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# Phys111 Report

**Experiment #4: DC Circuit**

| | | | |
|---|---|---|---|
| **Name:** | | **ID #:** | |
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| **Section:** | 3 | | |
| **Date:** | 27/4/2022 | | |

## (1) Abstract:


- **Aim of the experiment:**

Calculate the value of an unknown resistor, and calculate the equivalent resistance in different ways (Parallel and series) and find if the resistors are ohmic or not.

- **The main results are:**

$R = (215 \pm 40)\ \Omega \Rightarrow 220 \pm 40\ \Omega$

$R_s = (312 \pm 50)\ \Omega \quad 310 \pm 50\ \Omega$

$R_p = (71 \pm 6)\ \Omega$


## (2) Data:

*Part A: One resistor circuit*

| | 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|---|
| $I\ (mA)$ | 2 | 4 | 7 | 9 | 11 | 14 |
| $V\ (volts)$ | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |

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| | |
|---|---|
| $\Delta I = 1$ mA | $\Delta V = 0.1$ V |

*Part B: Two resistors in series*

| | |
|---|---|
| $I_s = 8$ mA | $V_s = 2.5$ V |
| $\Delta I_s = 1$ mA | $\Delta V_s = 0.1$ V |

*Part C: Two resistors in parallel*

| | |
|---|---|
| $I_p = 28$ mA | $V_p = 2.0$ V |
| $\Delta I_p = 1$ mA | $\Delta V_p = 0.1$ V |

## (3) Calculations:

*Part A: One resistor circuit*

| | | | |
|---|---|---|---|
| **From Graph** | $R =$ slop $= 215\,\Omega$ | **From Color code** | $R_2 = 200\,\Omega$ |
| | $\Delta R = 40\,\Omega$ | | $\Delta R = 10\,\Omega$ |

***Resistance form color code***

| | | | |
|---|---|---|---|
| A= Brown(1) | B= Black(0) | C= Brown ($10^1$) | D= Gold (5%) |
| $R_1 = (100 \pm 5)\,\Omega$ | | | |

| | | | |
|---|---|---|---|
| A= Red(2) | B= Black(0) | C= Brown ($10^1$) | D= Gold (5%) |
| $R_2 = (200 \pm 10)\,\Omega$ | | | |

*Part B: Two resistors in series*

| | | | |
|---|---|---|---|
| **From Experiment** | $R_s = \frac{V_s}{I_s} = \frac{2.5}{8\times10^{-3}} = 312\,\Omega$ | **From Color code** | $R_s = R_1 + R_2 = 300\,\Omega$ |
| | $\Delta R_s = R\left(\frac{\Delta V}{V} + \frac{\Delta I}{I}\right) = 50\,\Omega$ | | $\Delta R_s = \Delta R_1 + \Delta R_2 = 15\,\Omega$ |

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

*Part C: Two resistors in ~~series~~ Parallel*

| | | | |
|---|---|---|---|
| **From Experiment** | $R_p = \frac{V_R}{I_r} = \frac{2}{28\times10^{-3}} = 71\,\Omega$ | **From Color code** | $R_p = \frac{R_1 R_2}{R_1 + R_2} = 67\,\Omega$ |
| | $\Delta R_p = 6\,\Omega$ | | $\Delta R_p = R_p^2\left(\frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2}\right) \simeq 3\,\Omega$ |

## (4) Results:

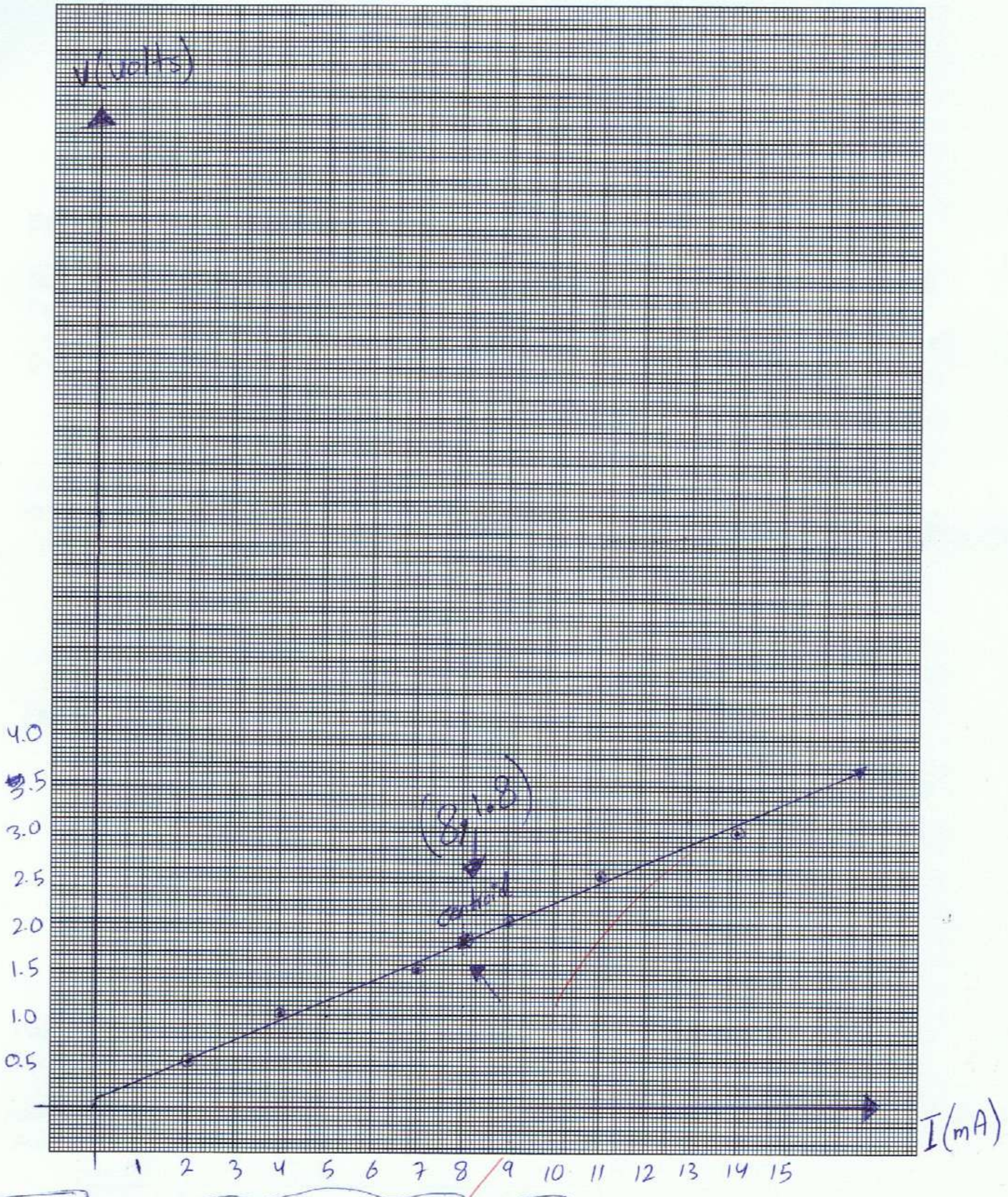
| |
|---|
| $R = (215 \pm 40)\,\Omega$ |
| $R_s = (312 \pm 50)\,\Omega$ |
| $R_p = (71 \pm 6)\,\Omega$ |

## (5)Conclusions:

All three results were accepted by applying the range test for them. First, With the range of R with the error is [175, 255] which overlaps the range of true value of R [190, 210], so the result is accepted. Second, with the range of equivalent resistance of two resistors in series [262, 362] and also agree with the range of true value [285, 315], so it's also accepted. The same thing goes for resistors in parallel [65, 77] and it overlaps the range of accepted values [64, 70], and it's also accepted. For all previous results, the carbon resistors that we use are ohmic (the voltage depends linearly on the current).

During the Experiment, we have possible sources of error that may leads to some systematic and random errors. First, resistors varies over time, the current that passes the resistor increases the temprecture of it and make it changing. Also, the current through the resistor is less than measured, that's because the voltmeter takes in some current in spite it's large resistence. Another source of error is non-caliprated instruments like ammeter and voltmeter, these tools should caliprated before using it to avoid any systematic error. In addition to the above, plugging the wires in wrong places, or reading from the wrong place also cause systematic errors, for example, voltmeter and ammeter can contain more than one scale, so we shoulp pay attention to what we read.

Our measured values were consistent with the true values from colour code, and this appear clearly during calculations and the Range Tests.




$\bar{I} = 8$

$\bar{V} = 1.8$

$$\text{centroid} = (\bar{I}, \bar{V}) = (8, 1.8)$$

$$\text{slop} = R = \frac{\Delta V}{\Delta I} = \frac{3.5 - 0.7}{(16 - 3)\times 10^{3}} = \frac{2.8}{13\times 10^{-3}} = 215.38 \approx 215\,\Omega$$

$$\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I} \Rightarrow \Delta R = 215.38\left(\frac{0.1}{1.8} + \frac{1}{8}\right) = 38.888\,\Omega \approx 40\,\Omega$$