# DE ANZA COLEGE – PHYSICS 4B LAB – FALL 2024

Lab 5 – Resistors in Series and in Parallel

## TITLE

Resistors in Series and in Parallel

## OBJECTIVE

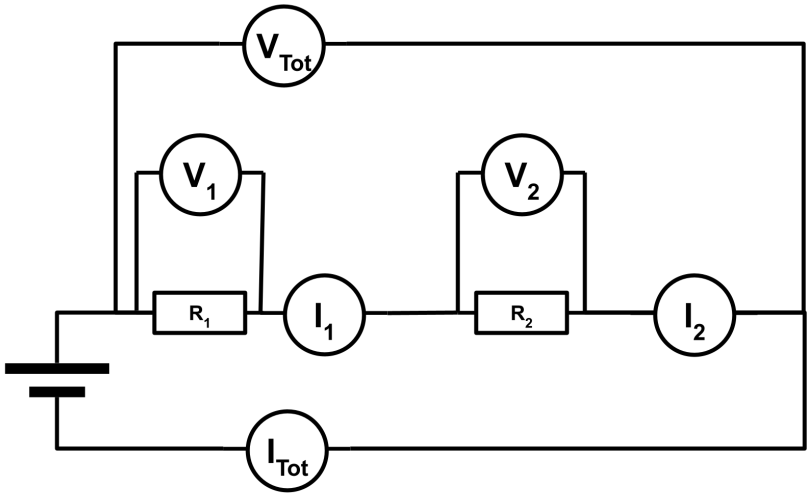
To analyze properties of resistors connected in series and in parallel

## THEORY

### Resistors in Series

Resistors connected in series have an equivalent resistance of:

$$R_{\text{eq}} = R_1 + R_2$$

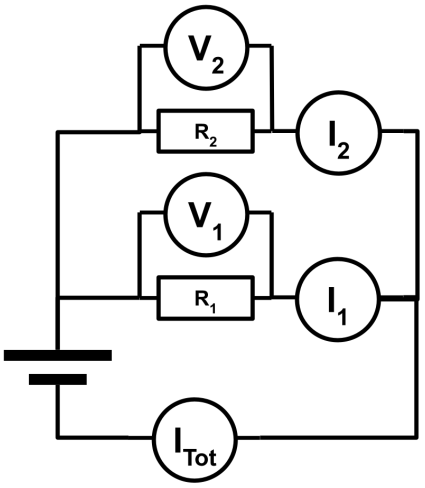



In this case

$$R_{\text{eq}} = V_{\text{tot}}/I_{\text{tot}}$$

### Resistors in Parallel

Resistors connected in parallel have an equivalent resistance given by:




$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Here the following will be true:

$$V_{\text{tot}} = V_1 = V_2$$

and

$$I_{\text{tot}} = I_1 + I_2.$$

Therefore we would have

$$R_{\text{eq}} = V_{\text{tot}}/V_{\text{tot}}.$$

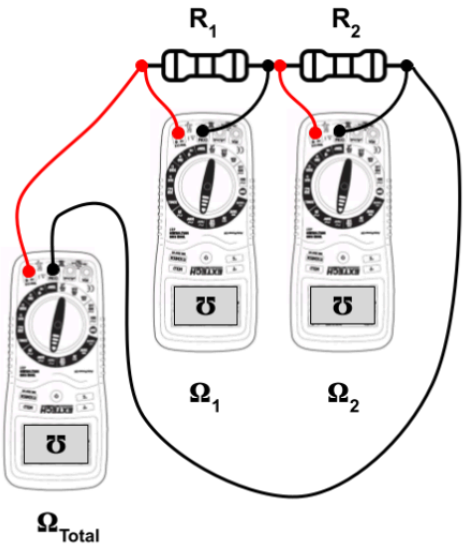
## APPARATUS

1. HP-DMM (used as an ammeter)
2. Hand-held DMM (used as a voltmeter)
3. Power Supply
4. 2 different resistors less than 5K Ω
5. Circuit boards
6. Leads and alligator clips

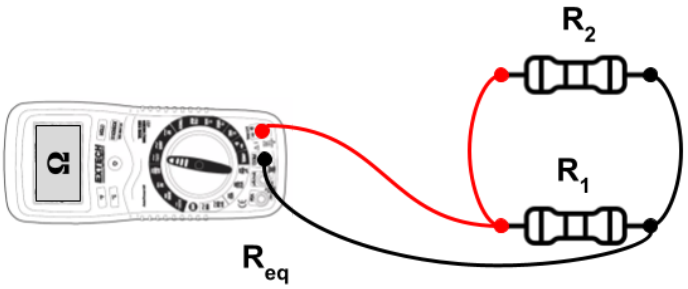
## PROCEDURE

### Part 1 Measuring $R_{\text{eq}}$

1. Measure $R_1$ and $R_2$ with the DMM.
2. Connect $R_1$ and $R_2$ in series, using the circuit board, and measure Req with the DMM. Compare Req with the expected value of $R_{\text{eq}} = R_1 + R_2$.




3. Connect $R_1$ and $R_2$ in parallel, using the circuit board, and measure Req with the DMM. Compare $1/R_{\text{eq}}$ with the expected value of $1/R_{\text{eq}} = 1/R_1 + 1/R_2$.



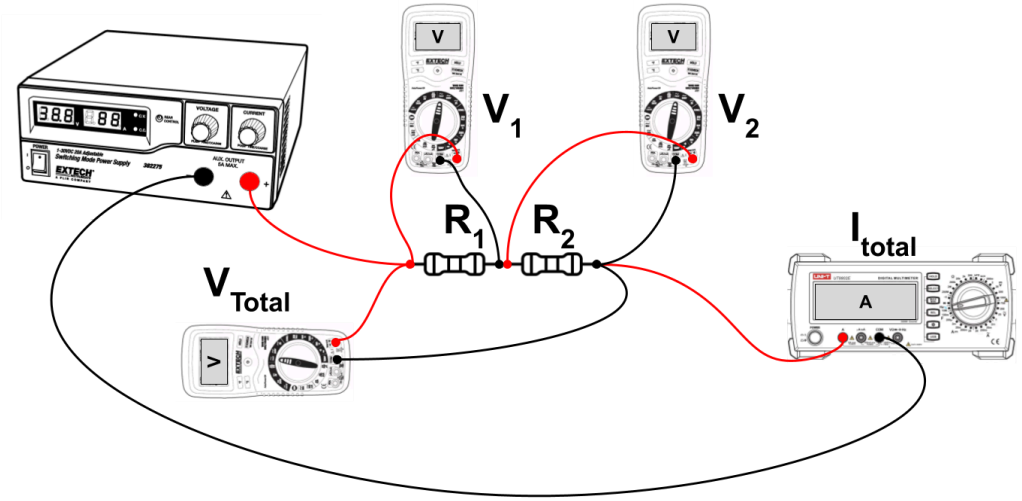
## Part 1: Series Combination

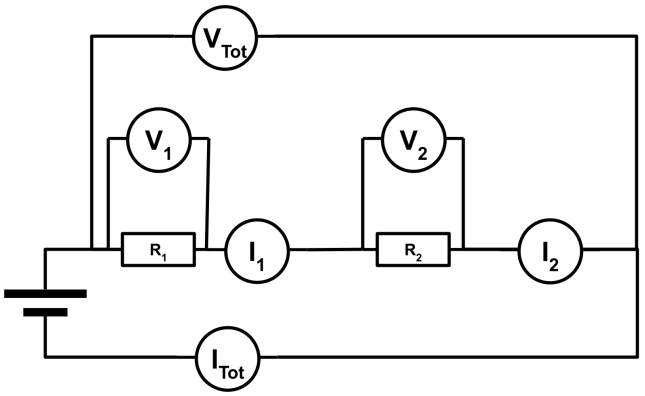
1. Connect $R_1$ and $R_2$ in series and apply a voltage of ≈10V with power supply.

2. Measure the total current in the circuit and compare with expected value of $I_{\text{expected}} = V/R_{\text{eq}}$, where $R_{\text{eq}} = R_1 + R_2$.

3. Measure $V_1$ and $V_2$ and show that $V = V_1 + V_2$.

4. Calculate $I_1 = V_1/R_1$ and $I_2 = V_2/R_2$ and show that $I_1 = I_2 = I$ .



## Part 2: Parallel Combination

1. Connect $R_1$ and $R_2$ in parallel and apply the same voltage as in the series combination.

2. Measure the total current in the circuit and compare with the expected value of $I_{\text{expected}} = V/R_{\text{eq}}$, where $1/R_{\text{eq}} = 1/R_1 + 1/R_2$

3. Measure $I_1$ and $I_2$ and show that $I_1 + I_2$ = $I_{\text{measured}}$

4. Measure $V_1$ and $V_2$ and show that $V_1 = V_2 = V$.

5. Calculate $I_1 = V_1/R_1$ and $I_2 = V_2/R_2$ and show that $I_1 + I_2 = I_{\text{expected}}$.

6. Compare $I_1 = V_1/R_1$ and $I_2 = V_2/R_2$ with measured values.