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Lab 1 Worksheet

1)

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August 25th, 2015
ENGR 210

Part 1 2.2 kΩ resistor

Supply voltage	Voltmeter	Current	Resistance
0.0 V	16.9×10^{3} V	7.56×10^{-6} A	2.2×10^{3} Ω
2.0 V	2.03 V	9.16×10^{-4} A	
4.0 V	4.02 V	1.79×10^{-3} A	
6.0 V	5.97 V	2.70×10^{-3} A	
8.0 V	8.02 V	3.63×10^{-3} A	
10.0 V	10.0 V	4.54×10^{-3} A	

Part 2

	2.2 kΩ	1.0 kΩ	
Supply Voltage	Voltmeter	~~Current~~ Voltmeter	Resistance
0.0 V	11.5×10^{-3} V	5.23×10^{-3}	982 Ω
2.0 V	1.36 V	6.10×10^{-2} V	
4.0 V	2.76 V	1.25 V	
6.0 V	4.16 V	1.86 V	
8.0 V	5.52 V	2.48 V	
10.0 V	6.93 V	3.08 V	

Part 3

	2.2 kΩ	1.0 kΩ		687.5 Ω
Supply Voltage	Current	Current	Resistance	Current
0.0 V	7.62×10^{-6} A	1.71×10^{-5} A	2.2×10^{3} Ω	2.40×10^{-3} A
2.0 V	9.18×10^{-4} A	1.98×10^{-3} A	982 Ω	2.88×10^{-3} A
4.0 V	1.79×10^{-3} A	4.04×10^{-3} A		5.83×10^{-3} A
6.0 V	2.72×10^{-3} A	6.06×10^{-3} A		8.67×10^{-3} A
8.0 V	3.63×10^{-3} A	8.05×10^{-3} A		1.16×10^{-2} A
10.0 V	4.51×10^{-3} A	1.00×10^{-2} A		1.46×10^{-2} A

Part 4

Power Supply	560 Ω voltmeter	red LED	resistance
0.0V	3.6×10^{-6} V		550 Ω - resistor
2.0V	5.06×10^{-1} V	1.53 V	4.75×10^{6} Ω blue LED
4.0V	2.39 V	1.59 V	2.02×10^{6} Ω red LED
6.0V	4.35 V	1.61 V	
8.0V	6.34 V	1.63 V	
10.0V	8.30 V	1.65 V	
1.0V			
1.5V		1.41 V	
0.5V		1.00 V	

Power Supply	Voltmeter	blue LED	
0.0V	0 V	~~[illegible]~~	1.70×10^{-2} V
2.0V	6×10^{-6} V	~~[illegible]~~	2.01 V
4.0V	1.19 V	2.78 V	
6.0V	3.02 V	2.92 V	
8.0V	4.99 V	3.02 V	
10.0V	6.85 V	3.10 V	
2.5V		2.47 V	
3.0V		2.65 V	

Power Supply	$Current_{Red}$	$Current_{Blue}$
2.0V	[redacted] 9.04×10^{-4} A	1.07×10^{-8} A
4.0V	4.27×10^{-3} A	2.13×10^{-3} A
6.0V	7.78×10^{-3} A	5.39×10^{-3} A
8.0V	1.13×10^{-2} A	8.91×10^{-3} A
10.0V	1.48×10^{-2} A	1.22×10^{-2} A
1.0V	A	A
1.5V	A	A
0.5V	A	A

2) V = IR; Using Ohm's Law, the average resistance over our data sheet proved to be 2,239 Ω. This agreed with the measured value of 2,200 Ω +/- 5%.

$V_1 = I_1 * R_1 = (9.16E\text{-}4)R_1 \rightarrow R_1 = 2216\ \Omega$
$V_2 = I_2 * R_2 = (1.79E\text{-}3)R_2 \rightarrow R_2 = 2245\ \Omega$
$V3 = I_3 * R_3 = (2.71E\text{-}3)R_3 \rightarrow R_3 = 2211\ \Omega$
$V4 = I_4 * R_4 = (3.63E\text{-}3)R_4 \rightarrow R_4 = 2209\ \Omega$
$V5 = I_5 * R_5 = (4.54E\text{-}3)R_5 \rightarrow R_5 = 2202\ \Omega$
$R \text{ average} = (R_1 + R_2 + R_3 + R_4 + R_5) / 5 = 2239\Omega$

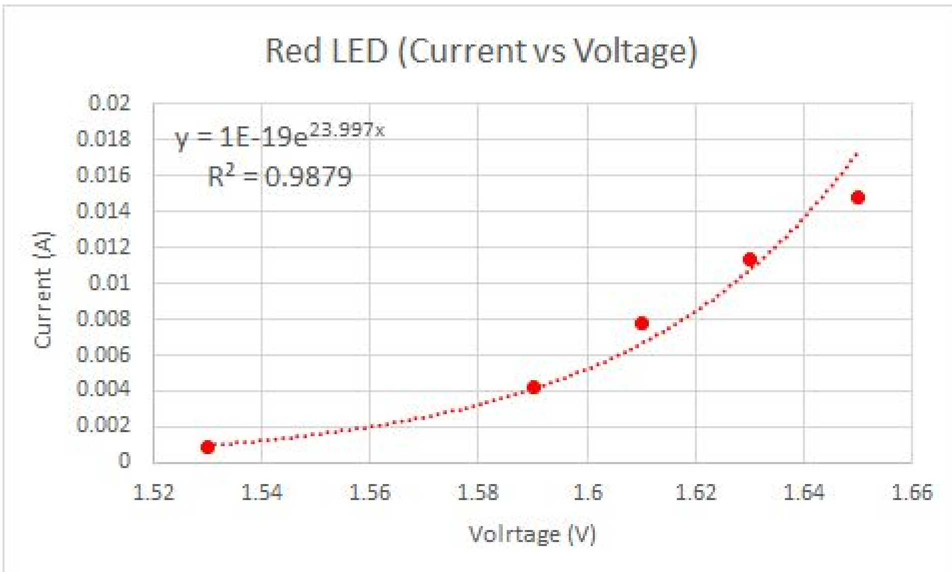
3) According to theory, current should stay equal throughout both resistors, because they are in series. However, through tests we observed a marginal error less than 5%. We further proved this concept with Ohm's law and our measurements.

4) In a parallel circuit, current splits, so according to Kirchhoff's current law we can relate the currents: $I \text{ power} = I_{R1} + I_{R2}$

5) Because the LEDs are in parallel, the voltage flowing through them has to be the same. Therefore, because the voltage is the same and the resistance differs, through Ohm's law we also know that the current will differ. Because the resistance of the blue LED is 2.35 times greater than the red LED, then the current of the blue LED is 2.3 times less than that of the red LED.

6) LEDs are similar to large resistors in that large voltage drop occurs when current flows through them. When these two LEDs are in series, in order to meet the threshold voltage of both LEDs, the supply voltage must be high enough to compensate for the voltage drop from the first to second LED for both of them to light up. Furthermore, when LEDs, which act as large resistors, are in series the current flowing through them is the same, but the voltage changes due to voltage drops. This differs from when LEDs are in parallel because current splits and voltage stays constant

7)



8) By using an exponential fit, we extrapolated the red LED graph from our I-V data. This produced an exponential function of best fit: $y = (1 \times 10^{-19})(e^{23.997x}) \rightarrow I = (1 \times 10^{-19})(e^{23.997V})$. According to our current function dictated by our line of best fit, the 9V voltage source across the red LED will produce a current of: $I = 6.25 \times 10^{74}$ A

9) Using the equation P = IV, it is possible to calculate the value of the current taking into account a voltage of 9V and the maximum power dissipated. This yields a maximum allowed current of 11.11 mA. This poses a problem because the allowable current is 5.63×10^{76} times smaller than the extrapolated value of current. Clearly this current is too large and the red LED would not be able to support such a large current. Therefore, if the 9 V were applied across the red LED, then the red LED would explode.

10) Once the power supply reached 6 V, the voltage through the Blue LED stayed constant at about 3 V. This leaves 6 V for the resistor, if the power supply is at the full 9 V due to Kirchhoff's Voltage Law. In conjunction with Ohm's Law, this leaves the resistor to have a necessary resistance of 300 Ω. In addition, 3 V applied over the blue LED

results in a 0.02 A current. Again, due to Kirchhoff’s Law, there must be 6 V over the resistor.

$R = V / I = 6\ V / 0.02\ A = 300\ \Omega$