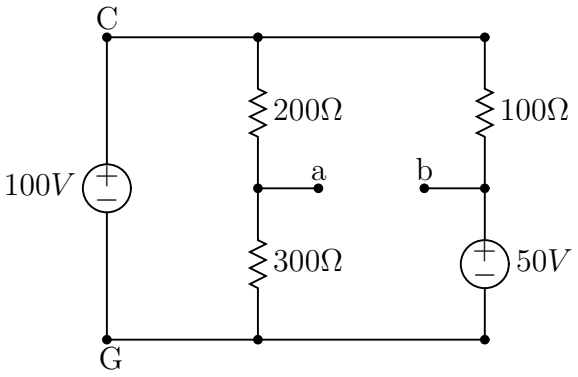
Thevenin Equivalent Circuit – Example

We would like to determine the Thevenin equivalent circuit at the terminals a and b. To do so, we need to compute two of the following three: (1) open circuit voltage, (2) short circuit current, and (3) Thevenin resistance R_{Th} directly.

Determination of open circuit voltage v_{oc} by inspection: Let us use G as the reference for node voltages. By inspection, the voltage at node b, namely $v_b = 50$V. By voltage division rule, the voltage at node a, namely $v_a = \frac{100}{200+300}300 = 60$V. Thus $v_{oc} = 10$V with terminal a at a higher potential than terminal b.

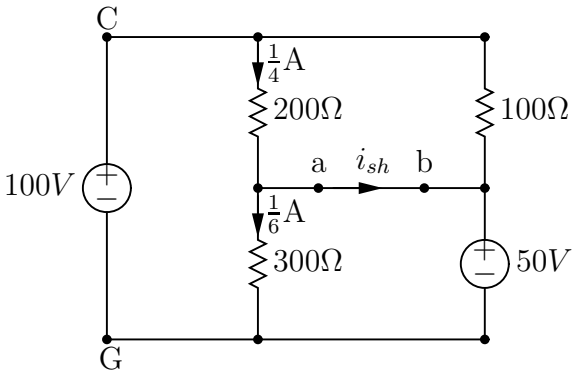


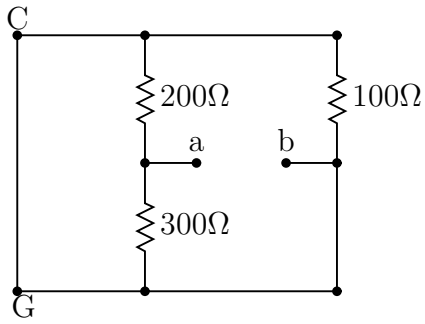
Determination of short circuit current i_{sh} by inspection: It is easy to observe that the voltage across 200Ω as well as across 300Ω equals 50 V. Thus the currents in these resistances are as shown. Hence

$$i_{sh} = \frac{1}{4} - \frac{1}{6} = \frac{1}{12}A.$$

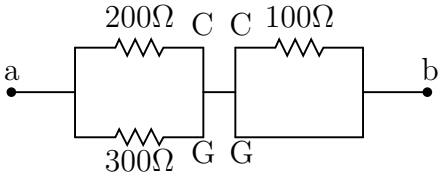
The Thevenin resistance R_{Th} is given by

$$R_{Th} = \frac{v_{oc}}{i_{sh}} = 120\Omega.$$





Direct determination of R_{Th} from the independent source-less network: The independent source-less network can be constructed as shown on the left side. It can be retraced as shown on the right. Then, R_{Th} equals the parallel combination of 200Ω and 300Ω resistances and thus it equals 120Ω.



The Thevenin equivalent circuit is shown on the right.