



In this circuit, the batteries have voltages $\mathcal{E}_1 = 2.0 \text{ V}$ and $\mathcal{E}_2 = 4.0 \text{ V}$. Two of the resistors have fixed resistances: $R_2 = 5.0 \Omega$ and $R_3 = 8.0 \Omega$. But R_1 is a variable resistor. You can manually adjust it.

Suppose R_1 is set to 3.0Ω . What's the current through R_1 ?

Step 1: Choose loops

Step 2: Write currents in each branch I_1, I_2, I_3

Junction Rule

Step 3: $I_1 = I_2 + I_3$ ①

Step 4: Loop Rule

Walk around top loop: $\mathcal{E}_1 - I_1 R_1 - I_2 R_2 = 0$ ②
"up the battery"

Walk around bottom loop

$$\mathcal{E}_2 - I_2 R_2 + I_3 R_3 = 0 \quad \text{③}$$

We want I_1 : 3 eqns, 3 unknowns \Rightarrow solve

} magic algebra wand

$$\underline{\underline{I_1 = 0.076 \text{ A}}}$$