Chapter 27: Circuits

Rylan Polster

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General

Quantities

$$\begin{aligned} R &= \text{resistance} \\ i &= \text{current} \\ \mathcal{E} &= \text{electromotive force (EMF)} \\ V_{\text{AB}} &= \text{terminal voltage} \end{aligned}$$

1 Single-Loop Circuits

Loop Rule The algebraic sum of the changes in potential encountered in a complete traversal of any loop of a circuit must be zero.

Resistance Rule For a move through a resistance in the direction of the current, the change in potential is $-iR$; in the opposite direction it is $+iR$.

EMF Rule For a move through an ideal emf device in the direction of the emf arrow, the change in potential is $+\mathcal{E}$; in the opposite direction it is $-\mathcal{E}$.

Terminal Voltage and Internal Resistance

$$V_{\text{AB}} = \mathcal{E} - iR \tag{1}$$

2 Resistors in Parallel and in Series

Resistance In Parallel

$$R_{\text{eq}} = \sum_{j=1}^{n} \frac{1}{R_j} \tag{2}$$

Resistance In Series

$$R_{\text{eq}} = \sum_{j=1}^{n} R_j \tag{3}$$

3 The Ammeter and the Voltmeter

Ammeters Ammeters must be placed in series with the component whose current is being measured. The ammeters should have a resistance that is as low as possible ($R_{\text{ammeter}} \approx 0\,\Omega$).

Voltmeters Voltmeters must be placed in parallel with the component whose voltage is being measured. The voltmeter should have a resistance that is as high as possible ($R_{\text{voltmeter}} \approx \infty$).