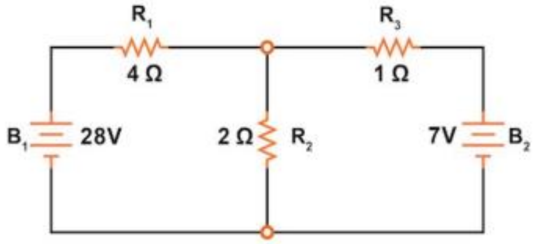
1. Calculate the current passes through the 2Ω resister in the given network using the superposition theorem.



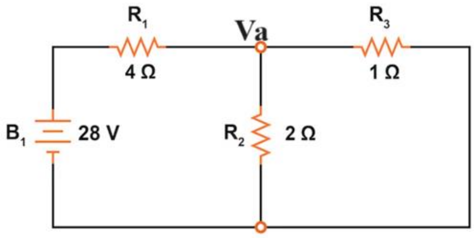
OR

State and Prove Superposition theorem?

In any linear circuit containing multiple independent sources, the current through (or voltage across) an element in this circuit is the algebraic sum of the currents through (or voltages across) that element due to each independent source acting alone.

Ans:

With first voltage source:



Using Nodal analysis:

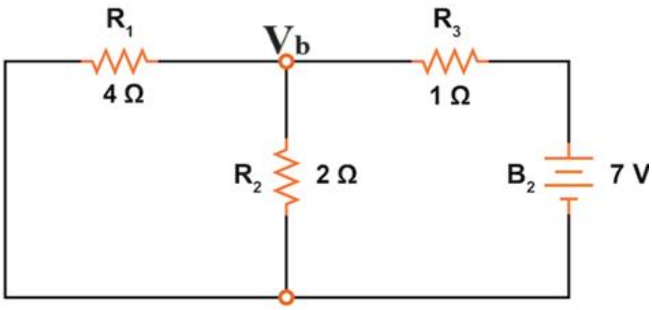
$$\frac{(v_a-28)}{4}+\frac{(v_a-0)}{2}+\frac{(v_a-0)}{1}=0$$

solving the above equation

We will get V_a= 4V

I1= V/R= 4/2=2A

With second voltage source:



Using Nodal analysis:

$$\frac{(v_b-0)}{4}+\frac{(v_b-0)}{2}+\frac{(v_b-7)}{1}=0$$

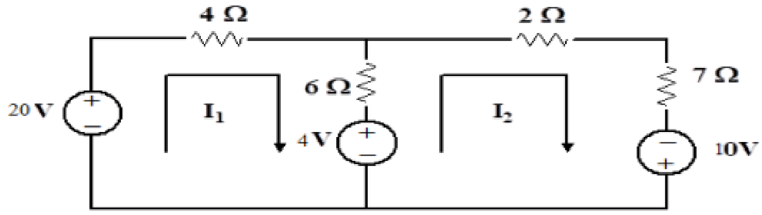
solving the above equation

We will get Vb= 4V

I2= V/R= 4/2=2A

Total current when two sources acting = 2A+2A=4A

2. Write the mesh equations and solve for the currents I_1, and I_2



Mesh1 KVL Equation:

$20-4I_1-6(I_1-I_2)-4=0$

Mesh2 KVL Equation:

$4-6(I_2-I_1)-2I_2-7I_2+10=0$

Solve the above equations...

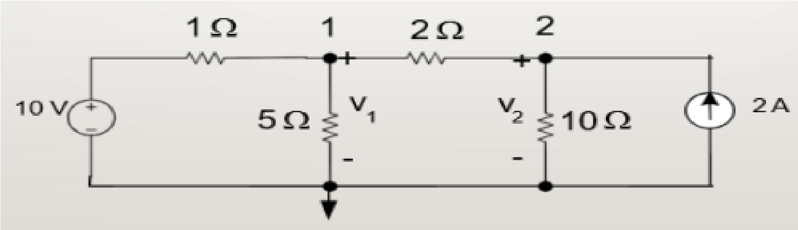
$10I_1-6I_2=16$

$6I_1-15I_2=-14$

I1= 54/19=2.8A

I2 = 118/57=2.07A

3. Determine the voltage V1 and V2 using node analysis.



Node voltage equation at node 1

$$\frac{(v_1-10)}{1}+\frac{(v_1-0)}{5}+\frac{(v_1-v_2)}{2}=0$$

Node voltage equation at node 2

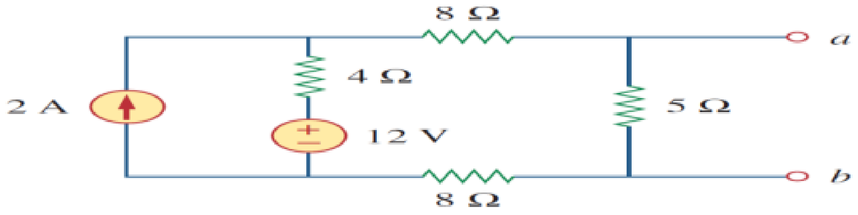
$$\frac{(v_2-v_1)}{2}+\frac{(v_2-0)}{10}-2=0$$

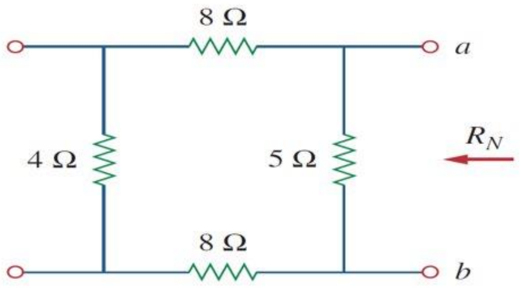
Solving above equations

We will get

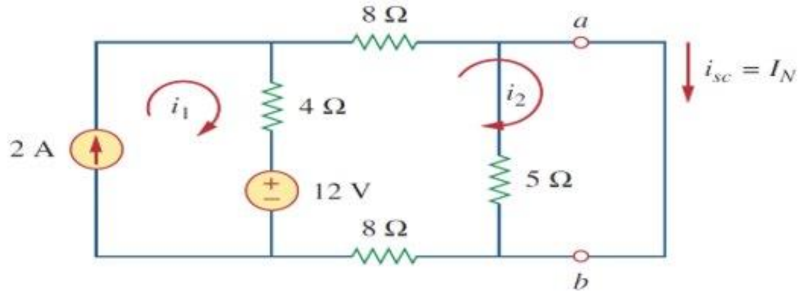
v_1 = 9.09V v_2 = 10.91 V

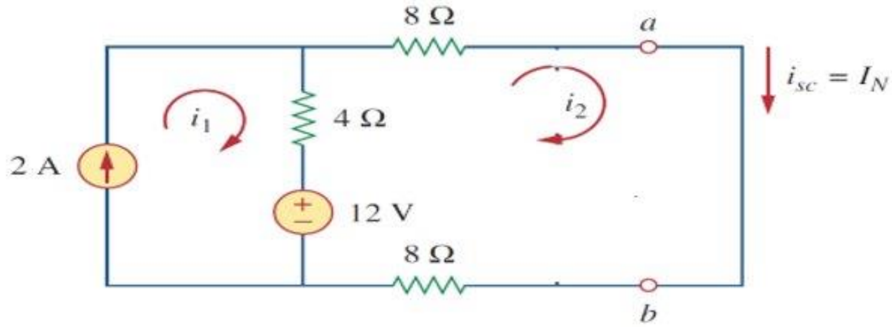
4. Find the Norton's equivalent for the circuit shown below





$$R_N = 5 \,\|\, (8 + 4 + 8) = 5 \,\|\, 20 = \frac{20 \times 5}{25} = 4\ \Omega$$





Applying Mesh analysis

$$i_1 = 2\ \text{A}$$

$$20i_2 - 4i_1 - 12 = 0$$

$$i_2 = 1\ \text{A} = i_{sc} = I_N$$

NORTON'S EQUIVALENT CIRCUIT

6. If four Inductors aare connected in case i) parallel each of 60 Henry each ii) in series with L1=L2=10H, L3=L4=20H, then calculate the total equivalence inductance in both cases?

Inductors are in parallel:

$$\frac{1}{L_{total}}=\frac{1}{L_1}+\frac{1}{L_2}+\frac{1}{L_3}+\frac{1}{L_4}$$

$$\frac{1}{L_{total}}=\frac{1}{60}+\frac{1}{60}+\frac{1}{60}+\frac{1}{60}$$

$$\frac{1}{L_{total}}=\frac{4}{60}$$

$$L_{total}=\frac{60}{4}=15H$$

Inductors are in series:

$$L_{total}=L_1+L_2+L_3+L_4$$
$$L_{total}=10+10+20+20$$
$$L_{total}=60H$$

7. Calculate

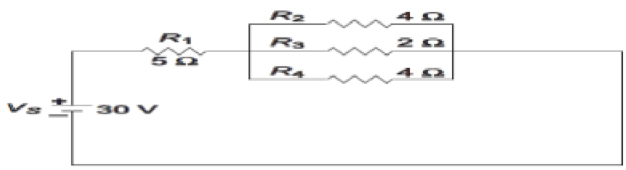


Fig. 1.34

Total Resistance in the circuit is R= 5+(4||2||4)= 6Ω

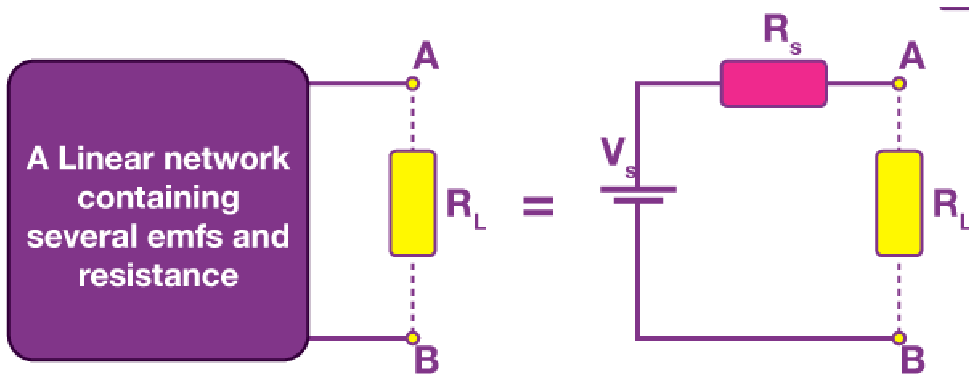
OHMS law: V=I R

V=30V
R=6Ω

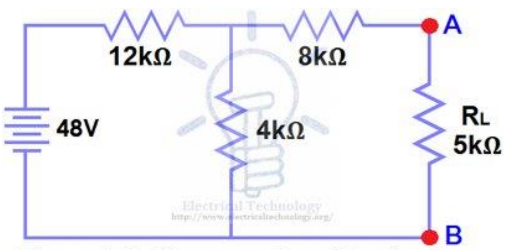
I =V/R= 30/6= 5 Amp

8. State and explain Thevenin's Theorem Explanation

Thevenin's theorem states that it is possible to simplify any linear circuit, irrespective of how complex it is, to an equivalent circuit with a single voltage source and a series resistance.

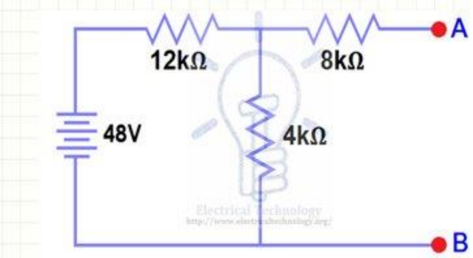


Find V_{TH}, R_{TH} and the load current flowing through and load voltage across the load resistor in figure by using Thevenin's Theorem.

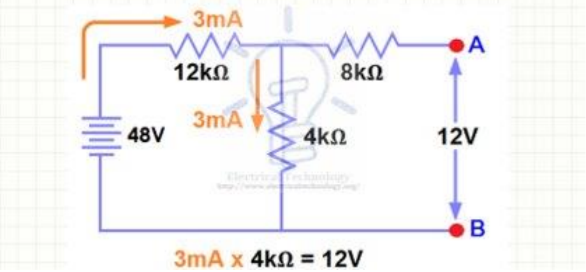


Thevenin's Theorem. Easy Step by Step Procedure with Example (Pictorial Views)

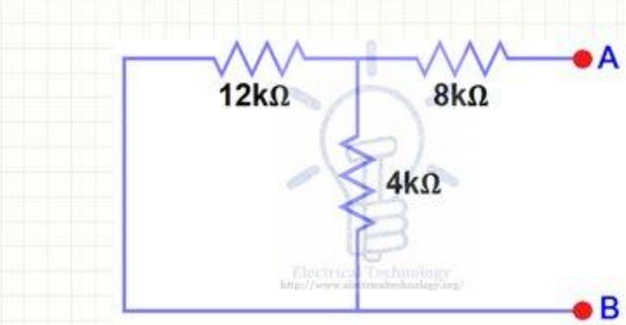
Step 1. Open the 5kΩ load resistor



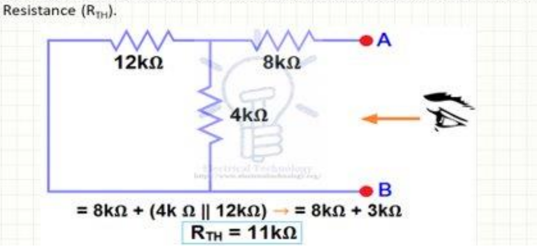
Step 2. Calculate / measure the Open Circuit Voltage. This is the Thevenin Voltage (V_{TH}).



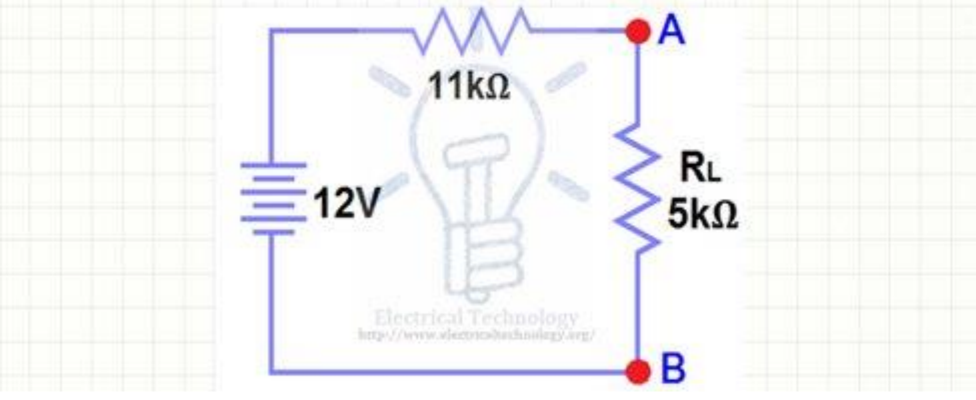
Step 3. Open Current Sources and Short Voltage Sources.



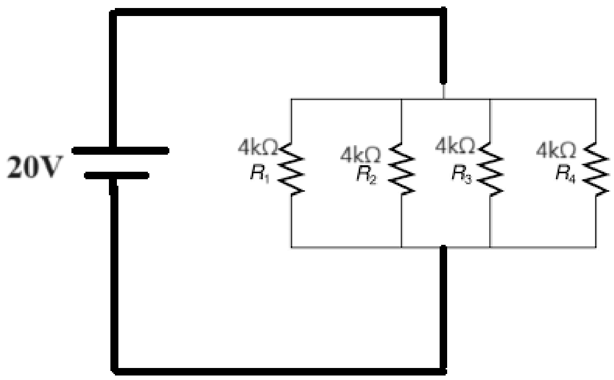
Step 4. Calculate /measure the Open Circuit Resistance. This is the Thevenin Resistance (R_{TH}).



Step 5. Connect the RTHin series with Voltage Source VTH and re-connect the load resistor. This is shown in fig (6) i.e. Thevenin circuit with load resistor. This is the Thevenin's equivalent circuit.



11. If Four resistors R1=R2=R3=R4=4kΩ, is connected in parallel with a power supply of 20V , then calculate total circuit current and individual currents flowing in each resistor



R= 4||4||4||4= 1kΩ

I = V/R = 20/ 1K = 20mA

I1= V/R1= 20/4K= 5mA

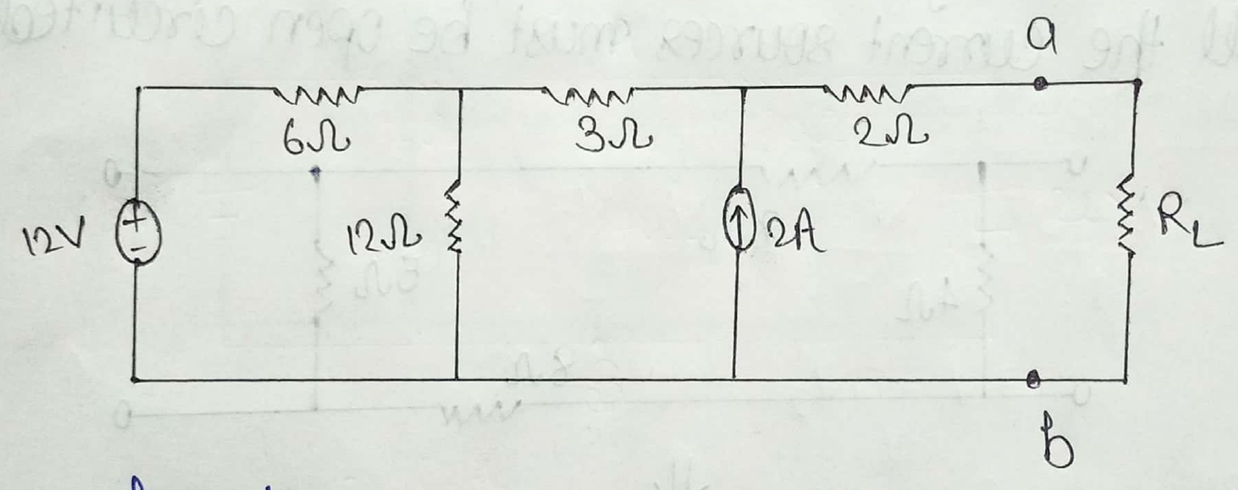
I2= V/R2= 20/4K= 5mA

I3= V/R3 = 20/4K= 5mA

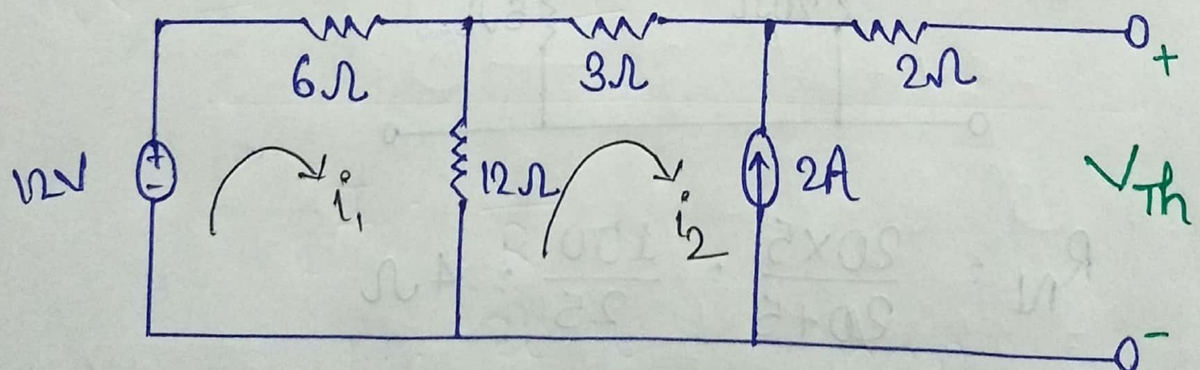
I4 = V/R4 =20/4K =5 mA

Norton's Equivalent Circuit

(5) Find the value of R_L for max^m power transfer for the below mentioned circuit and also find the max^m power



for V_{Th}



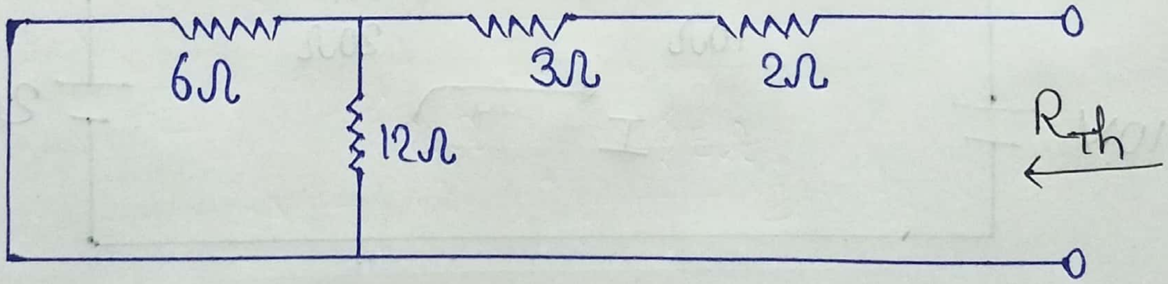
$i_2 = -2A$

$$6i_1 + 12(i_1 - i_2) = 12$$
$$18i_1 - 12i_2 = 12$$
$$18i_1 - 12(2) = 12$$
$$18i_1 = -12$$
$$i_1 = \frac{-2}{3} A$$

$$6i_1 + 3i_2 + 2(0) = 12 - V_{Th}$$
$$-4 - 6 = 12 - V_{Th}$$
$$\boxed{V_{Th} = 22V}$$

for R_{Th}

* All the voltage sources must be short circuited
* All the current sources must be open circuited



$$R_{Th} = 5\Omega + \frac{6 \times 12}{6+12} = 5\Omega + 4\Omega$$
$$\boxed{R_{Th} = 9\Omega}$$

for max^m power transfer

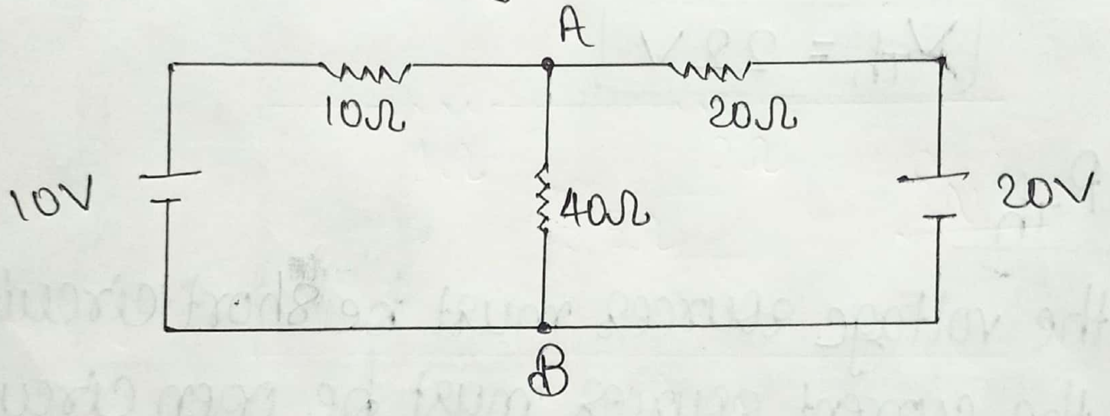
$$\boxed{R_L = R_{Th} = 9\Omega}$$

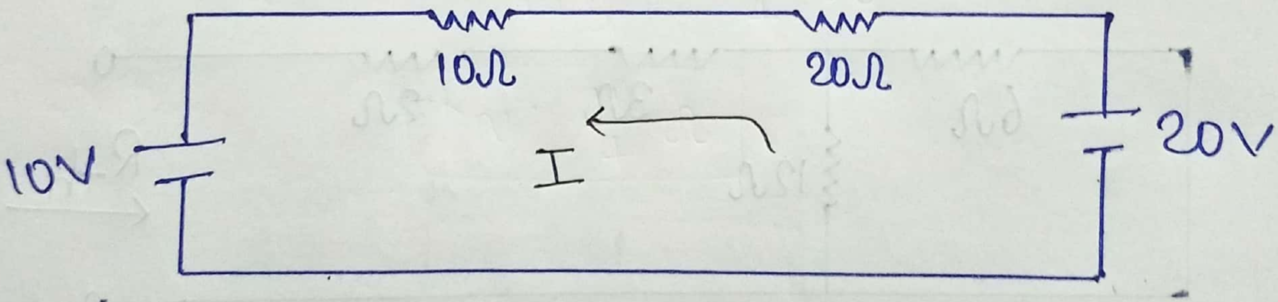
max^m power

$$P_{max} = \frac{V_{th}^2}{4R_L} = \frac{(22)^2}{4\times 9} = 13.44\,W$$

$$\boxed{P_{max} = 13.44\,W}$$

⑥ Find the Thevenin's voltage across 40Ω resistance in the given circuit ?

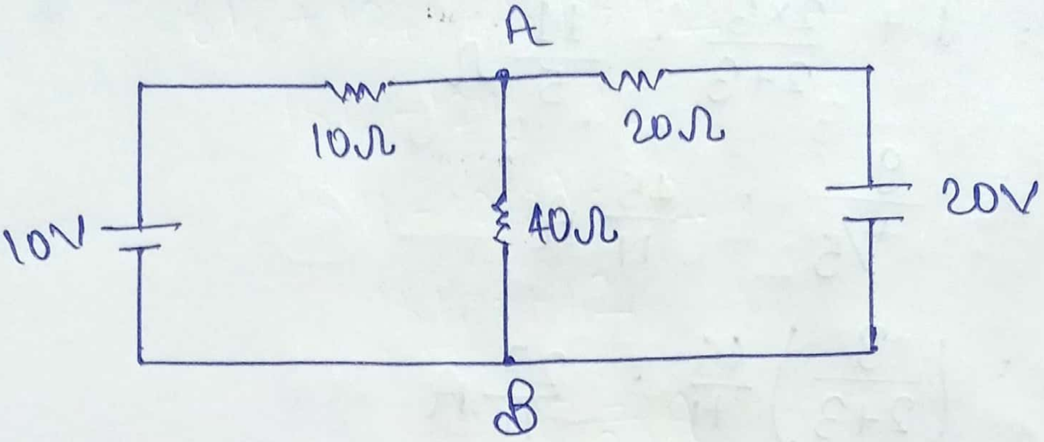




$$I = \frac{V}{R}$$

$$I = \frac{20-10}{20+10} = 0.33\,A$$

$$I = 0.33\,A$$

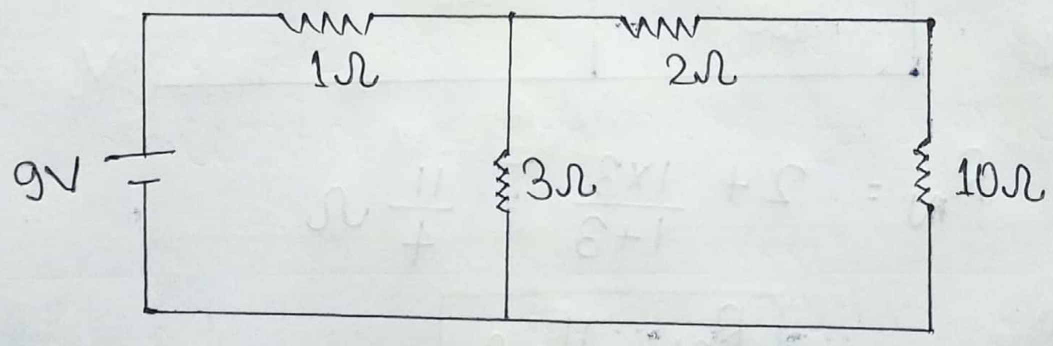


$$V_{AB} = 10_V + (10\Omega \times 0.33A) = 13.33V$$

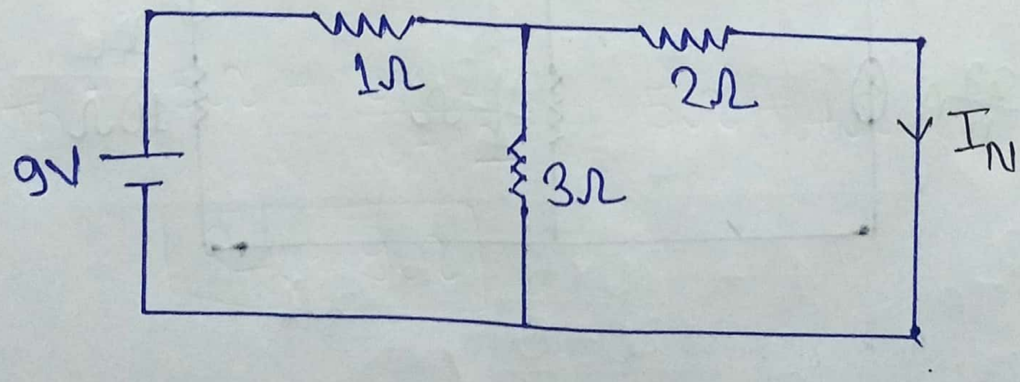
OR

$$V_{AB} = 20_V - (20\Omega \times 0.33A) = 13.33V$$

(7) Determine the current flowing through 10Ω resistor using Norton's theorem



for I_N



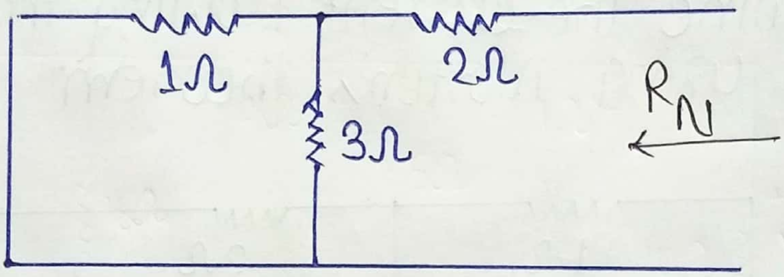
$$R_{eq} = 1 + \frac{2\times3}{2+3} = \frac{11}{5}\,\Omega$$

$$I = \frac{9}{11/5} = \frac{45}{11}\,A$$

$$I_N = \left(\frac{3}{2+3}\right)\frac{45}{11} = \frac{27}{11}\,A$$

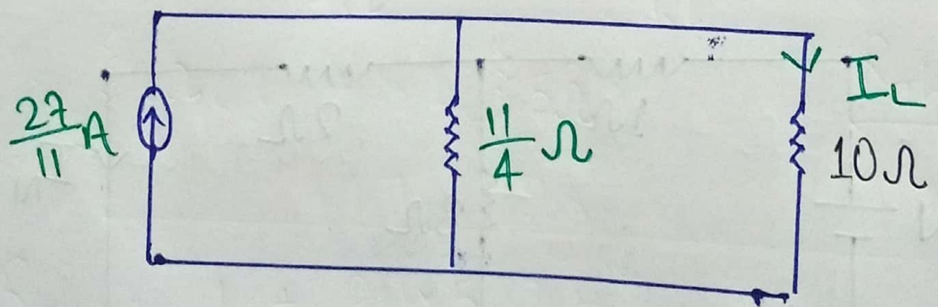
$$\boxed{I_N = \frac{27}{11}\,A}$$

for R_N



$$R_N = 2 + \frac{1\times3}{1+3} = \frac{11}{4}\,\Omega$$

$$\boxed{R_N = \frac{11}{4}\,\Omega}$$

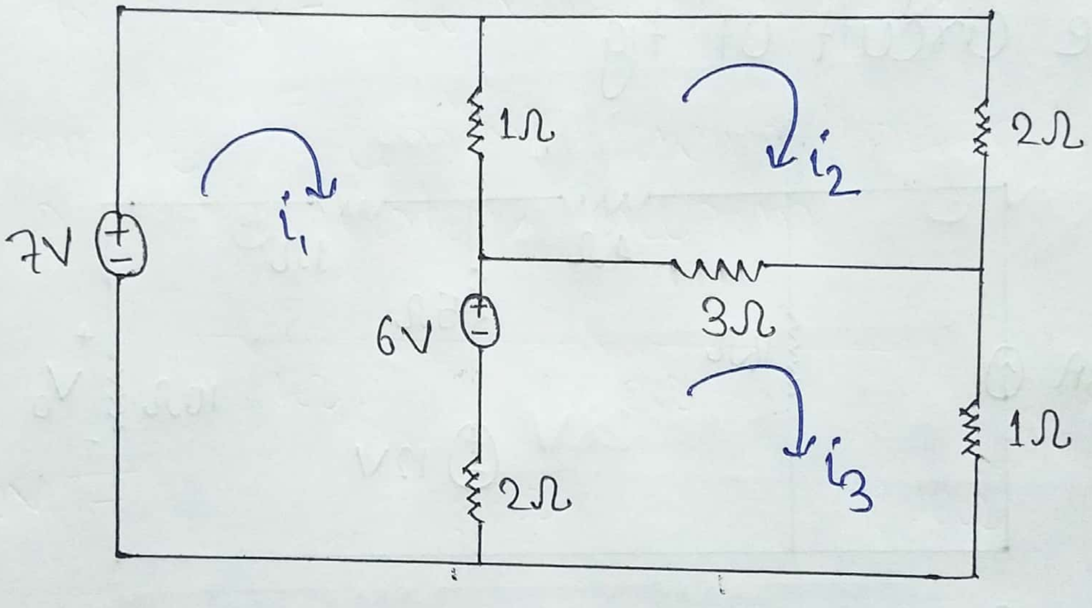


$$I_L = \left(\frac{11/4}{11/4 + 10}\right)\frac{27}{11}$$

$$I_L = \frac{2.75 \times 27}{12.75 \times 11} = \frac{74.25}{140.25} = 0.529\ A$$

$$\boxed{I_L = 0.529\ A}$$

(8) In the circuit shown in figure, determine the mesh currents i_1, i_2, i_3



Mesh 1

$$1(i_1 - i_2) + 2(i_1 - i_3) = 7 - 6$$

$$3i_1 - i_2 - 2i_3 = 1 \quad \text{— (i)}$$

Mesh 2

$$1(i_2 - i_1) + 2i_2 + 3(i_2 - i_3) = 0$$

$$-i_1 + 6i_2 - 3i_3 = 0 \quad \text{— (ii)}$$

Mesh 3

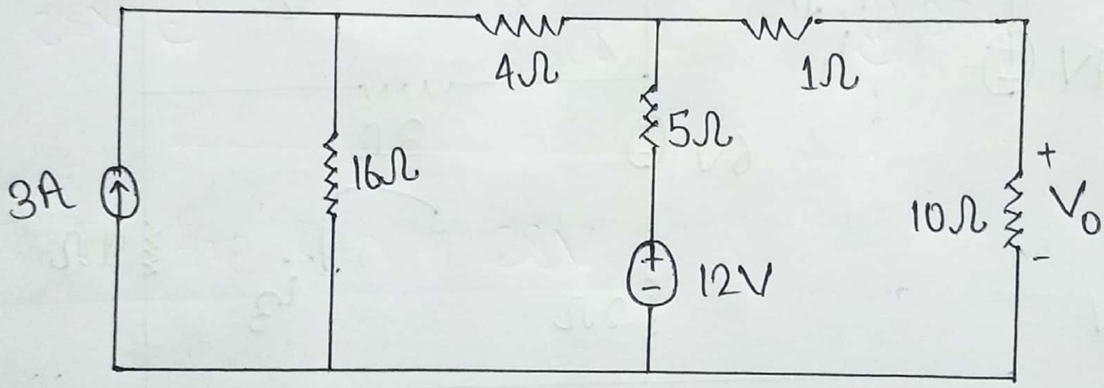
$$2(i_3 - i_1) + 3(i_3 - i_2) + i_3 = 6$$

$$-2i_1 - 3i_2 + 6i_3 = 6 \quad \text{--- (iii)}$$

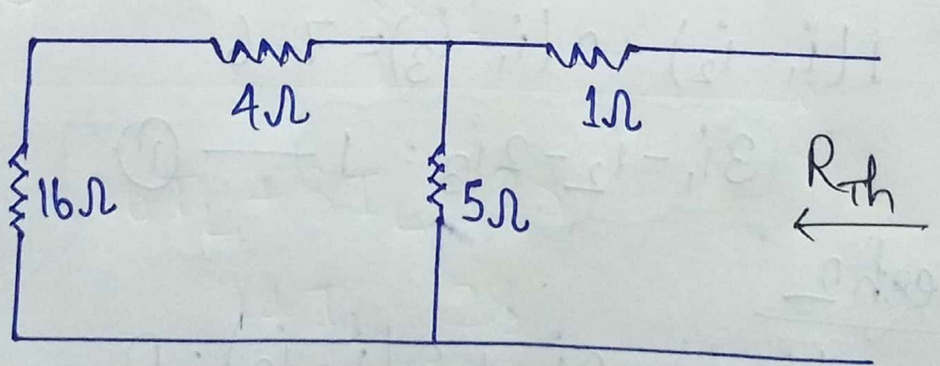
from eq^n (i), (ii) & (iii), we get

$\boxed{i_1 = 3A}$ $\boxed{i_2 = 2A}$ $\boxed{i_3 = 3A}$

(9) Apply Thevenin's theorem to find V_o in the circuit of fig



for R_{Th}



$$R_{Th} = 1 + \frac{20 \times 5}{20 + 5} = 5\Omega$$

$$\boxed{R_{Th} = 5\Omega}$$

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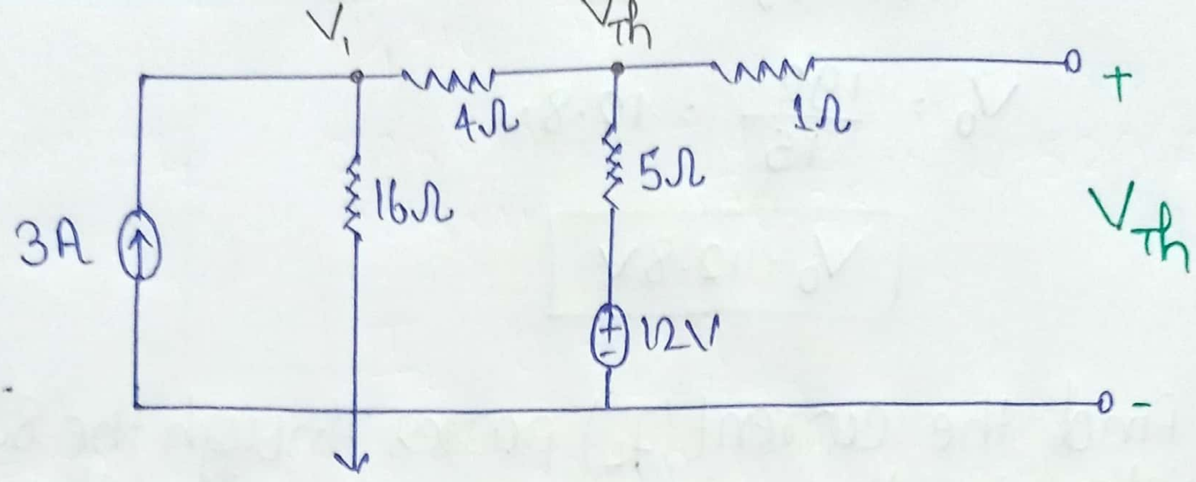
for V_{th}



at node V_1

$$\frac{V_1}{16} + \frac{V_1 - V_{th}}{4} = 3$$

$$5V_1 - 4V_{th} = 48 \quad \text{— (i)}$$

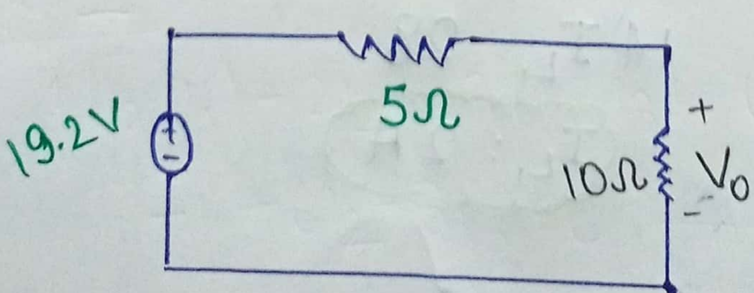
at node V_{th}

$$\frac{V_1 - V_{th}}{4} + \frac{12 - V_{th}}{5} = 0$$

$$5V_1 - 9V_{th} = -48 \quad \text{— (ii)}$$

from eqn (i) & (ii), we get

$$\boxed{V_{th} = 19.2\,V}$$

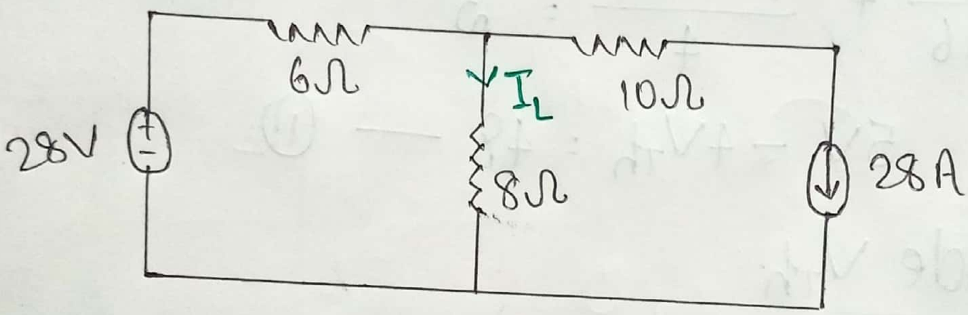


$$V_0 = \left(\frac{10}{10+5}\right) 19.2$$

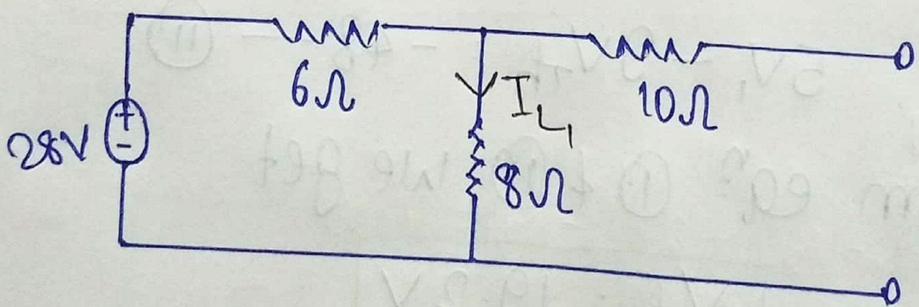
$$V_0 = \frac{192}{15} = 12.8\,V$$

$$\boxed{V_0 = 12.8\,V}$$

(10) Find the current (I_L) passes through the 8Ω resister in the given network using the superposition theorem



Take the source 28V

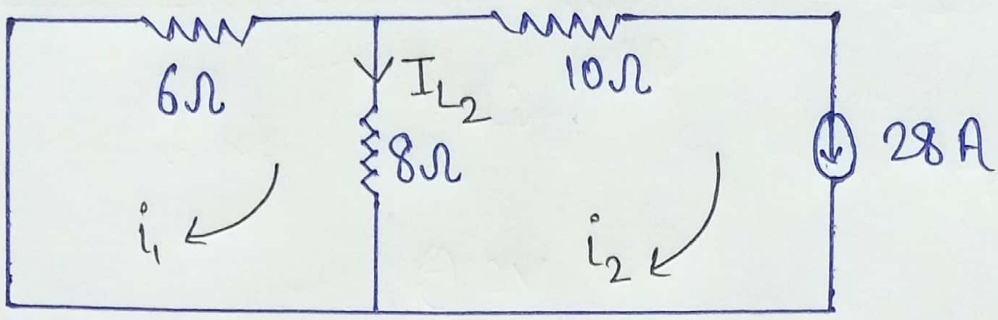


$$6I_{L_1} + 8I_{L_1} = 28$$

$$14 I_{L_1} = 28$$

$$I_{L_1} = 2\,A$$

Take the source 28A



$i_2 = 28\,A$

$$6i_1 + 8(i_1 - i_2) = 0$$

$$14i_1 - 8i_2 = 0$$

$$14i_1 = 224$$

$$i_1 = 16\,A$$

$$I_{L_2} = i_1 - i_2$$

$$I_{L_2} = 16 - 28$$

$$I_{L_2} = -12\,A$$

$$\boxed{I_{L_1} = 2A}$$

$$\boxed{I_{L_2} = -12A}$$

NOW,

$$I_L = I_{L_1} + I_{L_2}$$

$$\boxed{I_L = -10\,A}$$