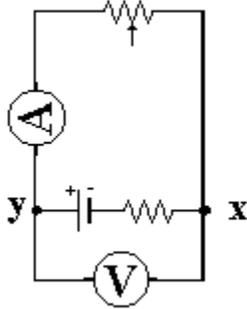


A.P. Physics C – Internal Resistance and EMF



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

Materials: Pasco circuit board, multimeter, and an old 1.5 V battery.

Procedure:

1. Assemble the circuit as shown to the left. Leave out the ammeter. You will have to remove a wire to measure the current.
2. Make sure you use the center spring and an outside spring on the potentiometer.
3. Turn the potentiometer clockwise until it stops.
4. Use the **V** setting on the multimeter.
5. Measure and record the terminal voltage across the battery springs. The springs represent points **y** and **x** in the diagram.
6. Remove the wire from the positive terminal of the battery to the potentiometer.
7. Switch the setting on the multimeter to the 200mA setting.
8. Measure and record the current through the potentiometer.
9. Reset the wire.
10. Place the multimeter back on the voltage setting.
11. While the meter is measuring the voltage, turn the potentiometer counter-clockwise until the voltage drops by 1/100 of a volt (Example: 1.35V to 1.34V).
12. Repeat steps 6-10.
13. Do a minimum of 6 trials.

Trial	Current	Terminal Voltage

Analysis

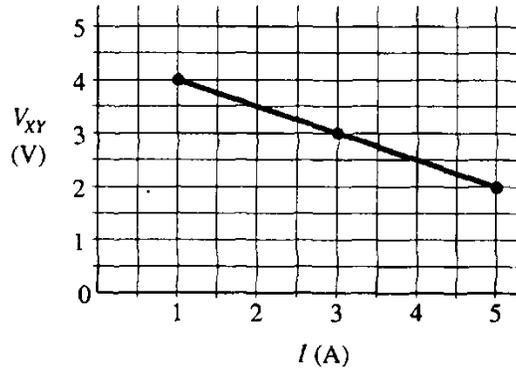
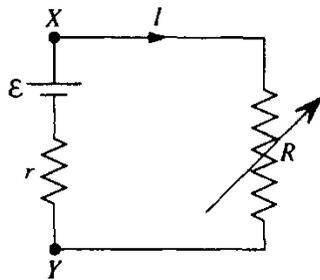
1. Plot a graph of Current (x-axis) vs. Voltage (y-axis).

Slope = _____ Y-intercept _____

What exactly does the SLOPE represent?

2. A “good” 1.5 V battery has an internal resistance of 0.0375 Ω . What is the % difference between your battery and a good one?

3. Graphically, what role does the current play? If you wanted to find the MAXIMUM current possible for your battery, how would you go about doing this? Explain in detail.



A battery with emf ϵ 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 ϵ 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.

- e. 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.

