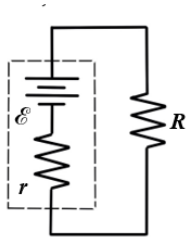
(15 min) From AP classroom: You want to determine the internal resistance r of a battery using a graphical approach. Given that you had access to a number of different sized resistors, multimeters and other equipment commonly found in physics labs, what experiment might you devise to do this?



a.) Clearly identify the quantities to be determine, their symbols and the equipment needed to measure them.

--the key to this is in the relationship between the voltage across the terminals of the battery (the terminal voltage) V and the current being drawn from that battery when placed across a resistor R.
--that relationship is V = E – i r; where E is the battery's EMF, "i" the drawn current and "r" the internal resistance of the battery;
--what needs to be noticed is that if you graphed "V" as a function of "i", that relationship would take on the form y = mx + b, where "b = E", "m" (the slope) would equal "-r" and "i" would equal "x";
--with that in mind, the experiment would entail taking a resistor R and placing across the battery, with a multimeter set in the circuit as an ammeter (to determine "i') and a multimeter across the battery's terminals to determine the terminal voltage "V."

b.) Describe the experiment you would run to execute this inquiry. Include enough information so a student could replicate the procedure, including steps necessary to reduce experimental uncertainty.

--using a single resistor R, set up the circuit as described in Part a;
--take the voltage and current data for several different voltage settings;
--graph the voltage along the y-axis and the current along the x-axis;
--take the slope of the graph to determine the internal resistance;
--to reduce uncertainty, repeat the experiment for several different R's.

c.) What information might be graphed on an X/Y axis that could be used to determine the internal resistance r.

--this was explained in Parts a and b

d.) Describe how the graph would be used to make that determination.

--this was explained in Parts a and b

e.) After completing the calculation, students realize they have ignored the resistance of the wires in the system. How might that have affected your determination of the battery's internal resistance. Explain your reasoning.

--the slope of the graph is related to the amount of unknown resistance in the circuit (originally assumed to be the internal resistance of the battery);

--if there was additional, unknown resistance associated with the wires, the slope would simply be bigger than if there was just the internal resistance of the battery;
--this means that if there was significant resistance associated with the wires, your internal resistance value would be bigger than the actual value of the internal resistance.