Ryerson University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

ELE 202
Electric Circuit Analysis
LAB COVER PAGE for Part II submission.

Lab #:	1	Lab Title:	Laboratory #1 Introduction to Basic Lab Equiptment, Tools, and DC measurements.

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(* Note: remove the first 4 digits from your student ID)

Section #:	22
Submission date and time:	11:40am Jan 21, 2022
Due date and time:	4pm Jan 21, 2022

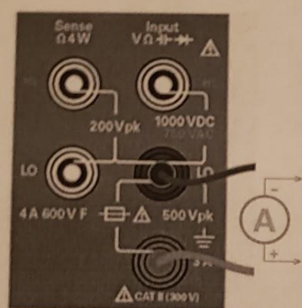
Document submission for Part II:

- A completed and signed "COVER PAGE – **Part II**" has to be included with your submission, a copy of which is available on D2L. The report will not be graded if the signed cover page is not included.
- Scan your completed pages of **Section 5.0** and **Section 6.0** (via a scanner or phone images), together with any required In-Lab Oscilloscope screen-shot images.
- Collate and create a .pdf or .docx file of the above, and upload it via D2L **by 11.59 p.m. on the same day** your lab is scheduled. *Late submissions will not be graded.*

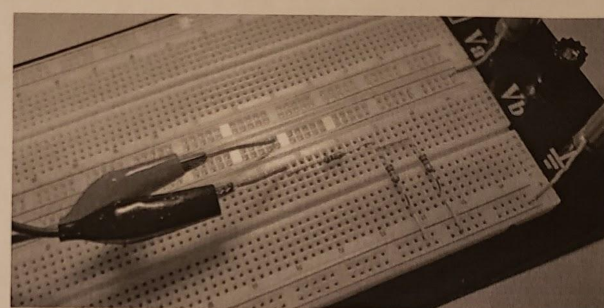
**By signing above, you attest that you have contributed to this submission and confirm that all work you have contributed to this submission is your own work. Any suspicion of copying or plagiarism in this work will result in an investigation of Academic Misconduct and may result in a "0" on the work, an "F" in the course, or possibly more severe penalties, as well as a Disciplinary Notice on your academic record under the Student Code of Academic Conduct, which can be found online at: www.ryerson.ca/senate/current/pol60.pdf.*

5.0 IN-LAB Experiment:

4. Current Measurements: Connect the cable probes to the DMM as shown in **Figure 5.0e-(i)**. Turn ON the DMM multimeter and set it as an ***Ammeter*** by pressing the "**DCI**" function key on the instrument.
   - To measure current, I_1 (through R_1), break the circuit to insert the ***Ammeter*** in series with R_1. Example of the ***Ammeter*** connected in series with R_1 is shown in **Figure 5.0e-(ii)**. Note: Be very careful when using the ***Ammeter*** feature of the multimeter. If the ***Ammeter*** is not placed in series with the resistor and the probe leads are placed across the resistor instead, then you can burn out the multimeter's fuse and/or damage the instrument.
   - Turn ON the Power Supply (PS) and set its voltage value back to **15 volts** for the V_1 input source. Record your ***Ammeter*** measured value of the current in **Table 5.1**.
   - Turn OFF the Power Supply (PS). Then, disconnect the ***Ammeter*** and restore the original wire connection in place.
   - Follow the above procedures to measure current, I_2 (through R_2). Repeat the same to measure current, I_3 (through R_3). Record the ***Ammeter*** measured values of the respective currents in **Table 5.1**.
   - Turn OFF the Power Supply (PS) and the DMM.



(i) DMM Ammeter Configuration



(ii) Example of how to measure current through resistor R_1, with the DMM

Figure 5.0e: DMM Ammeter Connections

V_1	V_2	V_3	I_1	I_2	I_3
10volts	5volts	5volts	1mA	0.5mA	0.5mA

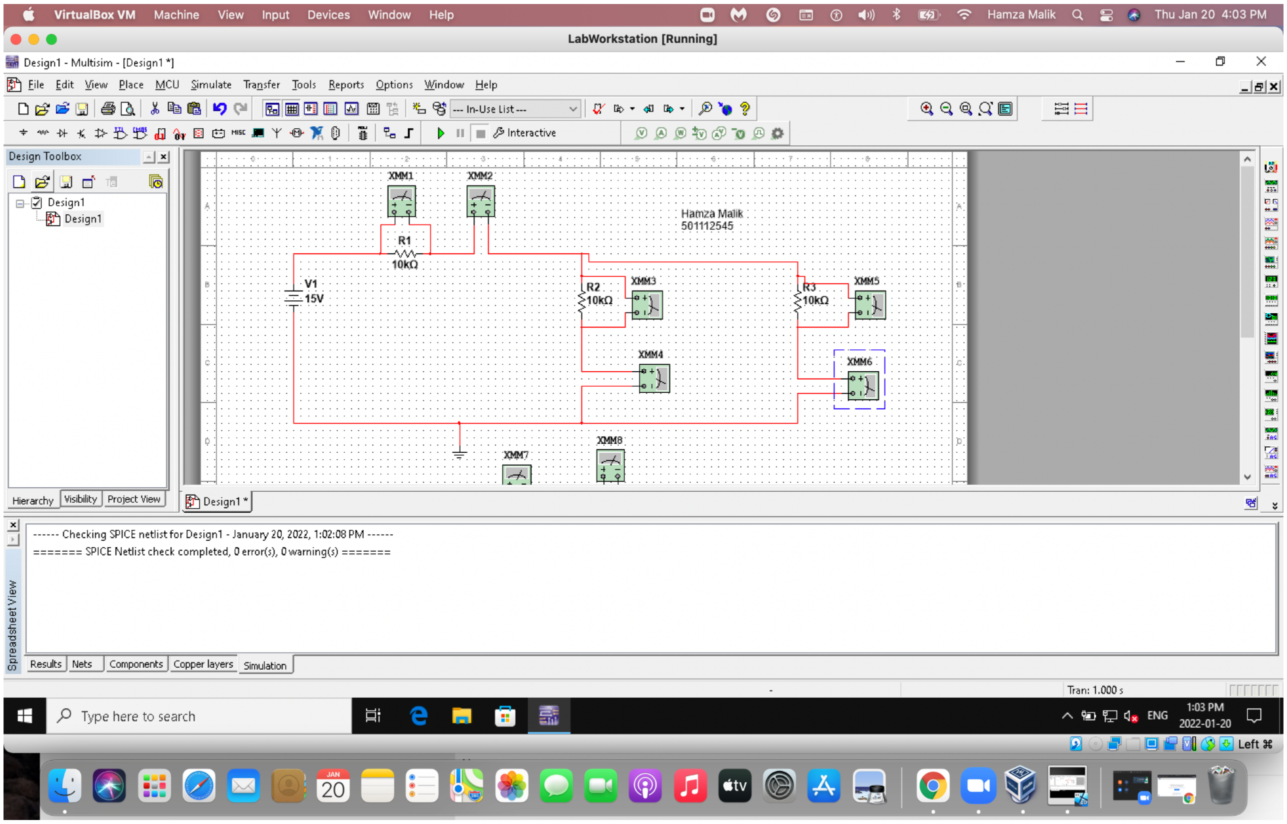
Table 5.1: Measured values (*on Multisim*) for the circuit in Figure 2.0

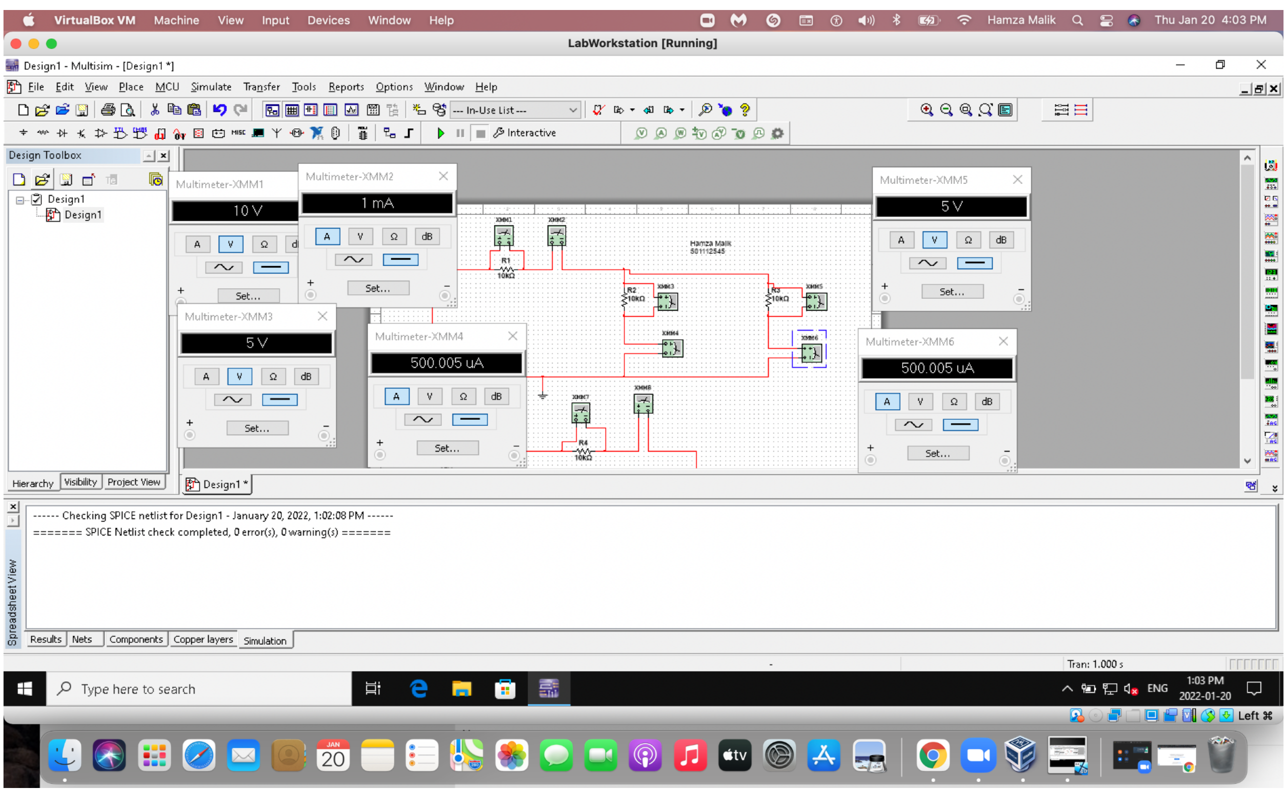
500uA = 0.5mA

- Copy and paste a screenshot showing your MultiSIM readings on each circuit. Include the MultiSIM circuit file (**.ms14**) of each circuit in your Post-Lab submission.

Circuit ScreenShots For Figure 5.1: (Same Circuit As Figure 2.0)

- The .ms14 file has been attached with the submission





Implementation of the Voltage-Divider circuit in Figure 2.1

1. Turn OFF the Power Supply (PS) and the DMM multimeter.

2. Modify your existing breadboard circuit in **Figure 2.0** to construct the voltage-divider circuit in **Figure 2.1**, as follows:

   - Leave resistor, $\mathbf{R_1}$ **(10 kΩ)** from the previous circuit in place to serve as the required value for resistor $\mathbf{R_X}$ **(10 kΩ)** of the voltage-divider circuit in **Figure 2.1**.
   - Remove resistor, $\mathbf{R_3}$ from the previous circuit.
   - Select **5.1 kΩ** from your Kit for the resistor value for $\mathbf{R_Y}$. (Note: *For the Pre-Lab analysis, a **5.0 kΩ** value was used for the resistor, R_Y. However, in practice the closet standard value resistor available to use is **5.1 kΩ**.*)
   - Replace resistor, $\mathbf{R_2}$ (10 kΩ) in the previous circuit with the **5.1** kΩ resistor to serve as the required resistor, $\mathbf{R_Y}$ of the voltage-divider circuit in **Figure 2.1**.

3. Turn ON the Power Supply (PS) and set its voltage value to **15 volts** for your $\mathbf{V_I}$ input source.

4. Turn ON the DMM multimeter and set it as a ***Voltmeter*** by pressing the **DCV** function key on the instrument, and connect the cable probes as was shown in **Figure 5.0d-(i)**. Measure the voltage, V_O across resistor, $\mathbf{R_Y}$. Record the measured value in **Table 5.2**.

5. Turn OFF the Power Supply (PS).

6. Set the DMM multimeter as an ***Ammeter*** by pressing the **DCI** function key on the instrument, and connect the cable probes as was shown in **Figure 5.0e-(i)**.

7. Insert the ***Ammeter*** in series with resistor, $\mathbf{R_X}$ [as was illustrated in **Figure 5.0e-(ii)**] to measure the current, **I** through it.

8. Turn ON the Power Supply (PS) and set its voltage value to **15V** for your $\mathbf{V_I}$ input source.

9. Record the measured value of the current, **I** in **Table 5.2**.

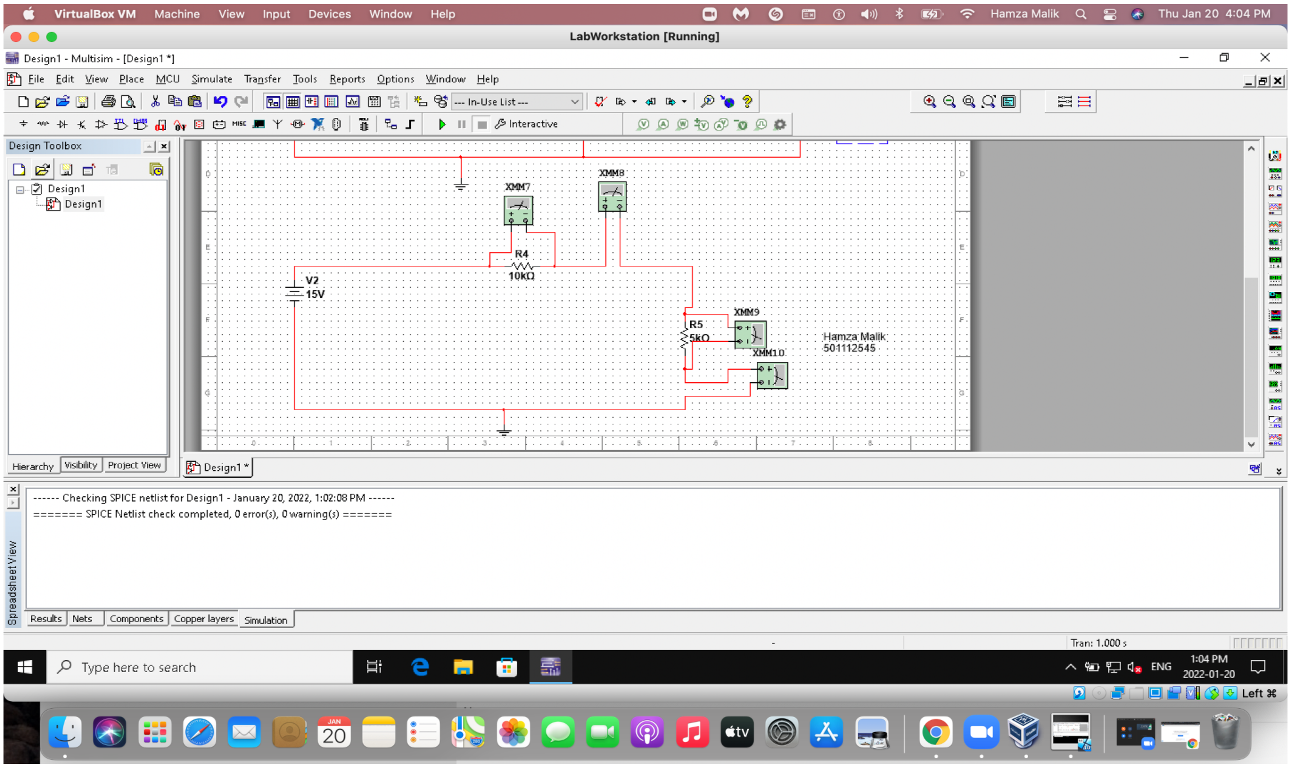
10. Turn OFF the Power Supply (PS) and the DMM multimeter.

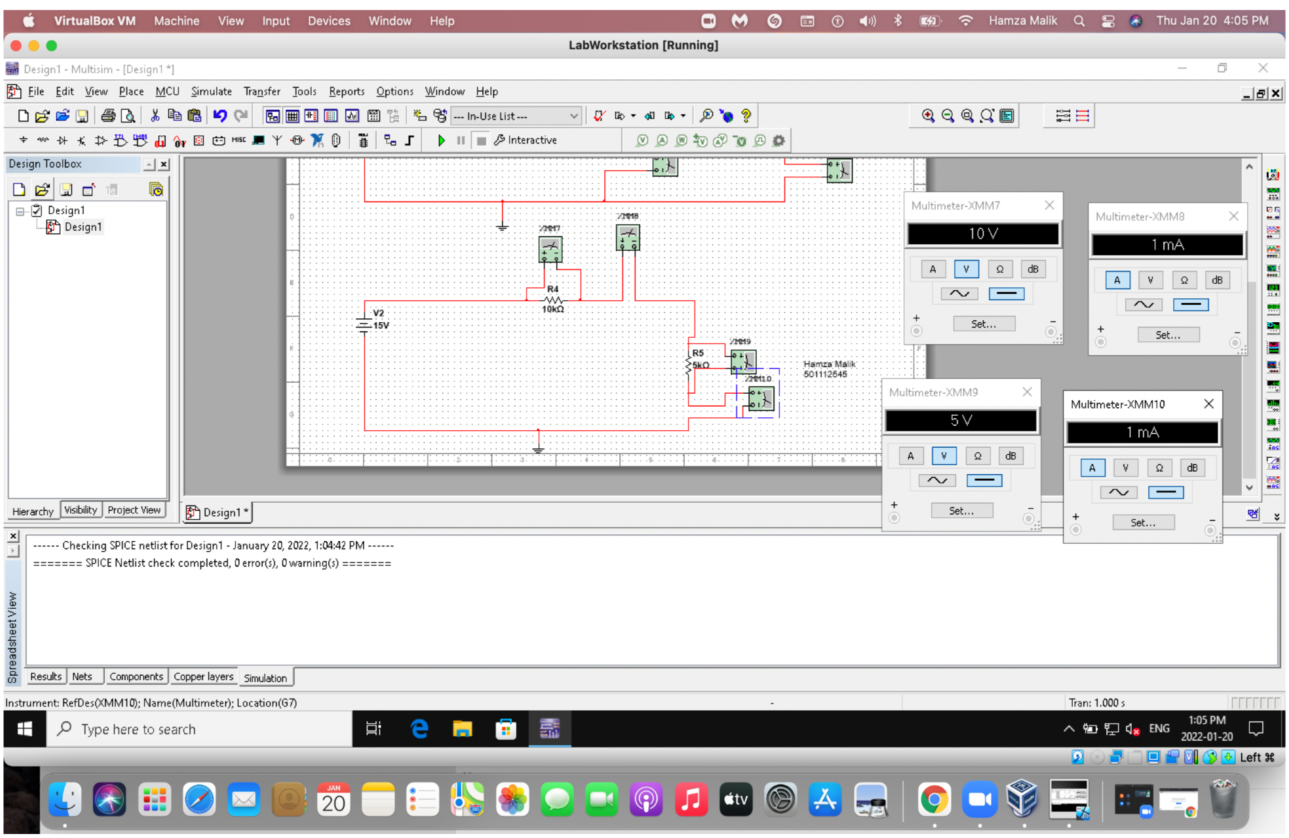
V_O	I
5volts	1mA

Table 5.2: Measured values (*on Multisim*) for the circuit in Figure 2.

Circuit ScreenShots For Figure 5.2: (Same Circuit As Figure 2.1)

- The .ms14 file has been attached with the submission as Design1.ms14

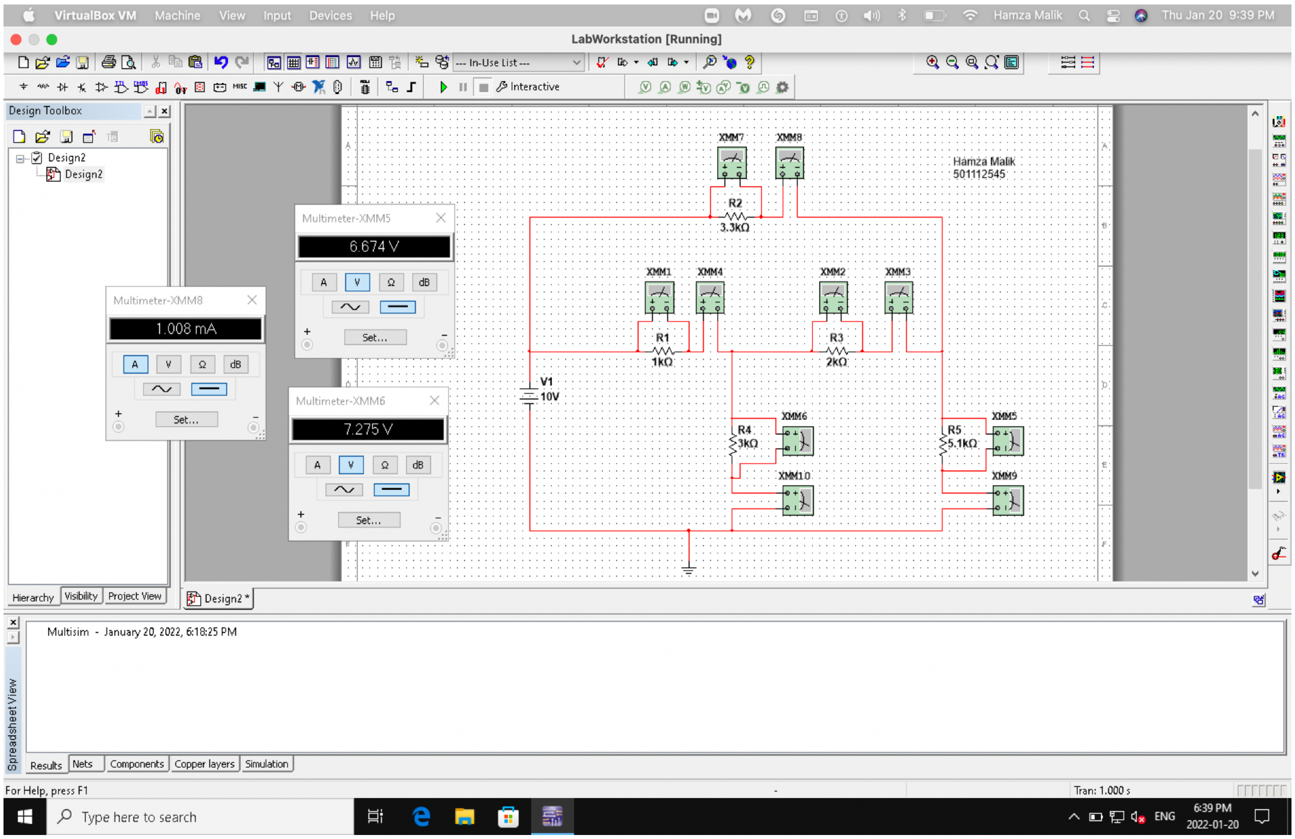




6.0 POST-LAB:

Part (A) Practice Exercise for MultiSim simulation:

- The .ms14 file has been attached with the submission as Design2.ms14



Part (B) Voltage-Current Measurement Questions:

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(b) Voltage-Current Measurements

Workspace

With reference to the "Simple DC Circuit" in **Figure 2.0**:

Explain how your measurement (*on Multisim*) results in **Table 5.1** compare to the corresponding theoretical values in **Table 2.0**? Explain possible causes of any discrepancies.

Comparing my measurement results in table 5.1 to the the theoretical values in Table 2.0, the calculated measurement were the same. Some possible causes of any discrepancies could be due to not placing the volt and amp meter correctly and or forgetting to add a grounding wire.

Did the experimental results in **Table 5.1** confirm the Kirchhoff's Current Law expression: $\mathbf{I_1 = I_2 + I_3}$ provided earlier? Explain?

Yes the experimental results in Table 5.1 has confirmed that KCL expression $I_1 = I_2 + I_3$ because as R2 and R3 are parallel, the current coming through R1 is split between R2 and R3 and therefore when $I_2 + I_3$ is added the result will be equal to I_1. Also as said KCL states that the sum of all currents entering or leaving a note is zero and therefore $I_1 = I_2 + I_3$.

From your measurement results in **Table 5.1**, calculate the resistance value of $\mathbf{R_1}$ (= V_1/I_1), $\mathbf{R_2}$ (=V_2/I_2) and $\mathbf{R_3}$ (= V_3/I_3) => $\mathbf{R_1}$ = ………; $\mathbf{R_2}$ = ………; and $\mathbf{R_3}$ = ………. .
Are these values expected to be the same as the corresponding *directly* measured resistance values in **Table 5.2**.? Why?

$R_1 = V_1/I_1 = 10/0.001 = 10\,k\Omega$

$R_2 = V_2/I_2 = 5/0.0005 = 10\,k\Omega$

$R_3 = V_3/I_3 = 5/0.0005 = 10\,k\Omega$

Yes these values are expected to be the same as the corresponding directly measured resistance values because Table 5.1 and 5.2 are basically the same circuits just 5.2 is a voltage divider configuration that uses two resistors in series to create the output voltage insted of 1 resistor in series and 2 in parallel. In terms of the values for the two 10kΩ parallel resistors from figure 5.1 and the one 5kΩ from 5.2, both hold the same current and voltage values and therefore would also be corresponding as well.

Workspace

With reference to the "Simple Voltage Divider" circuit in **Figure 2.1**:

Explain how your measurement (*on Multisim*) results in **Table 5.2** compare to the corresponding theoretical values in **Table 2.1**? Explain possible causes of any discrepancies.

comparing my measurement results in table 5.2 to the theoretical values in Table 2.1, the calculated measurements were the same. Some possible causes of any discrepancies could be due to errors in possible values, not placing the volt and amp meters correctly and or forgetting to add the grounding wire. It may also be due to using 5.1kΩ resistor insted of 5kΩ as 5.1kΩ was listed in the lab but the TA recommended to 5kΩ.

Use your Pre-Lab 4(c) analysis to recalculate a more reasonable theoretical prediction of the expected V_0 and I values, taking into consideration the use of a standard value of **5.1** kΩ resistor (instead of the **5.0** kΩ) for $\mathbf{R_Y}$. How do these recalculated values compare to the measured ones in **Table 5.2**? Explain.

$$V_0 = \left[\frac{R_y}{R_y + R_x}\right] \cdot V_1 \qquad I = \frac{V_1}{R_x + R_y}$$

$$= \left[\frac{5.1k\Omega}{5.1k\Omega + 10k\Omega}\right] \cdot 15v \qquad = \frac{15v}{5.1k\Omega + 10k\Omega}$$

$$= 5.066V \qquad = 0.000993A = 0.993mA$$

When taking 5.1kΩ resistor into consideration insted of the 5.0kΩ for RY, the voltage and current that is recalculated are in decimals where as in table 5.2 the RY resistor was in whole numbers. The voltage is a bit higher and current is a bit lower.