SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-35
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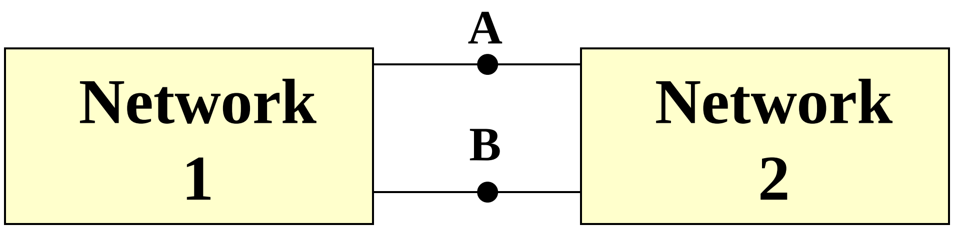
23EET102 / ELECTRIC CIRCUIT ANALYSIS
I YEAR / II SEMESTER
UNIT-II: NETWORK REDUCTION AND THEOREMS

THEVENIN’S AND NORTAN’S THEOREM -1

THEVENIN'S THEOREM:

Consider the following:

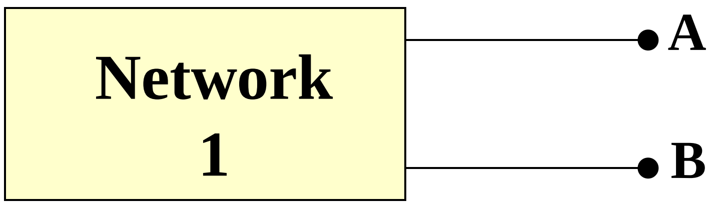


Coupled networks.

For purposes of discussion, at this point, we consider that both networks are composed of resistors and independent voltage and current sources

THEVENIN'S THEOREM:

Suppose Network 2 is detached from Network 1 and we focus temporarily only on Network 1.



Network 1, open-circuited.

Network 1 can be as complicated in structure as one can imagine. Maybe 45 meshes, 387 resistors, 91 voltage sources and 39 current sources.

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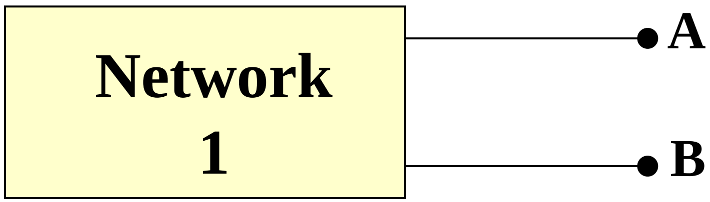
THEVENIN'S THEOREM:



Now place a voltmeter across terminals A-B and read the voltage. We call this the open-circuit voltage.

No matter how complicated Network 1 is, we read one voltage. It is either positive at A, (with respect to B) or negative at A.

We call this voltage V_{os} and we also call it $V_{THEVENIN} = V_{TH}$

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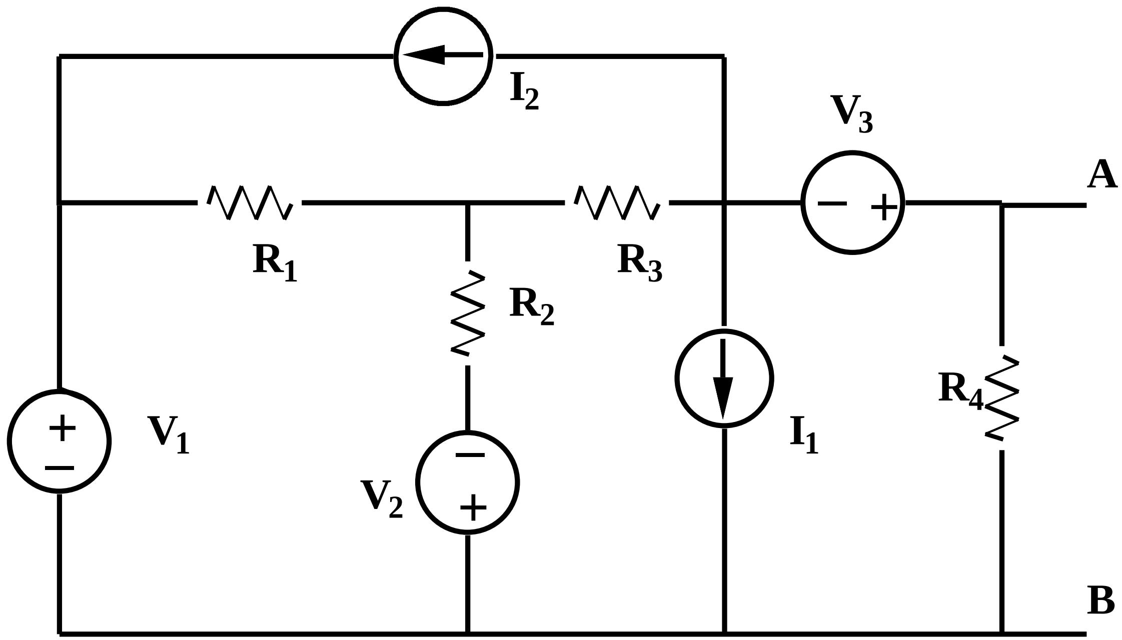
THEVENIN'S THEOREM:

- **We now deactivate all sources of Network 1.**
- **To deactivate a voltage source, we remove the source and replace it with a short circuit.**
- **To deactivate a current source, we remove the source (just open circuit it)**

THEVENIN'S THEOREM:

Consider the following circuit.



How do we deactivate the sources of this circuit?

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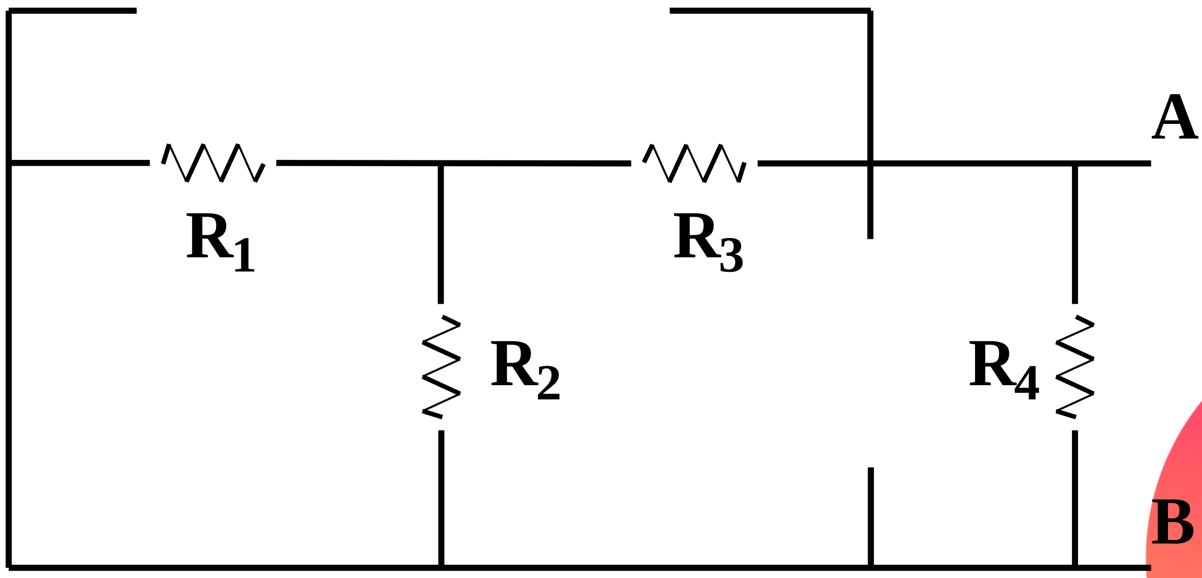
THEVENIN'S THEOREM:

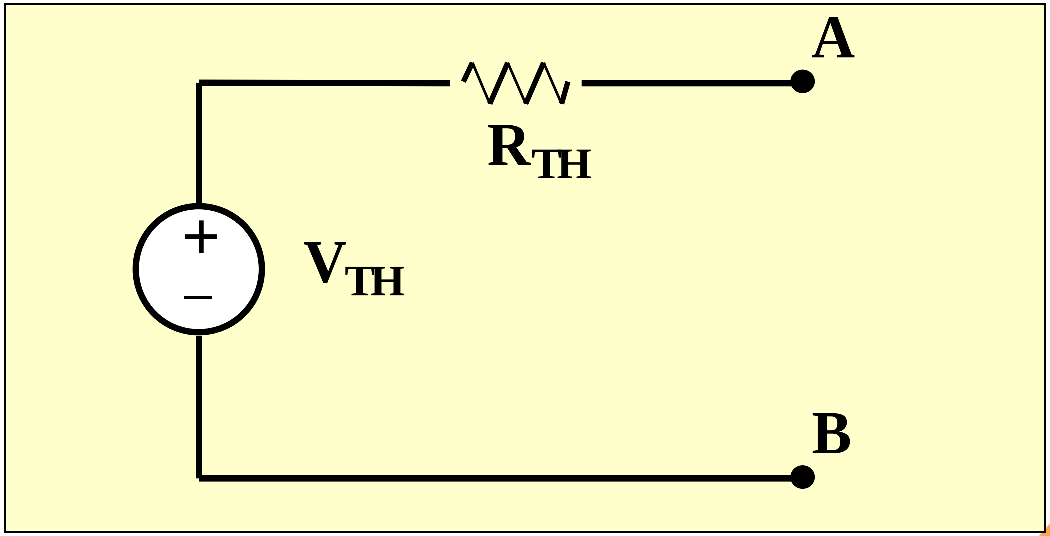
When the sources are deactivated.....



Now place an ohmmeter across A-B and read the resistance.
If $R_1 = R_2 = R_4 = 20\ \Omega$ and $R_3 = 10\ \Omega$ then the meter reads $10\ \Omega$.

THEVENIN'S THEOREM:

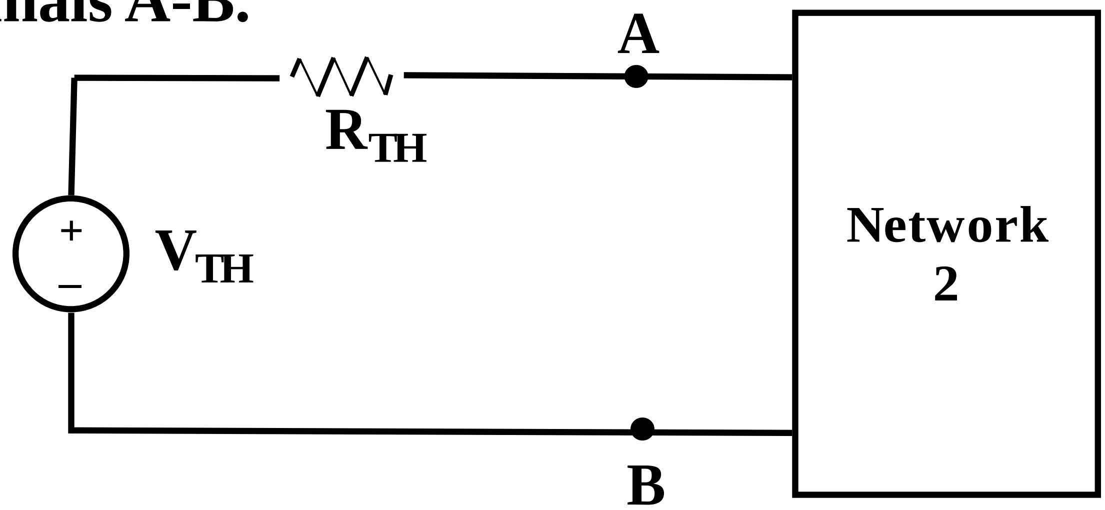
We call the ohmmeter reading, under these conditions, $R_{THEVENIN}$ and shorten this to R_{TH}. Therefore, the important results are that we can replace Network 1 with the following network.



THEVENIN & NORTON

THEVENIN'S THEOREM:

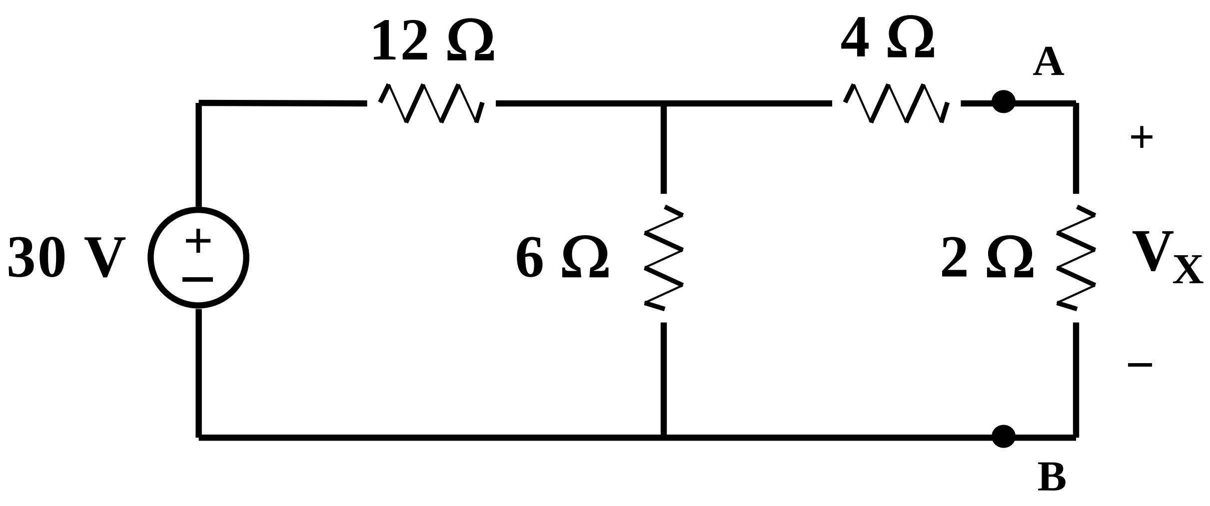
We can now tie (reconnect) Network 2 back to terminals A-B.



We can now make any calculations we desire within Network 2 and they will give the same results as if we still had Network 1 connected.

THEVENIN'S THEOREM: Example Problem

Find V_X by first finding V_{TH} and R_{TH} to the left of A-B.



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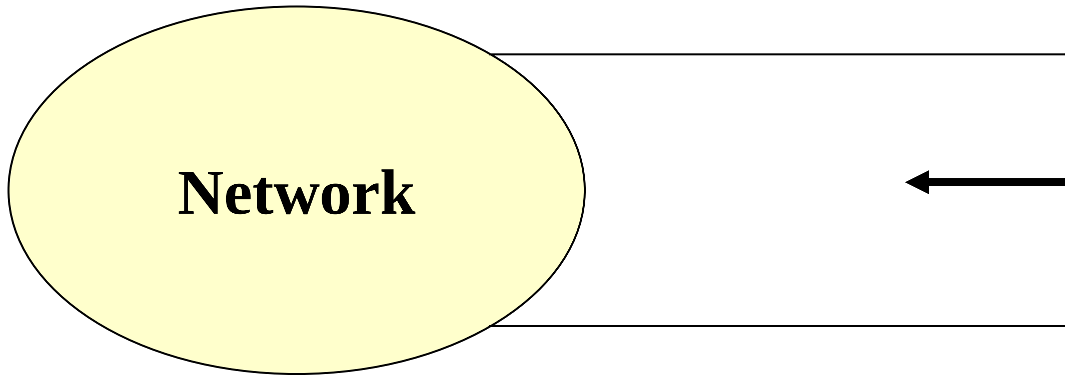
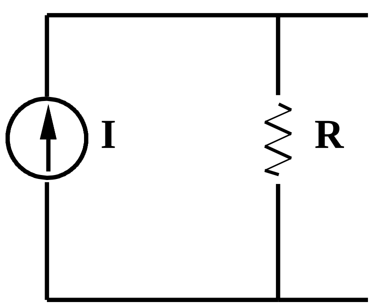
NORTON’S THEOREM:

Assume that the network enclosed below is composed of independent sources and resistors.

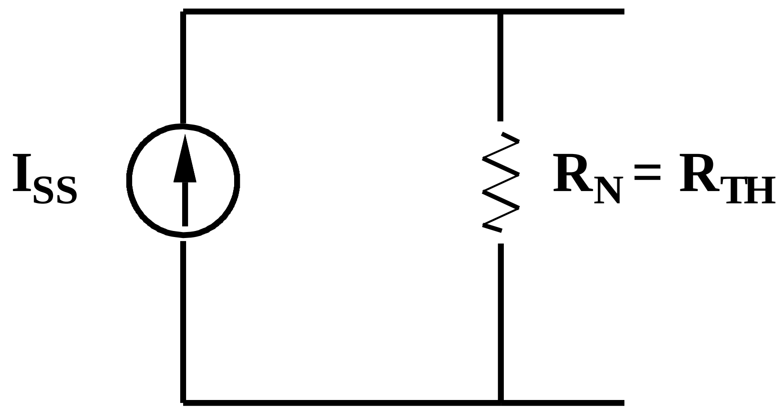


Norton’s Theorem states that this network can be replaced by a current source shunted by a resistance R.



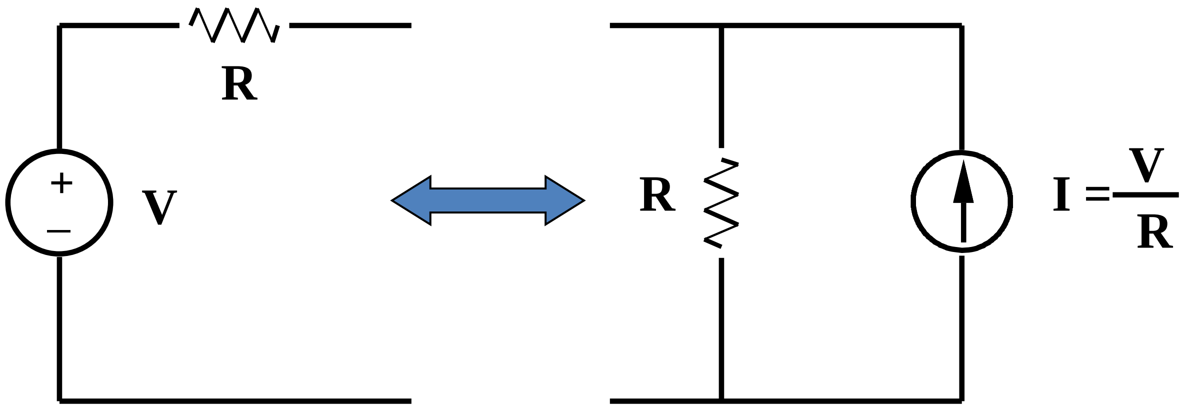
NORTON'S THEOREM:

In the Norton circuit, the current source is the short circuit current of the network, that is, the current obtained by shorting the output of the network. The resistance is the resistance seen looking into the network with all sources deactivated. This is the same as R_{TH}.



NORTON'S THEOREM:

We recall the following from source transformations.

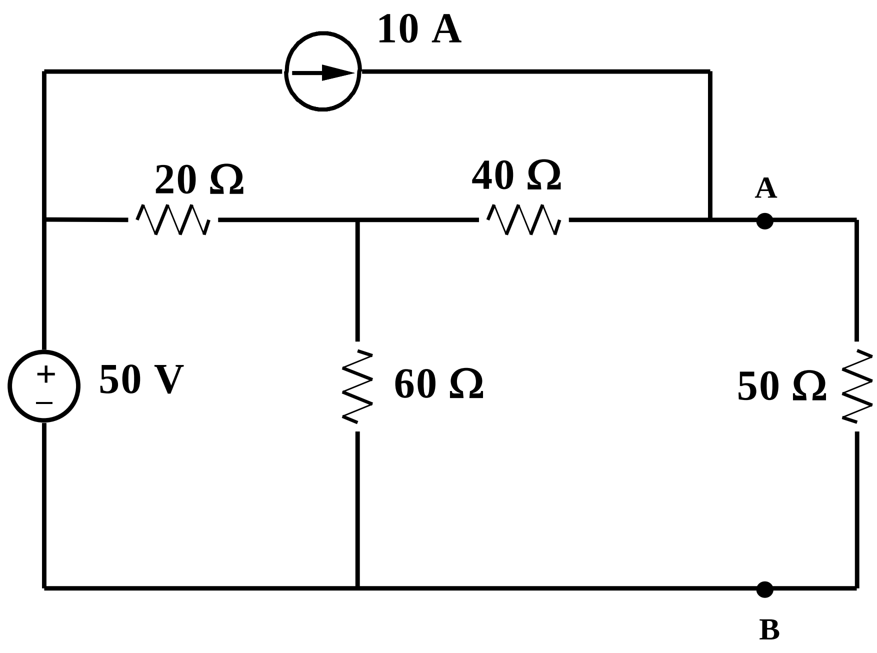


In view of the above, if we have the Thevenin equivalent circuit of a network, we can obtain the Norton equivalent by using source transformation.

However, this is not how we normally go about finding the Norton equivalent circuit.

NORTON'S THEOREM:

Find the Norton equivalent circuit to the left of terminals A-B for the network shown below. Connect the Norton equivalent circuit to the load and find the current in the 50 Ω resistor.



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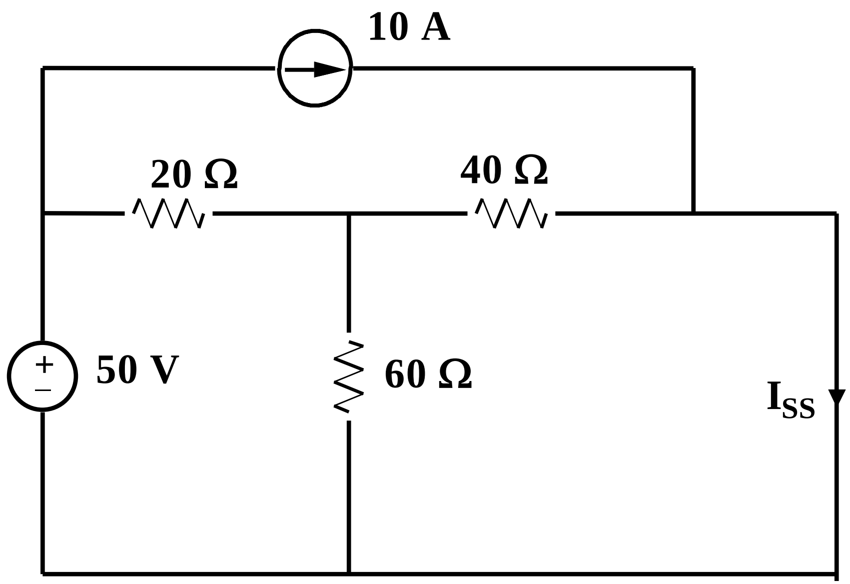
NORTON'S THEOREM:



It can be shown by standard circuit analysis that

$$I_{SS} = 10.7\ A$$

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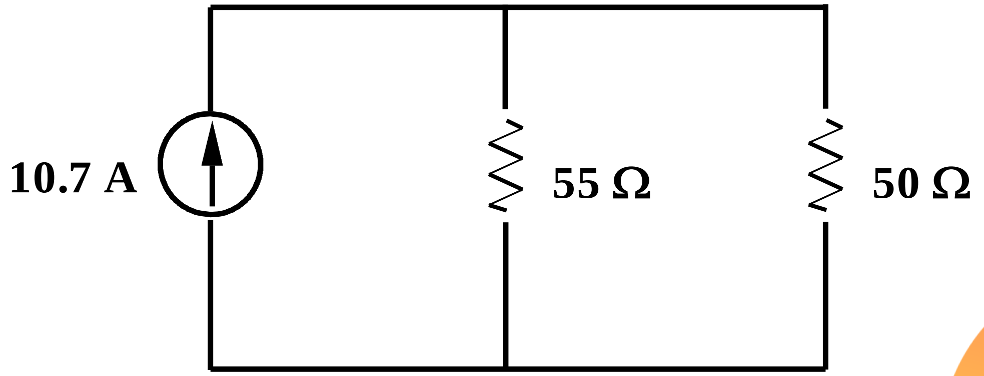
NORTON'S THEOREM:

It can also be shown that by deactivating the sources, We find the resistance looking into terminals A-B is

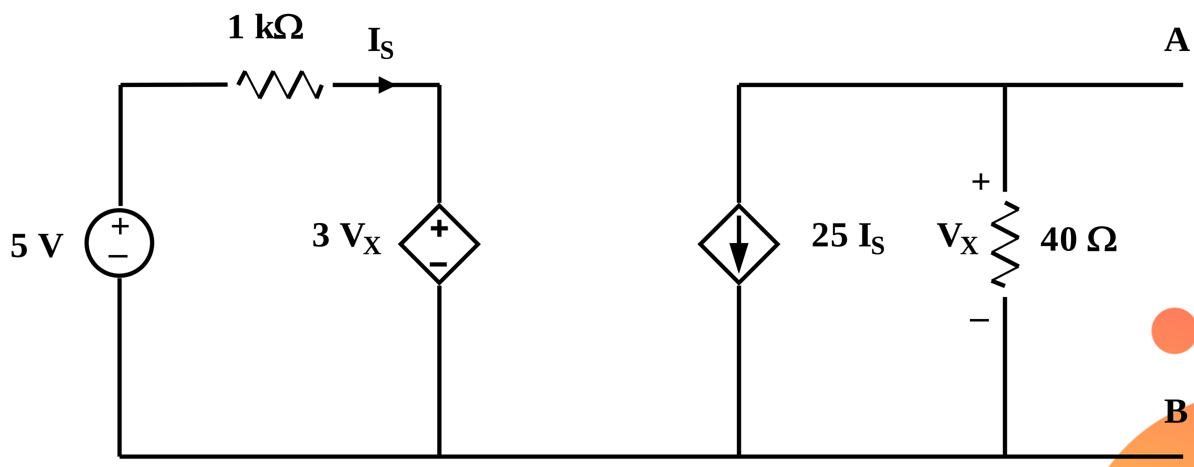
$$R_N = 55\ \Omega$$

R_N and R_{TH} will always be the same value for a given circuit. The Norton equivalent circuit tied to the load is shown below.



NORTON'S THEOREM: This example illustrates how one might use Norton's Theorem in Electronics. the following circuit comes close to representing the model of a transistor.

For the circuit shown below, find the Norton equivalent circuit to the left of terminals A-B.



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