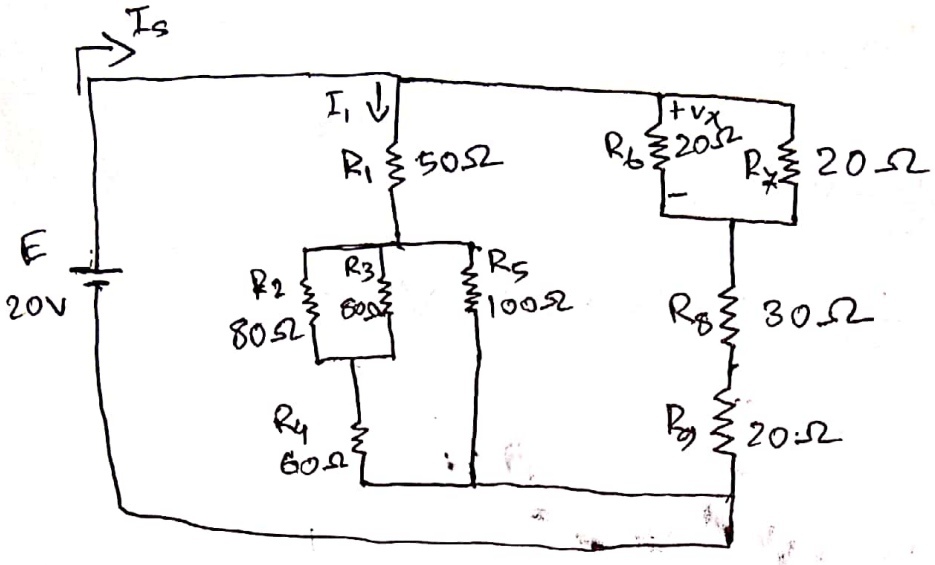
Problem-1



a) $I_s = ?$

$R' = \left(\frac{1}{80} + \frac{1}{80}\right)^{-1} \Rightarrow 40\,\Omega$

$R'' = R' + R_4 = 40 + 60 \Rightarrow 100\,\Omega$

$R''' = \left(\frac{1}{R''} + \frac{1}{R_5}\right)^{-1} = \left(\frac{1}{100} + \frac{1}{100}\right)^{-1} \Rightarrow 50\,\Omega$

$R^{IV} = R''' + R_1 = 50 + 50 = 100\,\Omega$

$R^{V} = \left(\frac{1}{R_6} + \frac{1}{R_7}\right)^{-1} = \left(\frac{1}{20} + \frac{1}{20}\right)^{-1} = 10\,\Omega$

$R^{VI} = R^{V} + R_8 + R_9 = 10 + 30 + 20 \Rightarrow 60\,\Omega$

$R_T = \left(\frac{1}{R^{IV}} + \frac{1}{R^{VI}}\right)^{-1} = \left(\frac{1}{100} + \frac{1}{60}\right)^{-1} \Rightarrow 37.5\,\Omega$

$I_s = \frac{E}{R_T} = \frac{20}{37.5} \Rightarrow 0.533\ A$

b) $I_1 = \frac{V}{R^{IV}} \Rightarrow \frac{20}{100} \Rightarrow 0.2\ A$

c) $V_x = ?$

VDR

$$V_x = \frac{R_x}{R_T} \times E$$

$$V_x = \frac{R^V}{60} \times 20$$

$$V_x = \frac{10}{60} \times 20 \Rightarrow 3.33\ V$$

d) KCL

$$V_{ba} - V_5 + V_3 + V_8 = 0$$

$$V_5 = 20 - (0.2 \times 50) \Rightarrow 10\ V$$

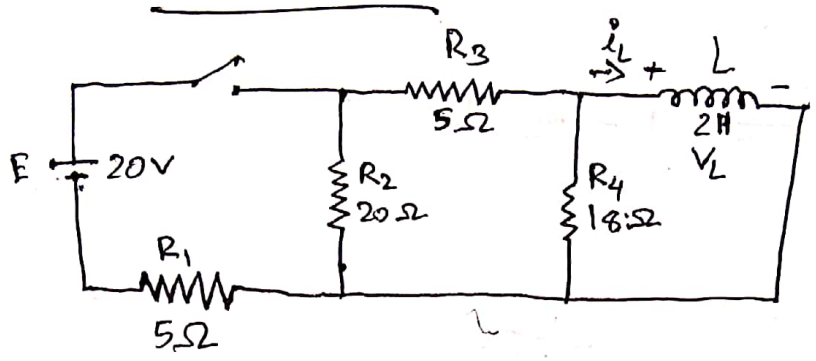
$$V_3 + V_8 = E - V_x = 20 - 3.33 \Rightarrow 16.67\ V$$

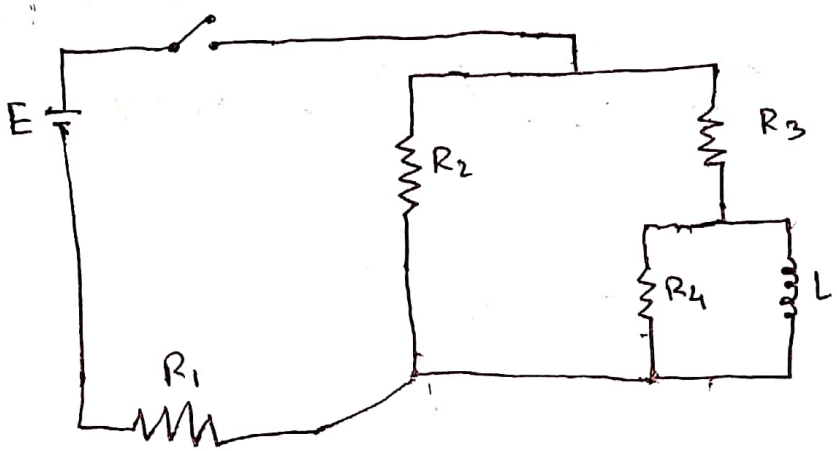
$$V_{ba} - 10 + 16.67 = 0$$

$$V_{ba} + 6.67 = 0$$

$$V_{ba} = -6.67\ V$$

Problem-2





a) ~~$V_L = E$~~

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

$$R = R_1 + \left(\frac{1}{R_2} + \frac{1}{R_3+R_4}\right)^{-1} = 5 + \left(\frac{1}{20} + \frac{1}{5+18}\right)^{-1}$$

$$= 15.7\ \Omega$$

$$\tau = \frac{2}{15.7} = 0.127\ s \quad | \quad 5\tau = 5 \times 0.127 = 0.635$$

$$V_L = E e^{-\frac{t}{\tau}}$$

$$V_L = 20 e^{0} \Rightarrow 20\ V$$

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

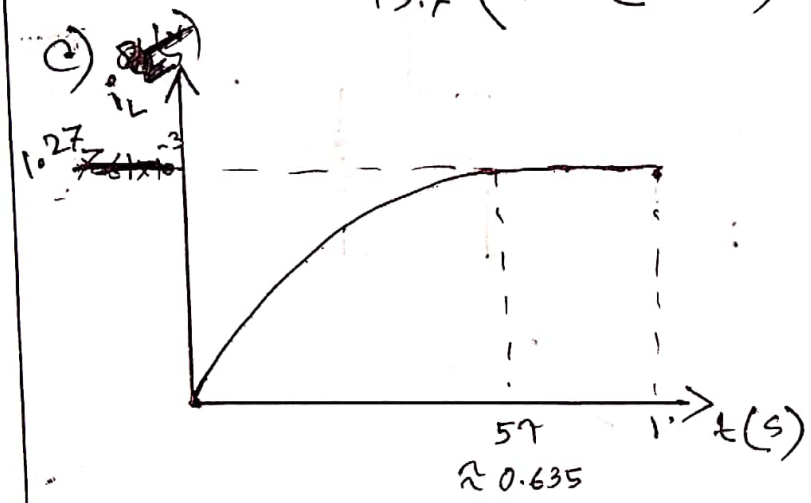
$$i_L = \frac{20}{15.7}\left(1 - e^{0}\right)$$

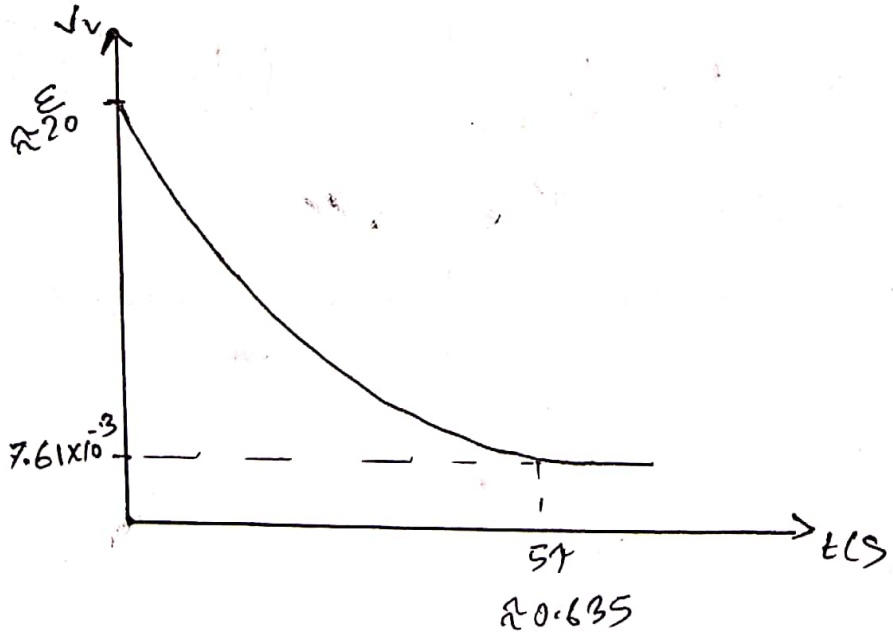
$$i_L = 0\ A$$

b) $$V_L = 20\, e^{-\frac{1}{0.127}} \Rightarrow 7.61 \times 10^{-3}\ V$$

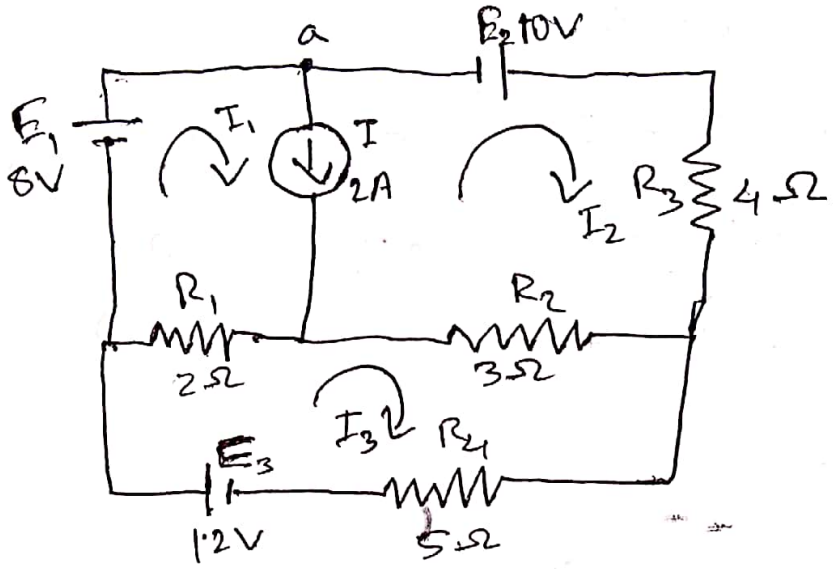
$$i_L = \frac{20}{15.7}\left(1 - e^{-\frac{1}{0.127}}\right) = 1.27\ A$$

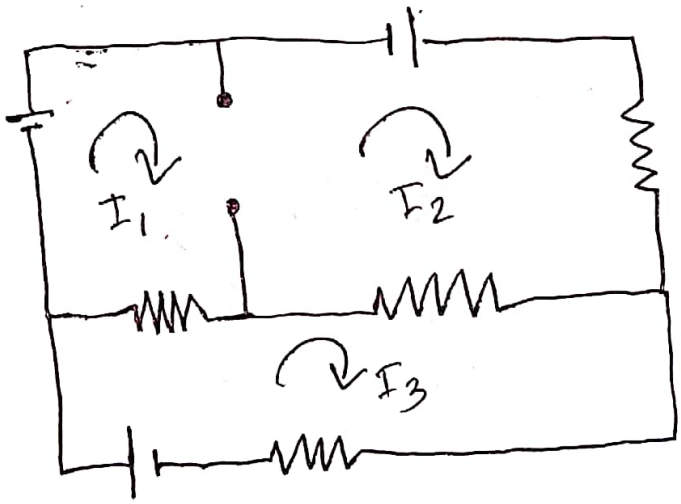
c)





Problem-3





Supermesh 1,2

$$E_1 + E_2 - V_3 - V_2 - V_1 = 0$$

$$8 + 10 - (I_2 R_3) - (I_2 - I_3) R_2 - (I_1 - I_3) R_1 = 0$$

~~$+8 - 3I_2$~~

$$18 - 4I_2 - 3I_2 + 3I_3 - 2I_1 + 2I_3 = 0$$

$$-2I_1 - 7I_2 + 5I_3 = -18 \quad -(1)$$

mesh - 3

$E_3 - V_1 - V_2 - V_4 = 0.$

$12 - (I_3 - I_1)R_1 - (I_3 - I_2)R_2 - I_3 \times R_4 = 0$

$12 - 2I_3 + 2I_1 - 3I_3 + 3I_2 - 5I_3 = 0$

$2I_1 + 3I_2 - 10I_3 = -12 \quad - (11)$

KCL at 'a'

$I_1 = I + I_2$

$I_1 - I_2 = 2 \quad - (111)$

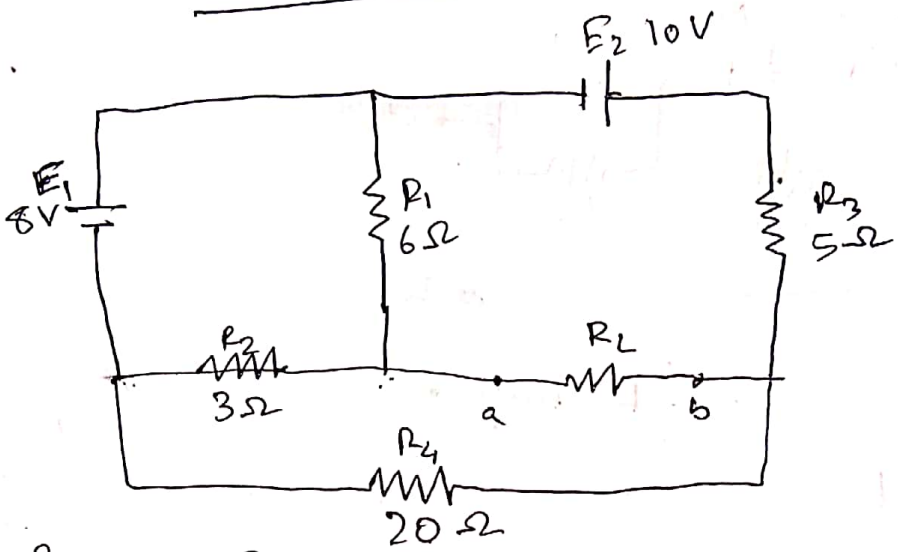
Using online calculator

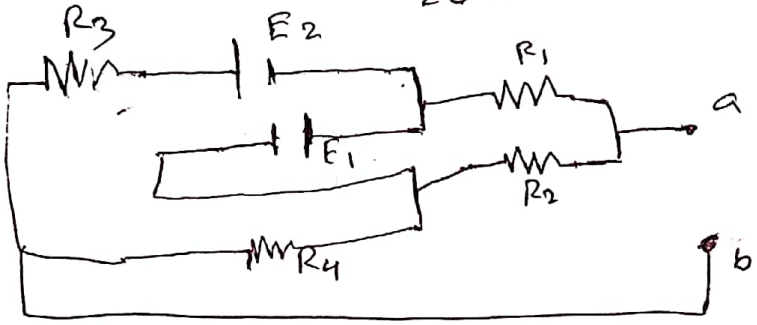
$I_1 = -0.953$	$I_1 = 5.384$
$I_2 = -2.153$	$I_2 = 3.38$
$I_3 = 0.523$	$I_3 = 3.29$

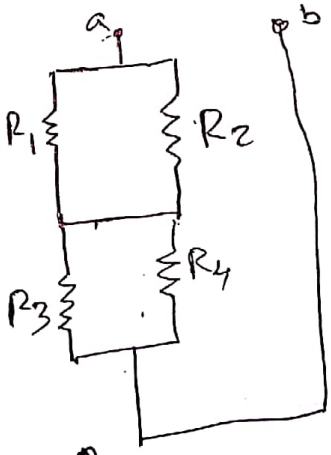
$\therefore I_{R_1} = I_1 = 5.384$

$V_{R_1} = I_{R_1} \times R_1 = 5.384 \times 2 \Rightarrow 10.768\ V$

Problem-4



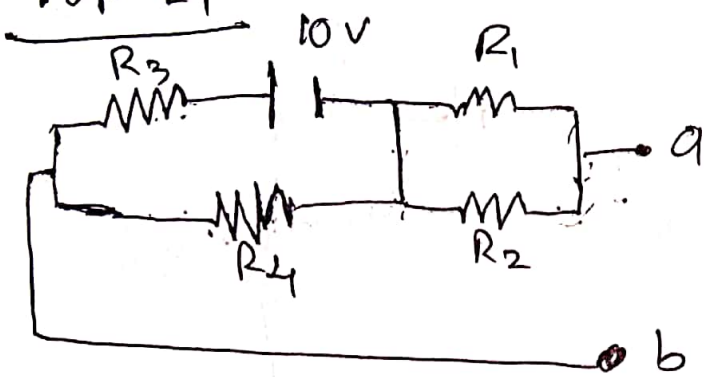




$$R_{Th} = \left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1} + \left(\frac{1}{R_3} + \frac{1}{R_4}\right)^{-1}$$

$$R_{Th} = \left(\frac{1}{6} + \frac{1}{3}\right)^{-1} + \left(\frac{1}{5} + \frac{1}{20}\right)^{-1} \Rightarrow 6\ \Omega$$

For E_1



$R' = R_1 = R$

$V_{ab} + E_1 -$

Problem :- 5