# Circuit Analysis Techniques

# Lecture 7
# Norton Theorem

Lecture delivered by:

# Topics

- Norton's Theorem Computing
- Norton's Equivalent Circuit
- To Find $I_N$
- To Find $R_N$

# Objectives

At the end of this lecture, student will be able to:

- State and implement Thevenin's theorem on any complicate linear bilateral network

# Norton’s Theorem

**Statement:**

- “Any two terminal active network when viewed from its load terminals, can be replaced by a single current source in parallel with a single resistance.”

- That single current source is called Norton’s current source ($I_N$)

- Resistance is called Norton’s resistance ($R_N$)

# Norton's Equivalent Circuit

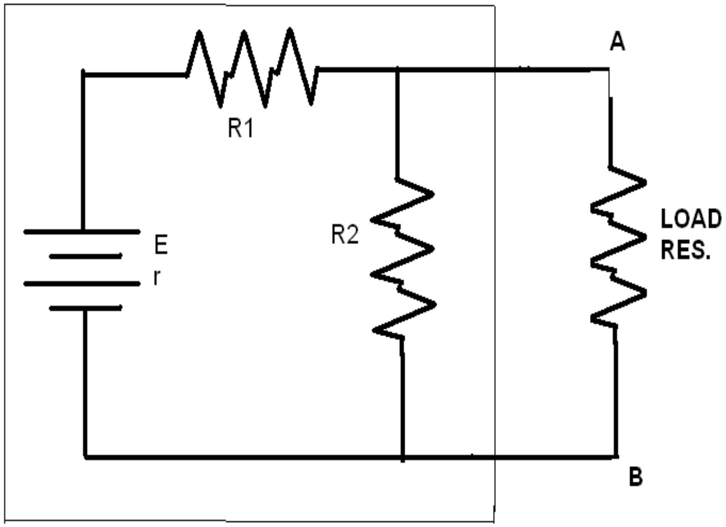


Fig.1 Two terminal circuit

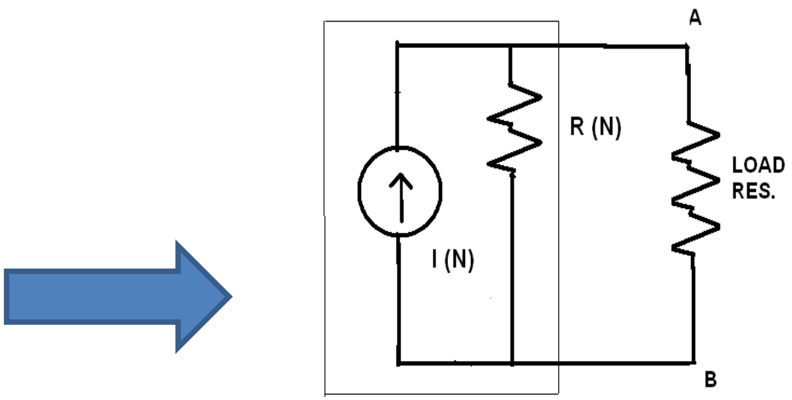


Fig.2 Norton's equivalent circuit

# To Find $I_N$

- Remove the load resistance & put a short there

- Then find the current flowing through the short circuited terminals

- $I_N = I_{SC}$

# To Find $R_N$

- Replace the voltage source (battery) with its internal resistance

- Calculate the resistance of the circuit as viewed by the open circuited load terminals. (i.e. terminals A & B as shown in Fig.1)

- $R_N = R_i$ (internal resistance)

# Problem

- Using Norton's theorem, calculate current through

  15 Ω resistor in the circuit shown in Fig.3

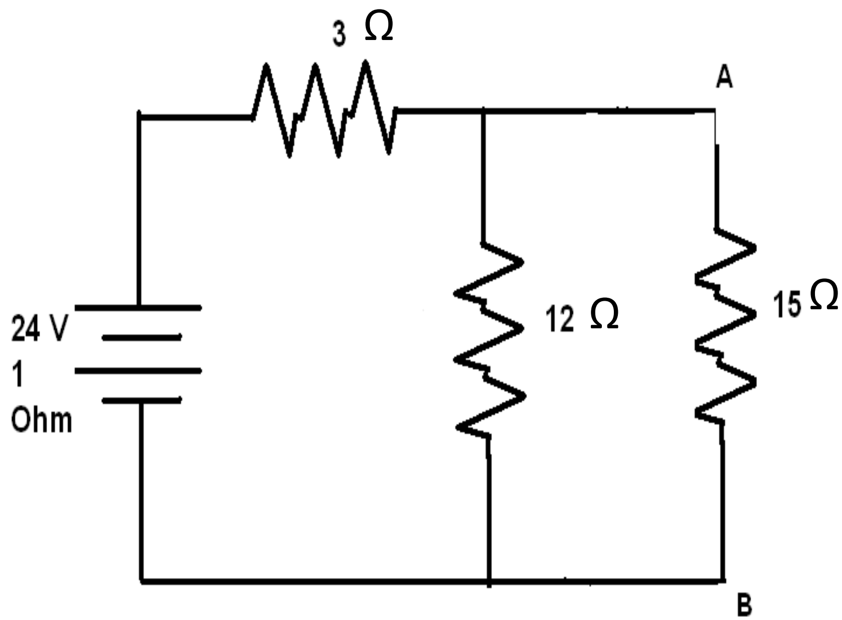


Fig.3

# Solution

Step 1: To find out $I_N$ :

- Remove the load resistance
- Short circuit the load terminals as shown in Fig.4
- Find the current flowing through the short
- 12 Ω resistor is in parallel with the short as shown in Fig.4

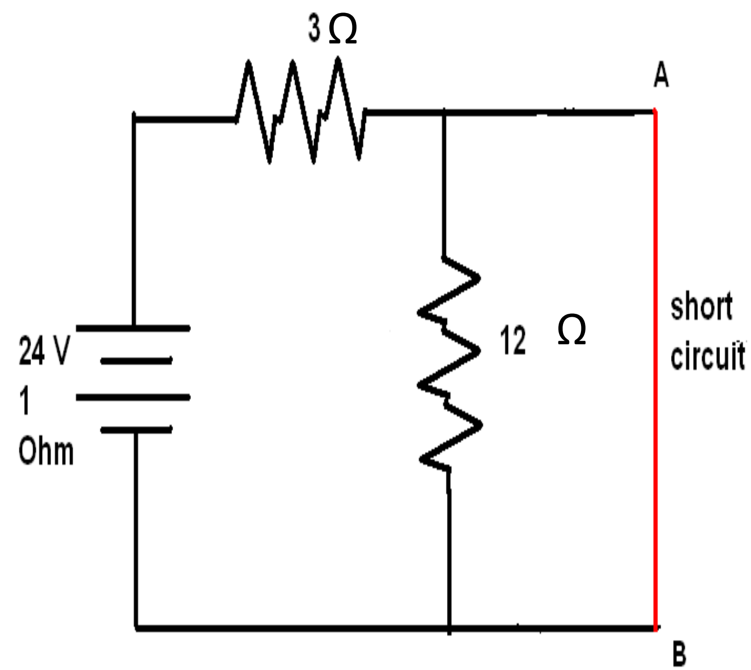


Fig.4

# Solution

- So,12 Ω resistor will also be short circuited
- Therefore the circuit will be as shown in Fig.5

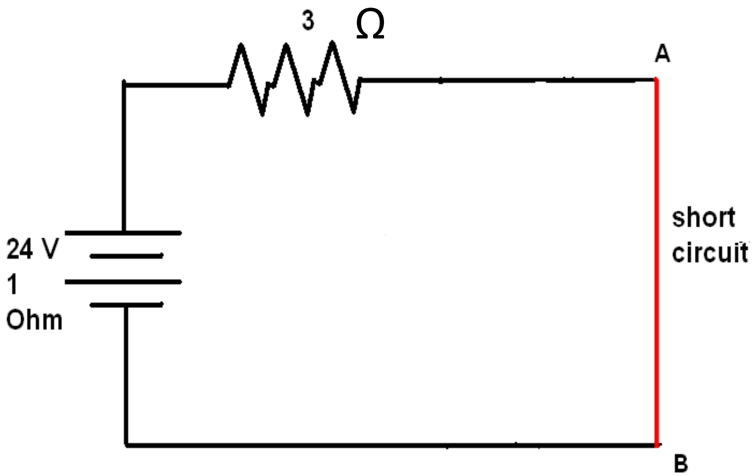


Fig.5

- $I_N = 24 / (3+1)$
  $= 6\ A$

# Solution

## Step 2 : To find out $R_N$ :

- Replace the battery with its internal resistance
- Open circuit load terminals as shown in Fig.6
- Calculate the resistance of the circuit as viewed from the open circuited load terminals

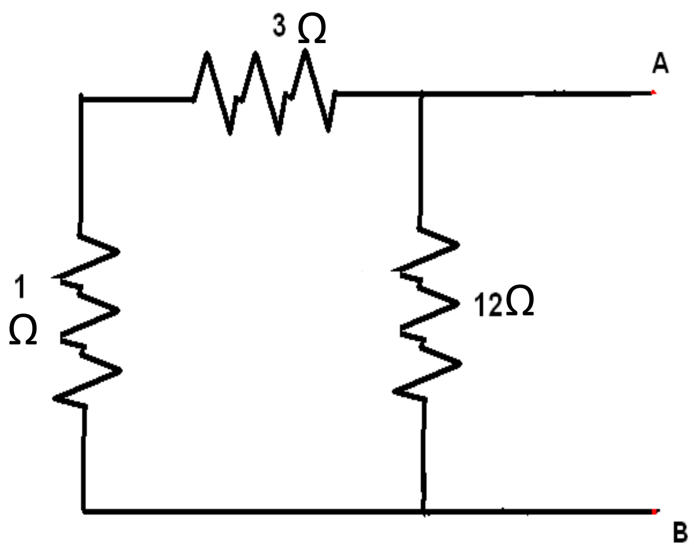


Fig.6

# Solution

- Replace the given network with Norton's equivalent circuit as shown in Fig.8
- $$I_L = \frac{I_N * R_N}{(R_N + R_L)}$$

$= 6 * 3 / (3 + 15)$

$= 18 / 18$

$= 1\ A$

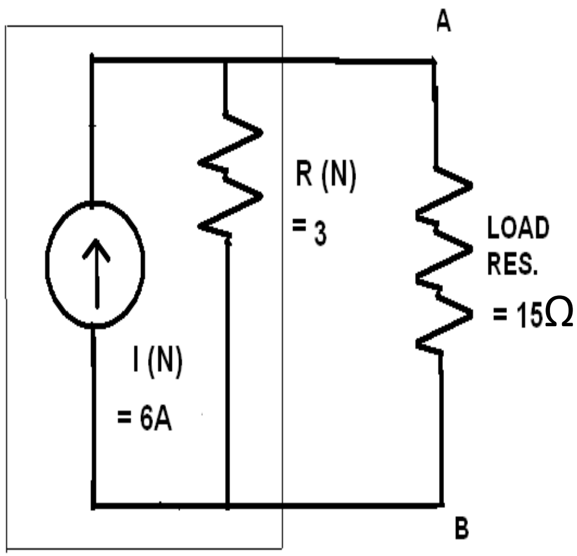


Fig.8

# Summary

- Norton’s theorem stares that, “Any two terminal active network when viewed from its load terminals, can be replaced by a single current source in parallel with a single resistance”