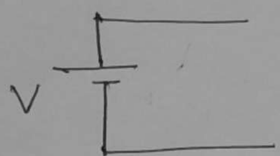
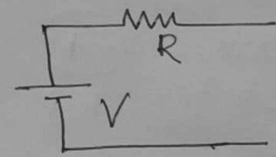
Independent Sources may be Ideal/practical voltage Sources and current sources

An ideal voltage source is the energy source which delivers const voltage irrespective of network configuration

practical voltage source is the energy source which has Small resistance with voltage source.



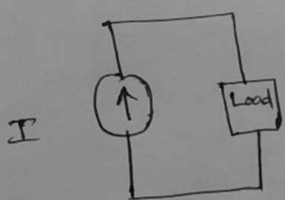
Ideal V/g Source



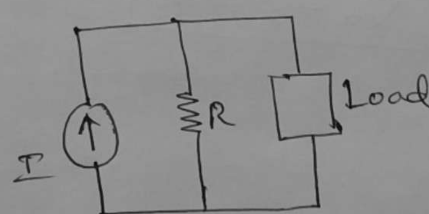
practical V/g Source

Ideal current source is the energy source which gives const current across its terminals irrespective of the voltage connected across its terminals

practical current source is the energy source which has Small internal resistance connected in parallel with the current source

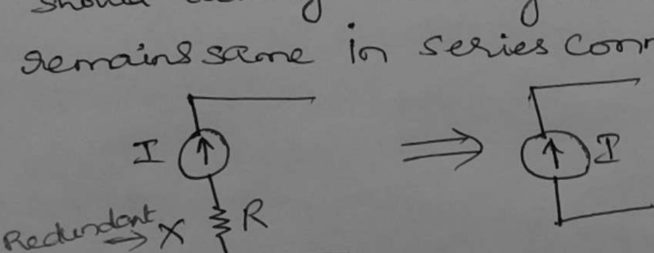


Ideal current source

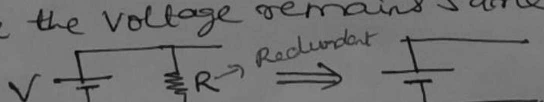


practical current Source

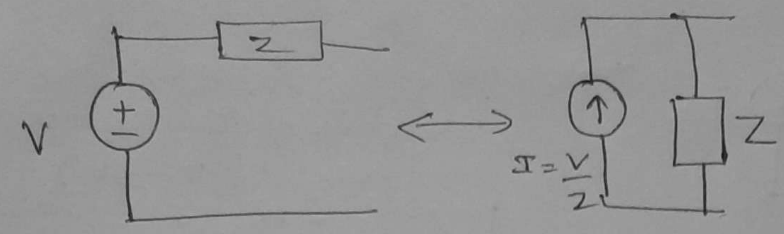
When resistance connected in series with the current source should always be neglected (redundant) because the current remains same in series connection.

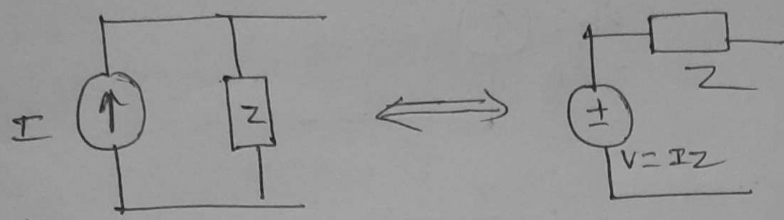


Resistance connected in parallel with the voltage source is redundant because the voltage remains same in parallel connection.

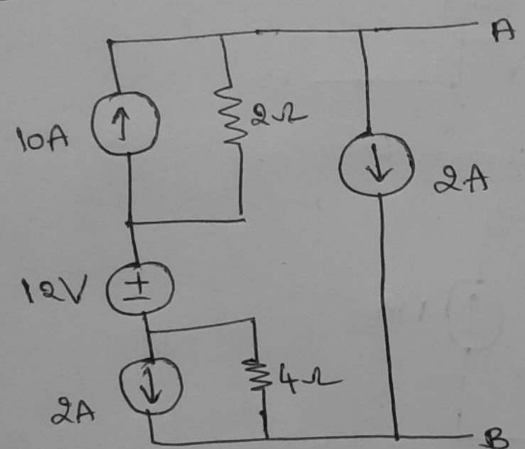


Source transformation

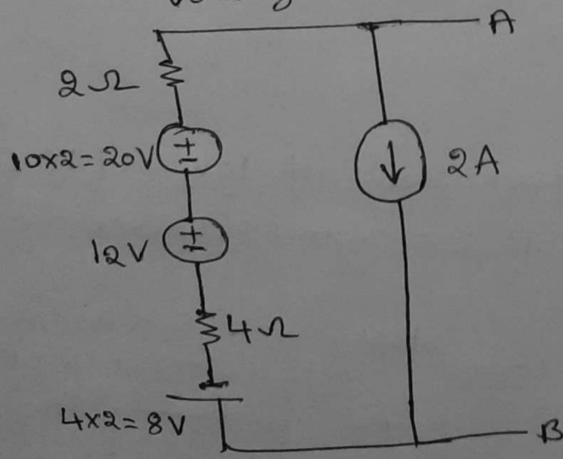




Ex: Reduce the network shown in figure into a single voltage source between A and B.

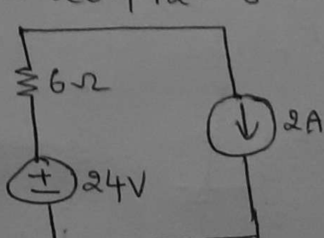


<u>Solution</u>: current source 10A and 2A are converted into voltage source

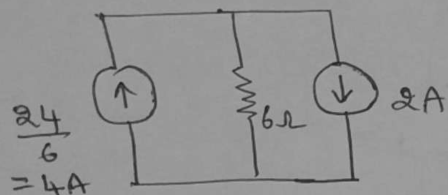


⟹ 20V, 12V and 8V voltage sources are in series and they can be reduced into a single v/g source.

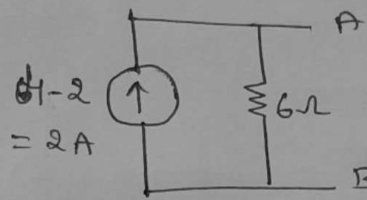
ie $20 + 12 - 8 = 24$



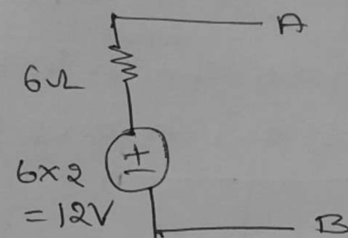
24V is converted into current source



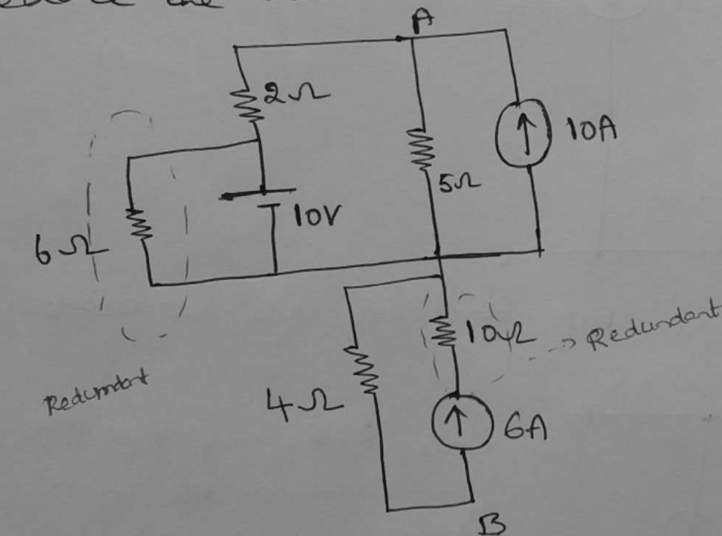
⟹ combining current source
(but direction is opposite
hence subtract)



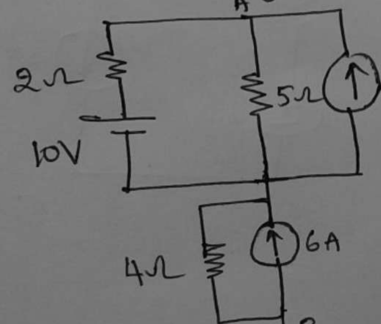
convert into voltage source



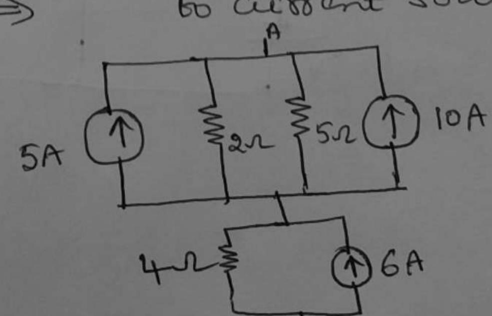
Ex: Reduce the network shown into a single source network

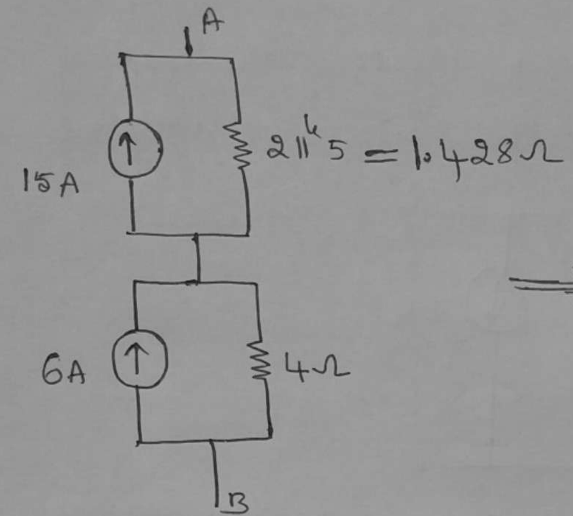


Solution: 6Ω resistor in parallel with 10V and 10Ω are redundant
resistor is in series with 6A current source are redundant
hence neglected.

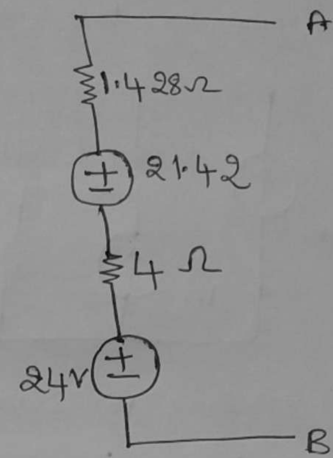


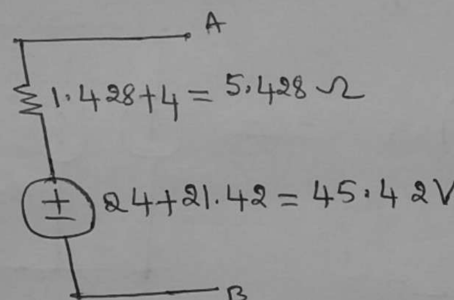
⟹ 10V source can be converted to current source



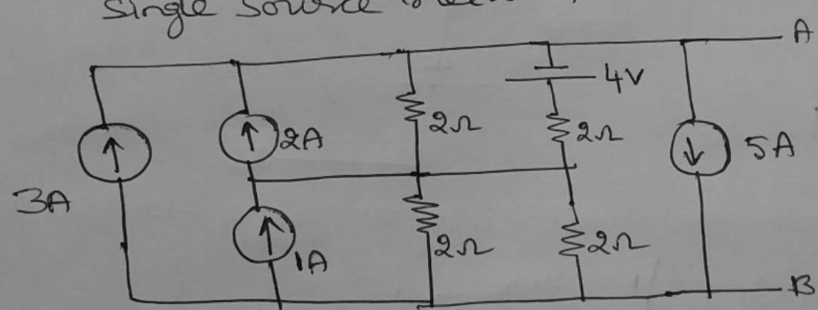


⟹



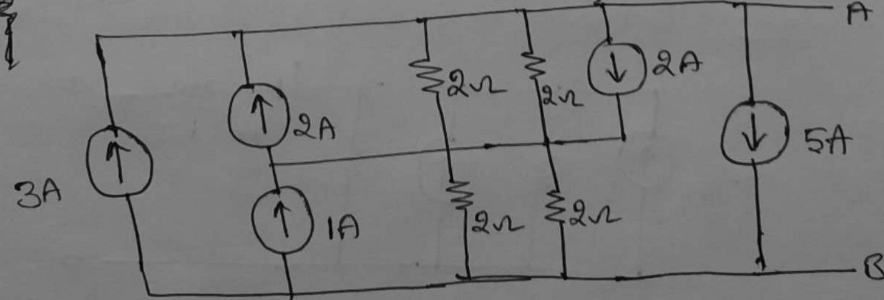


Ex: Using source transformation technique reduce it into a single source network.

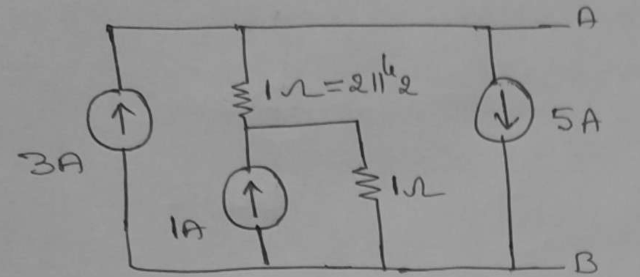


Solution: ~~Since the 2, 2A current sources are acting in opposite direction, the resultant current will be zero.~~

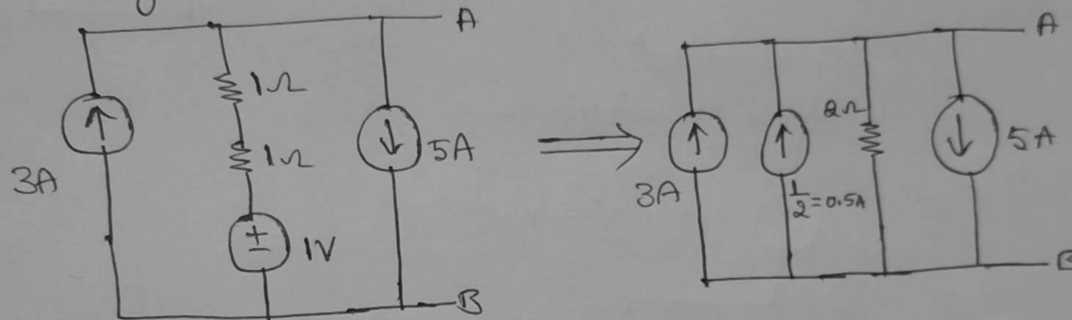
Converting 4V source to a current source.

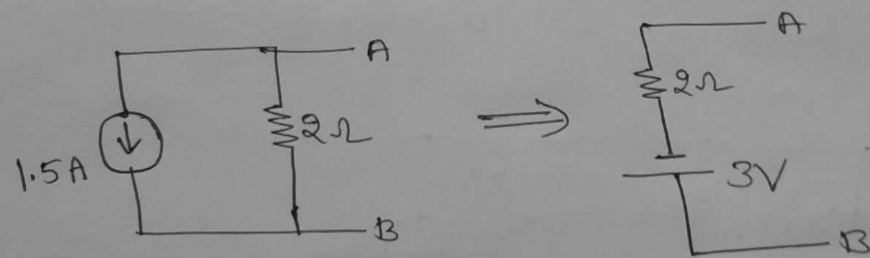


Since the 2, 2A current sources are acting in opposite direction the resultant current will be zero.

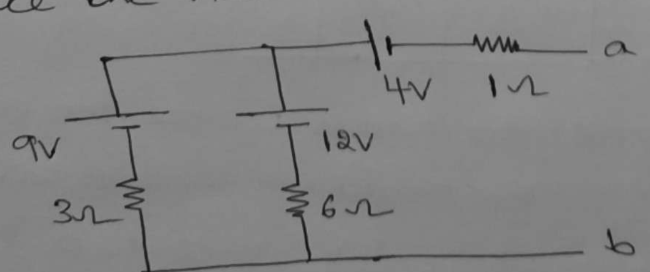


Converting 1A current source to V/g source.

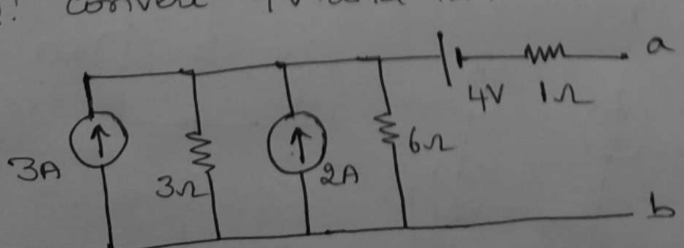




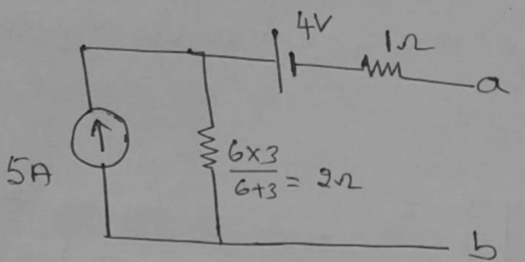
Ex: Reduce the network shown into a single source network.



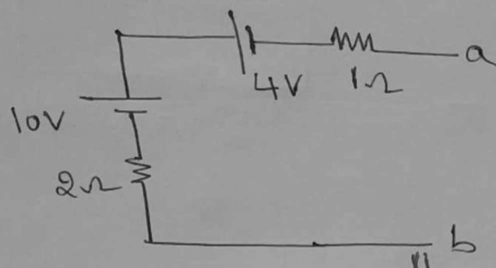
Solution: convert 9V and 12V into current source



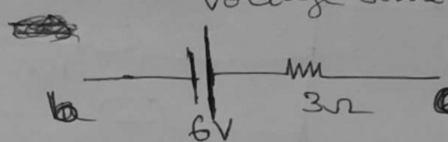
Combine 3A and 2A current source, direction is same
∴ perform addition.

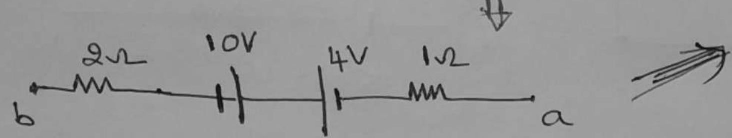


Convert 5A current Source into voltage Source

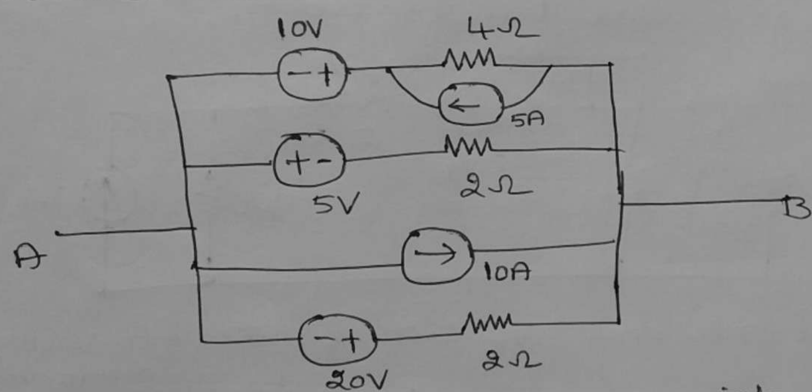


Combing 4V and 10V Voltage Source

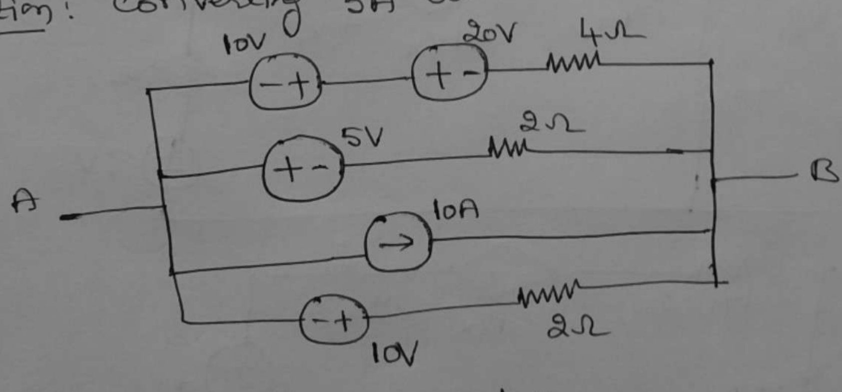


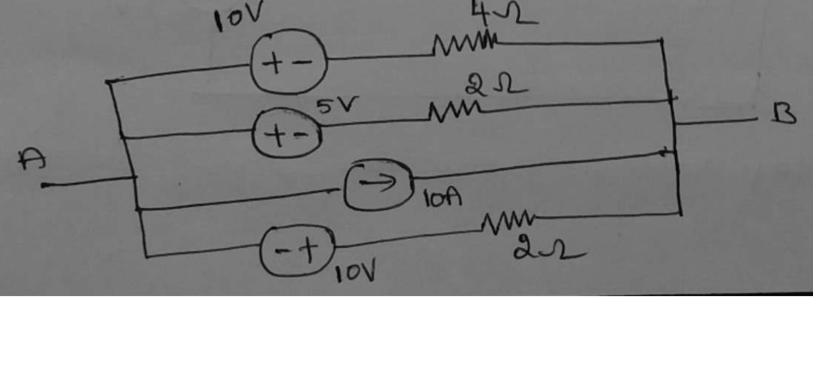


Ex: Reduce the network shown into a Single Source network.

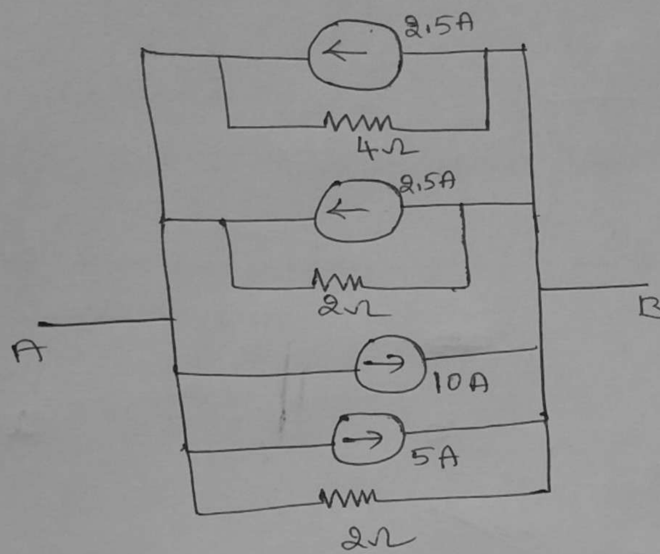


Solution: converting 5A current Source into Voltage Source

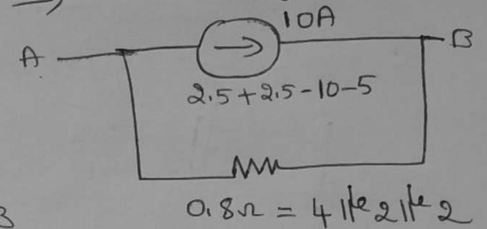




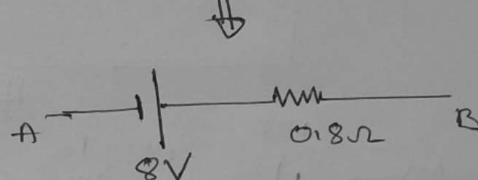
Converting all voltage sources into its equivalent current sources.



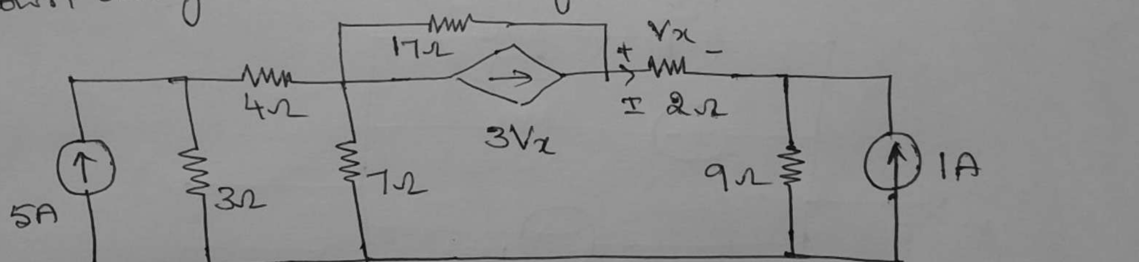
⟹ combining current source



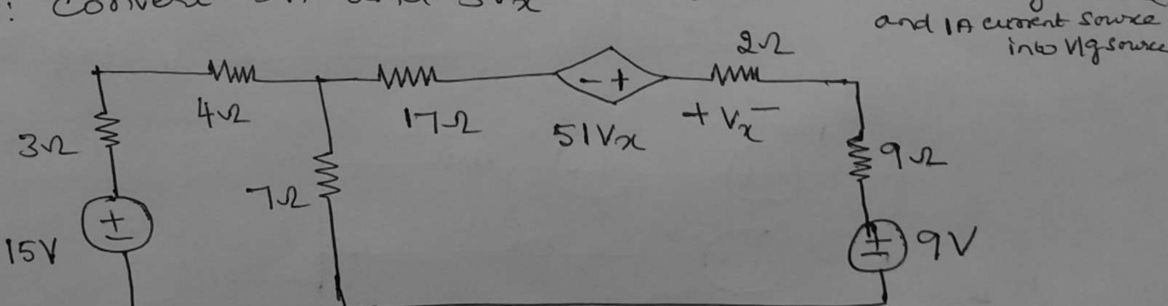
⇓

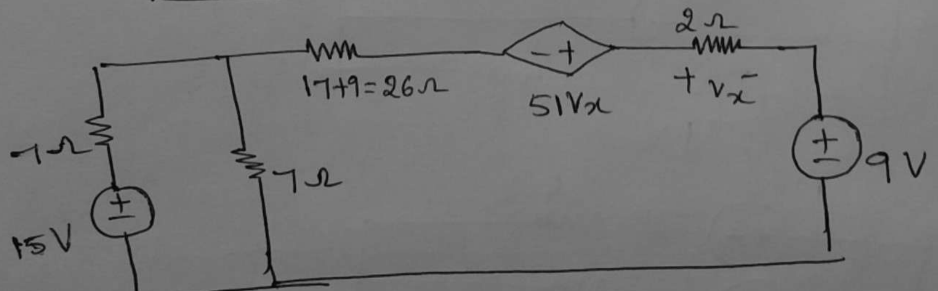


Ex: Calculate the current through 2Ω resistor for the circuit shown using source transformation.

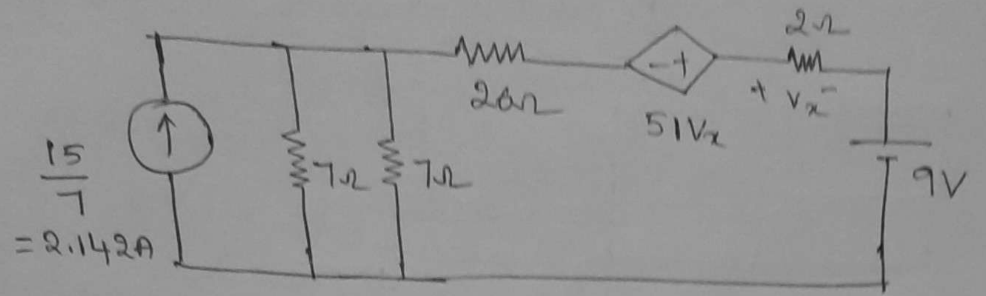


Solution: convert 5A and $3V_x$ current source into voltage source and 1A current source into V/g source





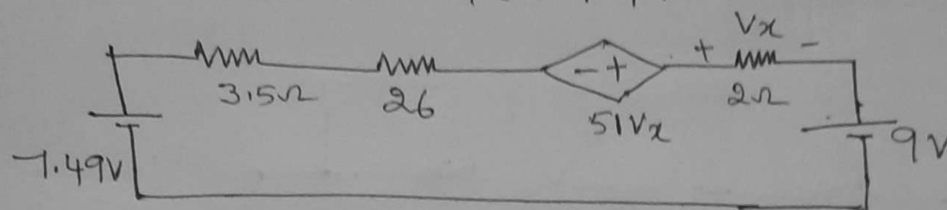
convert 15V voltage source into current source

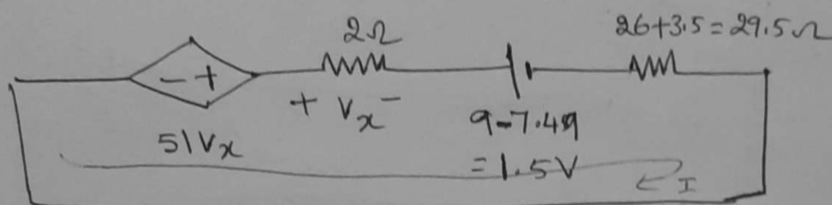


Reduce parallel ⇒ 7 || 7 = 3.5 Ω

Then convert 2.142 A into voltage source

ie $3.5 \times 2.142 = 7.49V$





To find V_x, $V_x = 2I$

Apply KVL to mesh 1

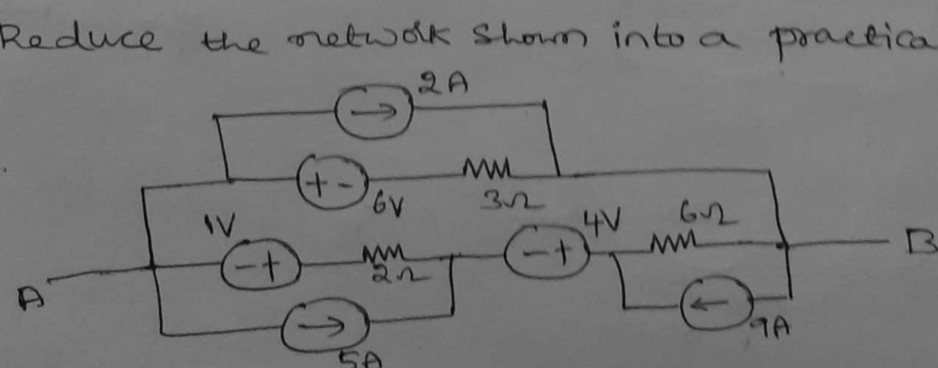
$$-51V_x + 2I + 1.5 + 29.5I = 0$$

$$-51(2I) + 2I + 1.5 + 29.5I = 0$$

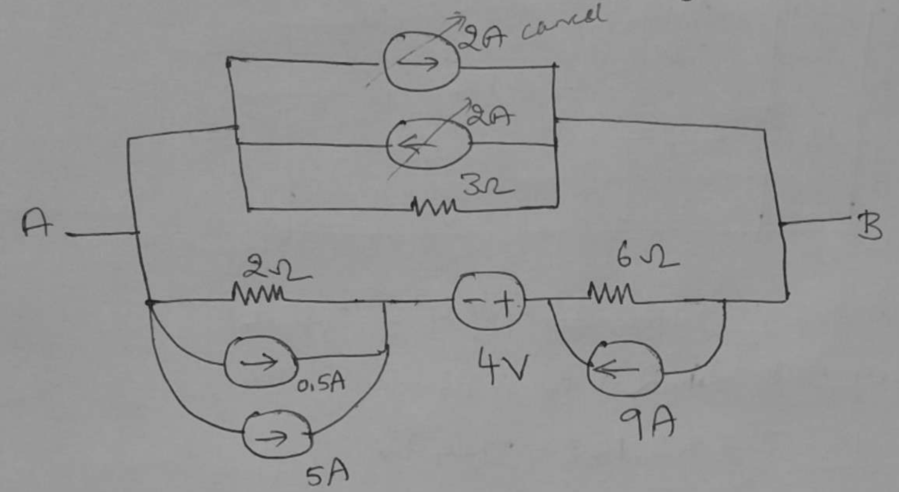
$$-70.5I = -1.5$$

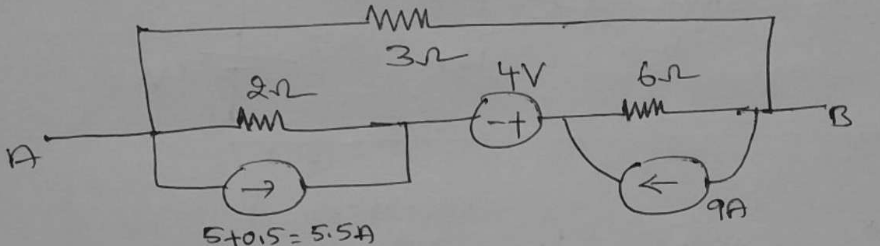
$$\boxed{I = 21.27mA}$$

Ex: Reduce the network shown into a practical voltage source



Solution: Convert 6V and 1V voltage source to current source





convert 5.5A and 9A current sources to voltage source