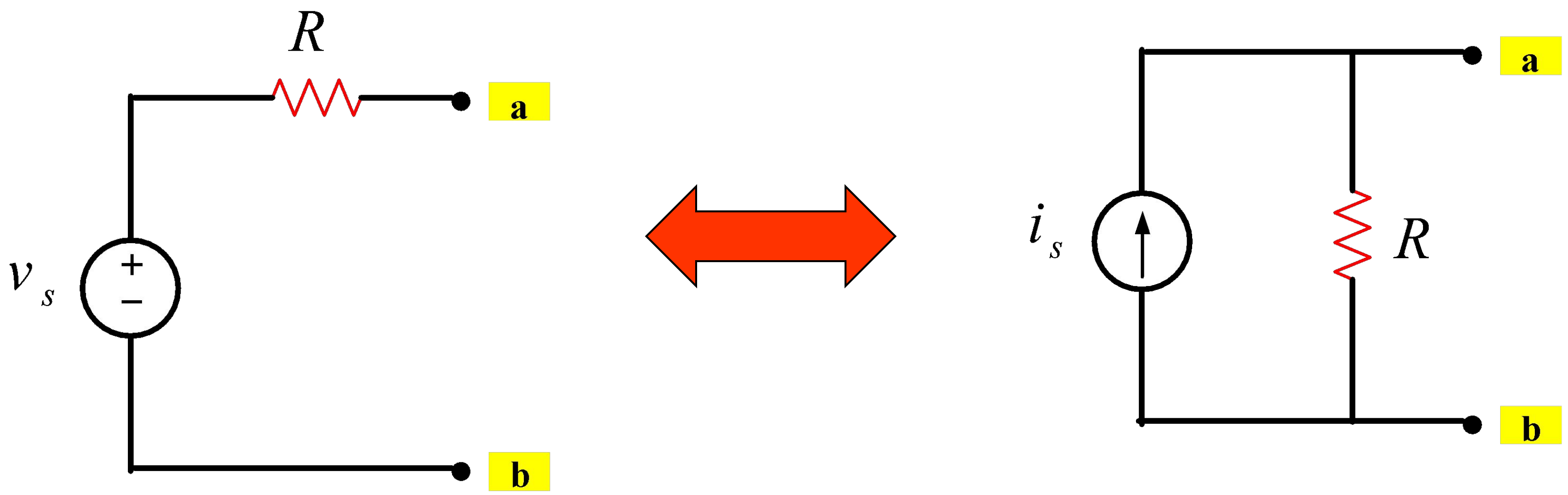
Source Transformations **4.9**

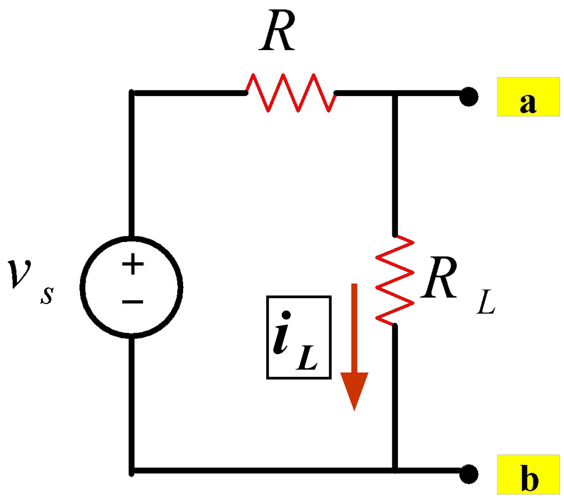
The Node-Voltage Method and the Mesh-Current Method are powerful techniques for .solving circuits

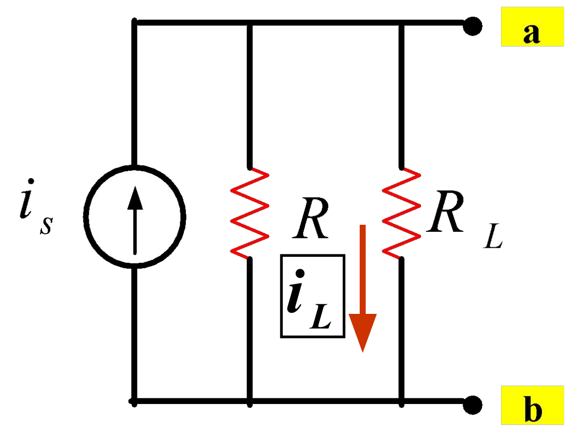
We are still interested in in methods that can be used to simplify circuits like to what we did in parallel and series resistors and **Δ** to **Y** transformations

A method called **Source Transformations** will allow the transformations of a voltage .source in series with a resistor to a current source in parallel with resistor



The double arrow indicate that the transformation is bilateral , that we can start with either configuration and drive the other





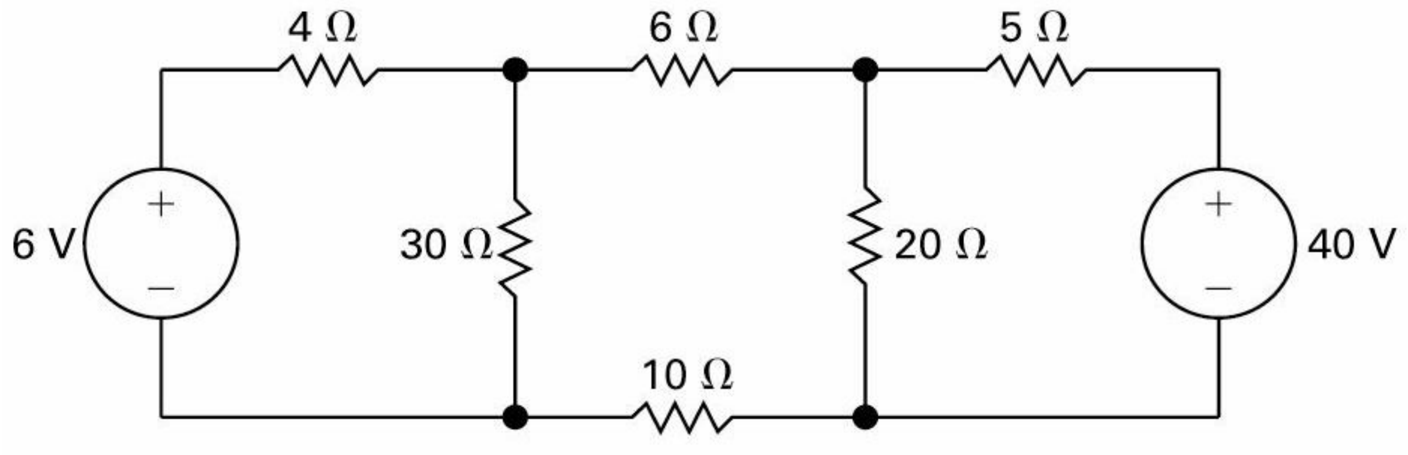
$$\boldsymbol{i}_L = \frac{v_s}{R + R_L}$$

$$\boldsymbol{i}_L = \frac{R}{R + R_L}\boldsymbol{i}_s$$

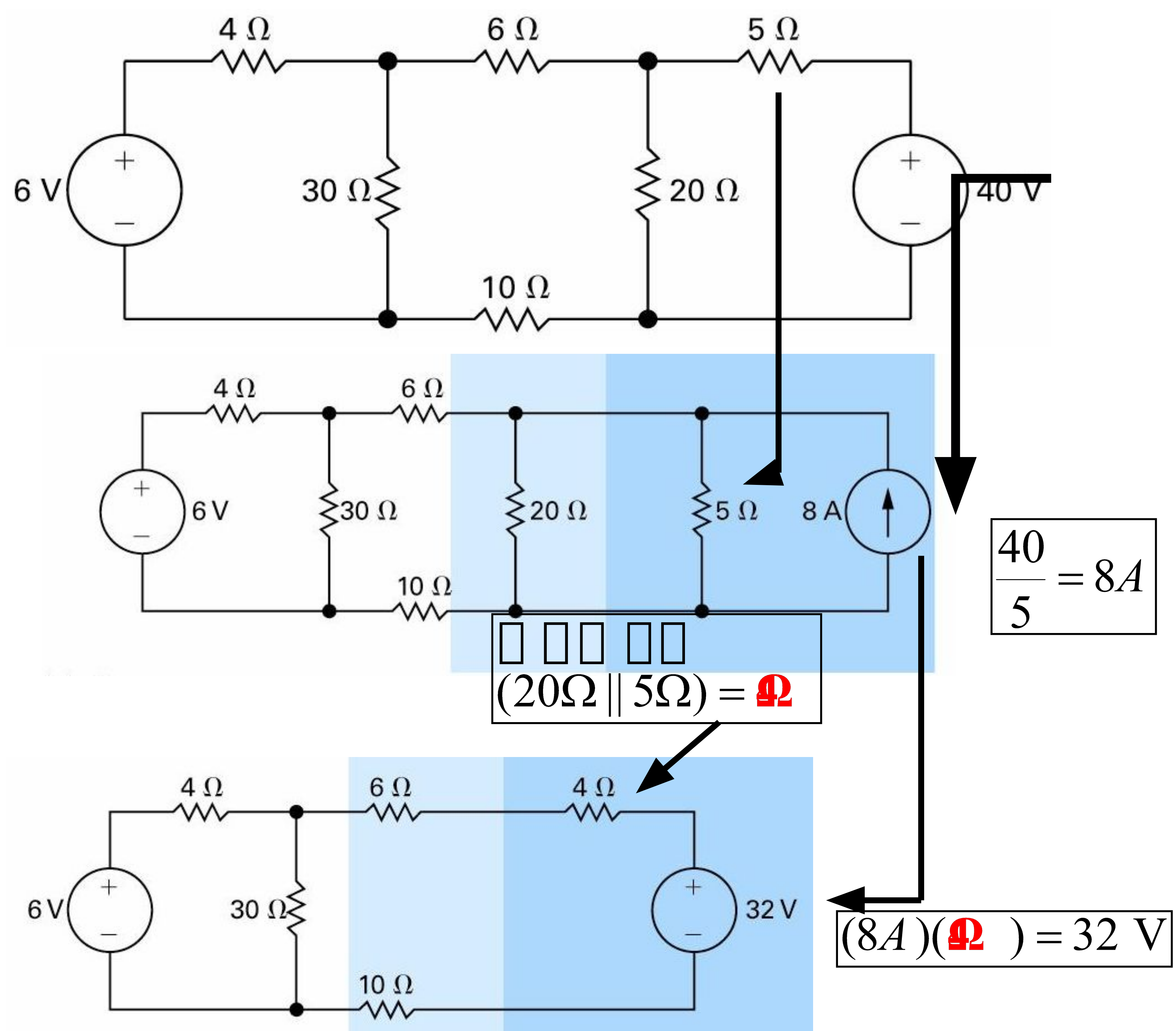
, Equating we have

$$\frac{v_s}{R + R_L} = \frac{R}{R + R_L}\boldsymbol{i}_s \quad \Rightarrow \quad i_s = \frac{v_s}{R} \quad \text{OR} \quad v_s = R i_s$$

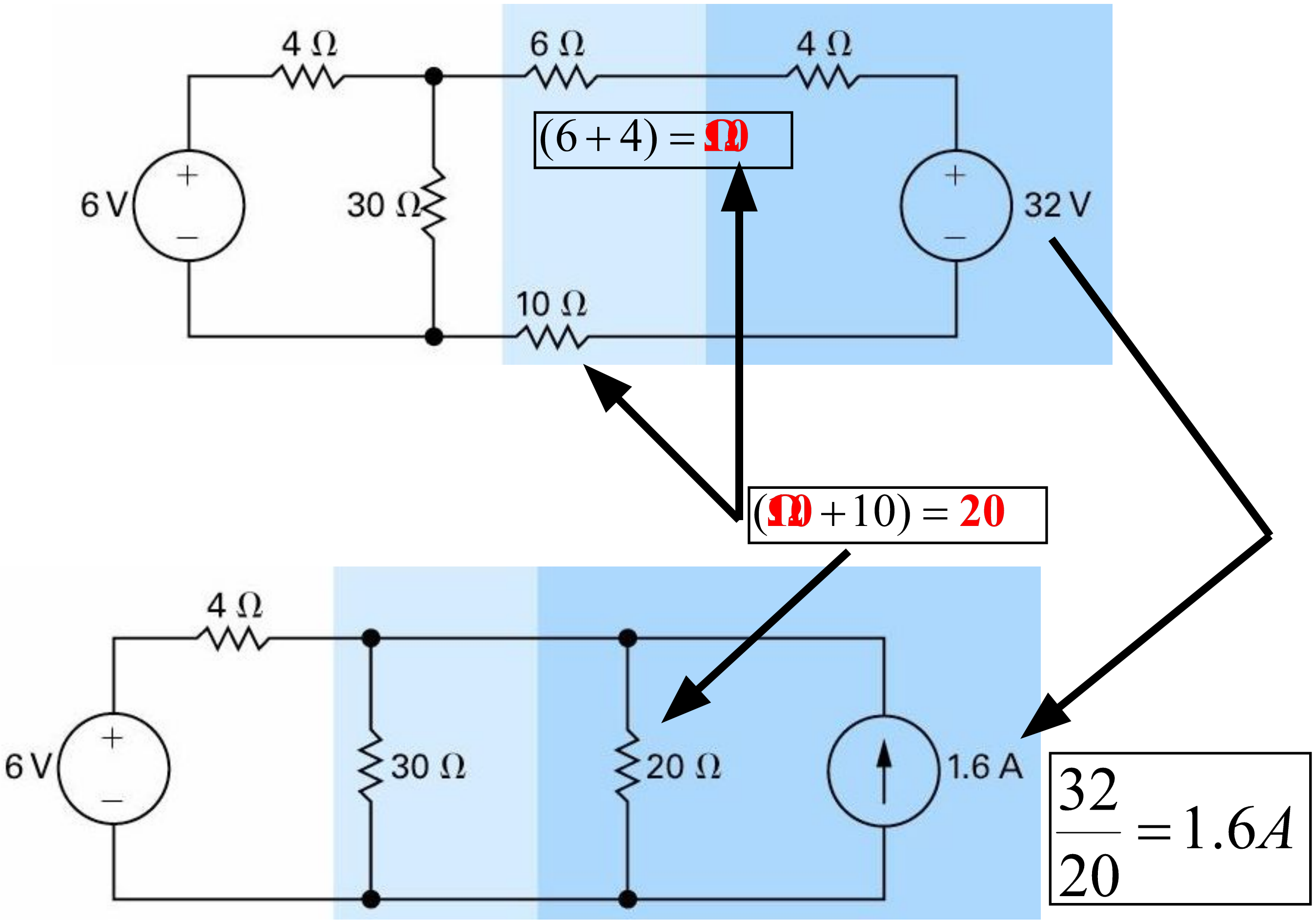
Example 4.8 (a) find the power associated with the 6 V source State whether the 6 V source is absorbing or (b) delivering power



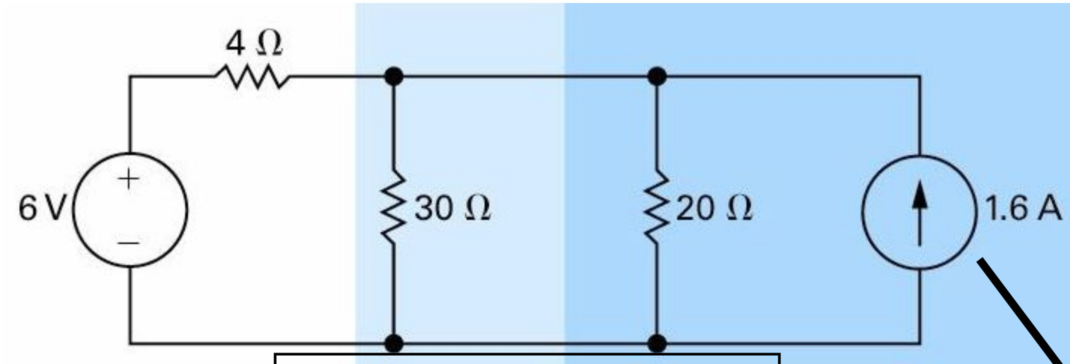
We are going to use source transformation to reduce the circuit, however note that we .will not alter or transfer the **6 V** source because it is the objective



4 Ω
6 Ω
5 Ω
6 V
30 Ω
20 Ω
40 V
10 Ω
4 Ω
6 Ω
6 V
30 Ω
20 Ω
5 Ω
8 A
10 Ω
$\frac{40}{5} = 8A$
$(20\Omega \,||\, 5\Omega) = 4\Omega$
4 Ω
6 Ω
4 Ω
6 V
30 Ω
32 V
10 Ω
$(8A)(4\Omega) = 32\ \mathrm{V}$



4 Ω
6 Ω
4 Ω
6 V
30 Ω
32 V
10 Ω
(6 + 4) = 10Ω
(10Ω + 10) = 20
4 Ω
6 V
30 Ω
20 Ω
1.6 A
32/20 = 1.6A



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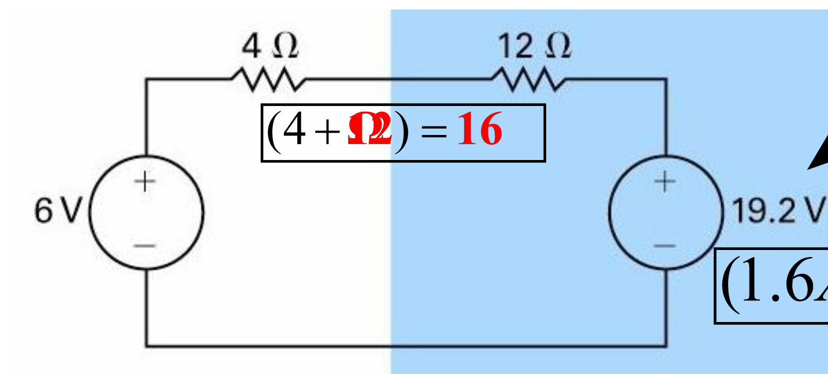
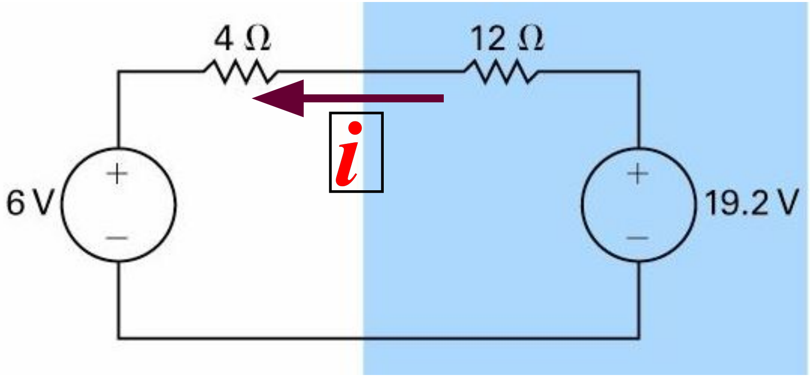
$(30\Omega \,||\, 20\Omega) = 12\Omega$



$(4 + 12\Omega) = 16$

$(1.6A)(12\Omega) = 19.2\ \text{V}$

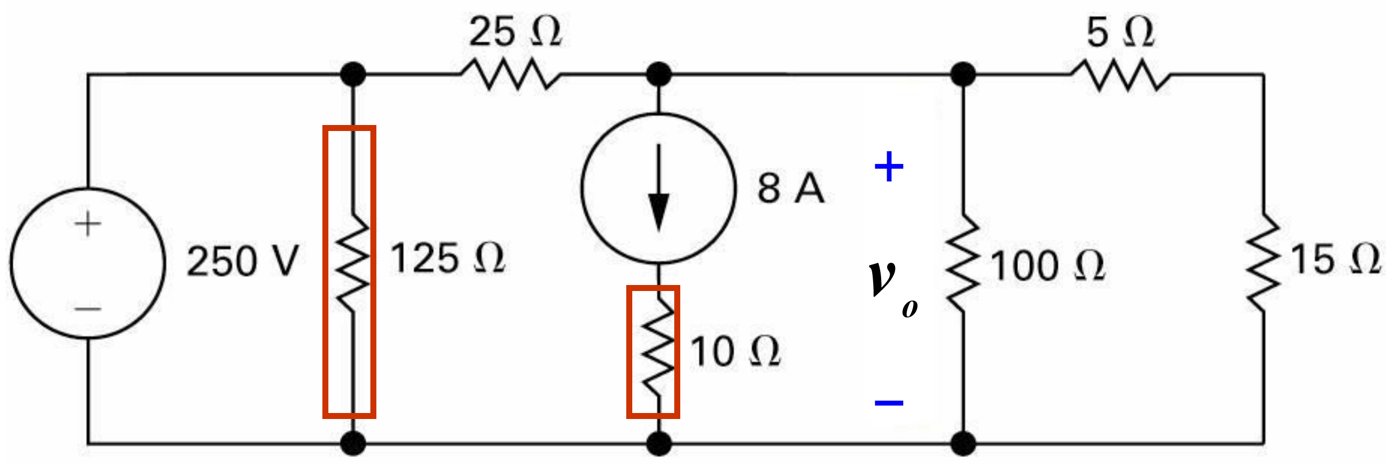


$$i = \frac{19.2-6}{(4+12)} = 0.825 \text{ A}$$

$$\Rightarrow P_{6V} = (0.825)(6) = 4.95 \text{ W}$$

It should be clear if we transfer the 6V during these steps you will not be able to find the power associated with it

? **Example 4.9** (a) use source transformations to find the voltage v_o



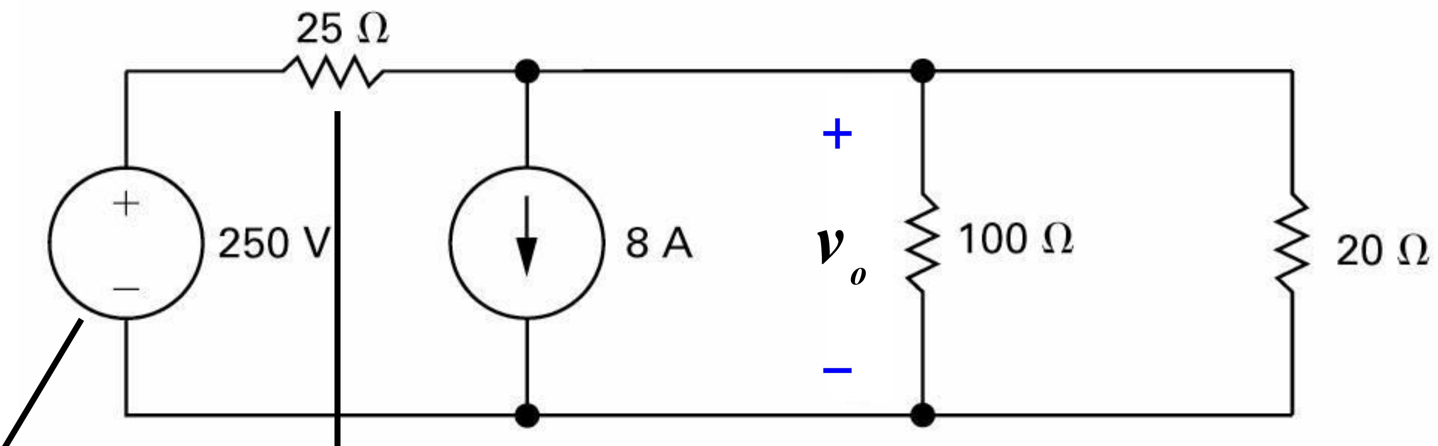
Since the **125 Ω** resistor is connected across or in parallel to the **250 V** source then we can remove it without altering any voltage or current on the circuit except the 250 V current which is not an objective any how

Our objective is v_o

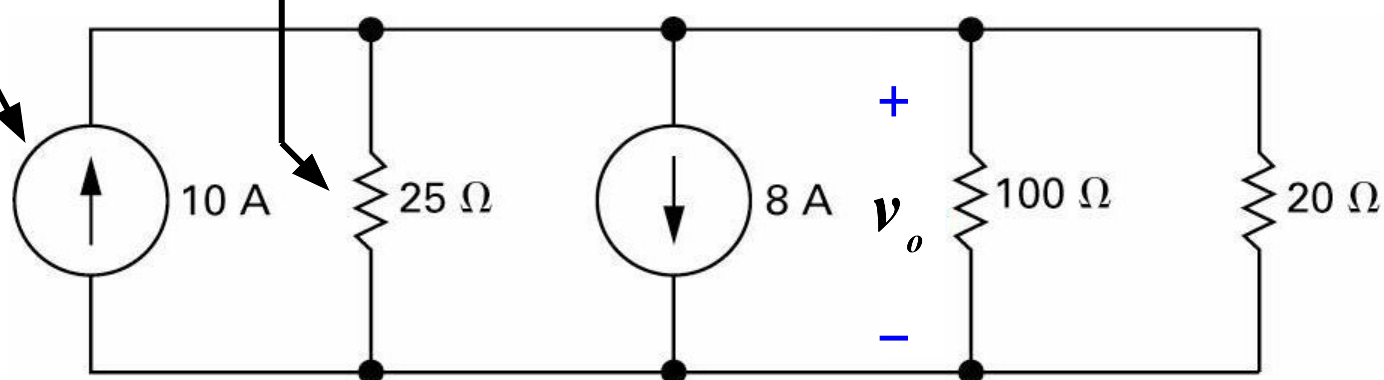
Therefore we remove the **125 Ω**

Similarly the **10 Ω** resistor is connected in series with the **8 A** source then we can remove it without altering any voltage or current on the circuit

Now the circuit become



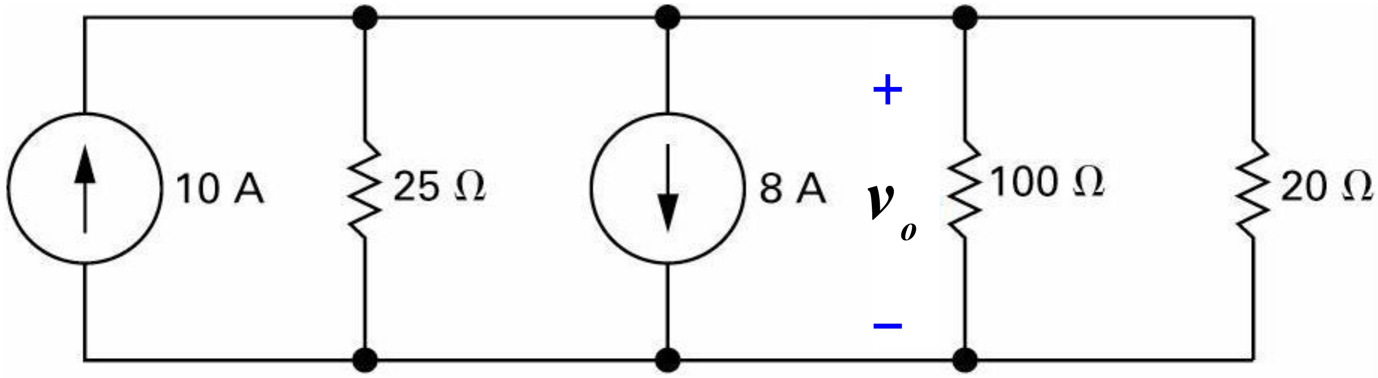
We now use the source transformation to replace the **250 V** with the **25 Ω** resistor with a current source and parallel resistor



$$\frac{250}{25} = 10A$$

We now combine the parallel resistors

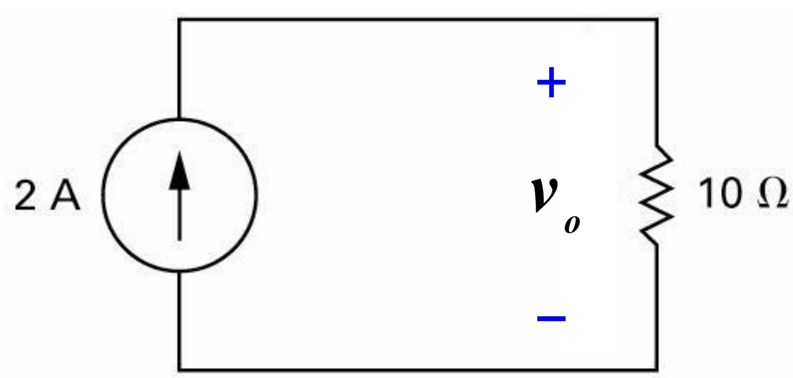
$$(25\Omega \,||\, 100\Omega \,||\, 20\Omega) = 10\Omega$$



We now combine the parallel resistors

$$(25\Omega \,||\, 100\Omega \,||\, 20\Omega) = 10\Omega$$

The circuit now become



$$\Rightarrow v_o = (2A)(10\Omega) = 20 \text{ V}$$