OHM'S LAW

Last modified 1/25

PURPOSE

1. Verifying Ohm's law and determining the resistances.
2. Calculating the equivalent resistance when we connect resistors in series
3. Calculating the equivalent resistance when we connect resistors in Parallel

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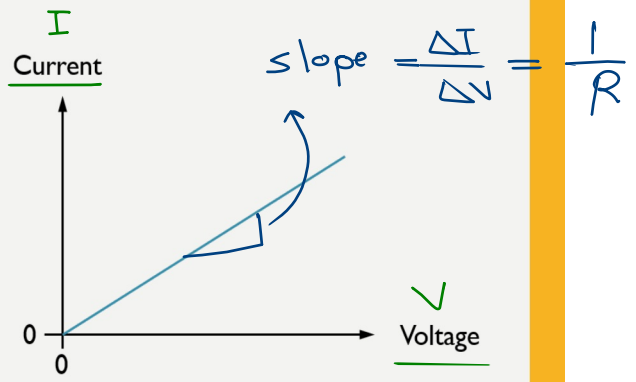
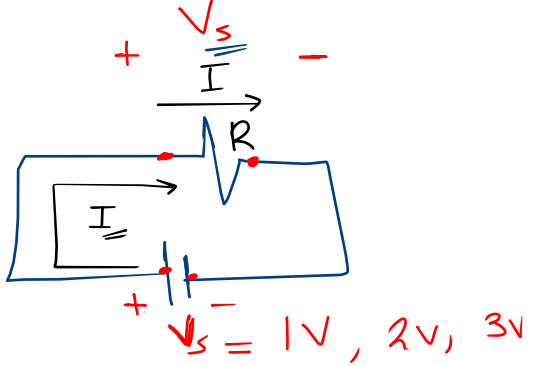
OHM'S LAW

- For some materials, the resistance is constant no matter how much voltage is applied across it. These materials are said to obey Ohm's Law.
- Since the resistance (R) is constant, a plot of voltage (V) vs. current (I) yields a straight line for these materials.
- Notice that resistance is always the ratio of voltage across a device to the current through the device. But the resistance is constant only for those materials that obey Ohm's law.





Vs = 1V, 2V, 3V

R → Constant

Ohm's Law

V = IR

slope = 1/R

R = 1/slope

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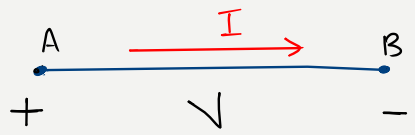
OHM'S LAW



$V \propto I$

$V = \text{Constant} \cdot I$

$V = RI$

- Ohm's law states that the current through a conductor between two points is directly proportional to the voltage

V =I.R

volt

Voltage (V) = current (A) × resistance (Ω)

Ampere ohm

V is the voltage measured across the conductor in units of volts (V),
I is the current through the conductor in units of amperes (A),
R is the resistance of the conductor in units of ohms (Ω).

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SERIES-CONNECTED RESISTORS

Current

$$\mathbf{I = I_1 = I_2}$$

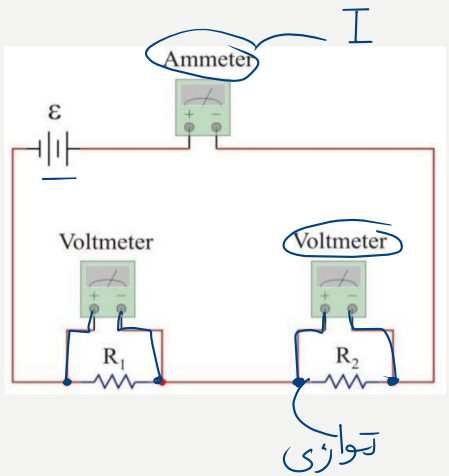
Voltage

$$\mathbf{V = V_1 + V_2}$$

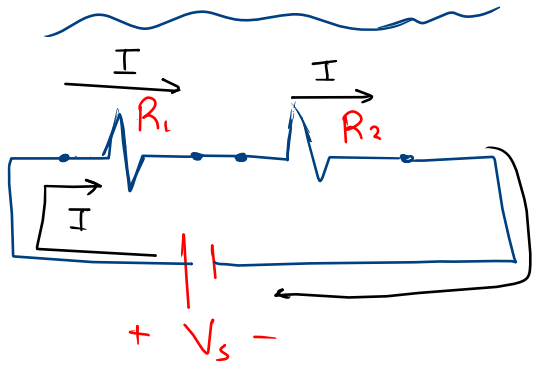
$$\mathbf{IR_{eq} = I_1R_1 + I_2R_2}$$

Equivalent Resistor

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



$R_{eq} = R_1 + R_2$



$V_s = V_{R_1} + V_{R_2}$

$I = I_1 = I_2$

$IR_{eq} = IR_1 + IR_2$

$R_{eq} = R_1 + R_2$

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PARALLEL-CONNECTED RESISTORS

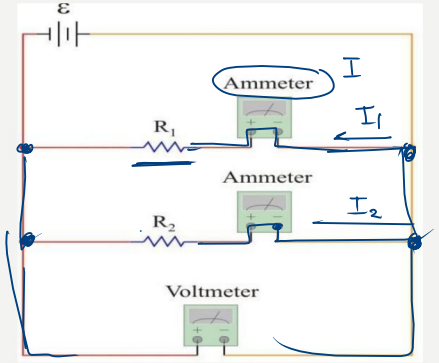
Current

$$\mathbf{I = I_1 + I_2}$$

Voltage

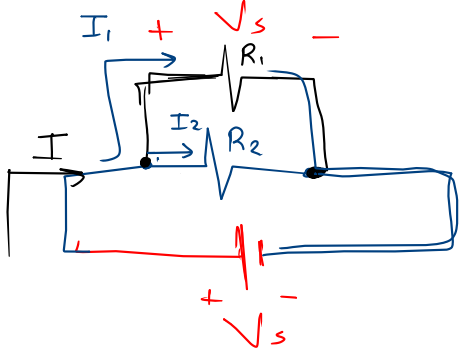
$$\mathbf{V = V_1 = V_2}$$

$$\frac{\mathbf{I}}{\mathbf{R_{eq}}} = \frac{\mathbf{I_1}}{\mathbf{R_1}} + \frac{\mathbf{I_2}}{\mathbf{R_2}}$$



Equivalent Resistor

$$\frac{\mathbf{1}}{\mathbf{R_{eq}}} = \frac{\mathbf{1}}{\mathbf{R_1}} + \frac{\mathbf{1}}{\mathbf{R_2}} \Rightarrow \mathbf{R_{eq}} = \frac{\mathbf{R_1 . R_2}}{\mathbf{R_1 + R_2}}$$



$$V_s = V_{R_1} = V_{R_2}$$

$$I = I_1 + I_2$$

$$\frac{V_s}{R_{eq}} = \frac{V_s}{R_1} + \frac{V_s}{R_2}$$

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

$$V = IR$$

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

'IF we have only Two resistors

$$R_{eq} = \frac{R_1 \cdot R_2}{R_1 + R_2}$$

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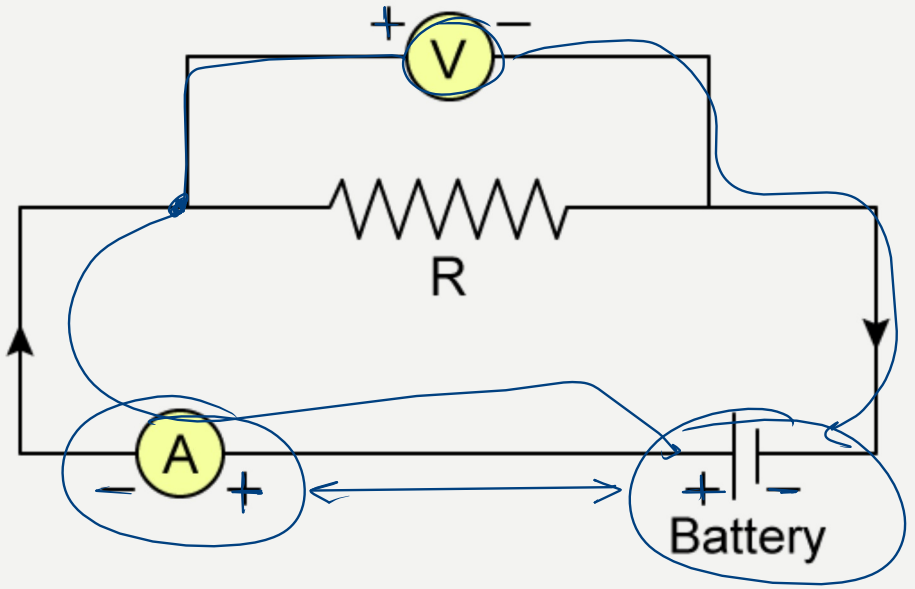
TOOLS

DC Power supply.
Circuits Experiment Board
Wires
Voltmeter
Ammeter
Different resistors



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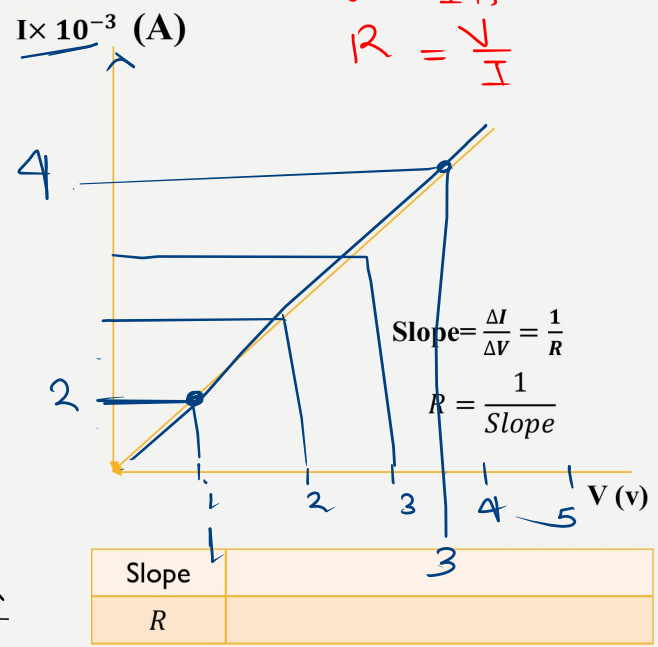
RESULTS:
PART I

mA ÷ 1000 or × 10^{-3} A

V (v)	I× 10^{-3} (A)	R (Ω) = $\frac{V}{I}$
1	2	$\frac{1}{2\times10^{-3}}$ =
2		
3		
4		
5		
Ravg =		

$R_{avg} = \frac{R+R+R+R+R}{5}$

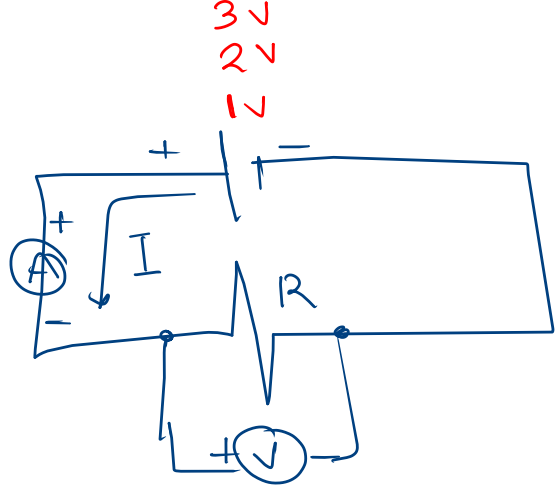
$\simeq$ 1kΩ



Slope	
R	

V = IR

R = V/I



$slope = \frac{\Delta I}{\Delta V} = \frac{(4-2)\times10^{-3}}{3-1} = 1\times10^{-3}$

$R = \frac{1}{slope}$ = 1kΩ

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PART II

DETERMINED R_{eq} EXPERIMENTALLY(SERIES)

$V = IR$

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

Theoretically **Calculated**

R1= 220 Ω
R2= 470 Ω

$R_{eq} = R_1 + R_2$
=470+220=690 Ω

Resistance R=V/I	Current (A)	Voltage (V)
~	~ × 10^{-3}	1 V
~	~ × 10^{-3}	2V
~		~
R_{ave}= $\frac{R+R+R+R}{4}$ = ~		

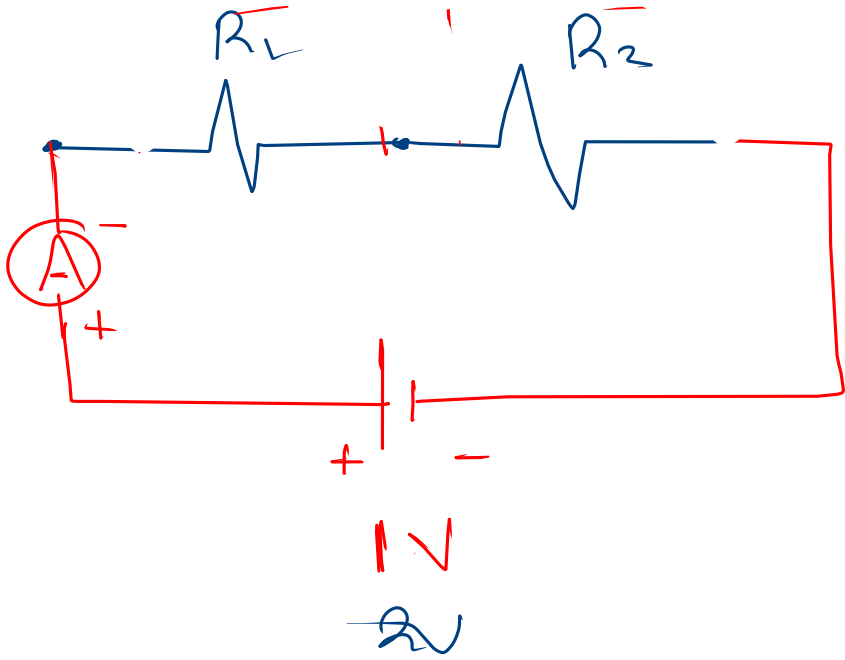
$\%Error = \frac{|R_{ave} - R_{eq}|}{R_{eq}}$

نسبة الخطأ

700 Ω

$\frac{700 - 690}{690} = \frac{10}{690} = \square\%$

Req



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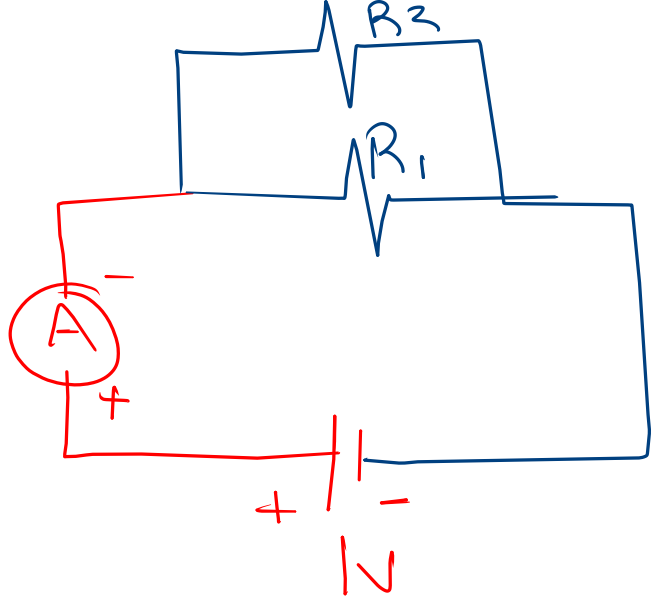
$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} = \square$$

PART III

DETERMINED R_{eq} EXPERIMENTALLY (PARALLEL)

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



Theoretically

R1= 220 Ω

R2= 470 Ω

$R_{eq}=R_1R_2/(R_1+R_2)$

$= \frac{470\times220}{470+220} = 149.85\ \Omega$

$\%\text{Error} = \frac{|R_{ave}-R_{eq}|}{R_{eq}}$

Calculated

Resistance R=V/I	Current A	Voltage V
	.... × 10^{-3}	1V
	.... × 10^{-3}	2V
		3V
R_{ave} =		

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