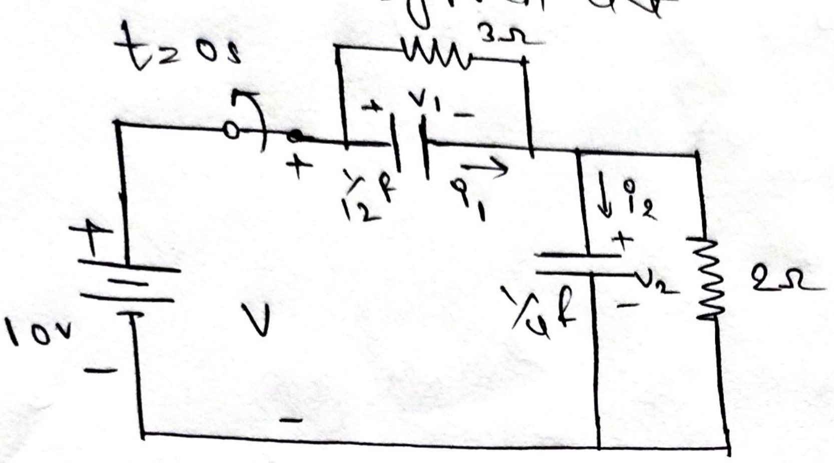
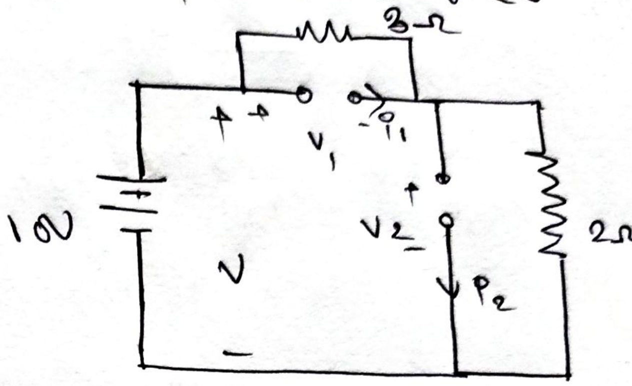
Tutorial-2

Ans (1) The given ckt



switch is opened at t=0 sec

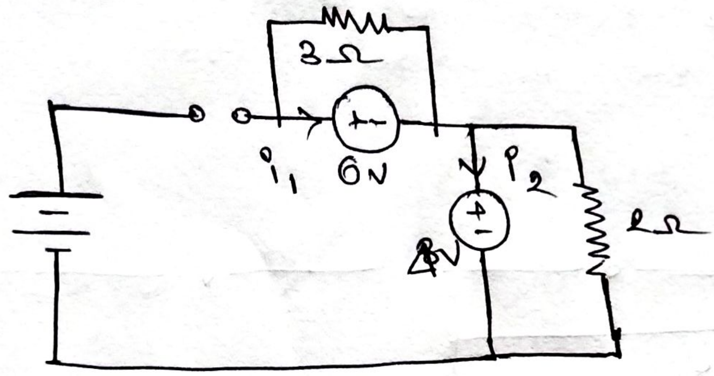
eq. ckt at t<0



(at t<0)

hence at t<0

$$V_1 = \frac{10\times 3}{3+2} = 6V, \quad V_2 = \frac{10\times 2}{3+2} = 4V$$

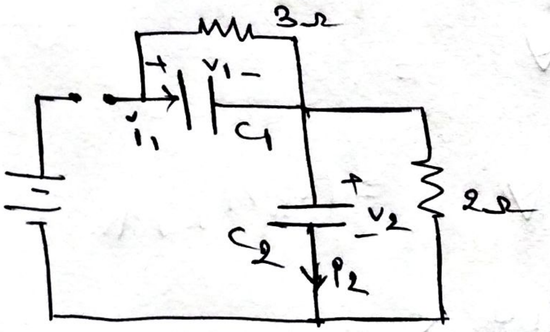


(at t=0+)

$i_1(0^+) = -6/3 = -2A$

$i_2(0^+) = -4/2 = -2A$

$V_1(0^+) = 6V, V_2(0^+) = 4V$



(at t>0)

for t>0; N/w is become source free.

Then

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

for C_1,

$$\tau = R_1C_1 = 3\times 1/12 = (1/4)$$

$V_{C_1}(\infty) = 0, \quad V_{C_1}(0^+) = 6V$

hence $V_1(t) = 6e^{-4t}$ {for $t \geq 0$}

Similarly, for c_2

$v_{c_2}(t) = v_2(t) = 4e^{-2t}$ {for $t \geq 0$}

for $i_1(t)$

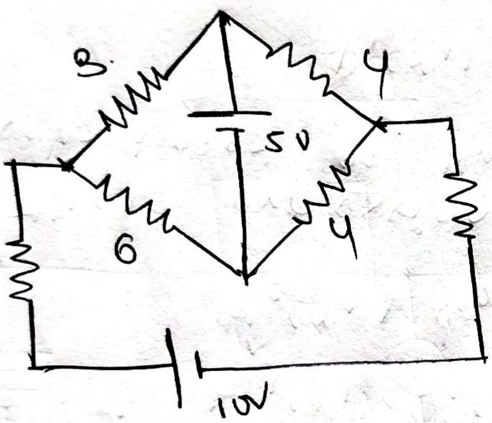
$i_1(t) = i_1(0^+)\, e^{-t/R_1C_1} = -2e^{-4t}$ {for $t \geq 0$

$i_2(t) = i_2(0^+)\, e^{-t/R_2C_2} = -2e^{-2t}$ {for $t \geq 0$

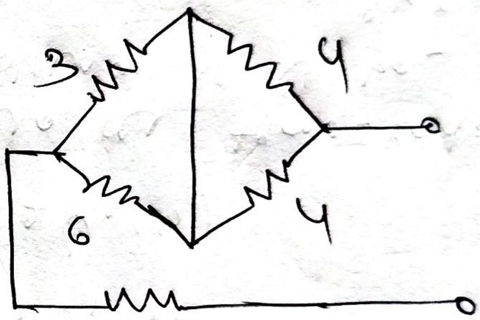
and $v(t) = v_1(t) + v_2(t) = 6e^{-4t} + 4e^{-2t}$ {for $t \geq 0$

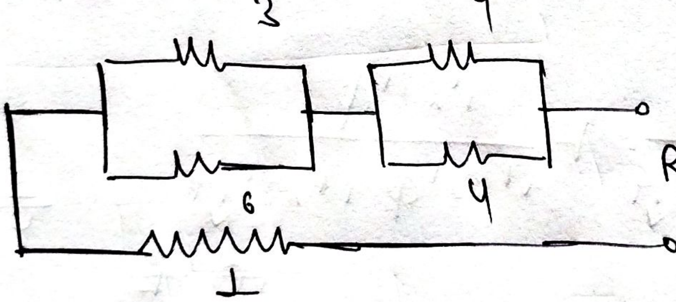
Ans

Q.2 The given ckt



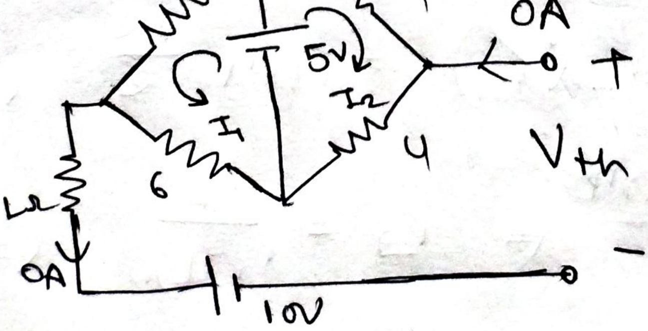
R_{th} across R_L





$R_{th} = 5\,\Omega$

for V_{th} calculation across R_L —



$-9I_1 = 5 \Rightarrow I_1 = 5/9$

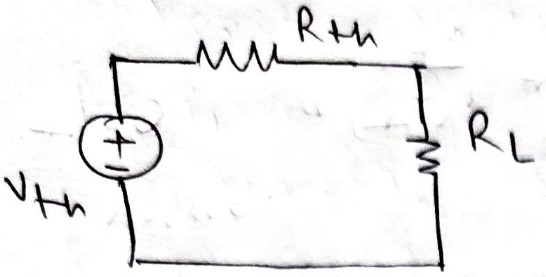
$8I_1 = 5 \Rightarrow I_2 = 5/8$

$-V_{th} + 4I_2 + 6I_1 + 10 = 0$

$V_{th} = 10 + 4\left(\frac{5}{8}\right) - 6\left(\frac{5}{9}\right)$

$= 10 + 2.5 - 3.33$

$V_{th} = 9.167$ volt



for MPT

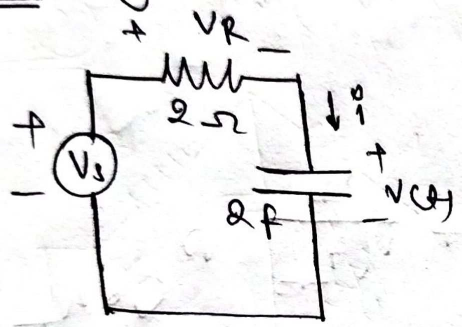
$R_L = R_{th}$

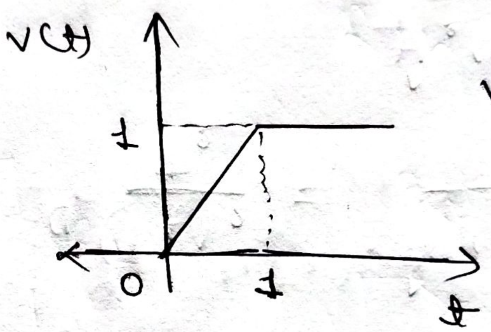
hence MPT across R_L

$$= \frac{V_{th}^2}{4R_{th}} = \frac{(9.167)^2}{4\times 5}$$

$$= 4.2 \text{ Watt } \underline{\text{Ans}}$$

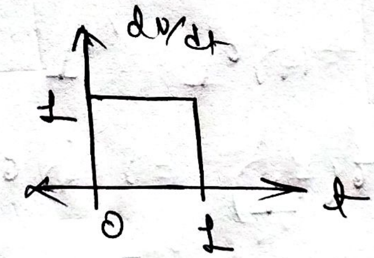
Q.③ given ckt and voltage graph across the cap.



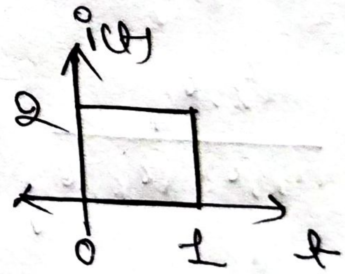


$$v(t) = \begin{cases} 0v & \text{for } t \le 0s \\ t\,v & \text{for } 0 \le t \le 1 \\ 1v & \text{for } t \ge 1 \end{cases}$$

Then $\dfrac{dv(t)}{dt} =$

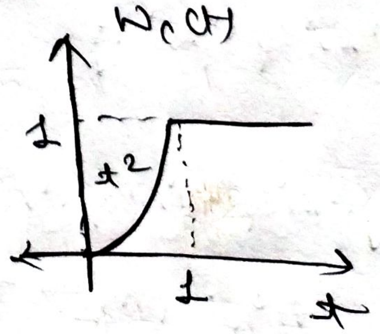


i) Then $i(t) = C\dfrac{dv(t)}{dt} = 2\dfrac{dv(t)}{dt} \Rightarrow$

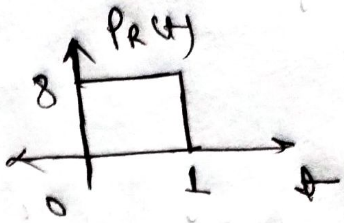


ii) $W_c(t) = \dfrac{1}{2}Cv^2(t) = v^2(t)$

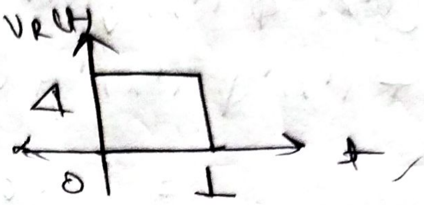
$$v^2(t) = \begin{cases} 0 & ; t \le 0 \\ t^2 & ; 0 \le t \le 1 \\ 1 & ; t \ge 1 \end{cases}$$



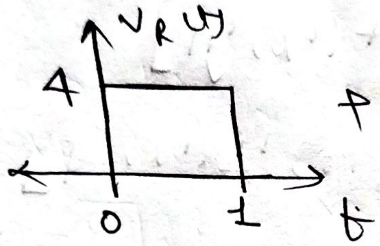
(iii) $P_R(t) = I^2(t).R = 2I^2(t) =$



(iv) $V_R(t) = i(t).R = 2i(t) =$



(v) $V_s(t) = V_R(t) + v(t)$



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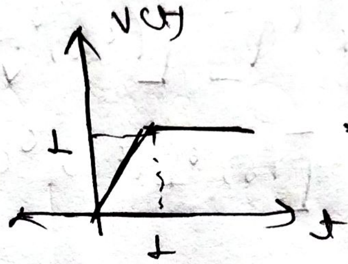
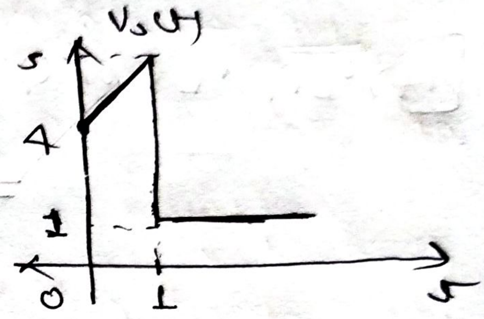
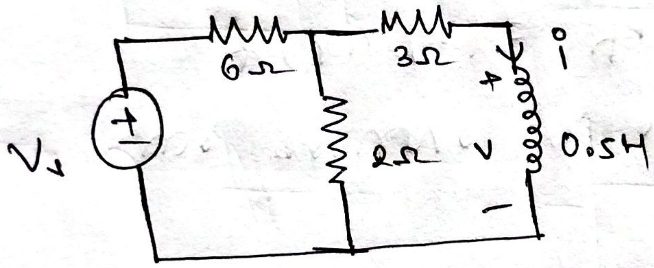


$\Rightarrow$

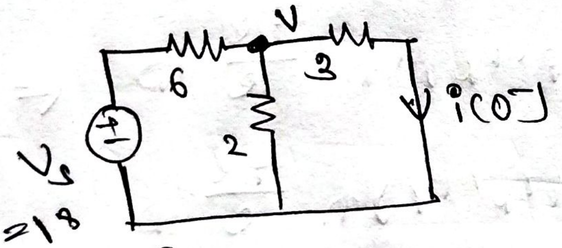


Q(4) The given ckt



$V_s = 18V$ for $t<0$ sec.

$= 0V$ for $t>0$ sec.

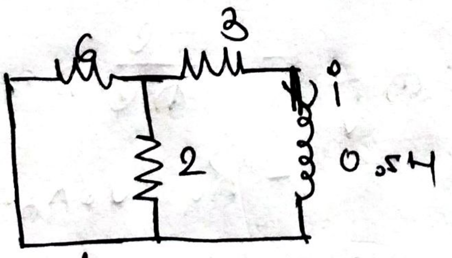


(at t<0)

$V = \frac{V_s \times 6/5}{6/5 + 6} = \frac{18 \times 6/5}{36/5}$

$= 3V$

hence $i(0^-) = 1A$



(for t>0)

$i(0^-) = i(0^+) = 1A$

$i(\infty) = 0A$

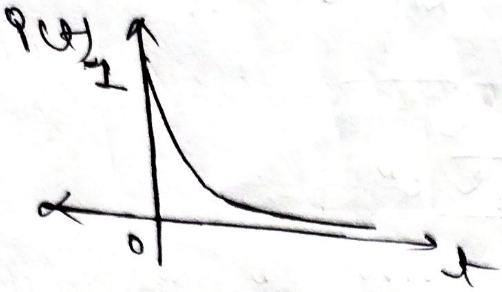
$L/R_{eq} = \frac{0.5}{4.5} = (1/9)$

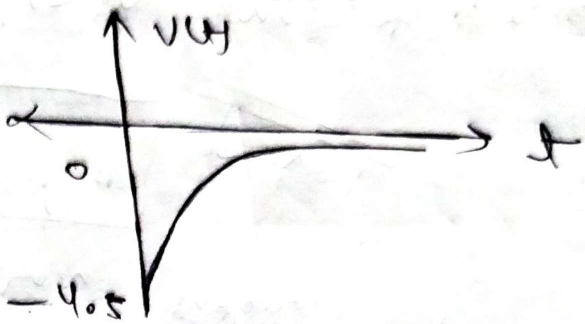
hence

$i(t) = i(0^+)e^{-R/L\,t} = e^{-9t}$

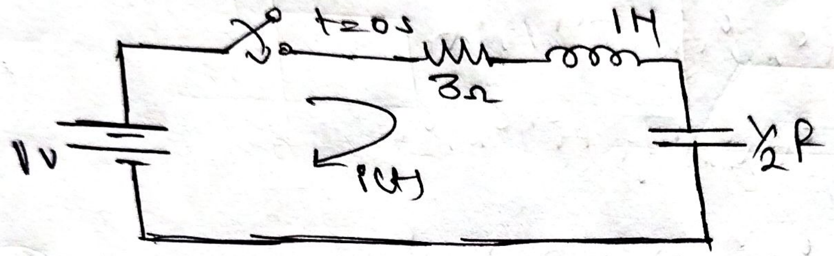
Then

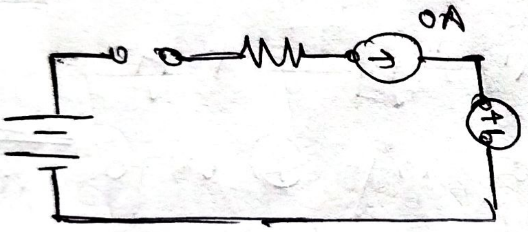
$$v(t) = L\frac{di(t)}{dt} = 0.5\frac{d}{dt}e^{-9t} = -4.5e^{-9t}$$ **Ans**



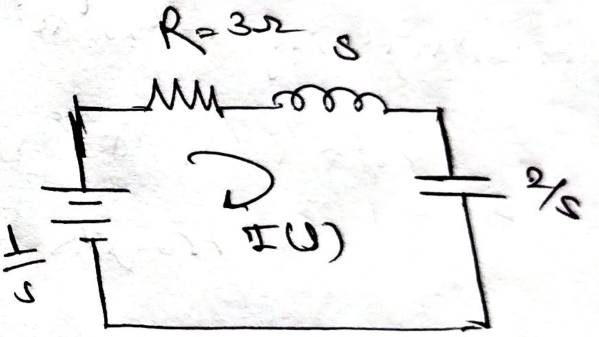


Q.5 The given ckt





(at t<0)

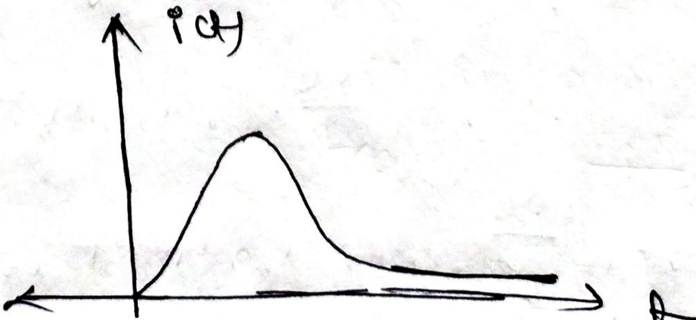


(Laplace form)

$$I(s) = \frac{1/s}{3+s+2/s} = \frac{1}{(s^2+3s+2)} = \frac{1}{(s+2)(s+1)}$$

$$i(t) = \cancel{e^{-2t}}\,(e^{-t} - e^{-2t})\,u(t)$$

graph ⇒



system Response -

$C(S) = s^2 + 3s + 2 = 0$

compare c/s eq with $s^2 + 2\xi\omega_n s + \omega_n^2 = 0$

$\omega_n = \sqrt{2}$, $2\xi\omega_n = 3 \Rightarrow \xi = \frac{3}{2\sqrt{2}} = 1.06$

$\xi > 1$ hence s/s will show overdampled response and stable

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