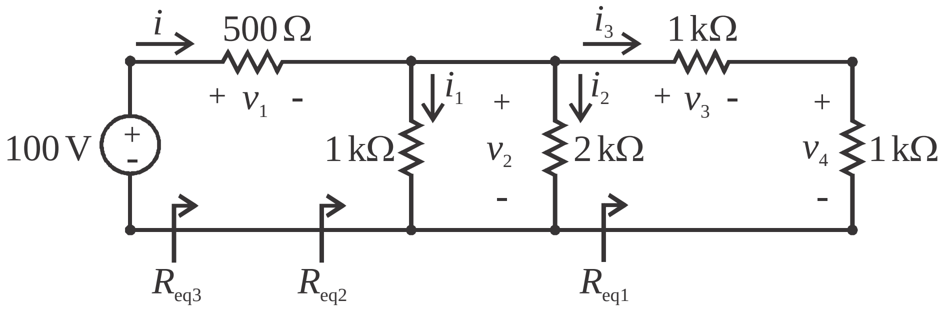
Example- Use **<u>circuit reduction</u>** techniques to solve for indicated variables

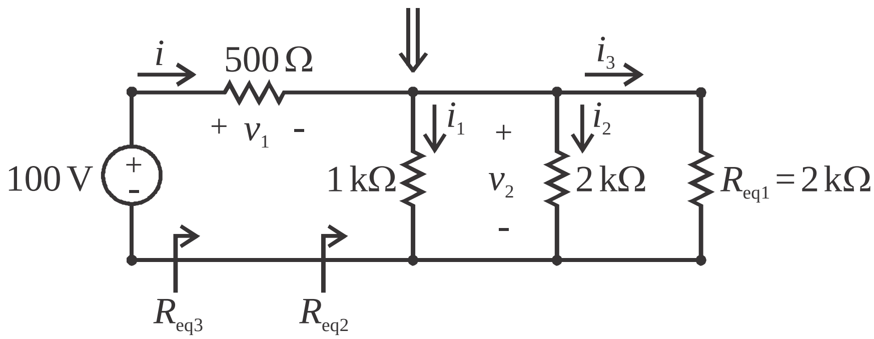


<u>Step 1</u>

Start by noting that the two 1 kΩ resistors furthest from the source are in **series**. Combine & replace with equivalent resistance

$$R_{eq1} = 1000 + 1000 \rightarrow \boxed{R_{eq1} = 2\text{ k}\Omega}.$$

Note that voltages v_3 and v_4 are 'lost' in the new reduced equivalent circuit.

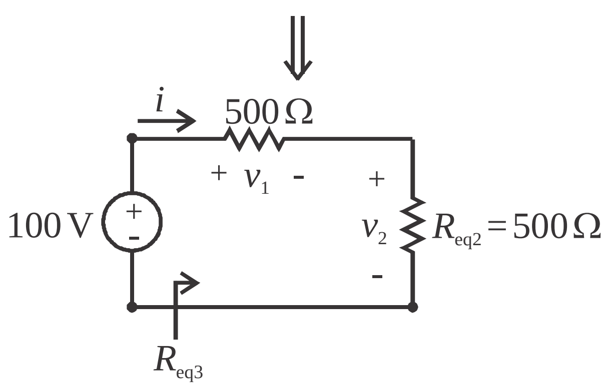


<u>Step 2</u>

Note that the three resistors (1 kΩ, 2 kΩ, & R_{eq1}) now furthest from the source are in **parallel**. Combine & replace with equivalent resistance

$$R_{eq2} = [1000^{-1} + 2000^{-1} + 2000^{-1}]^{-1} \rightarrow \boxed{R_{eq2} = 500\ \Omega}.$$

Note that currents i_1, i_2, and i_3 are 'lost' in the new reduced equivalent circuit.



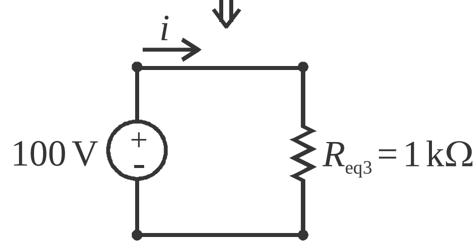
Step 3

Note that the remaining two 500 Ω resistors are in **series**. Combine & replace with equivalent resistance

$$R_{eq3} = 500 + 500 \rightarrow \boxed{\mathbf{R_{eq3} = 1\ k\Omega}}.$$

Note that voltages v_1 and v_2 are 'lost' in the final reduced equivalent circuit.

$\Downarrow$



Now, we can start solving for currents and voltages by determining the unknown current i for the final reduced equivalent circuit. By Ohm's Law,

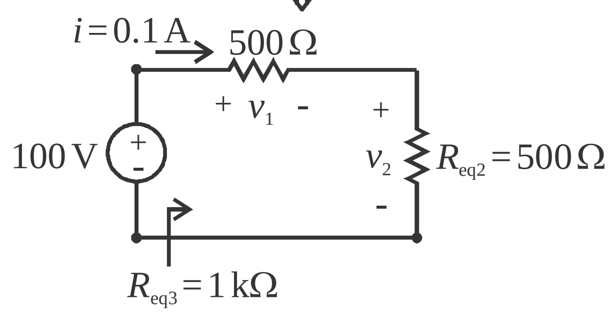
$$i = 100\ V / R_{eq3} = 100/1000 \rightarrow \boxed{\mathbf{i = 0.1\ A = 100\ mA}}.$$

Next, we will 're-expand' or undo the circuit reduction to find the remaining currents and voltages.

Step 4

Knowing i, go back to the circuit of step 2 and find v_1 and v_2.

$\Downarrow$



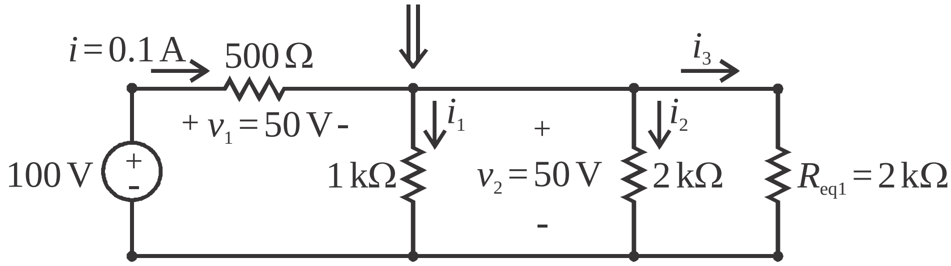
By Ohm's Law, $v_1 = v_2 = i\,(500\ \Omega) = 0.1\,(500) \rightarrow \boxed{\mathbf{v_1 = v_2 = 50\ V}}$.

Alternatively, we can find v_1 and v_2 by voltage division

$v_1 = v_2 = 100V\,(500\ \Omega / R_{eq3}) = 100\,(500/100) \rightarrow \boxed{\mathbf{v_1 = v_2 = 50\ V}}$.

Step 5

Knowing i, v_1, and v_2, go back to circuit of step 1 and find i_1, i_2, & i_3.



By Ohm's Law,

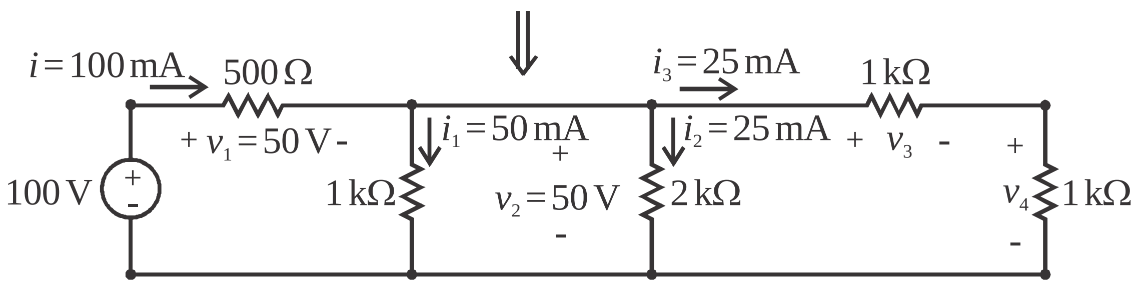
$i_1 = v_2 / 1\ \text{k}\Omega = 50 / 1000 \;\rightarrow\;$ $\boxed{\boldsymbol{i_1 = 0.05\ \text{A} = 50\ \text{mA}}}$, and

$i_2 = i_3 = v_2 / 2\ \text{k}\Omega = 50 / 2000 \;\rightarrow\;$ $\boxed{\boldsymbol{i_2 = i_3 = 0.025\ \text{A} = 25\ \text{mA}}}$.

[Note: We could also use current division to find i_1, i_2, & i_3.]

Step 6

Knowing i, v_1, v_2, i_1, i_2, & i_3, go back to original circuit and find v_3 & v_4.



By Ohm's Law,

$v_3 = v_4 = i_3\,(1\ \text{k}\Omega) = 25{*}10^{-3}(1000) \;\rightarrow\;$ $\boxed{\boldsymbol{v_3 = v_4 = 25\ \text{V}}}$.

[Note: We could also use voltage division to find v_3 and v_4.]

Our **final circuit,** with all values computed, is