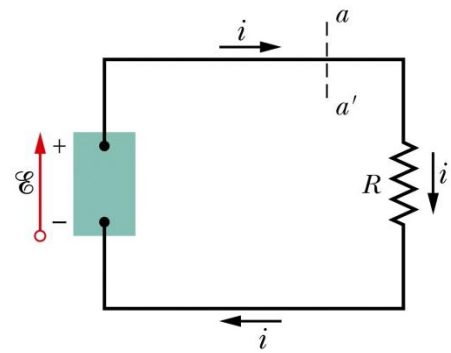
Interactive Problem Set 17, SP212 Spring 2013

Topic: Single Loop Circuits and Kirchhoff's Voltage Law (KVL)

---

1. Ideal battery and real battery:

a. The circuit below has an ideal battery (internal resistance r = 0) of emf (electromotive force) $\mathscr{E}$ and a resistor R as shown in the figure. Find the current i using Kirchhoff's Voltage Law (KVL).



b. The circuit below has a real battery of an internal resistance r = 2 Ω and emf (electromotive force) $\mathscr{E}$ = 12 V and a resistor R = 4.00 Ω as shown in the figure.

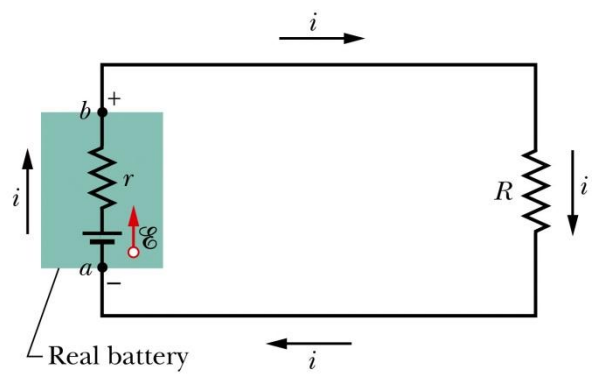
(i) Find the current i using Kirchhoff's Voltage Law (KVL).

(ii) Find the potential difference between b and a. (This is the potential difference across the battery.)

(iii) Calculate the rate at which the emf $\mathscr{E}$ delivers energy to the circuit. (This energy is dissipated as heat in the resistors r and R.)

(iv) What is the energy dissipation rate associated with the internal resistance r?

(v) What is the energy dissipation rate associated with the resistance R?

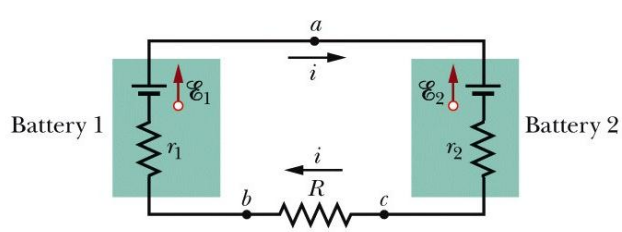


2. Single loop circuit with two real batteries:

$\mathscr{E}_1$ = 4.4 V, r_1 = 2.3 Ω, $\mathscr{E}_2$ = 2.1 V, r_2 = 1.8 Ω, R = 5.5 Ω

a. What is the current i in the circuit?

b. What is the potential difference between the terminals of battery 1?



Reading for next class: Chapter 27