DeAnza College

Electricity and Magnetism
DC Circuits
Using Kirchhoff's Laws

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Last time

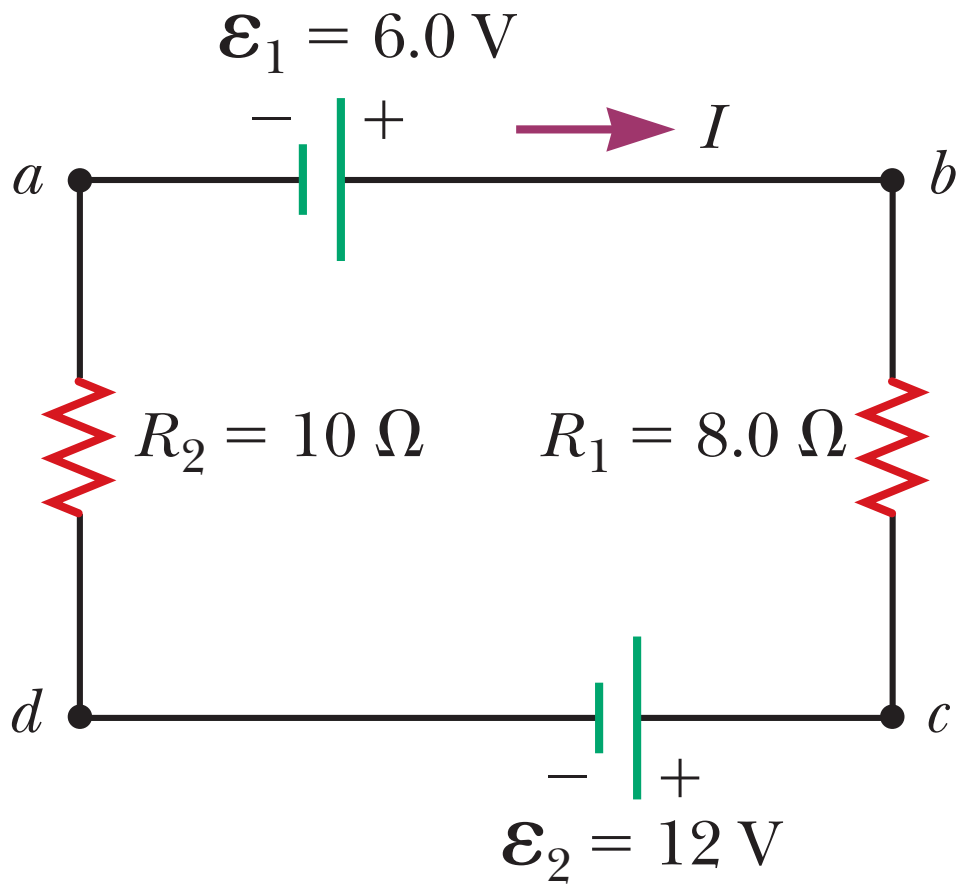
- power
- Kirchhoff's laws

Overview

- more Kirchhoff examples

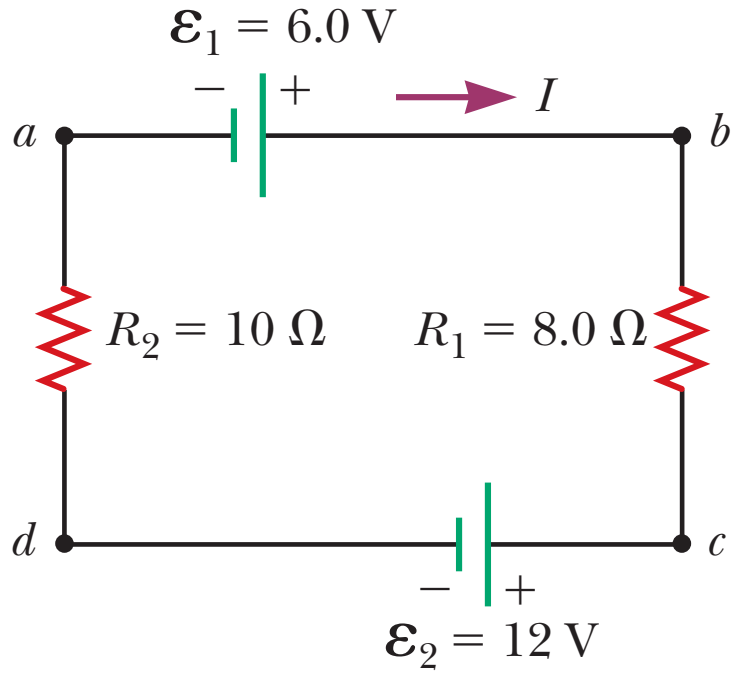
Example with Two Batteries

Find the current in the circuit.



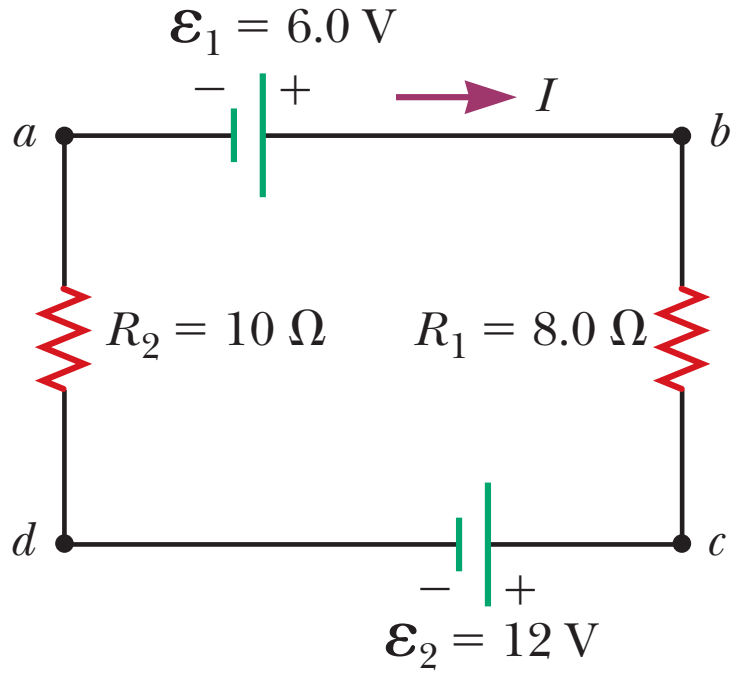
Suppose the current flows in the direction shown.

Example with Two Batteries



$$\sum \Delta V = \mathcal{E}_1 - IR_1 - \mathcal{E}_2 - IR_2 = 0$$

Example with Two Batteries



$$\sum \Delta V = \mathcal{E}_1 - IR_1 - \mathcal{E}_2 - IR_2 = 0$$

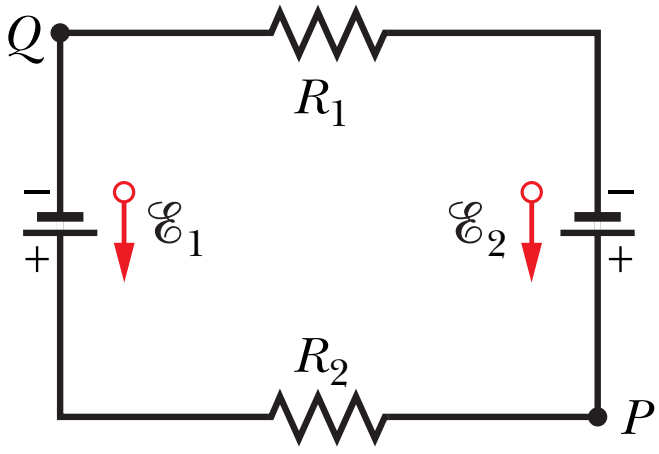
$$\Rightarrow \quad I = \frac{\mathcal{E}_1 - \mathcal{E}_2}{R_1 + R_2} = -0.33\ \text{A}$$

Minus sign means that the current flows opposite to the direction shown in the diagram.

Using Kirchhoff's Laws examples

Page 726, #2

•2 In Fig. 27-26, the ideal batteries have emfs $\mathscr{E}_1 = 150$ V and $\mathscr{E}_2 = 50$ V and the resistances are $R_1 = 3.0\ \Omega$ and $R_2 = 2.0\ \Omega$. If the potential at P is 100 V, what is it at Q?



Using Kirchhoff's Laws examples

Page 726, #2

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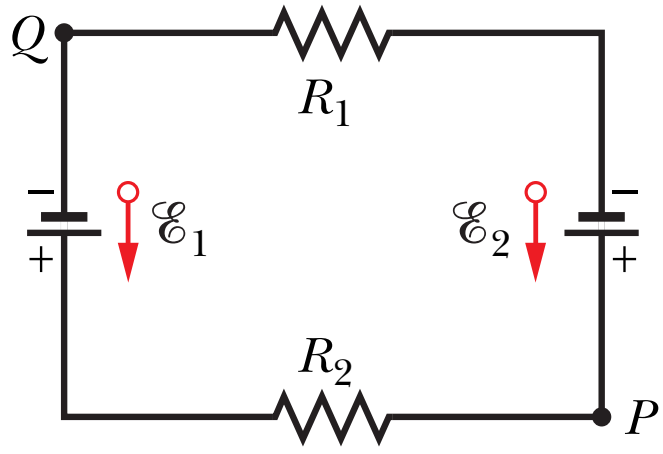
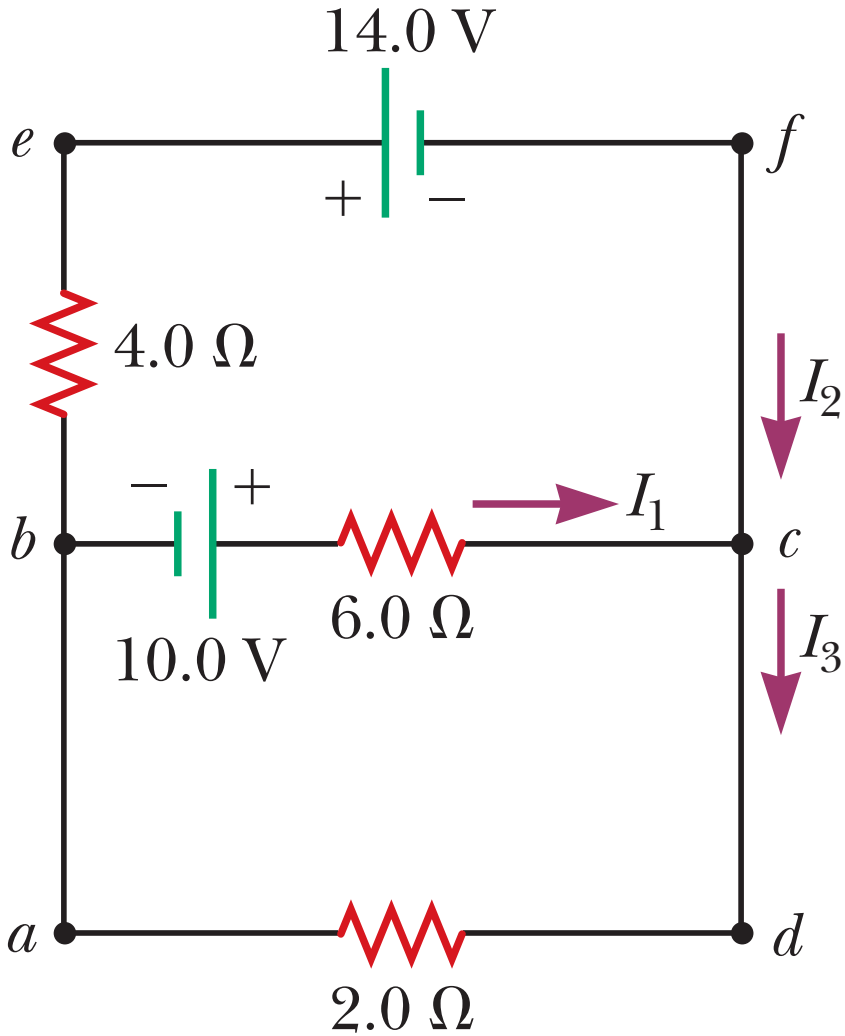


Loop rule: $-\mathcal{E}_2 - IR_2 + \mathcal{E}_1 - IR_1 = 0,\ I = 20$ A.

Potential at $Q = -10$ V.

Example with a Multiloop Circuit

Find the currents I_1, I_2, and I_3 in the circuit.



Suppose the currents flow in the direction shown.

Example with a Multiloop Circuit

Junction rule:

$$I_1 + I_2 = I_3 \tag{1}$$

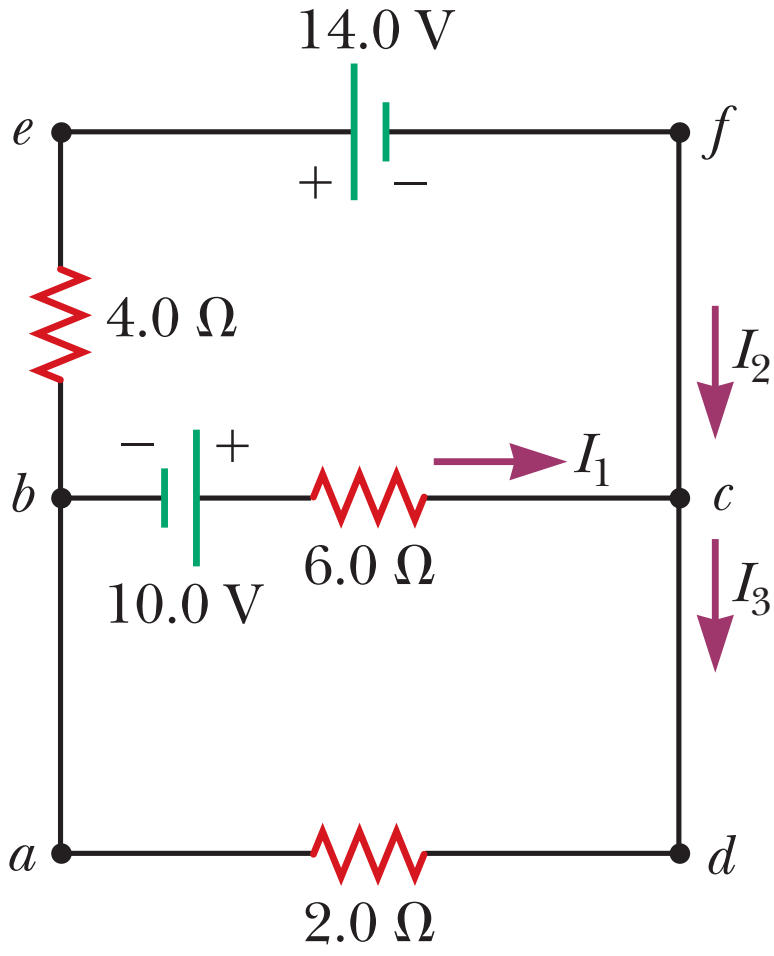
Loops:

$$10\text{V} - (6\Omega)I_1 - (2\Omega)I_3 = 0 \tag{2}$$

$$-14\text{V} + (6\Omega)I_1 - 10V - (4\Omega)I_2 = 0 \tag{3}$$

$$-14\text{V} - (2\Omega)I_3 - (4\Omega)I_2 = 0 \tag{4}$$

Example with a Multiloop Circuit



$I_1 = +2.0$ A $\quad I_2 = -3.0$ A $\quad I_3 = -1.0$ A

Summary

- using Kirchhoff's Laws

Next Test on Feb 15.

Homework

- Collected homework 2, posted online, due on Monday, Feb 12.

Serway & Jewett:

- PREVIOUS: Ch 28, onward from page 857. Problems: 5, 9, 15, 27, 31