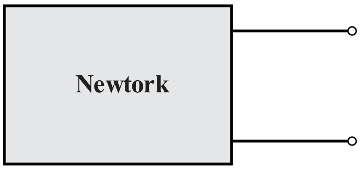
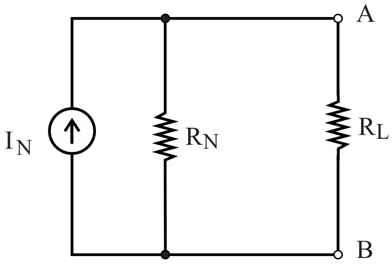
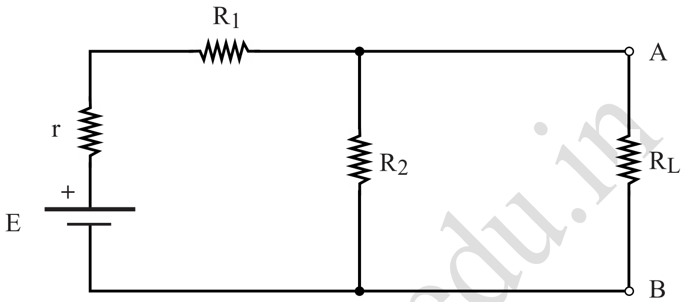
1.11.3 Norton's theorem

Statement: A complex network consisting of number of sources of e.m.f. and resistors can be replaced by a single constant current source in parallel with a single resistance or impedance.

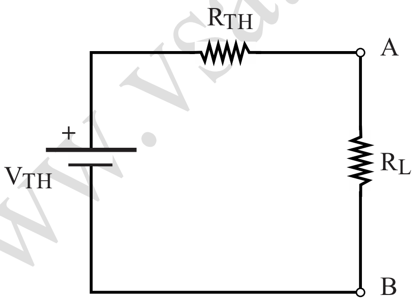




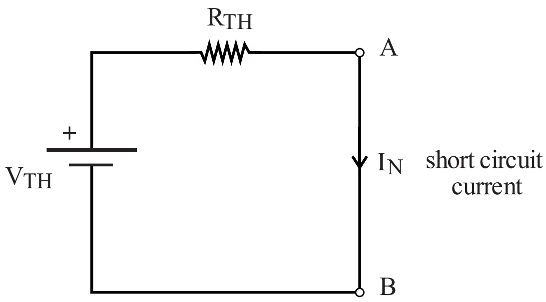
Proof Setp-1: Consider the following circuit –



We know that the Thevenin's equivalent of this circuit is given as follows:



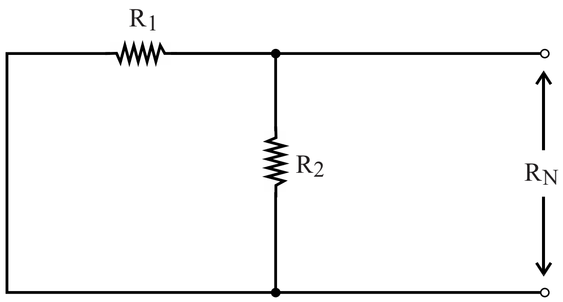
Setp-2: Now remove load resistor from the Thevenin's equivalent circuit and short circuit the terminals A-B, as shown below. So the short circuit current will flow, which is the Norton's current (I_N).



Mathematically we can calculate the Norton's current (I_N) as follows:

$$I_N = \frac{V_{TH}}{R_{TH}}$$

Setp-3: Now remove the short circuit and the e.m.f. source from the circuit, as follows:

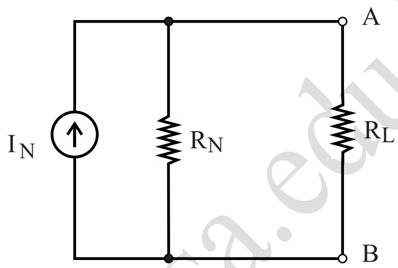


Here the value of R_N is calculated as follows:

$$R_N = R_1 || R_2$$

$$\therefore \quad R_N = \frac{R_1 . R_2}{R_1 + R_2}$$

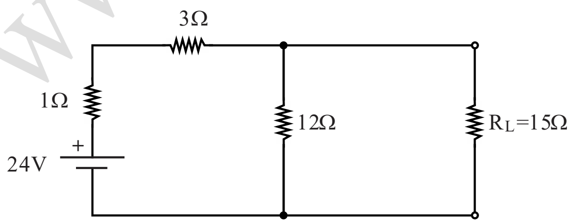
Finally the Norton's equivalent circuit is given below. The load current is given by the equation:



$$I_L = \frac{I_N . R_N}{R_N + R_L}$$

EXERCISE

1) Obtain the Norton's equivalent of following circuit and calculate the current flowing through R_L in following circuit. Use the given equations for the same. Draw Norton's equivalent circuit also. ***(Ans: I_N = 6A, R_N = 3Ω, I_L = 1A)***



2) Obtain the Norton's equivalent of following circuit and calculate the current flowing through the load resistor. Draw Norton's equivalent circuit also. ***(Ans: R_N = 6Ω, I_N = 4A, I_L = 1.33A)***