Thevenin's Theorem Problem

Determine the current through 1.5Ω resistor using Thevenin's theorem

Step I

$V_{TH} = V_{AB}$

Applying KVL in mesh ①

$-3I_2 - 7.5(I_2 - I_1) - 6I_2 = 0$

$-2.5I_1 + 7.5I_1 = 0$ ①

Applying KVL in mesh ②

$-7.5(I_1 - I_2) - 30 - 7.5I_1 = 0$

$7.5I_1 - 12.5I_2 = 30$ ②

Solving ① & ②

$I_2 = -3A$, $I_1 = -1A$

$V_{TH} = V_{AB} = -6 - 5I_2 - 6I_1$

$= -6 - 5(-3) - 6(-1)$

$V_{TH} = 15V$

Step II R_{TH}

$R_{AB} = \frac{9 \times 9}{9+9}$

$R_{AB} = 4.5\Omega$

Step III

$I_L = \frac{V_{TH}}{R_L + R_{TH}} = \frac{15}{1.5+4.5} = 2.5A$ ↓

Norton's Theorem

Complex circuit → Norton's equivalent ckt

Steps

Step ① :→ Short the branch resistance through which current is to be calculated.

② Obtain the current through this short-circuited branch. This is current I_N

③ Calculate R_N as viewed through the two terminals of the branch from which current is to be calculated.

④ Draw Norton's equivalent.

⑤ Reconnect the branch resistance calculate the required current.

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

Q1)

By Norton's theorem, find current in 4Ω resistor

Step I Calculation of I_N

$I_N = I_3$

By expressing current in common branch

$I_3 - I_2 = 2$ — ①

$I_1 = 5A$ — ②

By applying KVL to supermesh

$-6 - 2(I_2 - I_1) = 0$

$2I_1 - 2I_2 = 6$ — ③

$I_3 = I_N = 4A$

Step II Calculation of R_N

$R_N = R_{AB} = 2\Omega$

Step III Calculation of I_L

$I_L = \frac{4 \times 2}{4+2} = 1.33A$ ↓

Q2)

$V = IR$

$I = \frac{V}{R}$