ROQED PHYSICS LAB

# Determination of the EMF of the current source and its internal resistance

**Purpose: to** learn how to determine the electromotive force and internal resistance of the source of electrical energy.

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**Equipment:**

040 - Laboratory ammeter,

043 - power supply (4.5 V battery),

connecting wires

042 - single-pole switch, key

**voltmeter**

**6 Ohm Rheostat**

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**Theory:**

To measure the EMF of a source, you need to connect a voltmeter to it with an open circuit.

When the key is open, the EMF of the current source is equal to the voltage on the external circuit. In the experiment, the current source is closed to a voltmeter, the resistance of which must be greater than the internal resistance of the current source d. The internal resistance of the current source can be measured indirectly by taking the readings of the ammeter and voltmeter with the closed switch.

For the section of the circuit containing the EMF: $I = \frac{\varepsilon}{R + r}$

$I_1 = \frac{\varepsilon}{R1 + r}$ and $R_1 = \frac{U1}{I1}$, then $I_1R_1 + I_1r = \varepsilon$ or $U_1 + I_1r = \varepsilon$

$U_2 + I_2r = \varepsilon$, hence $U_1 + I_1r = U_2 + I_2r$ and $r = \frac{U1 - U2}{I2 - I1}$. And since $I_1r = \varepsilon - U_1$, and $I_2r = \varepsilon - U_2$, then

$\varepsilon = \frac{U2I1 - U1I2}{I1 - I2}$

The current in the circuit can be changed using a rheostat. ε and r can be determined empirically.

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**Board:**

When the key is open, the EMF of the current source is equal to the voltage on the external circuit. In the experiment, the current source is closed to a voltmeter, the resistance of which must be greater than the internal resistance of the current source.
The internal resistance of the current source can be measured indirectly by taking the ammeter and voltmeter readings with the switch closed.

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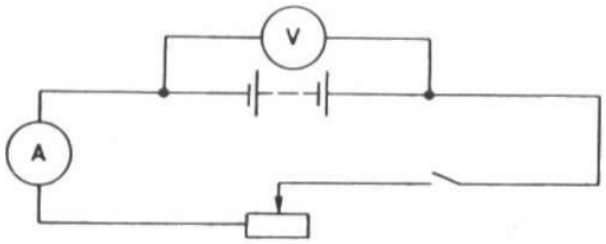


**Work progress:**

1. Build an experiment using the image on the board.

2. Start the simulation. The power supply turns on.

3. Enter the readings of the ammeter Iin the $Table_1$ and the voltmeter $U_1$.

4. Move the rheostat slider to a new position. Enter the readings of the ammeter Iin the $Table_2$ and the voltmeter $U_2$.

5. Collect the formula for calculating the EMF value of the source of electrical energy.

$$\varepsilon = \frac{U_2I_1 - U_1I_2}{I_1 - I_2}$$

6. Collect the formula for calculating the value of the internal resistance of the source of electrical energy.

$$r = \frac{U_1 - U_2}{I_2 - I_1}$$

7. Table.

| No. | $U_1$ (B) | $I_1$ (A) | $U_2$ (B) | $I_2$ (A) | ε (B) | r Ohm |
|---|---|---|---|---|---|---|
| 1 | ... | ... | ... | ... | | |

7. Make a conclusion.

**A.** In the course of this work, they learned how to measure the EMF and the internal resistance of the current source. When the key is open, the EMF of the current source is equal to the voltage on the external circuit.

**B.** In the course of this work, they learned how to measure the EMF and the internal resistance of the current source. The EMF of the current source is always equal to the voltage on the external circuit.

**C.** In the course of this work, they learned how to measure the EMF and the internal resistance of the current source. The EMF of the current source is always greater than the voltage on the external circuit.