P

I

Mesh analysis (or) Loop analysis :-

→ This method useful for ckts → have many nodes and loops.

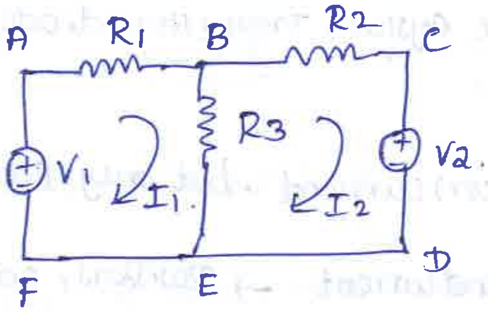
→ Here one current ~~~~ is assumed for each loop. So, one branch have more tha

one current.

$V_C = -0.300$

→ Volt balance eqn is written for each loop by applying the KVL.

→ Individual loop currents are determined by solving these equations.



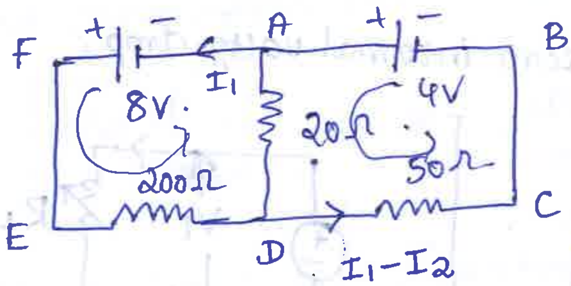
for loop A-B-E-F-A,

$-I_1R_1 - I_1R_3 + I_2R_3 + V_1 = 0.$

for loop B-C-D-E-B,

$-I_2R_2 - V_2 - I_2R_3 + I_1R_3 = 0.$

1) Calculate the current in 20Ω resistor from the ckt.



$8 - 200I_1 - 20I_2 = 0.$

$8 = 200I_1 + 20I_2. \rightarrow (1)$

$-4 + 50(I_1 - I_2) - 20I_2 = 0.$

from loop ADCDA,

$50I_1 - 70I_2 = 4. \rightarrow (2)$

$(2) \times 4 \Rightarrow 200I_1 - 280I_2 = 16.$

$(1) \Rightarrow 200I_1 + 20I_2 = 8.$

(-) (-) (-)

$-300I_2 = 8.$ $\boxed{I_2 = -26}$

Let current I_1 is flowing in branch FE. I_1 divides into 2 paths at node D. Let I_2 be the current through DA. (i.e 20Ω resistance) then, current through DCBA is $(I_1 - I_2)$. now if we apply KCL at node A, current in AF is I_1.

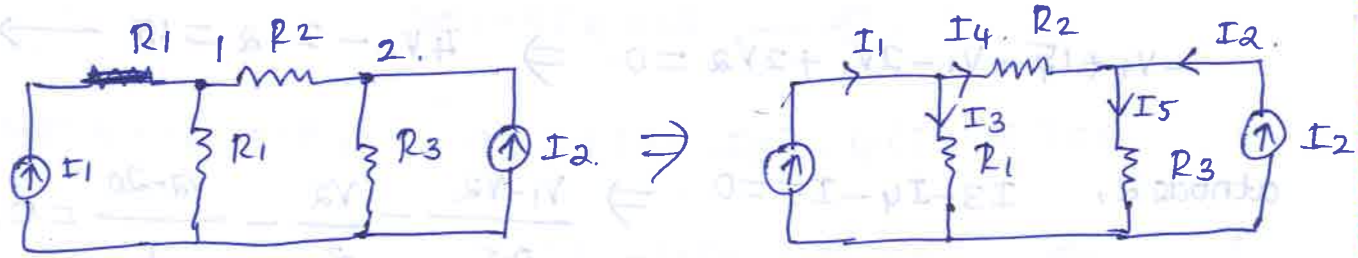
Analysis :- → Based on KCL. → Used to different nodes of the N/w.

→ 2 (or) more branches meet is called a node.

→ One node is assumed to be zero.
↳ That is ref. node.

→ At other nodes the diff. voltgs are to be measured with respect to the ref.

→ The ref. node should be given a number zero & write eqns by KCL.



→ Let voltages at node 1 & 2 is V_1 and V_2.

In node 1 · KCL, $I_1 - I_3 - I_4 = 0$ → ①

In node 2, $I_2 + I_4 - I_5 = 0$ → ②

In ①, current eqn is, $I_1 - \frac{V_1}{R_1} - \frac{(V_1 - V_2)}{R_2} = 0$ → (x)

& ②, $I_2 + \frac{(V_1 - V_2)}{R_2} - \frac{V_2}{R_3} = 0$ → (*)

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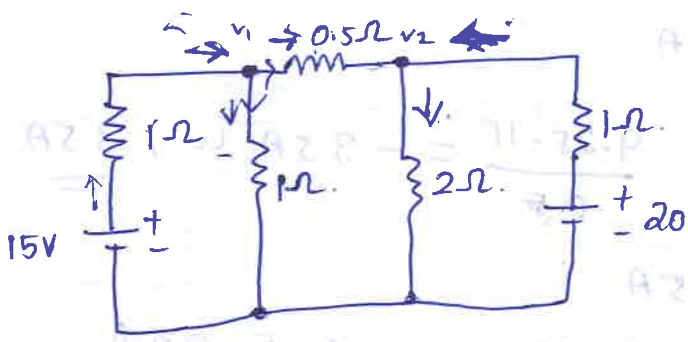
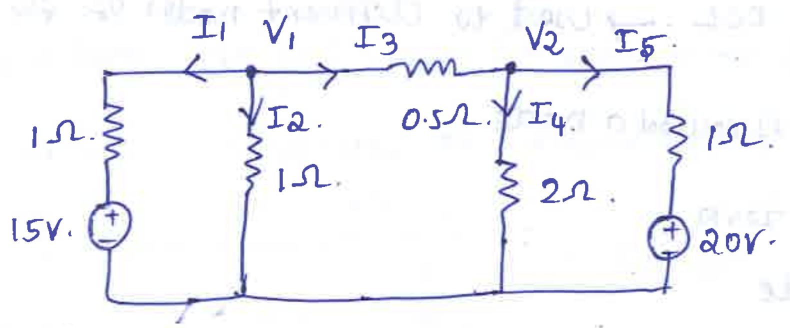
1) Find the current through each resistor of the circuit shown. Using Nodal analysis.



① $i_1 - i_2 - i_3 = 0$

② $i_2 + i_4 - i_5 = 0$

Soln:-



at node 1,

$$-I_1 - I_1 - I_3 = 0.$$

$$-\left[\frac{V_1-15}{1}\right] - \left[\frac{V_1}{1}\right] - \left[\frac{V_1-V_2}{0.5}\right] = 0.$$

$$-V_1 + 15 - V_1 - 2V_1 + 2V_2 = 0. \Rightarrow 4V_1 - 2V_2 = 15 \longrightarrow ①$$

at node 2, $I_3 - I_4 - I_5 = 0. \Rightarrow \frac{V_1 - V_2}{0.5} - \frac{V_2}{2} - \frac{V_2 - 20}{1} = 0.$

$$2V_1 - 2V_2 - 0.5V_2 - V_2 + 20 = 0.$$

$$2V_1 - 3.5V_2 = -20 \longrightarrow ②.$$

$② \times 2 \Rightarrow \cancel{4V_1} - 7V_2 = -40.$

$① \Rightarrow \cancel{4V_1} - 2V_2 = 15$

$(-) \quad (+) \quad (-)$

$-5V_2 = -55$ $\boxed{V_2 = 11V}$,

$\therefore 4V_1 - 22 = 15$

$4V_1 = 37.$

$\boxed{V_1 = 9.25V.}$

Various currents are,

$I_1 = \frac{V_1 - 5}{1} = 9.25 - 15 = -5.75A$ i.e, $\underline{\underline{5.75A\uparrow}}$.

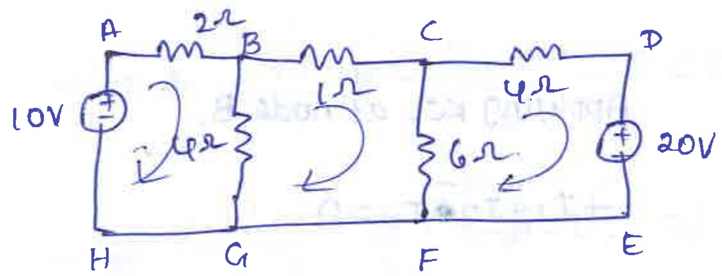
$I_2 = \frac{V_1}{1} = 9.25A.$

$I_3 = \frac{V_1 - V_2}{0.5} = \frac{9.25 - 11}{0.5} = -3.5A$ i.e, $\underline{\underline{3.5A}}$.

$I_4 = V_2/2 = 5.5A.$

$I_5 = V_2 - 20/1 = \frac{11-20}{1} \Rightarrow -9A$, i.e $9A\uparrow$.

...ate current through 6Ω resistance using loop analysis.



Soln:-

Loop A-B-G-H-A, $-2I_1 - 4(I_1 - I_2) + 10 = 0$.

$$6I_1 - 4I_2 = 10 \longrightarrow (1).$$

Loop B-C-F-G-B, $-1I_2 - 6(I_2 - I_3) - 4(I_2 - I_1) = 0$

$$4I_1 - 11I_2 + 6I_3 = 0 \longrightarrow (2).$$

Loop C-D-E-F-C, $-4I_3 - 20 - 6(I_3 - I_2) = 0$

$$6I_2 - 10I_3 = 20 \longrightarrow (3).$$

Cramer's Rule,

$$\Delta = \begin{bmatrix} 6 & -4 & 0 \\ 4 & 11 & 6 \\ 0 & 6 & -10 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 20 \end{bmatrix}, \quad \Delta = 6(110 - 36) + 4(-$$

$$= 6(74) - 160$$

$$\boxed{\Delta = 284.}$$

Then, for I_2,

$$D_2 = \begin{vmatrix} 6 & 10 & 0 \\ 4 & 0 & 6 \\ 0 & 20 & -10 \end{vmatrix} = -320. \quad , \quad D_3 = \begin{vmatrix} 6 & -4 & 10 \\ 4 & -11 & 0 \\ 0 & 6 & 20 \end{vmatrix} =$$

$$I_2 = \frac{D_2}{\Delta} = \frac{-320}{284} = -1.1267A.$$

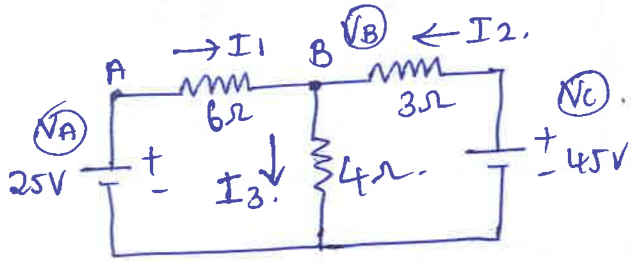
$$I_3 = \frac{D_3}{\Delta} = \frac{-760}{284} = -2.676A$$

Through 6Ω $= I_2 - I_3 = -1.1267-$

$\Rightarrow$ 1.5493A from (C-t...

$V_c = -0.300$

1) Using node votg analysis, obtain the currents flowing in all the resisto[rs of] the circuit shown.



Applying KCL at node B,

$+I_1+I_2 - I_3=0.$

$I_1 = \frac{V_A-V_B}{6} = \frac{25-V_B}{6}$, $I_2 = \frac{V_C-V_B}{3} = \frac{45-V_B}{3}$, $I_3 = \frac{V_B}{4}$.

$\left(\frac{25-V_B}{6}\right) + \left(\frac{45-V_B}{3}\right) - \frac{V_B}{4} = 0.$

$\frac{25}{6} - \frac{V_B}{6} + \frac{45}{3} - \frac{V_B}{3} - \frac{V_B}{4} = 0$ | $\frac{V_B}{6} + \frac{V_B}{3} + \frac{V_B}{4} = \frac{25}{6}$

$V_B\left(\frac{1}{6}+\frac{1}{3}+\frac{1}{4}\right) = \frac{25}{6} + \frac{45}{3} \Rightarrow V_B\left(\frac{9}{12}\right) = \frac{115}{6}$

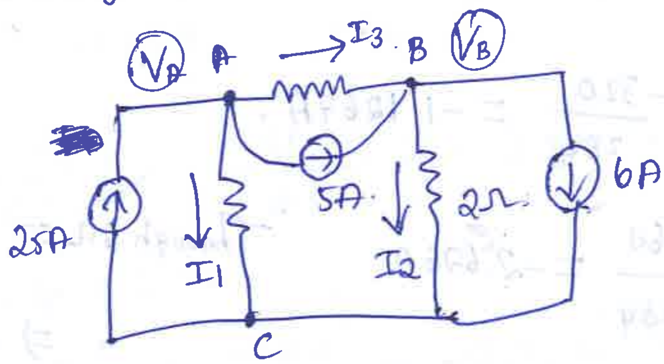
$\boxed{V_B = 25.56\,V}$

$I_1 = \frac{V_A-V_B}{6} \Rightarrow \frac{25-25.6}{6} = -0.1A$ (direction from B to A)

$I_2 = \frac{45-25.6}{3} = 6.47A.$

$I_3 = \frac{25.6}{4} = 6.4A.$

2) Compute the voltage at nodes A and B in the Circuit, C is the referen[ce] node?



$$+25 - I_1 - I_3 - 5 = 0.$$

$$+25 - \frac{V_A}{10} - \frac{V_A - V_B}{5} - 5 = 0.$$

$$-V_A\left(\frac{1}{10} + \frac{1}{5}\right) + (V_B/5) = -20 \Rightarrow -0.3V_A + 0.2V_B = -20 \longrightarrow (1)$$

at node B,

$$+I_3 + 5 - I_2 - 6 = 0.$$

$$+\frac{V_A - V_B}{5} - \frac{V_B}{2} = 1.$$

$$\frac{V_A}{5} - V_B\left(\frac{1}{5} + \frac{1}{2}\right) = 1.$$

$$0.2V_A - 0.7V_B = 1 \longrightarrow (2)$$

$$(1) \times 0.2 \Rightarrow -0.\cancel{06}V_A + 0.04V_B = -4.$$

$$(2) \times 0.3 \Rightarrow +0.\cancel{06}V_A - 0.21V_B = +0.3.$$

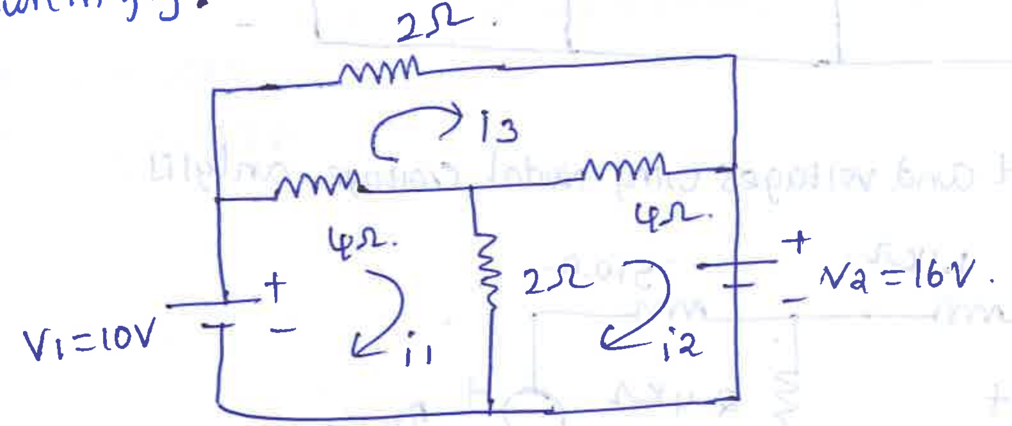
$$-0.17V_B = -3.7.$$

$$\boxed{V_B = 21.7 \text{ volts.}}$$

$$-0.3V_A + 0.2(21.7) = -20$$

$$\boxed{V_A = 81.1 \text{ Volts}}$$

*) Find the power delivered by the batteries for bridged T circuit shown in fig.



Soln:

$$6i_1 + 2i_2 - 4i_3 = 10$$

$$2i_1 + 6i_2 + 4i_3 = 16$$

$$-4i_1 + 4i_2 + 10i_3 = 0$$

$$\begin{bmatrix} 6 & 2 & -4 \\ 2 & 6 & 4 \\ -4 & 4 & 10 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} =$$

$\boxed{\Delta = 64}$

$V_c = -0.300$

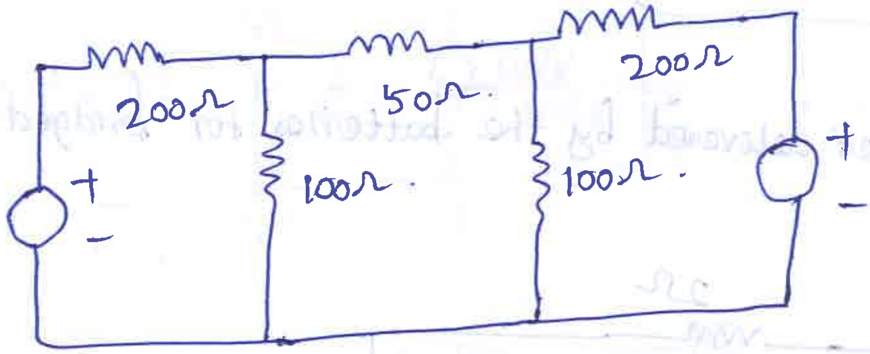
$$i_1 = \frac{\Delta i_1}{\Delta} \Rightarrow \frac{\begin{bmatrix} 10 & 2 & -4 \\ 16 & 6 & 4 \\ 0 & 4 & 10 \end{bmatrix}}{64} = -2.125A.$$

$$i_2 = \frac{\Delta i_2}{\Delta} = \frac{344}{64} = 5.375.$$

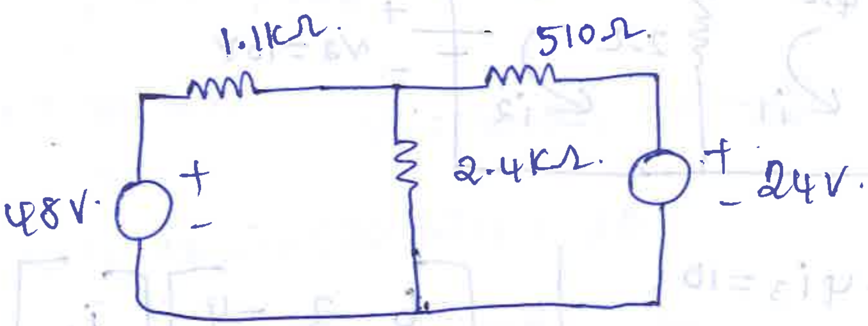
Battery 1 ⇒ $V_1 I_1 \Rightarrow 10(-2.125) = -21.25W$. (-Ve indicates power instead of delivering

Battery 2 ⇒ $V_2 I_2 \Rightarrow 16(5.375) = 86W$.

*) Using nodal Analysis, determine the current in branch in the circuit -

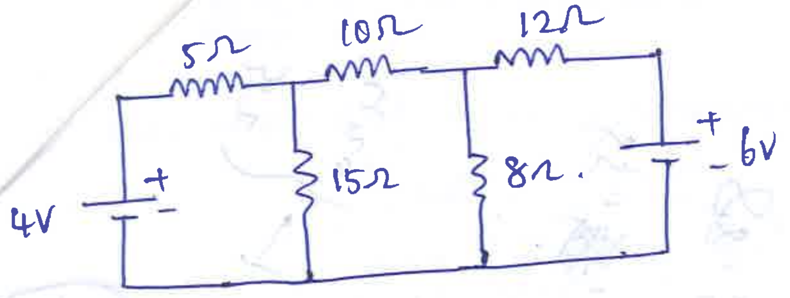


*) Find current and voltages using nodal voltage anlysis.



* A N/w is arranged as shown in fig. Determine the value of current i

the 8 Ω. resistor, Using mesh equation?



$4 = 5i_1 + 15(i_1 - i_2) \Rightarrow 20i_1 - 15i_2 = 4 \longrightarrow (1).$

$15(i_2 - i_1) + 10i_2 + 8(i_2 - i_3) = 0.$

$15i_2 - 15i_1 + 10i_2 + 8i_2 - 8i_3 = 0.$

$-15i_1 + 33i_2 - 8i_3 = 0. \Rightarrow 15i_1 - 33i_2 + 8i_3 = 0 \longrightarrow (2)$

$8(i_3 - i_2) + 12i_3 = -6.$

$8i_3 - 8i_2 + 12i_3 = -6.$

$-8i_2 + 20i_3 = -6. \Rightarrow 8i_2 - 20i_3 = 6 \longrightarrow (3).$

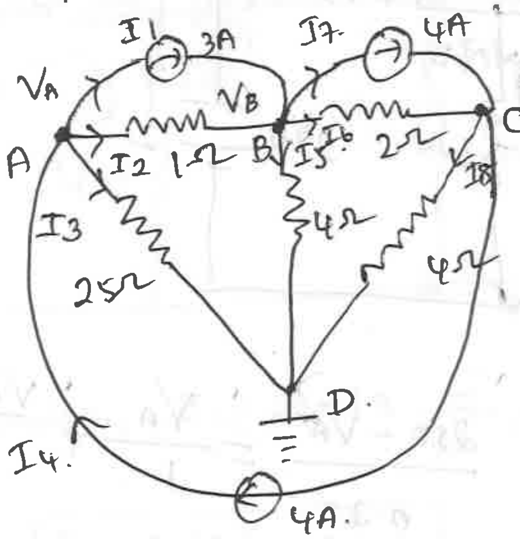
$$\left.\begin{aligned} i_1 &= 0.22A \\ i_2 &= 0.032A \\ i_3 &= -0.287A \end{aligned}\right\}.$$

Current through 8Ω registor $\Rightarrow 8(0.032+0$

$\Rightarrow 0.319A$

$V_c = -0.300$

...ower dissipated by the 4Ω resistor for the ckt shown.



Soln:-

At node 1, $I_4 = I_1 + I_2 + I_3 \Rightarrow 4 = 3 + \frac{V_A - V_B}{1\Omega} + \frac{V_A}{2.5}$

$$1 = V_A\left(1 + \frac{1}{2.5}\right) - V_B$$

$$\boxed{1 = 1.4V_A - V_B} \quad \text{--- (1)}$$

At node 2, $I_1 + I_2 = I_5 + I_6 + I_7$.

$$3 + \frac{V_A - V_B}{1} = \frac{V_B}{4} + \frac{V_B - V_C}{2} + 4.$$

$$\boxed{-1 = -V_A + V_B(1.75) - 0.5V_C} \quad \text{--- (2)}$$

At node 3, $I_6 + I_7 = I_4 + I_8$

$$\frac{V_B - V_C}{2} + 4 = 4 + \frac{V_C}{5}.$$

$$\boxed{0 = -0.5V_B + 0.7V_C} \quad \text{--- (3)}$$

$$\begin{bmatrix} 1.4 & -1 & 0 \\ -1 & 1.75 & -0.5 \\ 0 & -0.5 & 0.7 \end{bmatrix} \begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}.$$

$V_A = 0.41$

$V_B = -0.42$

$V_C = -0.300$

$\frac{V_A - V_B}{1} = 0.\ldots$

$4 = 3 + 0.83 + \ldots$

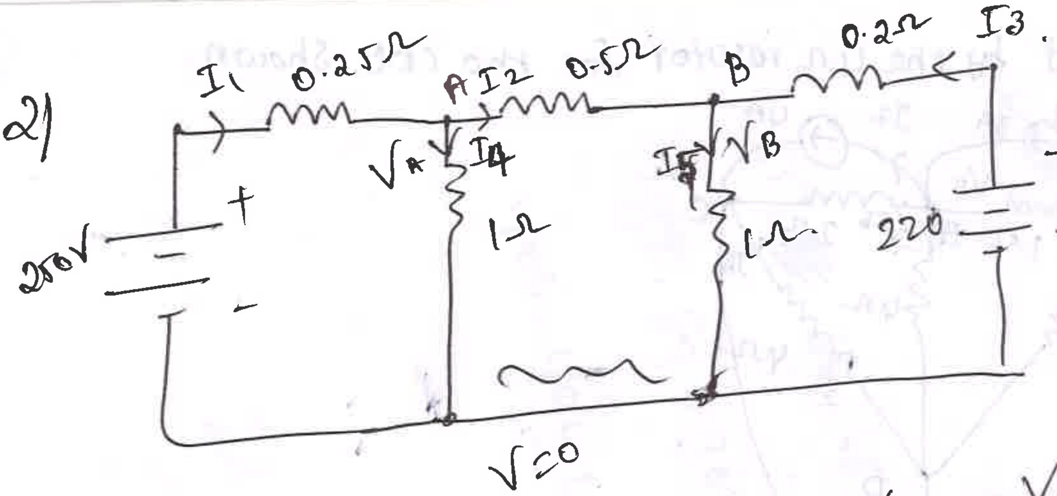
$3 + 0.83 = -\ldots$

$-0.12 + \ldots$

$-0.12 + \ldots$

$= 4 + \ldots$

2)



At node 1, $I_1 = I_4 + I_2$, $\Rightarrow \dfrac{250 - V_A}{0.25} = \dfrac{V_A}{1} + \dfrac{V_A - V_B}{0.5}$

$$\frac{250}{0.25} = V_A\left(1 + \frac{1}{0.5} + \frac{1}{0.25}\right) - V_B\left(\frac{1}{0.5}\right)$$

$$\boxed{1000 = 7V_A - 2V_B.} \text{ ——— (1).}$$

At node 2, $I_2 + I_3 = I_5$.

$$\frac{V_A - V_B}{0.5} + \frac{220 - V_B}{0.2} = V_B.$$

$$\frac{220}{0.2} = -V_A\left(1/0.5\right) + V_B\left(1 + \frac{1}{0.5} + \frac{1}{0.2}\right)$$

$$\boxed{1100 = -2V_A + 8V_B} \text{ ——— (2).}$$

$1000 = 7V_A - 2V_B \Rightarrow \times 2 \Rightarrow 2000 = 14V_A - 4V_B.$

$1100 = -2V_A + 8V_B \Rightarrow \times 7 \Rightarrow 7700 = -14V_A + 56V_B.$

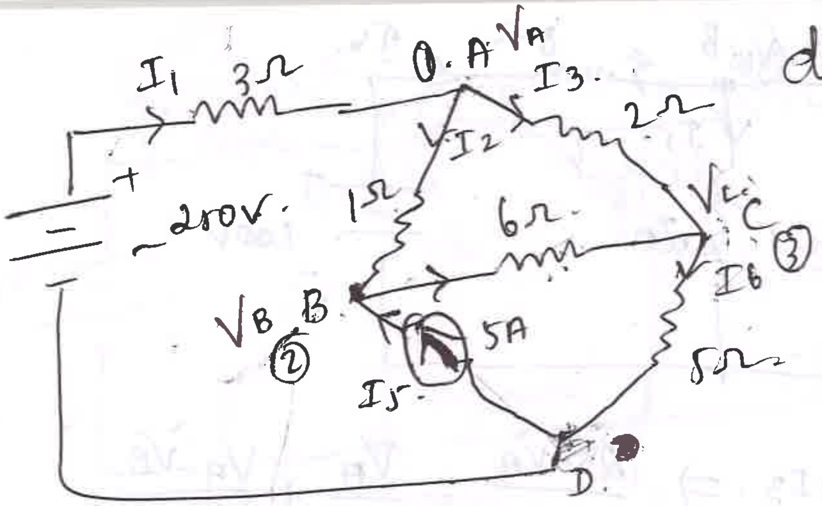
$9700 = 52V_B$

$V_B = \dfrac{9700}{52} = 186.5V.$, $V_A = 196.15V.$

$I_4 = \dfrac{V_A}{1\Omega} = 196.15A$, $I_5 = V_B/1 = 186.5A.$

(9). determine P in 1Ω

(7)



Soln: At node 1, $I_1 = I_2 + I_3 \Rightarrow \frac{250 - V_A}{3} = \frac{V_A - V_B}{1} + \frac{V_A - V_C}{2}$

$$\boxed{83.3 = V_A(1.83) - V_B - 0.5V_C} \text{ —— (1).}$$

At node 2, $I_2 + I_5 = I_4 \Rightarrow \frac{V_A - V_B}{1} + 5 = \frac{V_B - V_C}{6}$

$$\boxed{5 = -V_A + 1.167V_B - 0.167V_C} \text{ —— (2).}$$

At node 3, $I_3 + I_4 = I_6 \Rightarrow \frac{V_A - V_C}{2} + \frac{V_B - V_C}{6} = V_C/5$

$$\boxed{-0.5V_A - 0.167V_B + 0.867V_C = 0} \text{ —— (3).}$$

Cramer's rules,

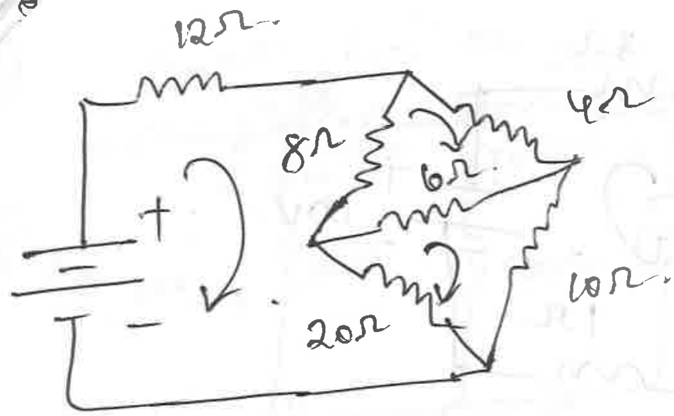
$$\begin{bmatrix} 1.83 & -1 & -0.5 \\ -1 & 1.167 & -0.167 \\ -0.5 & -0.167 & 0.867 \end{bmatrix} \begin{bmatrix} V_A \\ V_B \\ V_C \end{bmatrix} = \begin{bmatrix} 83.3 \\ 5 \\ 0 \end{bmatrix}$$

$V_A = 119.6V$, $V_B = 118.42V$.

$I_2 = \frac{V_A - V_B}{1} = 119.67 - 118.42 \Rightarrow 1.247 A.$

$P = I^2R \Rightarrow (1.247)^2(1) = 1.55W$

X.



Current flow in 6Ω resistor.

Soln:- in loop1, $24 = 12I_1 + 8(I_1 - I_2) + 20(I_1 - I_3)$

$$\boxed{24 = 40I_1 - 8I_2 - 20I_3} \quad \text{--- (1)}$$

in loop2, $+8I_2 - 8I_1 + 4I_2 + 6I_2 - 6I_3 = 0$.

$$\boxed{-8I_1 + 18I_2 - 6I_3 = 0} \quad \text{--- (2)}$$

in loop3, $\boxed{-20I_1 - 6I_2 - 36I_3 = 0}$ --- (3)

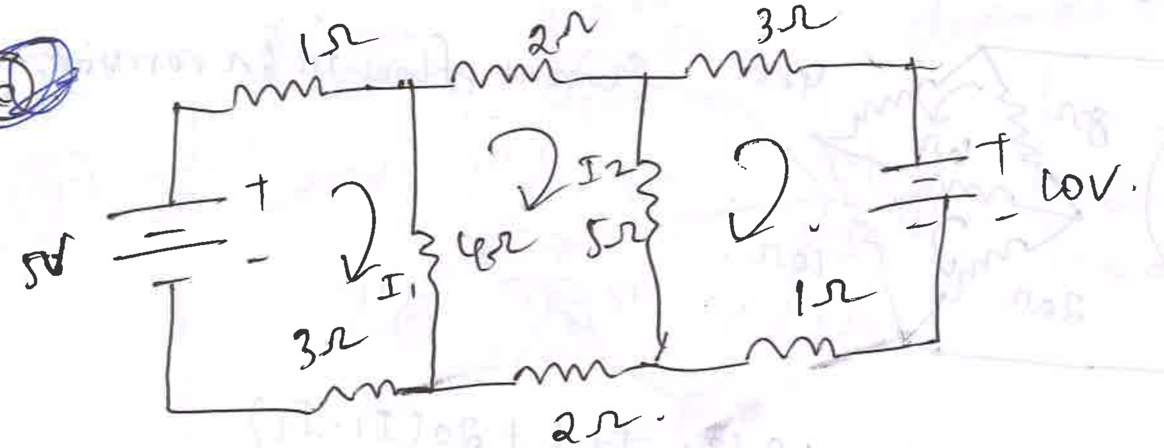
$$\begin{bmatrix} 40 & -8 & -20 \\ -8 & 18 & -6 \\ -20 & -6 & 36 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 24 \\ 0 \\ 0 \end{bmatrix}, \quad \Delta = 13056.$$

$$I_2 = \frac{-24(-288-120)}{13056} = 0.$$

$$I_3 = \frac{24(48+360)}{13056} = 0.75\,A.$$

Current flow through 6Ω resistor ⇒ $I_2 - I_1 = 0\,A$.

(a)



in loop①, $8I_1 - 4I_2 = 5$ —— ①

loop ② $2I_2 + 4I_2 - 4I_1 + 2I_2 + 5I_2 - 5I_3 = 0$.

$13I_2 - 4I_1 - 5I_3 = 0$ —— ②

loop③, $-10 = 3I_3 + 5I_3 - 5I_2 + I_3$

$-10 = 9I_3 - 5I_2$ —— ③

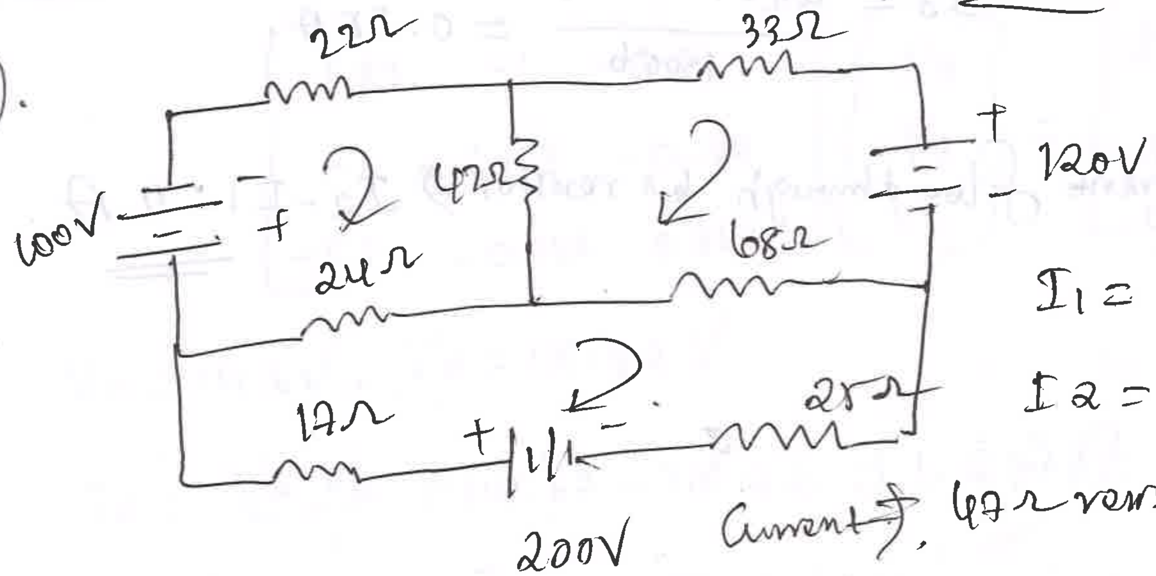
$$\begin{bmatrix} 8 & -4 & 0 \\ -4 & 13 & -5 \\ 0 & -5 & 9 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 0 \\ -10 \end{bmatrix}$$

$I_1 = 0.439A$

$I_2 = -0.371 A$

$I_3 = -1.31A$

(b).



$I_1 = 1.32A$

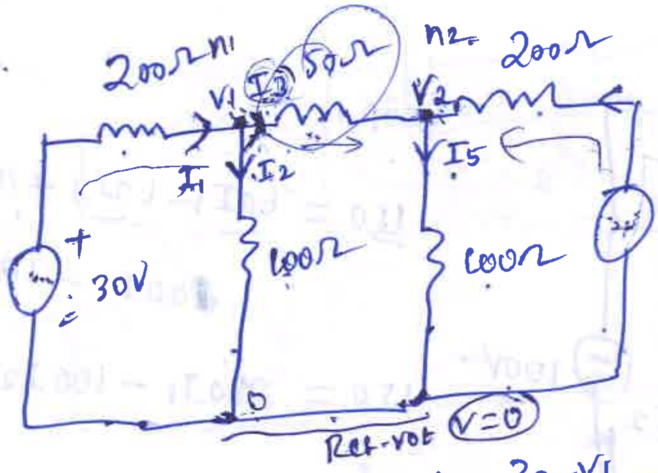
$I_2 = 1.08A$

Current of 47Ω resis $= I_1 - I_2$

$= 0.24 A$.

1/ (d).

$I = \frac{V}{R} = \frac{30-V_1}{200}$



→ Current through 50

$I_4 = \frac{V}{R}$

0.02 + 0.

0.0

→ node 1, $I_1 = I_3 + I_2 \Rightarrow \frac{30-V_1}{200} = \frac{V_1-V_2}{50} + \frac{V_1}{100}$.

→ node 2, $I_3 + I_4 = I_5 \Rightarrow \frac{V_1-V_2}{50} + \frac{40-V_2}{200} = \frac{V_2}{100}$.

$\frac{30}{200} - \frac{V_1}{200} = \frac{V_1}{50} - \frac{V_2}{50} + \frac{V_1}{100} \Rightarrow \frac{30}{200} = V_1\left(\frac{1}{50} + \frac{1}{100} + \frac{1}{200}\right)$

$\boxed{0.15 = 0.035 V_1 - 0.02 V_2}$ — (1).

$\frac{V_1}{50} - \frac{V_2}{50} + \frac{40}{200} - \frac{V_2}{200} = \frac{V_2}{100}$.

$0.02V_1 - V_2\left(\frac{1}{50} + \frac{1}{100} + \frac{1}{200}\right) = \frac{40}{200}$

$\boxed{0.02V_1 - 0.035(V_2) = 0.2}$ ← (2).

(1) × 0.02 ⇒ $0.003 = 0.007 V_1 - 0.0004 V_2$.

(2) × 0.035 ⇒ $0.007 = 0.007 V_1 - 0.001225 V_2$

(−) (−) (+)

$0.010 = 0.000825 V_2$.

$V_2 = \frac{0.010}{0.000825} = 12.12V$, $V_1 = 11.2V$.

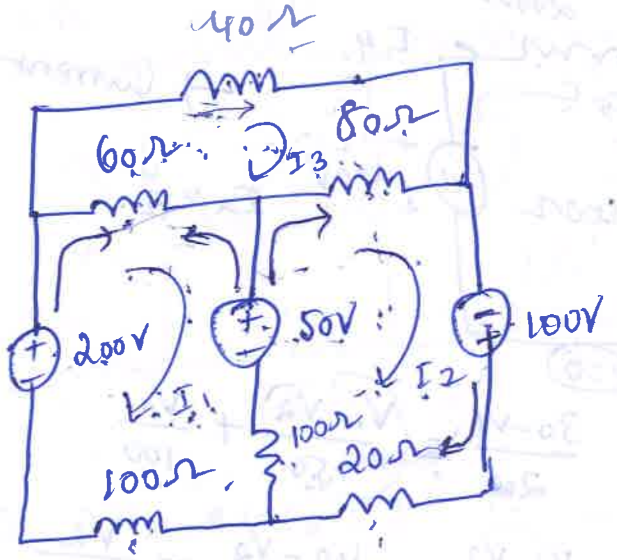
$I_3 = \frac{V_1 - V_2}{50} = \frac{11.2 - 12.12}{50} =$

0.

⇒ 18.4mA

(X)

2)



Loop 1,

$150 = 60I_1 - 60I_3 + 100I_1 +$

$100I_1 - 100I_2$

$150 = 260I_1 - 100I_2 - 60I_3$ — (1)

loop2 ⇒ $150 = 100I_2 - 100I_1 + 80I_2 - 80I_3 + 20I_2$.

$150 = 200I_2 - 100I_1 - 80I_3$ — (2).

loop3 ⇒ $0 = 40I_3 + 60I_3 - 60I_1 + 80I_3 - 80I_2$.

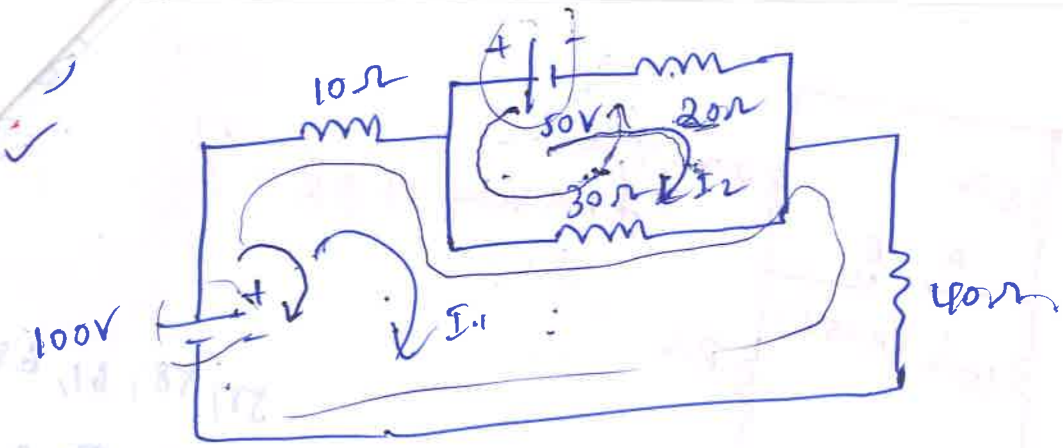
$0 = 180I_3 - 60I_1 - 80I_2$ — (3).

$$\begin{bmatrix} 260 & -100 & -60 \\ -100 & 200 & -80 \\ -60 & -80 & 180 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 150 \\ 150 \\ 0 \end{bmatrix}$$

$I_1 = 1.$

$I_2 = 2$

$I_3 = 0$



$$\text{loop}1 \Rightarrow 100 = 10I_1 + 30I_1 - 30I_2 + 40I_1$$

$$100 = 80I_1 - 30I_2 \quad \text{—— (1)}$$

$$\text{loop}2 \Rightarrow -50 = 20I_2 + 30I_2 - 30I_1$$

$$-50 = 50I_2 - 30I_1 \quad \text{—— (2)}$$

$$\cancel{(1) \times 30 \Rightarrow 3000 = 2400I_1 - 900I_2}$$

$$\cancel{(2) \times 80 \Rightarrow -4000 = -2400I_1 + 4000I_2}$$

$$\cancel{-1000 = 3100}$$

$$(1) = 10 = 8I_1 - 3I_2 \Rightarrow \times 5 \Rightarrow 50 = 40I_1 - \cancel{15I_2}$$

$$(2) = -5 = -3I_1 + 5I_2 \quad \times 3 \Rightarrow -15 = -9I_1 + \cancel{15I_2}$$

$$35 = 31I_1$$

$$\boxed{I_1 = \frac{35}{31} = 1.12A}$$

$$I_2 \Rightarrow 10 = 8(1.12) - 3I_2$$

$$10 - 8.96 = -3I_2$$

$$1.04 = -3I_2$$

$$\boxed{I_2 = 0.34A}$$