CheggSolutions - Thegdp

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## Electrical Engineering

### Topic: Norton Equivalent Circuit

#### Step-by-Step Solution

##### Step 1: Introduction and Given Data

The task here is to determine the Norton equivalent resistance (R_N) and the Norton equivalent current (I_N) as viewed from terminals A and B of the given circuit.

**Given:**

- Voltage source: 120 V
- Resistances: $6 \Omega, 3 \Omega, 4 \Omega, 2 \Omega$
- Current source: 6 A

*Explanation:* The Norton equivalent circuit consists of a single current source (I_N) in parallel with a single resistor (R_N) as viewed from the specified terminals.

##### Step 2: Calculation of Norton Equivalent Resistance (R_N)

To find $R_N$, all independent sources (both voltage and current) will be turned off.

- Turn off voltage source: Replace with a short circuit.
- Turn off current source: Replace with an open circuit.

The resulting resistive network between terminals A and B:

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6Ω-------(a)------4Ω-------- (b)
        | |
       3Ω   2Ω
```

**Calculation:**

Combine the $3 \Omega$ and $2 \Omega$ resistors in parallel:

$$R_{3\parallel2} = \frac{3Ω \times 2Ω}{3Ω + 2Ω} = \frac{6Ω}{5} = 1.2Ω$$

The series combination of $6Ω$, $1.2Ω$, and $4Ω$ resistors gives:

$$R_N = 6Ω + 1.2Ω + 4Ω = 11.2Ω$$

*Explanation:* When shorting the voltage source and opening the current source, equivalent resistance across A and B is calculated by considering combining resistances both in series and parallel.

##### Step 3: Calculation of Norton Equivalent Current (I_N)

To find the Norton current, the short-circuit current across terminals A and B needs to be determined. This is done by solving the circuit using superposition, considering both the independent sources.

**i) Contribution of 120 V Voltage Source Alone:**

- Set current source to an open circuit (ignore).
- Find the current through the $2 \Omega$ resistor being part of the mesh:

  $$\text{Total resistance in loop (6Ω + 3Ω + 2Ω):} \quad R_{\text{total}} = 6Ω + 3Ω + 2Ω = 11Ω$$

  $$I_{\text{total}} = \frac{120V}{11Ω} = 10.91A$$

  Currents division at node $b$ through $2Ω$:

  $$I_{2Ω} = I_{\text{total}} \times \frac{R_{\parallel}}{R_{\text{total}}} = 10.91A \times \frac{2Ω}{(2 + 3)Ω} = 4.36A$$

  $$I_{\text{through}} \, 4Ω= 10.91 - 4.36 = 6.55A$$

**ii) Contribution of 6 A Current Source Alone:**

- Set voltage source to 120V
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- \[6A\parallel (3Ω)= same current via 2 resistors \]

Sum of contributions:

\(\[I = 10.91OVER PART+ 6A = 16.91 \])

Step 4: Combining Contributions to Form Norton Equivalent Current:

The combined Norton current (short-circuit current):

MEASUREMENTS:

\[Implement measurement \small= | | Current values0.9 1.2 = \]

Final \(:

\[I_N + 4.5 - 0.5-IREST= 18.5 \small> calculations verify then user show final SUMMARIZED \]

Final Norton Equivalent Values

R_N=11.2 \]

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Supporting and Step-wise Explanations:

1. **Given Data Summary**
2. **R_N Calculation/Formation**
3. **I_N Determination/Division**
4. **Final Norton Value**

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