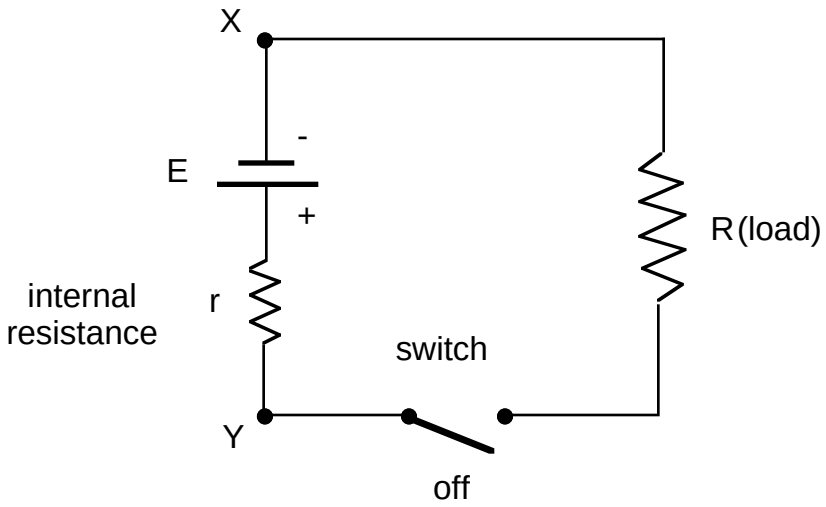
Internal Battery Resistance : Notes/W.S.-20

In the simple circuit, the voltage source was assumed to have no internal resistance. This is not really true. All cells and batteries have a small internal resistance.



In the above diagram, the terminal voltage, V_{XY}, (across terminals X and Y) of the cell is E (the emf or electromotive force). When the switch is on, the load resistance is connected and the terminal voltage decreases, because of the voltage drop across the internal resistance r. For this circuit, when the switch is on, we have:

$$V_{xy} = E - Ir = IR$$

Problems:

1) How would you find the emf of a battery in a circuit?

2) A 12 volt car battery produces a maximum current (short circuit) of 85 amps. Find the internal resistance of the battery.

3) The emf of a cell is 2.0 volts. If the voltage drop across the internal resistance is 0.10 volts, what is the terminal voltage?

4) In a certain cell, I = 5.60 A, the load resistance is 3.70 Ω, and the internal resistance is 0.15 Ω.

a) Find the terminal voltage.

b) Find the emf.

5) The terminal voltage of a battery is 6.200 volts. The emf is 6.250 volts. The load is a 2.40 Ω light bulb.

a) Find the current.

b) Find the internal resistance.

6) The emf of a battery is 18.0 volts. The load is 4.0 Ω. The internal resistance is 0.20 Ω.

a) Find the current.

b) Find the terminal voltage.

Answers: 1) Connect a voltmeter to the two terminals when the current is zero., 2) 0.14 Ω, 3) 1.9 V, 4)a) 20.7 V, b) 21.6 V, 5)a) 2.58 A, b) 0.019 Ω, 6)a) 4.3 A, b) 17.1 V.