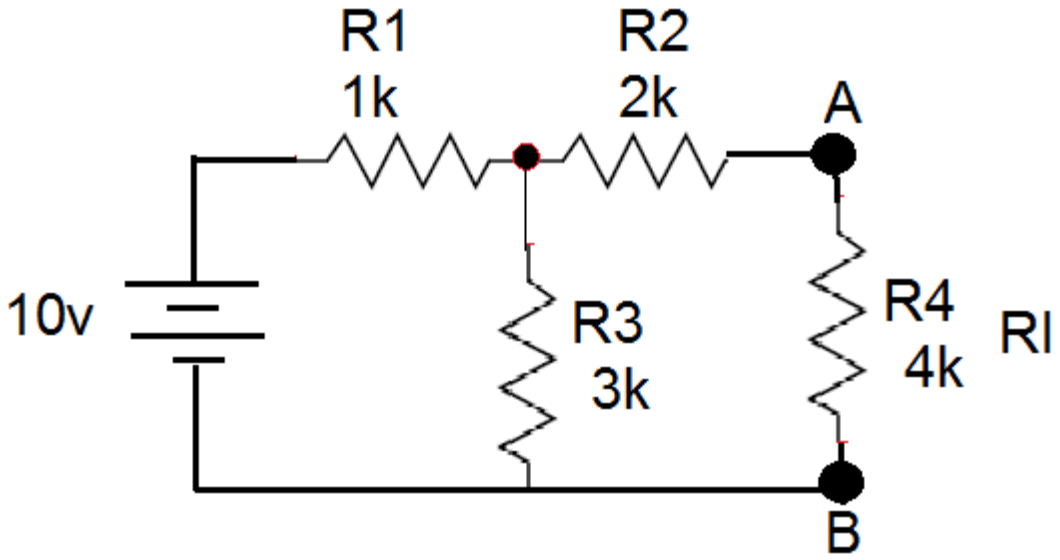
Basic Electricity – Unit 18: Thevenin's Theorem

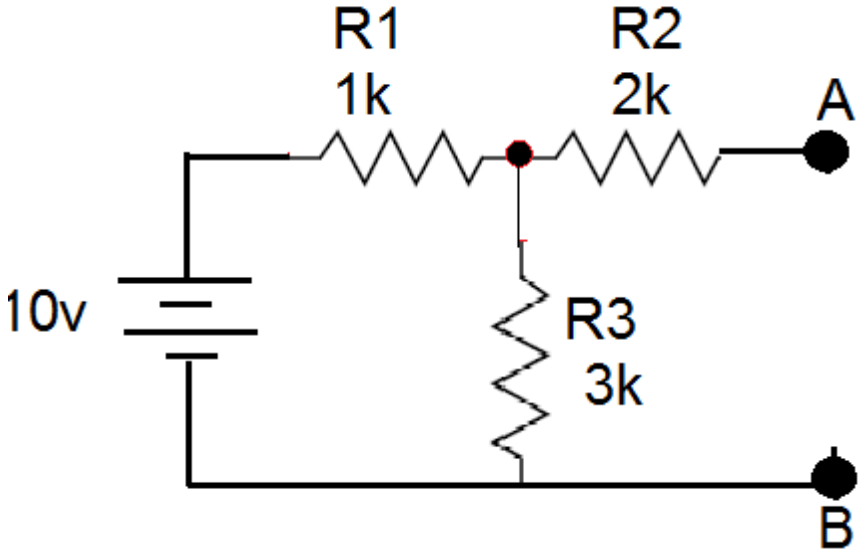
Thevenin's Theorem Worksheet - ANSWERS

ET 29 Construct and debug a series/parallel electrical circuit.
Apply Thevenin's Theorem to simplify the circuit for analysis.
Verify the results through practical substitution and measurement.

1. Find values using Thevenin's Method.
   Find V_{TH}, R_{TH} and the load current flowing through and load voltage across the load resistor.
   Thevenin's Theorem



1. Open the 4kΩ load resistor.



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2. Calculate / measure the Open Circuit Voltage. This is the Thevenin Voltage (V_{TH}).

3. The load has been removed. The circuit became an open circuit as shown.

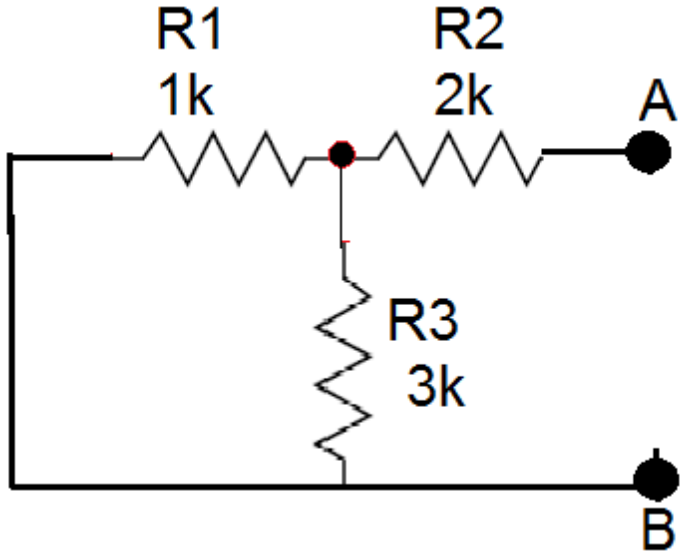
4. Now we have to calculate the Thevenin's Voltage. Since 2.5mA of current flows in both the 1kΩ and the 3kΩ resistors. This is so since this is a series circuit because current will not flow in the 2kΩ resistor as it is open.

5. So 7.5V (2.5mA x 3kΩ) will appear across the 3kΩ resistor.

6. Current is not flowing through the 2kΩ resistor as it is open circuit, but the 2kΩ resistor is in parallel with 3k resistor.

7. The same voltage (i.e. 7.5V) will appear across the 2kΩ resistor as 3kΩ resistor. Therefore 7.5V will appear across the AB terminals. So, **V_{TH} = 7.5V**

8. Open Current Sources and Short Voltage Sources.



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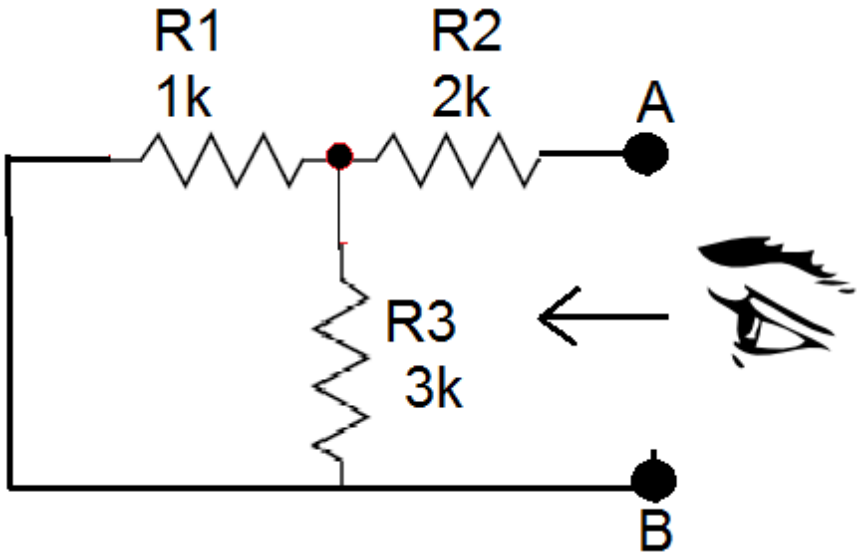
9. Calculate /measure the Open Circuit Resistance. This is the Thevenin Resistance (R_{TH})

10. The 10V DC source has been reduced to zero.

11. RTH = 2kΩ + [(1kΩ x 3kΩ) / (1kΩ + 3kΩ)]
    RTH = 2kΩ + 750kΩ
    RTH = 2750Ω



12. Connect the R_{TH} in series with Voltage Source V_{TH} and re-connect the load resistor.

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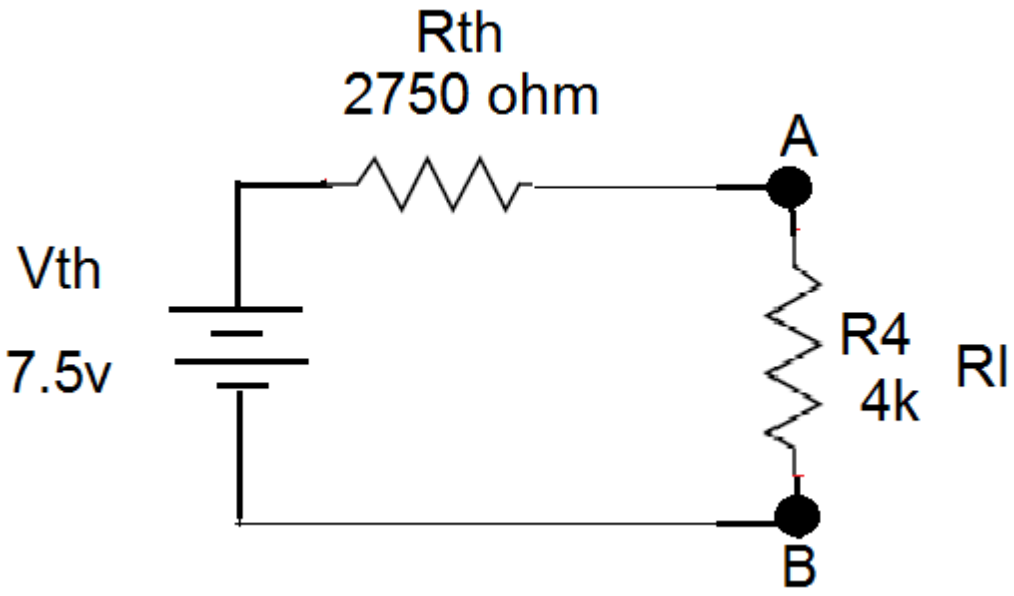

13. Calculate the total load current & load voltage.

$I_L = V_{TH} / (R_{TH} + R_L)$
$= 7.5V / (2750k\Omega + 4k\Omega) \rightarrow = 7.5v/6750\Omega$
$I_L = 1.111$ mA

And

$V_L = I_L \times RL$
$V_L = 1.111$ mA $\times 4k\Omega$
$V_L = 4.444V$

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