ScienceCube

Series Connection of Resistors

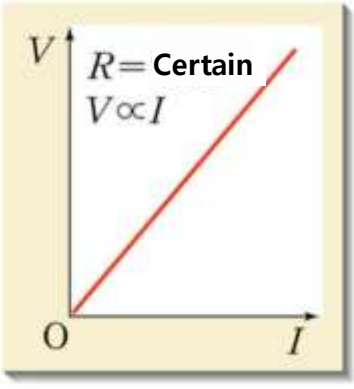
---

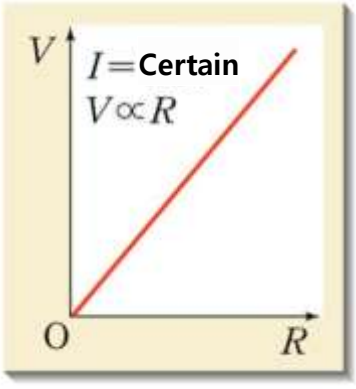
1. **Measure the current and voltage across each resistor when connected in series under a constant voltage and find the relationship between the parts and the whole.**
2. **Calculate the total resistance when multiple resistors are connected in series.**

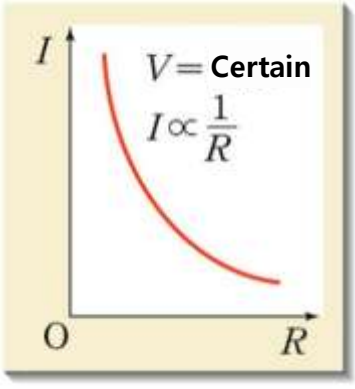
Fundamental Concept

1. Ohm's Law

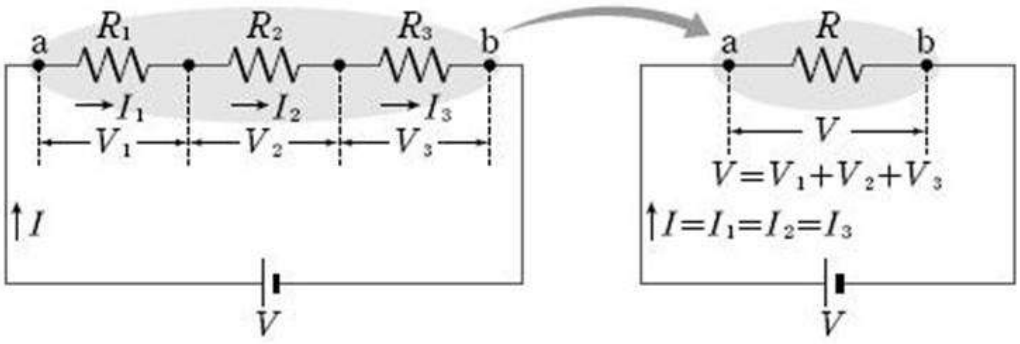
Ohm's Law states the relationship between voltage, current, and resistance in an electric circuit. The current flowing through a conductor is directly proportional to the voltage applied across it and inversely proportional to its resistance..







2. Series Connection of Resistors



Connecting three resistors R1, R2, and R3 in sequence is called a series connection of resistors.

(1) The current I flowing through each resistor is constant

I = I1 = I2 = I3

(2) The sum of the voltages V1, V2, and V3 across each resistor is equal to the total voltage V of the battery

V = V1 + V2 + V3

(3) The voltage across each resistor is proportional to its resistance, according to Ohm's Law:

V1 = I • R1, V2 = I • R2, V3 = I • R3

(4) Since the sum of the voltages across the resistors equals the total voltage:

V = V1 + V2 + V3 = I • (R1 + R2 + R3) = I • R

(5) The total equivalent resistance R of resistors in series is the sum of the individual resistances:.

R = R1 + R2 + R3 + ...

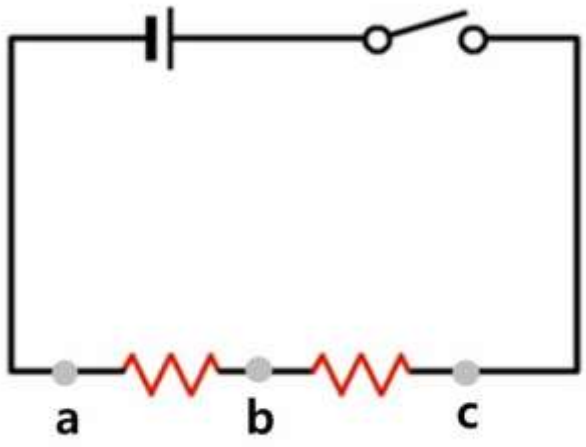
Experiment

Materials Needed

Interface, Science# program, Voltage sensor, Current sensor, Resistor board (five 10Ω resistors connected), Switch, Alligator clips, Battery holder (2), Batteries (2)

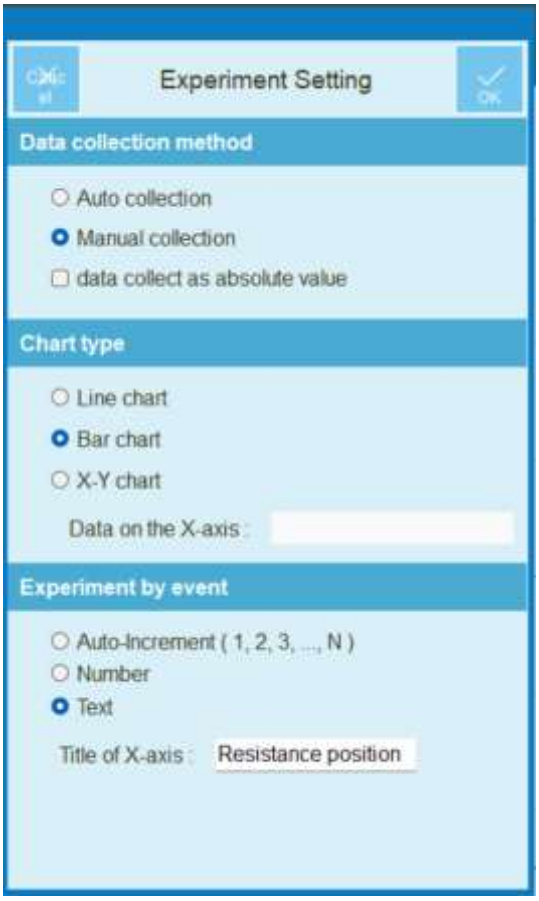
Experimental Setup

1. Connect two nichrome wires on the resistor board in series and connect them to two batteries in series, as shown in the diagram below.



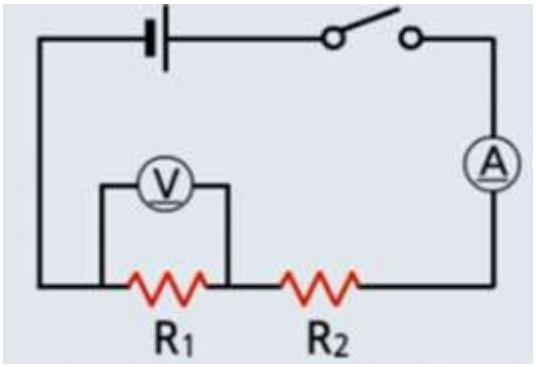
Interface Setup

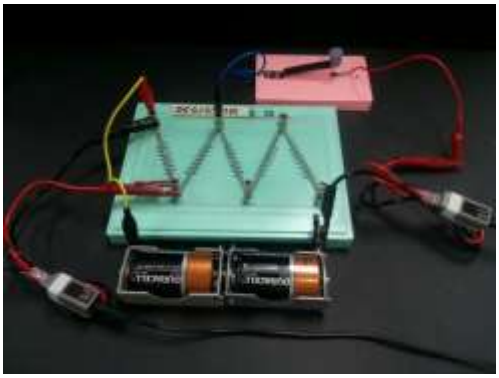
1. Run the Science# program.
2. Connect the voltage sensor and current sensor to the interface.
3. Press to set up the experimental environment as shown or press for automatic setup..



Data Collection

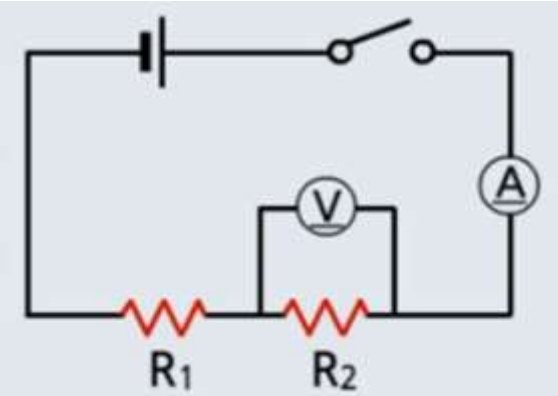
1. Connect the voltage sensor to points a and b in the circuit, and connect the current sensor in series with the circuit..

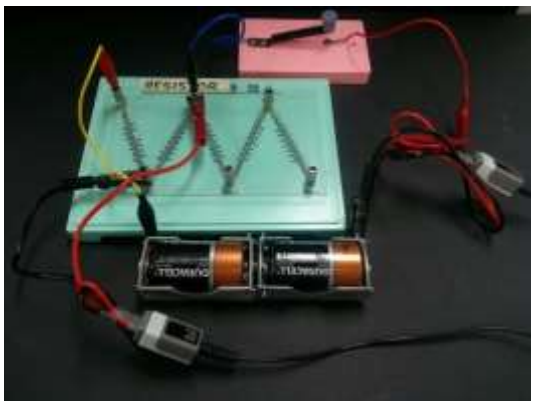




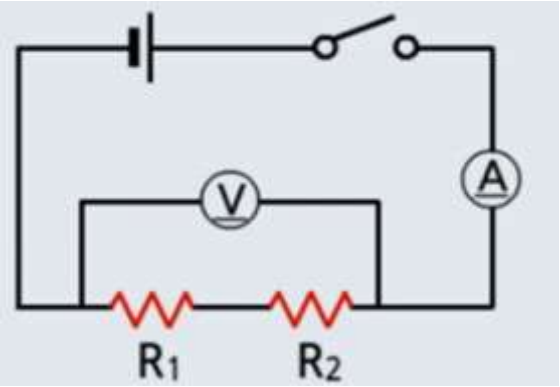
2. Press and then press to measure the voltage and current across R1.

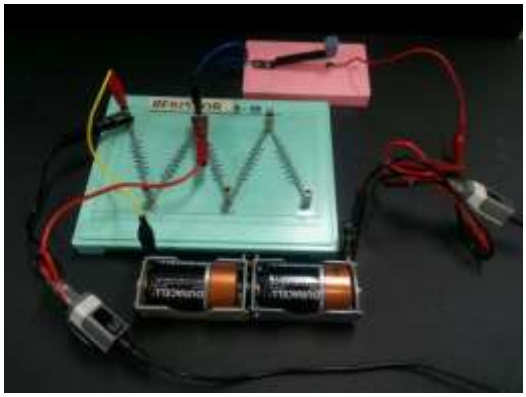
3. Connect the voltage sensor to points b and c and measure the voltage and current across R2 in the same way..





4. Finally, connect the voltage sensor to points a and c to measure the voltage across R1 and R2 together, and measure the current in the circuit with the current sensor..





5. Press to end the experiment.
6. Use Ohm's Law to calculate the resistance values R1, R2, and the total resistance R..

Data Analysis

Recording Data

1. Compare the measured voltage and current values for each resistor using a bar graph.

2. Record the measured voltage and current values for each resistor in the table below and calculate the resistance values using Ohm's Law..

Category	Voltage (V)		Current (A)		Resistance (Ω)	
R1	V1		I1		R1	
R2	V2		I2		R2	
R total	V total		I total		R total	

Data Application

1. Explain the relationship between the total voltage V and the voltages V1 and V2 across R1 and R2.

2. Explain the relationship between the total current I and the currents I1 and I2 through R1 and R2.

3. Examine the resistance values calculated using Ohm's Law and explain the relationship between R1, R2, and the total resistance R.

4. Think about how to calculate the total resistance when several resistors are connected in series.


Report
(For Teachers)
Report
(For Students)