Exp.1. **~~Impedance matching of source and load~~**

Date:

Varification of Thevenin's theorem

Objective:

1. To design a simplified equivalent circuit in analysing the power systems and other circuits where the load resistor is subject to change in order to determine the voltage across it and current through it using thevenin's theorem.
2. To design the circuit for maximizing the power transferred from the amplifier to the loudspeaker using maximum power transfer theorem.

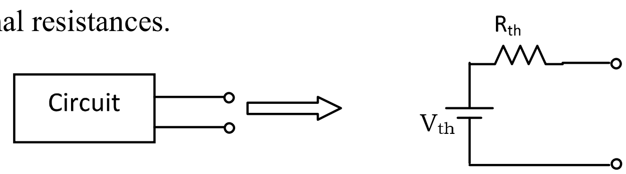
Experiment 1.a(Thevenin's Theorem)

Components Required :

S.No.	Name of the Components/Equipment	Range	Type	Quantity required
1	Resistor	100Ω, 560Ω, 270Ω	Wire wound	Each 1
2	DC power supply	(0-30)V	RPS	1
3	Voltmeter	(0-30)V	MC	1
4	Ammeter	(0-100)mA	MC	1
5	Wires	-	Single strand	Few nos
6	Bread board	-	-	1

Statement of the theorem:

Any two-terminal linear network composed of voltage sources, current sources, and resistors, can be replaced by an equivalent two-terminal network consisting of an independent voltage source in series with a resistor. The value of voltage source is equivalent to the open circuit voltage (V_{th}) across two terminals of the network and the resistance is equal to the equivalent resistance (R_{th}) measured between the terminals with all energy sources replaced by their internal resistances.



Circuit 1:

Find the current through 270Ω resistance in the figure 1 using thevenin's theorem.

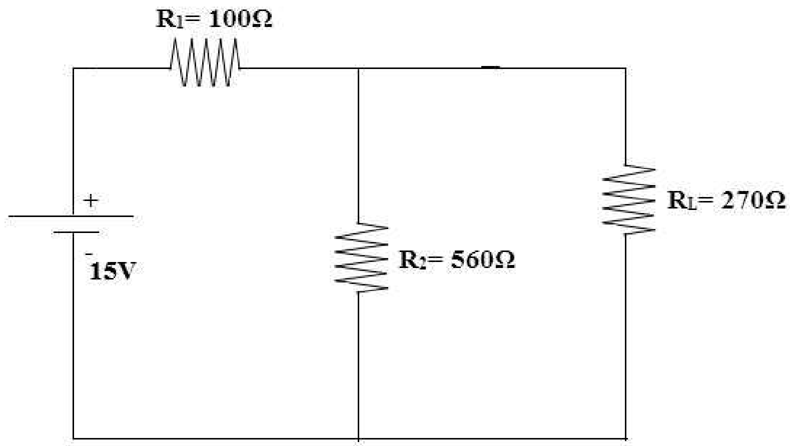


Figure 1

Step 1:

Remove the load (270Ω) (the element through which the current or voltage is going to be calculated) from the circuit and find out the open circuit voltage across the terminals.
In theoritically, the voltage can be found as follows (Figure 2)

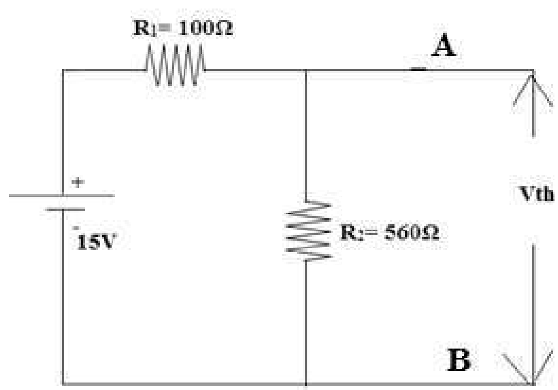


Figure 2

$V_{th}=V_{R2}=\frac{15*560}{100+560}$ =12.72V (From Voltage division rule)

Practical Circuit Diagram:

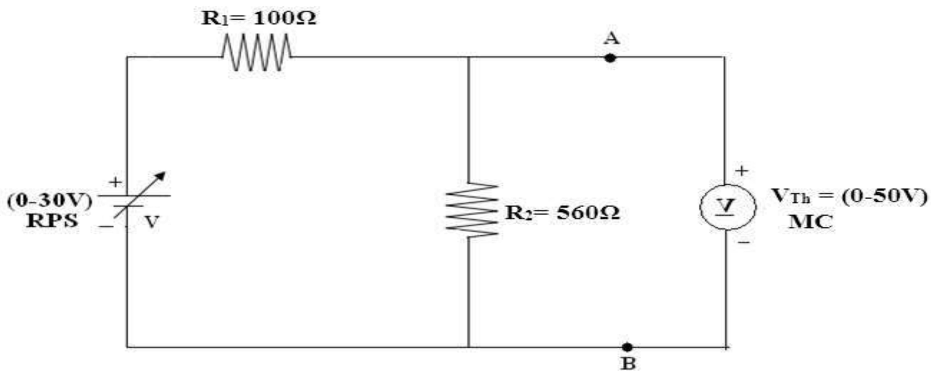


Figure 3

1. Give the connections in the breadboard as per the circuit diagram.(Figure 3)
2. Set the source voltage of 15V in the Regulated power supply.
3. Measure the thevenin's voltage in the voltmeter.

Step 2:

For finding the thevenin's resistance, the sources in the circuit must be removed. The voltage sources are short circuited and the current sources are open circuited. We have to find the looking back resistance from the open terminal.

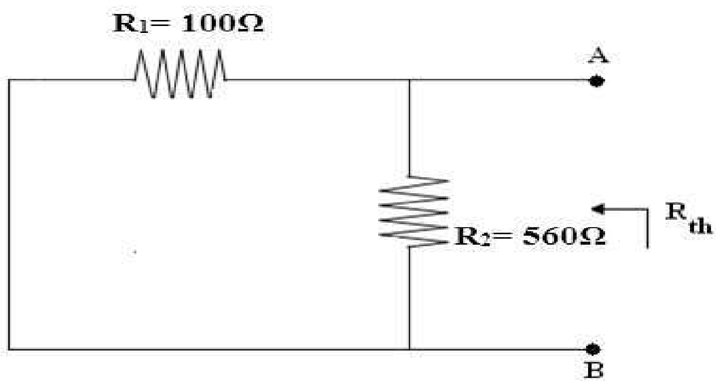


Figure 4

Theoretically, $R_{th} = \frac{100*560}{100+560} = 84.84\Omega$

same

Practical Circuit Diagram:

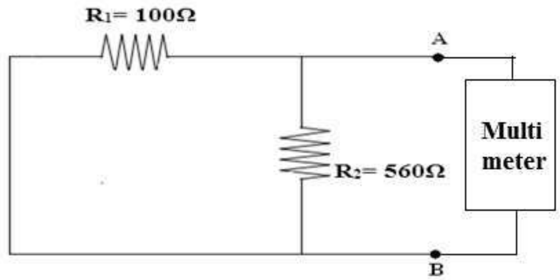


Figure 5

1. Give the connections in the breadboard as per the circuit diagram(Figure 5)
2. Measure the resistance across AB using multi meter.

Step 3:

After finding thevenin's voltage and thevenin's resistance, we can draw the thevenin's equivalent circuit by connecting V_{th} in series with R_{th}. (Figure 6.a)

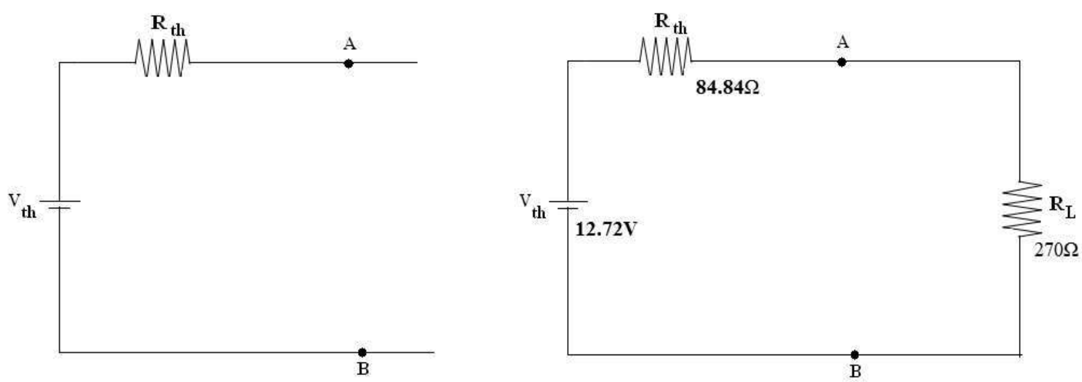


Figure 6

The load (270Ω) can be connected in series with the thevenin's equivalent circuit.(Figure 6.b) Theoretically, we can calculate the current through the load from the thevenin's equivalent circuit.

$I_{load}=\frac{12.72}{84.84+270}$ =35.84mA.

Practical Circuit Diagram:

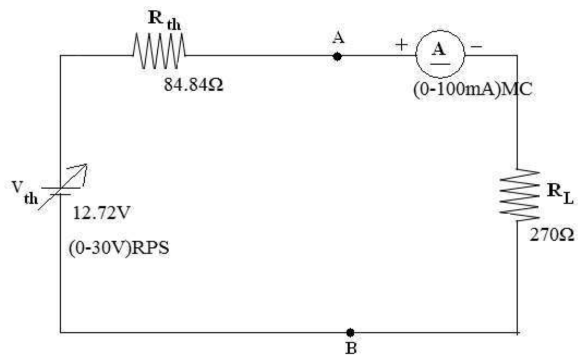


Figure 7

1. Give the connections in the breadboard as per the circuit diagram(Figure 7)
2. Measure the current through the load resistance in the Ammeter.

Step 4:

The load current can be verified using Kirchoff's laws.

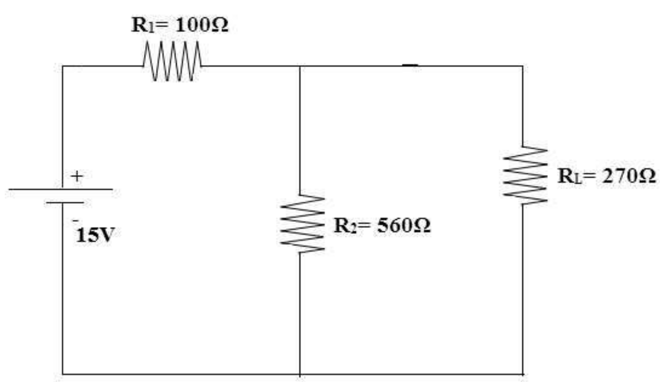


Figure 8

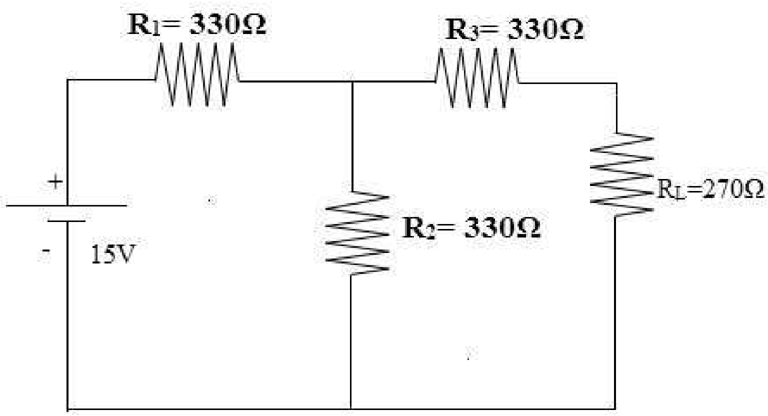
Total resistance = $\frac{560*270}{560+270} + 100 = 282.16\Omega$

Total current= $\frac{Voltage}{Resistance} = \frac{15}{282.16} = 53.16mA$

Current through 270Ω = $\frac{Total\ current*Opposite\ resistance}{Total\ resistance} = \frac{53.16*560}{560+270} = 35.84mA$

(Current Division rule)

Circuit 2:



Find the current through R_L using thevenin's theorem.

OBSERVATION TABLE

S. No	V_s (Volts)	V_{TH} (Volts)	(R_{th}) (Ω)	Current through Load Resistance I_L(mA)	
				Practical Value	Theoretical Value

Experiment 1.b(Maximum power transfer Theorem)

Components Required :

S.No.	Name of the Components/Equipment	Range	Type	Quantity required
1	Resistor	100Ω, 560Ω, 270Ω	Wire wound	Each 1
2	DC power supply	(0-30)V	RPS	1
3	Voltmeter	(0-30)V	MC	1
4	Ammeter	(0-100)mA	MC	1
5	Wires	-	Single strand	Few nos
6	Bread board	-	-	1
7	Decade resistance box	(0-10KΩ)		1

Statement of the theorem:

The Maximum Power Transfer Theorem states that maximum power is delivered from a source to a load when the load resistance is equal to source resistance.

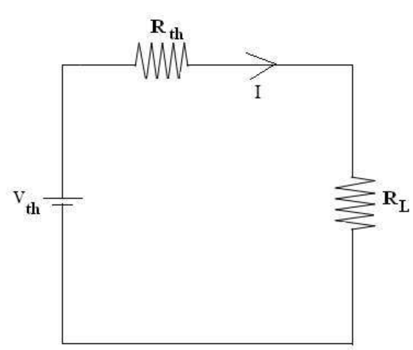


Figure 19

In the thevenin's equivalent circuit, the maximum power will be delivered from source to the load when the load resistance (R_L) is equal to the thevenin's resistance (R_{th}).

Circuit 1:

For finding the thevenin's equivalent circuit, the steps 1 to 4 in the experiment 1.a is repeated. Then as per the maximum power transfer theorem, maximum power will be delivered to the load when the load resistance is equal to the internal or thevenin's resistance of the network.

For the given problem in experiment 1,

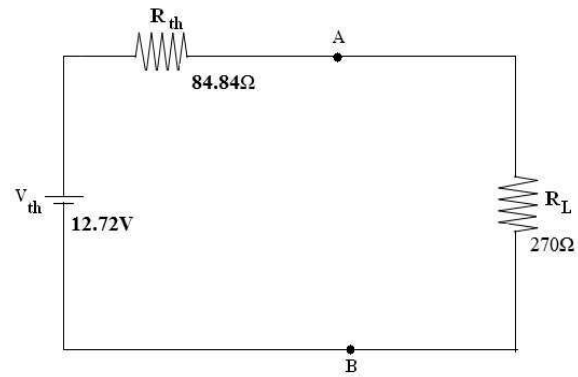


Figure 20

The power delivered to the load can be calculated theoretically as follows:

S.No	R_L	R_{TH}	I_L(mA)	$P_L=I_L^2R_L$(mW)
1	50	84.84	94.33	444.9
2	60	84.84	87	462.7
3	84.84	84.84	74.96	476
4	100	84.84	68.8	473.5
5	200	84.84	44.65	398.8
6	270	84.84	35.8	346.9
7	300	84.84	33	327.7

Practical Circuit:

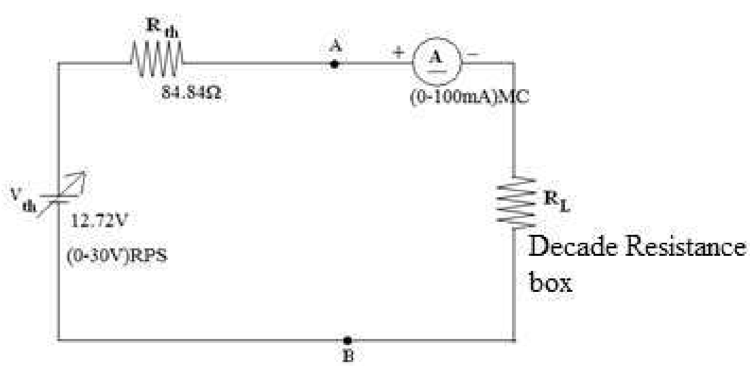


Figure 21

Model Graph

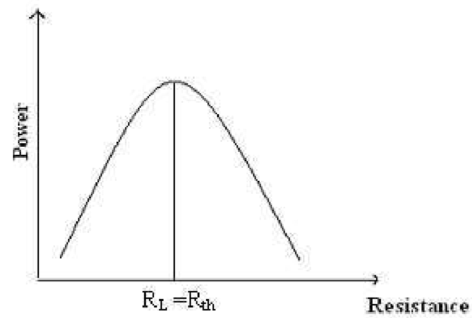
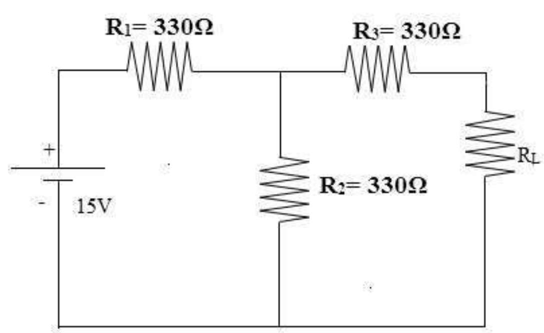


Figure 22

Circuit 2:



Find the maximum power delivered to the load using maximum power transfer theorem.

~~Application Circuit:~~

~~**Example 1**~~

~~Consider the practical example of a speaker with an impedance of 8 ohms is driven by audio amplifier with its internal impedance of 500 ohms. The Thevenin's equivalent circuit is also shown in figure.~~