L-14/16.03.2023/

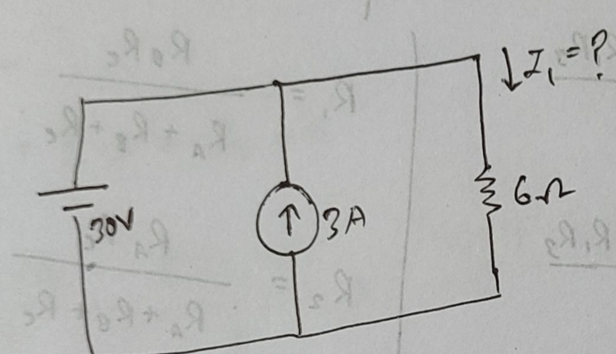
Review Class

L-15/18.03.2023/

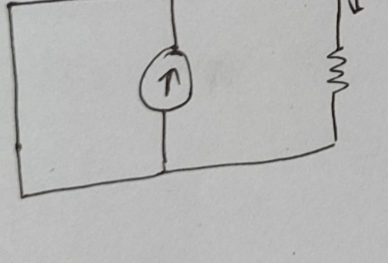
Midterm

L-16/23.03.2023/

⊛

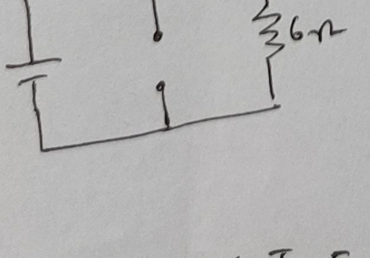


⇒



$\therefore I_1' = 0$

Because all the current goes ~~to~~ ~~the~~ through the short.

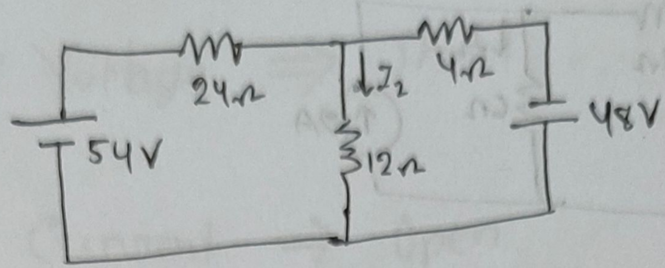


$$I_1'' = \frac{30}{6} = 5A$$

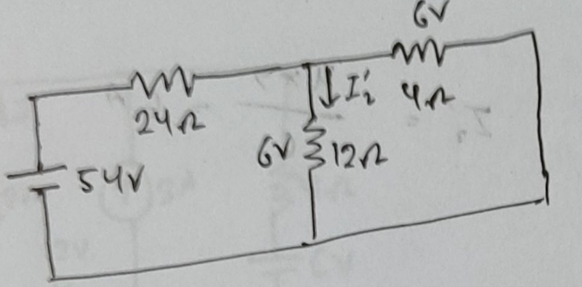
$$\therefore I_1 = I_1' + I_1''$$

$$= 0+5 = 5A$$

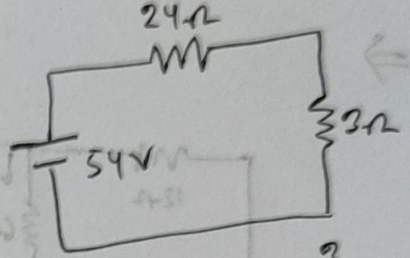
Example: 9.2



⇒



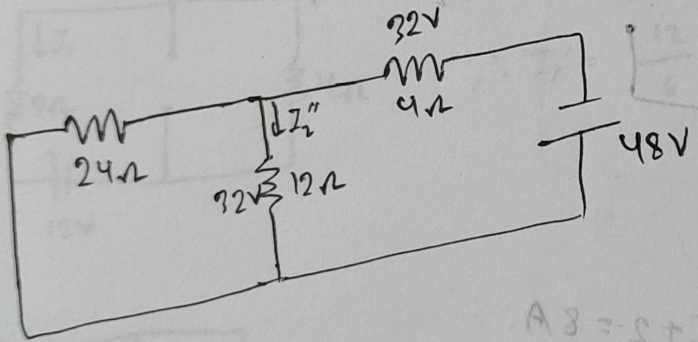
⇒



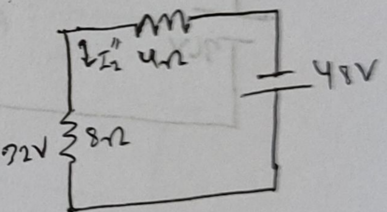
$$V_2 = \frac{3}{24+3} \times 54$$

$$= 6V$$

$$\therefore I_2' = \frac{6}{12} = 0.5\,A$$



⇒



$$V_2 = \frac{8}{8+4} \times 48$$

$$= 32V$$

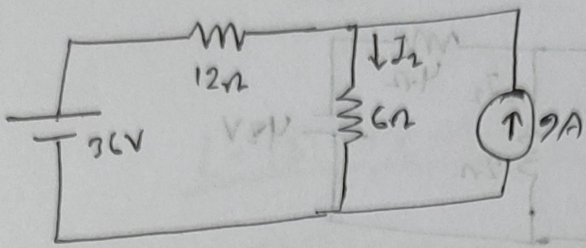
$$\therefore I_2'' = \frac{32}{12} = -2.67\,A$$

$$\therefore I_2 = I_2' + I_2''$$

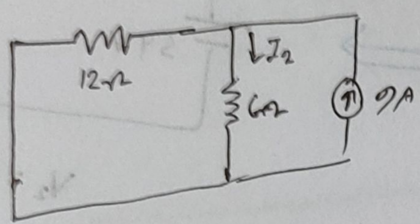
$$= 0.5 - 2.67$$

$$= -2.17\,A$$

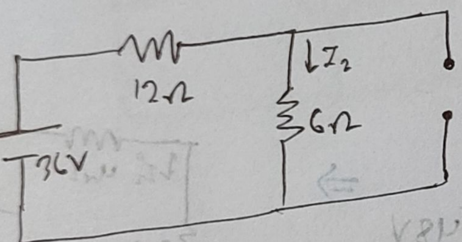
Fig 9.9



⇒



$$I_2' = \frac{4\times 9}{6} = 6A$$



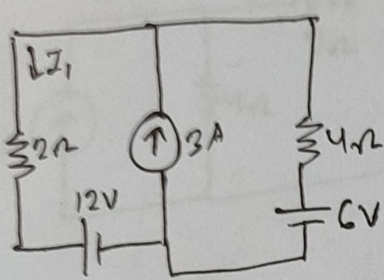
$$I_2'' = \frac{36}{18} = 2A$$

$$\therefore I_2 = 6+2 = 8A$$

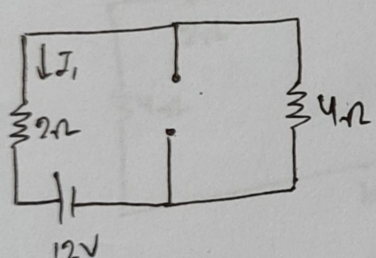
L-17/25.03.2023

* Voltage ⇒ Short

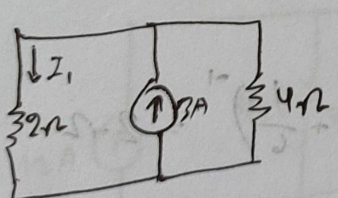
* Current ⇒ Open



⇒

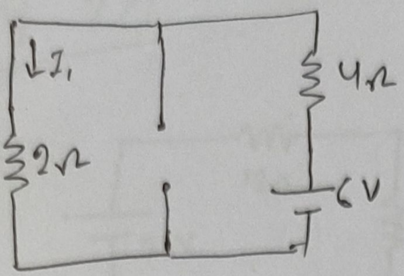


$\therefore I_1' = \frac{12}{6} = -2A$



$\therefore I_1'' = \frac{R_T}{R_x} \times I_s = \frac{4/3 \times 3}{2} = 2A$

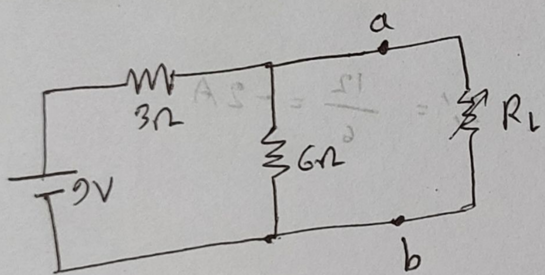
$R_T = \left(\frac{1}{2} + \frac{1}{4}\right)^{-1} = \frac{4}{3}\ \Omega$



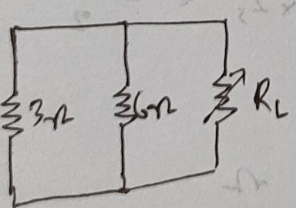
$$I_1''' = \frac{6}{6} = 1\,A$$

$$\therefore I = I' + I'' + I'''$$
$$= -2 + 2 + 1$$
$$= 1\,A$$

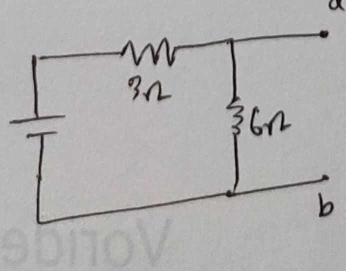
⊛ Fig - 9.26/



⇒

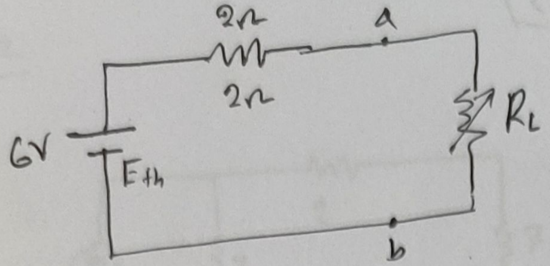


$$R_{Th} = \left(\frac{1}{3} + \frac{1}{6}\right)^{-1} = 2\,\Omega$$



$$E_{Th} = \frac{6}{3+6} \times 9 = 6\,V$$

∴



⇒

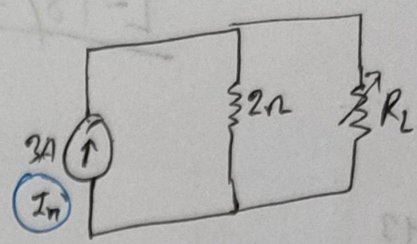
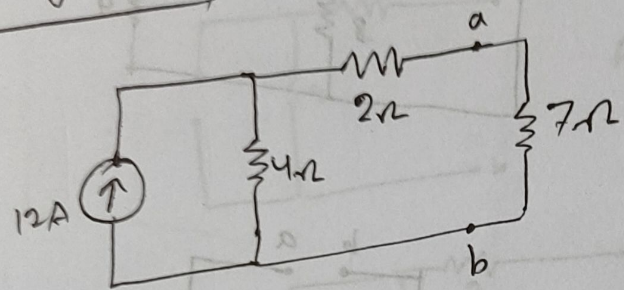
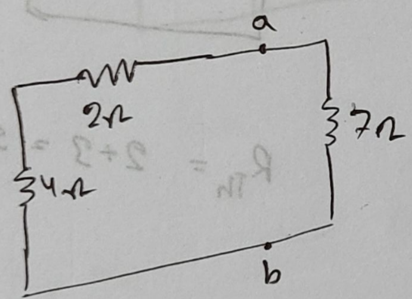


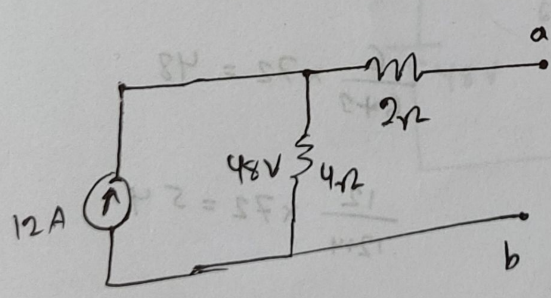
Fig- 9.32



⇒

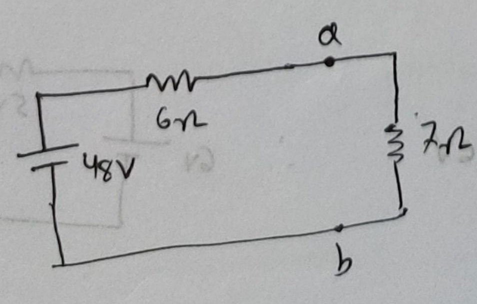


$R_{Th} = 2+4 = 6\Omega$



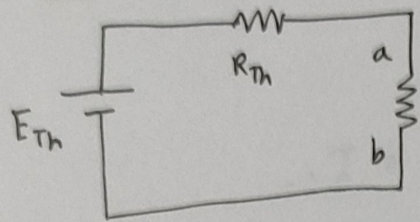
$E_{Th} = 48V$

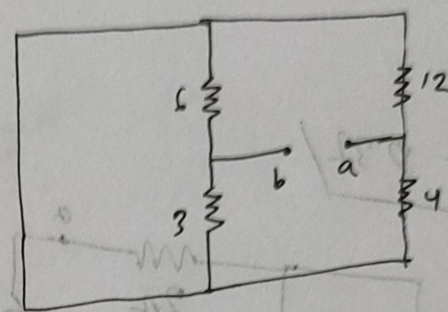
∴

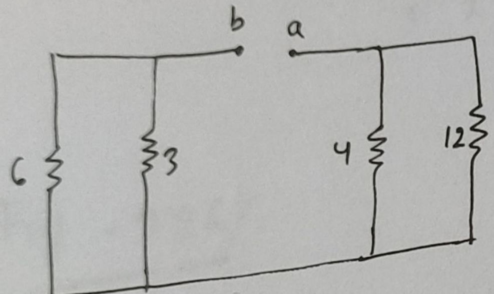


L-18/30.03.2023/

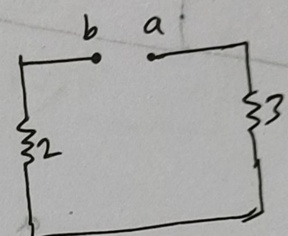
9.43



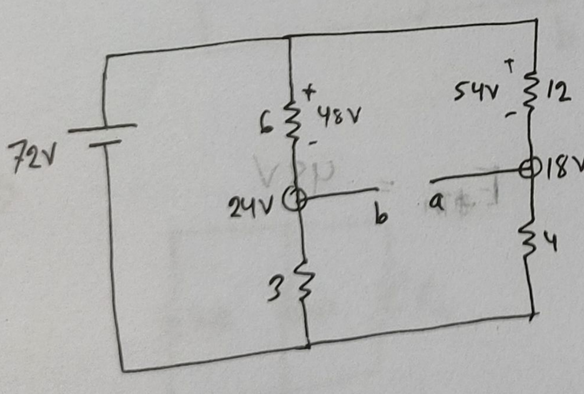




$\Rightarrow$



$R_{Th} = 2+3 = 5\Omega$



$\frac{6}{6+3} \times 72 = 48$

$\frac{12}{12+4} \times 72 = 54$

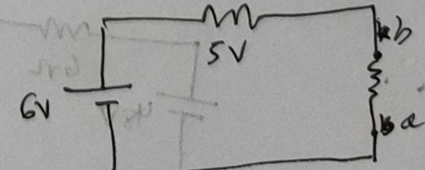
$V_b = 24V$

$V_a = 18V$

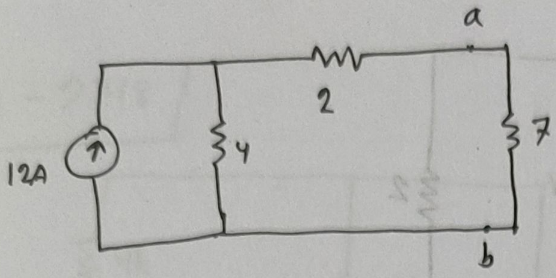
$\therefore V_{ba} = 24-18 = 6V$

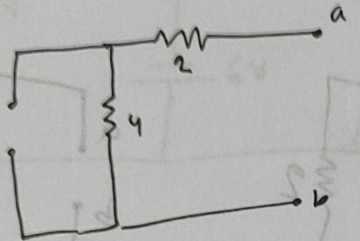
$\therefore E_{Th} = 6V$

$\therefore$

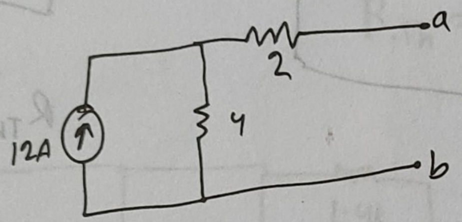


9.32





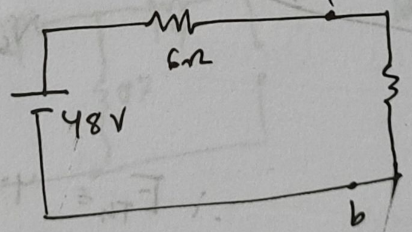
$R_{Th} = 6\Omega$



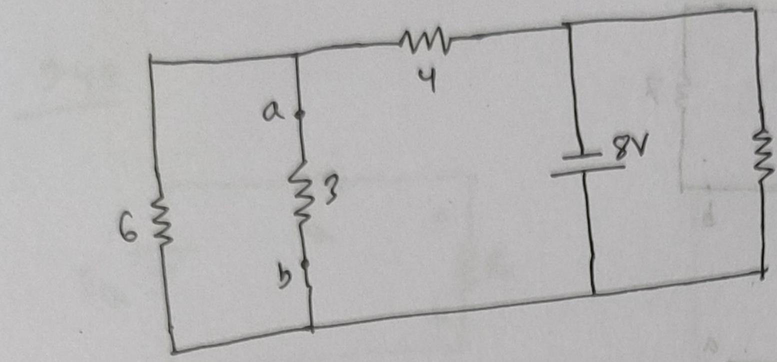
$V_{4\Omega} = 4 \times 12 = 48V$

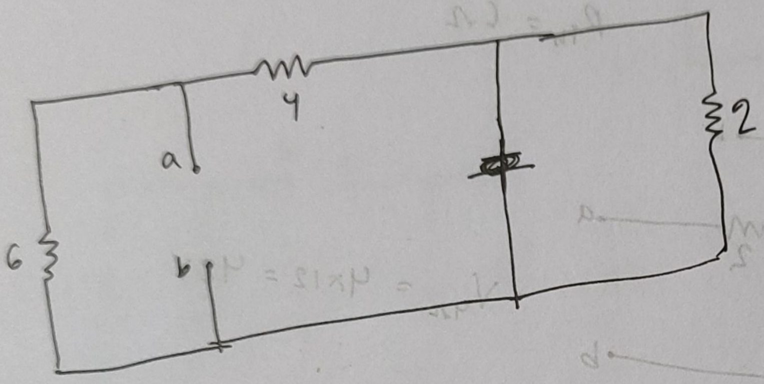
$\therefore V_{ab} = 48V$

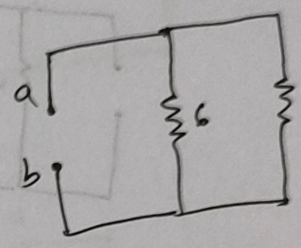
$\therefore E_{Th} = 48V$



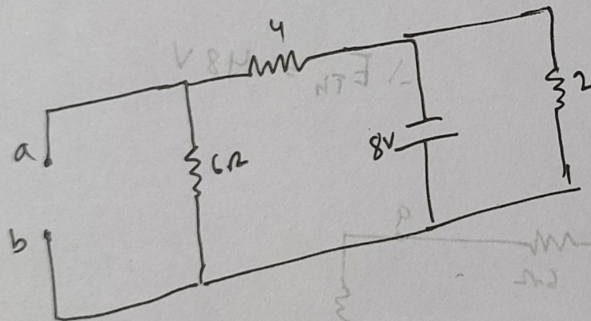
9.38





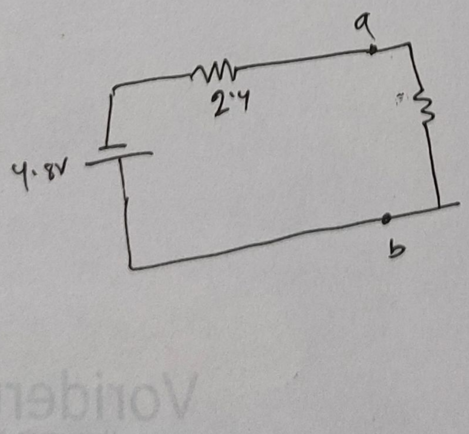


$$R_{Th} = \left(\frac{1}{6}+\frac{1}{4}\right)^{-1}$$
$$= 2.4\,\Omega$$



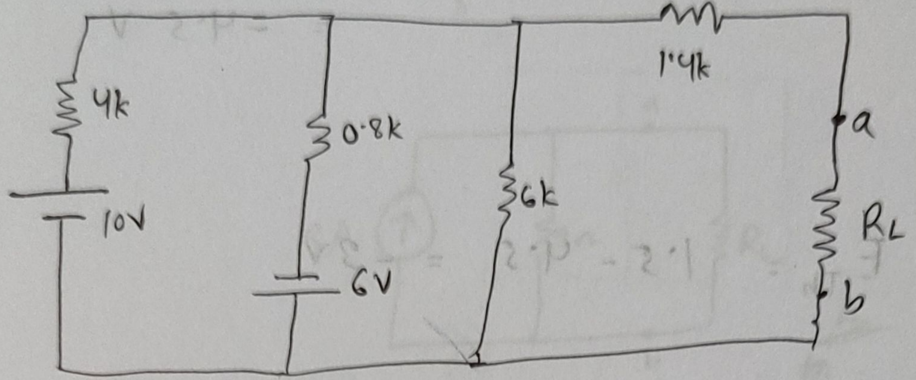
$$V_{6\Omega} = \frac{6}{6+4} \times 8 = 4.8\,V$$

$$\therefore E_{Th} = 4.8V$$



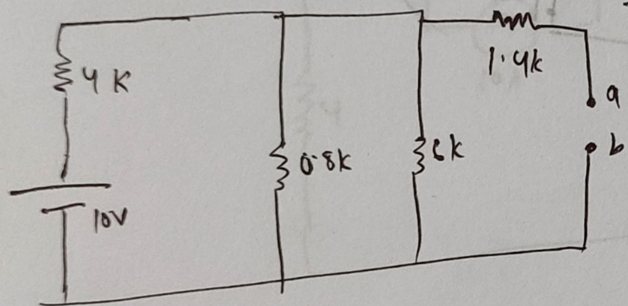
L-19/06.04.2023/

Fig - 2.48/

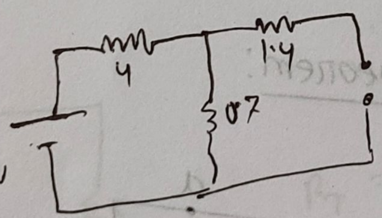


$$R_{Th} = \left(\frac{1}{4} + \frac{1}{0.8} + \frac{1}{6}\right)^{-1} + 1.4$$

$$= 2\ k\Omega$$

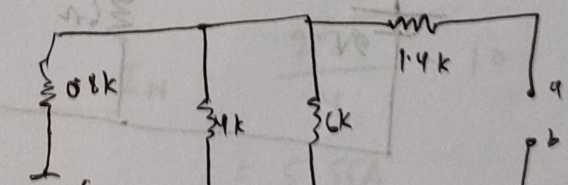


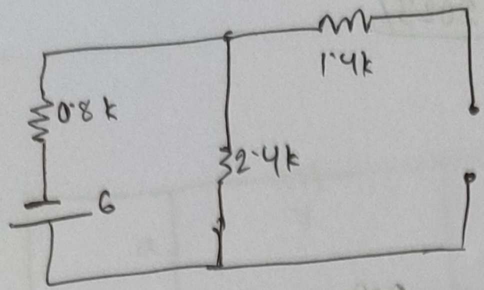
$$V'_{ab} = \frac{0.7}{4+0.7} \times 10$$



$$= 1.48\ V$$

$$\approx 1.5\ V$$

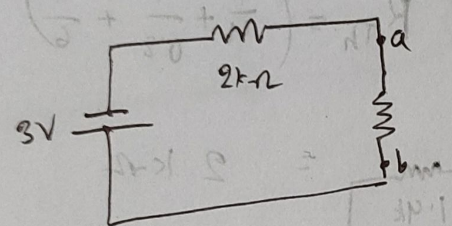




$$V''_{ab} = \frac{2.4}{0.8+2.4} \times 6$$

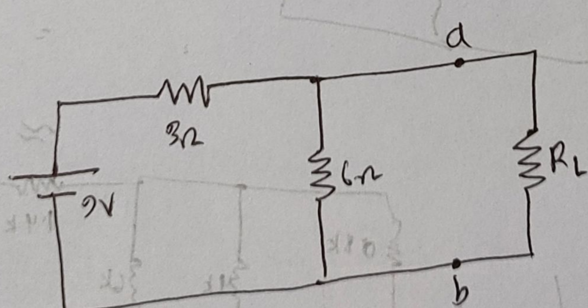
$$= -4.5 \text{ V}$$

$\therefore E_{Th} = 1.5 - 4.5 = -3\text{V}$



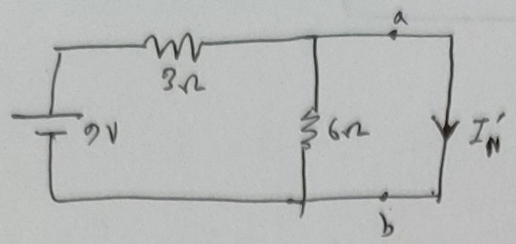
Final Question Must

⊛ Norton's Theorem:

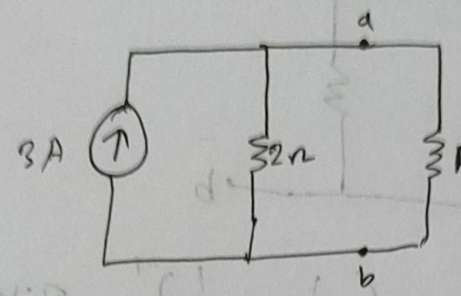


$$R_N = \left(\frac{1}{3} + \frac{1}{6}\right)^{-1}$$

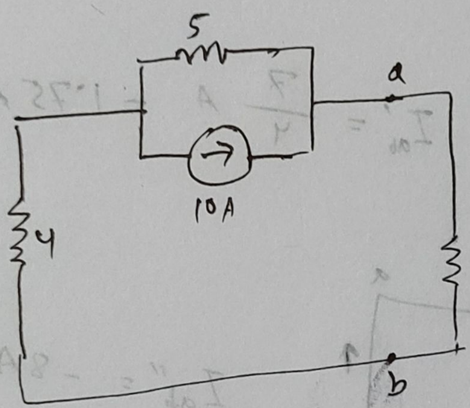
$$= 2\Omega$$



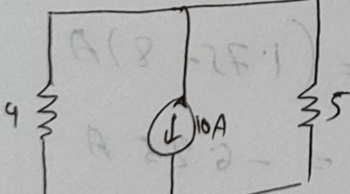
$$I_N' = \frac{9}{3} = 3A$$



9.67



$$R_N = 4+5 = 9\Omega$$

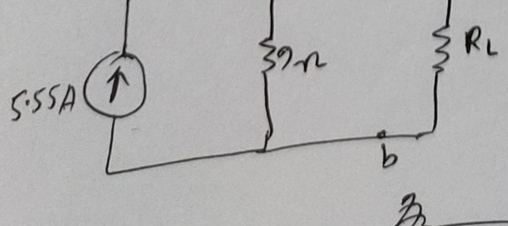


$$R_T = \left(\frac{1}{4} + \frac{1}{5}\right)^{-1}$$

$$= 2.22\ \Omega$$

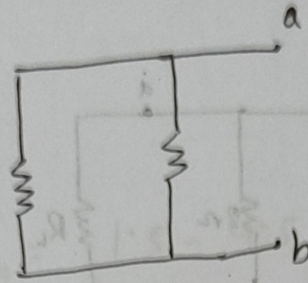
$$I_N = \frac{2.22}{4} \times 10$$

$$= 5.55A$$

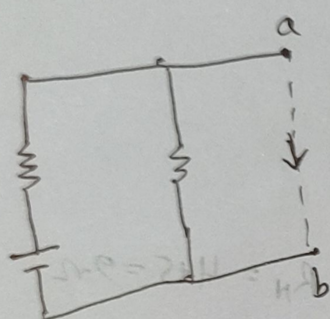


L-20/ 08.04.2023/

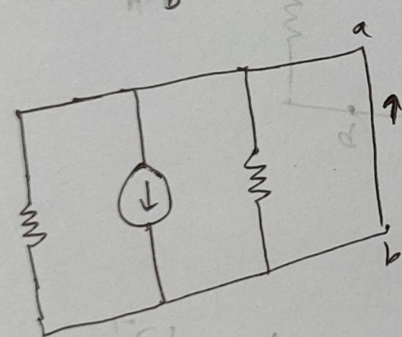
Example : 9.13/



$$R_N = \left(\frac{1}{4} + \frac{1}{6}\right)^{-1} = 2.4\,\Omega$$

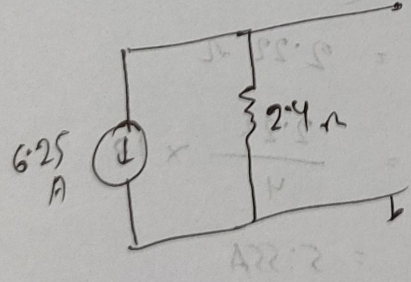


$$I'_{ab} = \frac{7}{4}\,A = 1.75\,A$$



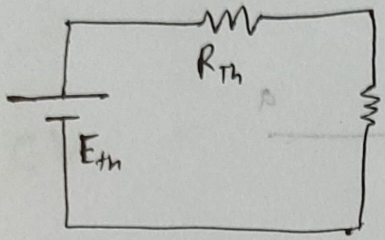
$$I''_{ab} = -8\,A$$

$$\therefore I_N = (1.75 - 8)\,A$$
$$= -6.25\,A$$



⊛ Maximum Power Transfer:

$$\boxed{R_L = R_{Th}}$$

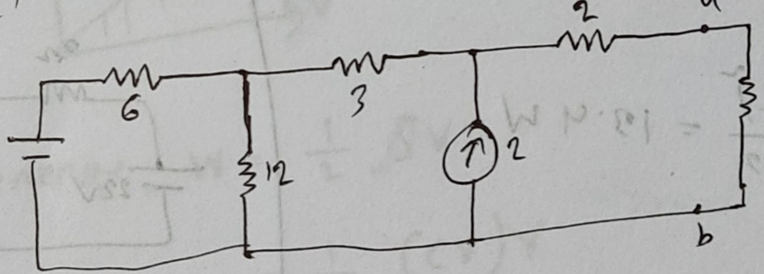


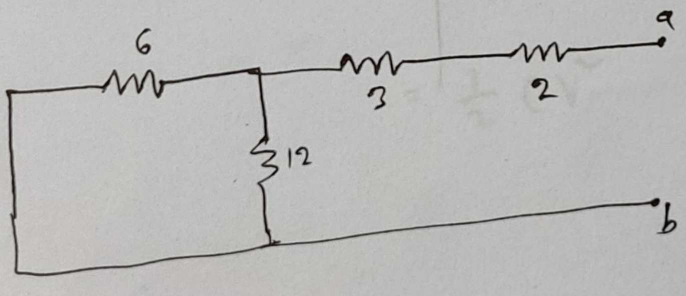
$$V_L = R_L \times \frac{E_{Th}}{R_L + R_{Th}}$$

$$= R_L \times \frac{E_{th}}{2R_L} = \frac{E_{th}}{2}$$

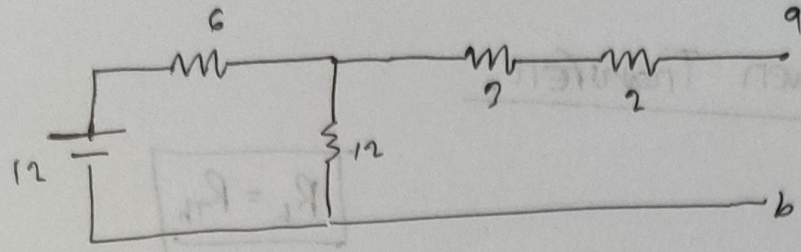
$$\therefore P_L = \frac{V^2}{R} = \frac{(E_{Th}/2)^2}{R_L} = \frac{(E_{Th})^2}{4R_L}$$

Fig- 4.50/



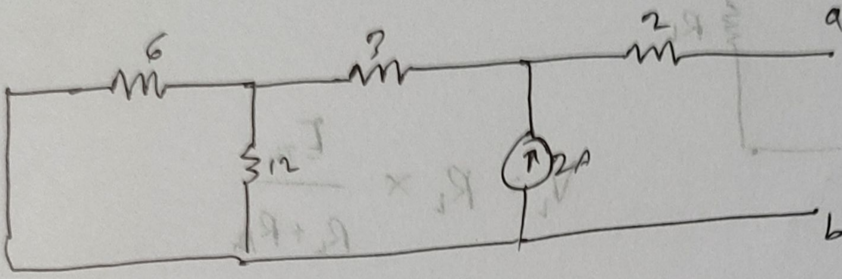


$$\therefore R_{Th} = 9\,\Omega$$



$$V_{ab}' = \frac{12}{12+6} \times 12$$

$$= 8V$$



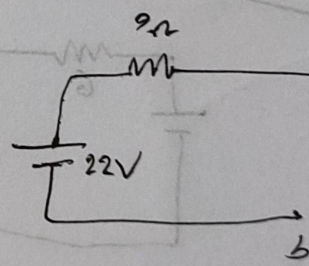
$R_T = 7\Omega$

$V_{ab}'' = 7 \times 2 = 14V$

$\therefore E_{th} = 8 + 14 = 22V$

$$\therefore P_L = \frac{E_{th}^2}{4R_L}$$

$$= \frac{(22)^2}{4 \times 7} = 13.4W$$



L-21/15.04.2023/

L-22/29.04.2023/

$Q = CV$

$C \propto \frac{1}{d}$

$C_x = \frac{A}{d}(7500\,\epsilon_0)$

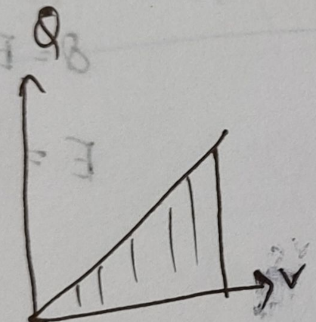
$= 7500\, C_y$

$C \propto A$

$C \propto \frac{A}{d}$

$C = \epsilon \frac{A}{d}$

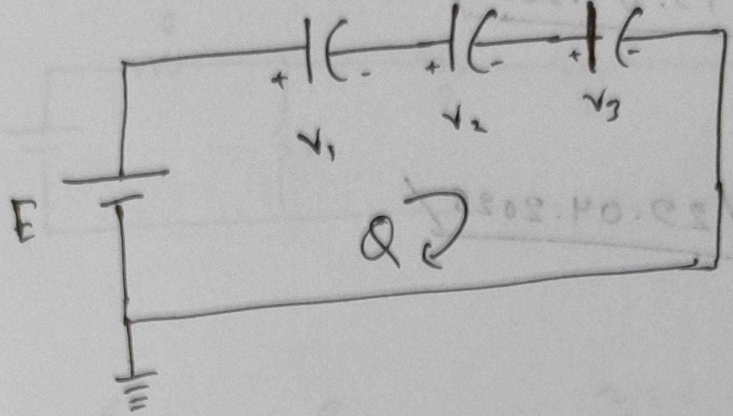
Permitivity



Store energy, $W = \frac{1}{2} QV$

$= \frac{1}{2}(CV)V$

$= \frac{1}{2} CV^2$



$$Q = C_1 V_1$$

$$V_1 = \frac{Q}{C_1}$$

$$V_2 = \frac{Q}{C_2}$$

$$V_3 = \frac{Q}{C_3}$$

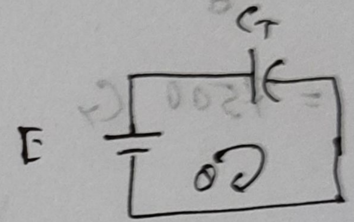
$$E = V_1 + V_2 + V_3$$

$$\Rightarrow \frac{Q}{C_1} = \frac{Q}{C_2} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$\Rightarrow \frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

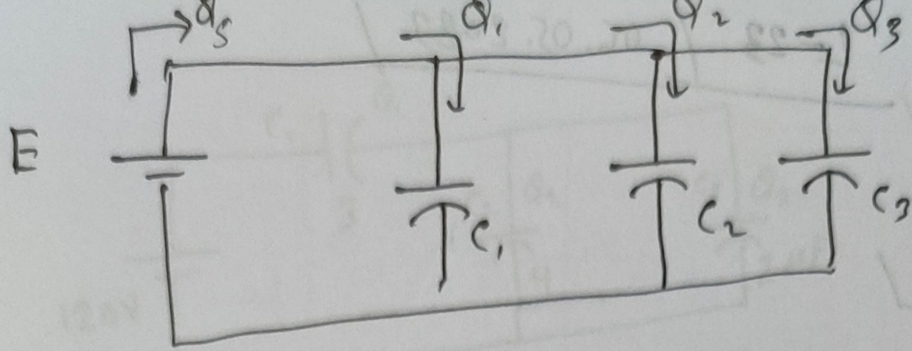
$$\boxed{C_T = \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)^{-1}}$$

Seneise Connection



$$Q = E C_T$$

$$E = \frac{Q}{C_T}$$



$$I_s = I_1 + I_2 + I_3$$

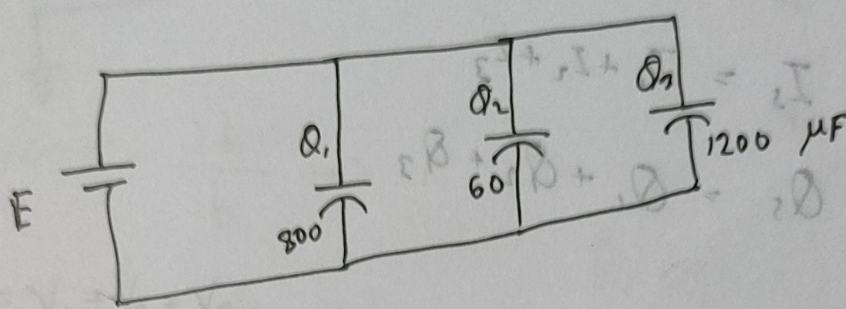
$$Q_s = Q_1 + Q_2 + Q_3$$

$$\Rightarrow \quad EC_T = EC_1 + EC_2 + EC_3$$

$$\boxed{\therefore C_T = C_1 + C_2 + C_3} \rightarrow \text{Parallel Connection}$$

L-23 / 06.05.2023 /

Example 10·6 /



a) $800+60+1200 = 2060\ \mu F$

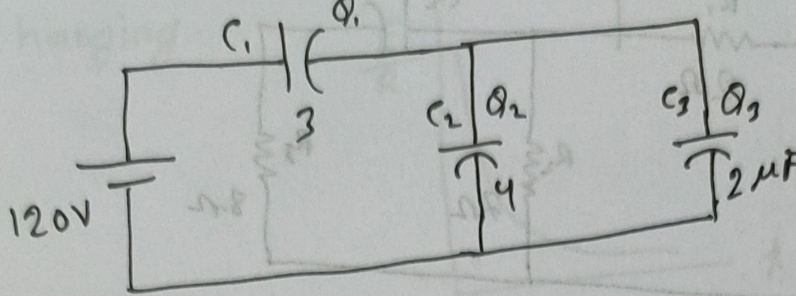
b) $Q_1 = C_1 V = (800 \times 10^{-6})(48) =$

$Q_2 = C_2 V = (60 \times 10^{-6})(48) =$

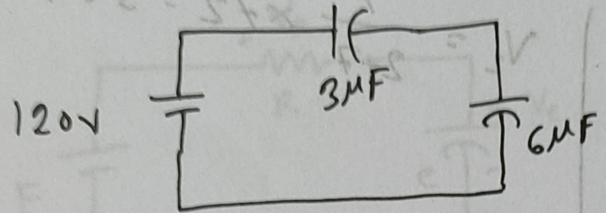
$Q_3 = C_3 V = (1200 \times 10^{-6})(48) =$

c) $Q_T = Q_1 + Q_2 + Q_3$

$=$



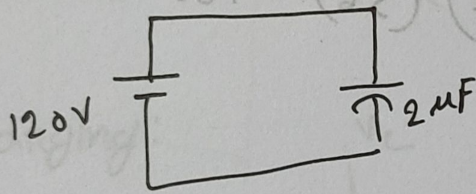
$V_3 = V_2 = 40V$



$V_1 = \frac{240}{3} = 80\ V$

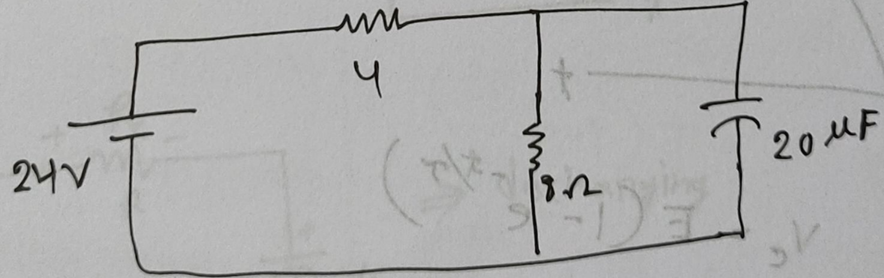
$V_2 = 120 - V_1$
$= 120 - 80$
$= 40V$

$C_T = \left(\frac{1}{3} + \frac{1}{6}\right)^{-1} = \left(\frac{1}{2}\right)^{-1} = 2\ \mu F$



$Q_T = C_T V = 120 \times 2 \times 10^{-6} = 240\ \mu Coul.$

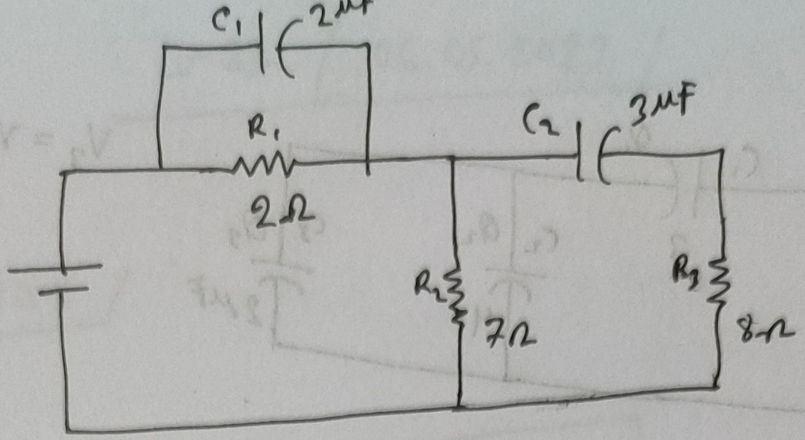
10.73



$V_c = \frac{8}{8+4} \times 24 = 16V$

$Q_1 = C_1 V_c = (20 \times 10^{-6})(10) = 320\ \mu Coul.$

(*)



$$V_1 = \frac{2}{2+7} \times 72$$

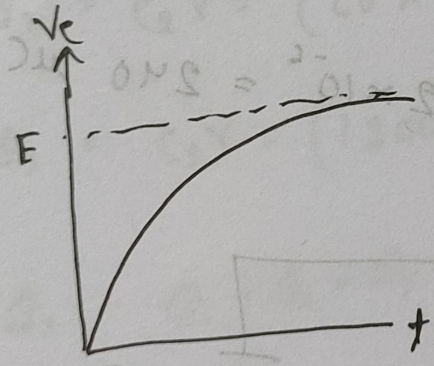
$$= 16V$$

$$V_2 = \frac{7}{2+7} \times 72 = 56V$$

$$Q_1 = V_1 \times C_1 = (2\times10^{-6})(16) = 32\,\mu C$$

$$Q_2 = V_2 C_2 = (3\,\mu F)(56) = 168\,\mu Coul.$$

(*)



$\Rightarrow$ Charging

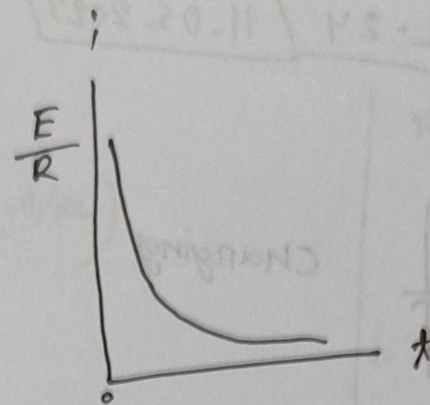
$$V_c = E(1 - e^{-t/\tau})$$

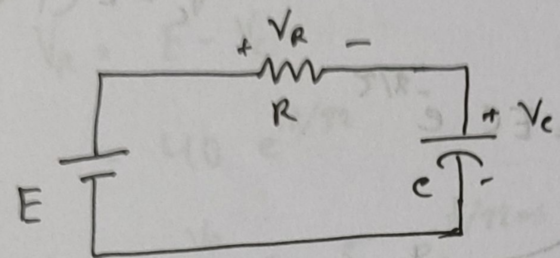
at, $t = 0$, $V_c = E(1 - e^{0}) = 0$

at, $t = \alpha$, $V_c = E\left(1 - \frac{1}{e^{\alpha/\tau}}\right)$

$$= E(1-0) = E_{max}$$

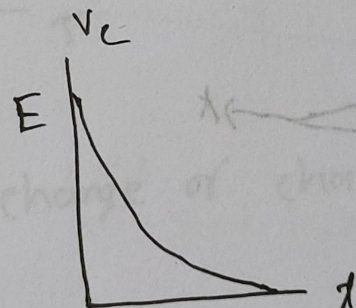
Changing



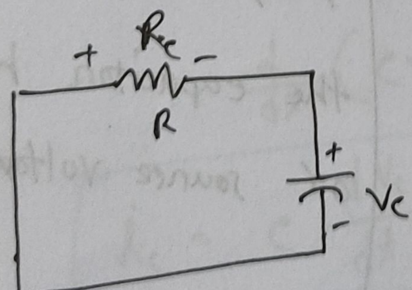


$$V_R = E - V_c = E - E(1 - e^{-t/T})$$
$$= (E e^{-t/T})$$

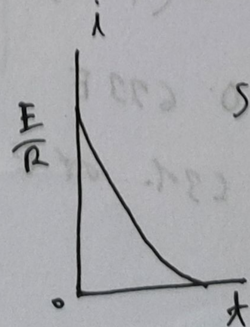
Discharging:



$$V_c = E e^{-t/T}$$

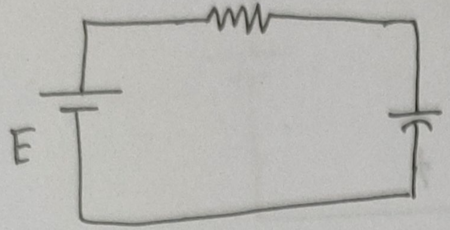


⇒ dischanging

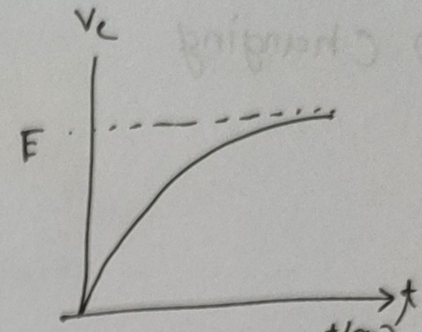


same as V_c

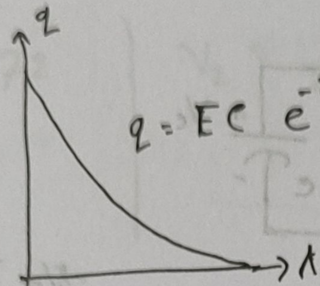
L-24 / 11.05.2023 /



Changing

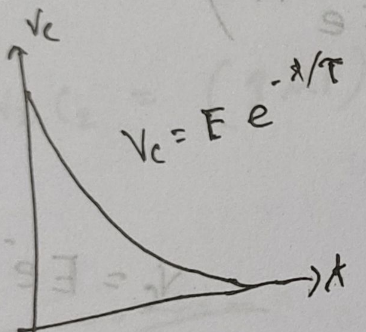


$V_c = E(1 - e^{-t/\tau})$

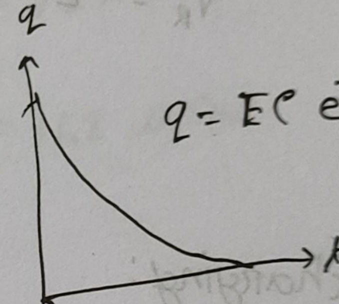


$q = EC\,e^{-t/\tau}$

dischanging:



$V_c = E\,e^{-t/\tau}$



$q = EC\,e^{-t/\tau}$

$\therefore$ When , $t = \tau$

at changing, $V_c = E(1 - e^{-\tau/\tau})$

$= E(1 - e^{-1})$

$= 0.633\,E$

$= 63\%$ of E

At, $t = \tau$

the capaciton has 63.3% of sounce voltage.

Enample 10.6

a) $V_c = 40(1 - e^{-t/RC})$

$E = V_c + V_R$

$\Rightarrow V_R = E - V_c$

$= 40\, e^{-t/32}$

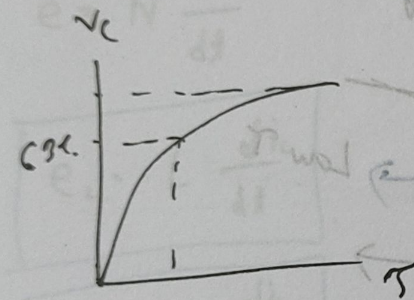
$i_c = \frac{V_R}{R} = 5\, e^{-t/32ms}$

$RC = 32$ m sec

$\because$ almost full change at

$t = 5\tau$.

b)



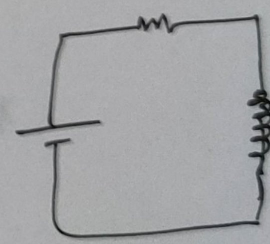
⊛ Currrent → rate of change of change.

$i_c = \frac{dq}{dt}$

$= \frac{d}{dt}(CV_c)$

$$\boxed{i_c = C\frac{dV_c}{dt}}$$

⊛ Inductor



$C = \varepsilon$ permittivity

$L = \mu$ permiability

L-25 / 13.05.2023 /

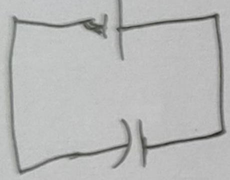
$$Q = CV$$

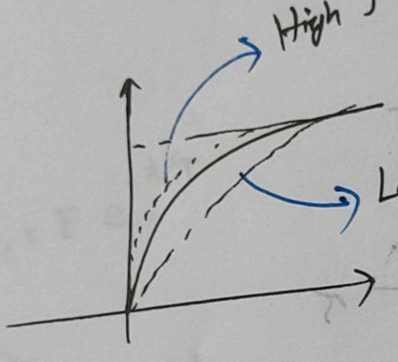
$$\Rightarrow C = \frac{Q}{V}$$

$$C_{parallel} = C_1 + C_2 + C_3 + \dots + C_n$$

$$C_{series} = \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots + \frac{1}{C_n} \right)^{-1}$$

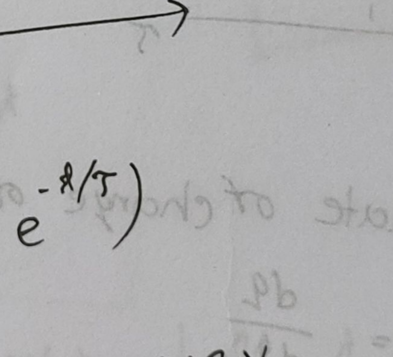
$$\tau = RC$$





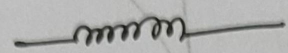
$$E_0 = V_0 \left(1 - e^{-t/\tau} \right)$$

after, $t = \tau$, $E_0 = 0.63\,V_0$



$C = \epsilon \frac{A}{d}$; ϵ = Permivity

Inductor



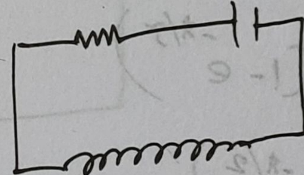
$$L = \mu \frac{N^2 A}{l}$$

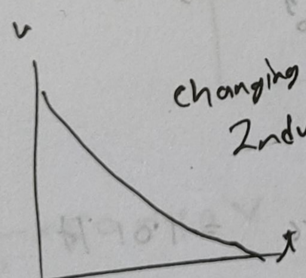
$$L = \mu L_0$$

$$e = N \frac{d\phi}{dt}$$

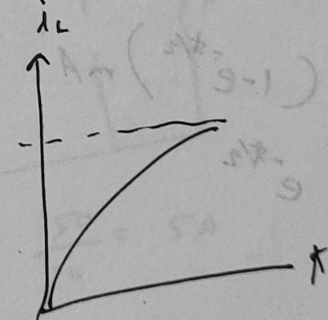
$$\boxed{e_L = L \frac{di_L}{dt}}$$

$$\boxed{V_L = L \frac{di_L}{dt}}$$

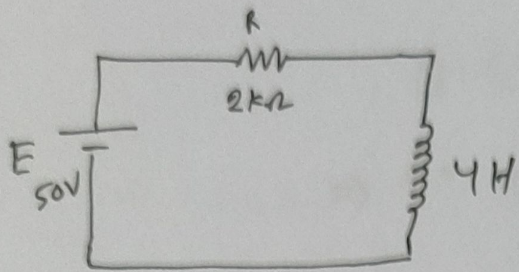


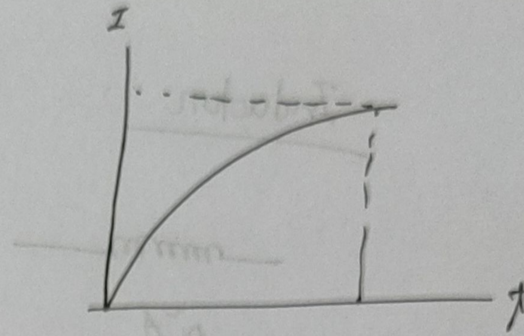


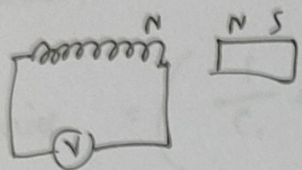
changing Inductor



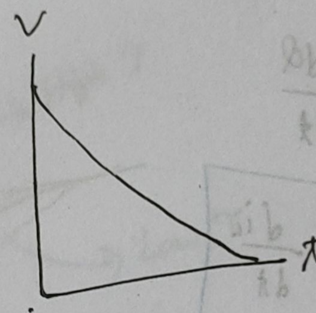
L-26 / 18.05.2023 /







induced current oppose the source current.



$$i_L = \frac{E}{R}\left(1 - e^{-t/\tau}\right)$$

$$i_L = \frac{50}{2\times10^3}\left(1 - e^{-t/2}\right)$$

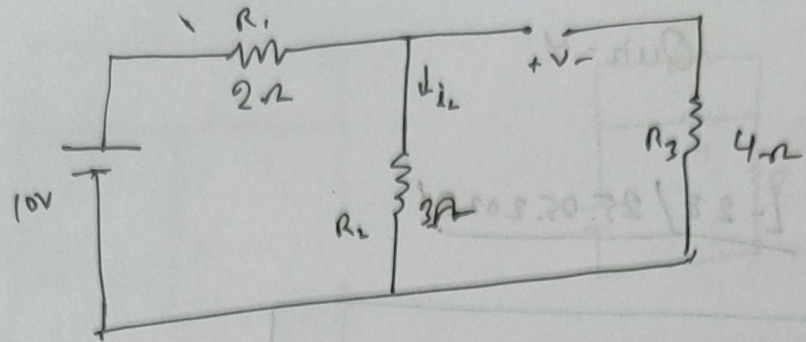
$$= 25\left(1 - e^{-t/2}\right) mA$$

$$v_L = 50\, e^{-t/2}$$

Here, $\tau = \frac{L}{R}$

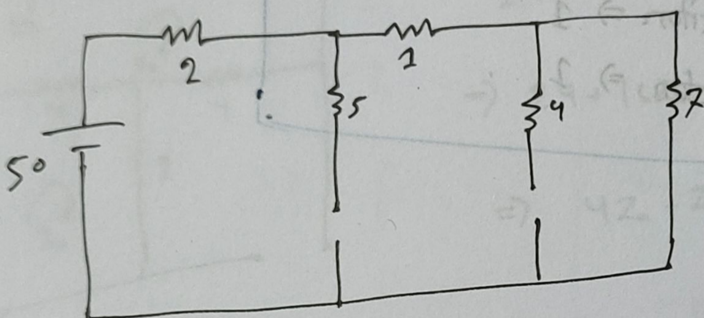
$$\tau = \frac{4}{2\times10^3} = 2ms$$

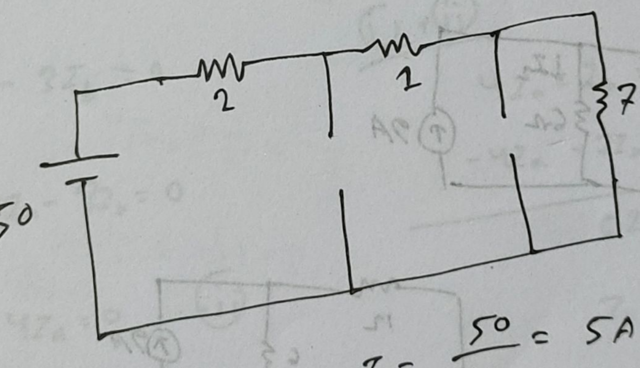
$$L_T = \left(\frac{1}{1.2} + \frac{1}{1.2} + \frac{1}{1.8}\right)^{-1} + 0.56 = 1.01\ H$$



$i_L = \frac{10}{2+3} = 2A$

$V_C = (3\times 2)\ V$
$= 6V$





$I = \frac{50}{10} = 5A$

$V_1 = \frac{8}{10}\times 50 = 40\ V$

$I_1 = I_2 = 5A$

$V_2 = \frac{7}{10}\times 50 = 35\ V$

Ex-11.2

$I = \frac{15}{3+2} = 3A$

$W = \frac{1}{2}(6\times 10^{-3})(3)^2$
$= 27\ mJ$

L-27/20.05.2023/

Quiz-4

L-28/25.05.2023/

Final Question Pattern

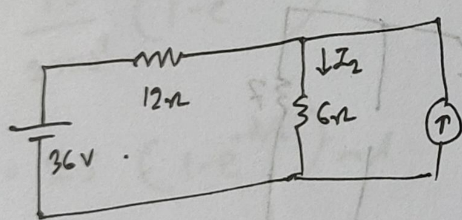
Super Position ⇒ 1

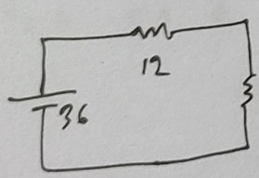
Norton's & Thevenin's Theorem ⇒ 1

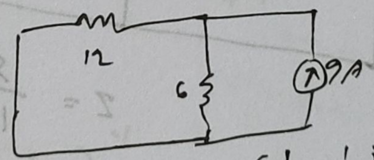
Capacitor ⇒ 1

Inductor ⇒ 1

Super Position:







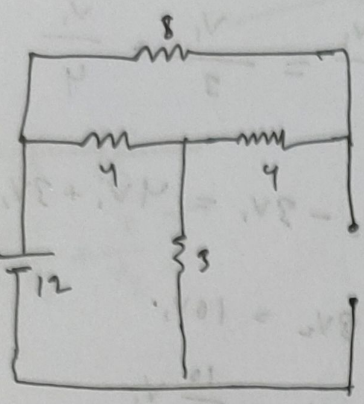
$I_2' = \frac{36}{18} = 2A$

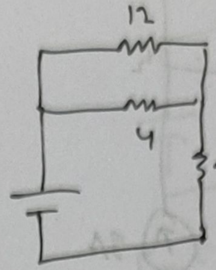
$I_2'' = \frac{\left(\frac{1}{12}+\frac{1}{6}\right)^{-1}}{6} \times 9$

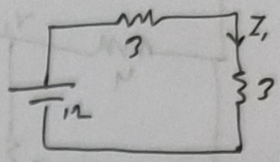
$= \frac{4}{6} \times 9$

$= 6A$

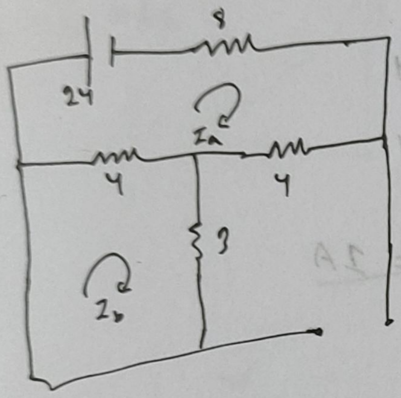
$\therefore I_2 = 2+6 = 8A$







$I_1' = \frac{12}{6} = 2A$



$24 + 8I_a + 4I_a + 4(I_a - I_b) = 0$

$\Rightarrow 24 + 16I_a - 4I_b = 0$

$\Rightarrow 4I_a - I_b = -6 \quad \ldots (i)$

$-4(I_a - I_b) - 3I_b = 0$

$\Rightarrow -4I_b + 4I_a - 3I_b = 0$

$\Rightarrow 7I_b - 4I_a = 0 \quad \ldots (ii)$

(i) + (ii),

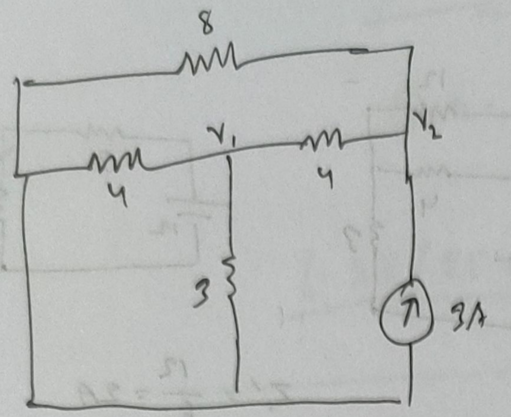
$4I_a - I_b = -6$

$-4I_a + 7I_b = 0$

$6I_b = -6$

$I_b = -1A$

$\therefore I_1'' = -1A$



$$\frac{V_2 - V_1}{4} = \frac{V_1}{3} + \frac{V_1}{4}$$

$$\Rightarrow 3V_2 - 3V_1 = 4V_1 + 3V_1$$

$$\Rightarrow 3V_2 = 10V_1$$

$$\Rightarrow V_2 = \frac{10}{3}V_1$$

$$3 = \frac{V_2}{8} + \frac{V_2 - V_1}{4}$$

$$\Rightarrow 24 = V_2 + 2V_2 - 2V_1$$

$$\Rightarrow -2V_1 + 3V_2 = 24$$

$$\Rightarrow -2V_1 + 3 \cdot \frac{10}{3}V_1 = 24$$

$$-2V_1 + 10V_1 = 24$$

$$8V_1 = 24$$

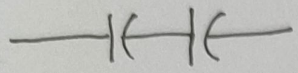
$$V_1 = 3V$$

$$\therefore I''' = \frac{3}{3} = 1A$$

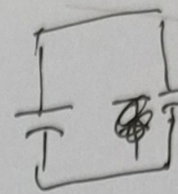
$$\therefore I = I' + I'' + I'''$$

$$= 2 - 1 + 1 = 2A$$

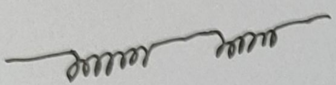
L-28/03.06.2023/



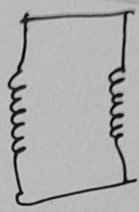
$C_T = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1}$



$C_T = C_1 + C_2$



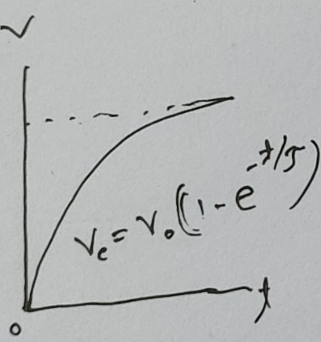
$L_T = L_1 + L_2$



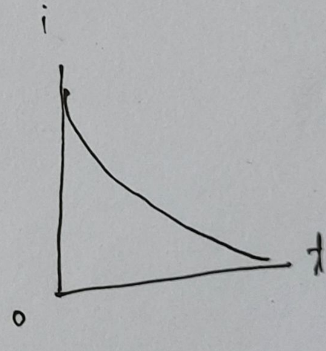
$L_T = \left(\frac{1}{L_1} + \frac{1}{L_2}\right)^{-1}$

RC

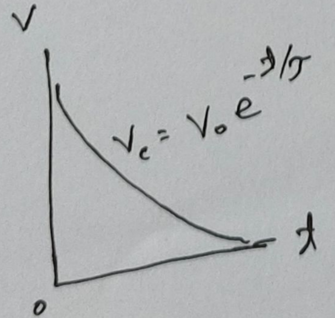
Changing:



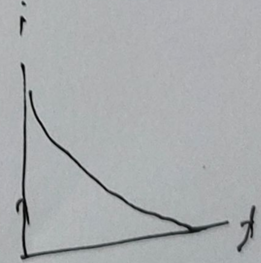
$v_c = v_0 (1 - e^{-t/\tau})$



Dischanging:

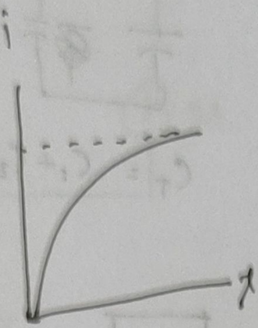


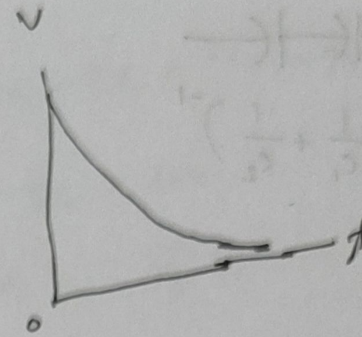
$v_c = v_0 e^{-t/\tau}$



RL

Changing:





Dischanging: