Laboratory work 3.36

Determination of the resistance milliamperemeter and resistance source of the current by method of bypass surgery

Appliances and accessories: 1) miliampermeter;2) power source; 3) store with resistors; 4) button and key; 5) connected conductors.

$$R_g = \frac{R_1 - R_2}{R_2} R_{sh}$$

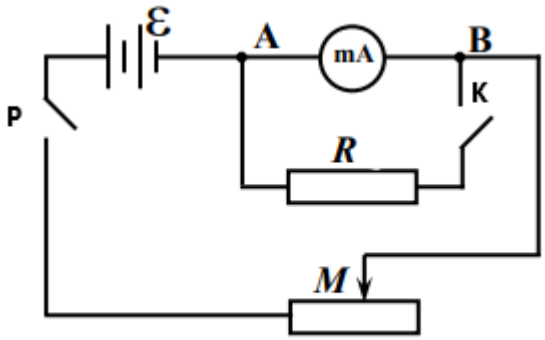
Destination of this work: 1) to study the laws of direct current, 2) determining the resistance of the galvanometer and source of the current by method of bypass surgery.

Description the appliance and theoretical statement:

To determine the resistance of milliamperemeter and the internal resistance of the source of the current by method of bypass surgery.

1. Milliamperemeter resistance is measured according to the scheme on Pic.1.

The current source ε, the key K, the milliammeter mA (resistance R_g that you have to measure) and the store of resistor M, connected sequentially. When switch on button P through the resistance R_1 of the store of M the current flows. After connection milliamperemeter shunt resistance R_{sh} parallel the current through the galvanometer will decrease. Now we can pick up in the store M such resistance R_2, in which the milliamperemeter will show the previous current I_1. Neglecting the internal resistance of a galvanic cell, in



Pi c. 1

the first case (without the shunt) define the Ohm's law for closed circuit write:

$$\varepsilon = I_1(R_1 + R_g) \qquad (1)$$

For the second case (with shunt) , applying the first and second rules

Kirchhoff gives:

for node A $I_2 = I_1 + I_{sh}$ (2)

for contour εABRε $\varepsilon = I_1 R_g + I_2 R_2$ (3)

for contour $ABR_{sh}A$ $0 = I_1 R_g - I_{sh} R_{sh}$ (4)

Solving these four equations, obtain

(5)

The sequence of measurements

1. To create the electrical circuit scheme according to pic. 1;
2. After checking the circuit by the teacher to include the store resistance 15000 –10000 Ohms, and switch on the button P , mark on the scale the position of the arrow of the galvanometer.
3. By the direction of the teacher to turn on the shunt R_{sh} and, switch on the button P to pick up in the store the resistance R_2 that we can observe pre-deviation arrow of the galvanometer;
4. Repeat the experiment with different values R_1,R_{sh};
5. The results of measurements and calculations write down in table 1;

The final result is written in the form

$$R_{g_{true}} = \left(\langle R_g \rangle \pm \Delta R_g \right) \text{ ohm where } \alpha =$$

2.To determine the internal resistance of a galvanic element r, it is necessary

make a circuit according to the pic. 2.

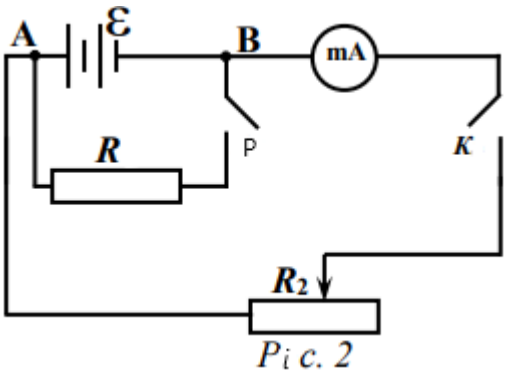
$$\varepsilon = I_1 (R_1 + R_g + r).$$

If you switch on the key the current will flow in the circuit according to Ohm's law for closed circuit.

(6)

Don't turn off the key and switch on the button to find in the store the resistor R_3 that the current flows through the galvanometer I_1.On the basis of Kirchhoff's rules we can write:

for node A (7)



Pi c. 2

for the contour $AR_{sh}BRA$ $0 = I_{sh} R_{sh} + I_1 (R_g + R_3)$ (8)

for the contour $A\varepsilon BR_{sh}A$ $\varepsilon = I_2 r - I_{sh} R_{sh}$ (9)

Solving system (6) – (9), we obtain

$$r = \frac{R_1 - R_3}{\langle R_g \rangle + R_3} R_{sh} .$$

$$I_1 = I_2 + I_{sh}$$

(10)

Measurement taken in such sequence, as in paragraphs 2, 3, 4, and R_1 take 15000 – 10000 Ohm, R_{sh} – taken by the direction of the teacher.

The measurement results write down in the table 2

The final result is written in the form

$r_{\text{true}} = (\langle r \rangle \pm \Delta r)$ ohm where $\alpha =$

Table 1

№ measur.	R_1, ohm	n	R_{sh}, ohm	R_2, ohm	R_{g_i}, ohm	$\langle R_g \rangle$, ohm	ΔR_{g_i}, ohm	$\Delta R_{g_i}^2$, $(\text{ohm})^2$	$S\langle R_g \rangle$, ohm	α	$t_{\alpha,n}$	ΔR, ohm	E, %
1													
2													
3													

Table 2

№ measur	R_1, ohm	n,	R_{sh} ohm	R_3, ohm	$\langle R_g \rangle$ ohm	r_i, ohm	$\langle r \rangle$, ohm	Δr_i, ohm	Δr_i^2, $(\text{ohm})^2$	$S\langle r \rangle$ ohm	α	$t_{\alpha,n}$	Δr, ohm	E, %
1														
2														
3														