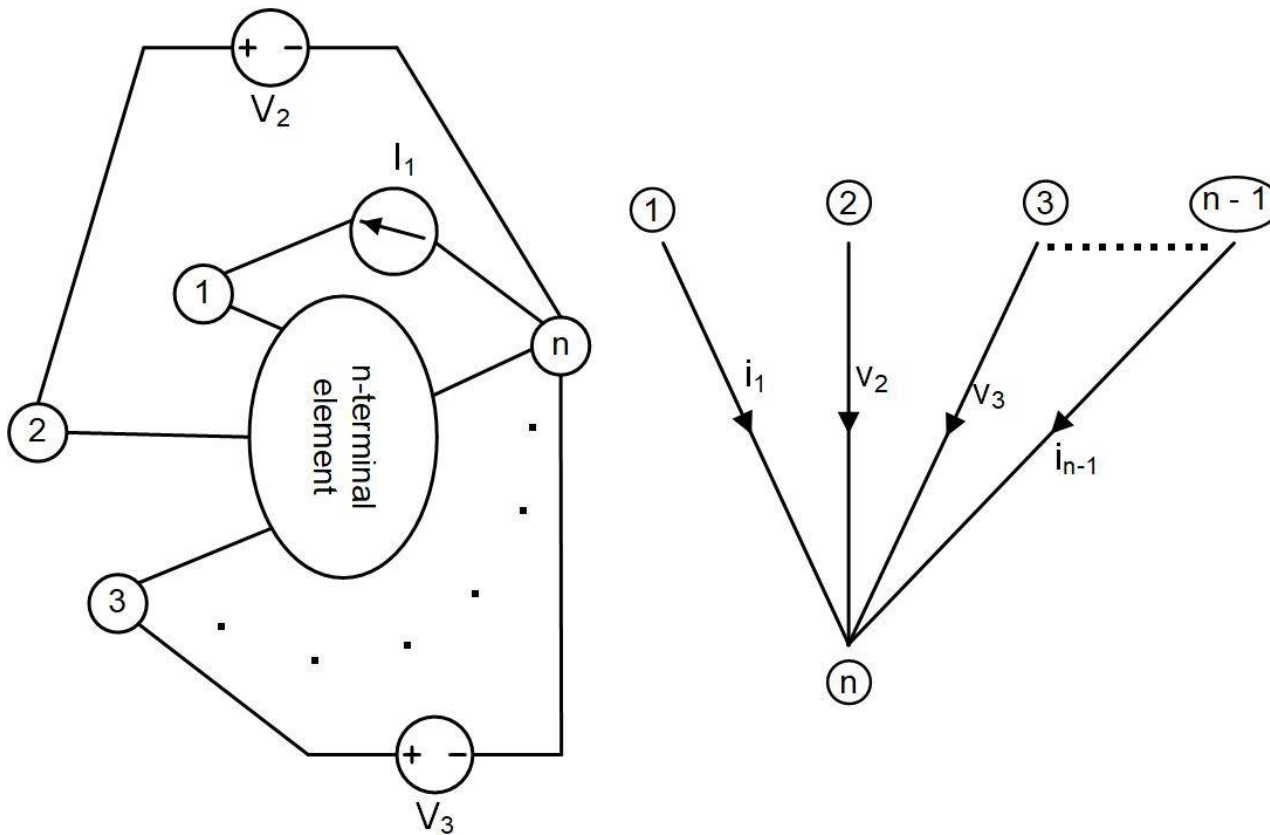


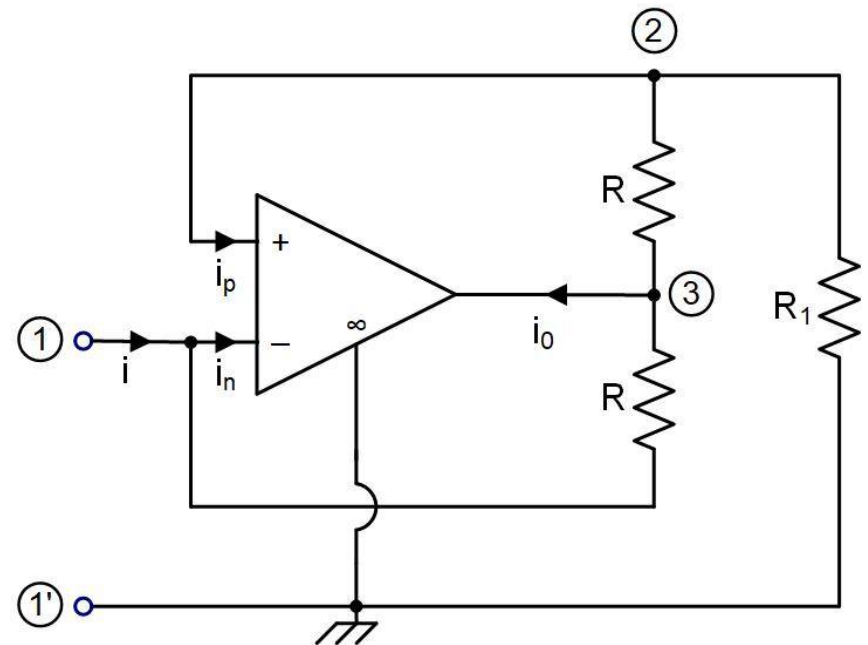
Element Equations of Multi-terminal Elements



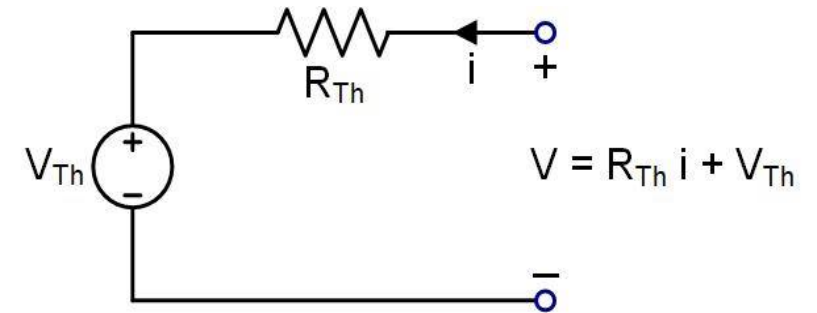
1. Appropriate sources are connected to the n-terminal element.
2. Unknown element variables are obtained in terms of known variables by solving circuit equations.

Multi-terminals with the same element equations are called **equivalent multi-ports**.

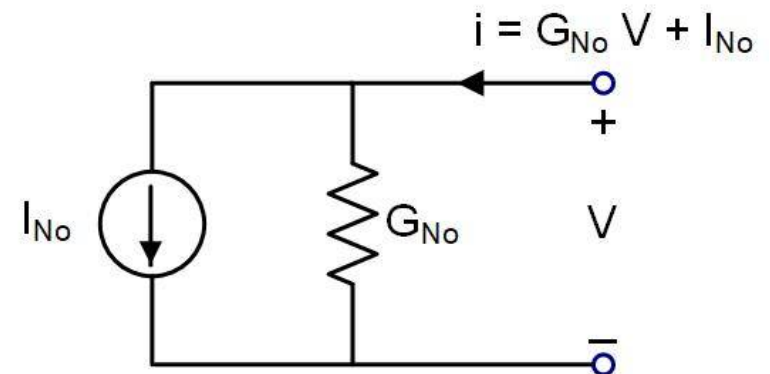
Example 6.1 Obtain the element equation of the 2-terminal 1-1'. To which 2-terminal element is it equivalent?



Let a 2-terminal be connected to a current source. If the terminal voltage can be written in terms of terminal current $v = R_{Th} i + v_{Th}$ then this 2-terminal is called **Thevenin equivalent**.



Let a 2-terminal be connected to a voltage source. If the terminal current can be written in terms of terminal voltage $i = G_{No} v + I_{No}$ then this 2-terminal is called **Norton equivalent**.

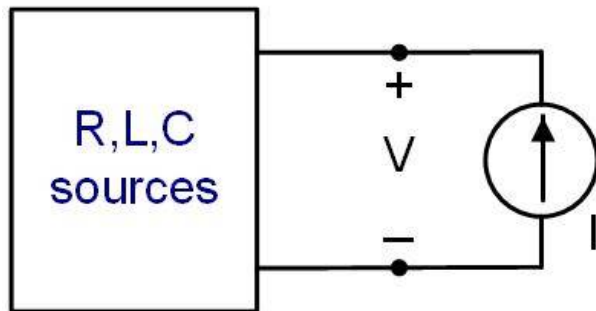


How to find Thevenin or Norton equivalent of a circuit?

1. Method

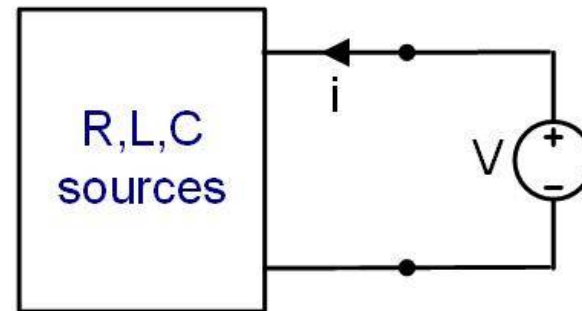
Independent current (voltage) source is connected to the 2-terminal.
Unknown terminal voltage (current) is found in terms of current (voltage) source.

For Thevenin equivalent



$$V = R_{Th} I + V_{Th}$$

For Norton equivalent



$$i = G_{No} V + I_{No}$$

2. Method

For Thevenin equivalent circuit

- I. Find the Thevenin voltage by calculating voltage across the open connection points.
- II. Find the Thevenin resistance by removing all power sources in the original circuit (voltage sources shorted and current sources open) and calculating total resistance between the open connection points.

For Norton equivalent circuit

- I. Find the Norton current by calculating current through a short jumping across the open connection points.
- II. Find the Norton resistance by removing all power sources in the original circuit (voltage sources shorted and current sources open) and calculating total resistance between the open connection points.