BOLD and Underline Word should be written with color pen. Use pencil margin, Page number with color pen, all drawing with pencil, table body with pencil but text will be ball pen, write both sides.

Experiment Name: Verification of Thevenin's, and Norton's Theorem.

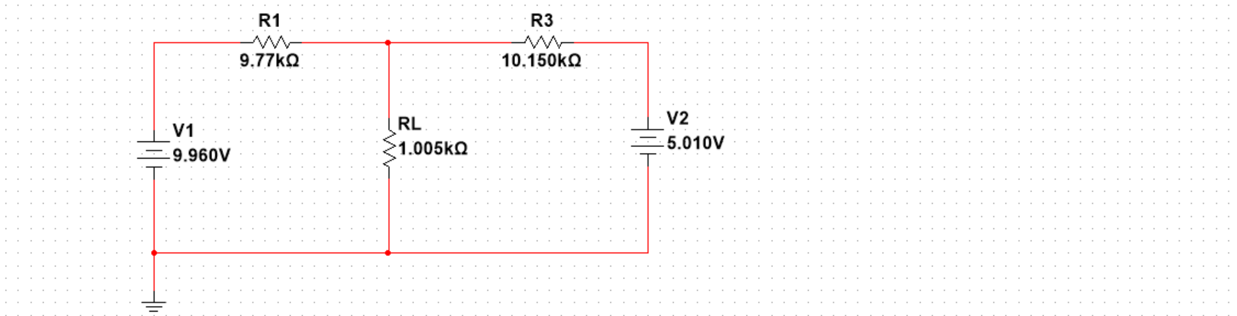
Objectives:

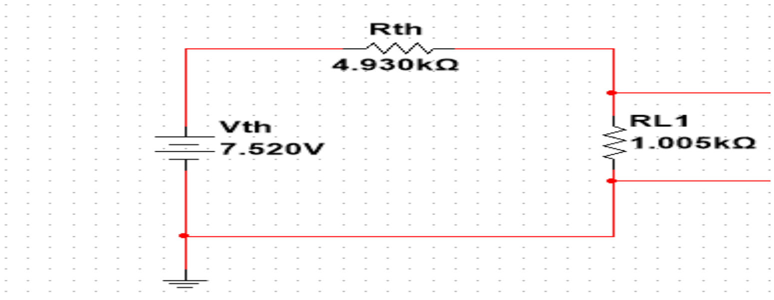
- Experimentally perform Thevenin's theorem, Norton's theorem.
- Perform theoretical calculations.
- Verify the experimental values with theoretical values.

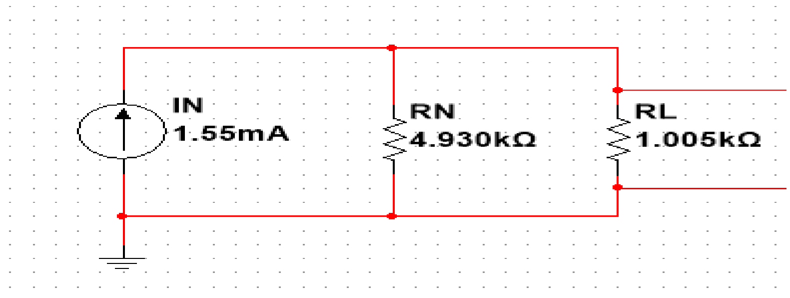
Apparatus:

- Breadboard
- Resistors (1x 1.0 kΩ, 1x 5.0 kΩ, 2x 10 kΩ)
- Digital Multimeter (DMM)
- DC Power Supply
- Wires

Circuit Diagram:







Data Table & Calculation:

Table-1:

Theoretical R	Measured R (kΩ)	% Error
	$R_1 = 9.770$ kΩ, $R_3 = 10.150$	
$R_{Th} = 4.978$	$R_L = 1.005$, $R_{Th} = 4.930$	$R_{Th} = 0.96\%$

Table-2

Original Circuit:

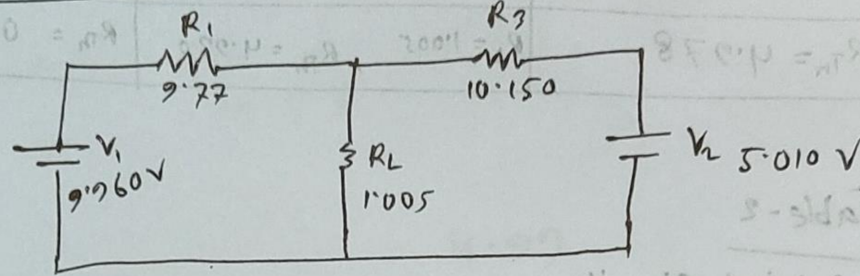
Value	Measured	Theoretical	% Error
V_L (V)	1.263 V	1.265 V	0.16%

Table-3

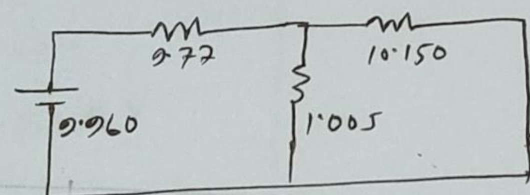
Measurement	Measured	Theoretical	% Error
V_{TH} (V)	7.520	7.532	0.16%
I_N (mA)	1.520	1.513	0.46%
R_{TH}(kΩ) = R_N (kΩ)	4.980	4.978	0.04%
V_L (V) (Th-circuit)	1.274	1.273	0.08%
I_N (mA)	1.550	1.513	2.45%
V_{RL} (V) (N-circuit)	1.293	1.294	0.08%

Calculation:

Original Circuit:

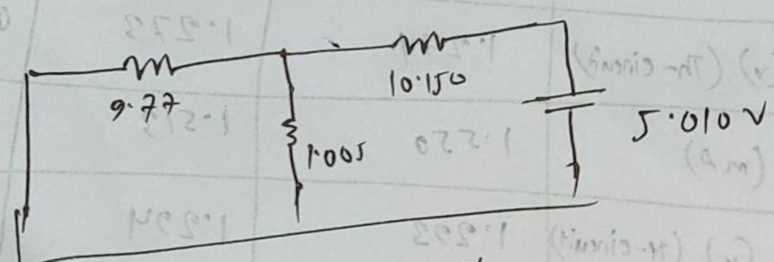


Using Super Position Theorem,



$$V_L' = \frac{\left(\frac{1}{1.005} + \frac{1}{10.150}\right)^{-1}}{9.77 + \left(\frac{1}{1.005} + \frac{1}{10.150}\right)^{-1}} \times 9.960$$

$$= 0.852 \text{ V}$$

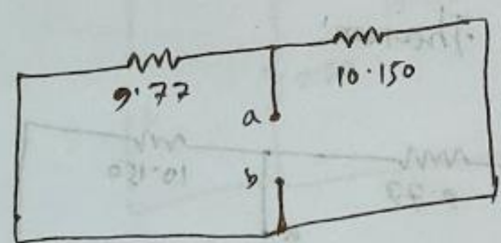


$$V_L'' = \frac{\left(\frac{1}{1.005} + \frac{1}{9.77}\right)^{-1}}{10.150 + \left(\frac{1}{1.005} + \frac{1}{9.77}\right)^{-1}} \times 5.010$$

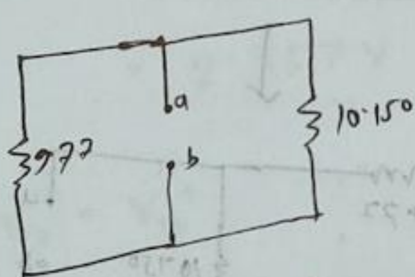
$$= 0.413 \text{ V}$$

$$\therefore V_L = V_L' + V_L''$$
$$= (0.852 + 0.413)\,V$$
$$= 1.265\,V$$

Thevenin's & Norton's equivalent, $R_{TH} = R_N$

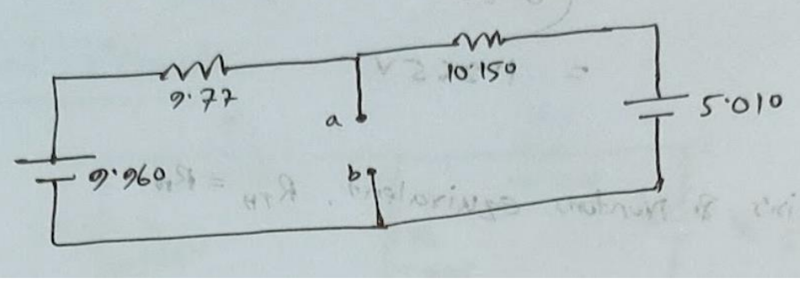


$\downarrow$

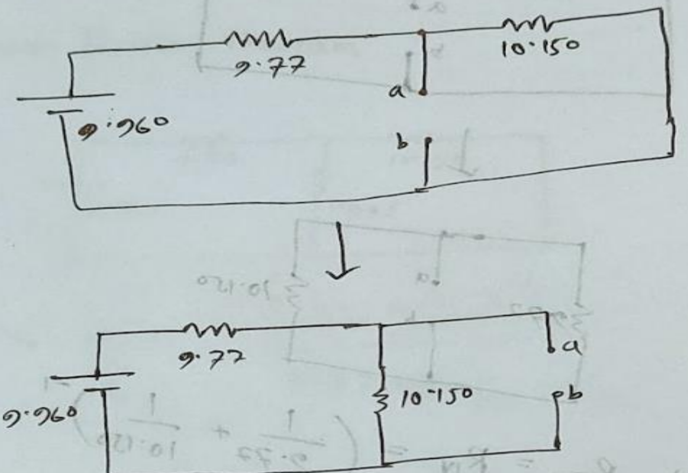


$$\therefore R_{TH} = R_N = \left(\frac{1}{9.77} + \frac{1}{10.150}\right)^{-1}$$
$$= 4.978\,a\,k\Omega$$

Thevenin's equivalent voltage b, V_{TH}:

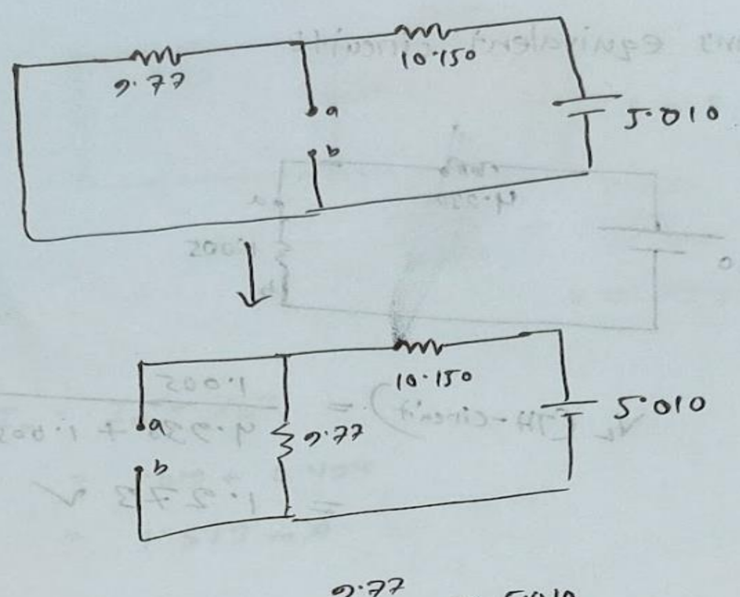


Using Superposition Theorem:



$$\therefore V_{TH}' = \frac{10.150}{9.77 + 10.150} \times 9.960$$

$$= 5.075 \text{ V}$$



$$V_{TH}'' = \frac{9.77}{9.77 + 10.150} \times 5.010$$

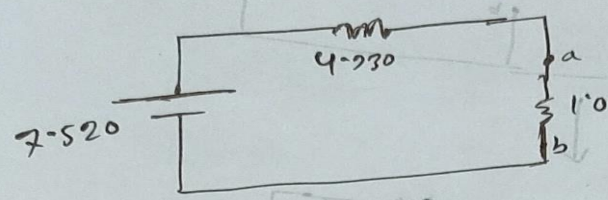
$$= 2.457 \text{ V}$$

$$\therefore V_{TH} = V_{TH}' + V_{TH}''$$

$$= 5.075 + 2.457$$

$$= 7.532 \text{ V}$$

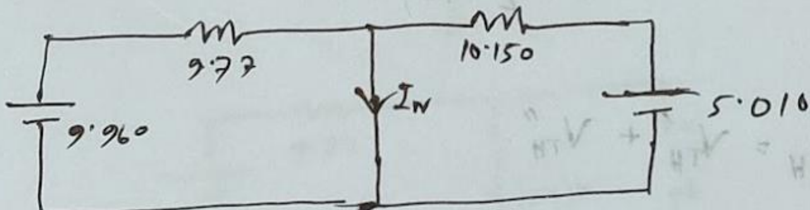
Thevenin's equivalent circuit:



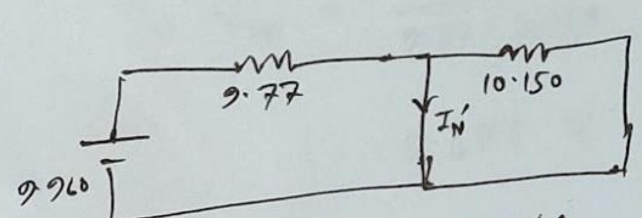
V_L (TH-circuit) $= \frac{1.005}{4.930 + 1.005} \times 7.520$

$= 1.273$ ✓

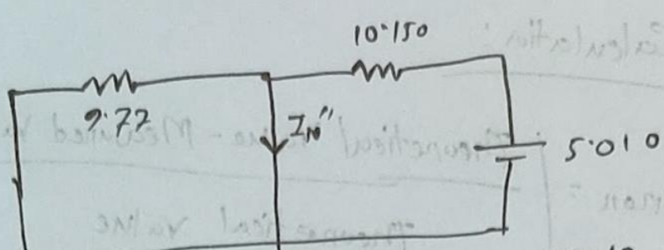
Norton's equivalent current, I_N:



Using Superposition Theorem:



$I_N' = \frac{9.960}{9.77} = 1.019$ mA



$I_N'' = \cancel{\frac{10.150}{5.010}} = \frac{5.010}{10.150}$

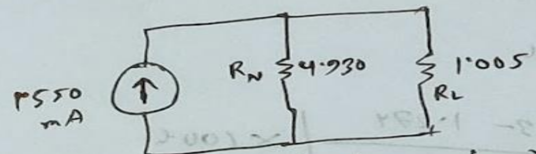
$= 0.494$ mA

$\therefore I_N = I_N' + I_N''$

$= 1.019 + 0.494$

$= 1.513\ mA$

Norton's equivalent circuit:



$$I_{R_L} = \frac{\left(\frac{1}{4.930} + \frac{1}{1.005}\right)^{-1}}{1.005} \times 1.550$$

$= 1.288\ mA$

$\therefore V_L\ (N\text{-Circuit}) = (1.288 \times 1.005)$

$= 1.294\ V$

Error Calculation:

$$\text{Error} = \left| \frac{\text{Theoretical Value} - \text{Measured Value}}{\text{Theoretical Value}} \right| \times 100\%$$

$$V_{TH} = \left| \frac{7.532 - 7.520}{7.532} \right| \times 100\%$$

$= 0.16\%$

$$I_N = \left| \frac{1.513 - 1.520}{1.513} \right| \times 100\%$$

$= 0.46\%$

$$R_{TH} = \left| \frac{4.978 - 4.980}{4.978} \right| \times 100\%$$

$= 0.04\%$

$$V_L\ (TH) = \left| \frac{1.273 - 1.274}{1.273} \right| \times 100\%$$

$= 0.08\%$

And so on.

Graph:

N/A

Result Analysis:

From the data table of this experiment, we found that the theoretical and measured values are the same. We also get that the VL of the original circuits and Thevenin's equivalent circuits, also Norton's equivalent circuits are the same. Therefore, our circuits completely follow Thevenin's and Norton's theorem.

Questions and Answers:

01. Already showed in Data Table Section.

02. Already showed in Data Table Section.

Discussion:

After completing this experiment, we learnt to verify Thevenin's and Norton's Theorem. Now we can convert a complex circuit into a simple circuit using these two theorems. We need to remove the load and measure the Rt and the voltage for Thevenin's Theorem and the Current for Norton's Theorem at points a and b. In this experiment, we don't face any difficulties. We completed this experiment on time.

Attachment:

01. Signed Data Table.

02. Simulation using Multisim.