SEM I

Program: Computer Engineering
SAP ID: 60004200132

Basic Electrical and Electronics Engineering

Expt. No.	Title of the Experiment	Date of Expt.	Date of Submission	CO	Signature
1	DC circuit analysis	06/03/21	13/03/21	1	
2	Mesh and nodal analysis	13/03/21	20/03/21	1	
3	Superposition theorem	20/03/21	26/03/21	2	
4	Thevenin’s and Norton’s theorem	27/03/21	02/04/21	2	
5	R-L and R-C circuit analysis	03/04/21	09/04/21	3	
6	Rectifier circuits	10/04/21	16/04/21	5	
7	Clipper and Clampers	17/04/21	23/04/21	5	

a

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First Year (Semester I) B.Tech.

Basic Electrical and Electronics Engineering

Experiment No. : 01
DC Circuit Analysis

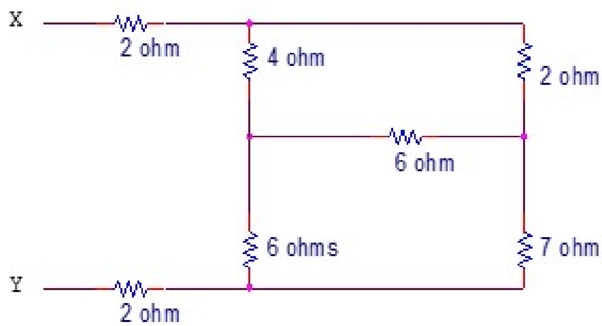
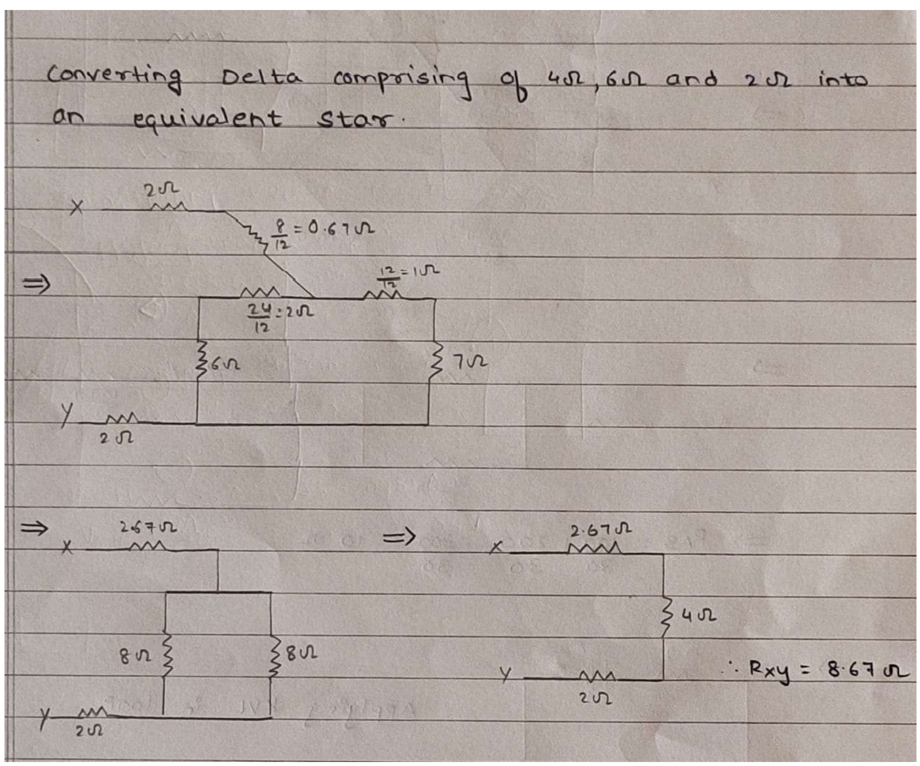
Name : Ayush Jain

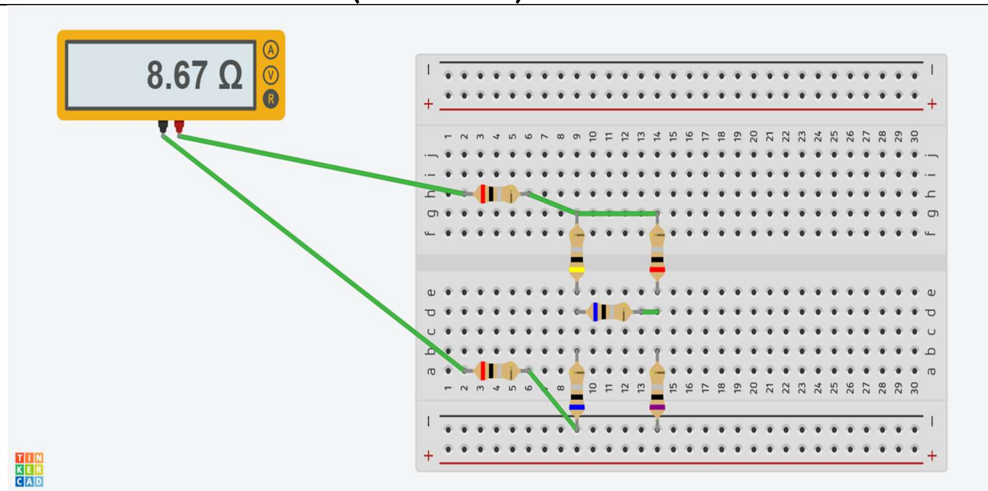
SAP No. : 60004200132

Date of performance : 6/3/2021

Signature of teacher-in-charge : ______________________

First Year (Semester I) B.Tech.

Aim:	To determine resistor, voltage and current value in a circuit.
Apparatus :	Online simulation tools (Tinkercad)
Theortical Analysis:	 read ***Fig. 1(a) Resistor equivalent across X and Y*** ***<u>Theoretical Calculations:</u>*** ***Resistor equivalent across X and Y*** 



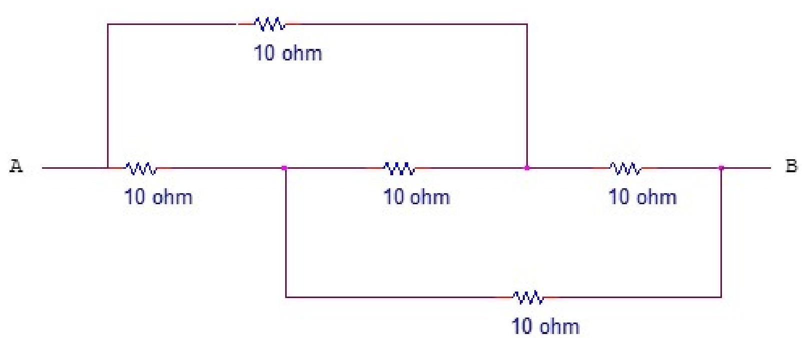
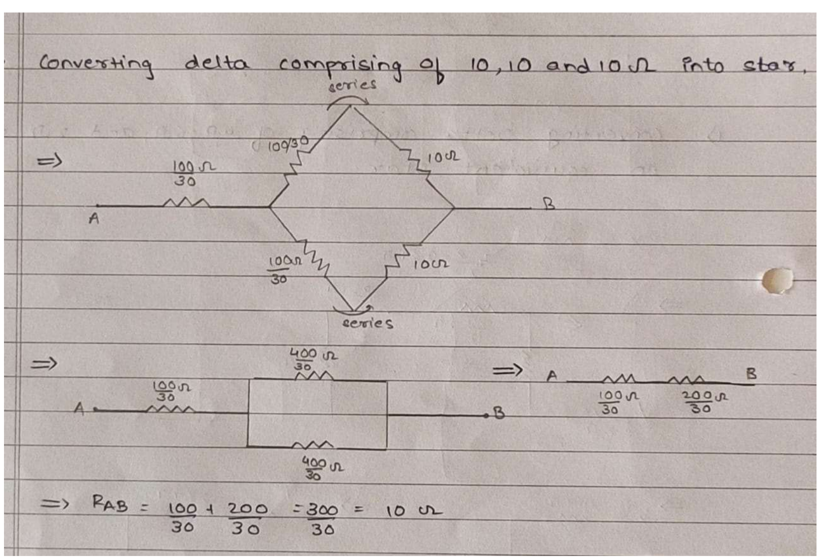
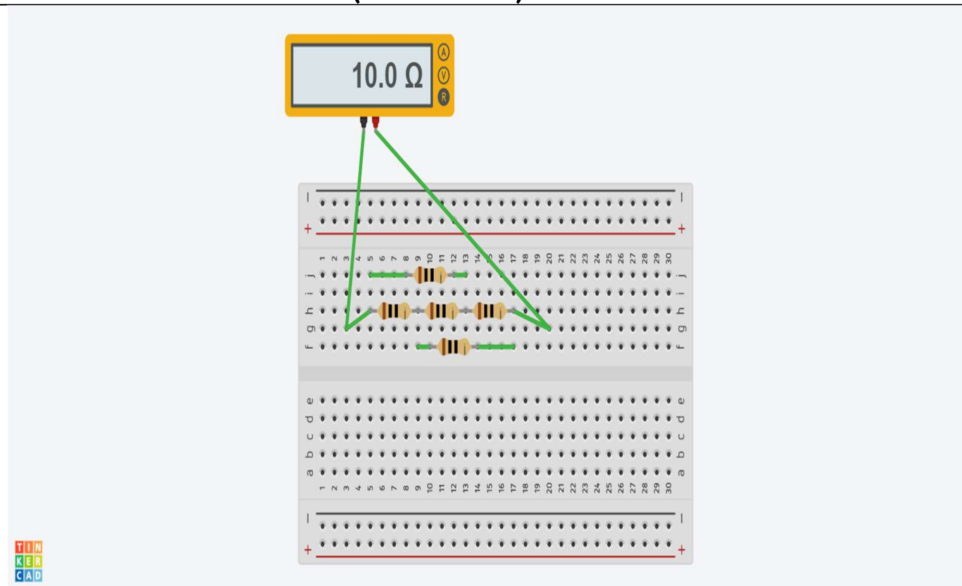


Fig. 1(b) Resistor equivalent across A and B

<u>Theoretical Calculations:</u>

Resistor equivalent across A and B





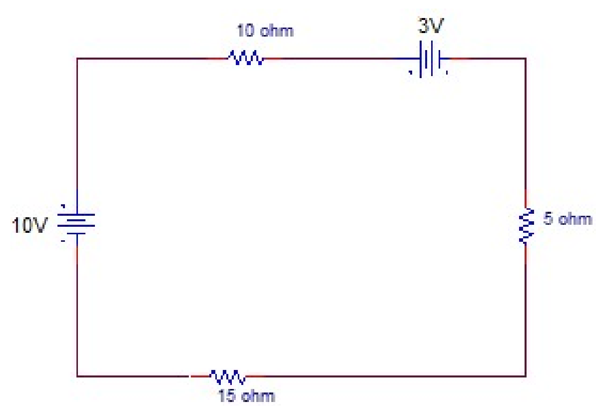
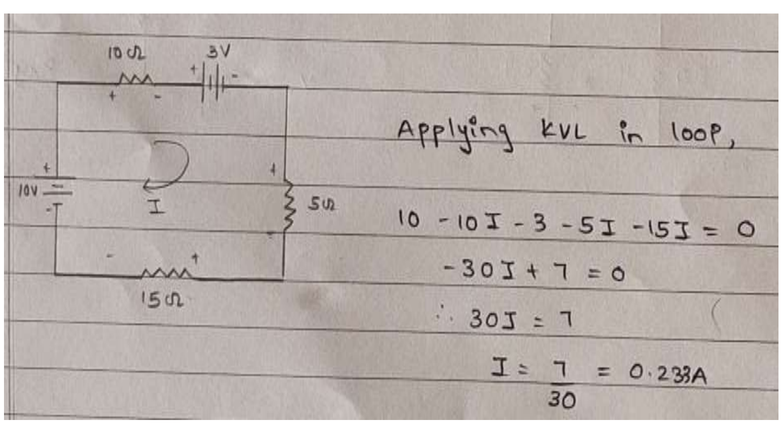


Fig. 1(c) Current in the circuit

Theoretical Calculations:

Current in the circuit



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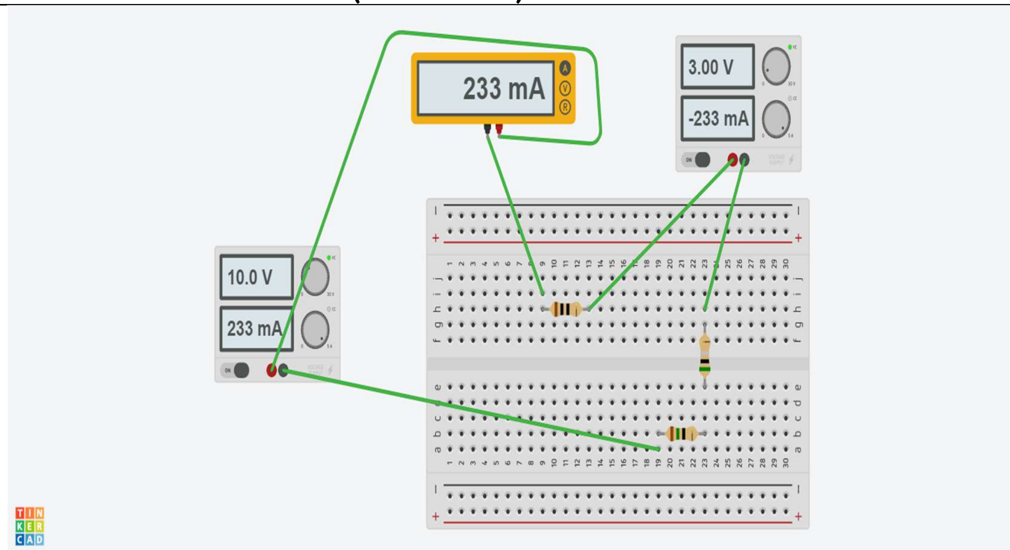
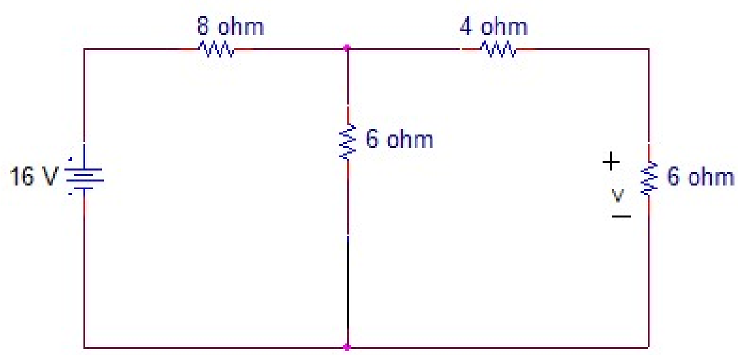
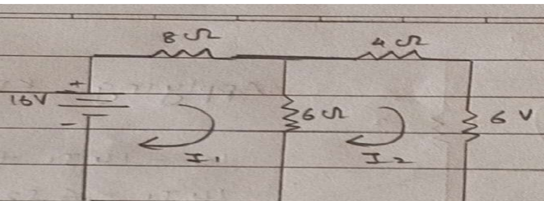




Theoretical Calculations:

Voltage across 6ohm



Applying KVL in mesh 1,

$16 - 14I_1 + 6I_2 = 0$

$\therefore 14I_1 - 6I_2 = 16$ — (1)

Now,

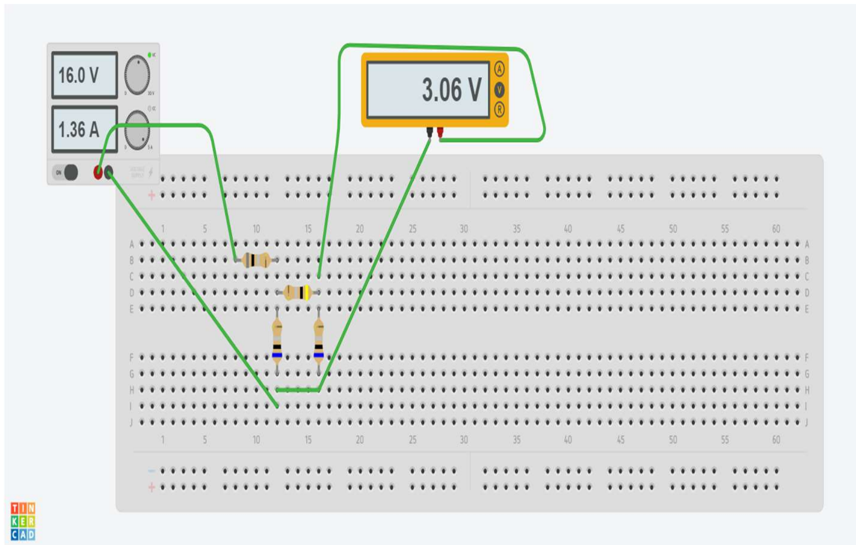
Applying KVL in mesh 2,

$-16I_2 + 6I_1 = 0$

$\therefore 6I_1 - 16I_2 = 0$ — (2)

$\therefore I_1 = 1.36$ A , $I_2 = 0.51$ A

$\therefore V_{6\Omega} = I_2R = 0.51 \times 6 = 3.06$ V



		Theoretical values	**Practical values**
Observation Table	Equivalent resistor R_{XY} (Fig 1.a)	8.67 Ω	8.67 Ω
	Equivalent resistor R_{AB} (Fig 1.b)	10 Ω	10 Ω
	Current in the circuit I (Fig 1.c)	0.233A	0.233A
	Voltage $V_{6\Omega}$ (Fig 1.d)	3.06V	3.06V

Conclusion:

1. We used Star-Delta transformation to simplify the circuit.
2. The practical values has been attained using an online simulator tool, Tinkercad
3. The theoretical values and practical values are equal to each other.

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Basic Electrical and Electronics Engineering

Experiment No. : 02
Mesh and Nodal Analysis

Name : Ayush Jain

SAP No. : 600004200132

Date of performance : 13-03-2021

Signature of teacher-in-charge : ________________________

First Year (Semester I) B.Tech.

Aim:	To determine mesh currents and nodal voltages in the given circuit.
Apparatus :	Online simulation tools (Suggested Tinkercad)

Theortical Analysis:

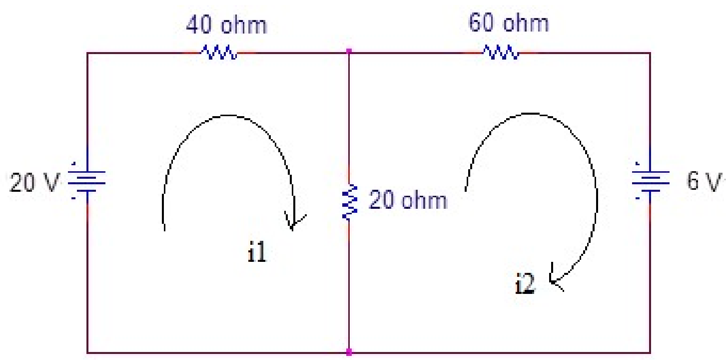
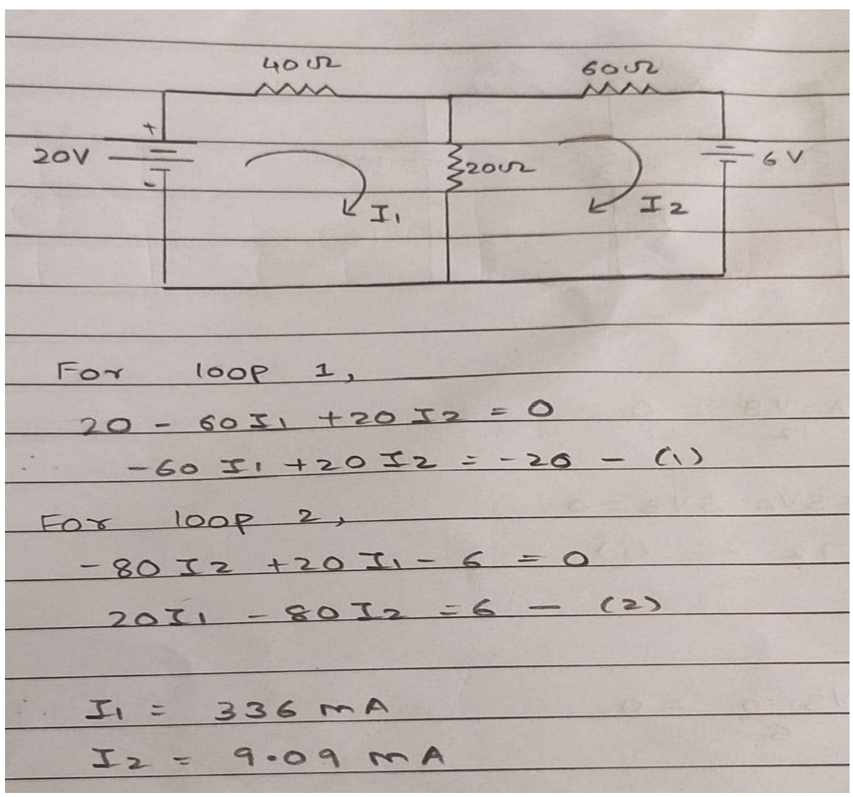


Fig. 1(a) Mesh Analysis

<u>Theoretical Calculations:</u>



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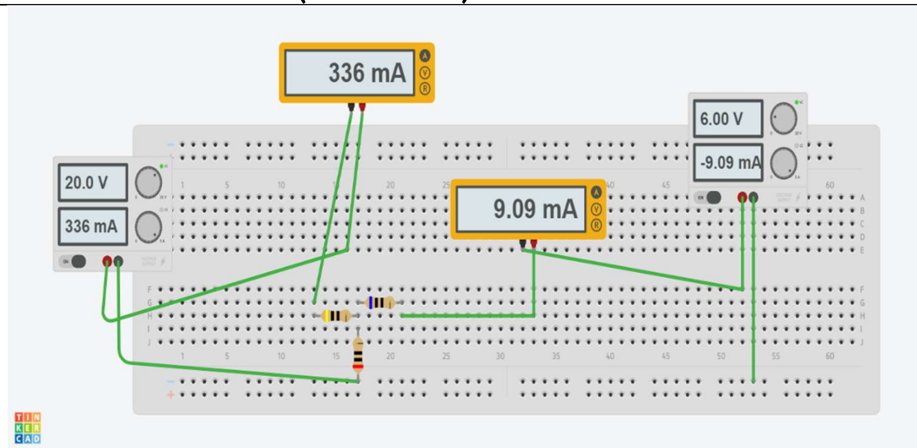


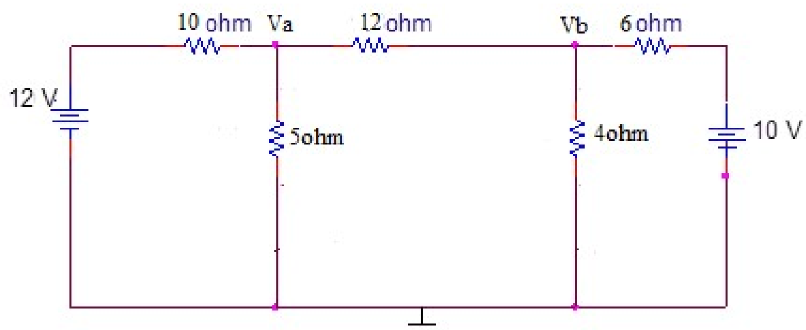
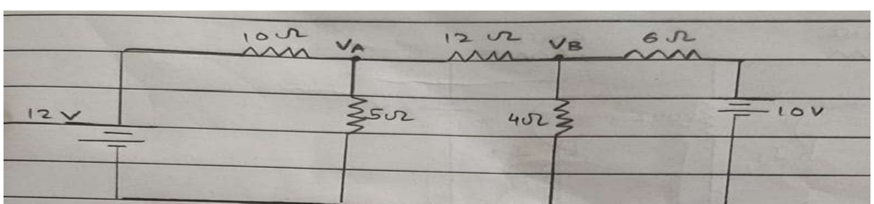


Fig. 1(b) Nodal Analysis

<u>Theoretical Calculations:</u>



KCL at A,

$$\frac{V_A-12}{10}+\frac{V_A}{5}+\frac{V_A-V_B}{12}=0$$

$$6V_A-72+12V_A+5V_A-5V_B=0$$

$$23V_A-5V_B=72 \quad \text{— (i)}$$

KCL at B,

$$\frac{V_B-V_A}{12}+\frac{V_B}{4}+\frac{V_B-10}{6}=0$$

$$2V_B-2V_A+3V_B+2V_B-20=0$$

$$-2V_A+7V_B=20 \quad \text{— (2)}$$

$$V_A = V_B = 4\,V$$

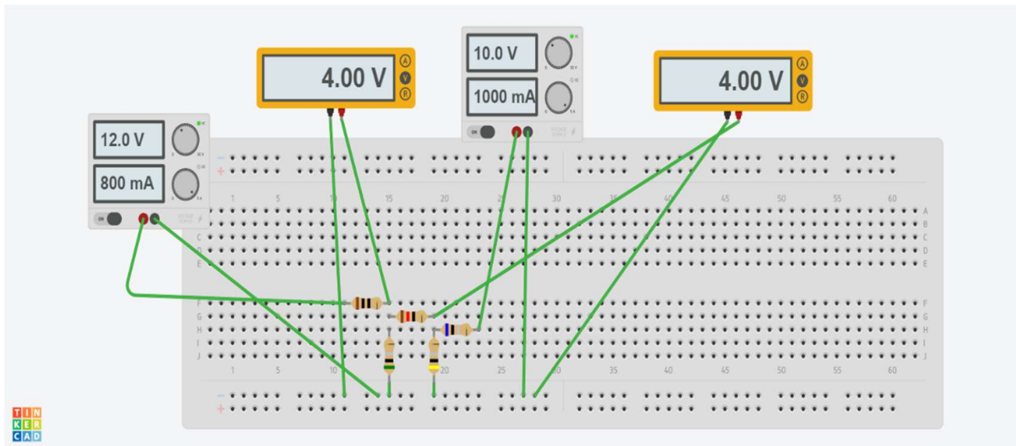


Table	**Mesh currents**	**Theoretical Values**	**Observation Values**
	i1 (A)	336 mA	336 mA
	i2 (A)	9.09 mA	9.09 mA

Table	**Nodal voltages**	**Theoretical Values**	**Observation Values**
	Va (V)	4 V	4 V
	Vb (V)	4 V	4 V

Conclusion:

1. We used Mesh analysis to find the values of current .
2. We used Nodal analysis to find the values of voltages .
3. For calculating the practical values ; we used an online simulation tool called Tinkercad
4. The Practical and Theoretical values when measured were found to be equal.

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Basic Electrical and Electronics Engineering

Experiment No. : 03

Superposition Theorem

Name : Ayush Jain

SAP No. : 60004200132

Date of performance : 20/3/2021

Signature of teacher-in-charge : ______________________

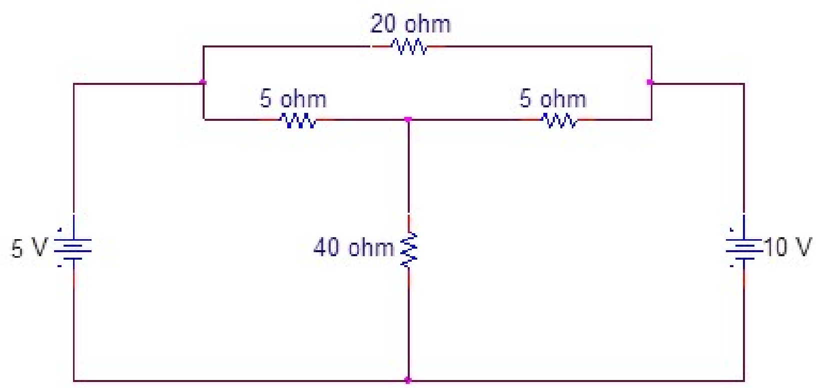
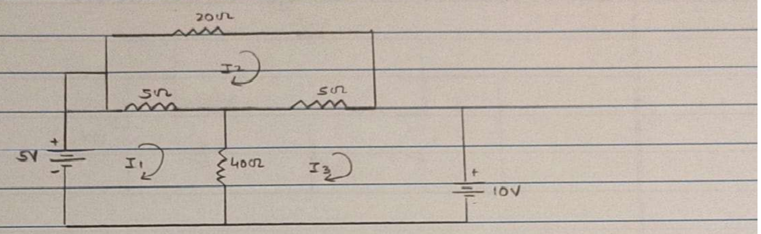
Aim:	To determine current and voltage value in a circuit using superposition theorem.
Apparatus :	Online simulation tools (Suggested Tinker cad)
Theortical Analysis:	 ***Fig. 1(a) Current across 40ohm resistor*** ***<u>Theoretical Calculations:</u>*** ***Current through 40ohm resistor***

Fig 1(a): Current across 40Ω resistor



KVL in loop 1,

$5 - 45I_1 + 5I_2 + 40I_3 = 0$

$\therefore\ -9I_1 + I_2 + 8I_3 = -1$ —(i)

KVL in loop 2,

$-30I_2 + 5I_1 + 5I_3 = 0$

$\therefore\ I_1 - 6I_2 + I_3 = 0$ — (2)

KVL in loop 3,

$-45I_3 + 40I_1 + 5I_2 - 10 = 0$

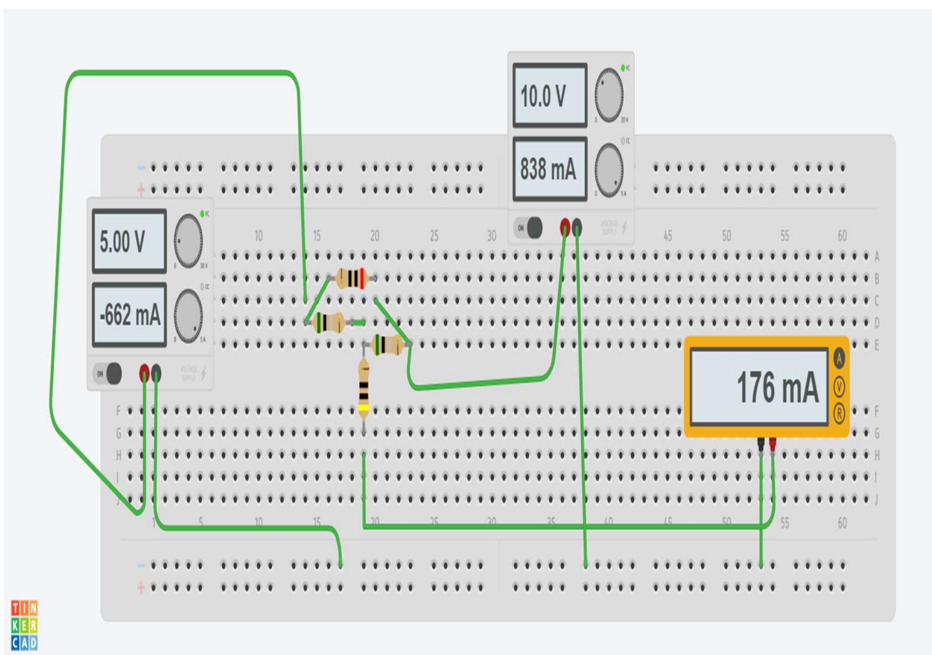
$8I_1 + I_2 - 9I_3 = 2$ — (3)

On solving eq. (1), (ii) and (iii)

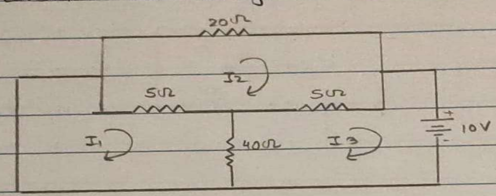
$I_1 = -0.662\text{ A}$, $I_2 = -0.25\text{A}$, $I_3 = -0.838\text{ A}$

$\therefore\ i_{40\Omega} = I_3 - I_1 = 0.838 - 0.662 = 0.176\text{A}$

$\therefore\ \boxed{I_{40\Omega} = 176\text{ mA}}$



Case 1: Consider 10V voltage source active.



KVL to loop 1,

$-45I_1 + 5I_2 + 40I_3 = 0$

$\therefore -9I_1 + I_2 + 8I_3 = 0$ — (1)

KVL to loop 2,

$-30I_2 + 5I_1 + 5I_3 = 0$

$\therefore I_1 - 6I_2 + I_3 = 0$ — (2)

KVL to loop 3,

$-45I_3 + 40I_1 + 5I_2 - 10 = 0$

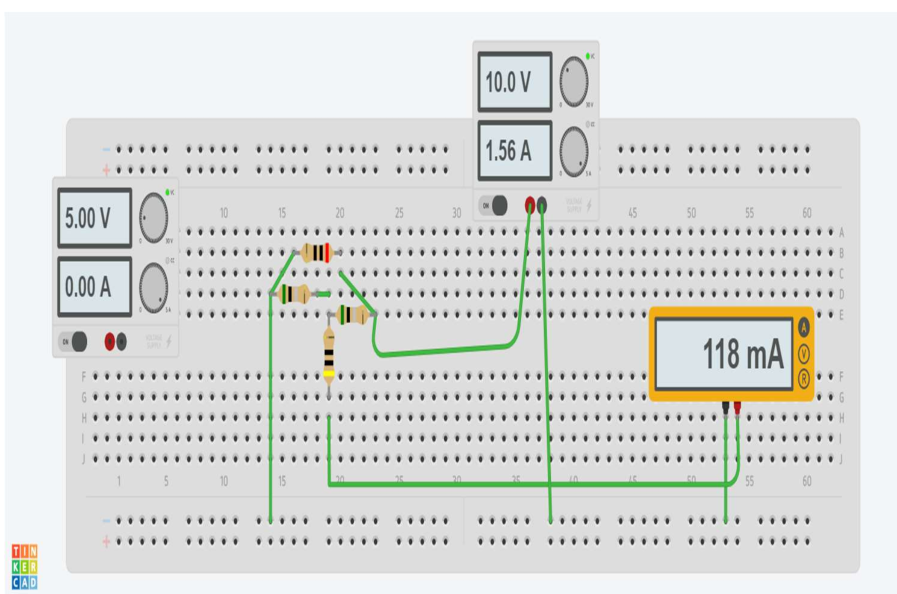
$\therefore 8I_1 + I_2 - 9I_3 = 2$ — (3)

On solving (i), (ii) and (3),

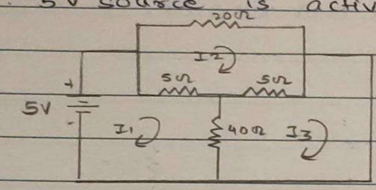
$I_1 = -1.441\,A$, $I_2 = -0.5\,A$, $I_3 = -1.559\,A$

$I'_{40\Omega} = I_3 - I_1 = 1.559 - 1.441 = 0.118\,A$

$\therefore \boxed{I'_{40\Omega} = 118\,mA\,(\downarrow)}$



Case 2: 5 V source is active.



KVL in loop 1,

$-45I_1 + 5 + 5I_2 + 40I_3 = 0$

$-9I_1 + I_2 + 8I_3 = -1$ — (i)

KVL in loop 2,

$-30I_2 + 5I_1 + 5I_3 = 0$

$\therefore I_1 - 6I_2 + I_3 = 0$ — (2)

KVL in loop 3,

$-45I_3 + 40I_1 + 5I_2 = 0$

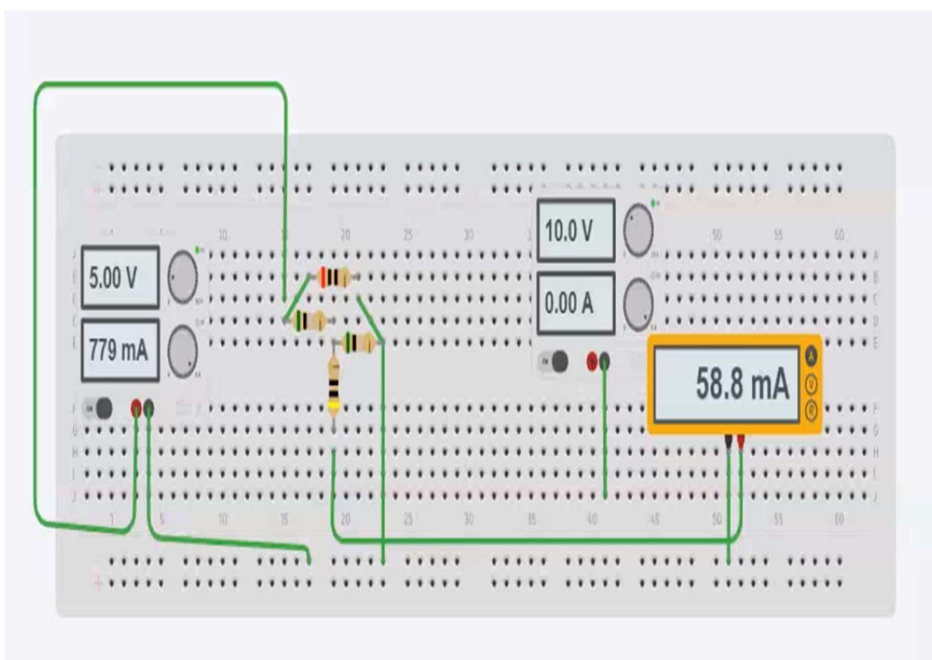
$8I_1 + I_2 - 9I_3 = 0$ — (3)

Solving (i), (2) and (3),

$I_1 = 0.779\,A$, $I_2 = 0.25\,A$, $I_3 = 0.720\,A$

$I''_{40\Omega} = i_1 - i_3 = 0.059\,A$

$\therefore \boxed{I''_{40\Omega} = 59\,mA\ (\downarrow)}$



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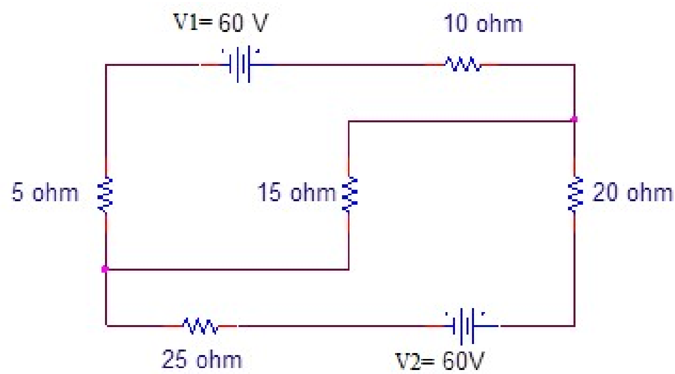

Fig. 1(b) Voltage across 15 ohm resistor

<u>Theoretical Calculations:</u>

Voltage across 15ohm resistor

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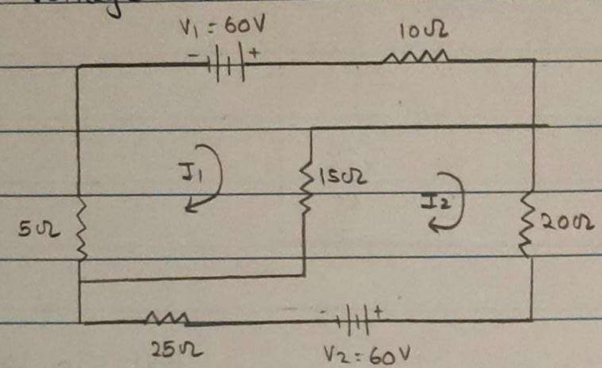
Fig 1(b) Voltage across 15Ω resistor,



KVL in loop 1,

$-30I_1 + 15I_2 + 60 = 0$

$\therefore -2I_1 + I_2 + 4 = 0$

$\therefore 2I_1 - I_2 = 4$ — (i)

KVL in loop 2,

$\therefore -60I_2 + 15I_1 - 60 = 0$

$\therefore -4I_2 + I_1 - 4 = 0$

$I_1 - 4I_2 = 4$ — (2)

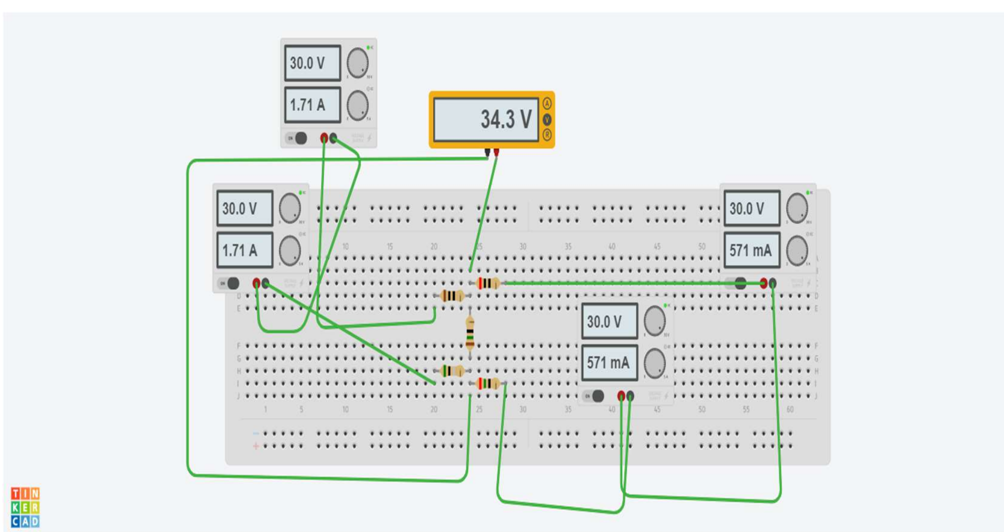
Solving (i) and (ii)

$\therefore I_1 = 1.714A$, $I_2 = -0.571A$

$\therefore I_{15\Omega} = i_1 - i_2 = 2.285A$

$\therefore V_{15\Omega} = I_{5\Omega} \cdot 15 = 34.3V$

$\therefore \boxed{V_{15\Omega} = 34.3V}$



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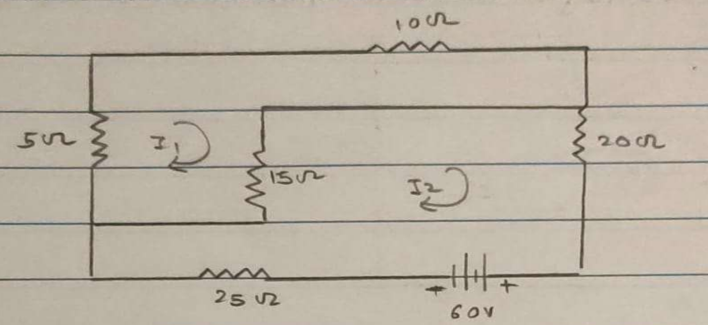
Consider 60 V marked V2 as active.



KVL in loop 1,

$-30I_1 + 15I_2 = 0$

$-2I_1 + I_2 = 0$ -(1)

KVL in loop 2,

$-60I_2 + 15I_1 = 60$

$I_1 - 4I_2 = 4$ - (2)

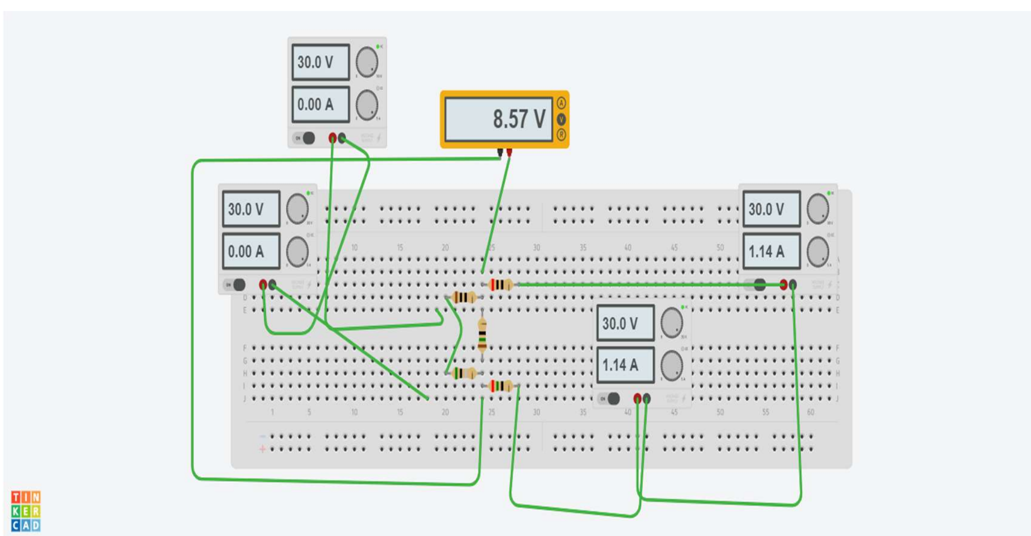
∴ On solving (1) and (2),

$I_1 = -0.571$ A , $I_2 = -1.1428$ A

∴ $I'_{15\Omega} = I_2 - I_1 = 0.571$ A

∴ $V'_{15\Omega} = I'_{15\Omega} \times 15 = 0.571 \times 15$

∴ $V'_{15\Omega} = 8.57$ V



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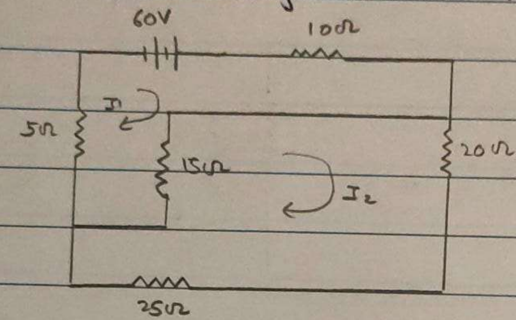
Consider 60V voltage source marked V_1 as active.



KVL in loop 1,

$-30 I_1 + 15 I_2 + 60 = 0$

$\therefore 2I_1 - I_2 = 4$ —(i)

KVL in loop 2

$-60 I_2 + 15 I_1 = 0$

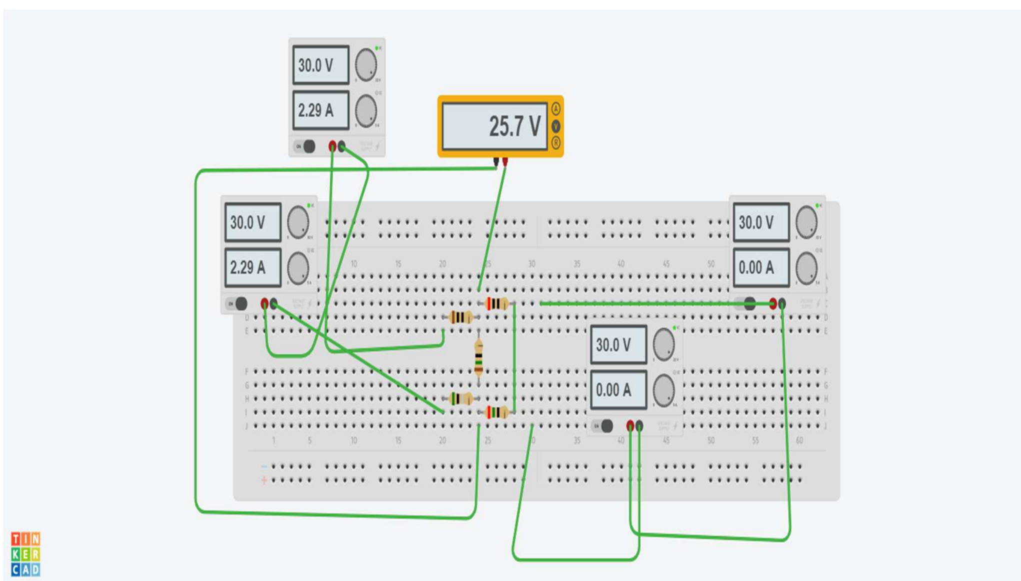
$\therefore I_1 - 4I_2 = 0$

$I_1 = 2.286$ A , $I_2 = 0.571$

$\therefore I''_{15\Omega} = 2.286 - 0.571 = 1.715$ A

$\therefore V''_{15\Omega} = 1.715 \times 15 = 25.7$ V

$\therefore V''_{15\Omega} = 25.7$ V



	Active Voltage source	**Theoretical values, $I_{40\Omega}$**	**Practical values, $I_{40\Omega}$**
Observation Table	**When 5V active**	**59 mA**	**58.8mA =59mA**
	When 10V active	**118mA**	**118mA**

	Active Voltage source	**Theoretical values, $V_{15\Omega}$**	**Practical values, $V_{15\Omega}$**
Observation Table	**When V1 active**	**25.7 V**	**25.7 V**
	When V2 active	**8.57 V**	**8.57 V**

Conclusion:

- The Practical values have been attained by using online simulation tool Tinkercad.
- We used Superposition theorem to find the theoretical value of voltage and current.
- The theoretical and practical values are equal to each other.

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First Year (Semester I) B.Tech.

Basic Electrical and Electronics Engineering

Experiment No. : 04

Thevenins and Nortons Theorem

Name : Ayush Jain

SAP No. : 60004200132

Date of performance : 27/03/2021

Signature of teacher-in-charge : ______________________

First Year (Semester I) B.Tech.

Aim:	To determine resistor, voltage and current value in a circuit.
Apparatus:	Online simulation tools (Suggested Tinkercad)
Theoretical Analysis:	***Thevenins Theorem***

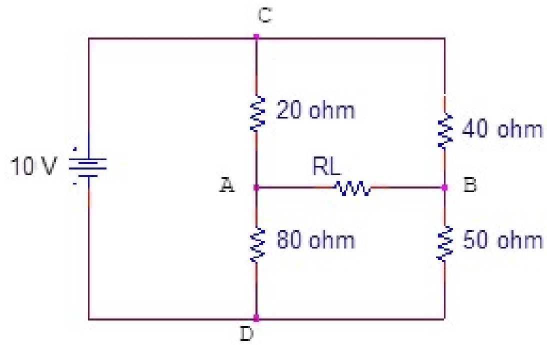
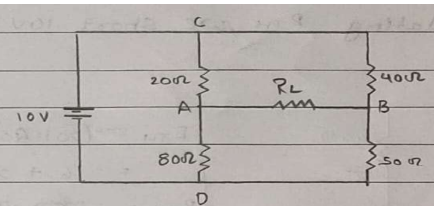
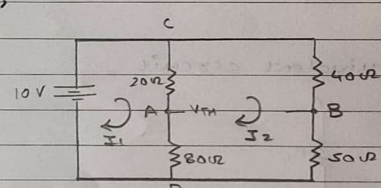


Fig. 1(a) Voltage acorss Rl load resistor value 10ohm, 20ohm, 30ohm

<u>Theoretical Calculations:</u>



For V_{TH},



KVL in loop 1,

$-100 I_1 + 100 I_2 + 10 = 0$

$\therefore 10 I_1 - 10 I_2 = 1$ —(i)

KVL in loop 2,

$-190 I_2 + 100 I_1 = 0$

$\therefore 10 I_1 - 19 I_2 = 0$ — (2)

On solving (i) and (ii)

$I_1 = 0.211A$ $I_2 = 0.111A$

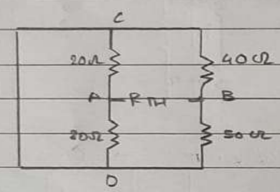
$\therefore$ KVL to find V_{TH},

$V_A + 20(I_1 - I_2) - 40 I_2 - V_B = 0$

$V_A - V_B = 2.44$

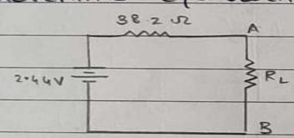
$\therefore \boxed{V_{TH} = V_{AB} = 2.44\ V}$

Now, for calculating R_{TH}, we short 10V source.



$$\therefore R_{TH} = (20 \| 80) + (40 \| 50)$$
$$= 16 + 22.2$$
$$\boxed{R_{TH} = 38.2\ \Omega}$$

∴ Thevenin's equivalent circuit,



when $R_L = 10\ \Omega$

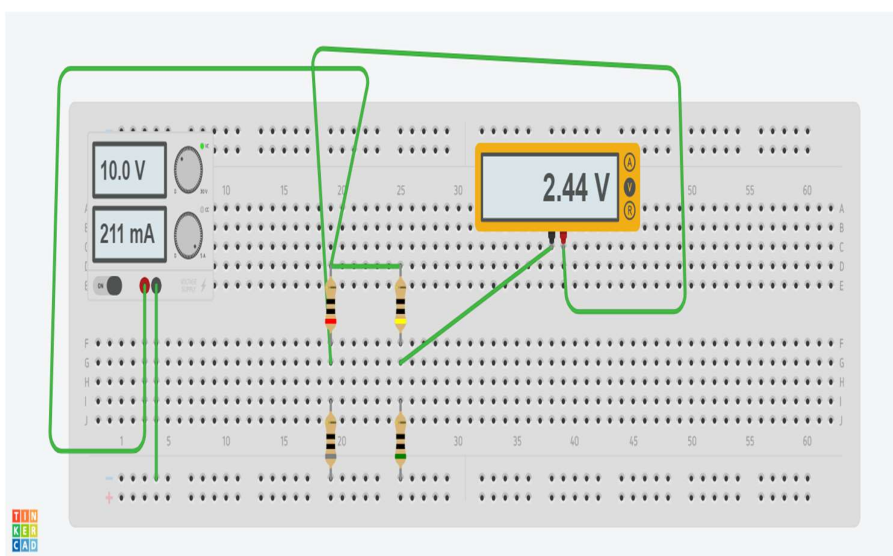
$$\therefore V_{10\Omega} = \frac{2.44 \times 10}{48.2} = 0.507\ V = 507\ mV$$

when $R_L = 20\ \Omega$,

$$V_{20\Omega} = \frac{2.44 \times 20}{58.2} = 0.838\ V = 838\ mV$$

when $R_L = 30\ \Omega$,

$$V_{30\Omega} = \frac{2.44 \times 30}{68.2} = 1.07\ V$$



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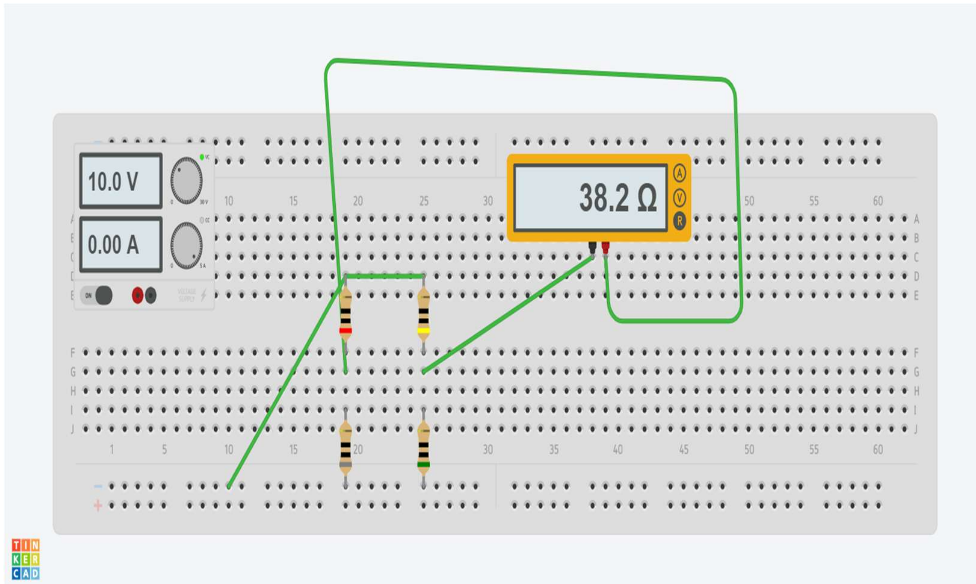
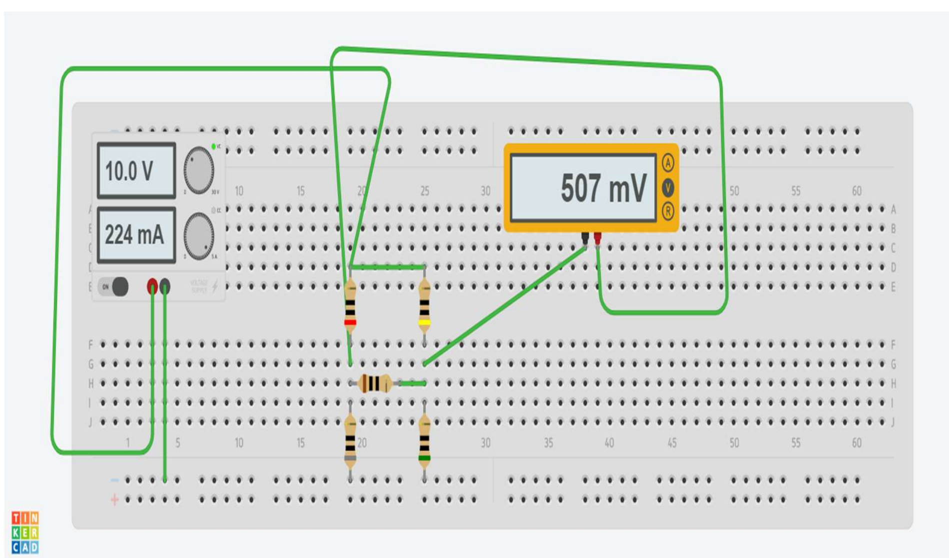




Nortons Theorem

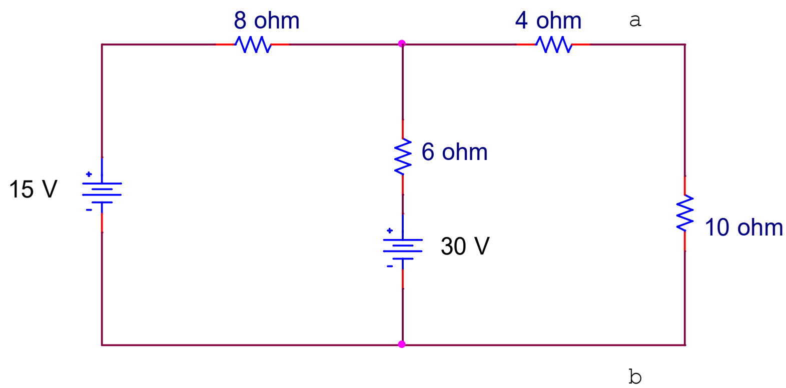
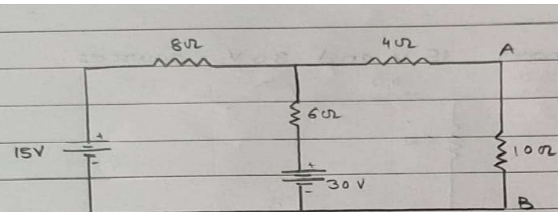
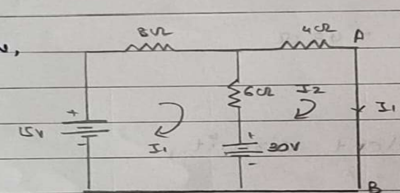


Fig. 1(b) Voltage across across a and b

Theoretical Calculations:



For I_N,



KVL in loop 1,

$-14 I_1 + 6 I_2 + 15 - 30 = 0$

$\therefore -14 I_1 + 6 I_2 = 15 \quad -(1)$

KVL in loop 2,

$-10 I_2 + 6 I_1 + 30 = 0$

$\therefore 6 I_1 - 10 I_2 = -30 \quad -(2)$

Solving (1) and (2)

$\therefore I_1 = 0.286A \qquad I_2 = 3.17A$

$\therefore \boxed{I_N = 3.17\ A}$

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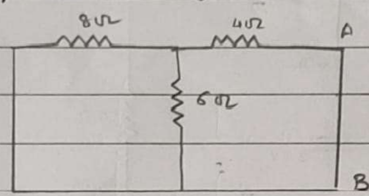
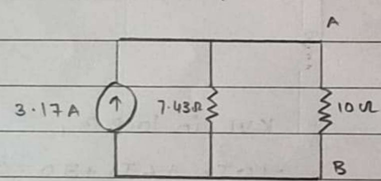
For R_N, short 15 V and 30 V sources.



$\therefore R_N = (8 \| 6) + 4 = 7.43\ \Omega$

$\therefore \boxed{R_N = 7.43\ \Omega}$

$\therefore$ Norton's equivalent circuit,

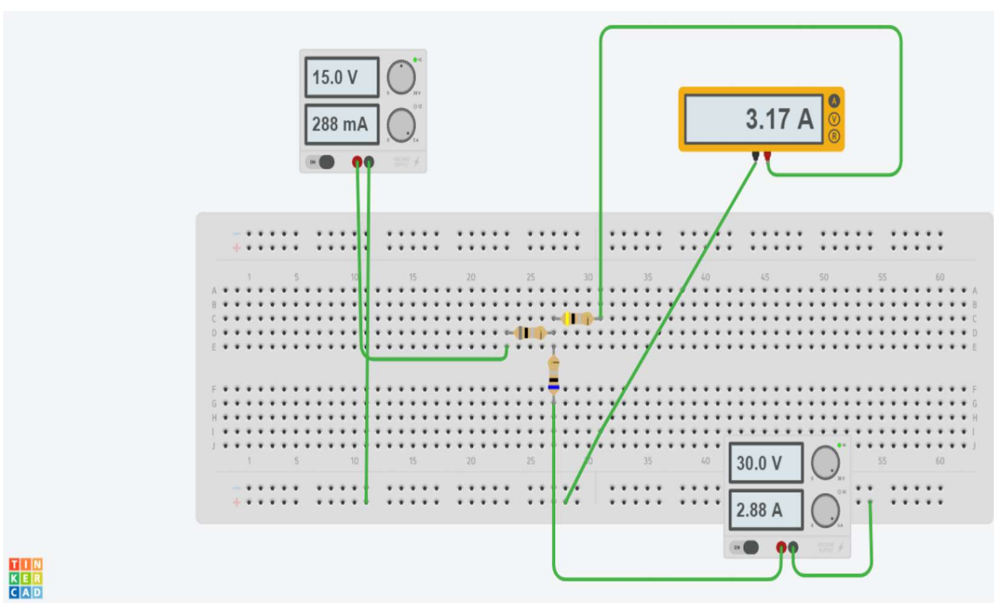


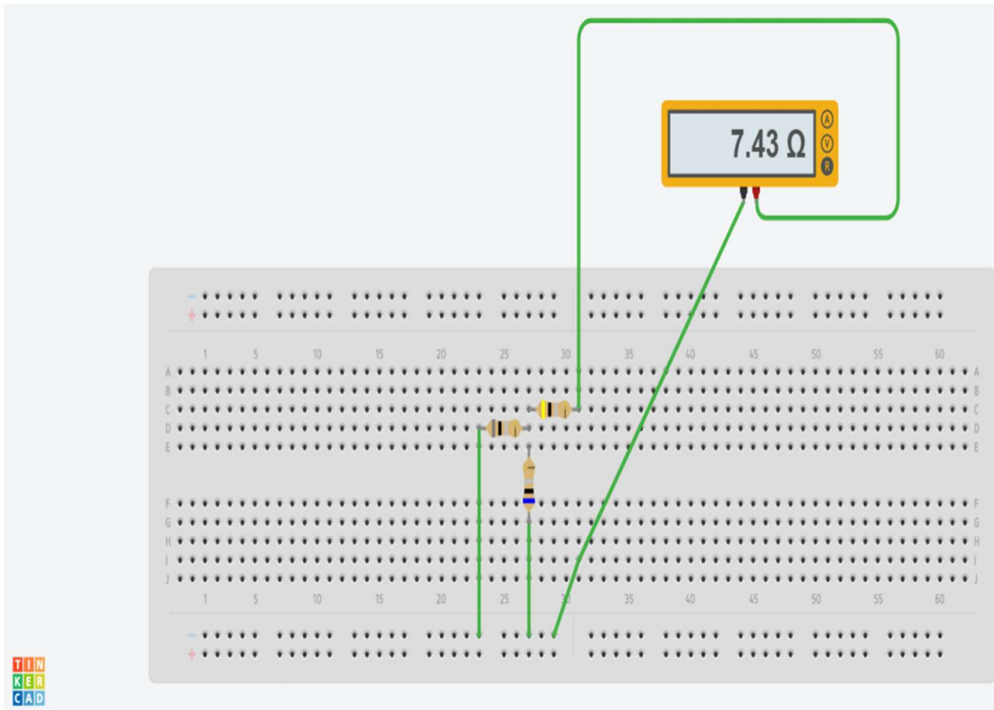
$\therefore I_{10\Omega} = \frac{3.173 \times 7.43}{17.43}$

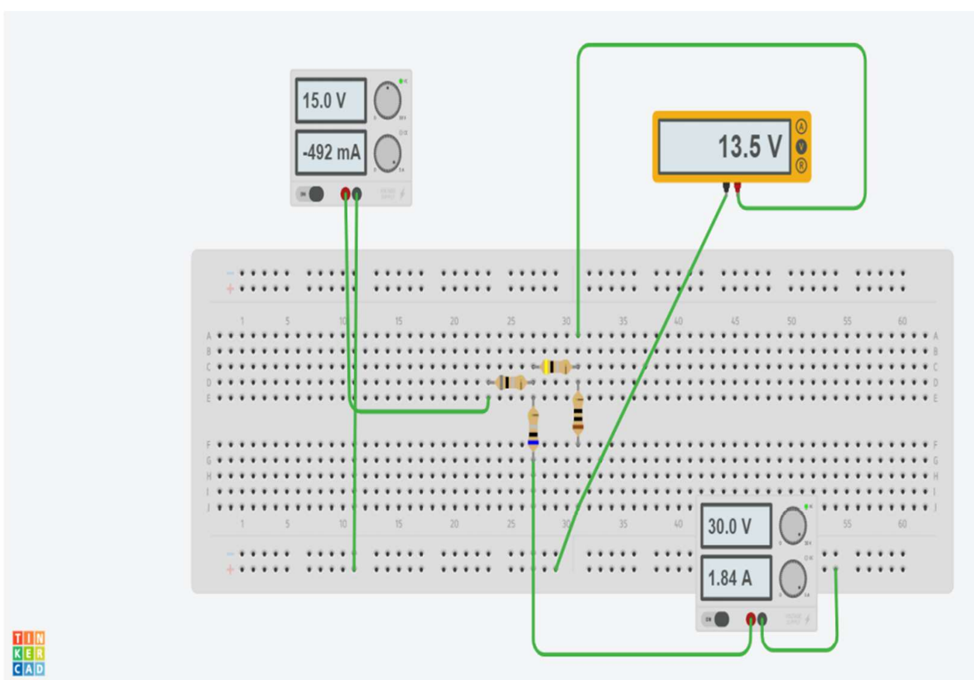
$= 1.35\ A$

$\therefore$ voltage across a and B = $V_{AB} = 1.35 \times 10$

$\therefore \boxed{V_{AB} = 13.5\ V}$




7.43 Ω
TIN
KER
CAD


15.0 V
-492 mA
13.5 V
30.0 V
1.84 A
TIN
KER
CAD

		Theoretical values	**Practical values**
Observation Table	Thevenins Voltage, V_{TH}	**2.44V**	**2.44V**
	Equivalent resistor, R_{TH}	**38.2 ohm**	**38.2 ohm**
	Voltage $V_{10\Omega}$	**507 mV**	**507mV**
	Voltage $V_{20\Omega}$	**838 mV**	**838 mV**
	Voltage $V_{30\Omega}$	**1.07 mV**	**1.07 mV**

		Theoretical values	**Practical values**
Observation Table	Nortons Current, I_N	**3.17 A**	**3.17 A**
	Equivalent resistor, R_N	**7.43 ohm**	**7.43 ohm**
	Voltage $V_{10\Omega}$	**13.5 V**	**13.5 V**

Conclusion:

- The Practical values has been attained using online simulation tool Tinkercad.
- Thevenins and Nortons Theorems are used to determine the values of current,resistance and voltage.
- The Theoretical and Practical values are equal to each other

Basic Electrical and Electronics Engineering

Experiment No. : 05

<u>AC Circuit Analysis</u>

Name : Ayush Jain

SAP No. : 60004200132

Date of performance : 03 |04 |2021

Signature of teacher-in-charge : ________________________

Aim:	A.C through 1) Resistor 2) R-L Series circuit 3) R-C Series circuit
Apparatus:	Online simulation tools (Suggested Tinkercad)
Theortical Analysis:	

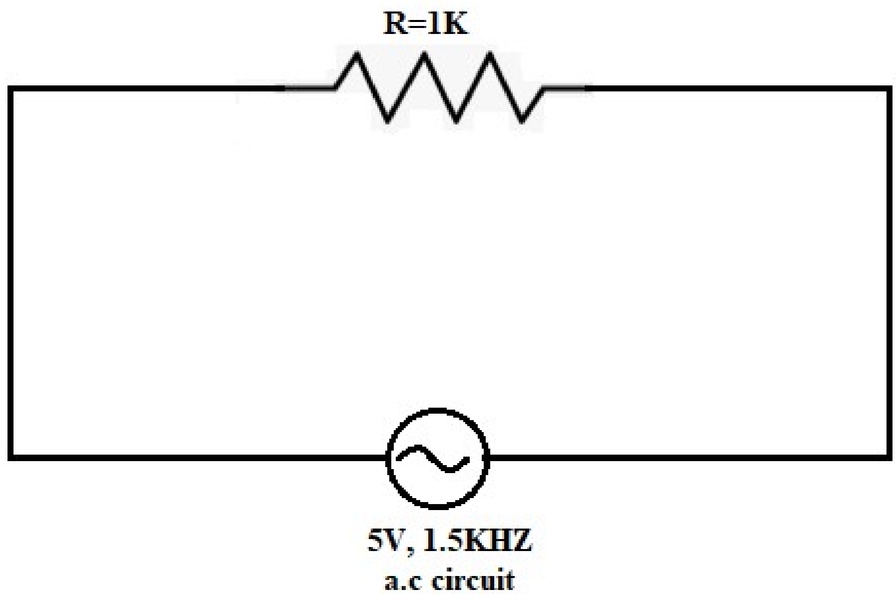


Fig. 1(a) A.C through resistor

<u>Theoretical Calculations:</u>

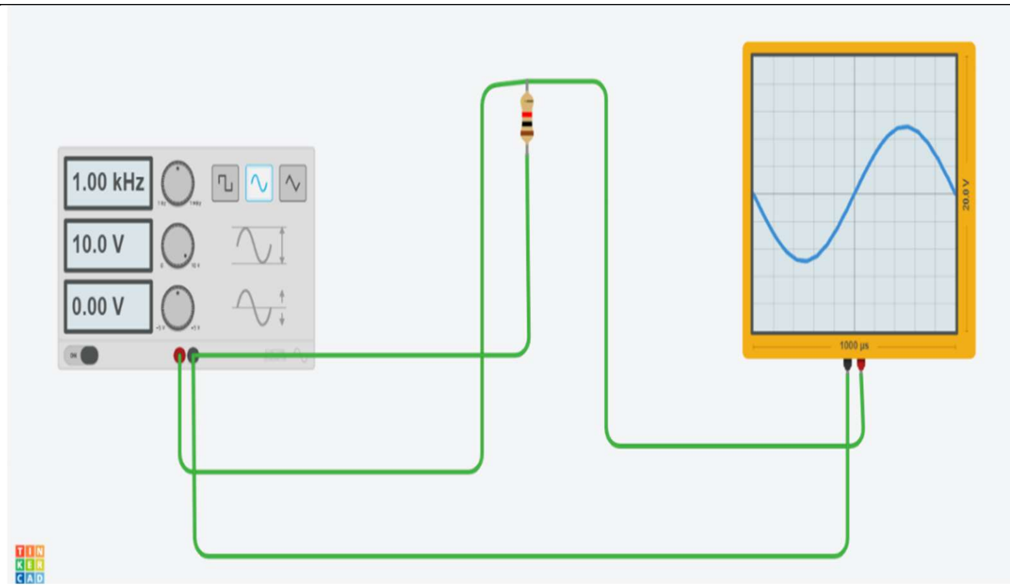
V=IZ

Since Z=R

I=V/R

Table 1

Sr. No.	Frequency	Current	Voltage	Resistance
1.	**1000Hz**	**1mA**	**5V**	**1K ohm**



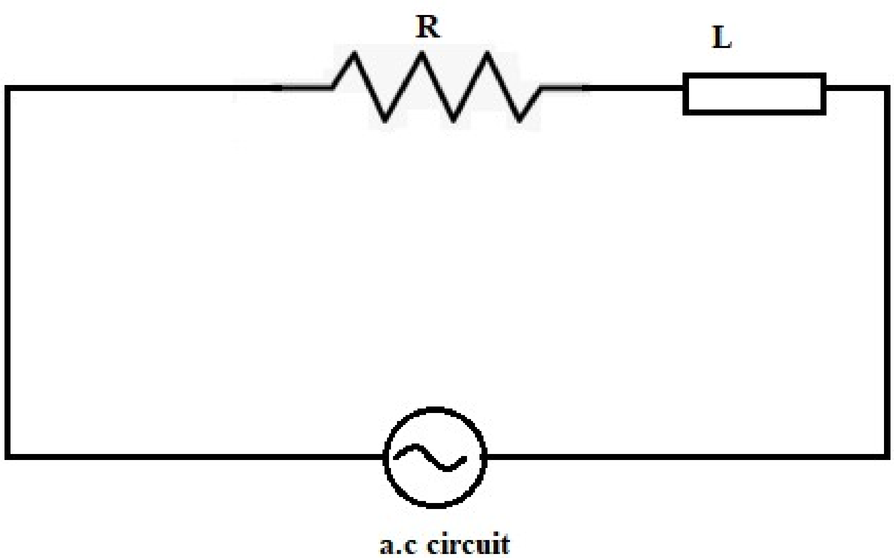


Fig. 1(b) R-L Series circuit

Theoretical Calculations:

R-L series circuit. ($L = 100\,mH$, $f = 50\,Hz$, $V = 5\,V$, $X_L = 2\pi f L = 31.42\,\Omega$)

Theoretical Table

Sr. No.	R (Ω)	Z (Ω)	I (A)	V_R (V)	V_L (V)	V_T (V)
1.	100 Ω	104.82	0.048	4.8	1.51	5
2.	50 Ω	59.05	0.085	4.25	2.67	5
3.	10 Ω	32.97	0.152	1.52	4.78	5

Theoretical calculations:

i) when $R = 100\,\Omega$,

$Z = \sqrt{R^2 + X_L^2} = 104.82\,\Omega$

$V_R = IR = 4.8\,V$

$V_L = I X_L = 1.51\,V$

$V_T = \sqrt{V_R^2 + V_L^2} = 5\,V$

ii) when $R = 50\,\Omega$

$Z = \sqrt{R^2 + X_L^2} = 59.05\,\Omega$

$V_R = IR = 4.25\,V$

$V_L = I X_L = 2.67\,V$

$V_T = \sqrt{V_R^2 + V_L^2} = 5\,V$

iii) when $R = 10\,\Omega$

$Z = \sqrt{R^2 + X_L^2} = 32.97\,\Omega$

$V_R = IR = 1.52\,V$

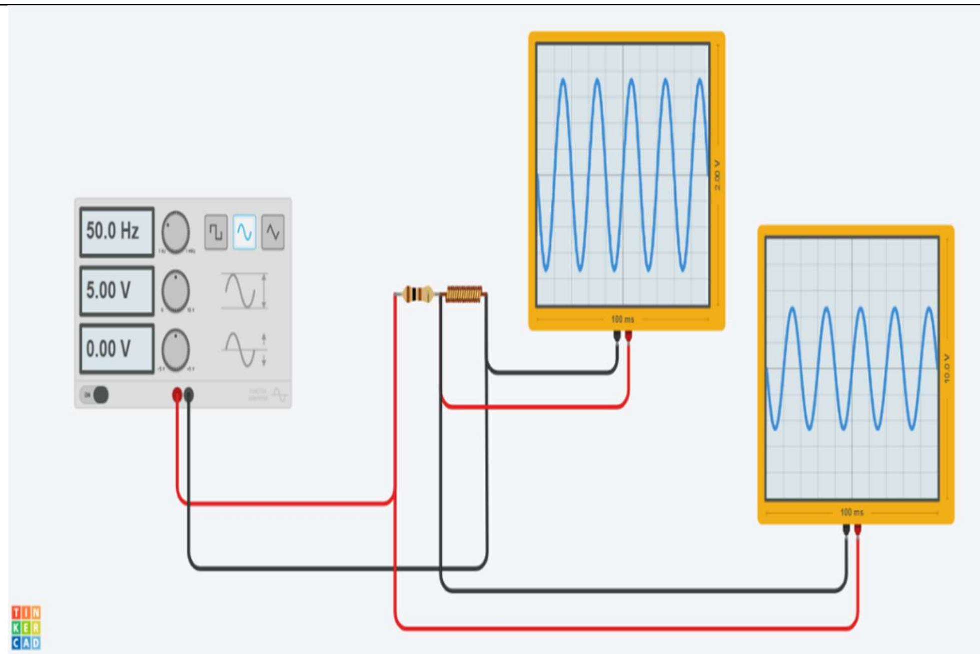
$V_L = I X_L = 4.78\,V$

$V_T = \sqrt{V_R^2 + V_L^2} = 5\,V$

Practical Calculations Table:

Sr. No.	Resistance	Current	V_R	V_L	V_T
1.	**100 ohm**	**47 mA**	**4.7 V**	**1.5 V**	**4.93 V**
2.	**50 ohm**	**82 mA**	**4.1 V**	**2.5 V**	**4.80 V**
3.	**10 ohm**	**150 mA**	**1.4 V**	**4.4 V**	**4.63 V**

Fig. 1(c) R-C Series circuit



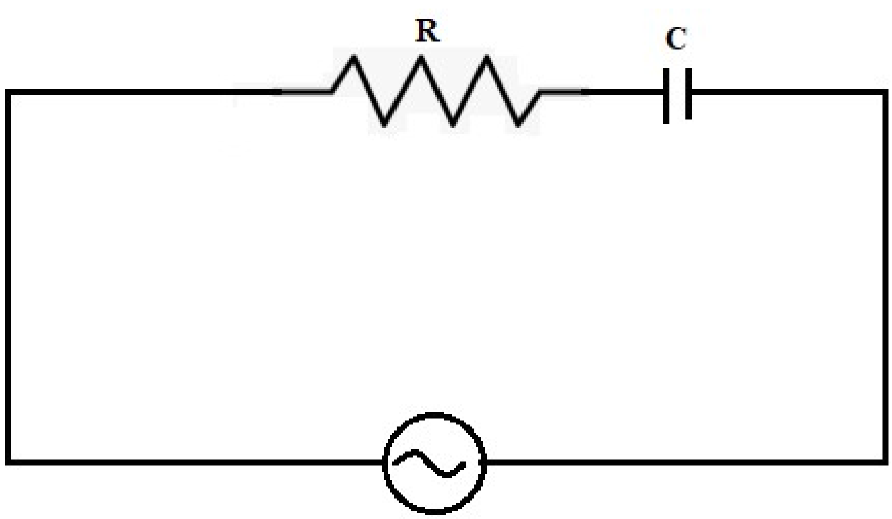


Fig. 1(c) R-C Series circuit

R-C series circuit:

[$C = 0.1 \mu F$, $f = 50 Hz$, $V = 5 V$

$X_c = 1/2\pi f C = 31831 \Omega$]

Table

Sr. No.	R	Z (Ω)	I (mA)	V_R (V)	V_C (V)	V_T (V)
1.	100 kΩ	104943	0.0476	4.76	1.52	5
2.	50 kΩ	59272	0.0844	4.22	2.69	5
3.	10 kΩ	33365	0.1499	1.50	4.77	5

Theoretical calculations:

1) When $R = 100 k\Omega$

$Z = \sqrt{R^2 + X_c^2} = 104943 \Omega$

$V_R = IR = 4.76 V$

$V_C = I X_c = 1.52 V$

$V_T = \sqrt{V_R^2 + V_C^2} = 5 V$

2) When $R = 50 k\Omega$

$Z = \sqrt{R^2 + X_c^2} = 59272 \Omega$

$V_R = IR = 4.22 V$

$V_C = I X_c = 2.69 V$

$V_T = \sqrt{V_R^2 + V_C^2} = 5 V$

3) When $R = 10 k\Omega$

$Z = \sqrt{R^2 + X_c^2} = 33365 \Omega$

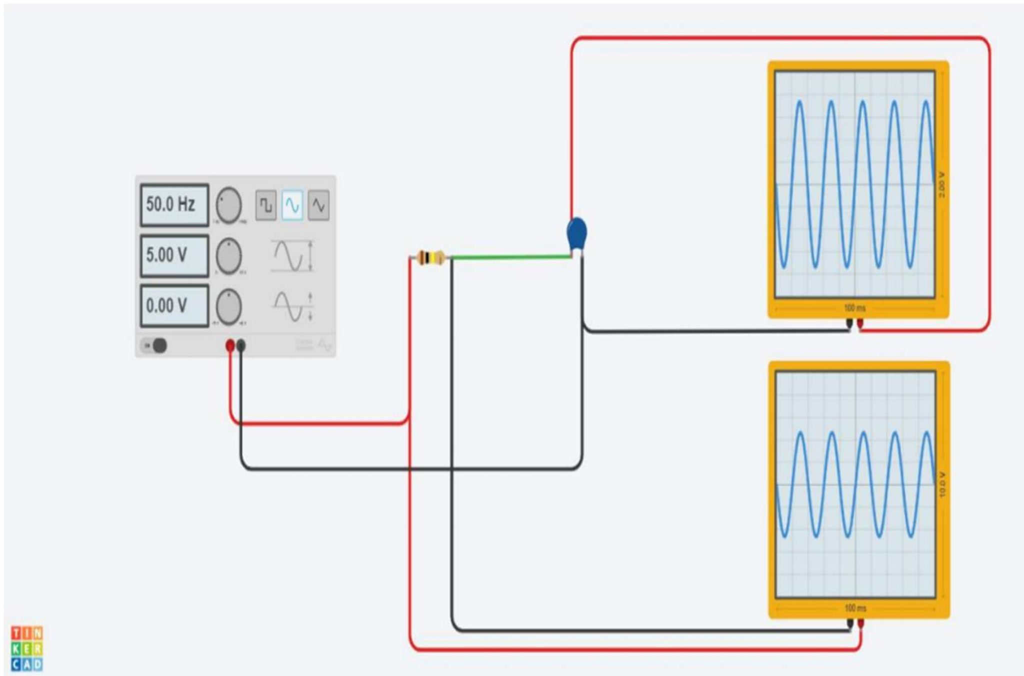
$V_R = IR = 1.50 V$

$V_C = I X_c = 4.77 V$

$V_T = \sqrt{V_R^2 + V_C^2} = 5 V$

__Practical Calculations Table:__

Sr. No.	Resistance	Current	V_R	V_C	V_T
1.	**100 K ohm**	**0.045 mA**	**4.5 V**	**1.44 V**	**4.72 V**
2.	**50 K ohm**	**0.084 mA**	**4.2 V**	**2.7 V**	**4.99 V**
3.	**10 K ohm**	**0.146 mA**	**1.46 V**	**4.6 V**	**4.826 V**



Conclusion:

- **We applied properties and formulae of pure R,series R-L and series R-C circuit for theoretical calculations.**
- **The practical values have been attained using an online simulation tool, Tinkercad.**
- **The theoretical and measured values are almost equal to each other.**

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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
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NAAC Accredited with "A" Grade (CGPA : 3.18)

First Year (Semester I) B.Tech.

Basic Electrical and Electronics Engineering

Experiment No : 06
Rectifier Circuit

Name : Ayush Jain

SAP No. : 60004200132

Date of performance :10/04/2021

Signature of teacher-in-charge : ________________________

First Year (Semester I) B.Tech.

Aim:	To design Half wave and full wave rectifier.
Apparatus:	Online simulation tools (Suggested Tinkercad)

Theortical Analysis:

Half Wave Rectifier

Circuit Diagram

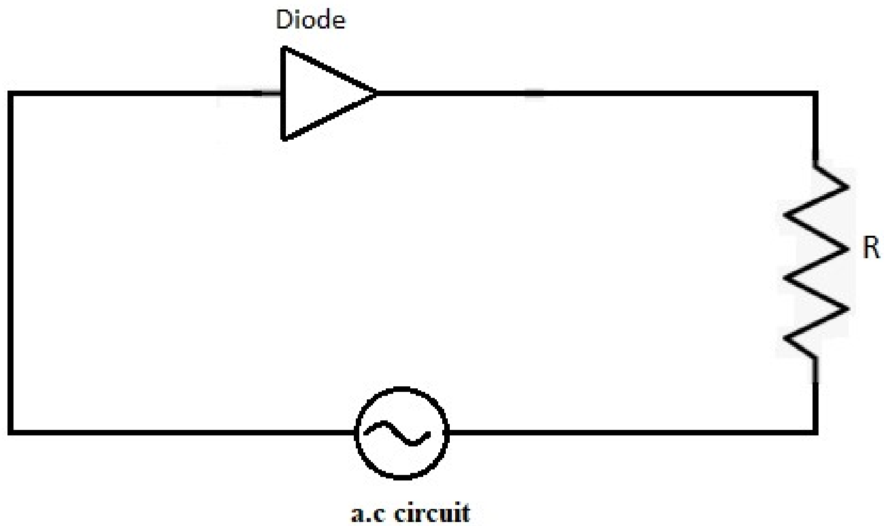
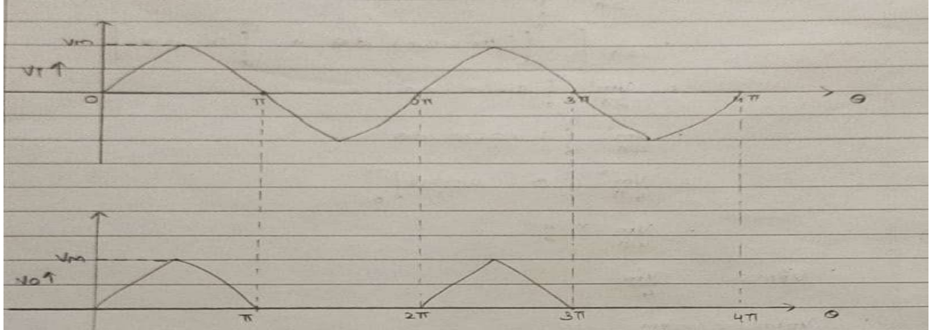


Fig LCR series resonance

Theoretical Calculations:

RMS and Average Value of a voltage (derivation)



WAVEFORMS FOR HALF WAVE RECTIFIER

Mathematically, voltage waveform can be described as

$V_o = V_m \sin\theta \qquad 0 < \theta < \pi$

$= 0 \qquad \pi < \theta < 2\pi$

$\therefore V_{avg} = \frac{1}{2\pi}\int_0^{2\pi} V_o \, d\theta$

$= \frac{1}{2\pi}\left[\int_0^{\pi} V_m \sin\theta \, d\theta + \int_{\pi}^{2\pi} 0 \cdot d\theta\right]$

$= \frac{1}{2\pi}\int_0^{\pi} V_m \sin\theta \, d\theta$

$= \frac{V_m}{2\pi}\left[-\cos\theta\right]_0^{\pi}$

$V_{avg} = \frac{V_m}{\pi}$

$$(V_{RMS})^2 = \frac{1}{2\pi}\int_0^{2\pi} V_o^2 \, d\theta$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi}(V_m \sin\theta)^2 \cdot d\theta + \int_{\pi}^{2\pi} 0 \cdot d\theta\right]$$

$$= \frac{V_m^2}{2\pi}\int_0^{\pi} \sin^2\theta \cdot d\theta$$

$$= \frac{V_m^2}{2\pi}\int_0^{\pi} \frac{1-\cos 2\theta}{2} \cdot d\theta$$

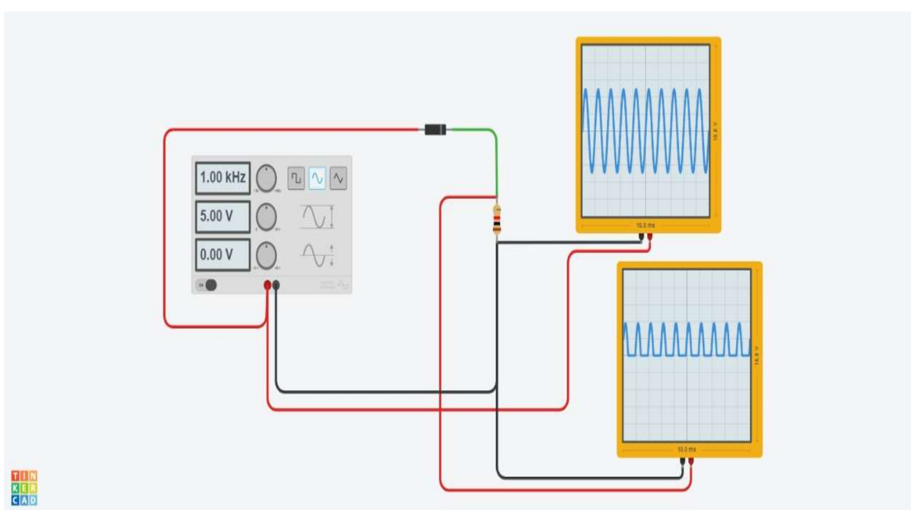
$$= \frac{V_m^2}{4\pi}\left[\theta - \frac{\sin 2\theta}{2}\right]_0^{\pi}$$

$$= \frac{V_m^2}{4\pi} \times \pi$$

$$V_{RMS}^2 = \frac{V_m^2}{4}$$

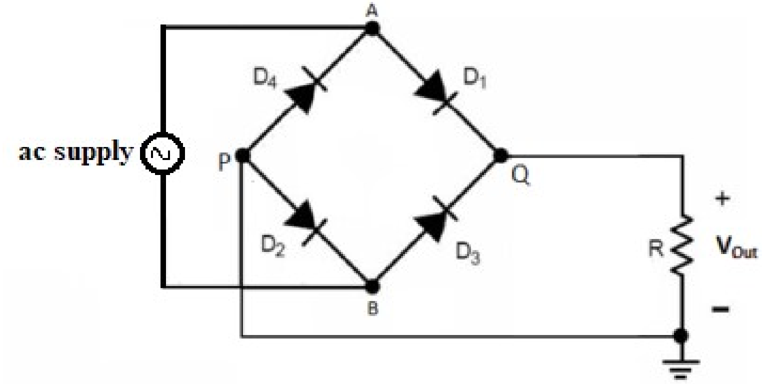
$$V_{RMS} = \frac{V_m}{2}$$

Observation waveform



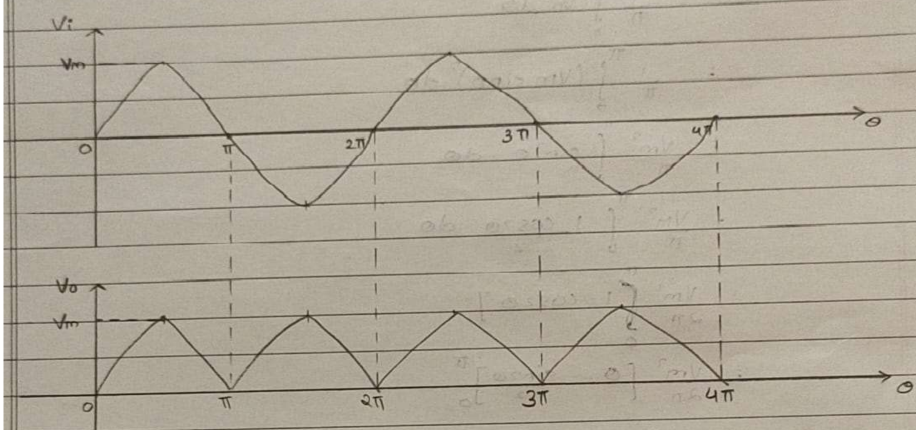
Full wave rectifier

Bridge Rectifier



Theoretical Calculations:

RMS and Average Value of a voltage (derivation)



WAVEFORMS FOR BRIDGE RECTIFIER

Mathematically, voltage waveforms can be described as

$V_o = V_m \sin\theta \qquad 0 < \theta < \pi$

$$V_{avg} = \frac{1}{\pi}\int_0^{\pi} V_o \, d\theta$$

$$= \frac{1}{\pi}\int_0^{\pi} V_m \sin\theta \, d\theta$$

$$= \frac{V_m}{\pi}\left[-\cos\theta\right]_0^{\pi}$$

$$V_{avg} = \frac{2V_m}{\pi}$$

$$V_{RMS}^2 = \frac{1}{\pi}\int_0^\pi V_o^2 \, d\theta$$

$$= \frac{1}{\pi}\int_0^\pi (V_m \sin\theta)^2 \cdot d\theta$$

$$= \frac{V_m^2}{\pi}\int_0^\pi \sin^2\theta \cdot d\theta$$

$$= \frac{V_m^2}{\pi}\int_0^\pi \frac{1-\cos 2\theta}{2} \cdot d\theta$$

$$= \frac{V_m^2}{2\pi}\int_0^\pi \left[1-\cos 2\theta\right]$$

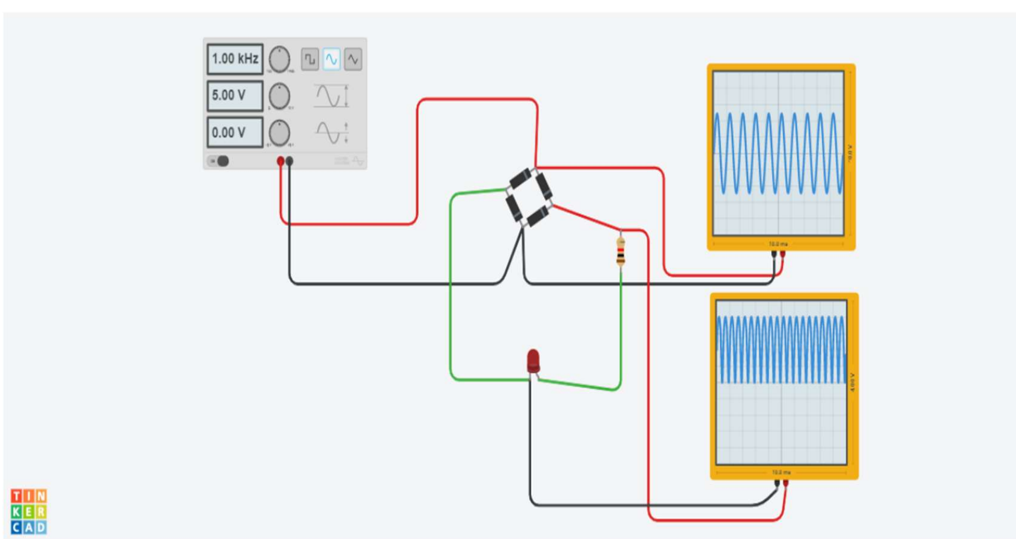
$$= \frac{V_m^2}{2\pi}\left[\theta - \frac{\sin 2\theta}{2}\right]_0^\pi$$

$$= \frac{V_m^2}{2\pi} \times \pi$$

$$\therefore V_{RMS}^2 = \frac{V_m^2}{2}$$

$$\therefore V_{RMS} = \frac{V_m}{\sqrt{2}}$$

Observation waveform



Conclusion:

- The circuits are made using an online simulation tool, Tinkercad
- This experiment helped us study the waveforms generated by a half wave and full wave (bridge) rectifier by implementing the circuit and making measurements using an oscilloscope.

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First Year (Semester I) B.Tech.

Basic Electrical and Electronics Engineering

Experiment No : 07

Clipper and Clamper Circuit

Name : Ayush Jain

SAP No. : 60004200132

Date of performance : 17/4/2021

Signature of teacher-in-charge : ______________________

First Year (Semester I) B.Tech.

<table>
<tr><td>Aim:</td><td>To design clipper and clamper circuit .</td></tr>
<tr><td>Apparatus:</td><td>Online simulation tools (Suggested Tinkercad)</td></tr>
<tr><td>Theory:</td><td>

Clipper circuit

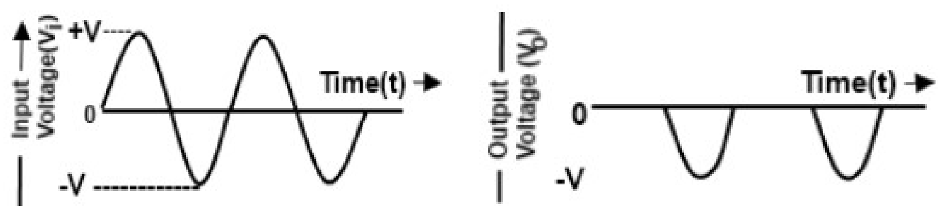
The Clipper circuit that is intended to attenuate positive portions of the input signal can be termed as a **Positive Clipper**.

Positive Clipper circuit:

A Clipper circuit in which the diode is connected in series to the input signal and that attenuates the positive portions of the waveform, is termed as **Positive Series Clipper**.

.

The diode will conduct until the supply voltage is less than the battery potential. As battery potential dominates the supply voltage, the signal appears at the positive half of output waveform. But as the supply voltage exceeds the battery potential, the diode is now reverse biased. Resultantly no further current will flow through the diode.



Negative clipper circuit

As we can see in the circuit shown above, the diode is reverse bias due to both supply voltage and battery potential. This cuts off the complete positive half of the input waveform.

But during the negative half cycle of the input waveform, the **diode** is in forward **biased** condition due to **supply voltage** but is **reverse biased** by the **battery potential**.

Here also initially when battery dominates the supply voltage, the diode is in reverse biased condition. But, as the supply voltage becomes greater than the battery potential, the diode will automatically come in forward biased condition. Thus, the signal starts to appear at the output.

</td></tr>
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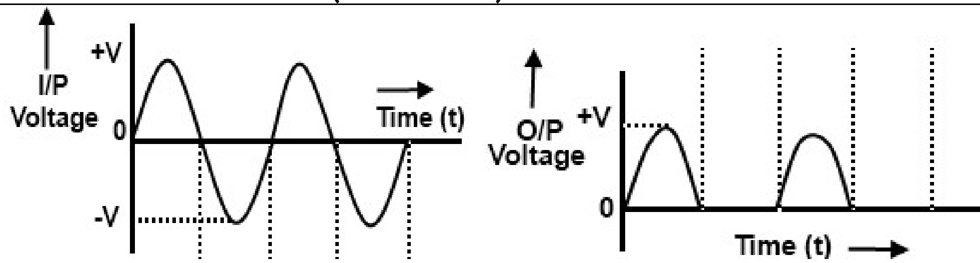


Clamper circuit

A Clamper Circuit is a circuit that adds a DC level to an AC signal. Actually, the positive and negative peaks of the signals can be placed at desired levels using the clamping circuits. As the DC level gets shifted, a clamper circuit is called as a **Level Shifter**.

Clamper circuits consist of energy storage elements like capacitors. A simple clamper circuit comprises of a capacitor, a diode, a resistor and a dc battery if required.

Clamper Circuit

A Clamper circuit can be defined as the circuit that consists of a diode, a resistor and a capacitor that shifts the waveform to a desired DC level without changing the actual appearance of the applied signal.

In order to maintain the time period of the wave form, the **tau** must be greater than, half the time period dischargingtimeofthecapacitorshouldbeslow.dischargingtimeofthecapacitor shouldbeslow.

$$\tau=Rc$$

Where

- R is the resistance of the resistor employed
- C is the capacitance of the capacitor used

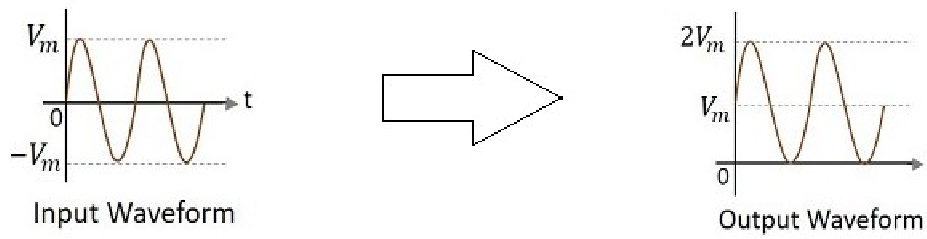
The time constant of charge and discharge of the capacitor determines the output of a clamper circuit.

- In a clamper circuit, a vertical shift of upward or downward takes place in the output waveform with respect to the input signal.
- The load resistor and the capacitor affect the waveform. So, the discharging time of the capacitor should be large enough.

Positive Clamper Circuit

A Clamping circuit restores the DC level. When a negative peak of the signal is raised above to the zero level, then the signal is said to be **positively clamped**.

A Positive Clamper circuit is one that consists of a diode, a resistor and a capacitor and that shifts the output signal to the positive portion of the input signal. The figure below explains the construction of a positive clamper circuit.



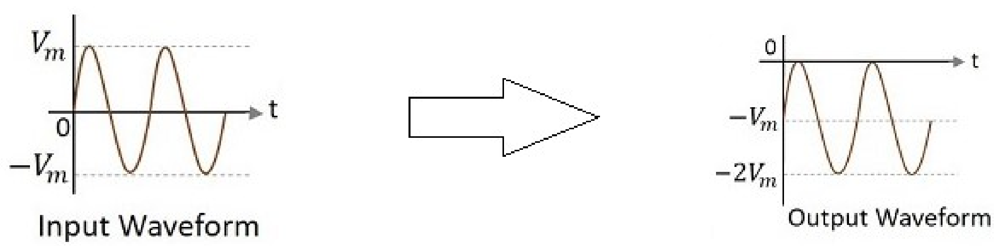
Negative Clamper

A Negative Clamper circuit is one that consists of a diode, a resistor and a capacitor and that shifts the output signal to the negative portion of the input signal. The figure below explains the construction of a negative clamper circuit.

During the positive half cycle, the capacitor gets charged to its peak value vmvm. The diode is forward biased and conducts. During the negative half cycle, the diode gets reverse biased and gets open circuited. The output of the circuit at this moment will be

$$V0=Vi+Vm$$

Hence the signal is negatively clamped as shown in the above figure. The output signal changes according to the changes in the input, but shifts the level according to the charge on the capacitor, as it adds the input voltage.



Circuit Diagram:

Clipper circuit

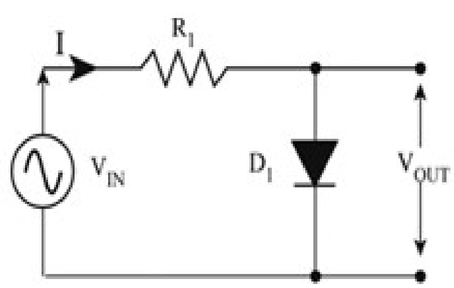


Fig 1. Positive clipper circuit

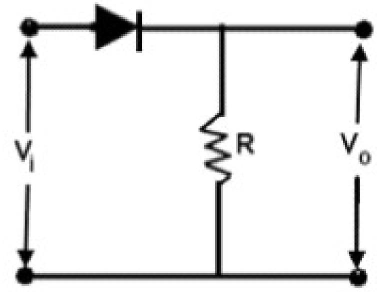
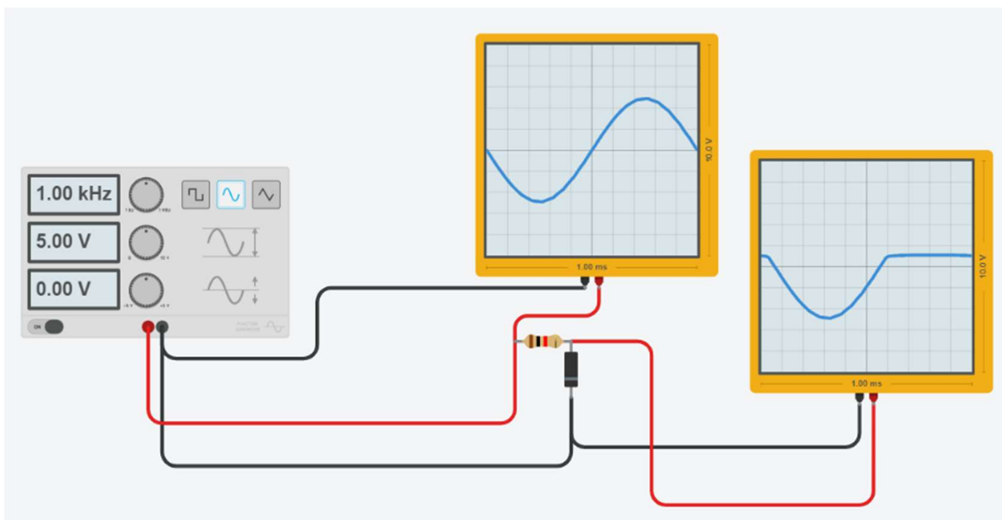


Fig 2. Negative clipper circuit

Observation waveform



Positive Clipper

Clamper circuit

Circuit Diagram

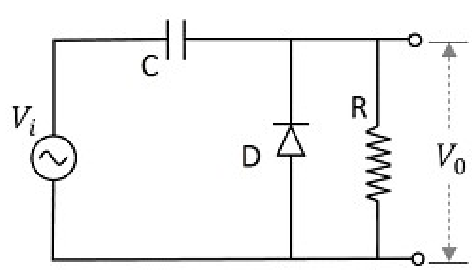


Fig 3. Positive Clamper Circuit

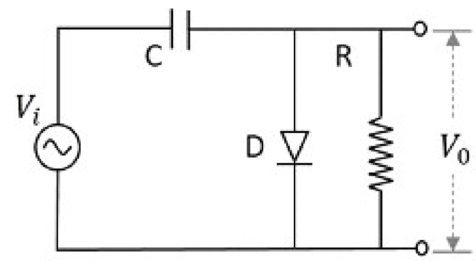
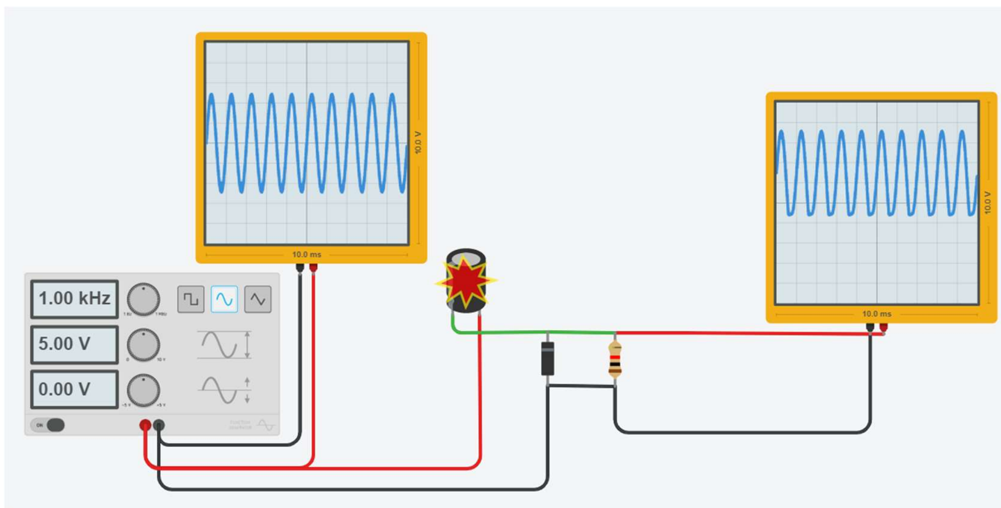
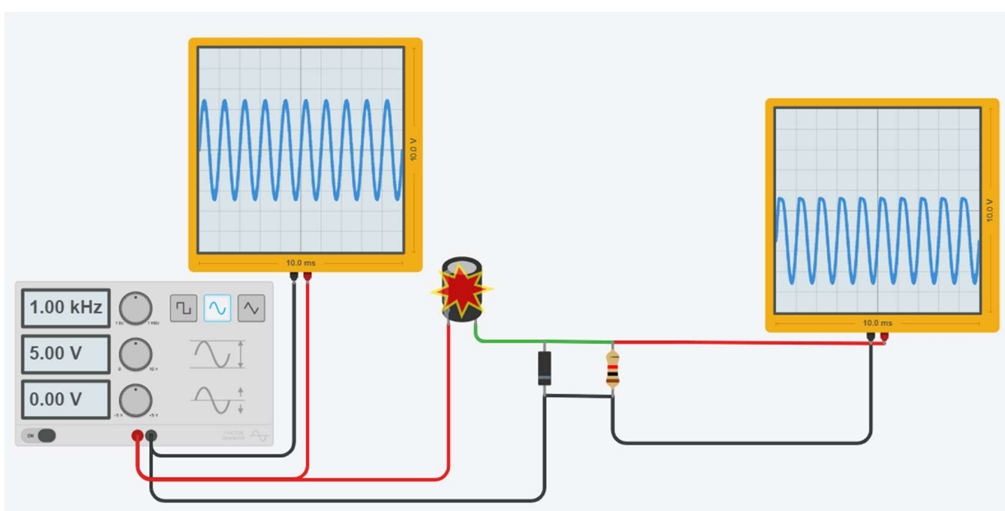


Fig 4. Negative Clamper Circuit

Observation waveform



Positive Clamper



Negative Clamper

Conclusion	• **This Experiment helped us study the waveforms generated by a clipper and clamper.** • **This Experiment was performed by implementing the circuit and taking readings in an online simulation tool, TinkerCad.**