

Name \_\_\_\_\_

Date \_\_\_\_\_

## Using The Resistance Bench for Physics Labs

### General Information

#### 1. Safety:

- a. The bench is made of wires and cardboard/plywood. As the voltage increases the wire's temperature increases and it might incandescent. As a result smoke might appear, and minor burns if wire is touched. Please be alert. In R vs. I or R vs. A experiment when only a multimeter is used an an ohmmeter there is no risk at all.
- b. If using a power source limit it to 1.5V (1 battery or set the power unit to 1.5V and instruct the student not to change it.

#### 2. There are various ways to measure resistance:

- a. Directly with a multimeter that functions as a ohmmeter (it is actually not direct as the meter provides voltage, measures current and calculates resistance)
- b. Using two multimeters - Voltmeter and Ammeter - reading both voltage and current and calculating resistance. This method requires understanding of connecting voltmeter (in parallel) and ammeter (in series) to a circuit - or just follow the diagram directly.
- c. Some power sources have voltage and current display which reduces the need of multimeters.
- d. Any combination of the above



Name \_\_\_\_\_

Date \_\_\_\_\_

### Experiment 1

**How is the Resistance of a wire change as the length of the wire changes.**

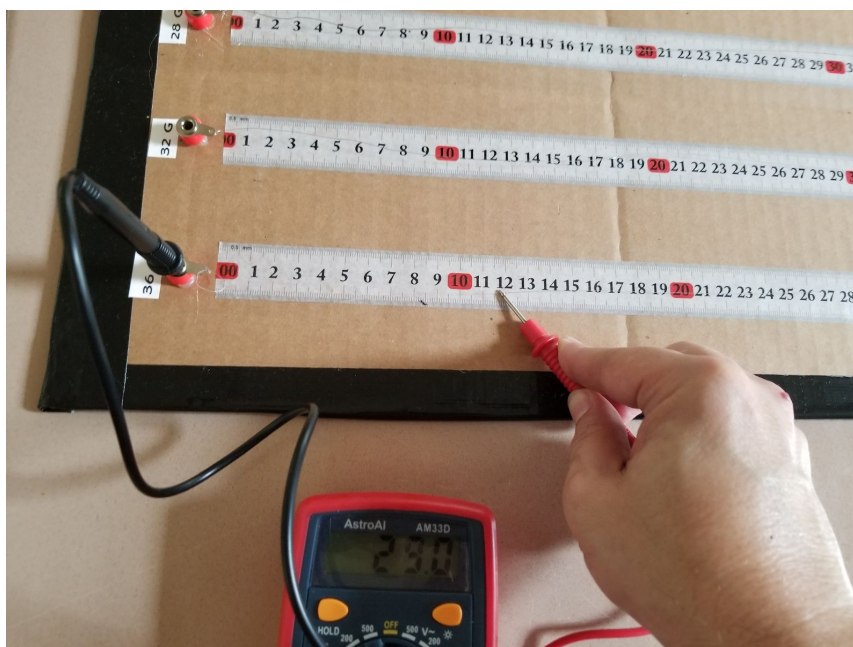
Theoretical background:

$$R = \frac{\rho}{A} L$$

Teacher's Notes: Since we are keeping the same material resistivity and the same cross-sectional area we are expecting a linear relationship.

We are expecting the slope to be equal to  $\rho / A$  so once the slope is found and the area is given (known gauge of the wire) we can also calculate the resistivity of the wire.

1. Predict! Sketch a graph of Resistance as a function of length. Explain why did you choose this graph shape? (Linear/quadratic/inverse etc) and what is the physical meaning of the slope and intercept (if exist)
2. Connect the circuit as shown in the following photo:



Name \_\_\_\_\_

Date \_\_\_\_\_

3. While one side of the circuit is fixed to one end of the wire - move the alligator clip / probe along the wire and record the resistance (or record the voltage and current (depends on settings)).
4. Record your data in the following chart: (V and I are optional, if you measure the resistance directly - skip those two columns)

L(m)	V(Volts)	I (Amperes)	R(Ohms)

5. Using graph paper or electronic spreadsheet (excel, google spreadsheet etc) create a scatter plot, add the line of best fit and find its equation.

Line equation:

6. How do the results match your prediction?

7. How many mm<sup>2</sup> in one m<sup>2</sup>? Use the attached chart to convert the wire gauge to m<sup>2</sup>.  
 Wire gauge is: \_\_\_\_\_





Name \_\_\_\_\_

Date \_\_\_\_\_

### Experiment #2

**How is the Resistance of a wire change as the cross sectional area of the wire changes.**

Theoretical background:

$$R = \frac{\rho}{A} L$$

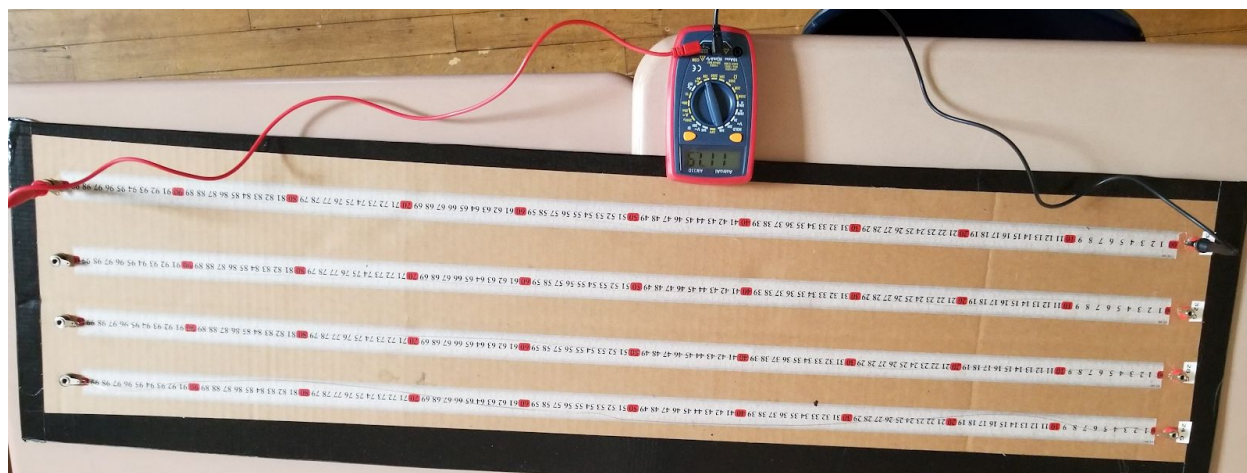
Or:

$$R = L\rho \cdot \frac{1}{A}$$

**Teacher's Notes:** Since we are keeping the same material resistivity and the same cross-sectional area we are expecting an inverse relationship. With advanced students discuss linearization

11. Predict! Sketch a graph of Resistance as a function of cross sectional area. Explain why did you choose this graph shape? (Linear/quadratic/inverse etc) and what is the physical meaning of the slope and intercept (if exist)

12. Connect the circuit as shown in the following picture:



13. Move both probes to different wires terminals (both of the same wire)



Name \_\_\_\_\_

Date \_\_\_\_\_

14. Record your data in the following chart: (V and I are optional, if you measure the resistance directly - skip those two columns)

A(m <sup>2</sup> )	V(Volts)	I (Amperes)	R(Ohms)

15. Using graph paper or electronic spreadsheet (excel, google spreadsheet etc) create a scatter plot of R (Vertical axis) vs. A(Horizontal Axis) , add the line of best fit and find its equation.

16. How do the results match your prediction?

17. Optional: Linearization - Graph the Resistance vs. 1/A find the slope. What is the physical meaning of the slope of the linear graph?



Name \_\_\_\_\_

Date \_\_\_\_\_

18. How many  $\text{mm}^2$  in one  $\text{m}^2$ ? Use the attached chart to convert the wire gauge to  $\text{m}^2$ .  
Wire gauge is: \_\_\_\_\_

19. Based on your slope and the given gauge, find the resistivity of the wire.

20. The known resistivity of nichrome is  $1.10 \times 10^{-6} \Omega\text{m}$  What is your %error?

21. List factors that might affect your error and what measure can we take to reduce these factors and decrease our %error.

