**Experiment 5:**

Kirchoff’s Law

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Physics 181

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**Purpose**: The purpose of this experiment is to experiment with Ohm’s Law with circuits in series and parallel and to verify expected results.

**Data**:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Resistors** | **Check 1** | **Check 2** | **V1,dm** | **Check 3** | **Check 4** | **Check 5** | | | **Check 6** |  | **Check 7** | | | **Check 8** |
| **R1** | **Rp,dm** | **Rs,dm** | **(V)** | **Is,dm** | **Vemf,dm** | **V1,dm** | **V2,dm** | **V3,dm** | **Loop Law** | **Vemf** | **v1** | **v2** | **v3** | **Node Law** |
| **(kW)** | **(kW)** | **(kW)** | 1.67 | **(mA)** | **(V)** | **(V)** | **(V)** | **(V)** | 0.1 | **(V)** | **(V)** | **(V)** | **(V)** | 3670.00 |
| 0.005 | 0.002725 | 0.03 | **V2,dm** | 330 | 10 | 1.67 | 3.33 | 5 |  | 10.00 | 10 | 10 | 10 |  |
| **R2** | **Rp,th** | **Rs,th** | **(V)** | **Ith=Vemf/Rs,dm** | **Vemf,th** | **V1,th** | **V2,th** | **V3,th** |  |  | **I1,dm** | **I2,dm** | **I3,dm** |  |
| **(kW)** | **(kW)** | **(kW)** | 3.33 | **(mA)** | **(V)** | **(V)** | **(V)** | **(V)** |  |  | **(mA)** | **(mA)** | **(mA)** |  |
| 0.01 | 0.002727 | 0.03 | **V3,dm** | 333.3333333 | 10 | 1.65 | 3.3 | 4.95 |  |  | 2000.00 | 1000.00 | 670.00 |  |
| **R3** | **% diff1** | **% diff2** | **(V)** | **% diff3** | **% diff4** | **% diff5a** | **% diff5b** | **% diff5c** |  |  | **I1,th=V1/R1** | **I2,th=V2/R2** | **I3,th=V3/R3** |  |
| **(kW)** | 0.090909 | 1.156E-14 | 5 | 1 | 0 | 1.19760479 | 0.900901 | 1 |  |  | **(mA)** | **(mA)** | **(mA)** |  |
| 0.015 |  |  |  |  |  |  |  |  |  |  | 2000 | 1000 | 666.6666667 |  |
|  | **Ip,dm** | **Is,dm** |  |  |  |  |  |  |  |  | **% diff7a** | **% diff7b** | **% diff7c** |  |
|  | **(mA)** | **(mA)** |  |  |  |  |  |  |  |  | 0 | 0 | 0.497512438 |  |
|  | 3670 | 330 |  |  |  |  |  |  |  |  |  |  |  |  |

Table 1: all calculated and measured data, Measured data in yellow, calculations in green

**Calculations**:

**Discussion**:

In this experiment the total resistance of the parallel circuit was calculated to be 0.002727 kilohms and was measured to be 0.002725, with only a .09% difference. In series the calculated resistance was 0.03 kilohms and was also measured to be the same, this is a 0% difference. These values were calculated from the voltage and current of the circuit and measured accurately within the simulation. The sections of check 6, loop law and check 8, node law are being ignored due to spreadsheet problems, we have been instructed to not worry about them. In check 5 the voltages at each resistor were also measured and calculated for the series circuit. This was calculated from the measured current and the set resistance. These were measured to be 1.67 V, 3.33 V, 5 V, across resistors 1-3 respectively. The % difference on these were all close to 1%. For check 7 I calculated the current from the voltage and resistance and then measured to verify, for v1 and v2 the %diff was zero, for v3 it was .5% In there were no %diffs greater than zero, so I would say the experiment was quite accurate and precise given that there isn’t any other source of error besides poor math and the limit number of significant figures displayed on the simulation tools.

**Conclusion & results**:

Check 1:

Rp,dm = 0.00272 kilohms

Rp,th = 0.00273 kilohms, 0.09% diff

Check 2:

Rs,dm = 0.03 kilohms

Rd,th = 0.03 kilohms, 0% diff

Check 3:

Is,dm = 330 mA

Is,th =333.333 mA, 1% diff

Check 5:

V1,dm = 1.67 V

V1,th = 1.65 V, 1.2% diff

V2,dm = 3.33 V

V2,th = 3.3 V, 0.9% diff

V3,dm = 5 V

V3,th = 4.95 V, 1% diff

Check 7:

V = 10 V

I1,dm = 2000 mA

I1,th = 2000 mA, 0% diff

I2,dm = 1000 mA

I2,th = 1000 mA, 0% diff

I3,dm = 670 mA

I3,th = 666.6667 mA, 0.5% diff

These values were all as far as experimental data goes as close to perfect as one can get, with many %diff being equal to zero and most below 1% the data was extremely accurate. Overlooking checks 6 and 8 the data is looking very good. The sources for error must be limited to the precision of displays, even then I would say those sources of error are neglible, as the final data was all very close to the measured values.

**Questions**: INCO

Questions

1.

a)

b) in series the resistance will be similar to the largest one since they are added, but for the parallel circuits, it will be similar to the smaller one because they are inverses.

2. In the circuit used to verify Kirchhoff’s current law, R2 and R3 are connected in parallel.

a. = 6 ohms

b.

c.

d.

e. if the circuit in the experiment were configured this way then they should be the same since this is just a different way of calculating that, but in the experiment all were in parallel instead of just r2 and r3 in this example.