EEE
Digital Assignment

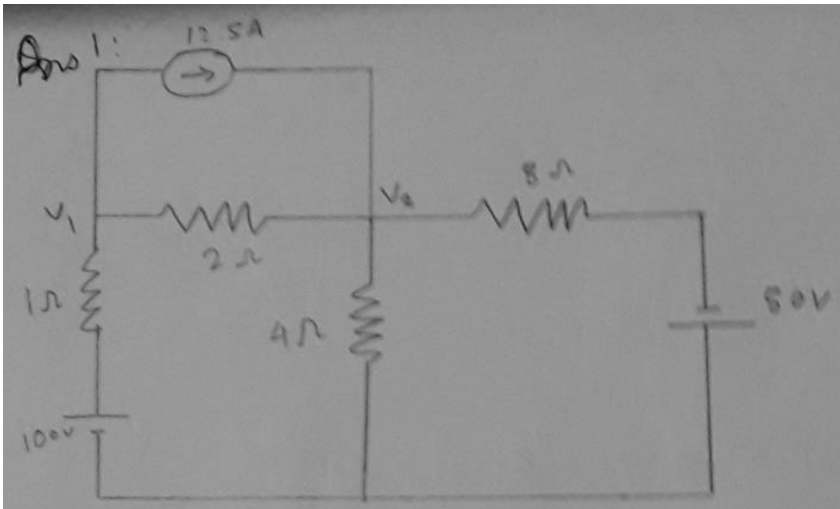
Name: Om Ashish Mishra

Registration No. : 16BCE0789

Slot: F2

Subject Code: EEE1001

Ans 1:



applying nodal analysis.

For V_1:

$$\frac{V_1 - 100}{1} + \frac{V_1 - V_2}{2} + 12.5 = 0 \quad \rightarrow (1)$$

For V_2:

$$\frac{V_2 - V_1}{2} + \frac{V_2}{4} + \frac{V_2 - 50}{8} - 12.5 = 0 \quad \rightarrow (2)$$

$\therefore$ Equation (1)

$$2V_1 - 200 + V_1 - V_2 + 25 = 0$$

$$\Rightarrow 3V_1 - V_2 = 175$$

$$\Rightarrow V_2 = -175 + 3V_1 \rightarrow (3)$$

$\therefore$ Equation (2)

$$4V_2 - 4V_1 + 2V_2 + V_2 + 50 = 100$$

$$\Rightarrow 7V_2 - 4V_1 = 50$$

$\Rightarrow 7(-175 + 3V_1) - 4V_1 = 50$ (Putting (3) in the equation)

$$\Rightarrow -1225 + 21V_1 - 4V_1 = 50$$

$$\Rightarrow 1275 = 17V_1 \Rightarrow V_1 = 75V$$

Putting the value of V_1 in equation (3) we get :-

$$V_2 = 3 \times 75 - 175$$
$$= 225 - 175$$
$$= 50V$$

Thus the nodal analysis gives us voltage $V_1 = 75V$ and $V_2 = 50V$

Ans 2:

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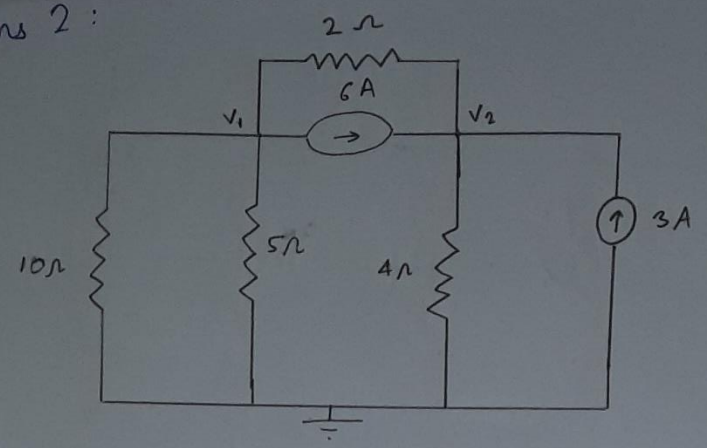


Applying the nodal analysis:

For V_1

$$\frac{V_1 - 0}{10} + \frac{V_1 - 0}{5} + \frac{V_1 - V_2}{2} + 6 = 0$$

$$V_1 + 2V_1 + 5V_1 - 5V_2 + 60 = 0$$

$$8V_1 - 5V_2 + 60 = 0 \rightarrow (1)$$

For V_2

$$\frac{V_2 - V_1}{2} - 6 + \frac{V_2 - 0}{4} - 3 = 0$$

$$3V_2 - 2V_1 - 36 = 0$$

$$3V_2 = 2V_1 + 36$$

$$V_2 = \frac{2V_1 + 36}{3} \rightarrow (2)$$

Putting (2) in (1):-

$$8V_1 - 5\left(\frac{2V_1 + 36}{3}\right) + 60 = 0$$

$$24V_1 - 10V_1 - 180 + 180 = 0$$

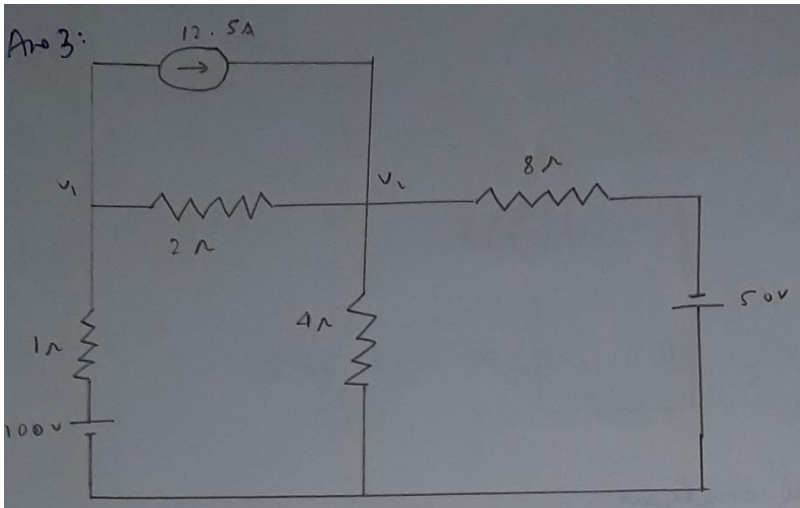
$$V_1 = 0$$

Putting the value of V_1 in (2)

$$V_2 = \left(\frac{2 \times 0 + 36}{3}\right) = 12$$

Thus the nodal analysis gives us voltage $V_1 = 0V$ and $V_2 = 12V$.

Ans 3:



Applying nodal analysis:

For V_1:

$$\frac{V_1 - 100}{1} + \frac{V_1 - V_2}{2} + 12.5 = 0 \rightarrow (1)$$

For V_2:

$$\frac{V_2 - V_1}{2} + \frac{V_2}{4} + \frac{V_2 - 50}{8} - 12.5 = 0 \rightarrow (2)$$

Equation (1)

$2V_1 - 200 + V_1 - V_2 + 25 = 0$

$3V_1 - V_2 = 175$

$V_2 = -175 + 3V_1 \rightarrow (3)$

Putting the value V_1 in (2)

$V_2 = -175 + 3 \times 75$

$= -175 + 225$

$= 50V$

Equation (2)

$4V_2 - 4V_1 + 2V_2 + V_2 + 50 = 100$

$7V_2 - 4V_1 = 50$

$7(-175 + 3V_1) - 4V_1 = 50$

$-1225 + 21V_1 - 4V_1 = 50$

$1275 = 17V_1$

$V_1 = 75V$

Thus the nodal analysis gives us voltage $V_1 = 75V$ and $V_2 = 50V$

$\therefore$ Current across $4\Omega = \frac{V_2}{4} = \frac{50}{4} = 12.5A$

$V_0 = V_2 = 50V$

Ans 4:

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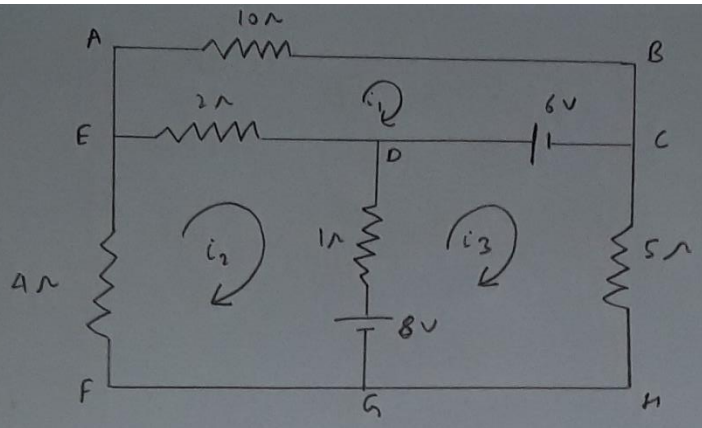


Applying mess analysis:

In loop EABCDE :

$6 - 2(i_1 - i_2) - 10 i_1 = 0$

$\Rightarrow 12 i_1 - 2 i_2 = 6$

$\Rightarrow 6 i_1 - i_2 = 3 \rightarrow (1)$

In loop EDGFE :

$-8 - 4 i_2 - 2(i_2 - i_1) - 1(i_2 - i_3) = 0$

$\Rightarrow -8 - 4 i_2 - 2 i_2 + 2 i_1 + i_3 - i_2 = 0$

$\Rightarrow 2 i_1 - 7 i_2 + i_3 = 8 \rightarrow (2)$

In loop DCHGD :

$-6 - 5 i_3 + 8 + (i_2 - i_3) = 0$

$i_2 - 6 i_3 = -2 \rightarrow (3)$

∴ Equation one, two, three are :-

$6 i_1 - i_2 + 0 i_3 = 3$

$2 i_1 - 7 i_2 + i_3 = 8$

$0 i_1 + i_2 - 6 i_3 = -2$

Solving the above equations we get :-

$i_1 = 0.329A \quad i_2 = -1.02A \quad i_3 = 0.16A$

~~$\therefore i = -(i_2 - i_3) = -(1.02 - (0.16))$~~

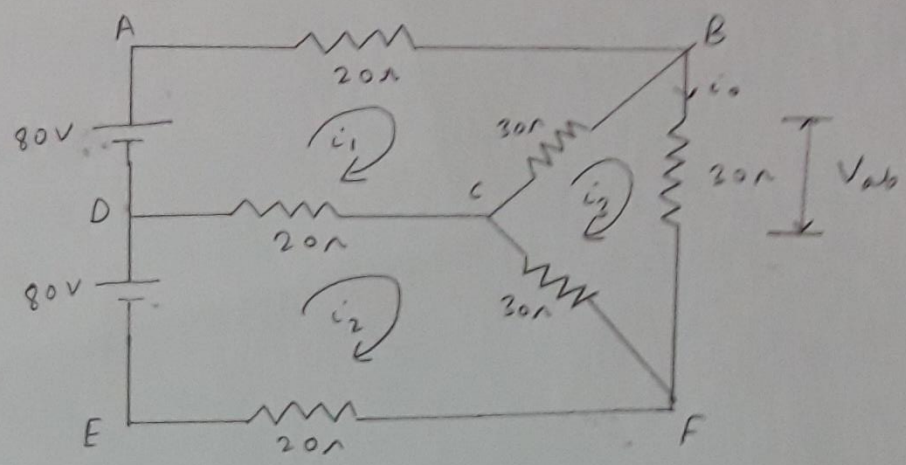
$\therefore i = -(i_2 - i_3) = -(-1.02 - (0.16))\ A$

$= 1.10A$

Ans: i is 1.1A

Ans 5:

Ans 5:



Applying Mess Analysis:

In loop ABCDA:

$$20 i_1 + 30(i_1 - i_3) + 20(i_1 - i_2) = 80$$

$$70 i_1 - 20 i_2 - 30 i_3 = 80 \rightarrow (1)$$

In loop DCFED:

$$30(i_2 - i_3) + 20 i_2 + 20(i_2 - i_1) = 80$$

$$-20 i_1 + 70 i_2 - 30 i_3 = 80 \rightarrow (2)$$

In loop BCFB:

$$30(i_3 - i_1) + 30 i_3 + 30(i_3 - i_2) = 0$$

$$-30 i_1 - 30 i_2 + 90 i_3 = 0 \rightarrow (3)$$

Solving equations (1), (2), (3) we get:-

$$i_1 = 2.666 \approx 2.67 \text{ A}$$

$$i_2 = 2.666 \approx 2.67 \text{ A}$$

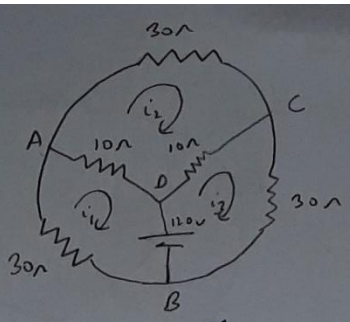
$$i_3 = 1.777 \simeq 1.78 \text{ A}$$

$$\therefore i_3 = i_o = 1.78$$

$$\therefore V_{ab} = i_o \times R = 1.78 \times 30 = 53.4 \text{ V}$$

Ans 6:

Ans 6:



Applying Mess analysis:

In loop ADBA:

$-120 - 30i_1 - 10(i_1 - i_2) = 0$

$\Rightarrow -40i_1 + 10i_2 = 120$

$\Rightarrow -4i_1 + i_2 = 12 \rightarrow (1)$

In loop ADCA:

$30i_2 + 10(i_2 - i_3) + 10(i_2 - i_1) = 0$

$\Rightarrow 50i_2 = 10i_1 + 10i_3$

$\Rightarrow i_1 - 5i_2 + i_3 = 0 \rightarrow (2)$

In loop DCBD:

$120 - 10(i_3 - i_2) - 30i_3 = 0$

$120 = 40i_3 - 10i_2$

$-i_2 + 4i_3 = 12 \rightarrow (3)$

$\therefore$ The equations (1), (2), (3):

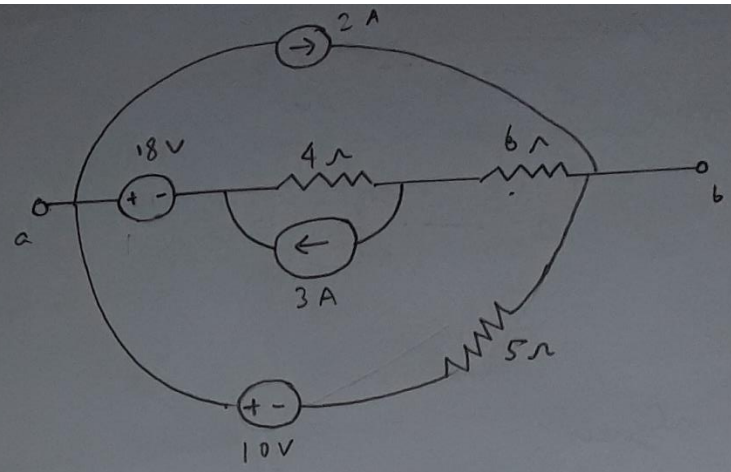
$$-4i_1 + i_2 + 0i_3 = 12$$
$$i_1 - 5i_2 + i_3 = 0$$
$$0i_1 - i_2 + 4i_3 = 12$$

Solving the above equations we get:

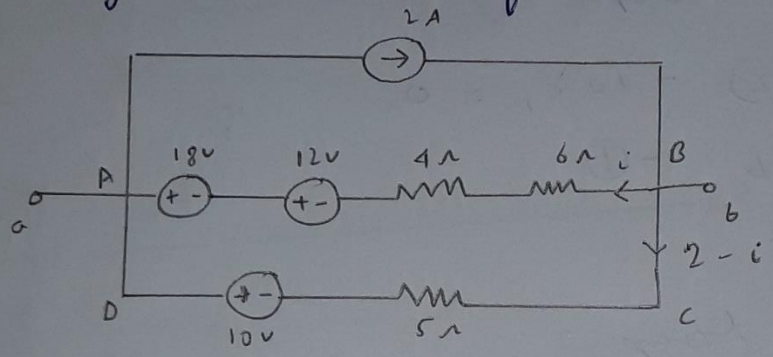
$i_1 = -3A \quad i_2 = 0A \quad i_3 = 3A$

Ans 7:

Ans 7:



By using source transformation :



Using KVL in Loop ABCDA :

$$12 + 18 - 10 + 5(2 - i) - 10i = 0$$

$$\Rightarrow -10i + 30 - 10 + 10 - 5i = 0$$

$$\Rightarrow -15i = -30$$

$$\Rightarrow i = 2A$$

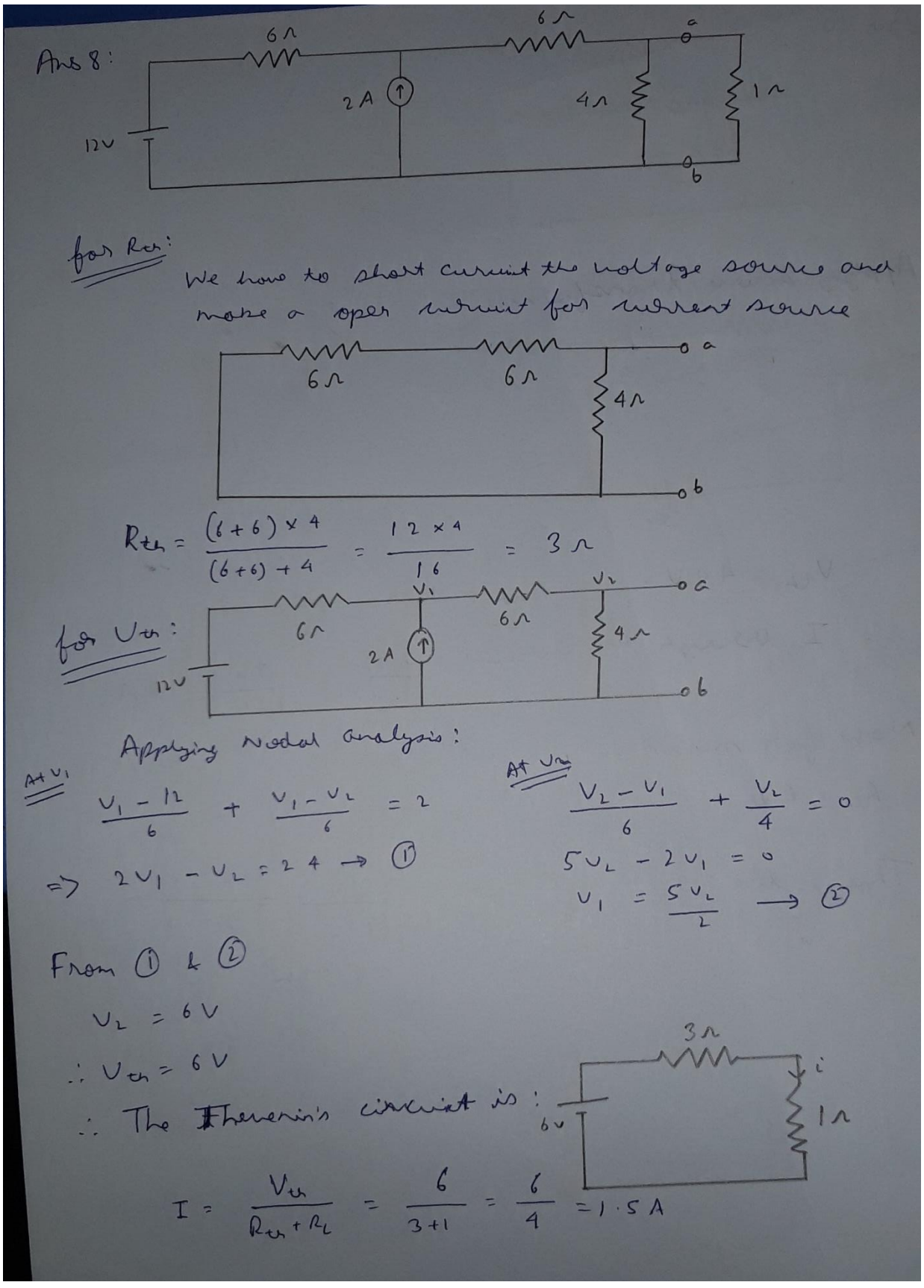
$$V_{ab} = V_{Th} = -4i - 6i + 12 + 18$$

$$= -10i + 30$$

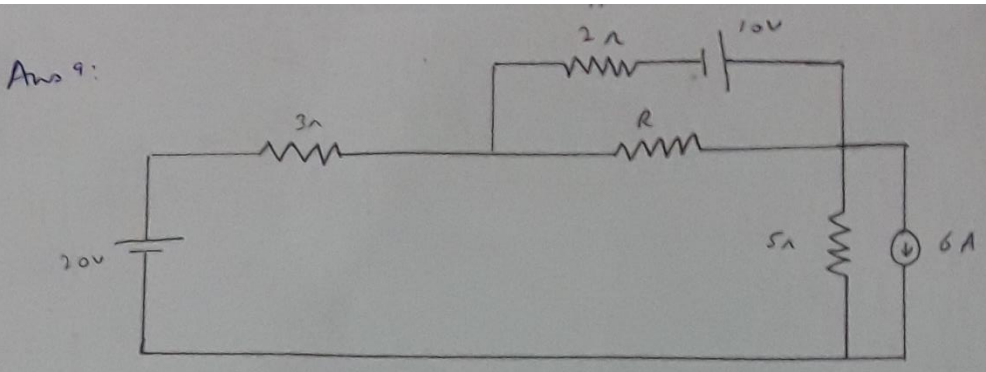
$$= 30 - 10(2)$$

$$= 10V$$

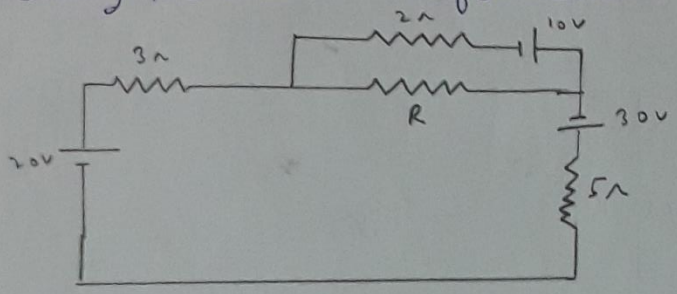
Ans 8:

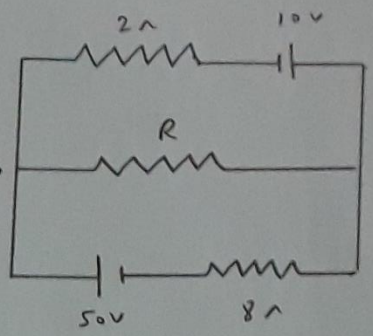

Ans 8:
6Ω
6Ω
a
2A
4Ω
1Ω
12V
b
for Rth:
We have to short circuit the voltage source and make a open circuit for current source
6Ω
6Ω
a
4Ω
b
$R_{th} = \frac{(6+6)\times 4}{(6+6)+4} = \frac{12\times 4}{16} = 3\Omega$
for Vth:
V_1
V_2
a
6Ω
6Ω
4Ω
2A
12V
b
Applying Nodal analysis:
At V_1
$\frac{V_1 - 12}{6} + \frac{V_1 - V_2}{6} = 2$
$\Rightarrow 2V_1 - V_2 = 24 \rightarrow (1)$
At V_2
$\frac{V_2 - V_1}{6} + \frac{V_2}{4} = 0$
$5V_2 - 2V_1 = 0$
$V_1 = \frac{5V_2}{2} \rightarrow (2)$
From (1) & (2)
$V_2 = 6V$
$\therefore V_{th} = 6V$
$\therefore$ The Thevenin's circuit is:
3Ω
i
6V
1Ω
$I = \frac{V_{th}}{R_{th} + R_L} = \frac{6}{3+1} = \frac{6}{4} = 1.5A$

Ans 9:

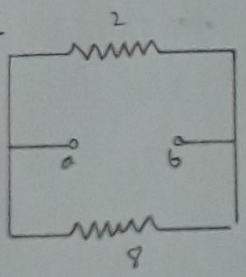


Using source transformation:





For R_{th}



$$R_{th} = \frac{2 \times 8}{8+2} = \frac{16}{10} = 1.6\ \Omega$$

For V_{th}

We can see the current coming out of a is back to b in two path (one of 2 Ω resistance and other of 8 Ω resistance).

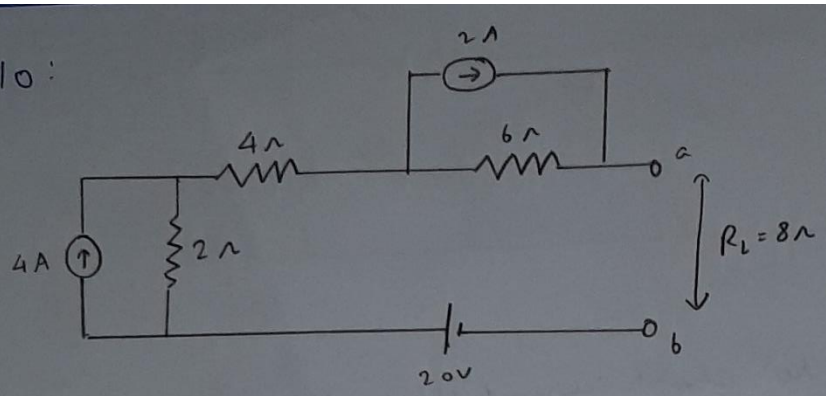
$$\therefore \frac{E_{net}}{1.6} = \frac{10}{2} + \frac{50}{8} = 5 + 6.25 = 11.25$$

$$E_{net} = 11.25 \times 1.6 = 18\ V$$

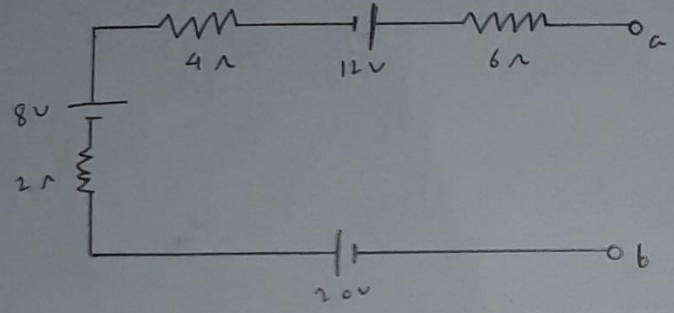
Max power delivered to $R = \frac{(18)^2}{4 \times 1.6} = 50.625\ W$

Ans 10:

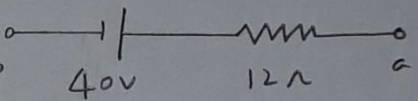
Ans 10:



Applying source transformation:



$\equiv>$



$\therefore V_{th} = 40\,V \qquad R_{th} = 12\Omega \qquad R_L = 8\Omega$

$\therefore$ I through the circuit $= \frac{40}{R_L + R_{th}} = \frac{40}{8+12} = 2\,A$

Now for maximum power

$R_L = R_{th} \qquad \therefore R_L = 12\Omega$

Thus, the maximum power $= \frac{V_{R_L}^2}{4R_L} = \frac{40 \times 40}{4 \times 12}$

$= 33.33\,W$