Verification of Thevenin's Theorem

4.1 Purpose/Objective:

The aim of this experiment is-

- To be familiar with the Thevenin's theorem and also to verify it.
- To know about its applicability.

4.2 Theory:

- Thevenin's Theorem states that it is possible to simplify any linear bilateral circuit, having a number of sources of energy, to an equivalent circuit with just a single **voltage source (V_{TH})** in series with a **single resistor (R_{TH})** which is connected to a **load (R_L)** where the value of the voltage source (V_{TH}) is equal to the open circuit voltage across the two terminals of the network, and resistance (R_{TH}) is equal to the equivalent resistance measured between the terminals with all the energy sources eliminated.
- The voltage sources are eliminated by shorting their terminals and the current sources are eliminated by opening their terminals.
- The Thevenin's equivalent network looks like this:

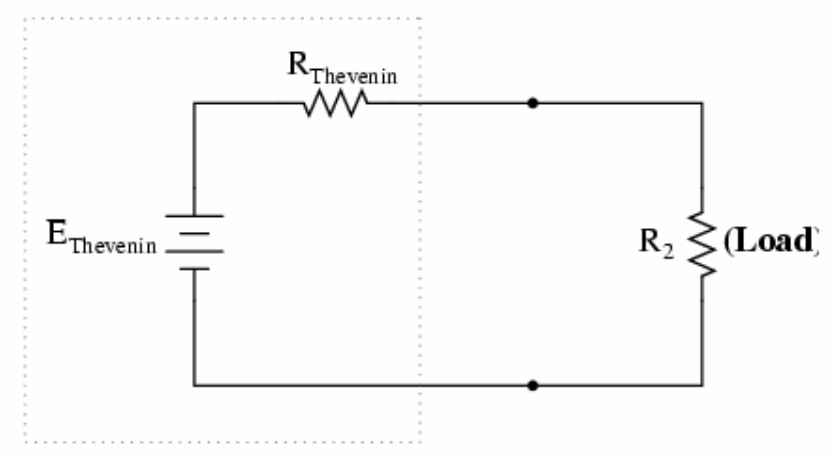

Figure-1: Thevenin equivalent Circuit

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- Consider the circuit given below where R_2 is designated as the "load" resistor. We apply Thevenin's Theorem to it:

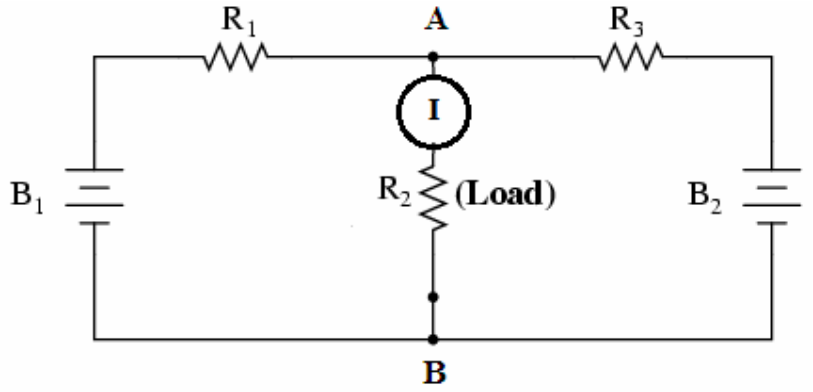

Figure-2: The original circuit under test

In the above circuit, ***I*** represent the value of current through the load resistor R_2. We want to find this current using Thevenin's theorem.

- To find the current ***I*** through the load resistor ***R_2***, just follow the steps below:

1. Remove the load resistor R_2 between terminal A and B and connect a voltmeter across these terminals. Now the circuit looks like this:

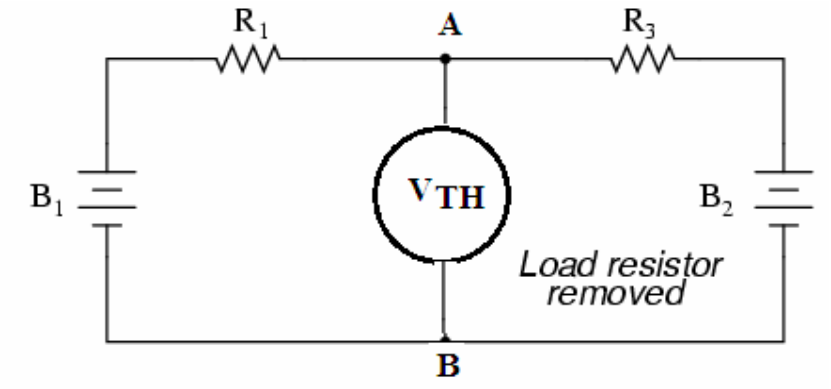

Figure-3: Calculating V_{TH} by removing load resistor R_2

2. Determine Thevenin's voltage V_{TH} by the above circuit.
3. Now determine the Thevenin resistance R_{TH} by removing load resistor from terminal A and B, and removing the power sources and then shorting their terminals as shown in the figure below:

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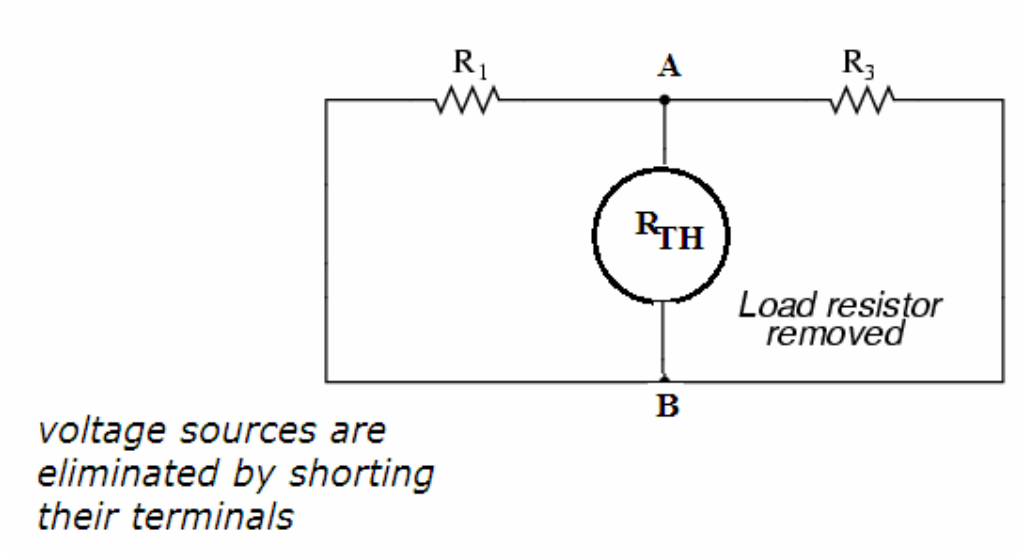

Figure-4: Calculating R_{TH} by removing and then shorting voltage sources

4. After determining the value of V_{TH} and R_{TH}, the Thevenin equivalent circuit is constructed and load resistor R_2 is attached between the terminal A and B shown below:

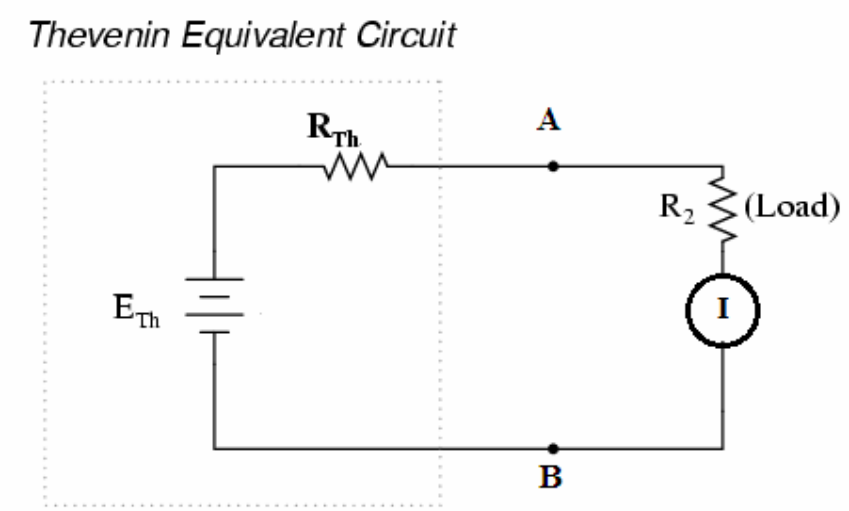

Figure-5: Thevenin's equivalent circuit with load resistor reattached

- If the current reading of figure-2 is same as the reading found in figure-5, then Thevenin's theorem will be verified.

Lab Work: Experiment-4: Verification of Thevenin's Theorem

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4.3 Equipment/ Apparatus:

a) Two regulated variable Power Supply (0-30 V)

b) One Digital Multimeter

c) Circuit Experiment Board (Breadboard)

d) Three resistors

e) Connecting wires

f) Cutting tools etc.

4.4 Cautions:

1. All connections should be tight and correct.
2. Switch off the supply when not in use.
3. Reading should be taken carefully.

4.5 Circuit Diagram:

The circuit diagrams to verify Thevenin's theorem are shown in figure-2, figure-3, figure-4 and figure-5 above.

4.6 Procedure:

1. Construct the circuit on the breadboard, as shown in figure-2 and observe the voltage of the two sources B_1 and B_2. Now take the ammeter reading I.
2. Remove the load resistor R_2 by opening terminal A and B. Connect a voltmeter across these terminals as shown in the figure-3. Now take the reading V_{AB}, which is V_{TH}.
3. Eliminate the voltage sources by shorting their terminals. Place an ohmmeter across terminal A and B as shown in the figure-4. Now take the ohmmeter reading which is R_{TH}.
4. Now construct the Thevenin's equivalent circuit by adding V_{TH} in series with R_{TH}. Then connect load resistor R_2 between terminal A and B. The circuit should look like figure-5. Now take the ammeter reading I.

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5. If the current reading of figure-2 is same as the reading found in figure-5, then Thevenin's theorem will be verified.
6. From the exact values of R_1, R_2, R_3, E_1 and E_2, calculate I through R_2 analytically. Compare the analytical value with that of the experimental value.

4.7 Data Table:

Fill up the following table and discuss on the experimental results.

Reading No.	I **(mA) Fig-2**	V_{TH} **(volt)**	R_{TH} **(Ohm)**	I **(mA) Fig-5**
1.				
2.				
3.				
4.				
5.				

4.8 Result:

Thevenin's Theorem has been verified.