

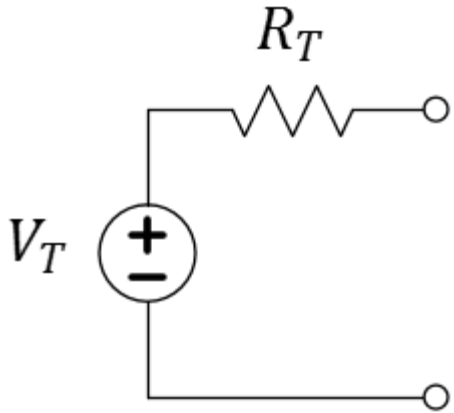


Lecture 14: Norton and IV tools

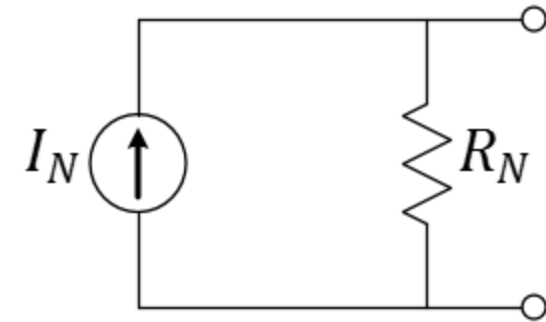
- Norton
- Source Transformations
- Superposition

Thevenin and Norton Equivalents

$$R_{eff} = R_T = R_N$$

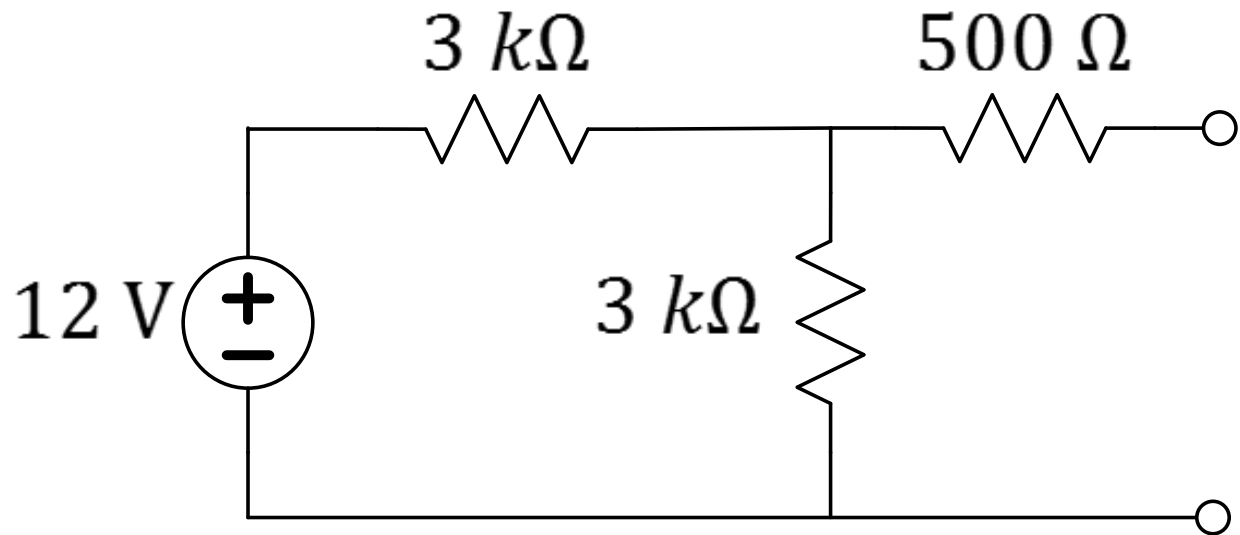


The circuit on the left and the circuit on the right can be made to behave identically by the choice of values as seen through the terminals.



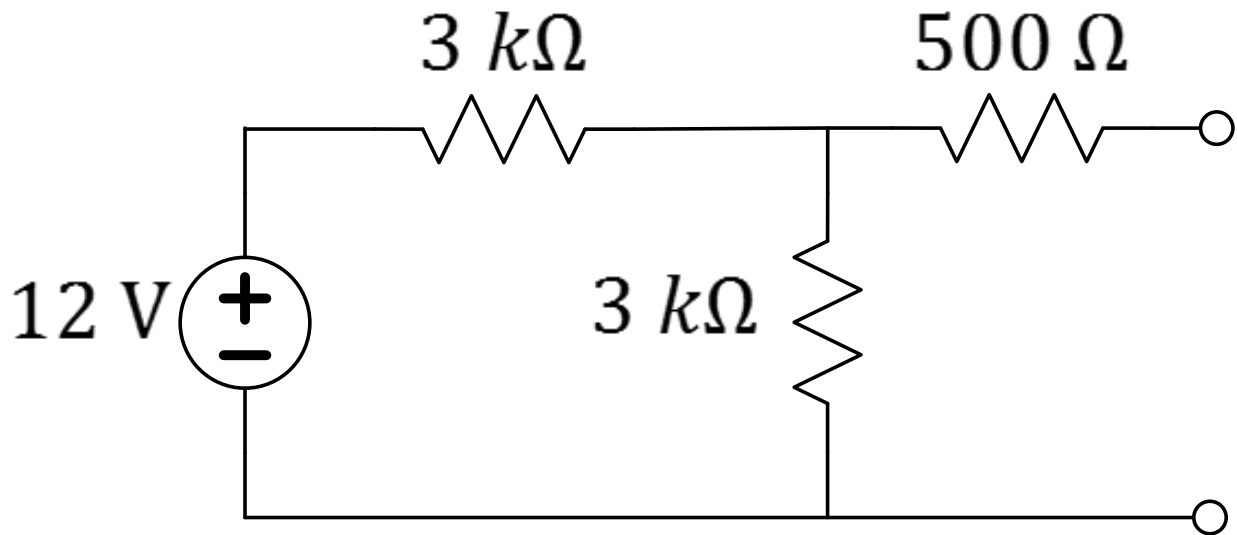
- Either can be used to represent universal: $I = I_{sc} - \frac{I_{sc}}{V_{oc}} V$
- Contain all information on how circuits interact with other circuits
- Loses information on power dissipation WITHIN the circuit

Norton



Q: What is the Norton equivalent for the circuit above?

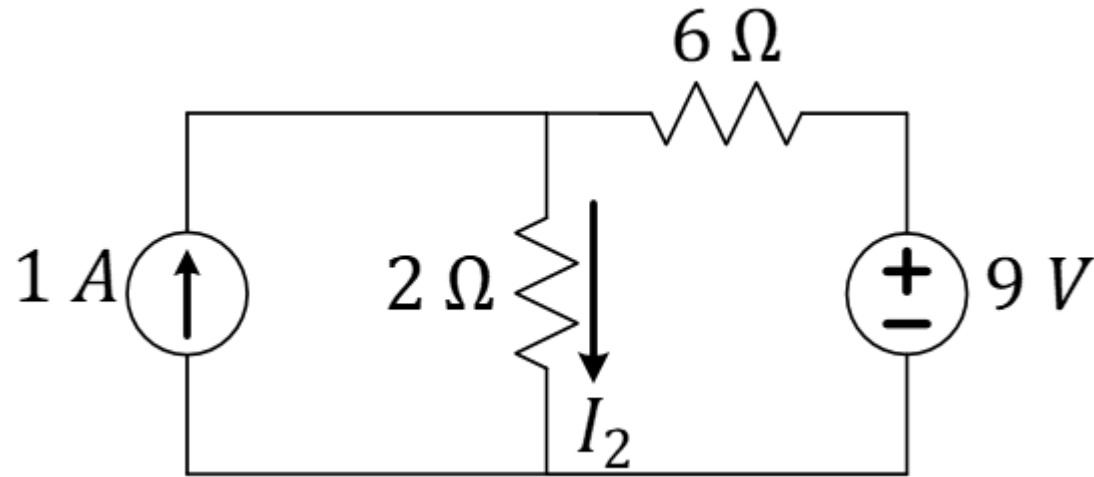
Source Transformations



“Source transformations” involve changing Thevenin subcircuits into Norton and Norton subcircuits into Thevenin to gain an advantage in absorbing another part of the circuit. Continue until the entire circuit has been reduced to either a Thevenin or Norton equivalent.

Q: Use “source transformations” to find the Thevenin equivalent of the circuit above.

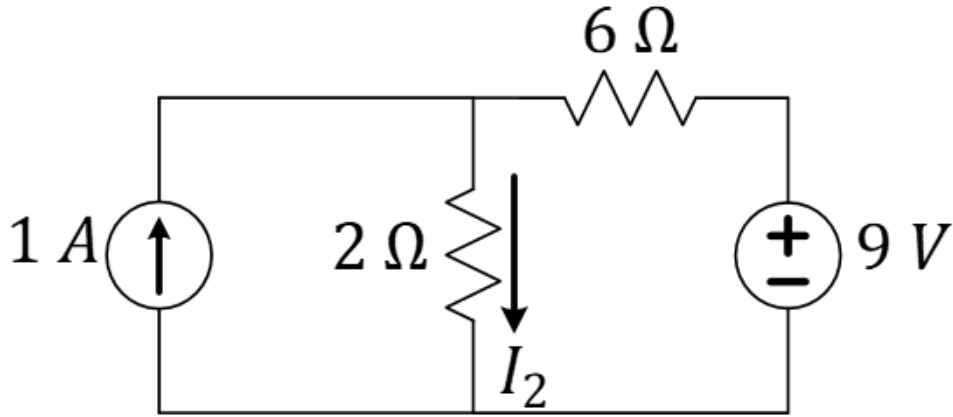
Superposition



Q: Find I_2 .

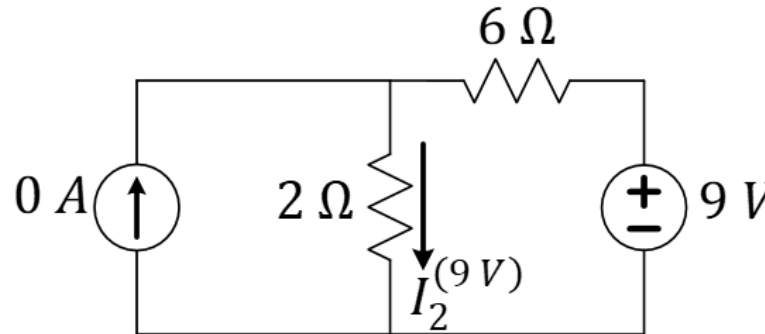
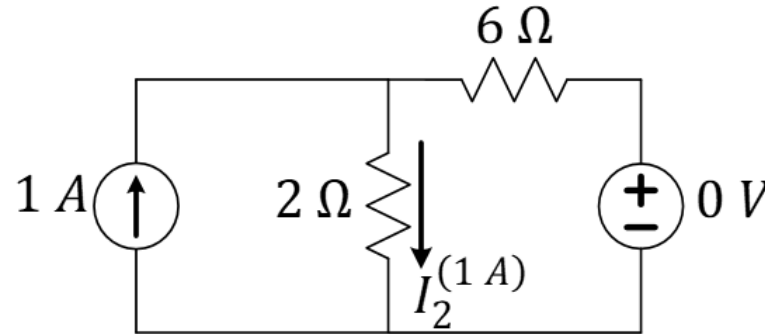
Superposition

$$A: I_2 = I_2^{(due\ to\ 1A)} + I_2^{(due\ to\ 9V)}$$



Solution...

$$I_2 =$$



Partial Solution...

CDR:

VDR:

Superposition Theorem. The total current in any part of a linear **circuit** equals the algebraic sum of the currents produced by each source separately. To evaluate the separate currents to be combined, replace all other voltage sources by short **circuits** and all other current sources by open **circuits**.

From: <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/suppos.html>



Summary

- Any linear network can be represented by a simple series Thévenin circuit or, equivalently, by a simple parallel Norton circuit
- It is the same resistance, R_{eff} , value for both the Thévenin and the Norton circuits, found as R_{eq} with the sources removed (SC for V-sources, OC for I-sources)
- Source transformations allow Thevenin-to-Norton and Norton-to-Thevenin changes of portions of a circuit to quickly find Thevenin or Norton equivalents of the entire circuit
- Superposition allows the currents in each branch due to each source separately (by turning off sources) to add to the current in that branch when all sources are turned on.



L14 Learning Objectives

- a. Explain equivalency of Thevenin and Norton by matching points on the IV.
- b. Solve circuits for the Norton Equivalent
- c. Represent *any* (non-vertical) linear IV characteristic by a parallel combination of a current source and a resistor (Norton equivalent circuit).
- d. Find the parameters of Thévenin and Norton equivalent circuits, R_{eff} , V_T , and I_N when given a circuit.
- e. Use Source Transformations to reduce a circuit to Thevenin and/or Norton
- f. Use Superposition to reduce a tougher circuit analysis to analysis of two or more single-supply circuits.