Abstract. This article is aimed at deepening the knowledge of the 8th class physics course on the comparative resistance of conductors by conducting laboratory classes "Determining the comparative resistance of a conductor" when studying the topic "Electrical resistance." The knowledge and qualifications of students on the use of conductors having less comparative resistance in laying new industries, as well as electrical networks are highlighted.

In the 8th class textbook "Physics" on the topic "Electrical Resistance," it is well shown that the electrical resistance of a conductor is directly proportional to its length and inversely proportional to the cross-sectional area. It has also been explained that the electrical resistance depends on another constant value in addition to these two values and depends on the conductor material by forming an electrical circuit of conductors of the same length and the same cross-section.

The advantage over a given theme. The term "resistance" is used in two different meanings:

1. Resistance characterizes one of the electrical properties of a circuit, network, wire or consumer. In this sense, it can be said that the resistance of the lighting lamp is 110 ohms or the resistance of the wire is 1.0 ohms.

2. A resistor is a device designed to be connected to limit or reduce the current in electrical circuits. An alternating resistor, called a rheostat, is designed to control the current in the circuit. The concept of resistivity is introduced, according to which the resistance of the conductor depends on the material of the conductor in addition to its dimensions.

\[ R \sim \rho \]

\[ R = \frac{\rho l}{S} \quad \text{from} \quad \rho = \frac{S}{l} \quad (11) \]

The specific resistance is measured in ohms. The resistance of the substances in which the conductor is made varies. (Table 1)
### Table 1

| №  | Substances | ρ,10⁻⁸Ωм.m | №  | Substances | ρ,10⁻⁸Ωм.m |
|----|------------|-------------|----|------------|-------------|
| 1  | Copper     | 1,7         | 1  | Lead       | 20,5        |
| 2  | Aluminum   | 2,8         | 2  | Chromium   | 14          |
| 3  | Tungsten   | 5,5         | 3  | Nickel     | 40          |
| 4  | Iron       | 9,8         | 4  | Nichrome   | 110         |

In this table, the table clearly shows the conductor with the highest and lowest resistivity, where the resistivity of the metal conductors is different. If the resistivity of at least three of these metal conductors is calculated in the laboratory or if the cross-sectional area of the same material is calculated as the relative resistance of the three conductors, students will be convinced of the difference in the resistivity of the material. For example, the resistivity of a copper conductor $\rho_1=1,7*10^{-8}\text{ Om*m}$, specific resistance of aluminum conductor $\rho_2=2,53*10^{-8}\text{ Om*m}$. $S_1$ – the cross-sectional surface of the copper conductor, $S_2$–the cross-sectional surface of the aluminum conductor if the resistance $R=\rho \frac{I}{S}$ from the formula

$$\frac{S_2}{S_1} = \frac{\rho_2}{\rho_1} = \frac{2.53*10^{-8}}{1.7*10^{-8}} = 1.48 \approx 1.5$$

If we use copper cross-section instead of aluminum conductive electrical networks, which are pulled in the streets, we can use copper wires, the cross-section of which is 1,5 marotaba smaller than aluminum. In Radio Engineering, Gold is used as a conductor, since the specific resistance is the least in the range of metals, in heating systems, the reason for the benefit of nixrome Wire is the greatest in comparison resistance.

**Definition of conductor resistivity.** (Laboratory work).

**Necessary tools and materials:** ammeter, voltmeter, measuring tape, calliper or micrometre, AC power supply, rheochord, electric switch, three different nichrome conductors with a different length of 1 meter and cross-sectional area, connecting wires, rheostat.

**The purpose of the work:** to give students knowledge and skills that the resistivity of metal conductors depends on the material of the metal conductor.

**Theoretical part.** According to the Ohm law for a part of the circuit, the current is directly proportional to the voltage applied to the part of the conductor and is inversely proportional to the resistance of the conductor:

$$I = \frac{U}{R}$$

(12)

$I$ – current strength,
$U$ - is the voltage across the conductor,
$R$- is the resistance of the conductor.

Conductor resistance is measured in Ohm. When the voltage is 1 V and the current in the conductor 1 A, the resistance of this conductor is 1 Ohm. [2].

In metals, electrons are the particles that generate electricity. As the electric current passes through the metal, electrons that are weakly bound to their atoms - electrons free of atoms - move. Atoms that have lost one or more electrons - ions -
remain in the nodes of the crystal lattice. Free electrons involved in the formation of current hit the nodes of the crystal lattice, reducing their ordered speed. The kinetic energy of electrons is converted into the internal energy of the conductor. As a result of such collisions, a force is created that prevents the ordered movement of charged particles in the conductor. Part of the power of the current source is used to overcome this power. The physical size that characterizes the property of the conductor that makes it difficult to conduct electricity is called resistance. Experiments show that the resistance of the conductor $R$ is directly proportional to its length $l$ and inversely proportional to the surface of the cross-section $S$, depending on which material it is made of [3].

$$R = \rho \frac{l}{S} \quad \text{(13)}$$

$\rho$ – resistivity of the conductor depends on the conductor material.

$$\rho = R \frac{S}{l} \quad \text{(14)}$$

For example, copper is widely used as a conductive material because of its low specific resistance, sufficient mechanical permeability, ease of processing, and corrosion resistance. Copper can be an inelastic MT grade and a softened MM grade.

Hard copper is used in contact wires, collector plates, etc. Soft copper is widely used in the manufacture of wires used for the manufacture of coils of electric machines, electrical equipment and devices [3]. In HBT, as the conductor resistivity unit, the comparative resistance of conductor 1m is used, the length of which is 1M, and the cross-sectional surface-1m² is taken as m.

![Figure 1. Electrical circuit diagram](image1)

![Figure 2. Electrical circuit for resistance determination](image2)
In HBT, as the conductor resistivity unit, the comparative resistance of conductor 1Ωm is used, the length of which is 1m, and the cross-sectional surface 1m² is taken as m. Taking into account the above and

\[ S = \pi \left( \frac{d}{2} \right)^2 , \]

we obtain

\[ \rho = \frac{U \pi \left( \frac{d}{2} \right)^2}{I} \]  \hspace{1cm} (15).

(5) the formula is a formula for calculating the resistivity of the conductor from the voltmeter reading to the formula (5), measuring the value of U - voltage, the value of the strength of I - current from the reading of the ammeter to the formula (5) the length and diameter of the conductor and determining the resistivity of the substance studied by us. To obtain the result by performing the experiment, you need to perform the following works.

**The procedure of work execution.**
1. Measure the Nihrom length of the conductor using a measuring tape.
2. Measure the diameter of the nichrome wire using a calliper or micrometre.
3. A current source, R - rheochord, A - ammeter, V - voltmeter, K - electric switch.
4. Connect the switch and measure the current in the circuit and voltage at the ends of the rheochord.
5. Calculate the ohm resistance using the Ohm law.
6. Calculate the resistivity of the rheochord (nichrome) material by attaching the results to the last formula.
7. By changing the stress using the rheostat, repeat the experiment three times and calculate the error.
8. Write the results of the experiment in the table below.

| The number of the experiment | I  | d  | S M² | l A | U B | R O M | ρ 10⁻⁸Ω.m | ̅ρ 10⁻⁸Ω.m | Δρ 10⁻⁸Ω.m | Δ ̅ρ 10⁻⁸Ω.m | δ =  \frac{Δ ̅ρ}{ρ} 100% |
|-----------------------------|----|----|------|-----|-----|-------|----------|----------|----------|-------------|----------------|
| 1                           |    |    |      |     |     |       |          |          |          |             |                |
| 2                           |    |    |      |     |     |       |          |          |          |             |                |
| 3                           |    |    |      |     |     |       |          |          |          |             |                |

Calculate result on a formula \( ρ = ̅ρ + Δ ̅ρ \)

Questions and assignments.
1. Tell me about Ohm law.
2. Explain the conductor resistance.
3. What physical quantities do the resistance of metals depend on?
4. What is meant by comparative resistance?

**Conclusion.** The laboratory lesson “determination of conductor resistivity” is carried out after completing the 8th class of the physics course on the topic “electrical resistance”. Therefore, we recommend the following laboratory work “determining the resistivity of the pointer” after the topic “electrical resistance”. If in the above sequence
the subject of “electrical resistance” is taught, then the knowledge and skills of students will certainly increase. To make sure of this opinion, you can draw a conclusion from the answers of students to the question of reinforcements after laboratory studies.

References:

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