ELEMENTS OF ELECTRICAL ENGINEERING

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Numerical Examples on Thevenin's Theorem

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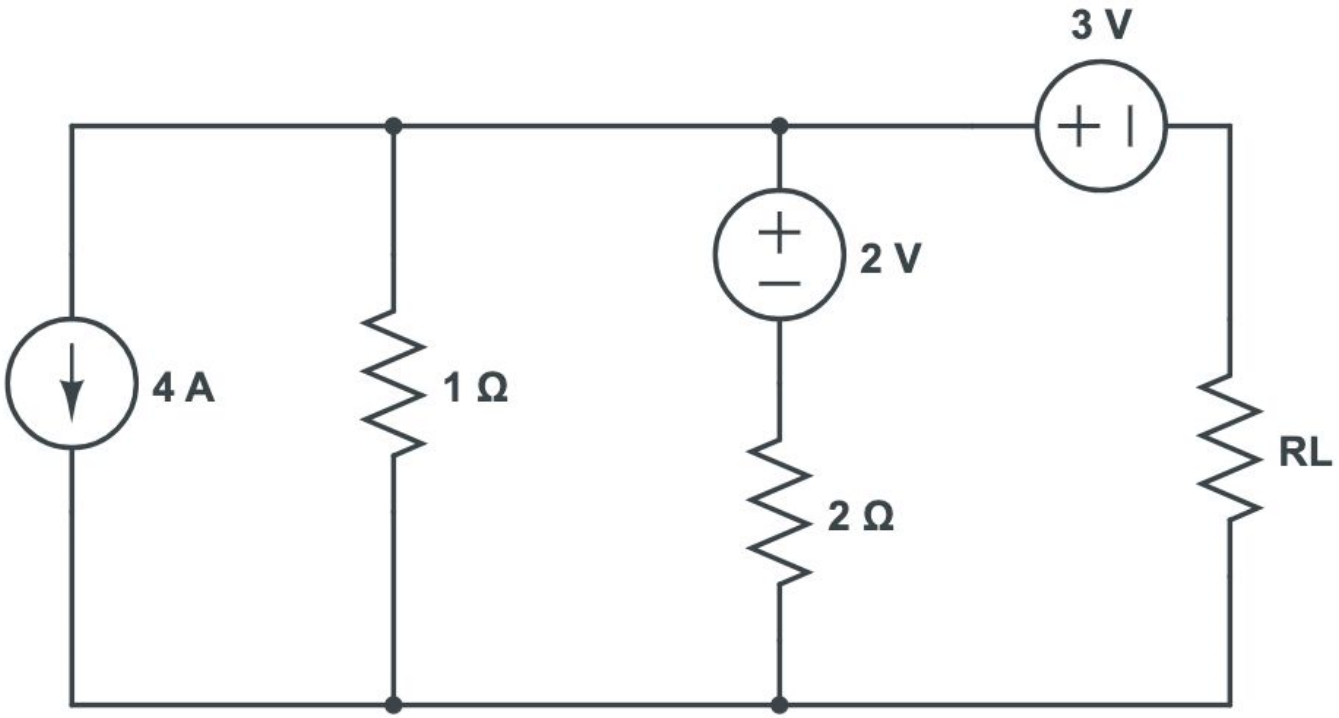
Numerical Example 1

Question:

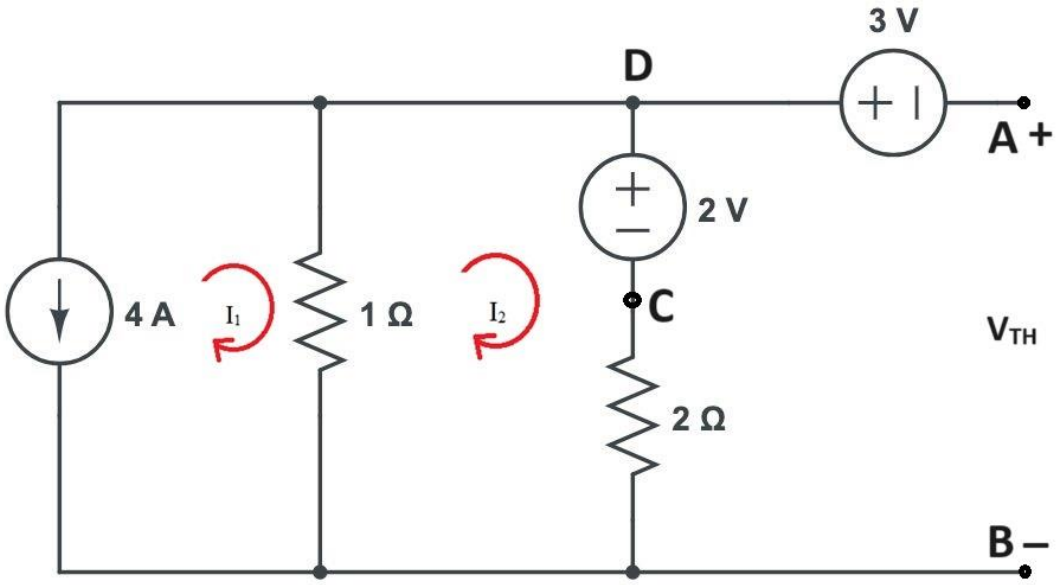
Using Thevenin's Theorem, determine the range of current through R_L as it varies from 10Ω to 100Ω.



Numerical Example 1

Solution:

Finding V_{TH} :



By Mesh Analysis,

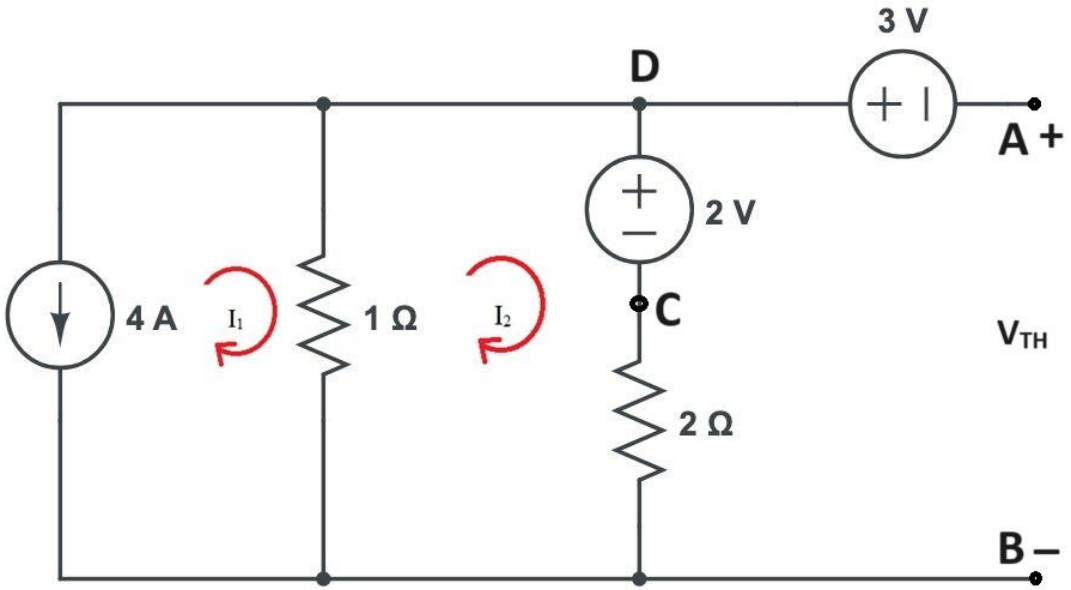
Mesh 1 (Current Equation) : $I_1 = -4$ --------- (1)

Mesh 2 (KVL) : $-1 * I_1 + 3 * I_2 = -2$ --------- (2)

Solving (1) & (2), $I_1 = -4A$; $I_2 = -2A$

Numerical Example 1

Solution (Continued)



By writing KVL in the path ABCDA,

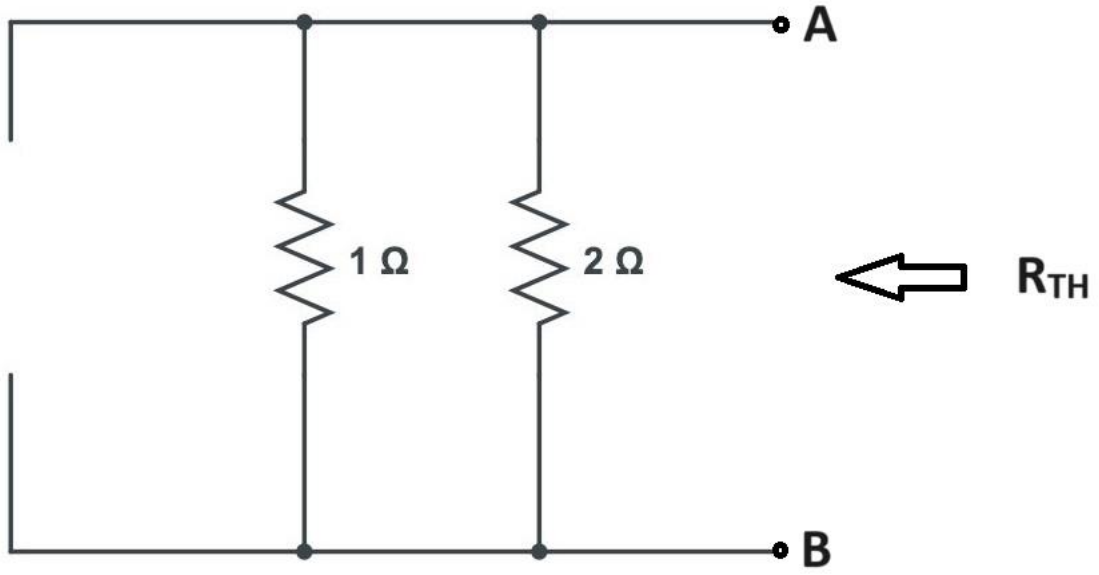
$-V_{TH} + 2 * I_2 + 2 - 3 = 0$

Hence, $V_{TH} = -5V$

Numerical Example 1

Solution (Continued)

Finding R_{TH} :



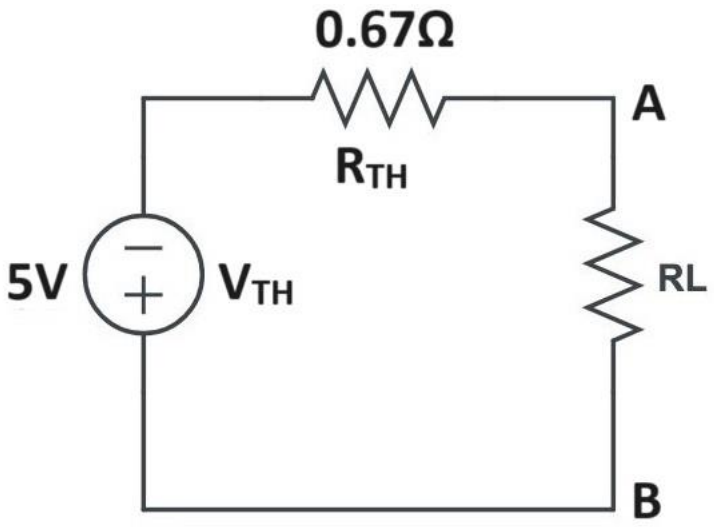
It can be observed that 1Ω and 2Ω are in parallel.

Hence, R_{TH} = 1Ω ‖ 2Ω = 0.67Ω

Numerical Example 1

Solution (Continued)

Thevenin's Equivalent Circuit:



$$I_L = \frac{V_{TH}}{R_{TH} + R_L}$$

When R_L is = 100Ω , I_L = 49.67mA

When R_L is = 10Ω , I_L = 0.468A

Range of current through R_L is 49.67mA to 0.468A

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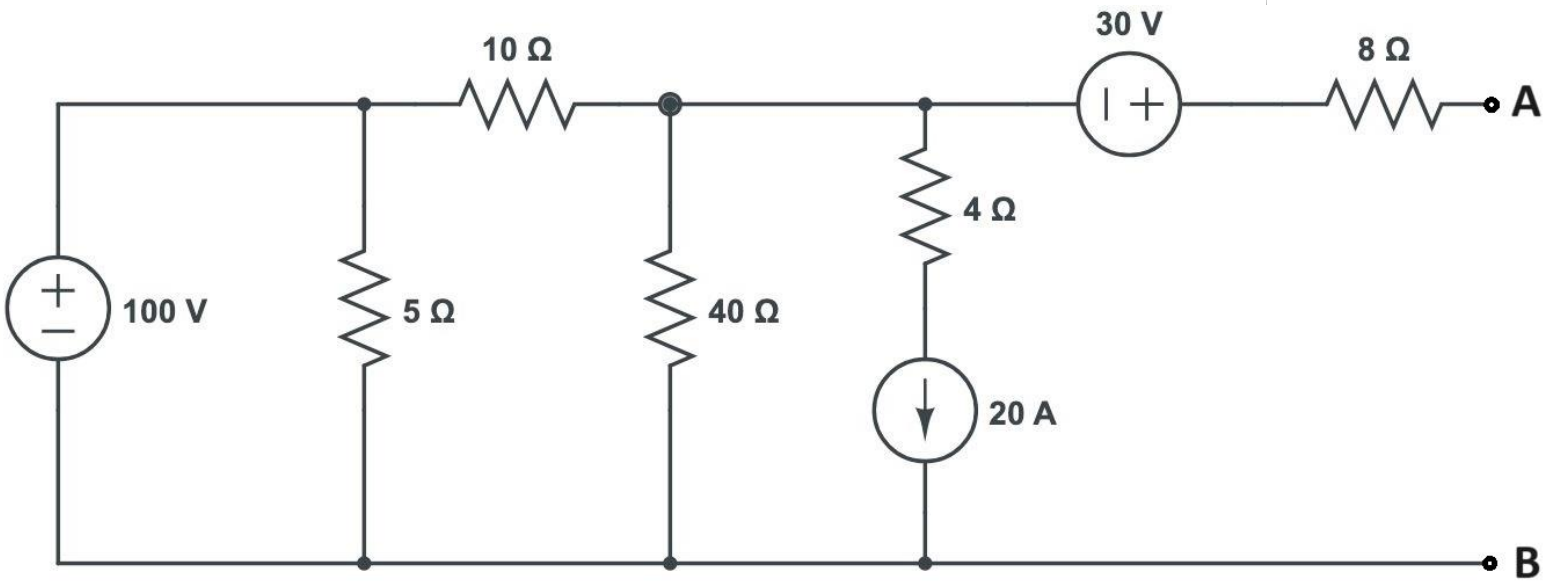
Numerical Example 2

Question:

Obtain the Thevenin's Equivalent of the given network between the terminals A & B



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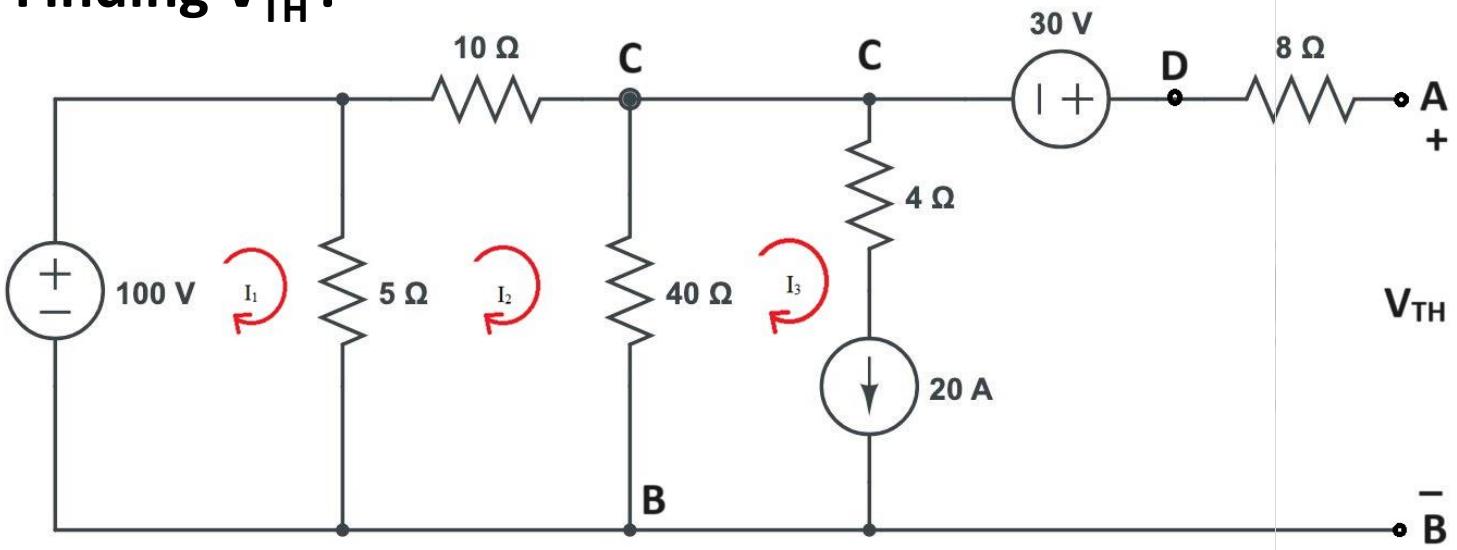
Numerical Example 2

Solution:

Finding V_{TH} :



By Mesh Analysis,

Mesh 1 (KVL) : $5*I_1 - 5*I_2 = 100$ --------- (1)

Mesh 2 (KVL) : $-5*I_1 + 55*I_2 - 40*I_3 = 0$ --------- (2)

Mesh 3 (Current Equation) : $I_3 = 20$ A -------- (3)

Solving (1) , (2) & (3), $I_1 = 38$ A ; $I_2 = 18$ A ; $I_3 = 20$ A

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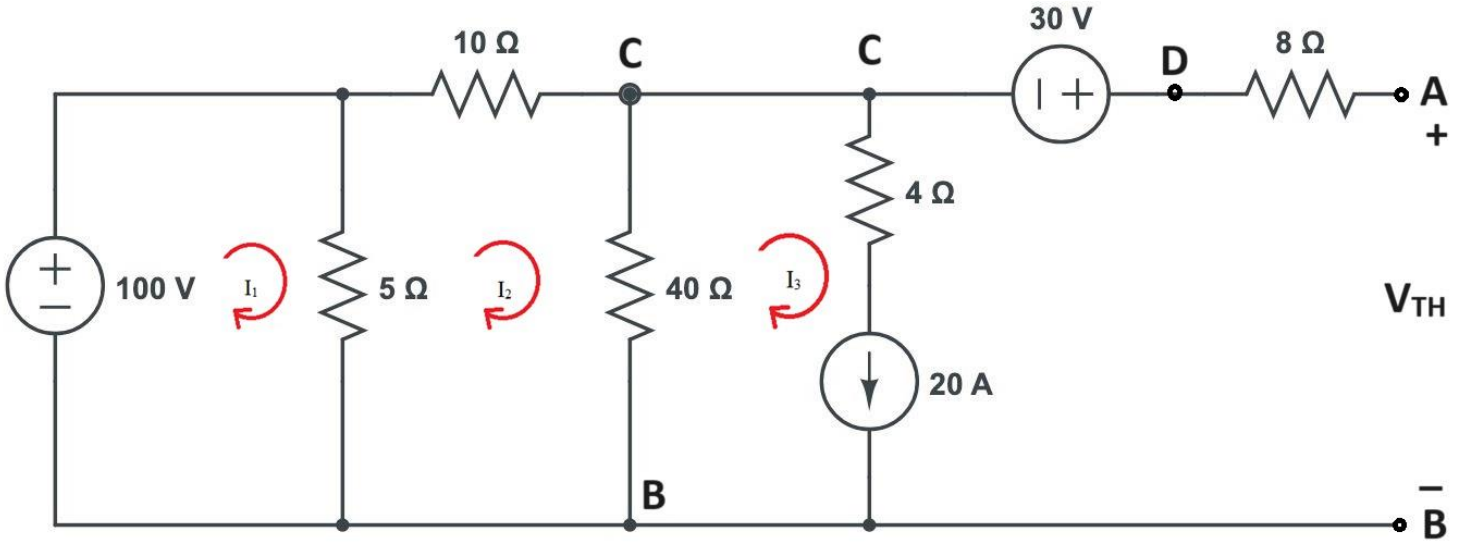
Numerical Example 2

Solution (Continued)



By writing KVL in the path ABCDA,

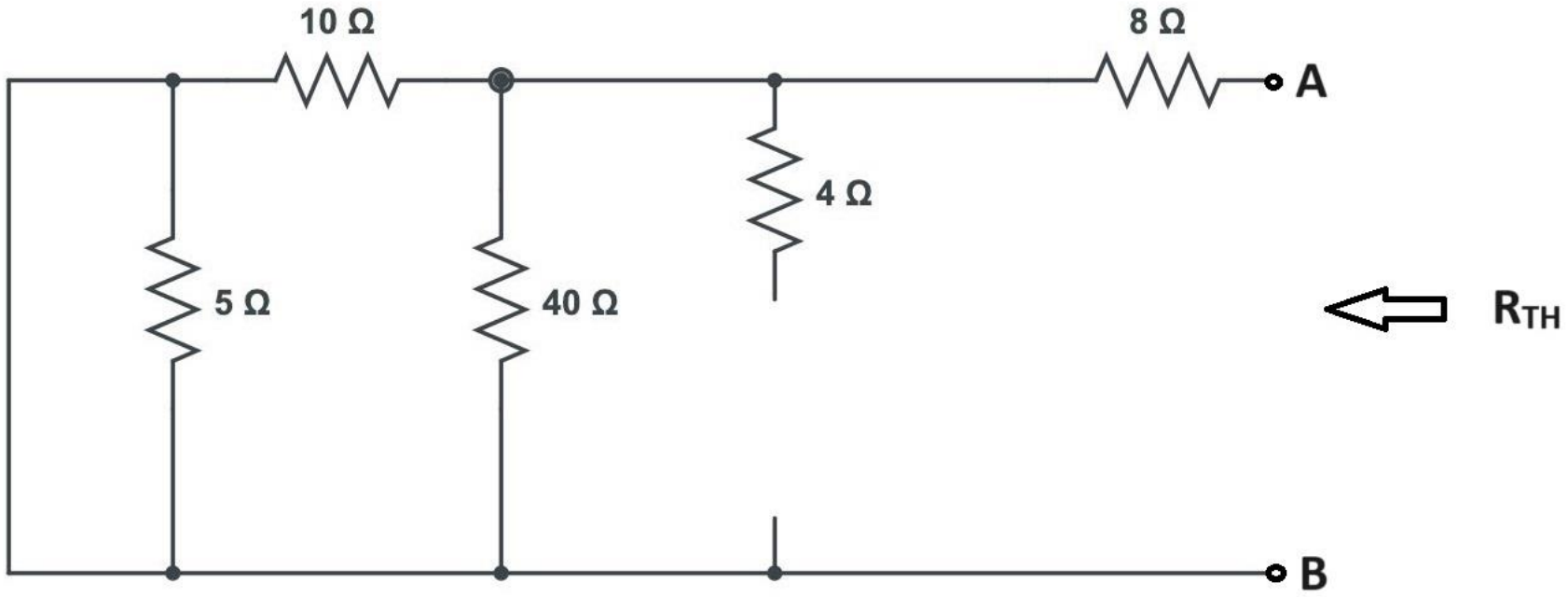
$-V_{TH} - 40^{*} (I_3 - I_2) + 30 = 0$

Hence, $V_{TH} = -50$ V

Numerical Example 2

Solution (Continued)

Finding R_{TH} :



It can be observed that 5Ω resistor is shorted.

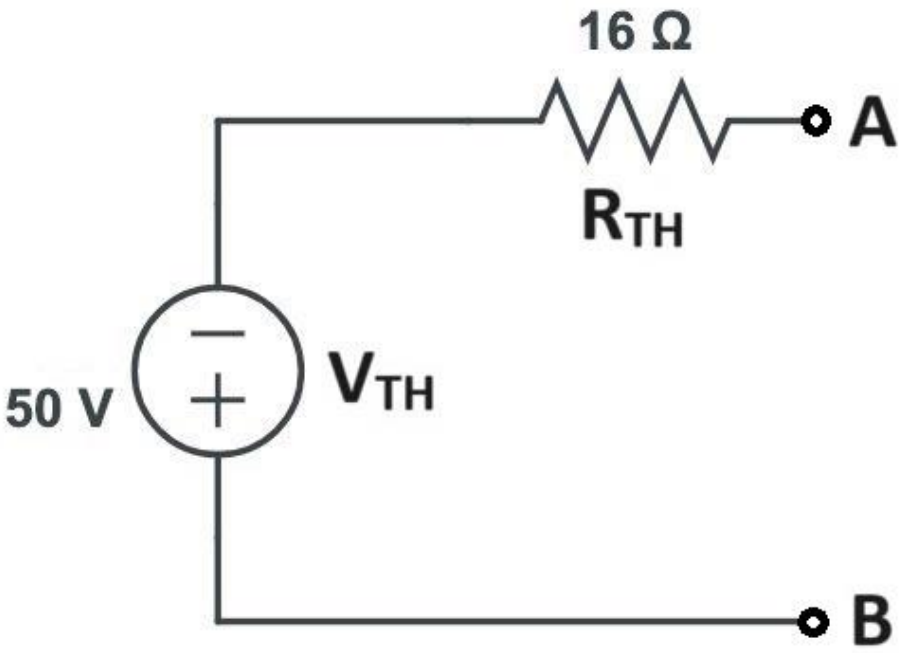
Hence, R_{TH} = (10 Ω ‖ 40 Ω) + 8Ω = 16 Ω

Numerical Example 2

Solution (Continued)

Thevenin's Equivalent Circuit:

Thevenin's Equivalent circuit for the given network is as follows:



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Text Book & References

Text Book:

1.“Basic Electrical Engineering”, D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019

Reference Books:

1. “Engineering Circuit Analysis” William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023

2. “Electrical and Electronic Technology” E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

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