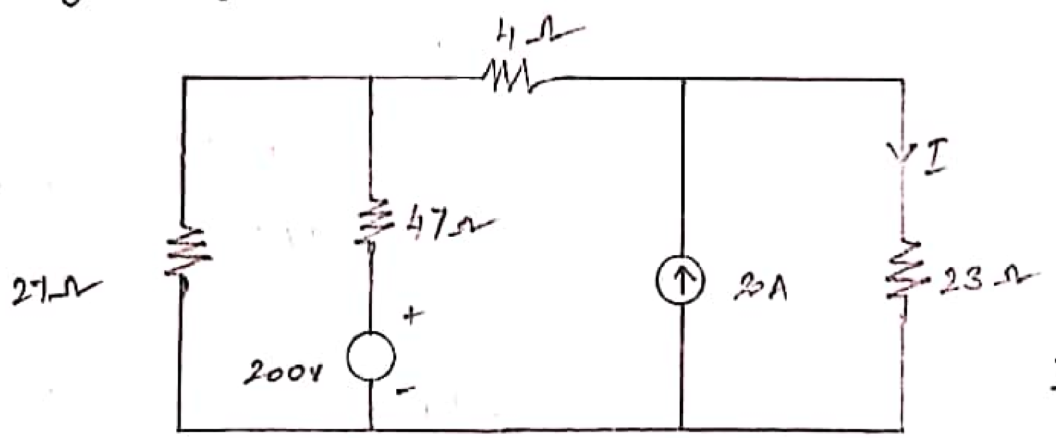
## Super position theorem:

**Statement:** Any linear active network Containing more than one Source, the Current that flows at any Point or Voltage that exists between any two points is the algebric Sum of the Currents or the voltages that would have been produced by each Source taken Separately with all other Sources removed.

$$I_L = I_L' + I_L''$$

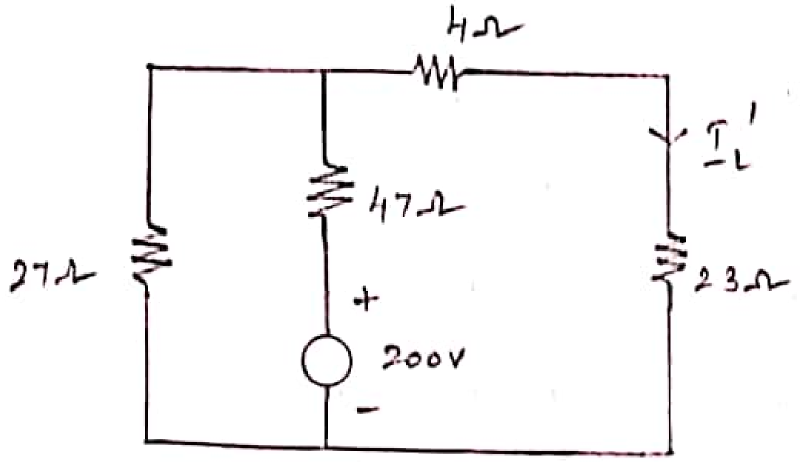
1. Compute the current through 23Ω resistor of the figure by using super position theorem.



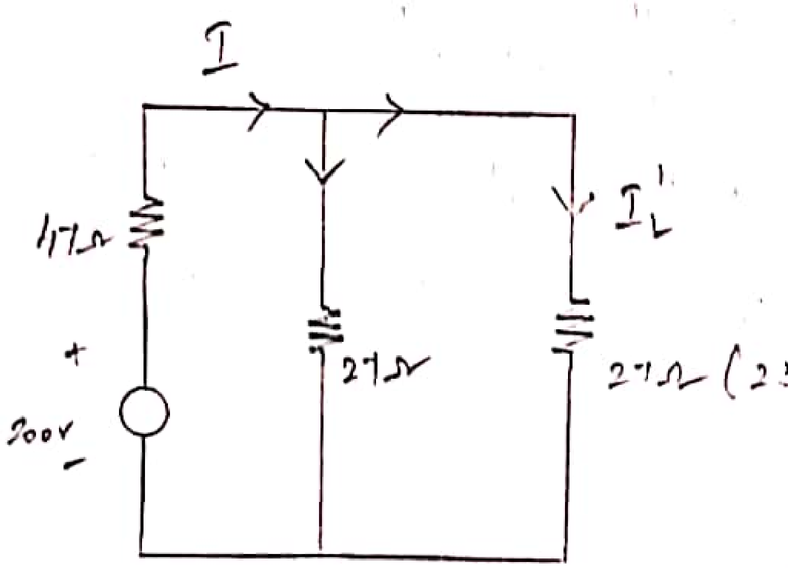

$I = I_L$

Take each Source Separately and find currents through 23Ω resistor.

Consider only 200V Source!



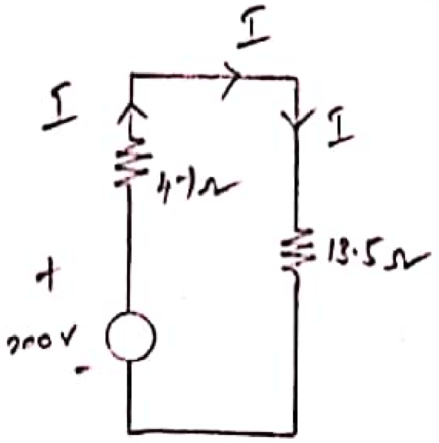

⇒




27Ω (23+4)Ω

Use current division rule to find $I_L'$

$$\frac{27 \times 27}{27+27} = 13.5\,\Omega$$




$$R = 47 + 13.5 = 60.5\,\Omega$$

$$R = 60.5\,\Omega$$

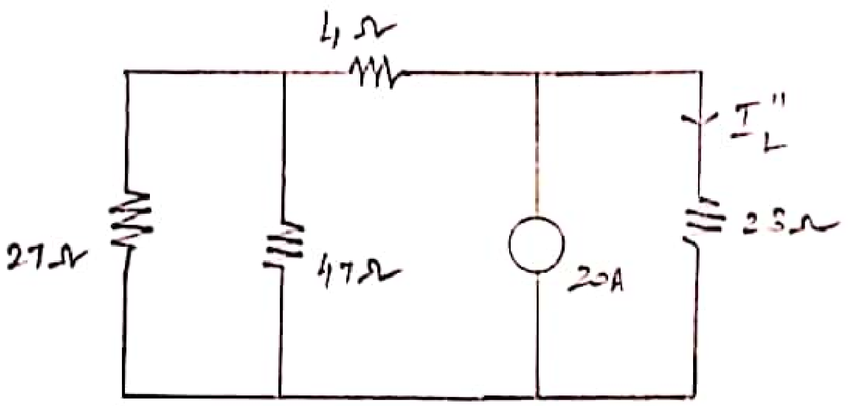
$$I = \frac{V}{R} = \frac{200}{60.5} = 3.306\text{ A}$$

$$I_L' = I \frac{\text{opp. resistance}}{\text{total resistance}} = I \frac{27}{27+27}$$

$$I_L' = 3.306 \; \frac{27}{27+27}$$

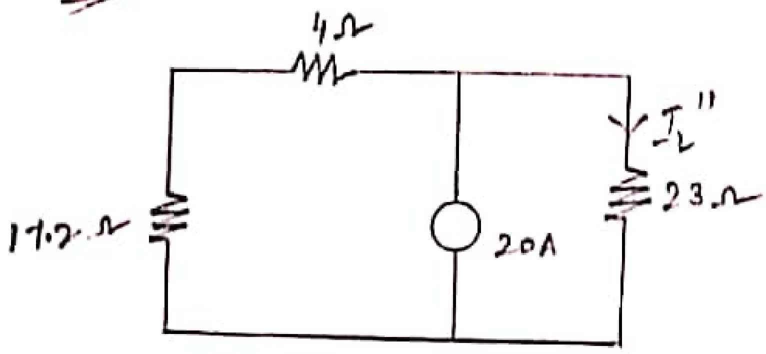
$$\boxed{I_L' = 1.653\ A}$$

Consider only 20 A source :




$$\frac{27 \times 47}{27+47} = 17.2\ \Omega$$

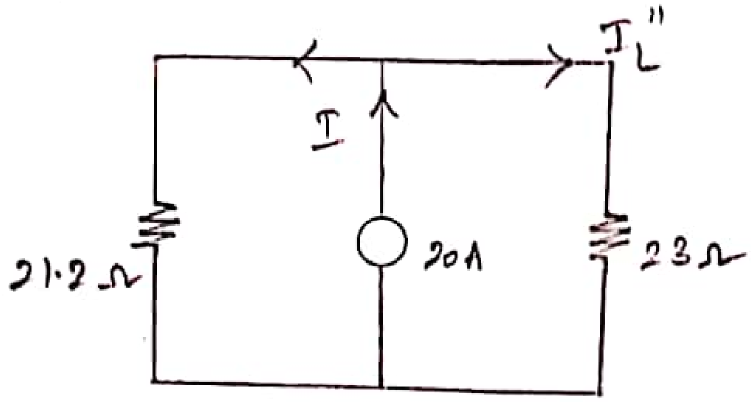
⟹




$21.2 + 4 = 2$

$17.2 + 4 = 21.2\ \Omega$

⟹




$$I_L'' = 20 + \frac{21.2}{21.2+23}$$

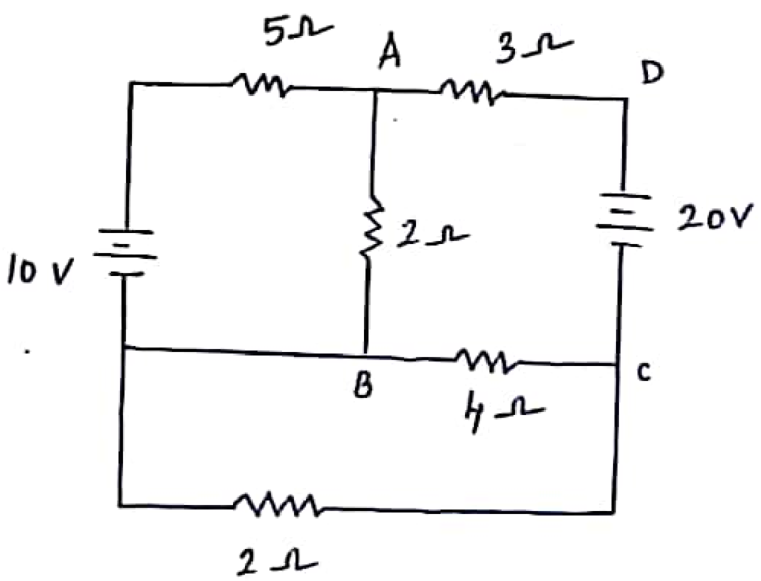
$$\boxed{I_L'' = 9.6\ A}$$

$$I_L = I_L' + I_L''$$

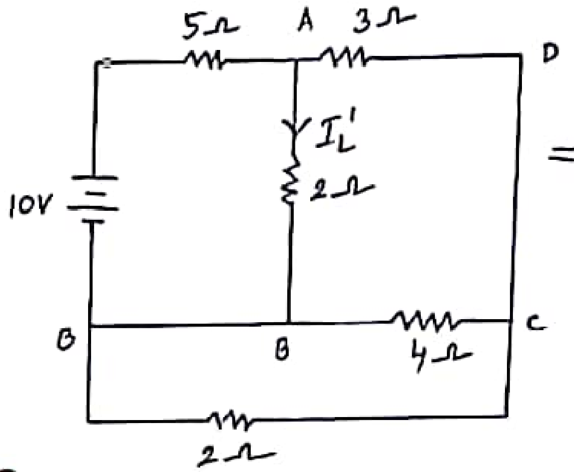
$$I_L = 1.653 + 9.6$$

$$\boxed{I_L = 11.253 \text{ A}}$$

2. Find the current in the 2 Ω resistor between A and B for the network using superposition theorem.

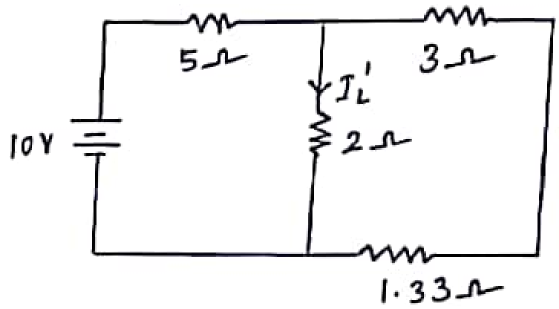


Step 1: Keep 10 V source and remove 20V source and find $I_L'$

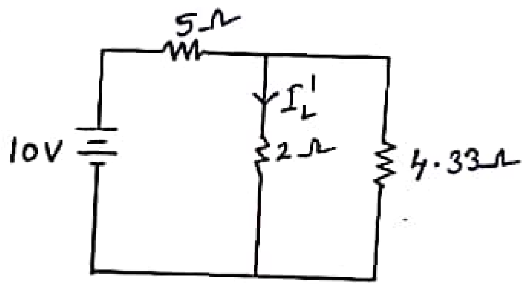



$\Rightarrow$

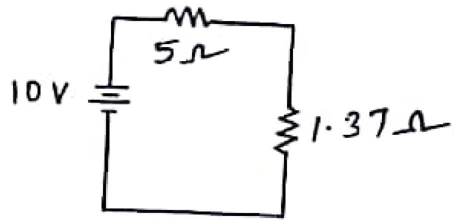
$$\frac{2\times4}{2+4} = \frac{8}{6} = 1.33\,\Omega$$



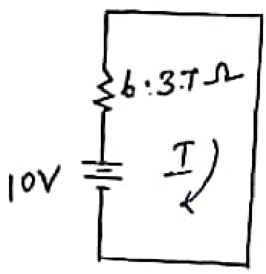

$\Rightarrow \; 3 + 1.33 = 4.33\,\Omega$




$$\Rightarrow \; \frac{4.33\times2}{4.33+2} = 1.37\,\Omega$$



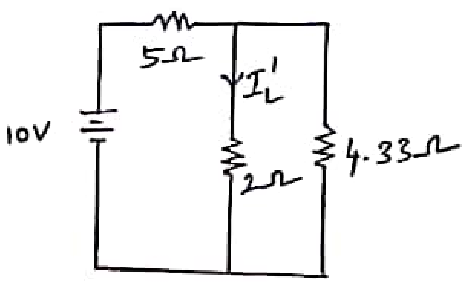

$\Rightarrow \; 5 + 1.37 = 6.37\,\Omega$




$$I = \frac{V}{R} = \frac{10}{6.37} = 1.57\,A$$

$$\boxed{I = 1.57\,A}$$

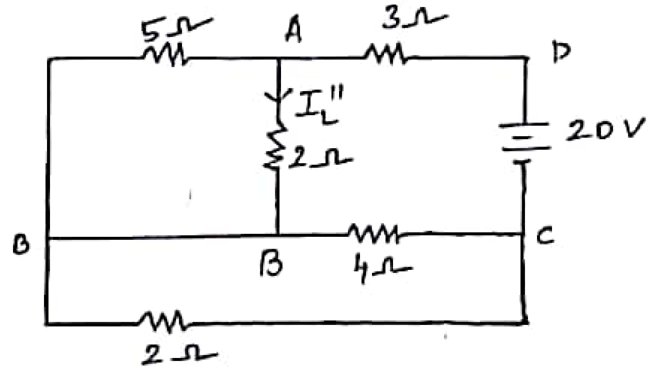
Using current division rule




$$I_L' = 1.57 \; \frac{4.33}{2+4.33} = 1.07\,A$$

$$\boxed{I_L' = 1.07\,A}$$

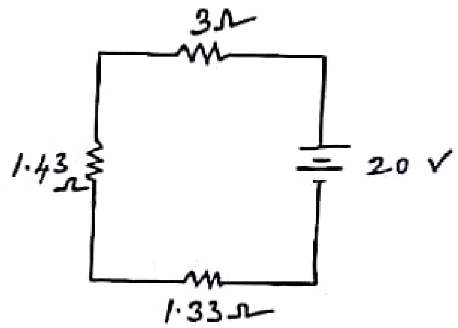
Step 2: Keep 20V Source, Remove 10V Source and find $I_L''$



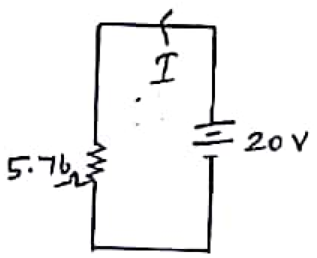

$\Rightarrow$ 5Ω & 2Ω are parallel
2Ω & 4Ω, are connecte.
parallel

$\Rightarrow$ $$\frac{5 \times 2}{5+2} = \frac{10}{7} = 1.43\Omega$$

$$\frac{2 \times 4}{2+4} = \frac{8}{6} = 1.33\Omega$$



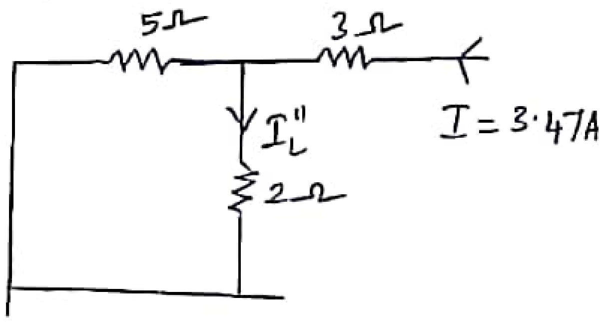

$\Rightarrow$ $1.33 + 1.43 + 3$ are connected in series
$= 5.76\Omega$




$$I = \frac{V}{R} = \frac{20}{5.76} = 3.47A$$

$$\boxed{I = 3.47A}$$

using current division rule.




$$I_L'' = I \frac{5}{5+2}$$

$$= 3.47 \frac{5}{5+2} = 2.48A$$

$$\boxed{I_L'' = 2.48A}$$

By superposition theorem, Current through 2Ω resistor is

$$I_{2\Omega} = I_L = I_L' + I_L'' = 1.07 + 2.48 = 3.55A$$

$$\boxed{I_L = 3.55A}$$