Practical No: 5

Aim: To study and verify Thevenin’s Theorem.

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APPARATUS:

1. Network Theorems Trainerkit.
2. Multimeter.
3. ConnectingLeads.

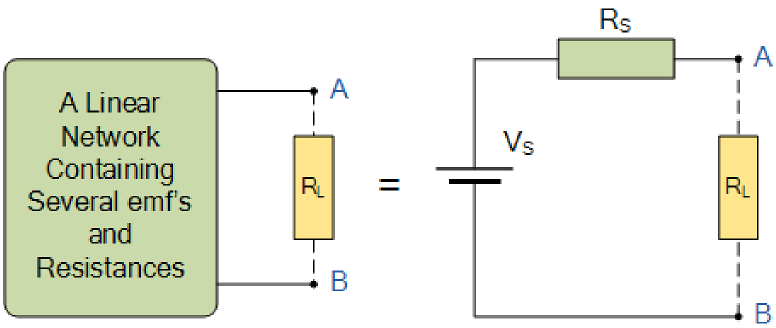
THEORETICAL BACKGROUND:

Thevenin Theorem is converse of Norton’s Theorem. It consists of equivalent current source instead of equivalent voltage source as we do in Norton’s theorem .The determination of internal resistance of the source network is identical in both the theorems. However, in final stage, i.e., in the Thevenin equivalent circuit, the equivalent voltage source is placed in series with the internal resistance unlike to that in Norton’s theorem where the current generator was placed in parallel to the internal resistance

Statement of Thevenin’s Theorem :

A linear active network consists ofindependent and dependent voltage and current sources and linear bilateral network elements can be replaced by an equivalent circuit, consisting of a voltage source in series with a resistance. The voltage source beingthe open circuited voltage across the load terminal and the resistance being theinternal resistance of the source network, looking through the open circuited loadterminals.

PROCEDURE:



Sequences to find value of R_{TH} and V_{TH}

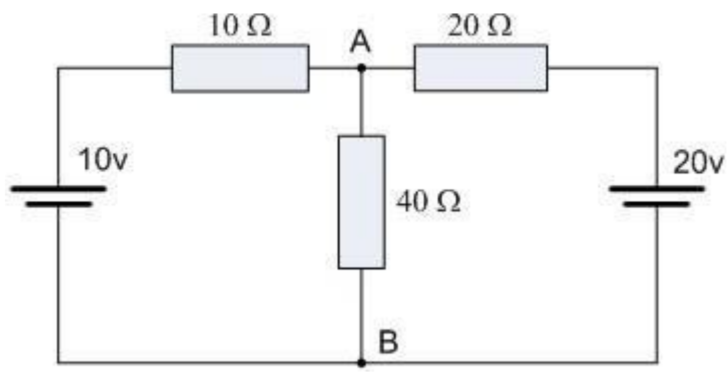
1. Remove that portion of the network across which the Thevenin equivalent circuit isto be found. In the figure 1, this requires that theload resistor R_L be temporarily removed from the network.
2. **R_{TH}**
   Calculate R_N by first setting all sources to zero (voltage sources are replaced by short circuits and current sources by open circuits) and then finding the resultant resistance between the two marked terminals. (If the internal resistance of the voltage and/or current sources is included in the original network, it must remain when the sources are set to zero.)
   $$R_N = R_3 + (R_1R_2/R_1+R_2)$$
3. **V_{TH}**
   Calculate V_{TH} by first open the load and find the open circuit voltage across the load terminals using conventional networkanalysis.
   $$V_{TH}=(E/R_1+R_2)R_2$$

Thevenin's equivalent circuit is drawn by keeping R_N in series to voltage source as shown in figure1.

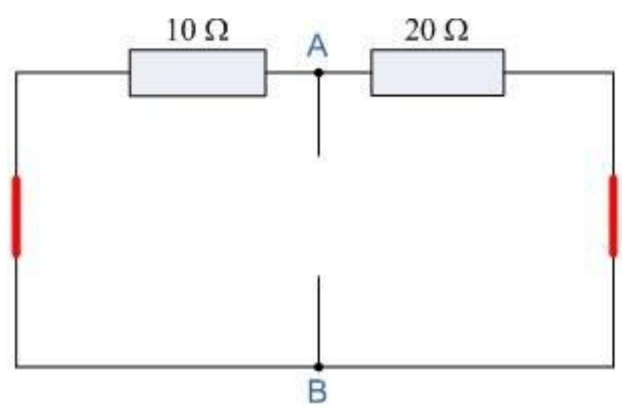
4. Reconnect the load resistance (R_L) across the load terminal and the current through it (I_L) is then givenby;

$$I_L = \left(\frac{V_{TH}}{R_{TH} + R_L}\right)$$

For example, consider the following circuit;



Firstly, we have to remove the centre40Ω resistor and short out (not physically as this would be dangerous) all the emf´s connected to the circuit, or open circuit any current sources. The value of resistor Rs is found by calculating the total resistance at the terminals A and B with all the emf´s removed, and the value of the voltage required Vs is the total voltage across terminals A and B with an open circuit and no loadresistor Rs connected. Then, we get the followingcircuit;

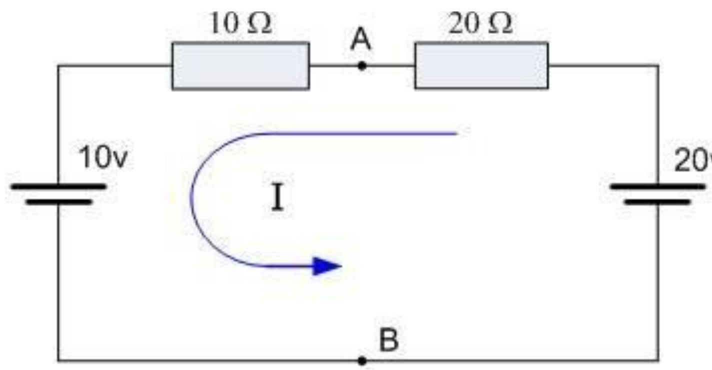


Find the Equivalent Resistance (Rs):

10ΩResistor in parallel with the 20ΩResistor

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{20 \times 10}{20 + 10} = 6.67\Omega$$

Find the Equivalent Voltage (Vs):

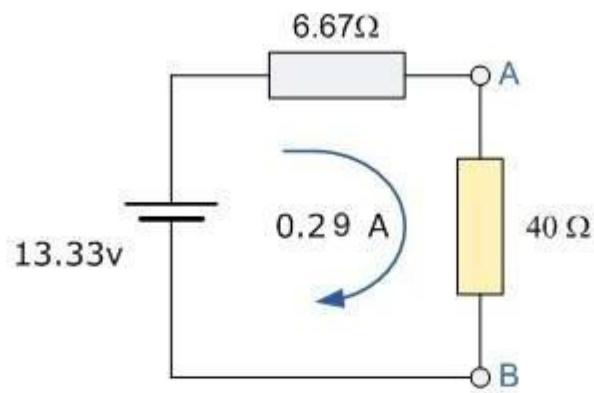


We now need to reconnect the two voltages back into the circuit, and as $V_S = V_{AB}$ the current flowing around the loop is calculated as:

$$I = \frac{20v - 10v}{20\Omega + 10\Omega} = 0.33amps$$

So the voltage drop across the 20Ω resistor can be calculated as:
$V_{AB} = 20 - (20\Omega \times 0.33amps) = 13.33$ volts.

Then the Thevenin's Equivalent circuit is shown below with the 40Ω resistorconnected.



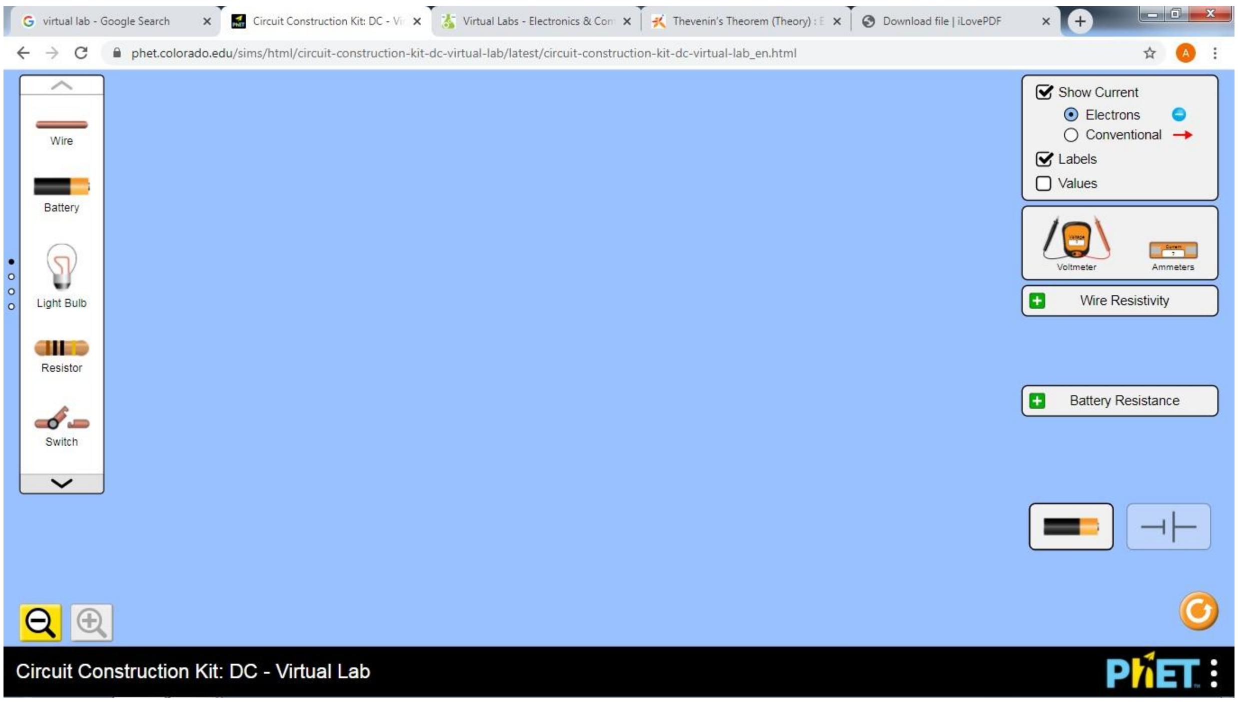
And from this the current flowing in the circuit is given as:

$$I = \frac{13.33v}{6.67\Omega + 40\Omega} = 0.29amps$$

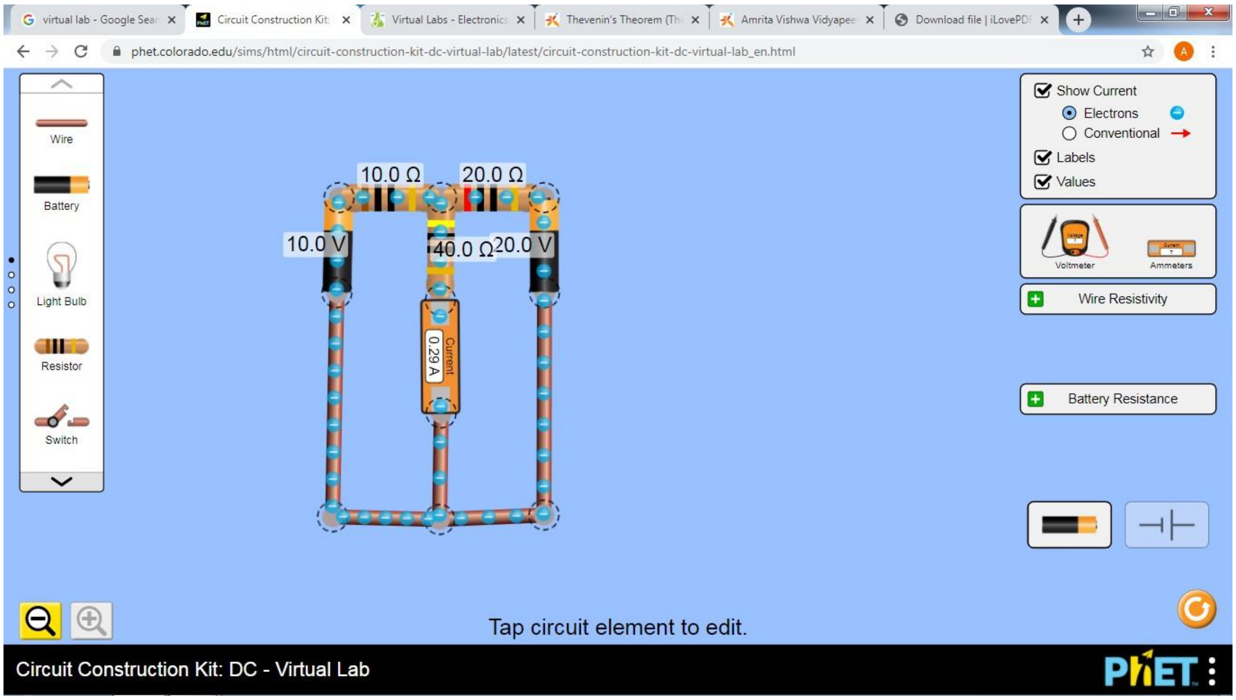
Thevenin's theorem can be used as a circuit analysis method and is particularly useful if the load is to take a series of different values. It is not as powerful as Mesh or Nodal analysis in larger networks because the use of Mesh or Nodal analysis is usually necessary in any Thevenin exercise, so it might well be used from the start. However, Thevenin's equivalent circuits of Transistors, Voltage Sources such as batteries etc, are very useful in circuit design.

Verification of Thevenin's Theorem using the virtual lab simulator:

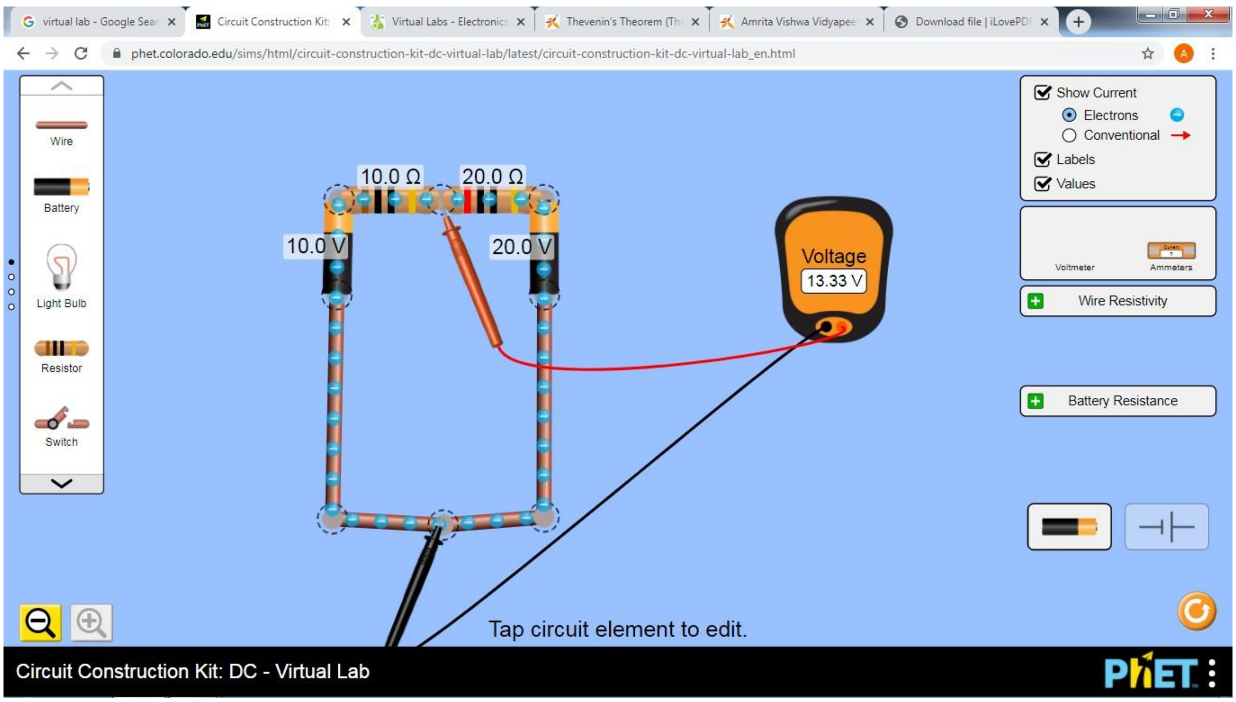
virtual lab:



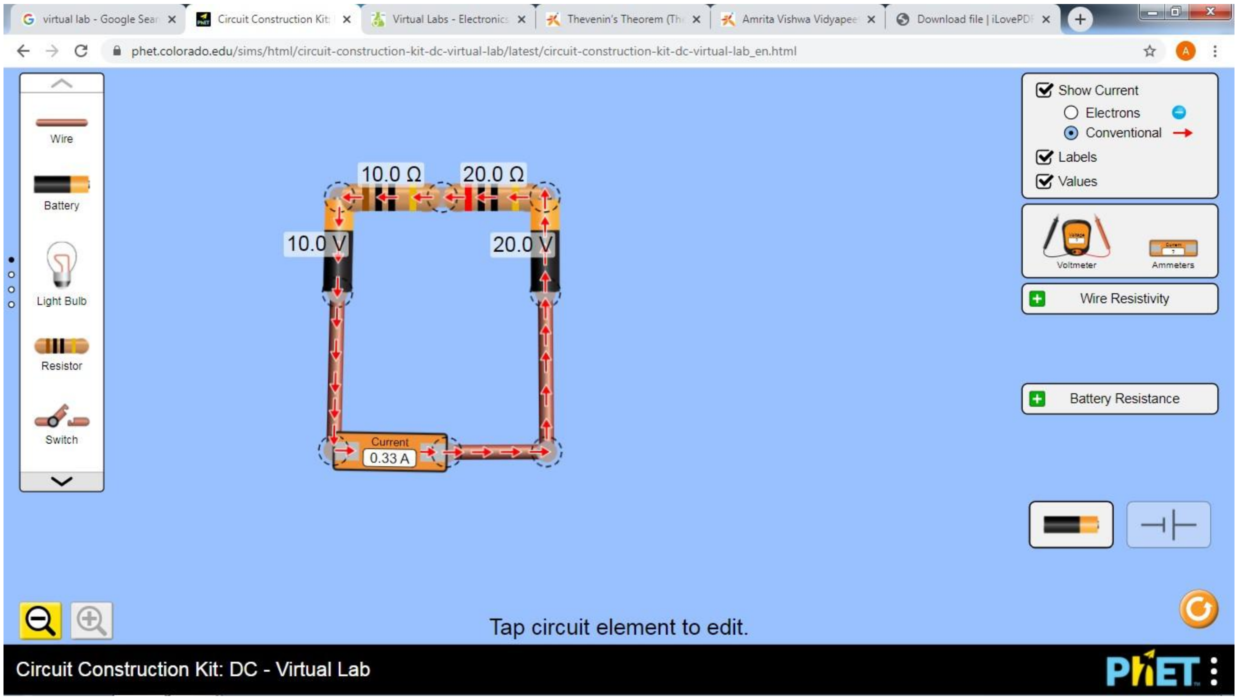
s tep1 :- C reate the ac tual c ircuit and measure the c urrentac ross the load points .



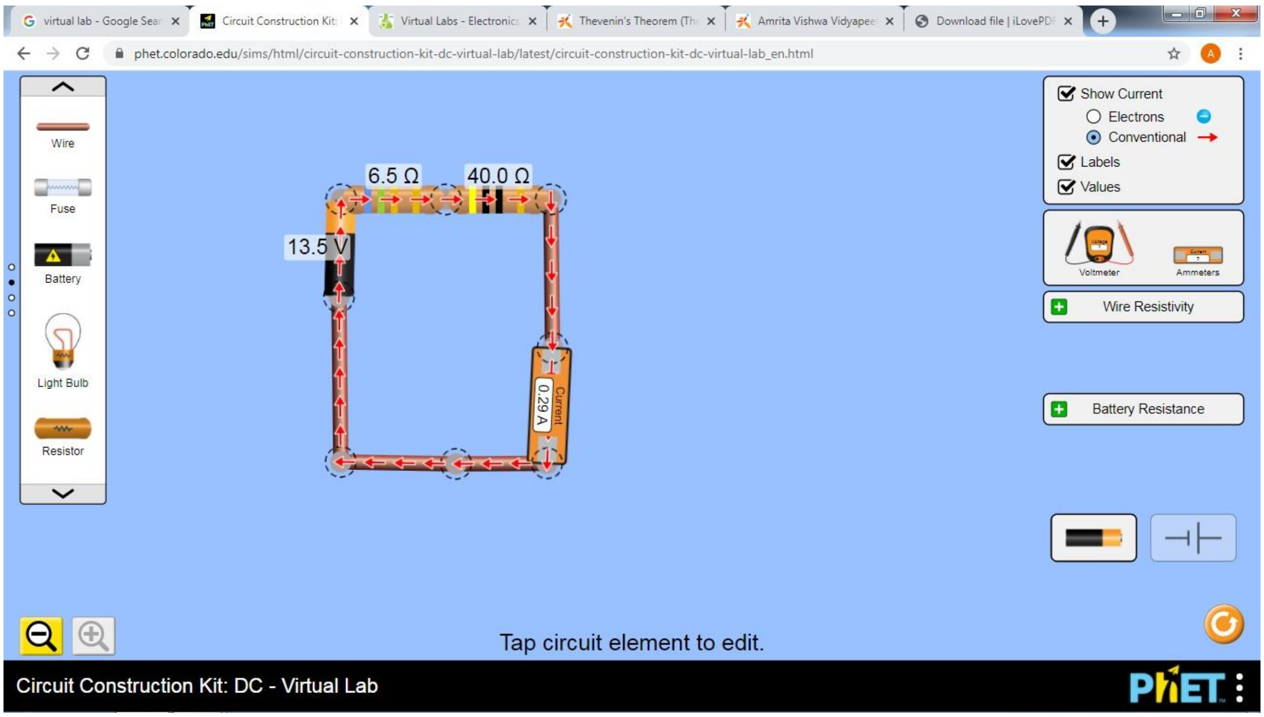
Step 2 :- c reate the voltage across load 40 ohm by this simulator,



Step 3 :- C reate the loop c urrent acc ording to KVL as per in theory in page 11 for find VTH .



Step4:-CreatetheThevenin’sequivalentcircuit
byfirstcreatingtheequivalentvoltagesourceandequivalentresistanceandthenmeasurethecurrentacrosstheloadusinganammeter.



RESULT TABLE:

Sr. No		V_{TH} (v)	R_{TH} (ohm)	I_L (A)
1	Theoretically	13.33	6.67	0.29
2	Practically	13.33	6.67	0.2856

CONCLUSION: