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| ID | 16434. |
| Date | 20-06-2020. |
| Submitted to | Sir. Sohail Imran. |
| Subject | Linear Circuit Analysis |
| Assignment | Second |

(ii) applying KCL on node 2:

$$\frac{V_2 - V_1}{40} + \frac{V_2}{100} + \frac{V_2 - V_3}{50} = 0$$

$$\frac{5V_2 - 5V_1 + 2V_2 + 4V_2 - 4V_3}{200} = 0$$

$$\therefore \quad -5V_1 + 11V_2 - 4V_3 = 0 \quad \text{—} \quad (2)$$

(iii) Applying KCL on node 3:

$$\frac{V_3 - V_2}{50} + \frac{V_3 - V_4}{10} = 2 - 2.5$$

$$\cancel{\boxed{\frac{5V_3 - 5V_2 + V_3 - V_4}{50} = -0.5}}$$

$-5V_2$

$$\frac{V_3 - V_2 + 5V_3 - 5V_4}{50} = -0.5$$

$$-V_2 + 6V_3 - 5V_4 = -25 \quad \text{—} \quad (3)$$

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(4) Applying KCL on node (4) n

$$\frac{V_3 - V_2}{10} + \frac{V_3}{200} = 5-2$$

$$\frac{20V_3 - 20V_2 + V_3}{200} = 3$$

$$-20V_2 + 21V_3 = 600 \quad \text{--- (4)}$$

Solving further by using Calculator.

we get

$V_1 = 180.46\,V$

$V_2 = 141.37\,V$

$V_3 = 163.22\,V$

$V_4 = 172.59\,V$

As from the figur we know

$V_2 = V_P$

Resultin

$V_P = 141.37\,V$

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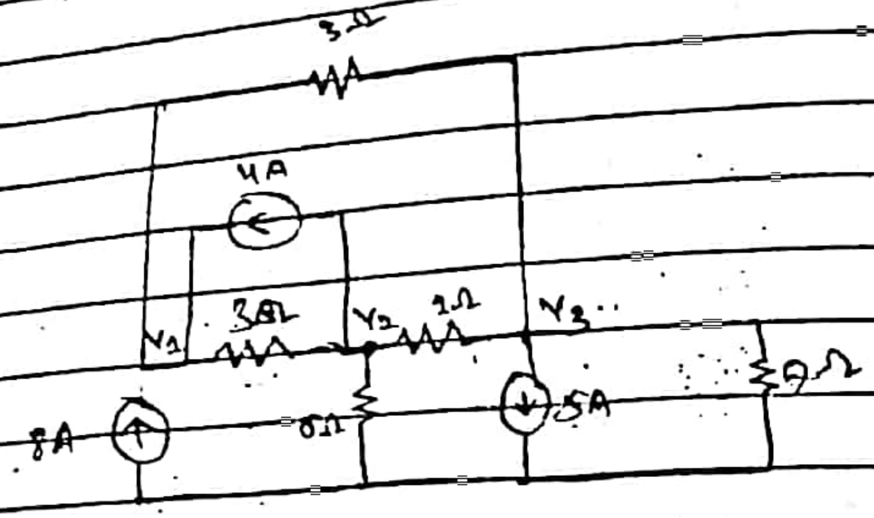
Q no 3 figure:
Ans:




Solution:
Solving by node analysis

(1) Applying KCL on node 1:

$$\frac{V_1 - V_2}{3} + \frac{V_1 - V_3}{3} = 8 + 4$$

$$\frac{V_1 - V_2 + V_1 - V_3}{3} = 12$$

$$2V_1 - V_2 - V_3 = 36 \quad \text{--- (1)}$$

(2) Applying KCL on node 2:

$$\frac{V_2 - V_1}{3} + \frac{V_2}{5} + \frac{V_2 - V_3}{1} = 4$$

$$\frac{5V_2 - 5V_1 + V_2 + 15V_2 - 15V_3}{15} = 4$$

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$$-5V_1 + 23V_2 - 15V_3 = -60 \quad \text{—— (2)}$$

(iii) applying KCL on node (3) n

$$\frac{V_3 - V_2}{1} + \frac{V_3 - V_1}{3} + \frac{V_3}{7} = 5$$

$$\frac{21V_3 - 21V_2 + 7V_3 - 7V_1 + V_3}{21} = 5$$

$$-7V_1 - 21V_2 + 31V_3 = -105 \quad \text{—— (3)}$$

Solving by Cramer's rule

$$\underbrace{\begin{bmatrix} 2 & -1 & -1 \\ -5 & 2 & -15 \\ -7 & -21 & 31 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}}_{X} = \underbrace{\begin{bmatrix} 36 \\ 4 \\ -105 \end{bmatrix}}_{B}$$

$$|A| = \begin{vmatrix} 2 & -1 & -1 \\ -5 & 2 & -15 \\ -7 & -21 & 31 \end{vmatrix}$$

$$= 2\begin{vmatrix} 2 & -15 \\ -21 & 31 \end{vmatrix} + 1\begin{vmatrix} -5 & -15 \\ -7 & 31 \end{vmatrix} - 1\begin{vmatrix} -5 & 2 \\ -7 & -21 \end{vmatrix}$$

$$= -506 - 260 - 119$$

$$= -786$$

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$$V_1 = \frac{|AB|}{|A|} = \begin{vmatrix} 36 & -1 & -1 \\ 4 & 2 & -15 \\ -105 & -21 & 31 \end{vmatrix}$$

$$= 36\begin{vmatrix} 2 & -15 \\ -21 & 31 \end{vmatrix} + \begin{vmatrix} 4 & -15 \\ -105 & 31 \end{vmatrix} - 1\begin{vmatrix} 4 & 2 \\ -105 & -21 \end{vmatrix}$$

$$= -9108 - 1451 - 126$$

$$= \frac{-10685}{-786}$$

$$V_1 = 13.59$$

$$V_2 = \begin{vmatrix} 2 & 36 & -1 \\ -5 & 4 & -15 \\ -7 & -105 & 31 \end{vmatrix}$$

$$= 2\begin{vmatrix} 4 & -15 \\ -105 & 31 \end{vmatrix} - 36\begin{vmatrix} -5 & -15 \\ -7 & 31 \end{vmatrix} + (-1)\begin{vmatrix} -5 & 4 \\ -7 & -105 \end{vmatrix}$$

$$= -2902 - 9360 - 553$$

$$= \frac{-12815}{786}$$

$$V_2 = 16.30$$

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$$V_3 = \begin{vmatrix} 2 & -1 & 36 \\ -5 & 2 & 4 \\ -7 & -21 & -105 \end{vmatrix}$$

$$= 2\begin{vmatrix} 2 & 4 \\ -21 & -105 \end{vmatrix} + 1\begin{vmatrix} -5 & 4 \\ -7 & -105 \end{vmatrix} + 36\begin{vmatrix} -5 & 2 \\ -7 & -21 \end{vmatrix}$$

$= -35280 + 553 + 4284$

$= \dfrac{-30443}{-786}$

$V_3 = 38.73$

Now we know that

$V_{5\Omega} = V_2$

$\boxed{V_{5\Omega} = 16.30V}$

$P = \dfrac{V^2}{R} = \dfrac{V_3^2}{7}$

$P = \dfrac{(38.73)^2}{7}$

$P = 214.28\ W$

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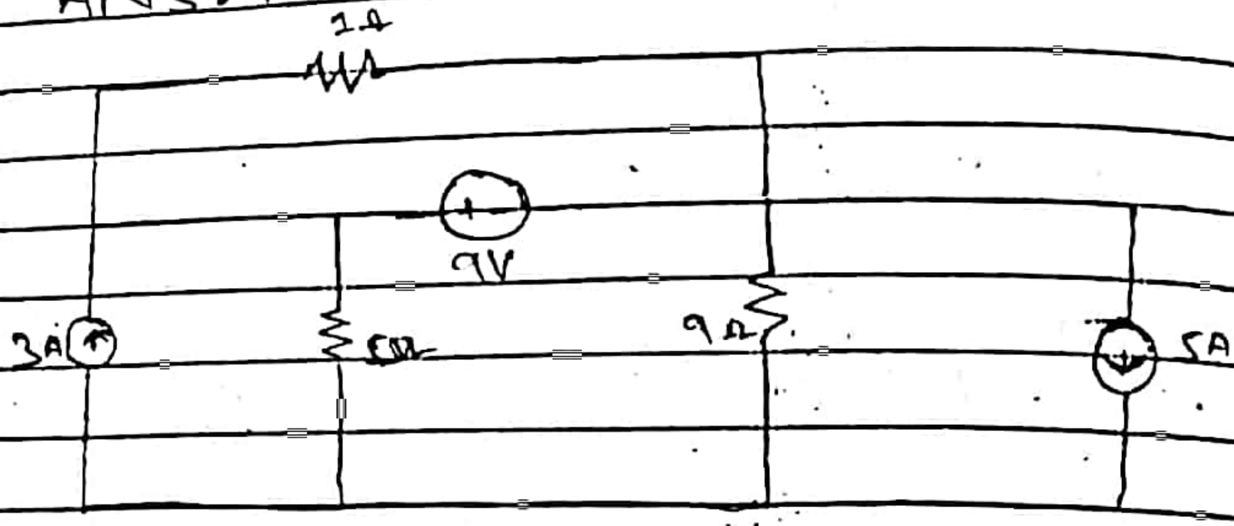
Q NO 4

ANS:-




Solution:-

Considering $V_1$ & $V_2$ as a Supernode

Applying KCL on Supernode:-

$$\frac{V_1 - V_2}{1} + \frac{V_1}{5} + \frac{V_2 - V_1}{1} + \frac{V_2}{9} = 3 - 5$$

$$\frac{45V_1 - 45V_2 + 9V_1 + 45V_2 - 45V_1 + 9V_2}{45} = 3$$

$$9V_1 + 9V_2 = 135 \quad \text{— } (1)$$

&

$$V_1 - V_2 = 9 \quad \text{— } (2)$$

Combining eq (1) & (2)

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$$9V_1 + \cancel{9V_2} = 135$$
$$9V_1 - \cancel{9V_2} = 81$$
$$18V_1 = 216$$

$$V_1 = \frac{216}{18}$$

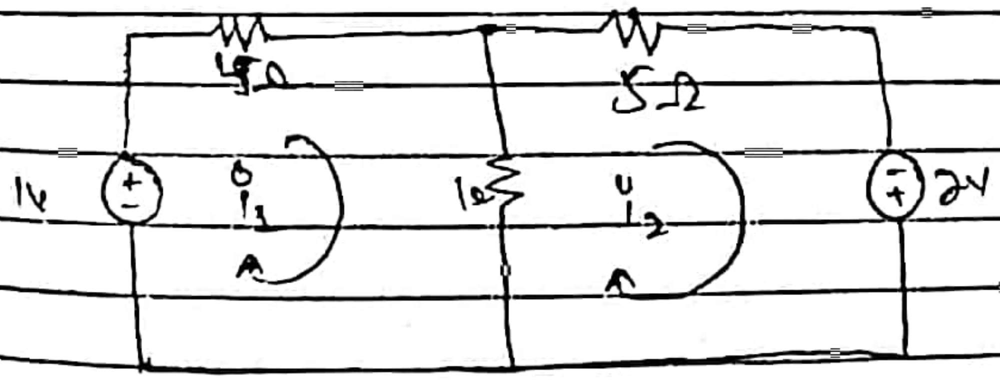
$$\boxed{V_1 = 12V}$$

Putting in eq (2)

$$V_2 = V_1 - 9$$
$$V_2 = 12 - 9$$
$$\boxed{V_2 = 3}$$

Q no 5

ANS: figure




Solution

Solving by mesh analysis.

Applying KVL on $i_1$

$$4i_1 + 1(i_1 - i_2) = 1$$

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$5i_1 - i_2 = 1$ ——— (i)

(ii) Applying KVL on $i_2$:

$1(i_2 - i_1) + 5i_2 = 2$

$-i_1 + 6i_2 = 2$ ——— (ii)

Multiplying 5 with eq (2)
& adding with eq (1)

$\cancel{5i_1} - i_2 = 1$
$\cancel{-5i_1} + 30i_2 = 10$

$29i_2 = 11$

$i_2 = 11/29$

$i_2 = 0.3794$

Putting in eq (1)

$5i_1 = 1 + 0.379$

$i_1 = 0.275A$

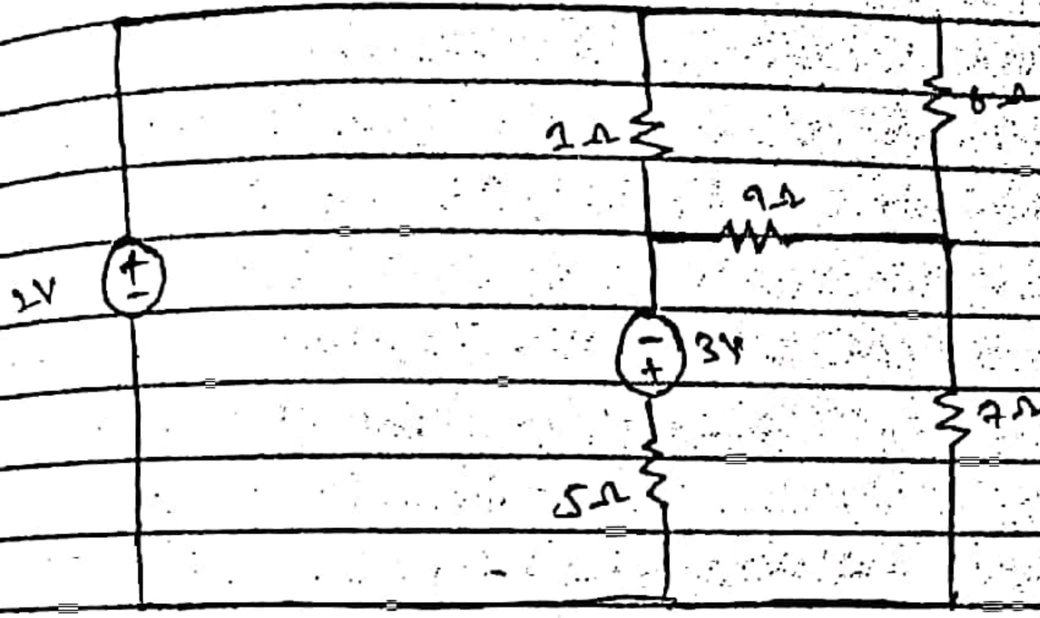
Result

$i_1 = 0.275A$

$i_2 = 0.379A$

QNO 6

ANS: figure:




Sol:

Applying KCL on $i_1$/Mesh 1

$$1(i_1 - i_2) + 5(i_1 - i_3) = 3 + 2$$

$$i_1 - i_2 + 5i_1 - 5i_3 = 5$$

$$6i_1 - i_2 - 5i_3 = 5 \quad \text{—— (1)}$$

Applying KCL on $i_2$/Mesh 2

$$1(i_2 - i_1) + 6i_2 + 9(i_2 - i_3) = 0$$

$$-i_1 + 16i_2 - 9i_3 = 0 \quad \text{—— (2)}$$

Applying KCL on loop 3

$$5(i_3-i_1)+9(i_3-i_2)+7i_3=-3$$

$$-5i_1-9i_2+21i_3=-3 \quad \text{--- (3)}$$

Solving by Cramer's rule

$$\begin{bmatrix} 6 & -1 & -5 \\ -1 & 16 & -9 \\ -5 & -9 & 21 \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}=\begin{bmatrix} 5 \\ 0 \\ -3 \end{bmatrix}$$

$$|A|=\begin{vmatrix} 6 & -1 & -5 \\ -1 & 16 & -9 \\ -5 & -9 & 21 \end{vmatrix}$$

$$=6\begin{vmatrix} 16 & -9 \\ -9 & 21 \end{vmatrix}+1\begin{vmatrix} -1 & -9 \\ -5 & 21 \end{vmatrix}-5\begin{vmatrix} -1 & 16 \\ -5 & -9 \end{vmatrix}$$

$$=6(255)-(-1)(-66)-5(89)$$

$$=1015$$

$$i_1=\begin{vmatrix} 5 & -1 & -5 \\ 0 & 16 & -9 \\ -3 & -9 & 21 \end{vmatrix}$$

$$=5\begin{vmatrix} +16 & -9 \\ -9 & 21 \end{vmatrix}+0-3\begin{vmatrix} -1 & -5 \\ 16 & -9 \end{vmatrix}$$

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$$i_1 = \frac{1008}{1015}$$

$$\boxed{i_1 = 0.993}$$

$$i_2 = \begin{vmatrix} 6 & 5 & -5 \\ -1 & 0 & -9 \\ -5 & -3 & 21 \end{vmatrix}$$

$$= 6\begin{vmatrix} 0 & -9 \\ -3 & 21 \end{vmatrix} - 5\begin{vmatrix} -1 & -9 \\ -5 & 21 \end{vmatrix} - 5\begin{vmatrix} -1 & 0 \\ -5 & -3 \end{vmatrix}$$

$$i_2 = \frac{153}{1015} = \boxed{0.150}$$

$$i_3 = \begin{vmatrix} 6 & -1 & 5 \\ -1 & +16 & 0 \\ -5 & -9 & 3 \end{vmatrix}$$

$$= 6\begin{vmatrix} 16 & 0 \\ -9 & 3 \end{vmatrix} + 1\begin{vmatrix} -1 & 0 \\ -5 & 3 \end{vmatrix} + 5\begin{vmatrix} -1 & 16 \\ -5 & -9 \end{vmatrix}$$

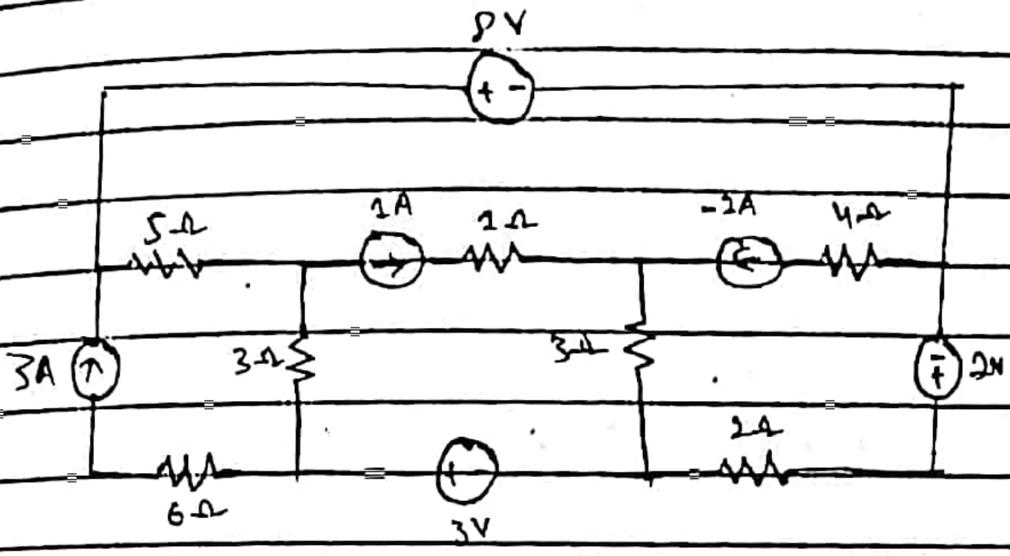
$$= \frac{730}{1015}$$

$$\boxed{i_3 = 0.719}$$

Q.NO 7 :-

ANS :-

figure :-




Considering $i_1, i_2, \&\ i_3$ as a supernode,

Applying KCL supernode,

$$5(i_1-3)+3(i_2-3)+2i_3 = 3+2-8$$

$$5i_1-15+3i_2-9+2i_3 = -3$$

$$5i_1+3i_2+2i_3 = 12 \longrightarrow (1)$$

we also know that

$$i_2 - i_1 = 1$$

where $i_2 = 1+i_1 \longrightarrow (a)$

&

$$i_1 - i_3 = -2$$

$$i_3 = +2+i_1 \longrightarrow (b)$$

Putting in eq (1)

$5i_1 + 3(1+i_1) + 2(-2+i_1) = 12$

$5i_1 + 3 + 3i_1 - 4 + 2i_1 = 12$

$10i_1 - 1 = 12$

$i_1 = 11/10$

$i_1 = 1.1\,A$

Putting in eq A & B

$i_2 = 1 + 1.1$

$i_2 = 2.1\,A$

&

$i_3 = +2 + 1.1$

$i_3 = 3.1\,A$

Result

$i_1 = 1.1A$

$i_2 = 2.1A$

$i_3 = 3.1A$.

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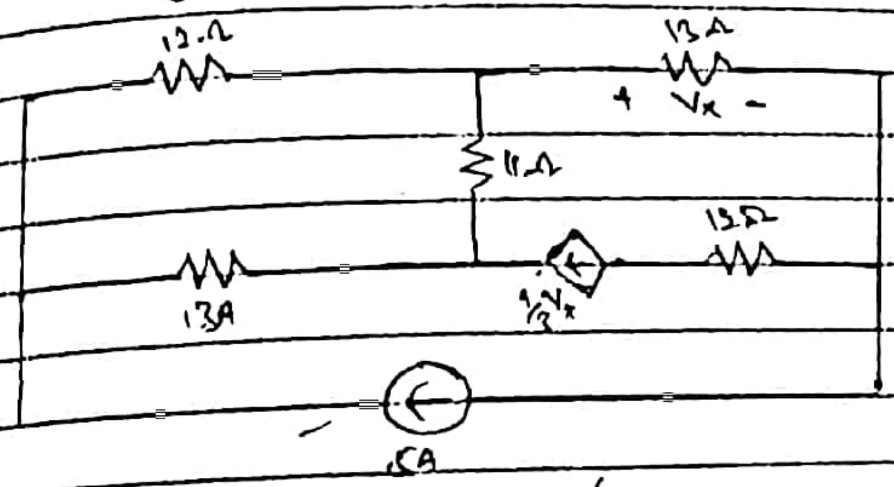
(ii)
Ans :- figure :-




from the figure, we know that 5A current is flowing through $i_1$

$$i_1 = 5A$$

Now there is an independent source b/w $i_1$ & $i_3$

So

$$i_1 - i_3 = \frac{1}{13} V_x \qquad \because V_x = 13 i_3$$

$$i_3 = \frac{13 i_3}{13} + 5$$

$$i_3 = -1.5A$$

Applying mesh analysis on $i_2$.

$$13(i_2 - i_1) + 11(i_2 - i_3) + 12 i_2 = 0$$

$$13 i_2 - 13 i_1 + 11 i_2 - 11 i_3 + 12 i_2 = 0$$

$$36 i_2 - 13(5) + 11(+1.5) = 0$$

$$36 i_2 = 65 - 16.5$$

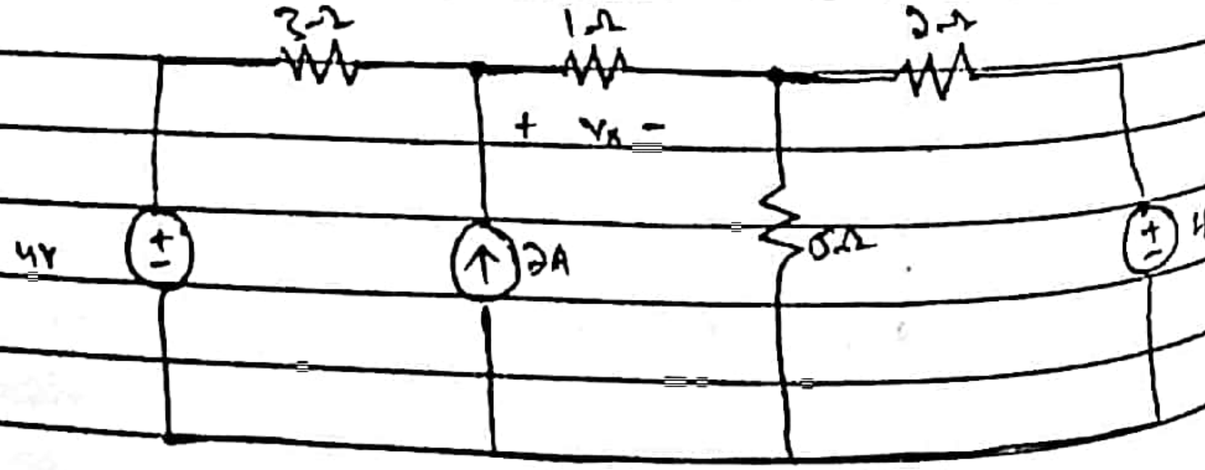
$$i_2 = \frac{48.5}{36}$$

$$\boxed{i_2 = 1.347\,A}$$

Q NO 2 CHATER 5

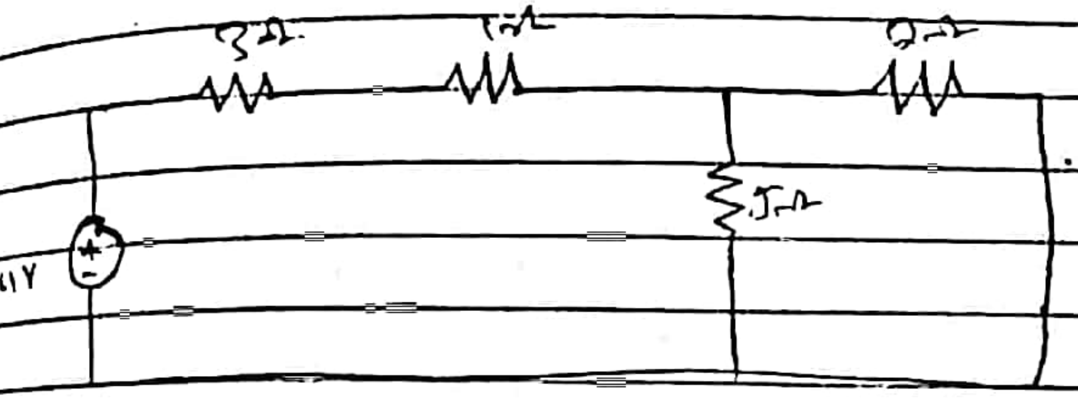
ANS # 1

Figure #



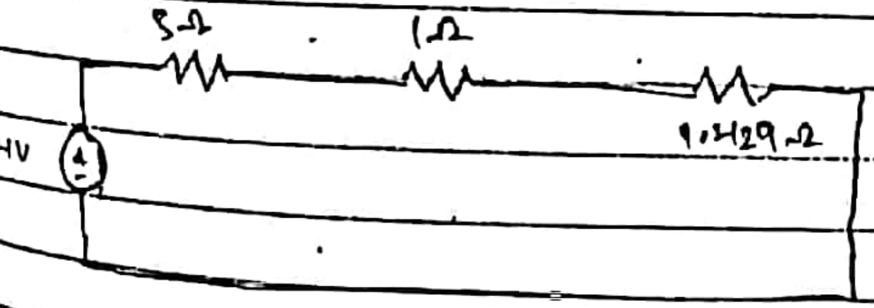
Solution: Setting the right-hand side voltage as a short circuit & the current source as an open circuit

Re-drawing the circuit.




∵ $5\Omega$ & $2\Omega$ are in parallel
Combining both.

$$= \frac{5 \times 2}{5 + 2} = 1.429\,\Omega$$




Apply mesh analysis

$$3i_1 + 1i_1 + 1.429i = 4$$

$$i_1 = \frac{4}{5.429}$$

$i_1 = V_x = 0.73$

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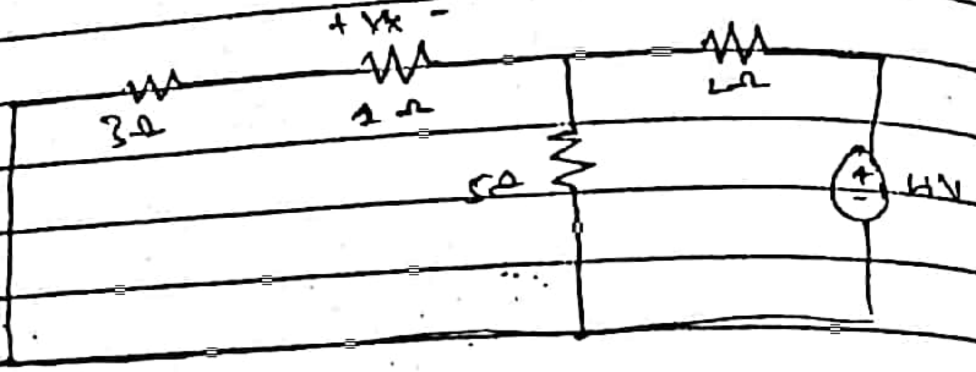
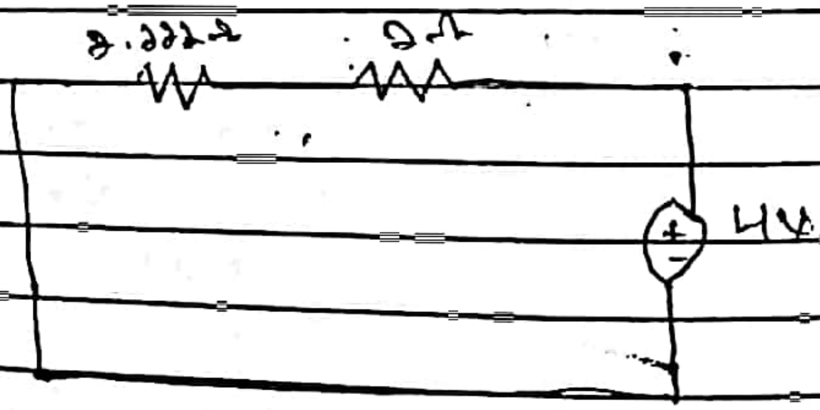
Now set the left hand side voltage as a short circuit & current source as an open circuit.




As 5Ω is in parallel with (3Ω & 1Ω

$$R_{eq} = \frac{5 \times (3+1)}{5+3+1} = \frac{20}{9}$$

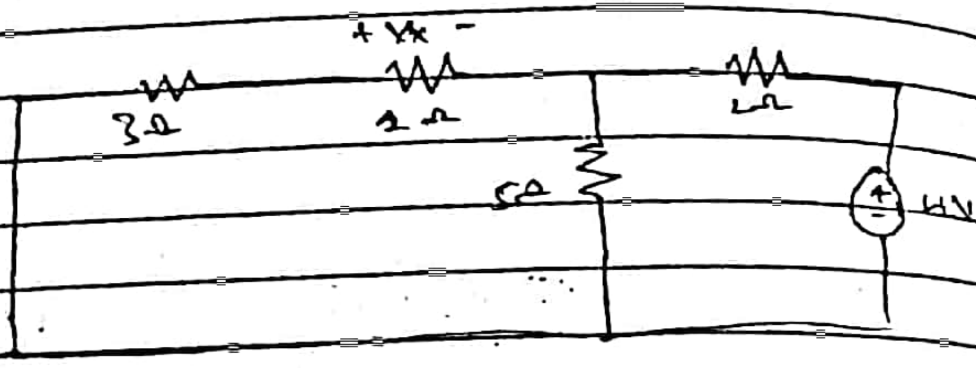
$$= 2.222\ \Omega$$




Now by mesh analysis

$$i_1 = \frac{4}{4.222} = -0.947$$

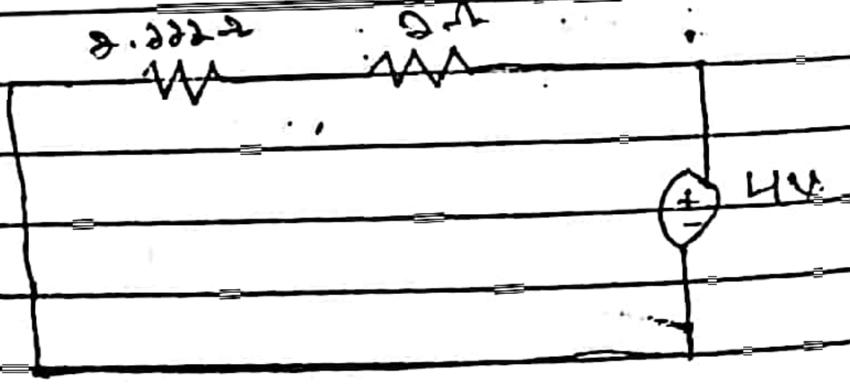
Now Set the left hand Side voltage as a Short Circuit & Current Source as an open Circuit.




As 5Ω is in parallel with 3Ω & 1Ω

$$Req = \frac{5 \times (3+1)}{5+3+1} = \frac{20}{9}$$

$$= 2.222\ \Omega$$




Now by Mesh analysis

$$i_1 = \frac{4}{4.222} = -0.947$$

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$$V_{2.222\Omega} = \frac{4\,(2.222)}{2.222+2}$$

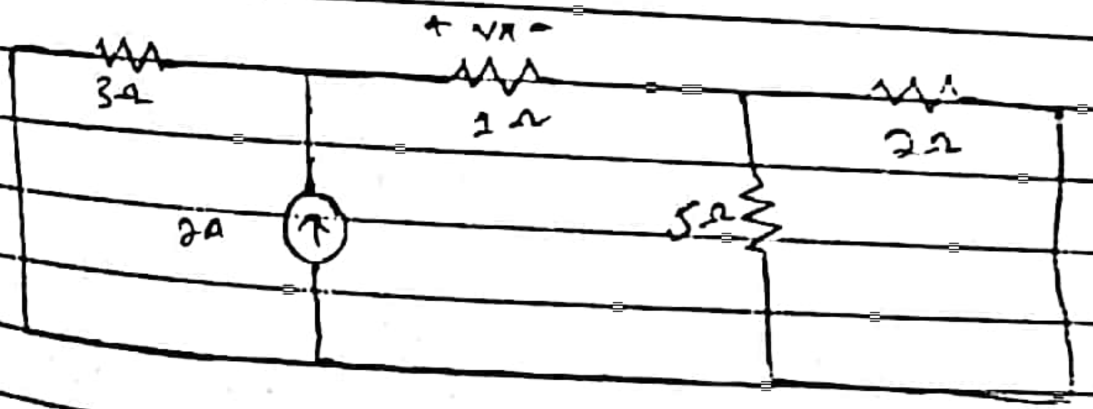
$$V_{2.222\Omega} = -2.1053V$$

Now for $1\Omega$

$$V_{x2} = \frac{-2.1053\,(1)}{1+3}$$

$$V_{x2} = -0.5622V$$

Now letting the two voltages at a short circuit and Re-drawing the circuit




$$R_{eq} = 5 \parallel 2$$

$$= \frac{2 \times 5}{5+2} = \frac{10}{7} = 1.429\Omega$$

Redrawing the circuit.

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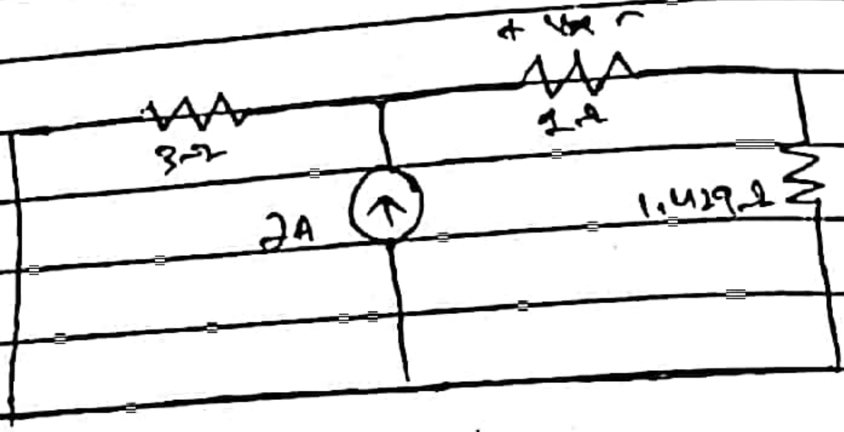


Applying Current dividing rule

$$I_{1\Omega} V_{x3} = \frac{2\,(3)}{3+1+1.429}$$

$I_{1\Omega} = 1.105$

Now

$V_x = IR$

$V_{x3} = (1.105)(1)$

$V_{x3} = 1.105$

Now

adding all the voltages

$V_x = V_{x1} + V_{x2} + V_{x3}$

$= 0.73684 + (-0.52632) + 1.105$

$V_x = 1.3155\ V$

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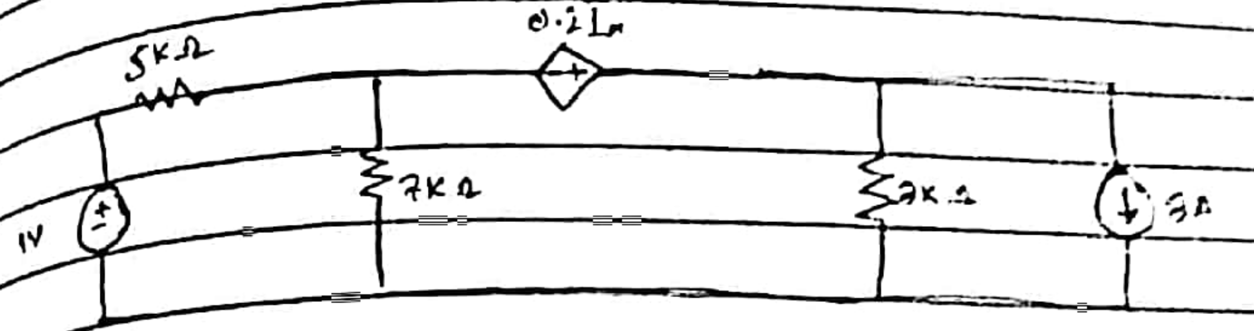
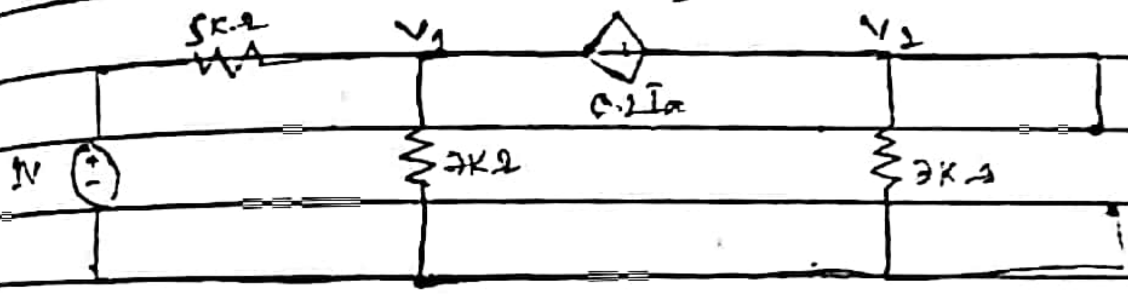
Q No 2 :
ANS : figure :




Removing the Current Source so it will be act as open circuit - Redrawing the circuit.




V1 & V2 will be a super node applying KCL on a supernode

$$\frac{V_1 - 1}{5000} + \frac{V_1}{7000} + \frac{V_2}{2000} = 0$$

&

Now $V_1 - V_2 = 0.2I_x$

$V_1 = 0.2I_x + V_2$

$$\frac{V_1 - 1}{5000} + \frac{V_1}{7000} + \frac{0.2I_x + V_2}{2000} = 0$$

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But $V_1 = 7000\, I_{x1}$

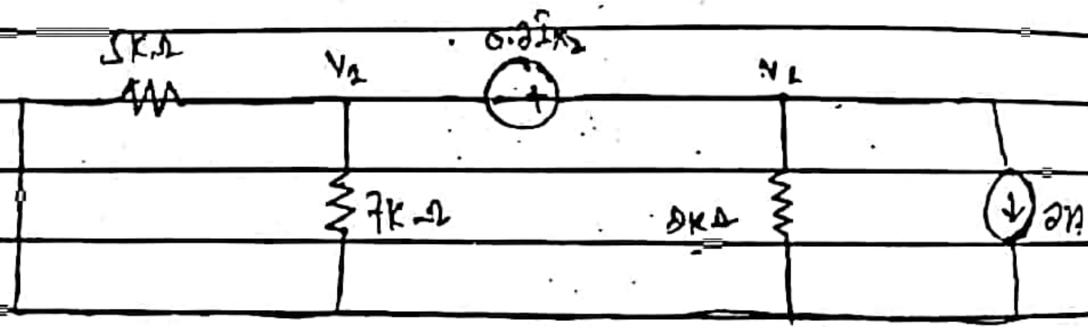
$$\frac{7000 I_{x1} - 1}{5000} + \frac{7000 I_{x1}}{7000} + \frac{7000 I_{x1} + 0.2 I_{x1}}{2000} = 0$$

$$1.4 I_{x1} - 0.2 + 1 I_{x1} + 3.5 I_{x1} + 0.2 I_{x1} = 0$$

$$6 I_{x1} = 0.2$$

$$I_{x1} = 0.03333\ A$$

Now the voltage source will be get short circuit




Applying KCL on supernode

$$\frac{V_1}{5000} + \frac{V_1}{7000} + \frac{V_2}{2000} = -2$$

$$\therefore V_2 = V_1 + 0.2 I_{x1}$$

$$\frac{V_1}{5000} + \frac{V_1}{7000} + \frac{V_1 + 0.2 I_{x1}}{2000} = -2$$

$$\therefore V_1 = 7000\, I_{x1}$$

Bilal Register

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$$\frac{7000 I_{x2}}{5000} + \frac{7000 I_{x2}}{7000} + \frac{7000 I_{x2} + 0.2 I_{x2}}{2000} = -2$$

$$1.4 I_{x2} + I_{x2} + 3.5 I_{x2} + 0.2 I_{x2} = -2$$

$$6 I_{x2} = -2$$

$$I_{x2} = -2/6$$

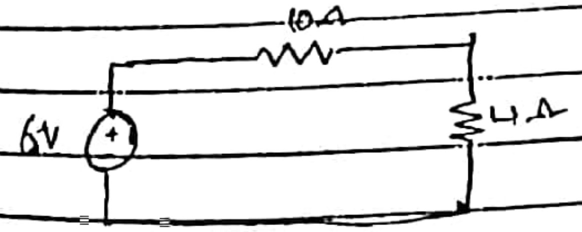
$$I_{x2} = -0.3333\,A$$

$$I = I_{x1} + I_{x2}$$

$$I = 0.0333 - 0.3333$$

$$\boxed{I = -0.3A}$$

Q.NO 3
Ans (i) figures




According to Ohm's law

$$V = IR$$

$$I = \frac{V}{R} = \frac{6}{10}$$

$$I = 0.6A$$

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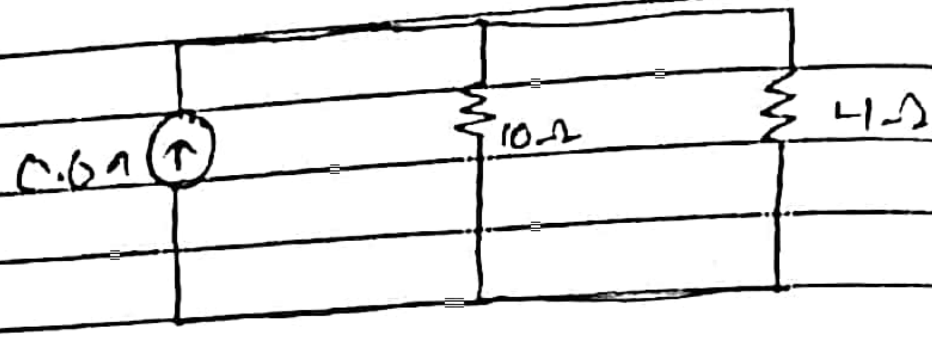
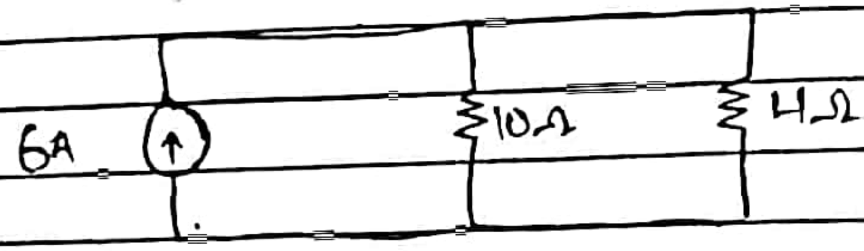
# Re drawing Circuit




(ii) Figure (2)




$$V = IR$$

$$V = (6)(10)$$

$$V = 60\,V$$

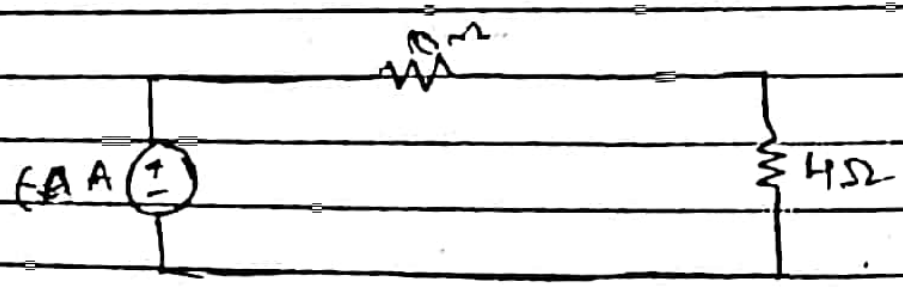
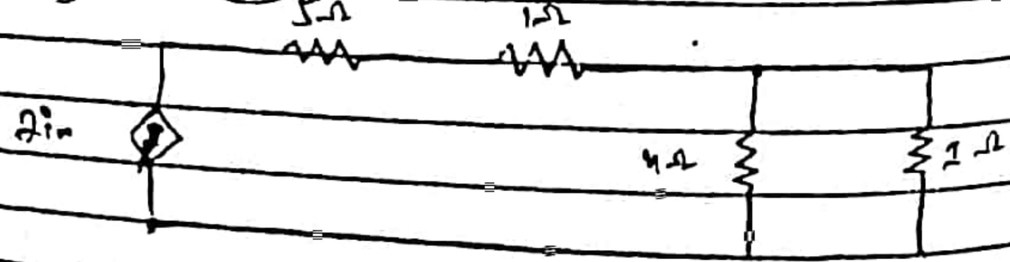



Figure (3)



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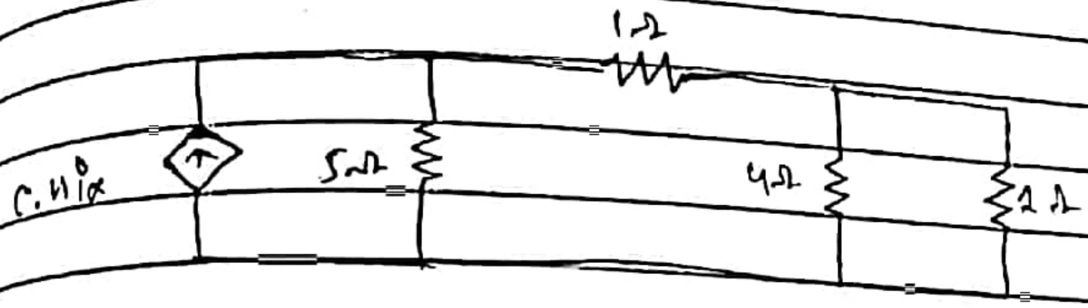
$V = IR$

$I = V/R$

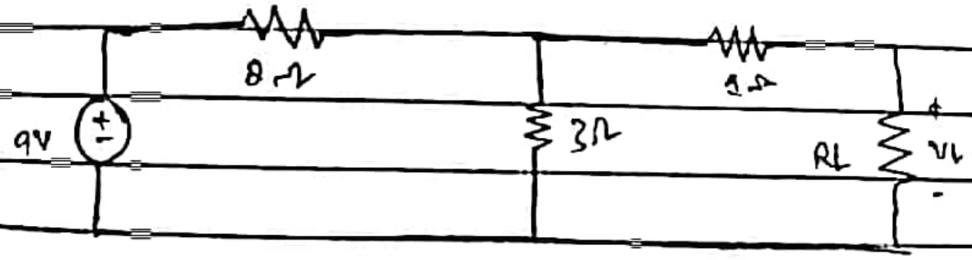
$= \frac{2}{5}$

$I = 0.4\, i_x$




Q NO 4

ANS:




Soln

To get $R_{Th}$ we will add all the resistors accept $R_L$

$R_{Th} = 2 \parallel 3 + 1$

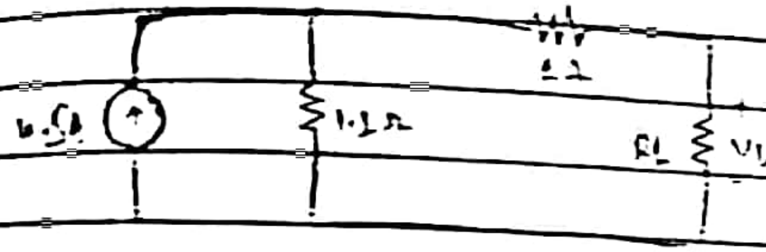
$= \frac{6}{5} + 1$

$R_{Th} = 2.2\ \Omega$

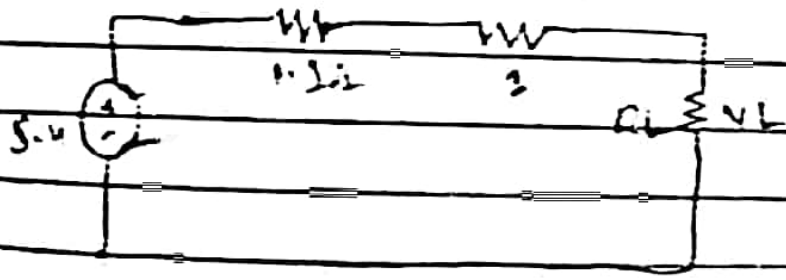
Now Solving by source transformation

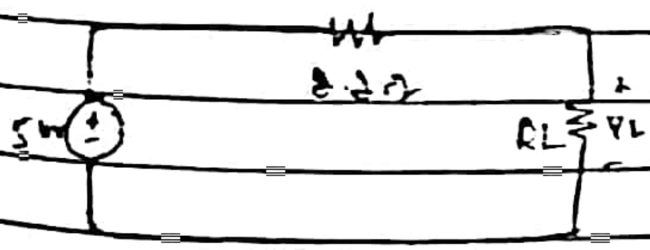
$I = V/R = \frac{9}{2} = 4.5$


$R_{eq} = \frac{2 \times 3}{2+3} = \frac{6}{5} = 1.2$




$V = IR = (4.5)(1.2) = 5.4V$




$V_{th} = 5.4V$

$R_{th} = 2.2\Omega$

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Now calculating each value of RL

(i)

$$R_L = 1\,\Omega = \frac{5.4\,(1)}{1 + 2.2}$$

$$V_L = 1.688V.$$

(ii) $R_L = 3.5\,\Omega$

$$= \frac{(5.4)(3.5)}{3.5 + 2.2}$$

$$V_L = 3.316\,V$$

(iii) $R_L = 6.257\,\Omega$

$$= \frac{(5.4)(6.257)}{(6.257)(2.2)}$$

$$V_L = 3.995V$$

(iv) $R_L = 9.8\,\Omega$

$$= \frac{(5.4)(9.8)}{2.2 + 9.8}$$

$$V_L = 4.41V$$

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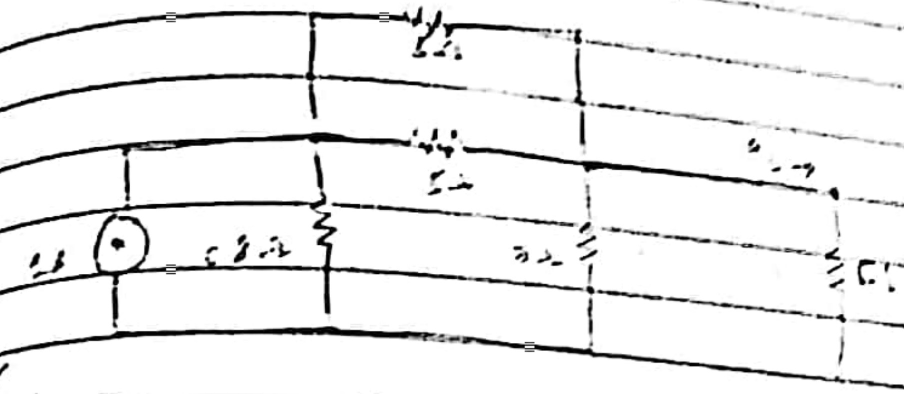
Unit I
with figure

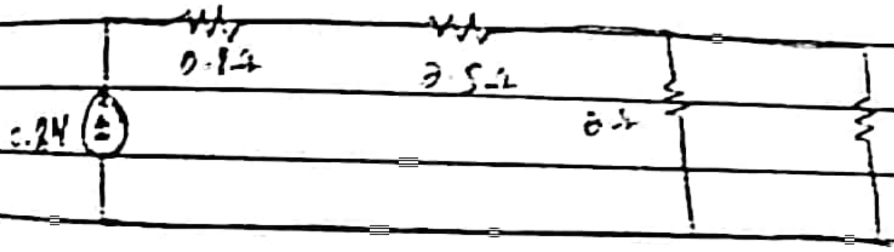


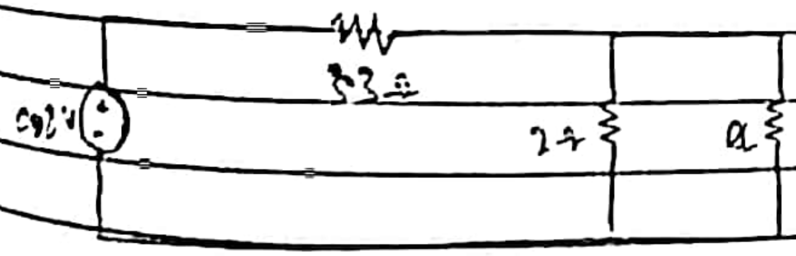
Sol:

$$Req = \frac{5\times5}{5+5} = \frac{25}{10} = 2.5$$

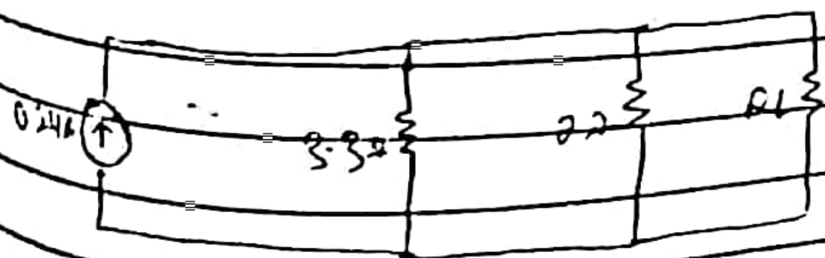
$$V = IR$$

$$= (1)(0.8) = 0.8$$





$$I = 0.8/3.3 = 0.24$$



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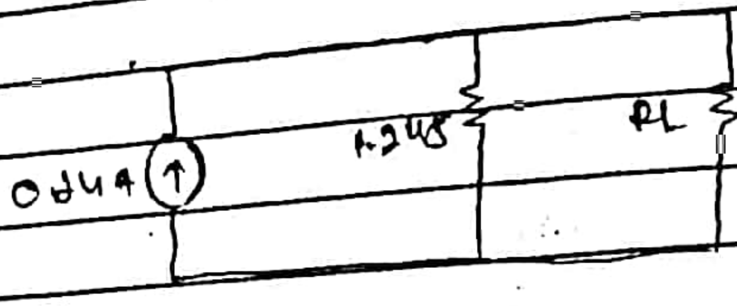
$$Req = \frac{3.3 \times 2}{2 + 3.3} = \frac{6.6}{5.3}$$

$$Req = 1.245$$




$$I_n = 0.24A$$

$$R_n = 1.245\Omega$$

Now

$$V = IR$$

$$V_{Th} = I_N \cdot R_N$$

$$= (0.24)(1.245)$$

$$V_{Th} = 0.302V$$

&

$$R_N = R_{Th}$$

$$R_{Th} = 1.245$$

Find each value for RL

(i) $RL = 0\Omega$

$$= \frac{0.302}{1.245 + 0}$$

$$i_L = 0.243A$$

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(2) $RL = 1\,\Omega$

$$= \frac{0.302}{1.245+1} = 0.135A$$

$IL = 0.135A$

(3) $RL = 4.923\,\Omega$

$$= \frac{0.302}{1.245+4.923}$$

$IL = 0.049A$

(4) $RL = 8.107\,\Omega$

$$= \frac{0.302}{1.245+8.107}$$

$IL = 0.032\ A$

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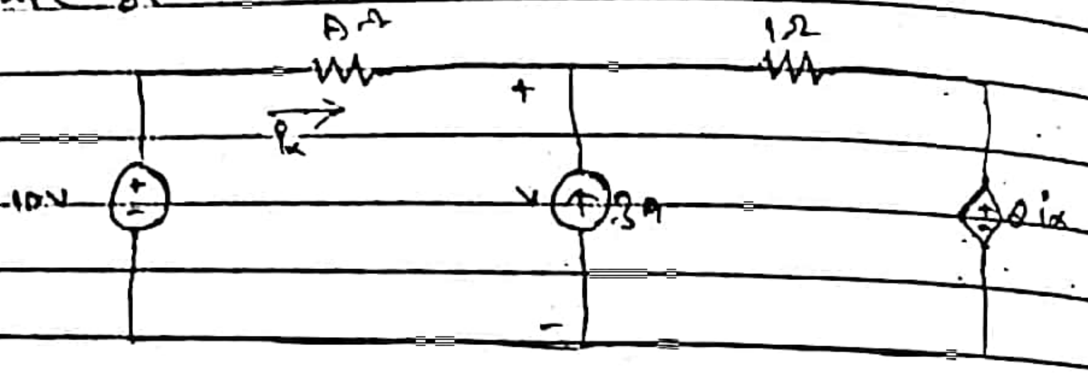
Q no 2 Part (ii)

Ex. 5.3

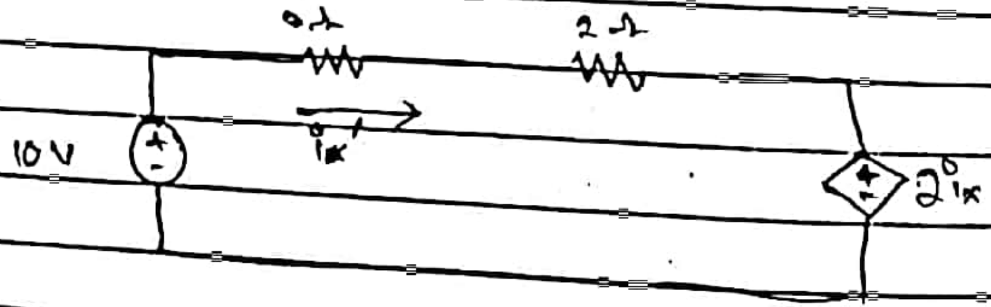
Figure:




Solution:

First we will remove current source and will make it an open circuit

Redrawing the circuit



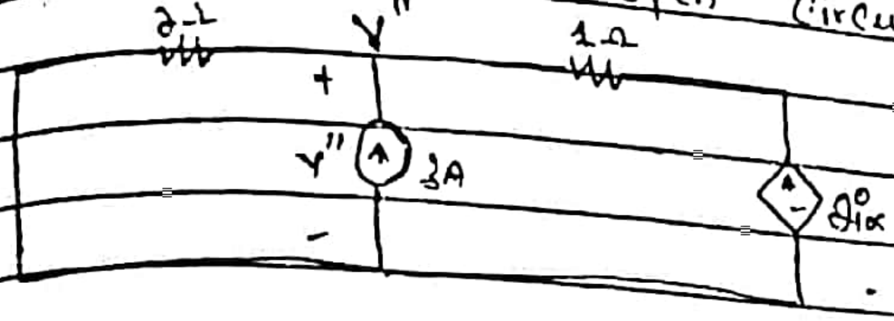

Applying KVL on mesh.

$$2i_x' + 1i_x' + 2i_x' = 10$$

$$5i_x' = 10$$

$$i_x' = 2A$$

And we will remove voltage source and make it an open circuit.




Applying KCL on v''

$$\frac{v''}{2} + \frac{v'' - 2i_x''}{1} = 3$$

$$\cancel{\frac{v'' + 2v'' - 4i_x''}{2} = 3}$$

$$3v'' - 4i_x'' = 6$$

We know from the figure

$$v'' = -2i_x''$$

$$3(-2i_x'') - 4i_x'' = 6$$

$$-10\, i_x'' = 6$$

$$i_x'' = -0.6A$$

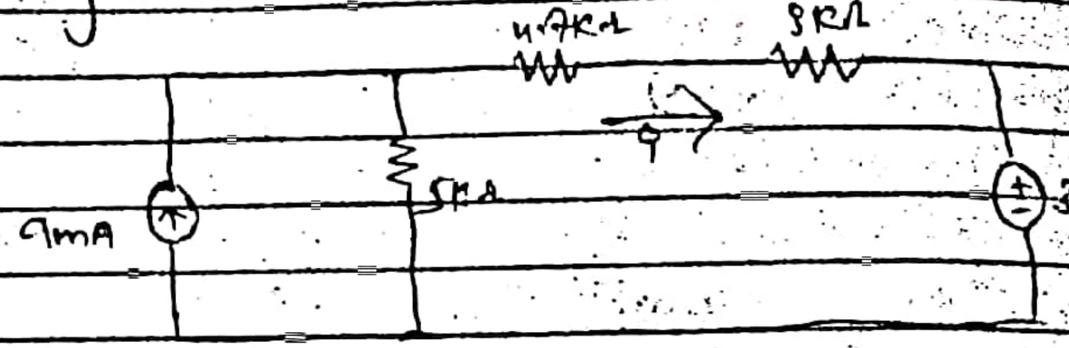
$$i_x = i_x' + i_x''$$

$$= 2 + (-0.6)$$

$$\boxed{i_x = 1.4A}$$

Solved Example 5.4

Figure m




Soln

we know that

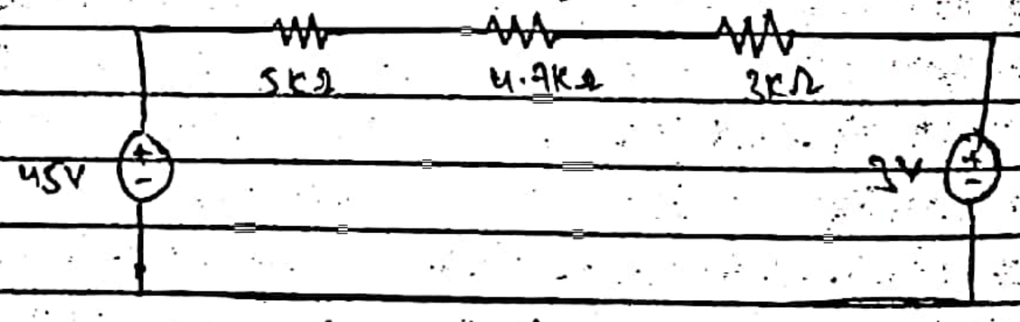
$V = IR$

$V = (9\times10^{-3})(5000)$

$= (0.009)(5000)$

$V = 45$

Re drawing the Circuit




applying KVL on Mesh

$5000i + 4700i + 3000i = 45 - 3$

$12700i = 42$

$\boxed{i = 0.0033\,A}$

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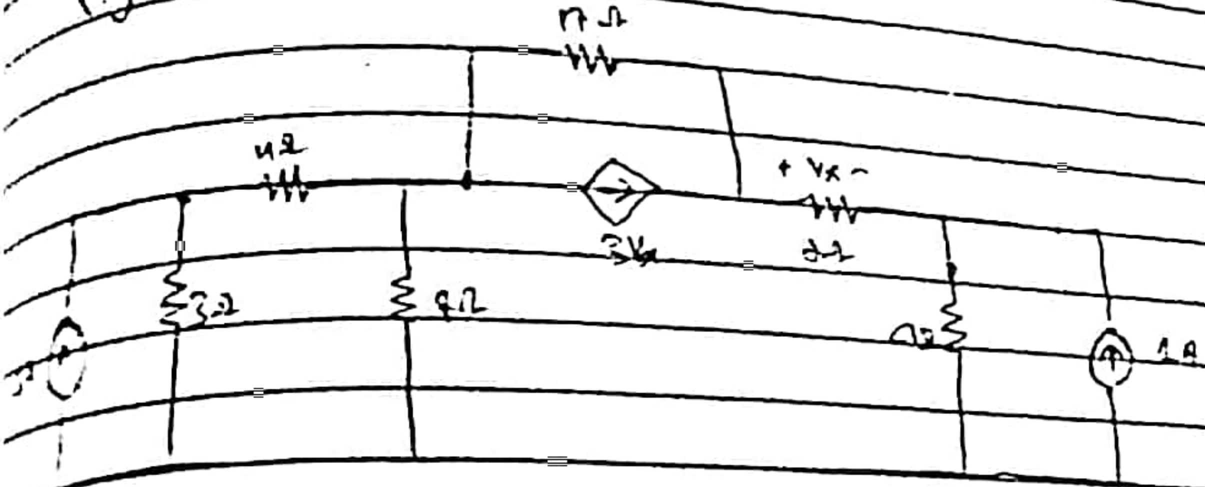
Example 5.5

Figure 5



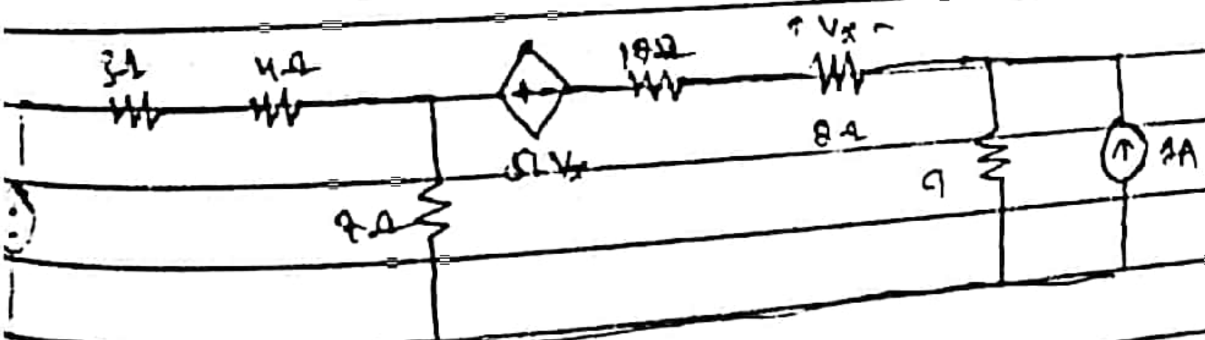
$V = IR$

$V = 5(3) = 15V$

$V_x = 3(17)$

$V_x = 51$

Re drawing a Circuit



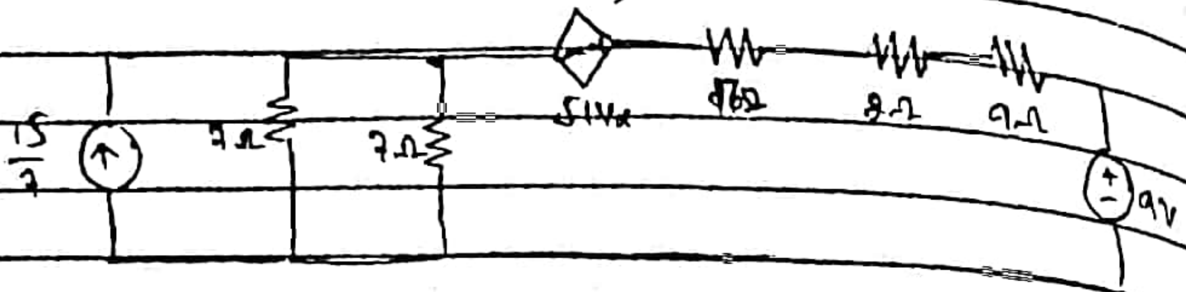
$R = 3 + 4$

$= 7\Omega$

$I = \frac{V}{R} = \frac{15}{7} = 7.5$

$V = IR = 9(7)$

# Redrawing a Circuit

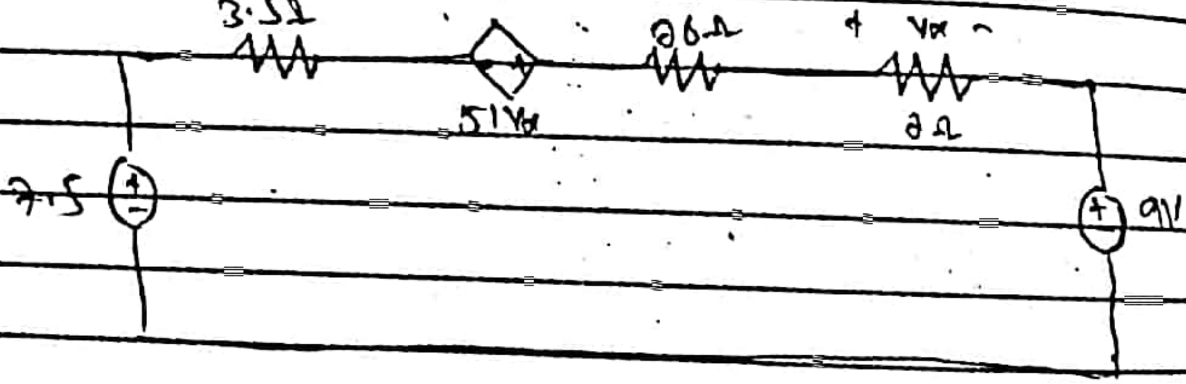



$$V = IR = \left(\frac{15}{7}\right)(7)$$

$$V = 7.5$$

$$R = 17 + 9$$

$$R = 26\,\Omega$$




Applying KVL on Mesh:

$$3.5i - 51V_x + 28i = 7.5 - 9$$

$$V_x = 2i$$

$$3.5i - 51(2i)i + 28i = -1.5$$

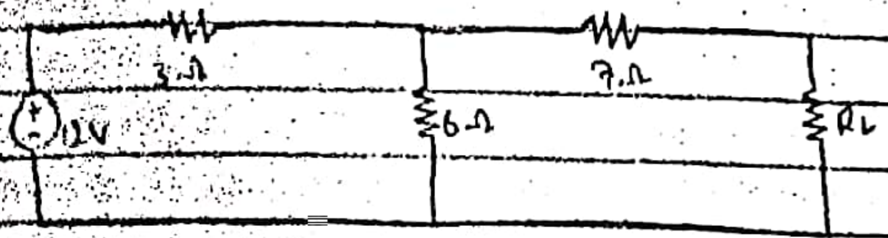
$$-1039.5i = -1.5$$

$$i = \frac{-1.5}{-1039.5}$$

$i$

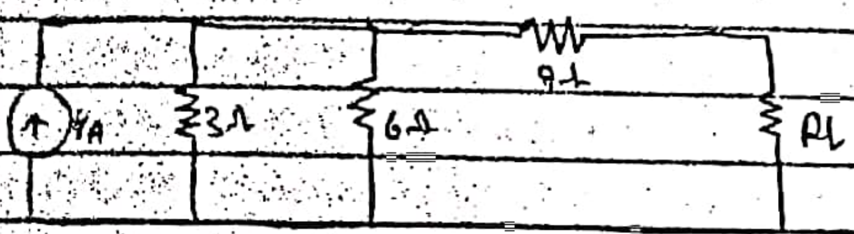
## Example 5.6

Figure a

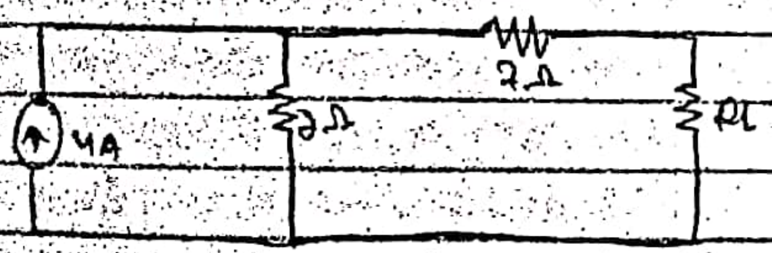



Solution

$$I = V/R = 12/3 = 4A$$

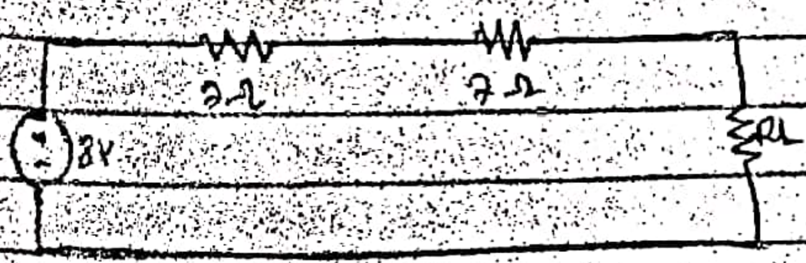



$$R_{eq} = \frac{3\times 6}{3+6} = \frac{18}{9} = 2\Omega$$

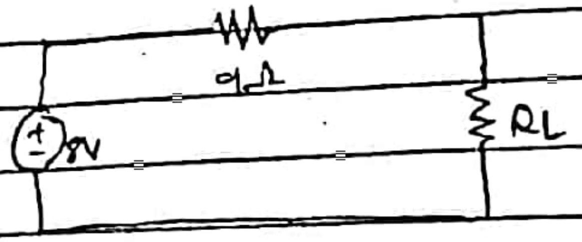



$$V = IR = (4)(2)$$

$$V = 8V$$



$R = 2 + 7 = 9$



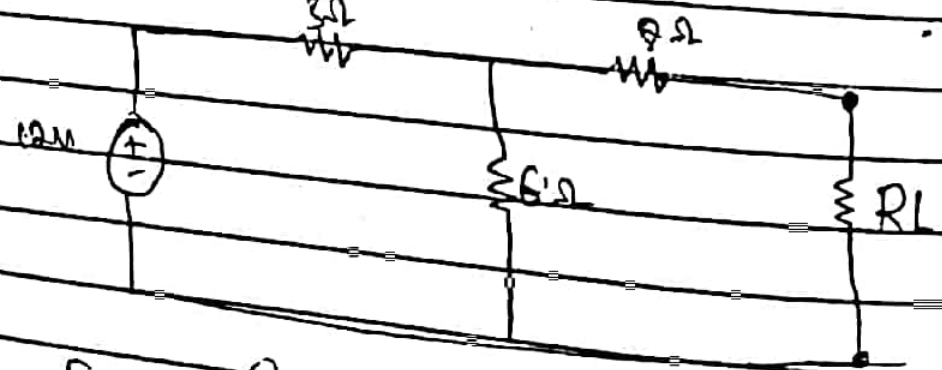

$V_{th} = 8V$

$R_{th} = 9\Omega$

$P = \left(\frac{8}{9 + R_L}\right)^2 R_L$

For any value of RL will have different solution.

Example 5.7
Figure




For finding $R_{th}$ we will remove voltage source & make it as a short circuit.

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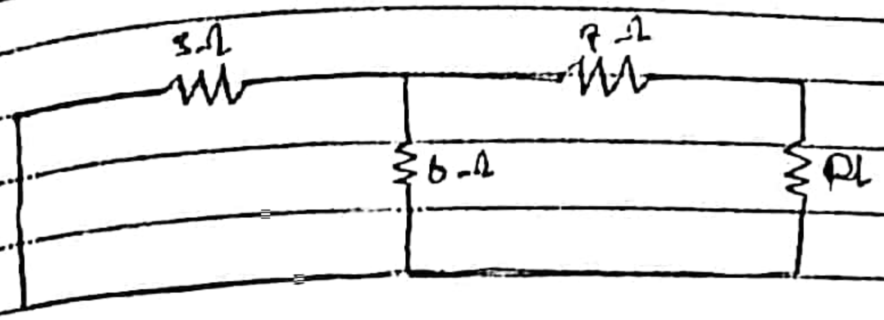


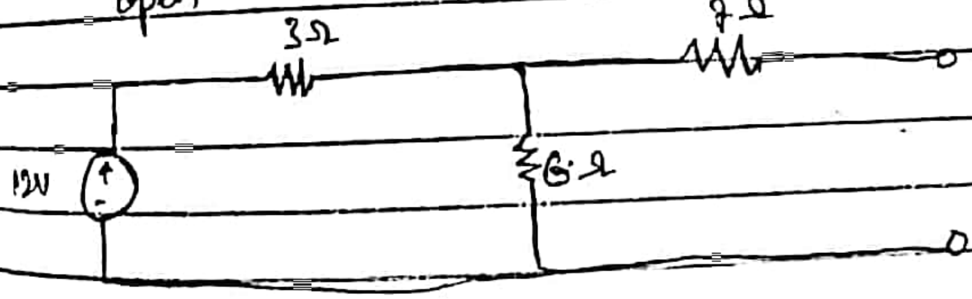

For $R_{TH}$ we will add all the resistor except RL

$$R_{TH} = 3 \| 6 + 7$$

$$= \frac{18}{9} + 7$$

$$R_{TH} = 9$$

For $V_{OC}$ we will remove RL and make it as an open Circuit




$$V_{OC} = 12 \left( \frac{6}{3+6} \right)$$

$$V_{OC} = 8V$$

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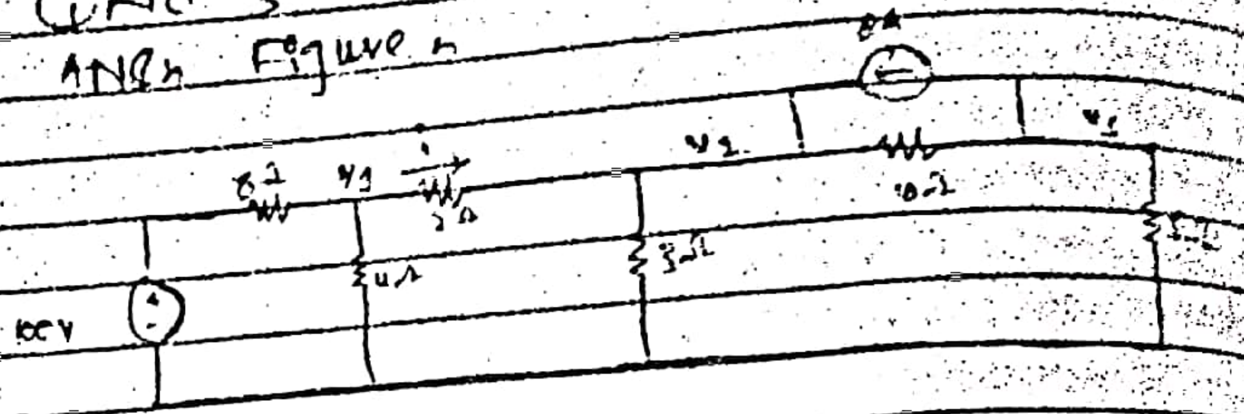
Q No 3

ANS: Figure:




Applying KCL on node 1:

$$\frac{V_1-100}{8}+\frac{V_1}{4}+\frac{V_1-V_2}{2}=0$$

$$\frac{V_1-100+2V_1+4V_1-4V_2}{8}=0$$

$$7V_1-4V_2=100 \quad (1)$$

Applying KCL on node 2:

$$\frac{V_2-V_1}{2}+\frac{V_2}{3}+\frac{V_2-V_3}{10}=8$$

$$\frac{30V_2-30V_1+20V_2+3V_2-3V_3}{60}=8$$

$$-30V_1+53V_2-3V_3=480 \quad (2)$$

Applying KCL on node 3:

$$\frac{V_3-V_2}{10}+\frac{V_3}{5}=-8$$

$$\frac{V_3-V_2+2V_3}{10}=-8$$

$$-V_2+3V_3=-80 \quad (3)$$

Taking eq (1)

$7V_1 - 4V_2 = 100$

$V_1 = \frac{4V_2 + 100}{7}$ — (a)

Taking eq (2)

$-V_2 + 3V_3 = -80$

$V_3 = \frac{V_2 - 80}{3}$ — (b)

Putting eq (a) & (b) in eq (2)

$-30(0.57V_2 + 14.28) + 53V_2 - 3(0.33V_2 - 26.67) = 480$

$-17.1V_2 - 428.4 + 53V_2 - 0.99V_2 + 80.01 = 480$

$34.91V_2 = 828.39$

$V_2 = \frac{828.39}{34.91}$

$V_2 = 20.31$

Putting in eq (a)

$V_1 = \frac{4(20.31) + 100}{7} = 25.89$

$i_x = \frac{V_1 - V_2}{2} = \frac{25.89 - 20.31}{2}$

$\boxed{i_x = 2.79A}$

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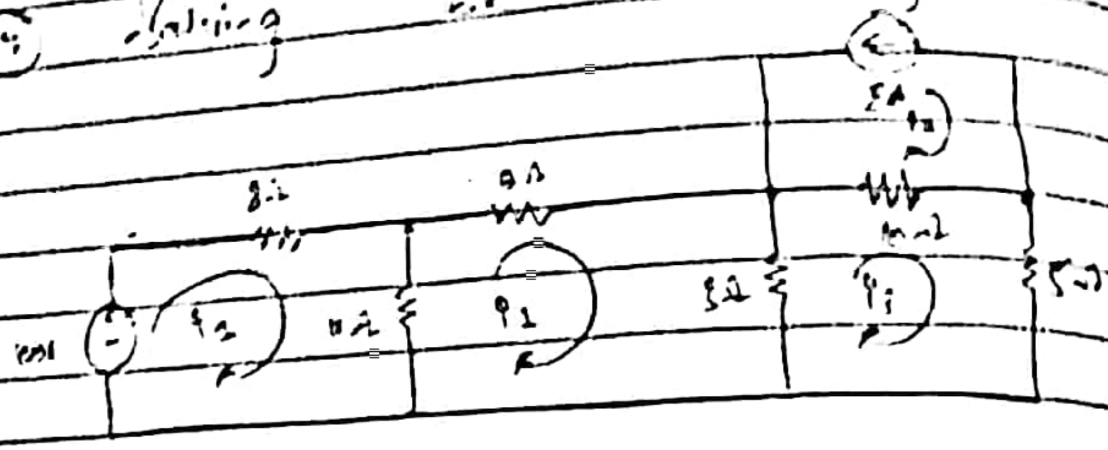
(Q) Solving by mesh analysis.




Applying KVL on loop 1

$8i_1 + 4(i_1 - i_2) = 100$

$8i_1 + 4i_1 - 4i_2 = 100$

$12i_1 - 4i_2 = 100$ —— (1)

Applying KVL on loop 2.

$3i_2 + 4(i_2 - i_1) + 3(i_3 - i_2) = 0$

$3i_2 + 4i_2 - 4i_1 + 3i_3 - 3i_2 = 0$

$-4i_1 + 9i_2 - 3i_3 = 0$ —— (2)

Applying KVL on loop 3

$3(i_3 - i_2) + 10(i_3 - i_4) + 5i_3 = 0$

$3i_3 - 3i_2 + 10i_3 - 10i_4 + 5i_3 = 0$

As $i_4 = 8$

$-3i_2 + 18i_3 = -80$ —— (3)

Date: __/__/__

Taking eq (1)

$$i_1 = \frac{17 i_2 - 100}{12} \quad \text{— (a)}$$

Taking eq (3)

$$-3i_2 + 18 i_3 = -80$$

$$i_3 = \frac{-3i_2 + 80}{18} \quad \text{— (b)}$$

putting eq a & b in eq (2)

$$-4(0.33i_2 - 8.33) + 9i_2 - 3(0.16 i_2 + 4.44) = 0$$

$$\Rightarrow -1.32 i_2 + 33.32 + 9i_2 - 0.48 i_2 - 13.32 = 0$$

$$7.2 i_2 = +20 = 20/7.2$$

$$i_2 = 2.77A$$

$$i_2 = i_\alpha$$

$$\boxed{i_\alpha = 2.77A}$$

Applying KCL on node (3)

$$\frac{V_3 - V_2}{10} + \frac{V_3}{5} = 0$$

$$\frac{V_3 - V_2 + 2V_3}{10} = 0$$

$$-V_2 + 2V_3 = 0 \quad \text{--- (8)}$$

Now Taking eq (1) & (8)

$$7V_1 - 4V_2 = +100$$

$$V_1 = \frac{4V_2 + 100}{7} \quad \text{--- (9)}$$

Now

$$-V_2 + 3V_3 = 0$$

$$V_3 = \frac{1}{3} V_2 \quad \text{--- (6)}$$

Putting in eq (2)

$$\cancel{-30(0.57V_2 + 14.28) - 4V_2 + 2(0.33V_2) = 0}$$

$$-17.1V_2 - 428.4 - 4V_2 + 0.66V_2 = 0$$

$$20.44V_2 = 428.4$$

$$V_2 = -20.95$$

Putting in eq (9)

$$V_1 = 2.31$$

$$i_1 = \frac{2.31 + 20.95}{2} \Rightarrow \boxed{i_1 = 11.63}$$

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Applying KCL on node 3.

$$\frac{V_3 - V_2}{10} + \frac{V_3}{5} = 0$$

$$\frac{V_3 - V_2 + 2V_3}{10} = 0$$

$$-V_2 + 3V_3 = 0 \quad \text{--- (3)}$$

Now Taking eq (1) & (3).

$$7V_1 - 4V_2 = +100$$

$$V_1 = \frac{4V_2 + 100}{7} \quad \text{--- (4)}$$

Now

$$-V_2 + 3V_3 = 0$$

$$V_3 = \frac{1}{3}V_2 \quad \text{--- (5)}$$

Putting in eq (2)

$$-30(0.57V_2 + 14.28) - 4V_2 + 2(0.33V_2) = 0$$

$$-17.1V_2 - 428.4 - 4V_2 + 0.66V_2 = 0$$

$$\cancel{20} \; 20.44V_2 = 428.4$$

$$V_2 = -20.95$$

Putting in eq (4)

$$V_1 = 2.31$$

$$i_1 = \frac{2.31 + 20.95}{2} \Rightarrow \boxed{i_1 = 11.63}$$

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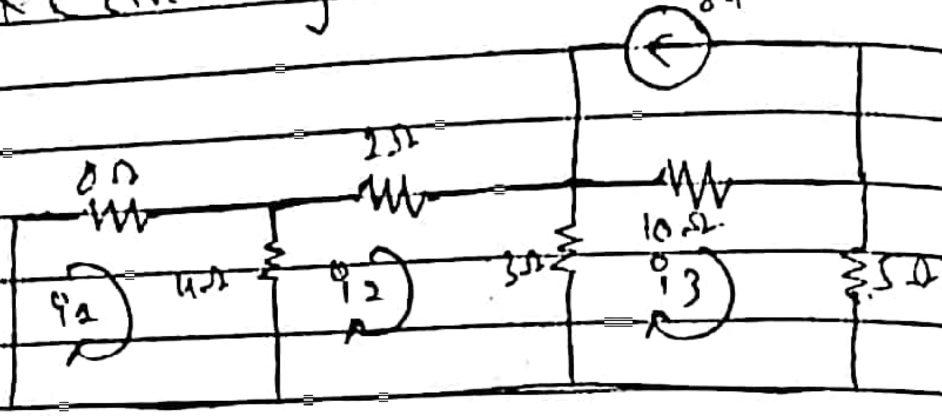
Now Removing voltage source and making it short circuit.
Re drawing circuit.




$i_4 = 8A$

Applying KVL on loop 1

$$8i_1 + 4(i_1 - i_2) = 0$$

$$8i_1 + 4i_1 - 4i_2 = 0$$

$$12i_1 - 4i_2 = 0$$

$$3i_1 - i_2 = 0 \quad \text{—— (1)}$$

Applying KVL on loop 2.

$$2i_2 + 3(i_2 - i_3) + 4(i_2 - i_1) = 0$$

$$2i_2 + 3i_2 - 3i_3 + 4i_2 - 4i_1 = 0$$

$$-4i_1 + 9i_2 - 3i_3 = 0 \quad \text{—— (2)}$$

Applying KVL on loop 3

$$10i_3 + 5i_3 + 3i_3 - 3i_2 + 8(10) = 0$$

$$-3i_2 + 18i_3 = -80$$

Date: __/__/__

Taking eq (1)

$3i_1 - i_2 = 0$

$i_1 = 0.33\, i_2$ —— (a)

Taking eq (3)

$-3i_2 + 18i_3 = -80$

$i_3 = \dfrac{3i_2 - 80}{18}$ —— (b)

$-4(0.33i_2) + 9i_2 - 3(0.16i_2 - 4.44) = 0$

$1.32i_2 + 9i_2 - 0.48i_2 + 13.32 = 0$

$i_2 = 1.354$

Now $i = i_1 + i_2$

$i = 1.44 + 1.35$

$i = 2.79\,A$

Result

$\boxed{i = 2.79A}$

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QNO 1: Evalute determinant

ANS (i) Given

$$\begin{vmatrix} 2 & 1 \\ -4 & 3 \end{vmatrix}$$

Solution

$$\begin{vmatrix} 2 & 1 \\ -4 & 3 \end{vmatrix}$$

$= 6-(-4)$

$= 6+4$

$= 10$

(ii) Given :-

$$\begin{vmatrix} 0 & 2 & 11 \\ 6 & 4 & 1 \\ 3 & -1 & 5 \end{vmatrix}$$

Solution

$$0\begin{vmatrix} 4 & 1 \\ -1 & 5 \end{vmatrix} - 2\begin{vmatrix} 6 & 1 \\ 3 & 5 \end{vmatrix} + 11\begin{vmatrix} 6 & 4 \\ 3 & -1 \end{vmatrix}$$

$= 0-2(30-3)+11(-6-12)$

$= -2(27)+11(-18)$

$= -54-198$

$= -252$

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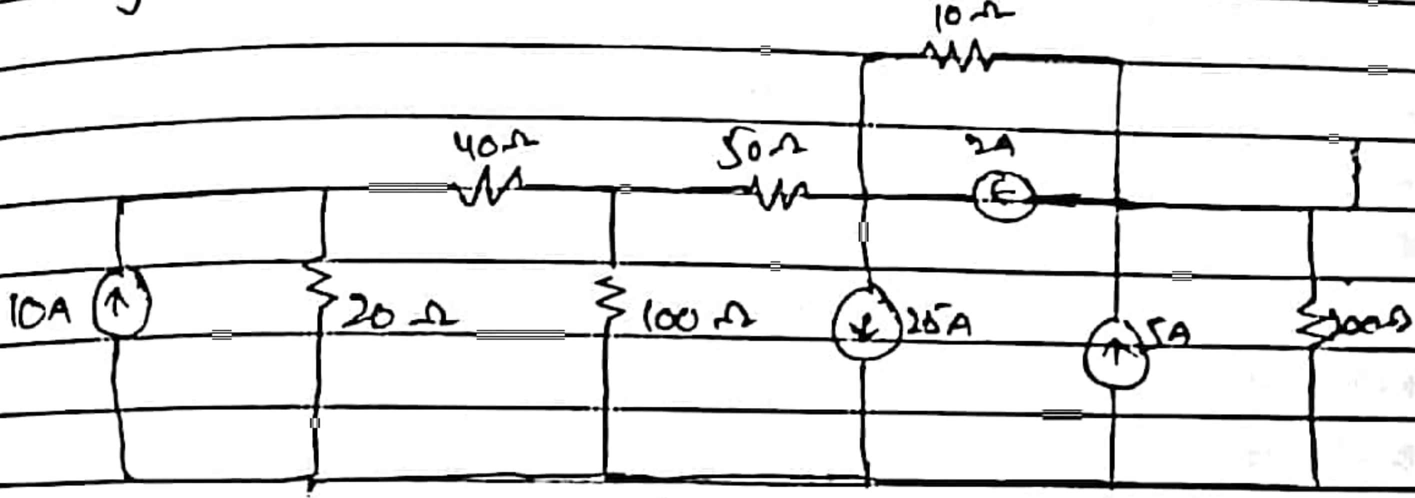
Q No 2
Ans:

figure:




Solution:

All nodes in the above circuit is verified now applying or solving through nodel analyses.

(1) Applying KCL on node 1:

$$\frac{V_1}{20} + \frac{V_1 - V_2}{40} = 10$$

$$\frac{2V_1 + V_1 - V_2}{40} = 10$$

$$3V_1 - V_2 = 400 \quad \text{— (1)}$$