Simulation of Internal Resistance of a Dry Cell

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Contents

1 Aim

The aim is to measure the internal resistance of a "battery," that is DC voltage source, such as a 1.5V D-cell, using an electric circuit-simulator.

2 Apparatus

See lab sheet.

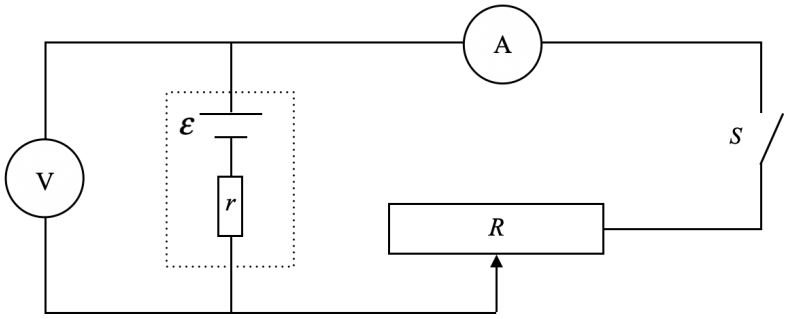

Figure 1: Circuit Setup

3 Procedure

See lab sheet.

4 Data Collection

Trials	**Resistance** (Ω)	**Voltage** (V)	**Current** (mA)
1	20	1.539	76.96
2	18	1.537	85.36
3	16	1.533	95.83
4	14	1.529	109.2
5	12	1.524	127.0
6	10	1.516	151.6
7	8	1.505	188.1
8	6	1.486	247.7
9	4	1.451	362.6
10	2	1.353	676.6

Table 1: Data Collected

5 Data Analysis

$$\varepsilon = I(R + r) \tag{1}$$

where

ε: the emf of the dry cell

I: the current read by the ammeter when the switched is closed

R: the resistance of the rheostat (variable resistor)

r: the internal resistance of the dry cell

V: the voltage indicated by the voltmeter

Because ε and r is constant, we can then calculate them by listing a equation as

$$\begin{aligned} \varepsilon_1 &= \varepsilon_2 \\ I_1(R_1 + r) &= I_2(R_2 + r) \\ 7.696 \times 10^{-2}\text{A}(20\Omega + r) &= 6.766 \times 10^{-1}\text{A}(2\Omega + r) \end{aligned}$$

which gives

$$\begin{aligned} r &= 3.102 \times 10^{-1}\Omega \\ \varepsilon &= 1.563\text{V} \end{aligned}$$

5.1 Fit Equation and Derived Equation

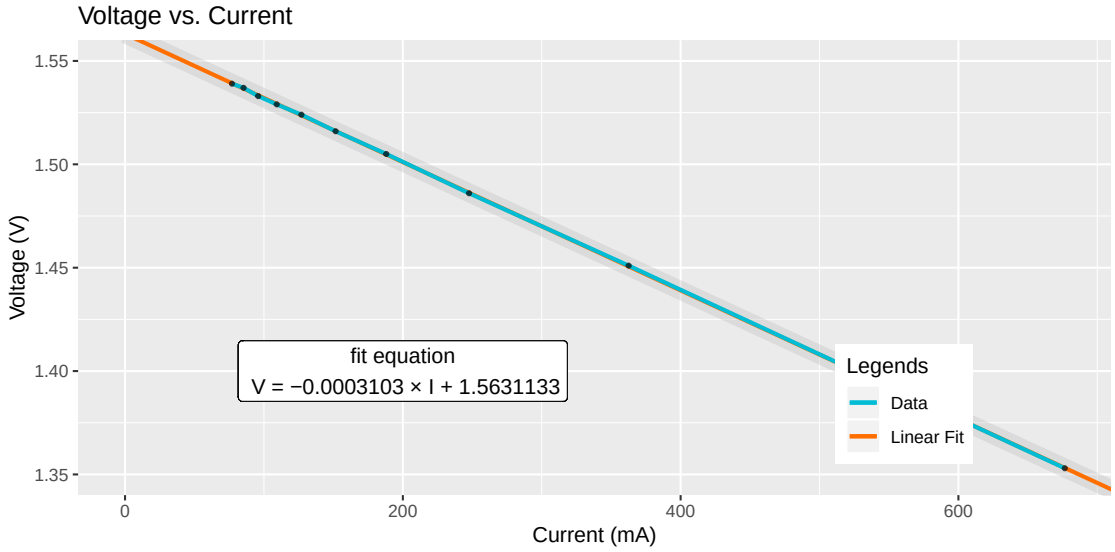

Figure 2: Voltage vs. Current

We can observe that the fit equation perfectly alignes with the equation that derives from $\varepsilon = I(R + r)$ in terms of ε as following:

$$\begin{aligned} \varepsilon &= I(R + r) \\ \varepsilon &= I\left(\frac{V}{I} + r\right) \\ V &= -rI + \varepsilon \end{aligned}$$

6 Conclusion

From the calculations we've done we found that the emf ε of the dry cell is 1.563V with an internal resistance r of $3.102 \times 10^{-1}\Omega$. It's amazing for the plot to show the exact linear regression values as the equation matches with those values. Which proves again that Physics is working! ;)