

# INTERNAL RESISTANCE AND EMF

**NAME:** \_\_\_\_\_

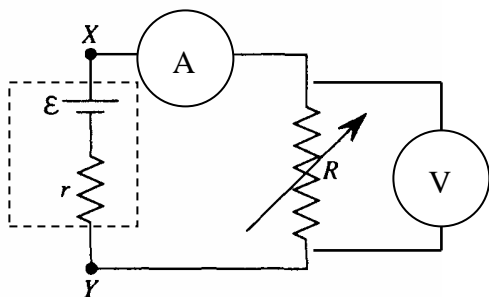
**DATE:** \_\_\_\_\_

**HYPOTHESIS:** The potential difference from one terminal to another on a battery varies directly with the internal resistance of the battery.  $V = -I r + \epsilon$

**PURPOSE:** To determine the internal resistance of a battery using measurements of current and terminal voltage in a circuit with a variable resistor.

**MATERIALS:** variable resistor, old 1.5 volt battery, ammeter, voltmeter.

**PROCEDURE:**



1. Construct the circuit shown to the left in the schematic.
2. Adjust the variable resistor to a very low resistance position. Record the terminal voltage and current. The current should be in milliamps.
3. Increase the resistance by moving the slide and again measure the voltage and current as before. Complete the data table of current and terminal voltage for at least four different resistance settings.

Current, I (mA)	Voltage, V (volts)

4. Plot a graph of V vs. I. Determine the slope and the y-intercept. What are they?

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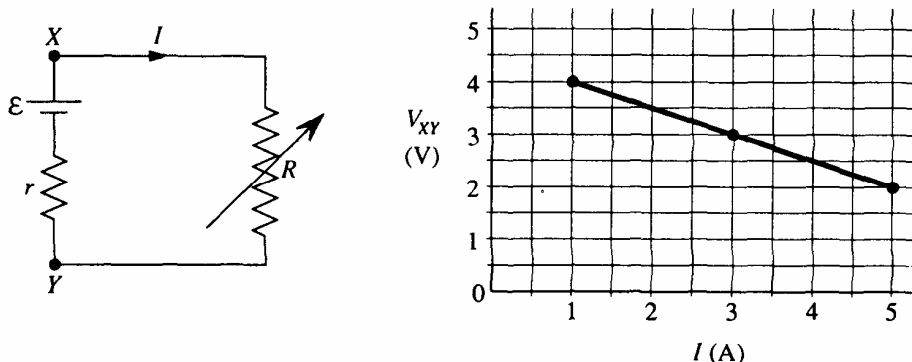
5. Disconnect the variable resistor and measure the terminal voltage of the battery with no current through it. This is the EMF of the battery and should be equal to the y-intercept. of your graph. Does it?

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6. Write a general equation for your graph and a specific equation for your graph using your slope and y-intercept.

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7. Solve the AP Problem from the 1991 exam



A battery with emf,  $\mathcal{E}$  and internal resistance  $r$  is connected to a variable resistance  $R$  at points X and Y, as shown above on the left. Varying  $R$  changes both the current  $I$  and the terminal voltage  $V_{XY}$ . The quantities  $I$  and  $V_{XY}$  are measured for several values of  $R$  and the data are plotted in a graph, as shown above on the right.

- Determine the emf,  $\mathcal{E}$  of the battery.
- Determine the internal resistance  $r$  of the battery.
- Determine the value of the resistance  $R$  that will produce a current  $I$  of 3 amperes.
- Determine the maximum current that the battery can produce.
- The current and voltage measurements were made with an ammeter and a voltmeter. On the diagram below, show a proper circuit for performing these measurements. Use  $\textcircled{A}$  to represent the ammeter and  $\textcircled{V}$  to represent the voltmeter.

