Resistance Lab

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1. Purpose

For part 1, the goal was to examine how material, cross-sectional area, and length impact resistance. For each coil of wire, resistance was determined in three ways: based on measurements of voltage and current; based on the resistance reading from the multimeter; and based on the dimensions of the wires and the resistivity of the material. In addition, the results of the three methods of determining resistance were compared.

2. Results

Table 1 contains the properties of the resistance coils used in part 1. ρ is the resistivity of the material. L is the length of the coil of wire. D is the diameter of the wire.

Table 1. Resistance Coils

Coil	Material	ρ (Ω m)	L (cm)	D (cm)
1	Nickel-Silver	44×10^{-8}	40	0.0254
2	Nickel-Silver	44×10^{-8}	80	0.0254
3	Nickel-Silver	44×10^{-8}	120	0.0254
4	Nickel-Silver	44×10^{-8}	160	0.0254
5	Nickel-Silver	44×10^{-8}	200	0.0254
6	Nickel-Silver	44×10^{-8}	200	0.0320
7	Copper	1.72×10^{-8}	2000	0.0254

Table 2 contains the measurements made during part 1. ΔV is the voltage across the resistance coil. I is the current through the resistance coil. $R_\mathrm{m} + r$ is the resistance, measured using the multimeter, of the resistance coil and the wires connecting it to the multimeter. r is the resistance, measured using the multimeter, of just the wires used for connecting the multimeter to the resistance coil.

Table 2. Part 1 Measurements
Note: r, the resistance of the two wires connected to the multimeter, was measured to be (0.1 ± 0.1) Ω.

Trial	ΔV (V)	I (mA)	$R_\mathrm{m} + r$ (Ω)
1	0.214 ± 0.001	55.07 ± 0.05	4.0 ± 0.1
2	0.400 ± 0.001	49.72 ± 0.01	8.3 ± 0.1
3	0.536 ± 0.001	44.53 ± 0.02	12.0 ± 0.1
4	0.662 ± 0.001	41.70 ± 0.01	15.9 ± 0.1
5	0.772 ± 0.001	38.19 ± 0.01	20.3 ± 0.1
6	0.538 ± 0.001	45.44 ± 0.01	11.7 ± 0.1
7	0.357 ± 0.001	51.31 ± 0.01	7.3 ± 0.1

Table 3 contains the two experimental values for resistance in the coil ($R_{V/I}$ and R_m) and the theoretical value (R_th) $R_{V/I}$ is the experimental resistance determined using

measured values for ΔV and I. R_{m} is the experimental resistance determined using the readings from the multimeter. R_{th} is the theoretical resistance determined using the dimensions of the wires (L and D) and the resistivity of the material (ρ).

Table 3.

Trial	$R_{V/I}$ (Ω)	R_{m} (Ω)	R_{th} (Ω)
1	3.89 ± 0.02	3.9 ± 0.1	3.47
2	8.05 ± 0.02	8.2 ± 0.1	6.95
3	12.04 ± 0.02	11.9 ± 0.1	10.42
4	15.88 ± 0.02	15.8 ± 0.1	13.89
5	20.21 ± 0.03	20.2 ± 0.1	17.37
6	11.84 ± 0.02	11.6 ± 0.1	10.94
7	6.96 ± 0.02	7.2 ± 0.1	6.79

3. Uncertainty

4. Conclusion

5. Citations

[1] Karen Schnurbusch, *Physics 4B Lab Book*, Mt. San Antonio College, 2023, pp. 65-70.
[2] Karen Schnurbusch, *Physics 4B Equations*, Mt. San Antonio College, 2023, pp. 4, 10.