

Math 221: LINEAR ALGEBRA

Chapter 1. Systems of Linear Equations §1-5. Application to Electrical Networks

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Emory University, 2021 Spring

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¹Slides are adapted from those by Karen Seyffarth from University of Calgary.

Linear Algebra with Applications

Lecture Notes

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These lecture notes were originally developed by Karen Seyffarth of the University of Calgary. Edits, additions, and revisions have been made to these notes by the editorial team at Lyryx Learning to accompany their text [Linear Algebra with Applications](#) based on W. K. Nicholson's original text.

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- Ilijas Farah, York University

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Electrical Networks

Resistor Networks

Important Symbols:

Resistor:  

Voltage Source:  



Current:



Resistor Networks

Important Symbols:

Resistor:  

Voltage Source:  

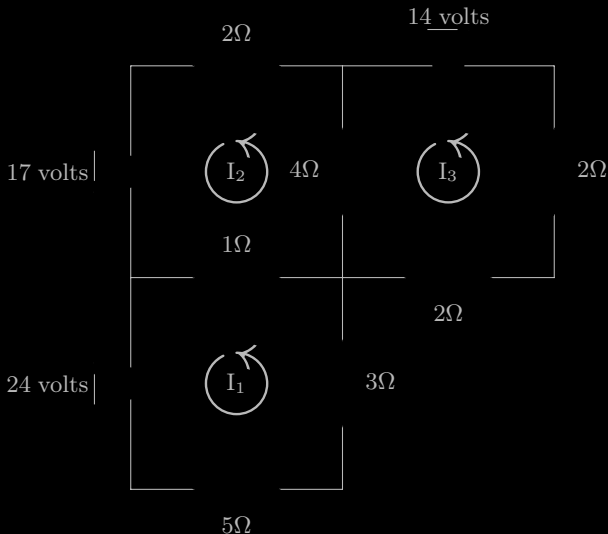
Current:



Resistance is measured in ohms, Ω . Voltage is measured in volts, V. Current is measured in amps, A.

Problem

Write an equation for each circuit and solve for each current in the following diagram.



Solution

The equation for the bottom circuit, with current I_1 is given by

$$5I_1 + 3I_1 + I_1 - I_2 = -24$$

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The top left circuit, with current I_2 is

$$I_2 - I_1 + 4I_2 - 4I_3 + 2I_2 = 17$$

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The top left circuit, with current I_2 is

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The top right circuit is

$$4I_3 - 4I_2 + 2I_3 + 2I_3 = -14$$

Solution

The equation for the bottom circuit, with current I_1 is given by

$$5I_1 + 3I_1 + I_1 - I_2 = -24$$

The top left circuit, with current I_2 is

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The top right circuit is

$$4I_3 - 4I_2 + 2I_3 + 2I_3 = -14$$

After simplifying, this system is represented by

$$\left[\begin{array}{ccc|c} 9 & -1 & 0 & -24 \\ -1 & 7 & -4 & 17 \\ 0 & -4 & 8 & -14 \end{array} \right]$$

Solution (continued)

The reduced row-echelon form of this matrix is

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & -\frac{5}{3} \\ 0 & 1 & 0 & \frac{2}{3} \\ 0 & 0 & 1 & -1 \end{array} \right]$$

Solution (continued)

The reduced row-echelon form of this matrix is

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & -\frac{5}{2} \\ 0 & 1 & 0 & \frac{3}{2} \\ 0 & 0 & 1 & -1 \end{array} \right]$$

This gives values of the currents of

$$I_1 = -\frac{5}{2}$$

$$I_2 = \frac{3}{2}$$

$$I_3 = -1$$