SNS COLLEGE OF TECHNOLOGY
Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECB101 – CIRCUIT ANALYSIS AND DEVICES

I YEAR/ II SEMESTER

UNIT 2 – NETWORK THEOREMS AND SOURCE TRANSFORMATION

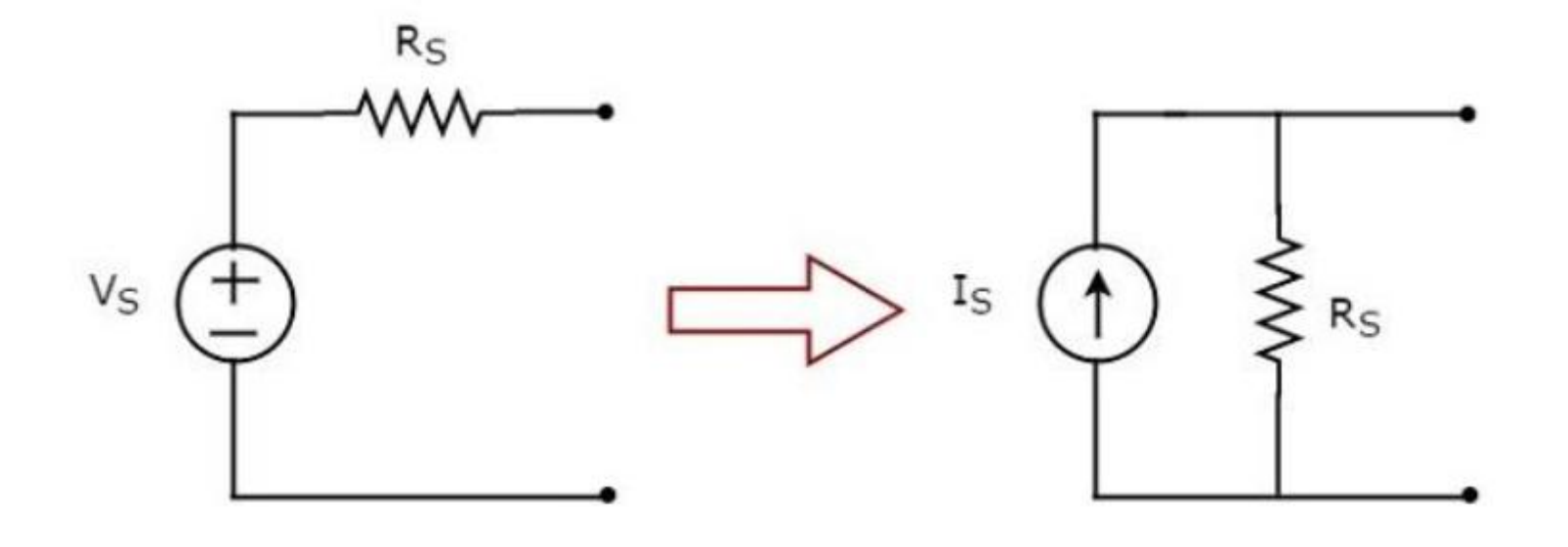
TOPIC - Source Transformation

urce Transformation

The technique of transforming one source into the other is called as source transformation technique

Following are the two possible source transformations
voltage source into a current source
current source into a voltage source

Voltage Source into a Current Source



oltage source (Vs) in series with a resistor (Rs) can be converted into a current source (Is) in parallel with a resistor (Rs).

- The value of Is will be equal to the ratio of Vs and Rs.
- Mathematically, it can be represented as

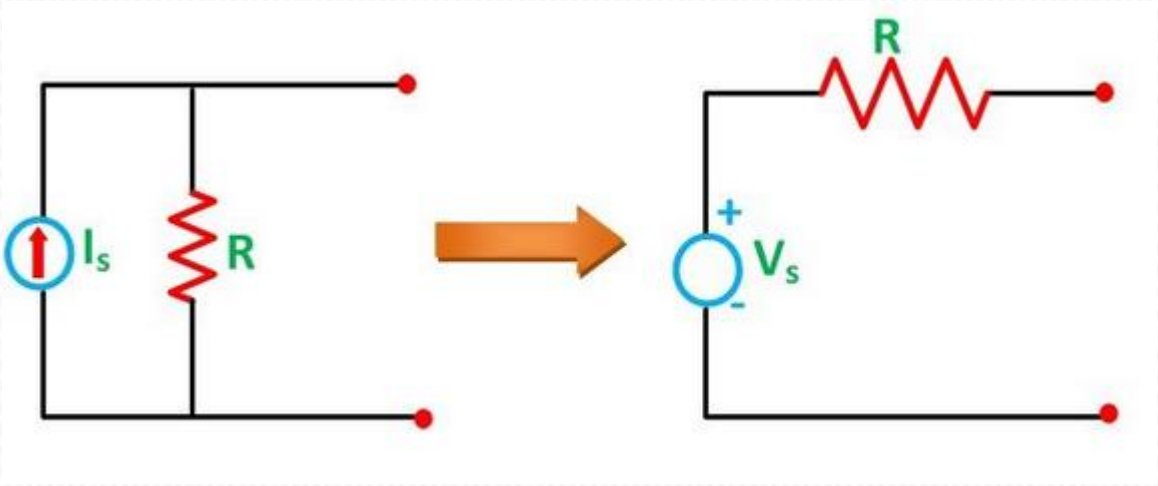
  Is = Vs/Rs

Current Source into a Voltage Source

- Current source (Is) in parallel with a resistor (Rs) can be converted into a voltage source (Vs) in series with a resistor (Rs).
- The value of Vs will be equal to the product of Is and Rs.
- Mathematically, it can be represented as

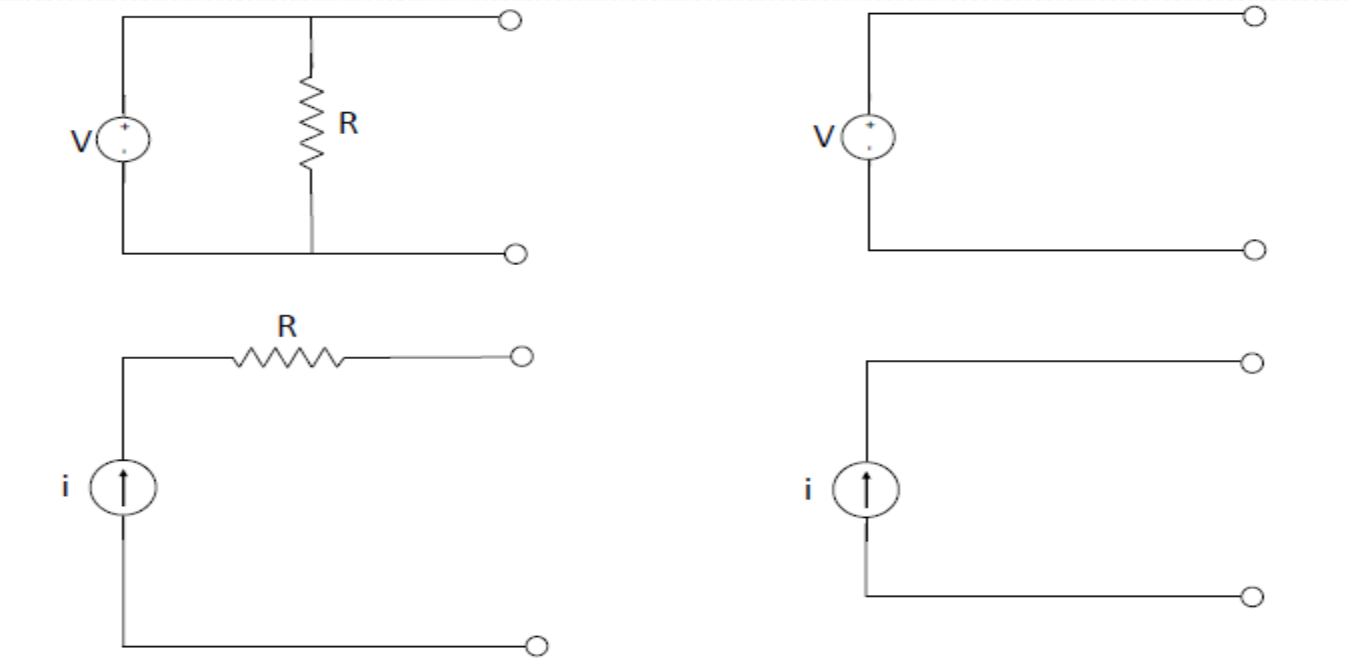
  $Vs = IsRs$

urrent Source into a Voltage Source



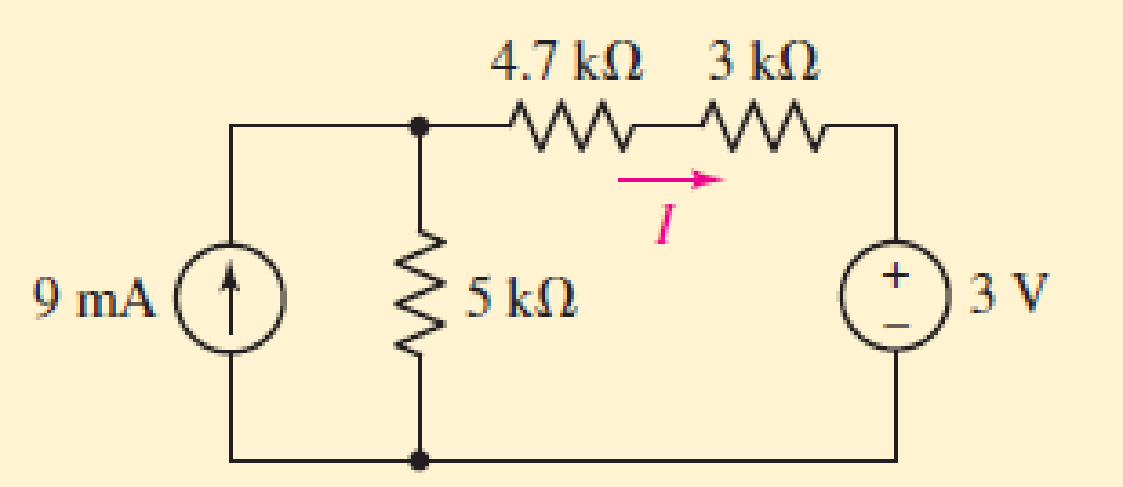
- voltage source is connected with resistance in parallel then the resistance can be neglected

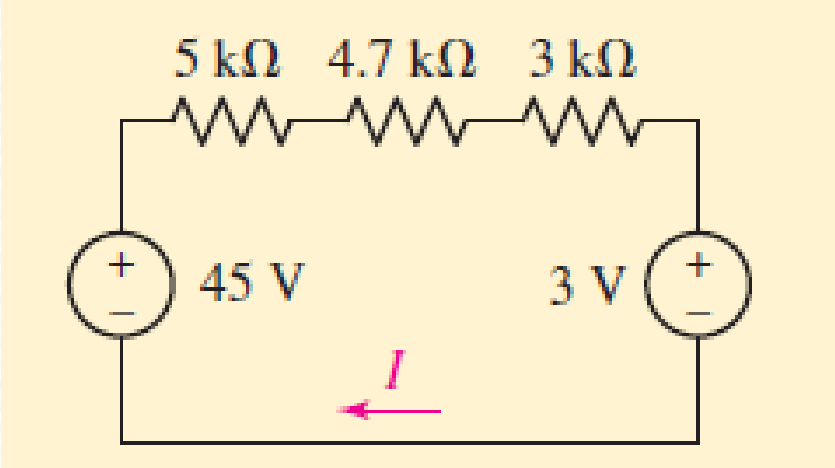
- If current source is connected with resistance in series then the resistance can be neglected



Example

- Compute the current through the 4.7 k resistor in Fig. 5.17*a* *after* transforming the 9 mA source into an equivalent voltage source.





- We then replace them with a voltage source in series with a 5 k resistor. The value of the voltage source must be (0.09)(5000) 45 V.

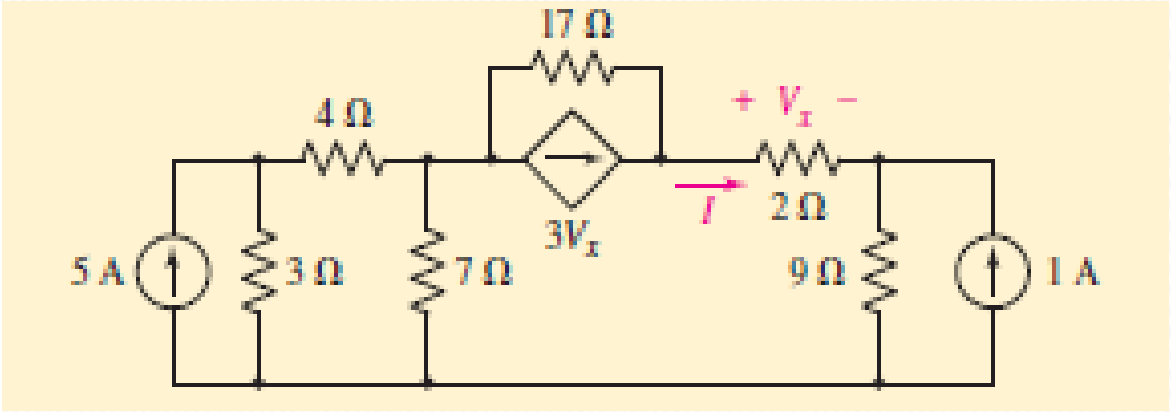
- *We can write a simple KVL* equation

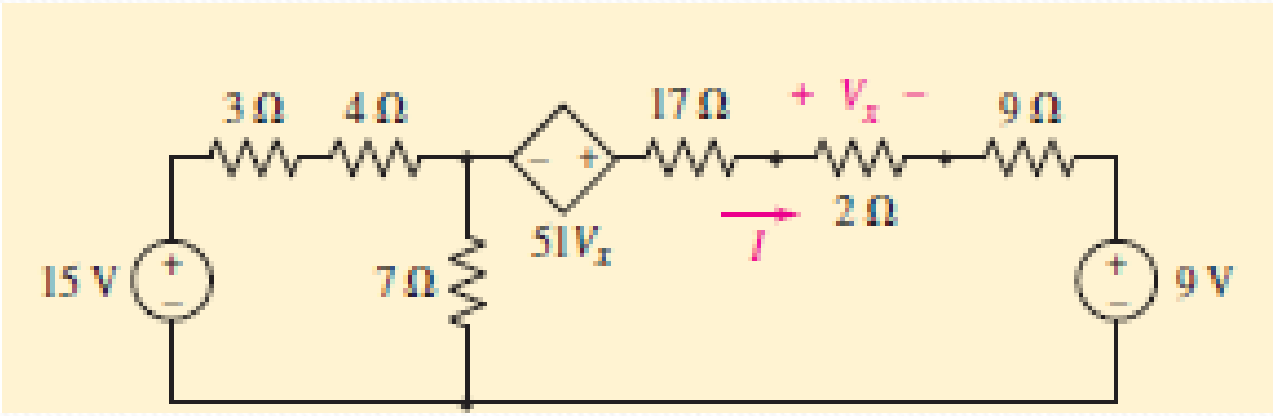
$$-45 + 5000I + 4700I + 3000I + 3 = 0$$

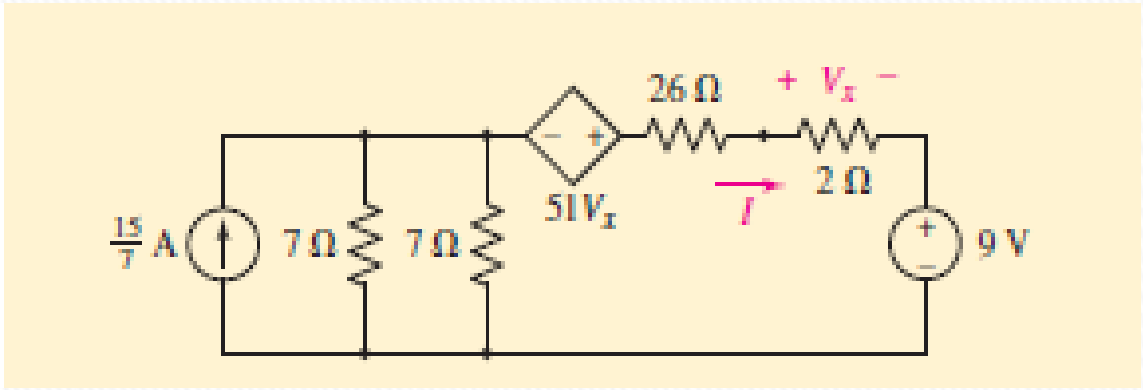
which is easily solved to yield $I = 3.307\ mA$.

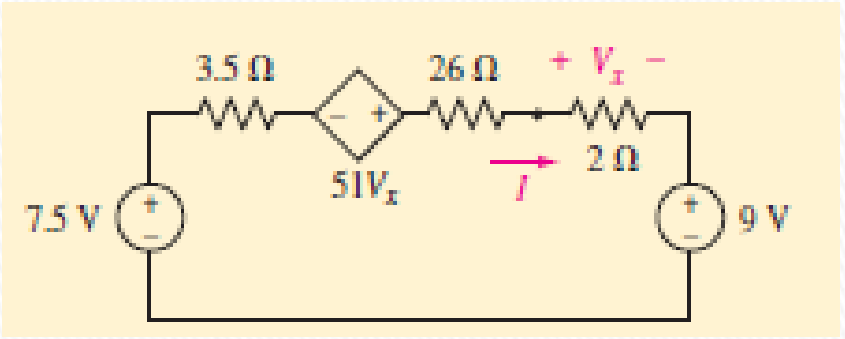
Example

- Calculate the current through the 2 ohm resistor in Figure by making use of source transformations to first simplify the circuit.




3 Ω
4 Ω
17 Ω
+ V_x −
9 Ω
2 Ω
I
15 V
7 Ω
$5IV_x$
9 V


26 Ω
+ V_x −
$\frac{15}{7}$ A
7 Ω
7 Ω
5IV_x
I
2 Ω
9 V


3.5 Ω
26 Ω
+ V_x −
5IV_x
I
2 Ω
7.5 V
9 V

- *The current I can now be found using KVL:*

$$-7.5 + 3.5I - 51V_x + 28I + 9 = 0$$

where

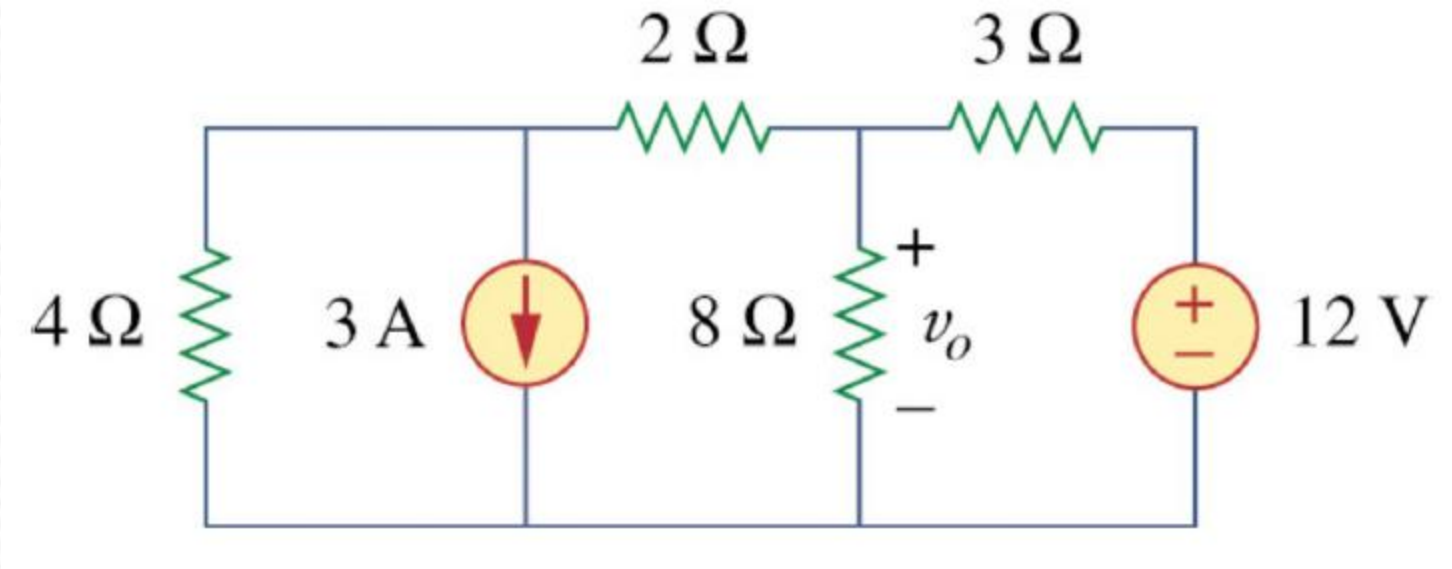
$$V_x = 2I$$

Thus,

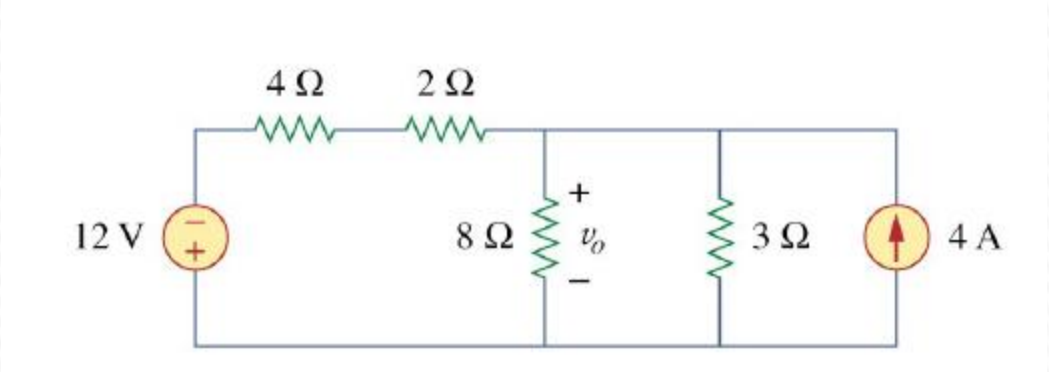
$$I = 21.28\ mA$$

Example

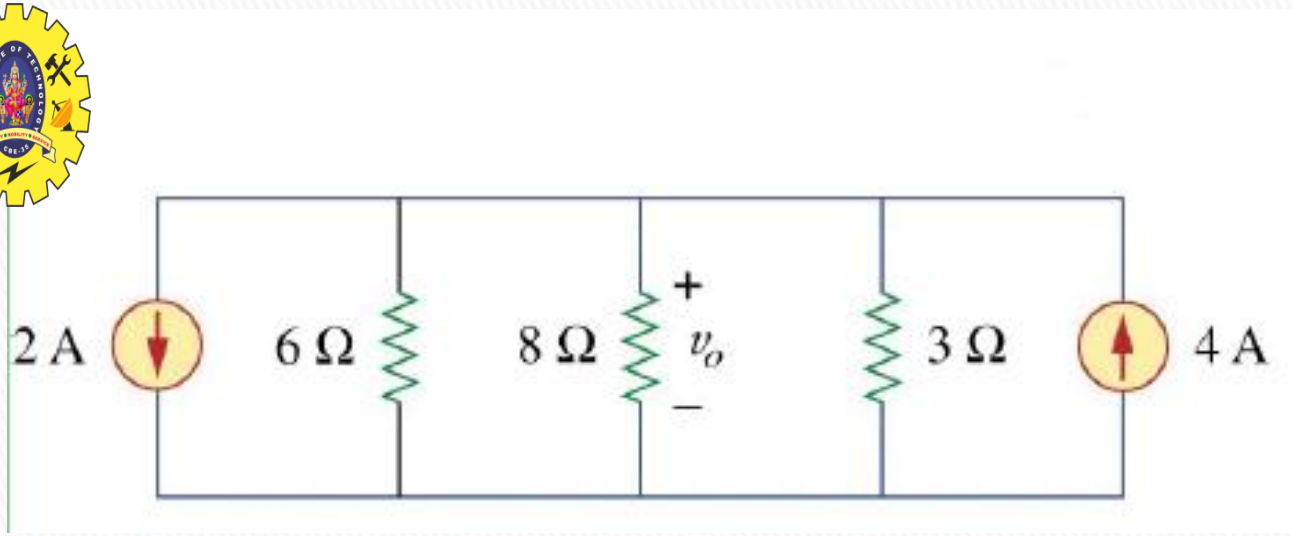
- Use source transformation to find vo in the circuit.



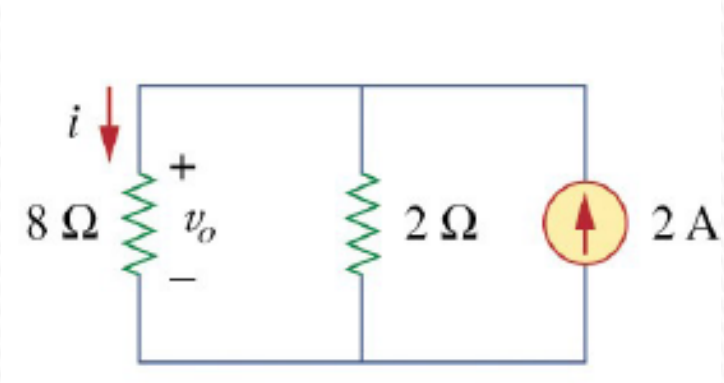
Converting 3A current source into voltage source and 12V voltage source into current source



Converting 12V voltage source into current source



Adding the two current sources



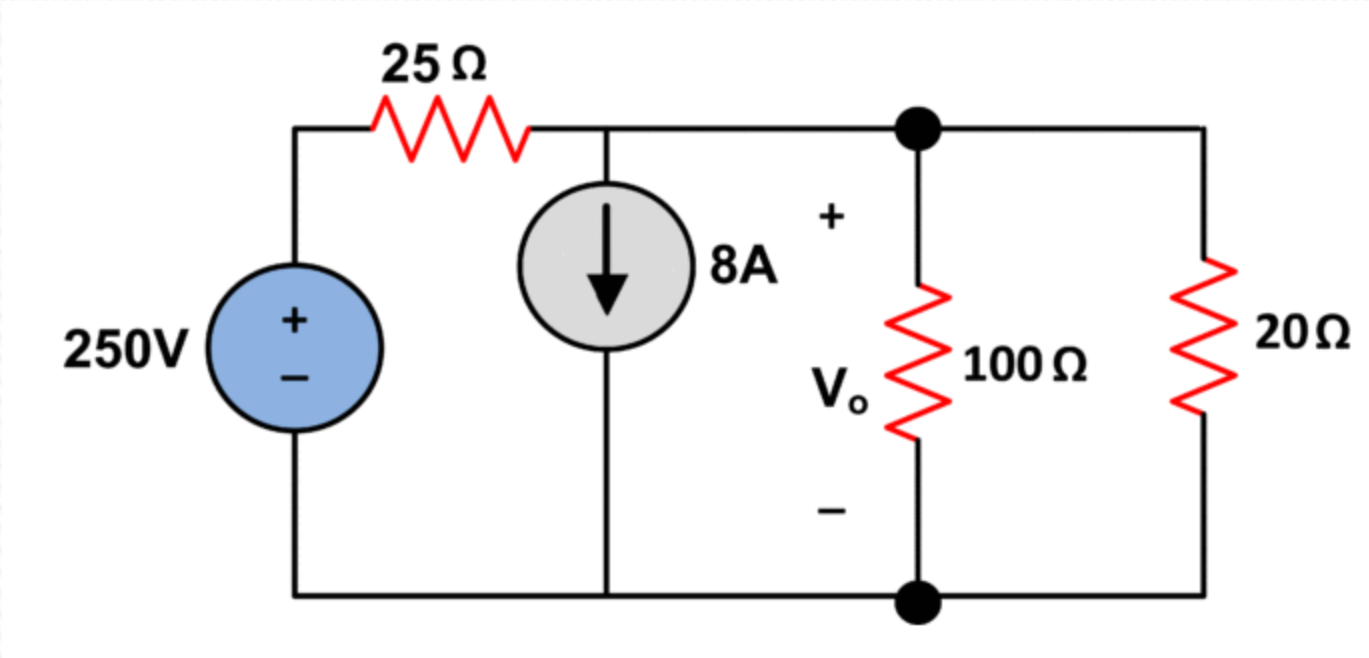
We get

I = 0.4A

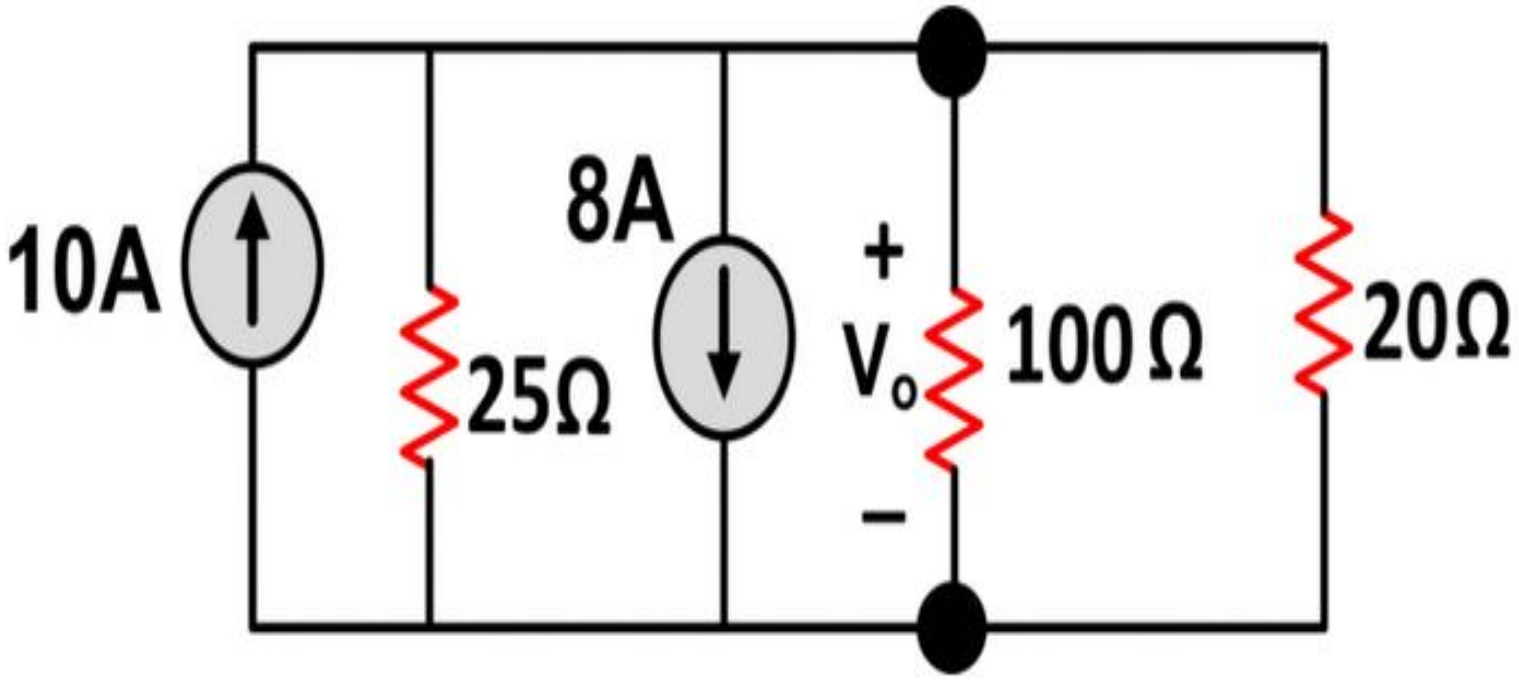
Vo = 3.2 V

ample

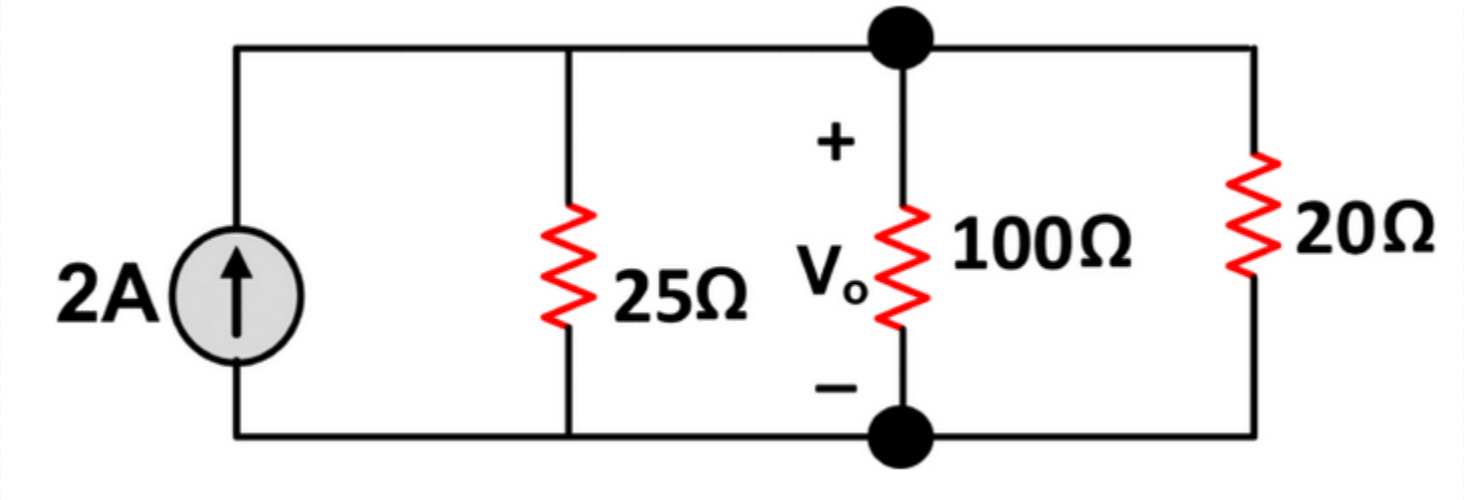
- Find V_o using source Transformation



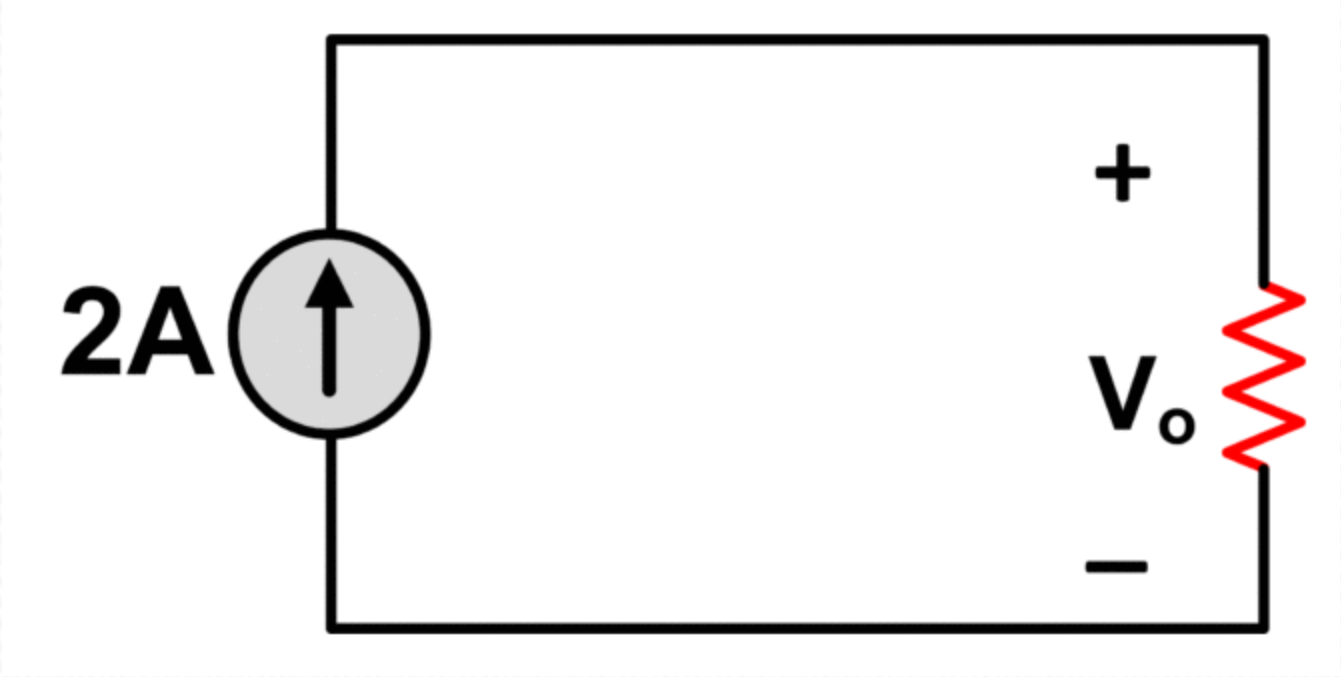
e convert 250V voltage source into 10A urrent source.



ombining both current sources, we obtain



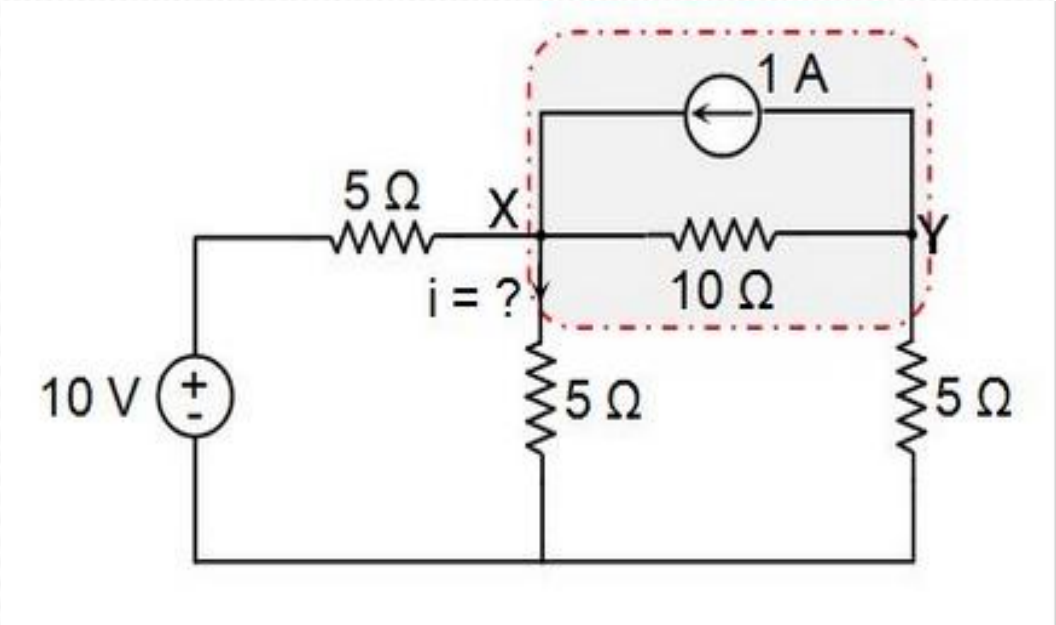
dding resistance in a parallel ma will give us the following circuit



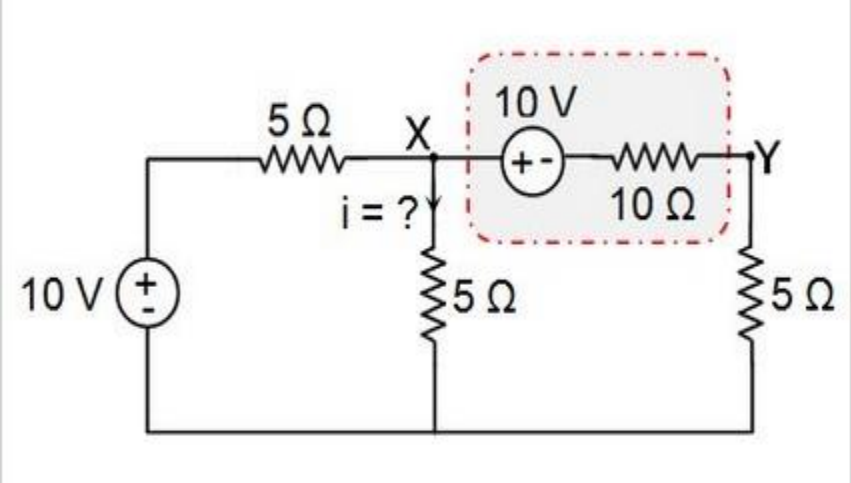
Vo =
20V

Example

- Consider the circuit shown in Figure below, find the current (denoted by i) through the central 5 Ω resistor.



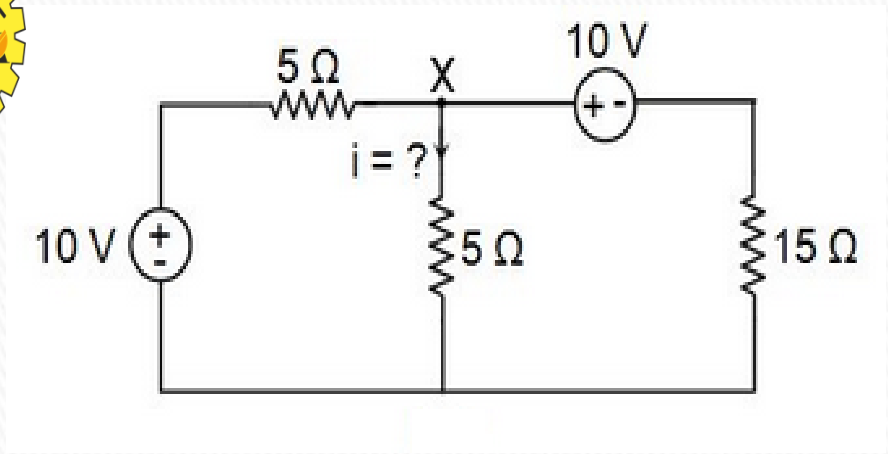
- 1 A current source has a 10 Ω resistor in parallel with it.
- Let us now replace this combination with a voltage source, V = 1 A × 10 Ω = 10 V, and a 10 Ω series resistor.



- The positive terminal of the voltage source is placed to the left, because the current-source arrow was pointing to the left.

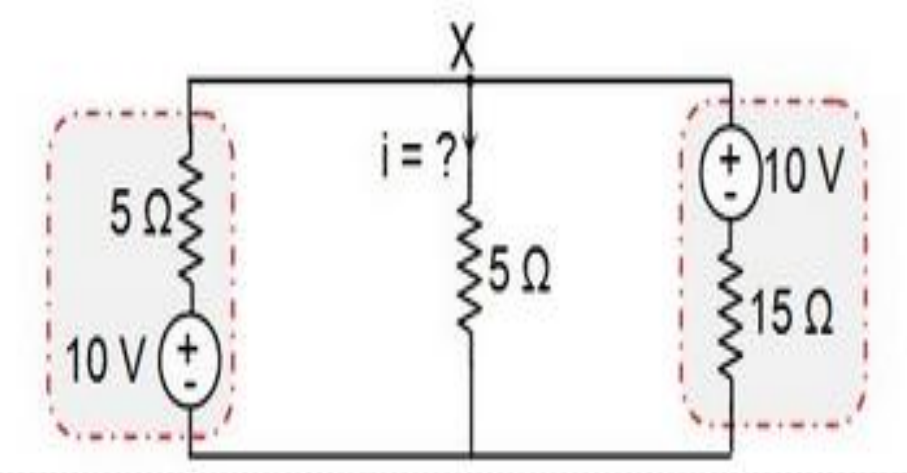
- The process carried out here is called source transformation. We have transformed an existing current source with a parallel resistor into an equivalent voltage source with a series resistor.

- The circuit can be further simplified as it has a 10 Ω resistor in series with a 5 Ω resistor. These can be replaced by an equivalent 15 Ω (= 10 Ω + 5 Ω) resistor.



Now we can easily apply mesh analysis to solve the problem

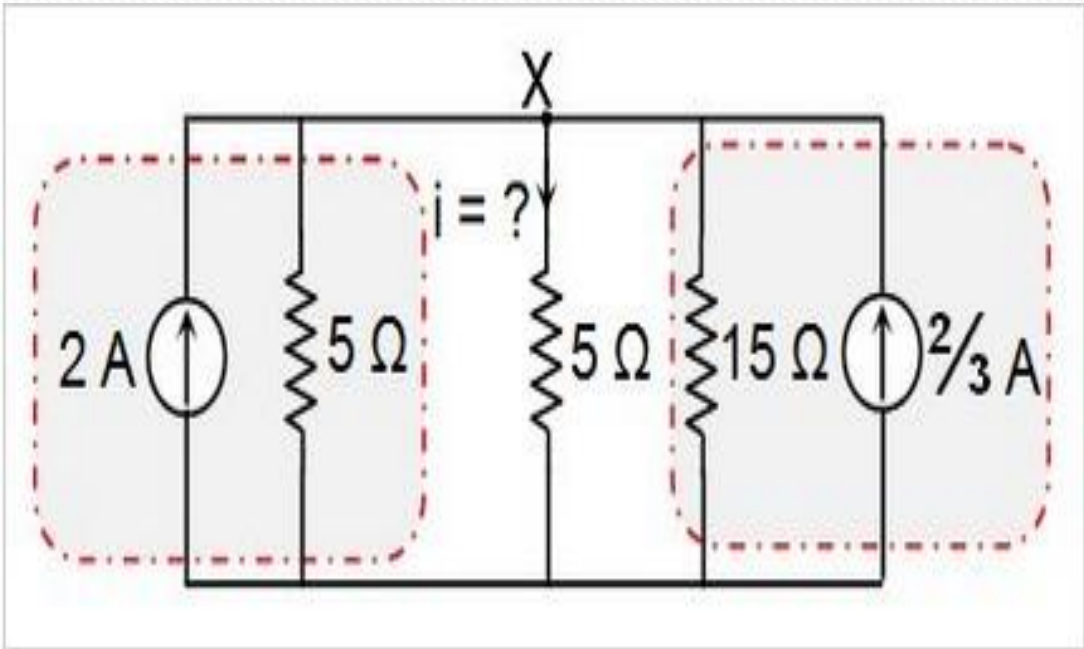
Previously we transformed a current source with a Parallel resistor, but we can also apply source transformation to a voltage source with a series resistor.



for the leftmost branch, we have a current source I=10/5=2 A in parallel with a 5 Ω resistor.

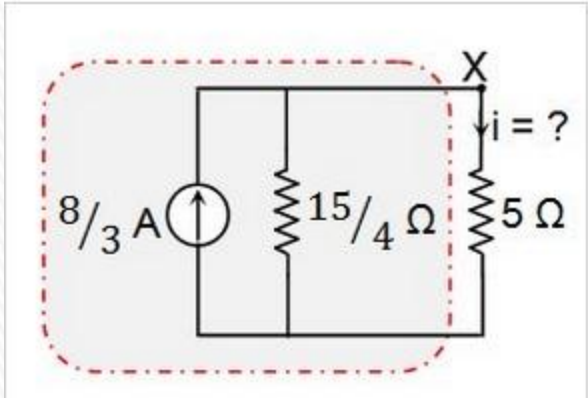
Similarly, for the rightmost branch, we get I=10/15=23 A in parallel with a 15 Ω resistor.

The circuit in Figure has two current sources pointing in the same direction, and hence these can be replaced by a single current source whose value is equal to their sum, i.e., 8/3 A.

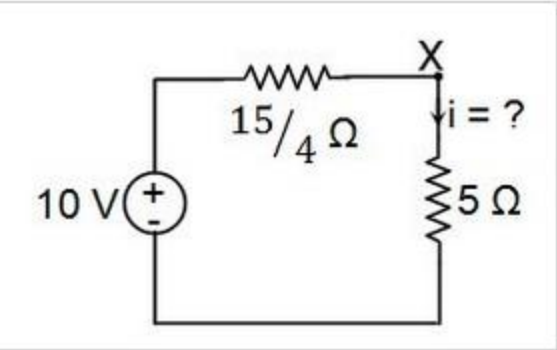


There are three resistors: two 5 Ω resistors and one 15 Ω resistor, all in parallel. We could replace all three of them with an equivalent resistance (R_{EQ}), but our goal is to find the current through the 5 Ω resistor, so we will combine only the other two.

- $R_{EQ} = 15/4\ \Omega$



The resulting circuit is



For Figure we can readily apply KVL to obtain the current through the 5 Ω resistor:

$$10 - \frac{15}{4}i - 5i = 0$$

$$10 - \frac{35}{4}i = 0$$

$$10 = \frac{35}{4}i$$

$$i = 10 \times \frac{4}{35} = \frac{8}{7}\ A$$

THANK YOU