EXPERIMENT 3
REPORT SHEET

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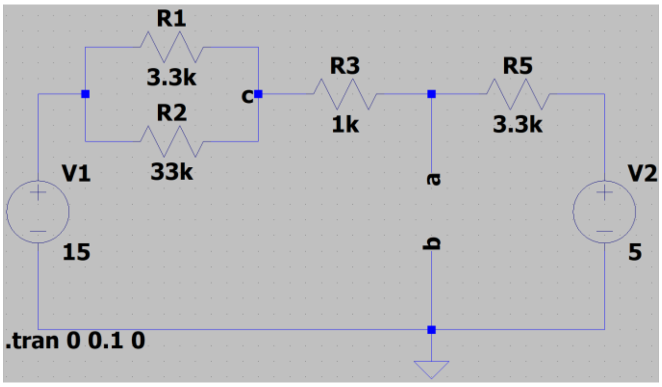
Date: 26/11/2020

Important Notes:

- You will be expected to provide screenshots of your simulation results. You have to take full screenshots for all of them. You can use the full-screen mode of the Snipping Tool for this. **DO NOT crop** any image.
- If the image is too dense or too small that makes it difficult to view, then add zoomed-in images as EXTRAS (again full screenshots).
- You will name your report as “**Exp#_First/Final Report_StudentID.pdf**”

Preliminary Work:

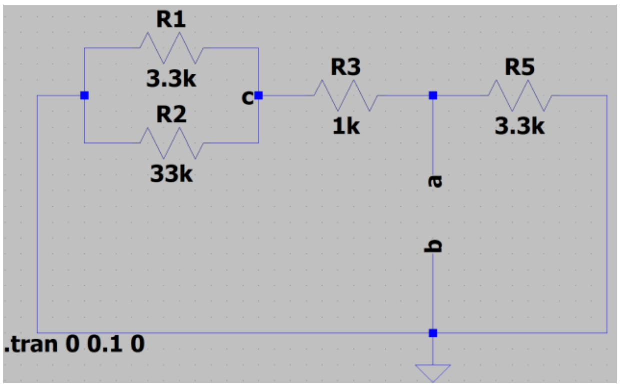
1.i.



$(V_c - 15V)/3.3k\Omega + (V_c - 15V)/33k\Omega + (V_c - V_a)/1k\Omega = 0$
$(V_a - V_c)/1k\Omega + (V_a - 5V)/3.3k\Omega = 0$

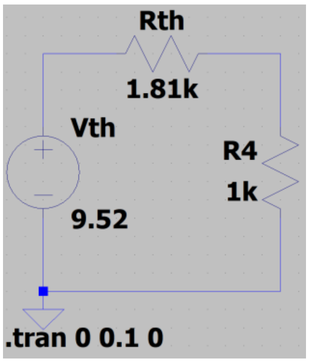
$4V_c - 3V_a = 15V$
$-3.3V_c + 4.3V_a = 5V$
$V_c = 10.89V$
$V_a = 9.52V$

$E_{TH} = V_a = 9.52V$



$R_{TH} = R_{eq} = 1/(1/(1/(1/3.3k\Omega + 1/33k\Omega) + 1k\Omega) + 1/(3.3k\Omega)) = 1.81k\Omega$

1.ii.



I = (9.52V)(1kΩ)/(1.81kΩ + 1kΩ) = 3.39mA
V = (3.39mA)(1kΩ) = 3.39V

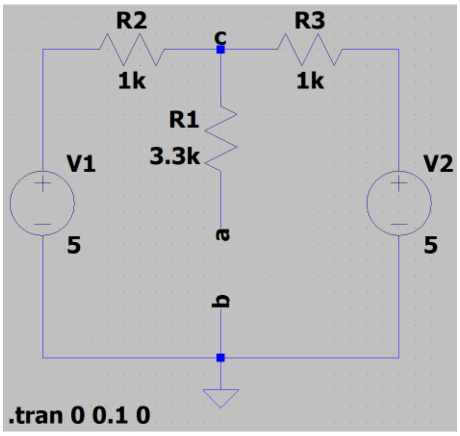
1.iii.

$(V_c - 15V)/3.3k\Omega + (V_c - 15V)/33k\Omega + (V_c - V_a)/1k\Omega = 0$
$(V_a - V_c)/1k\Omega + V_a/1k\Omega + (V_a - 5V)/3.3k\Omega = 0$

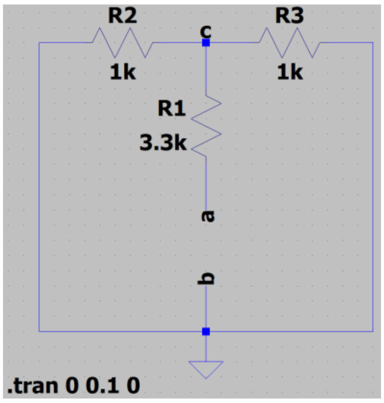
$4V_c - 3V_a = 15V$
$-3.3V_c + 7.6V_a = 5V$
$V_c = 6.29V$
$V_a = 3.39V$

I = 3.39V/1kΩ = 3.39mA

2.i.



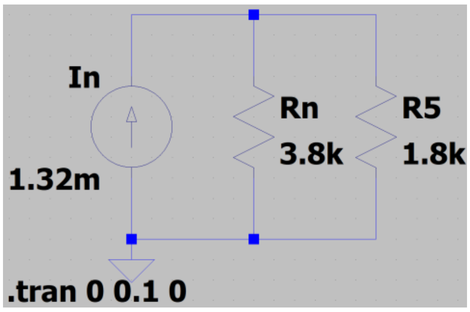
$(V_c - 5V)/1k\Omega + (V_c - 5V)/1k\Omega = 0$
$2V_c = 10V$
$V_c = 5V$
$V_a = 5V$



$R_N = R_{eq} = 1/(1/1k\Omega + 1/1k\Omega) + 3.3k\Omega = 3.8k\Omega$

$I_N = 5V/3.8k\Omega = 1.32mA$

2.ii.



$I = (1.32mA)(3.8k\Omega)/(3.8k\Omega + 1.8k\Omega) = 0.89mA$

$V = (0.89mA)(1.8k\Omega) = 1.61V$

2.iii.

$-5V + (1k\Omega)(I_1) + (3.3k\Omega)(I_1 - I_2) + (1.8k\Omega)(I_1 - I_2) = 0$

$5V + (3.3k\Omega)(I_2 - I_1) + (1.8k\Omega)(I_2 - I_1) + (1k\Omega)(I_2) = 0$

$(6.1)I_1 - (5.1)I_2 = 5mA$

$(-5.1)I_1 + (6.1)I_2 = -5mA$

$I_1 = 0.45mA$

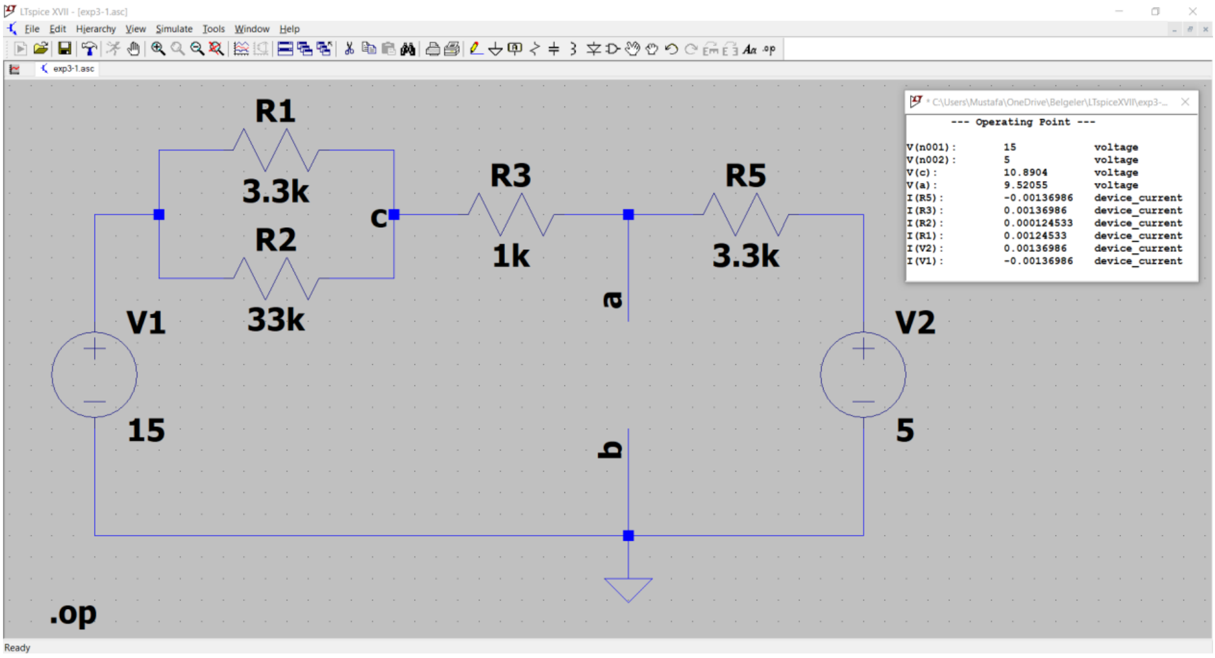
$I_2 = -0.45mA$

$I = 0.45mA - (-0.45mA) = 0.89mA$

$V_a = (0.89mA)(1.8k\Omega) = 1.61V$

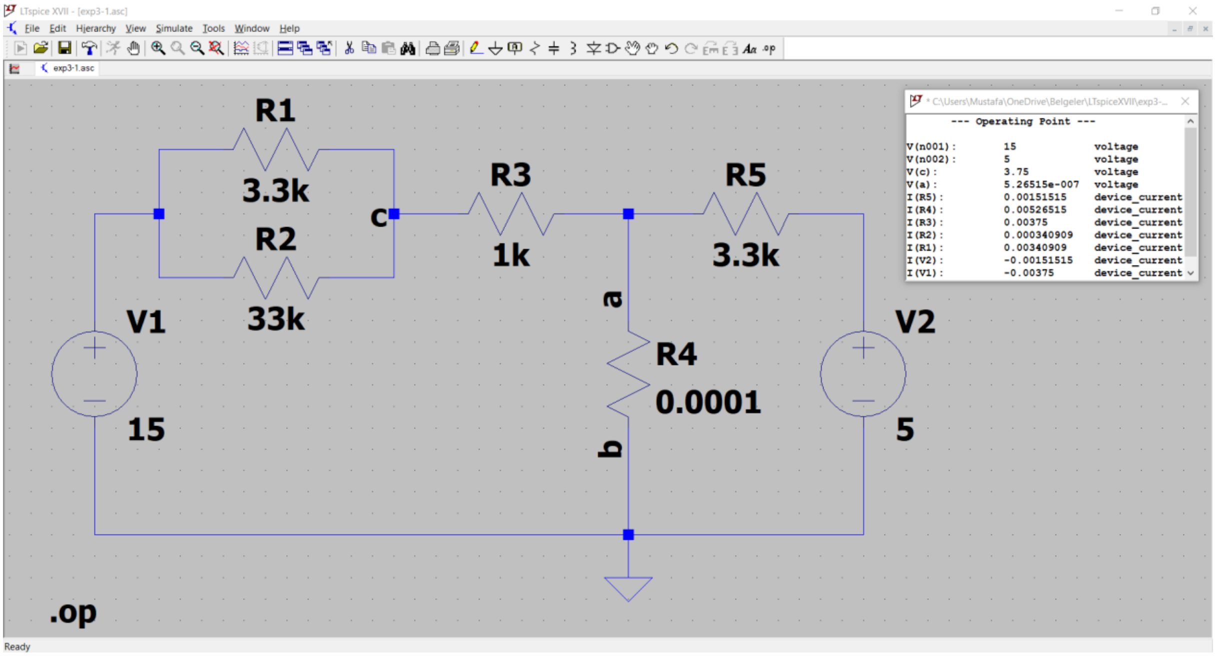
Experimental Work:

1. Take the screenshots of both circuit and DC operating point simulation results and fill the table given below with calculated and measured values.



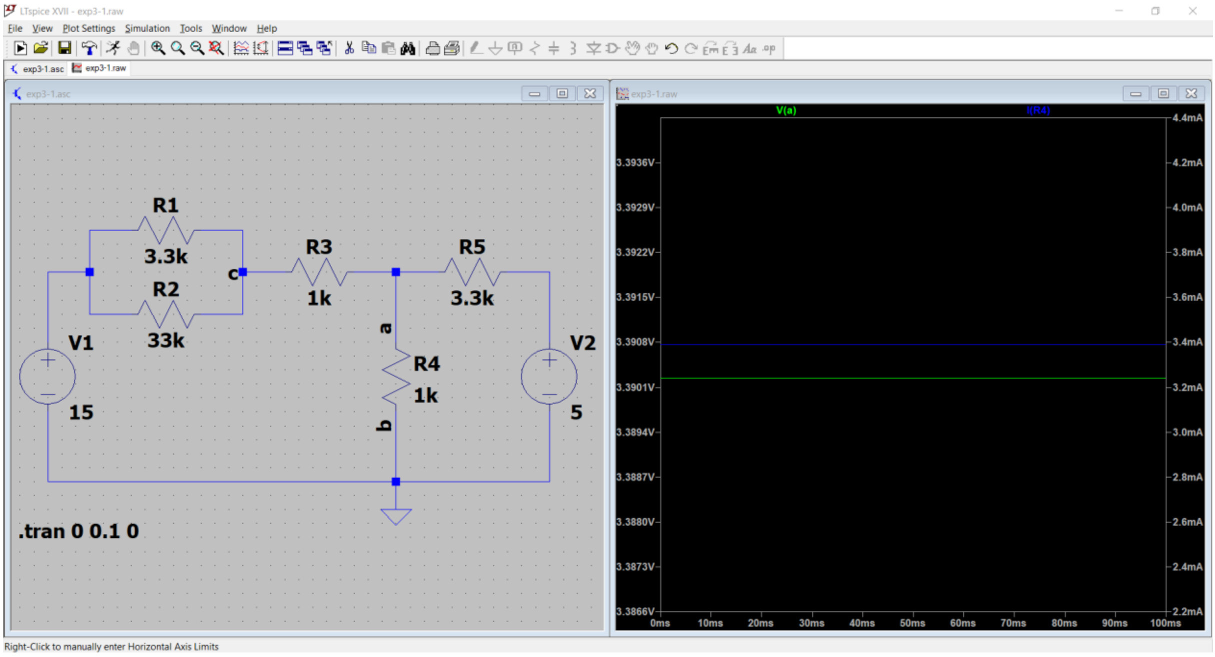
	Calculated	Measured
E_{TH}	9.52V	9.52V

2. Take the screenshots of both circuit and DC operating point simulation results and fill the table given below with calculated and measured values.



	Calculated in Preliminary Work	**Measured/Calculated in LTSpice**
$\mathbf{I_{SC}}$	**X**	5.26515mA
$\mathbf{R_{TH}}$	1.81kΩ	1.81kΩ

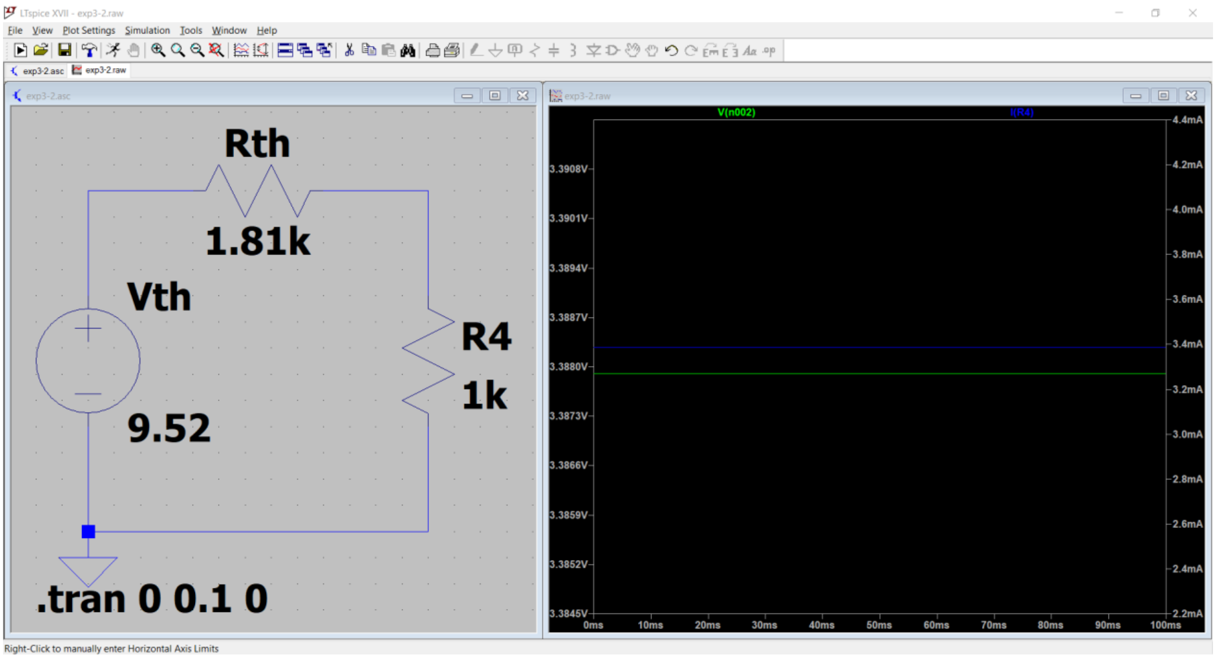
3. Take the screenshots of both circuit and transient simulation results.



Voltage: 3.39V

Current: 3.39mA

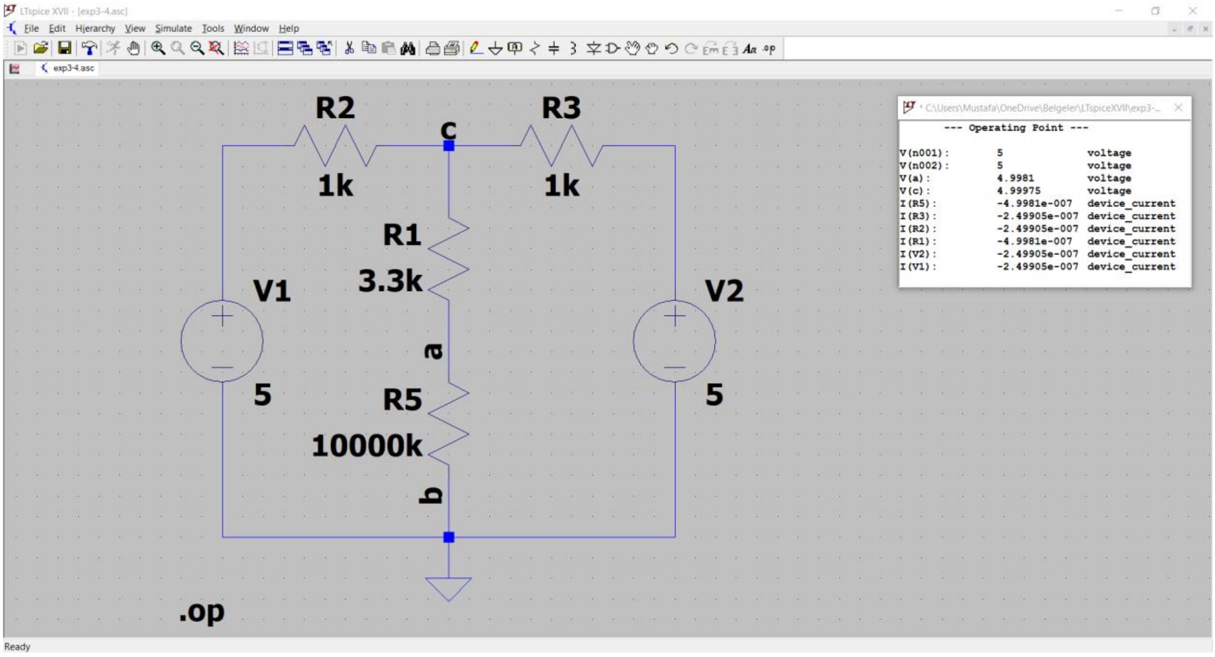
4. Take the screenshots of both circuit and transient simulation results.

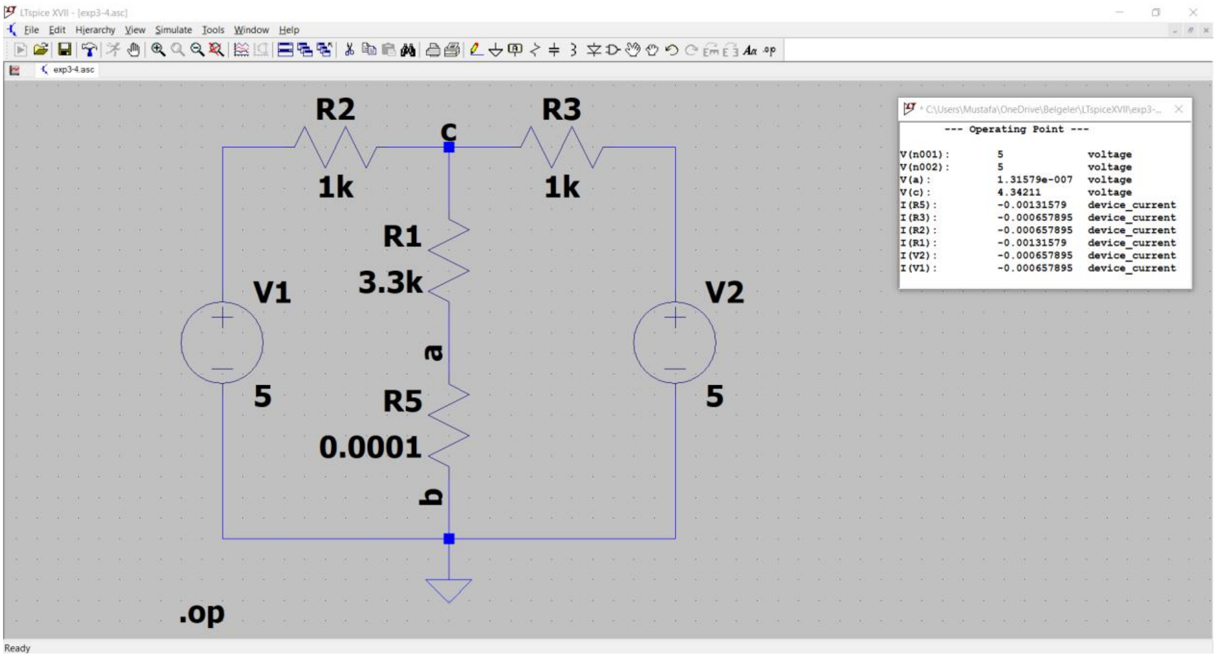


Voltage: 3.39V

Current: 3.39mA

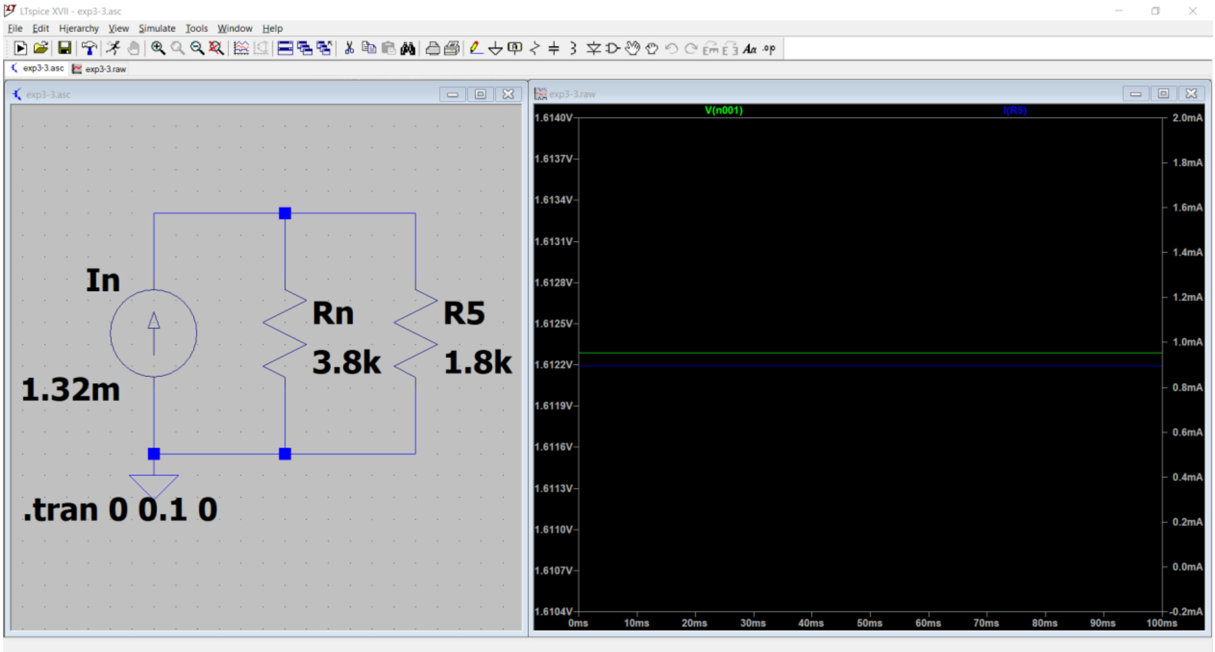
5. Take the screenshots of both circuits and DC operating point simulation results and fill the table given below with calculated and measured values. Compare your results with previous step.





	Calculated in Preliminary Work	**Measured/Calculated in LTSpice**
I_N	1.32mA	1.32mA
R_N	3.8kΩ	3.8kΩ

6. Take the screenshots of both circuit and transient simulation results. Compare your results with your calculations.



Voltage: 1.61V Current: 0.9mA

Conclusion

1. Discuss experimental results from Norton and Thevenin equivalent circuits.

In the experiment, we created the two circuits without the load resistors, measured the voltage values of the nodes a and b, and then replaced the voltage sources with short circuits to measure the equivalent resistors between that nodes. Then, we created the corresponding Thevenin and Norton circuits and measured the voltage values of and the current value flowing through the nodes a and b of each circuit. Both Thevenin and Norton circuits behaved the same as their corresponding circuits.

2. Compare Thevenin and Norton equivalent circuit results with your calculation and simulation results.

My calculation and simulation results are consistent with each other with small differences due to rounded values of Thevenin, or Norton, circuits. And, those results are consistent with the simulation results as well. However, the difference this time is due to the tolerances of resistors and sources, resistances of cables, and any other parameters that we ignore in calculations.