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Experiment - 2

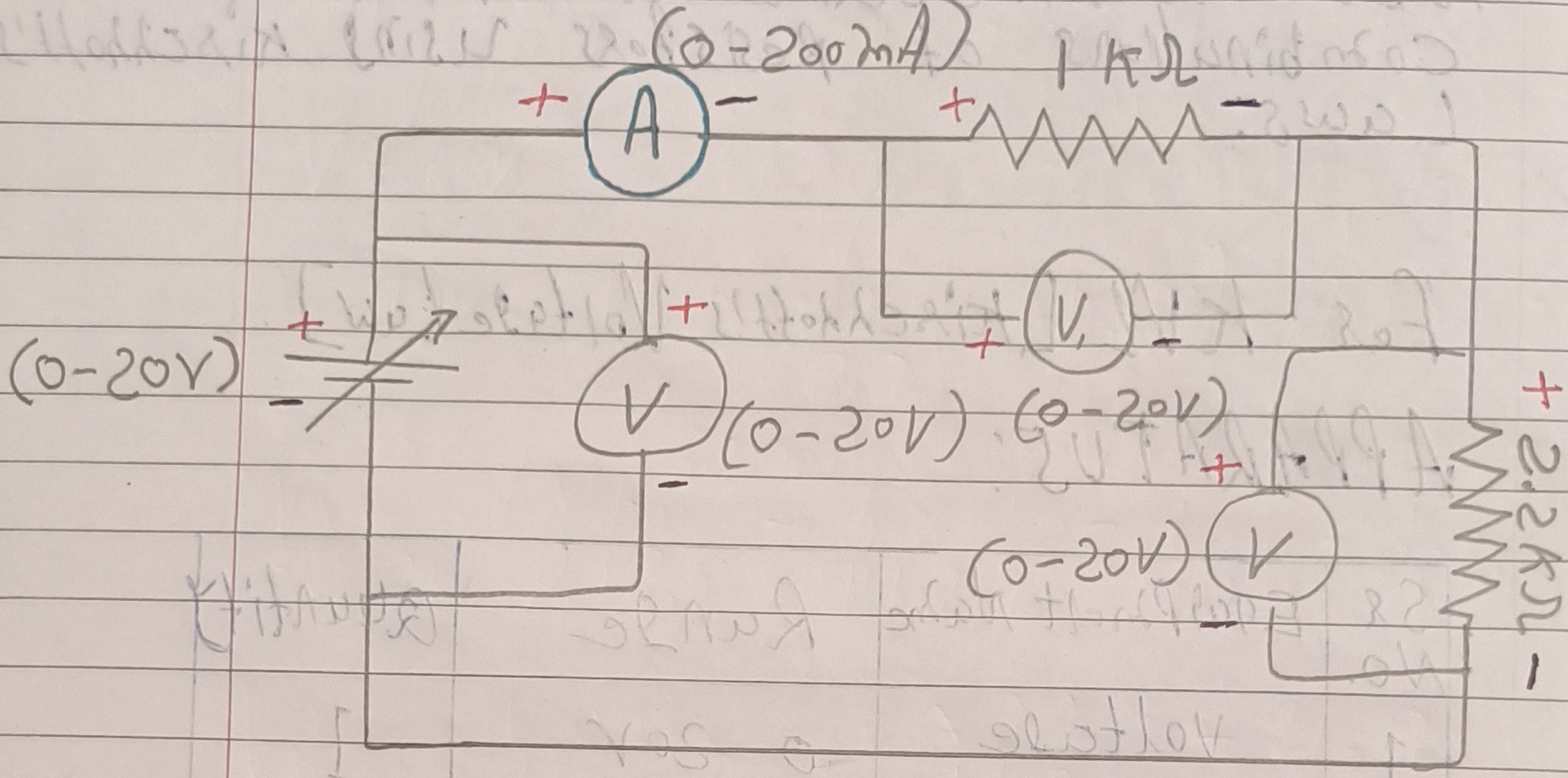
Aim:- To Perform and solve Electrical Network with series and Parallel combinations of Resistors using Kirchhoff's Laws.

For KVL [Kirchhoff's Voltage Law]

APPARATUS:

Sr No.	Equipment Name	Range	Quantity
1	Voltage Source	0 - 20V	1
2	voltmeter	0 - 20V	3
3	Ameter	0 - 200mA	1
4	Resistors	2.2 KΩ 1 KΩ	1 1
5	Patch corde	-	as Per Required

Circuit Diagram



Observation Table:-

Sr No.	Supply Voltage V_s (Volts)	Current I (mA)	Voltage across R_1 V_{R_1} (Volts)	Voltage across R_2 V_{R_2} (Volts)
1	2V	0.6	0.60	1.37
2	4V	1.0	1.18	2.58
3	6V	1.86	1.86	4.08
4	8V	2.4	2.5	5.5

calculation

$V = 2V$ Voltage divider rule [VDR]

$$R_{eq} = R_1 + R_2$$
$$= 1k\Omega + 2.2k\Omega$$
$$= 3.2k\Omega$$

$$I_1 = \frac{V}{R_{eq}} = \frac{2}{3.2} = 0.6mA$$

$$V_{R_1} = \frac{V \times R_1}{R_1 + R_2} = \frac{2 \times 1}{1 + 2.2} = \frac{2}{3.2} = 0.6V$$

$$V_{R_2} = \frac{2 \times 2.2}{3.2} = 1.37V$$

$V = 4V$

$$R_{eq} = R_1 + R_2$$
$$= 1k\Omega + 2.2k\Omega$$
$$= 3.2k\Omega$$

$$I_2 = \frac{V}{R_{eq}} = \frac{4}{3.2} = 1.25mA$$

$$V_{R_1} = \frac{V \times R_1}{R_1 + R_2} = \frac{4 \times 1}{1 + 2.2} = \frac{4}{3.2} = 1.25V$$

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$$V_{R_2} = \frac{V \times R_2}{R_1 + R_2} = \frac{4 \times 2.2}{1 + 2.2} = 2.75\,V$$

<u>$V = 6\,V$</u>

$$I_3 = \frac{V}{R_{eq}} = \frac{6}{3.2} = 1.87\,mA$$

$$V_{R_1} = \frac{V \times R_1}{R_1 + R_2} = \frac{6 \times 1}{1 + 2.2} = \frac{6}{3.2} = 1.87\,V$$

$$V_{R_2} = \frac{V \times R_2}{R_1 + R_2} = \frac{6 \times 2.2}{1 + 2.2} = 4.12\,V$$

<u>$V = 8\,V$</u>

$$I_4 = \frac{V}{R_{eq}} = \frac{8}{3.2} = 2.5\,A$$

$$V_{R_1} = \frac{V \times R_1}{R_1 + R_2} = \frac{8 \times 1}{1 + 2.2} = \frac{8}{3.2} = 2.5\,V$$

$$V_{R_2} = \frac{V \times R_2}{R_1 + R_2} = \frac{8 \times 2.2}{3.2} = 5.5\,V$$

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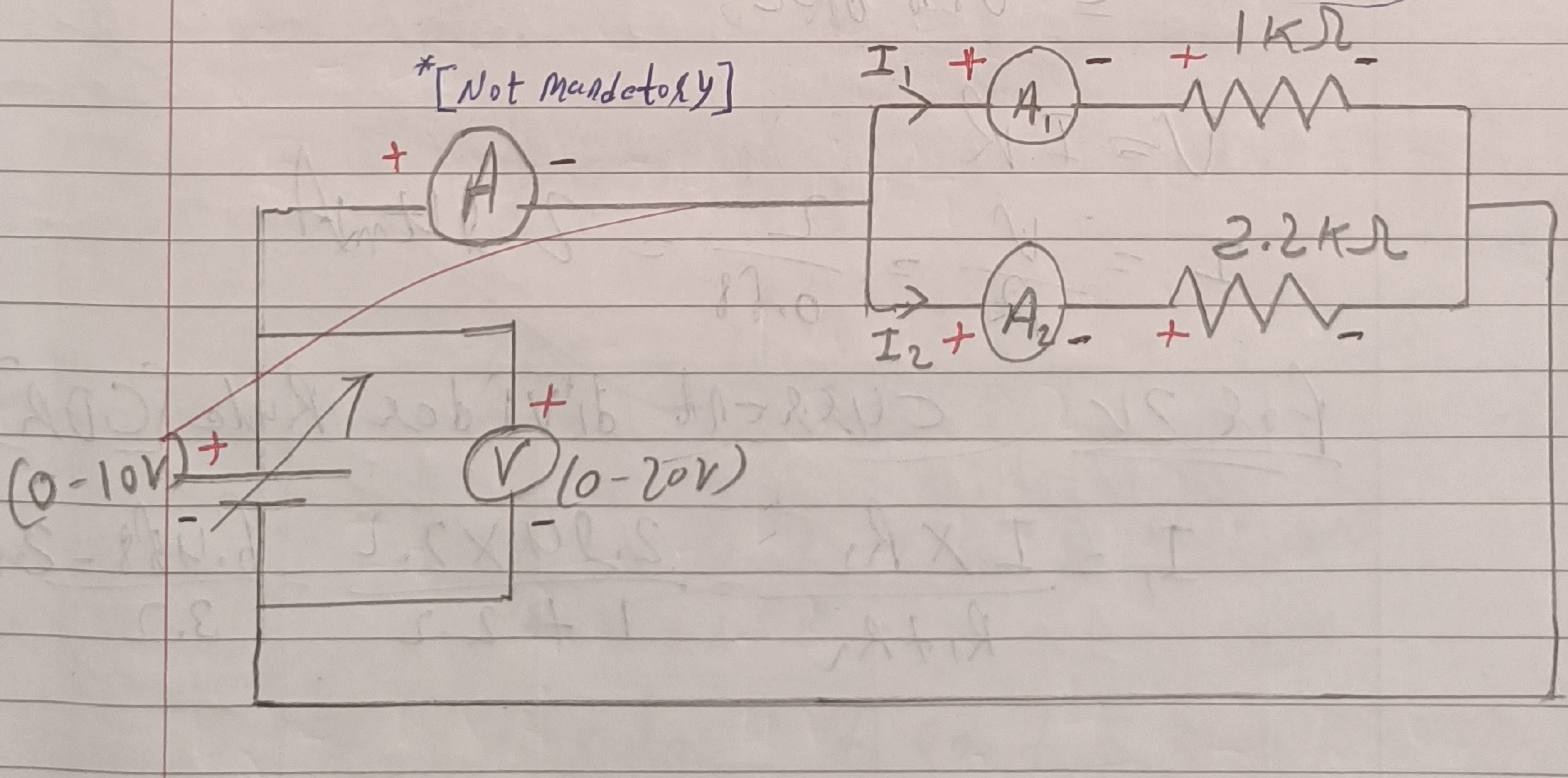
for KCL [Kirchhoff's Current Law]

APPARATUS

Sr No.	Equipment Name	Range	quantity
1	Voltage source	0 - 20V	1
2	Voltmeter	0 - 20V	3
3	Ammeter	0 - 200mA	3
4	Resistor	2.2 KΩ 1 KΩ	1 1
5	Patch corde	-	as per Require

circuit Diagram



Observation table

Sr No	Supply voltage [V_s]	current through 1 KΩ (I_1)	current through 2.2 KΩ (I_2)	total current $I = I_1 + I_2$
1	2V	2.0 mA	0.9 mA	2.0 + 0.9 = 2.9
2	5V	5.1 mA	2.4 mA	5.1 + 2.4 = 7.4
3	7V	6.5 mA	3.3 mA	6.5 + 3.3 + 10.2

Calculation

$$R_{eq} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 R_2}{R_1 + R_2} = \frac{1 \times 2.2}{1 + 2.2} = \frac{2.2}{3.2}$$

$$= 0.68 K\Omega$$

$$V = IR$$

$$I = \frac{V}{R} = \frac{2}{0.68} = 2.94 mA$$

For 2V current divider Rule [CDR]

$$I_1 = \frac{I \times R_2}{R_1 + R_2} = \frac{2.94 \times 2.2}{1 + 2.2} = \frac{6.468}{3.2} = 2mA$$

$$I_2 = \frac{I \times R_1}{R_1 + R_2} = \frac{2.24 \times 1}{3.2} = 0.9 mA$$

$$I = I_1 + I_2 = 2 + 0.9 = 2.9 mA$$

For 5V

$$I = \frac{V}{R_{eq}} = \frac{5}{0.68} = 7.3 mA$$

$$I_1 = \frac{I \times R_2}{R_1 + R_2} = \frac{7.3 \times 2.2}{1 + 2.2} = \frac{16.06}{3.2} = 5 mA$$

$$I_2 = \frac{I \times R_1}{R_1 + R_2} = \frac{7.3 \times 1}{1 + 2.2} = \frac{7.3}{3.2} = 2.2 mA$$

$$I = I_1 + I_2 = 5 + 2.2 = 7.2 mA$$

For 7V

$$I = \frac{V}{R_{eq}} = \frac{7}{0.68} = 10.29 mA$$

$$I_1 = \frac{I \times R_2}{R_1 + R_2} = \frac{10.29 \times 2.2}{1 + 2.2} = 7.07 mA$$

$$I_2 = \frac{I \times R_1}{R_1 + R_2} = \frac{10.29 \times 1}{1 + 2.2} = 3.21 mA$$

$$I = I_1 + I_2 = 7.07 + 3.21 = 10.28$$

Conclusion [For KVL] :- After Performing experiment we verified the Kirchoff's voltage law with the help of two series Resistance. The calculate resistance value for the two resistance were found to be same as we calculated.

Conclusion [For KCL] :- After Performing this experiment we can verify the KCL with help of Parallel resistor the calculated total resistance of the circuit using the formula was to be appear same to the reading performed during the experiment.

Sr No.	~~Current due to 9V [I']~~ Supply Voltage (V_s) ~~(mA)~~	Current due to 9V (I') (mA)	Current due to 5V [I''] (mA)	total current I = I' + I'' (mA)
1	9V	2.14	—	2.14 + 0.54
2	5V	—	0.54	=

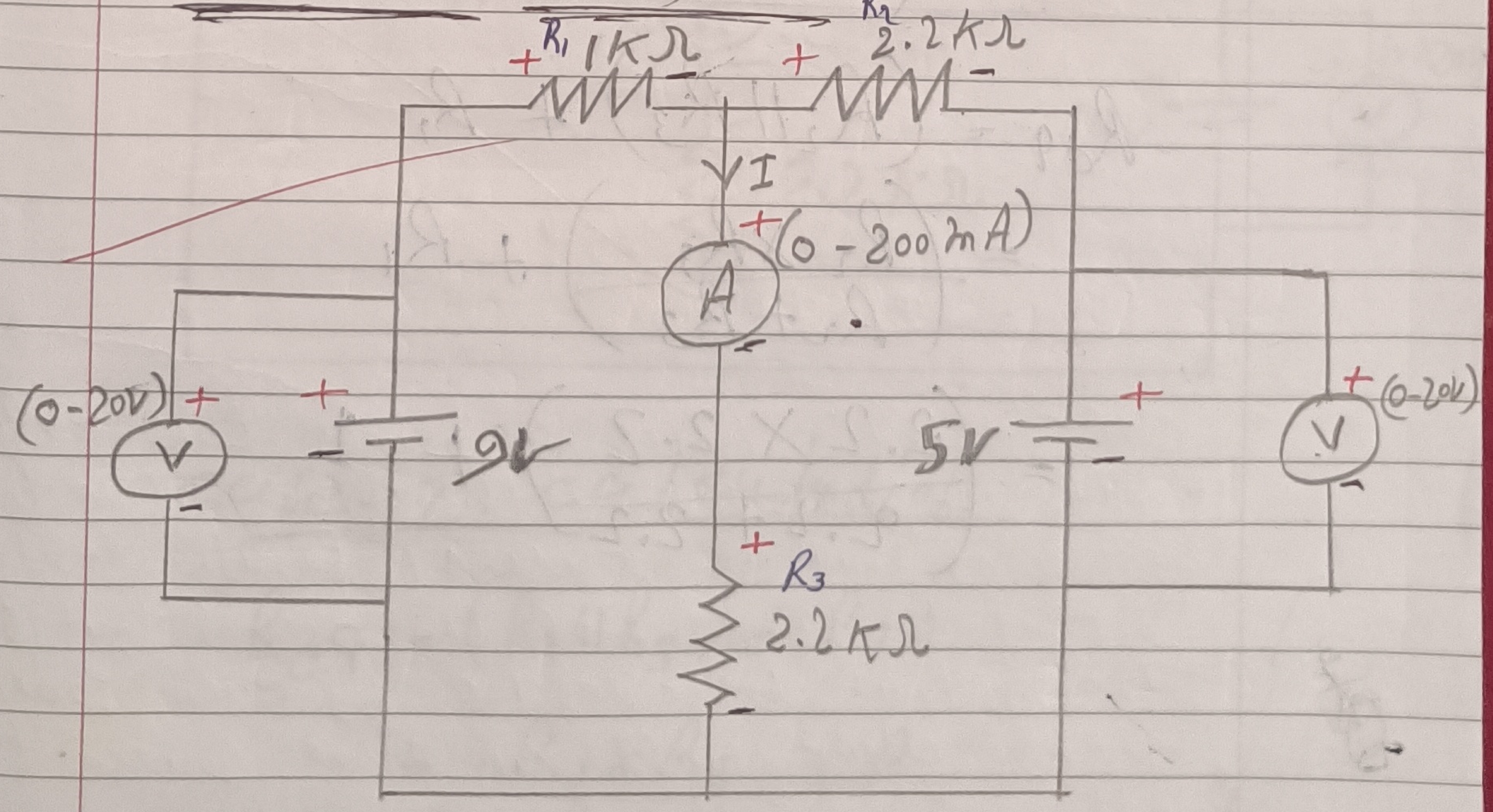
Experiment - 3

Aim:- To varify superposition theorem.

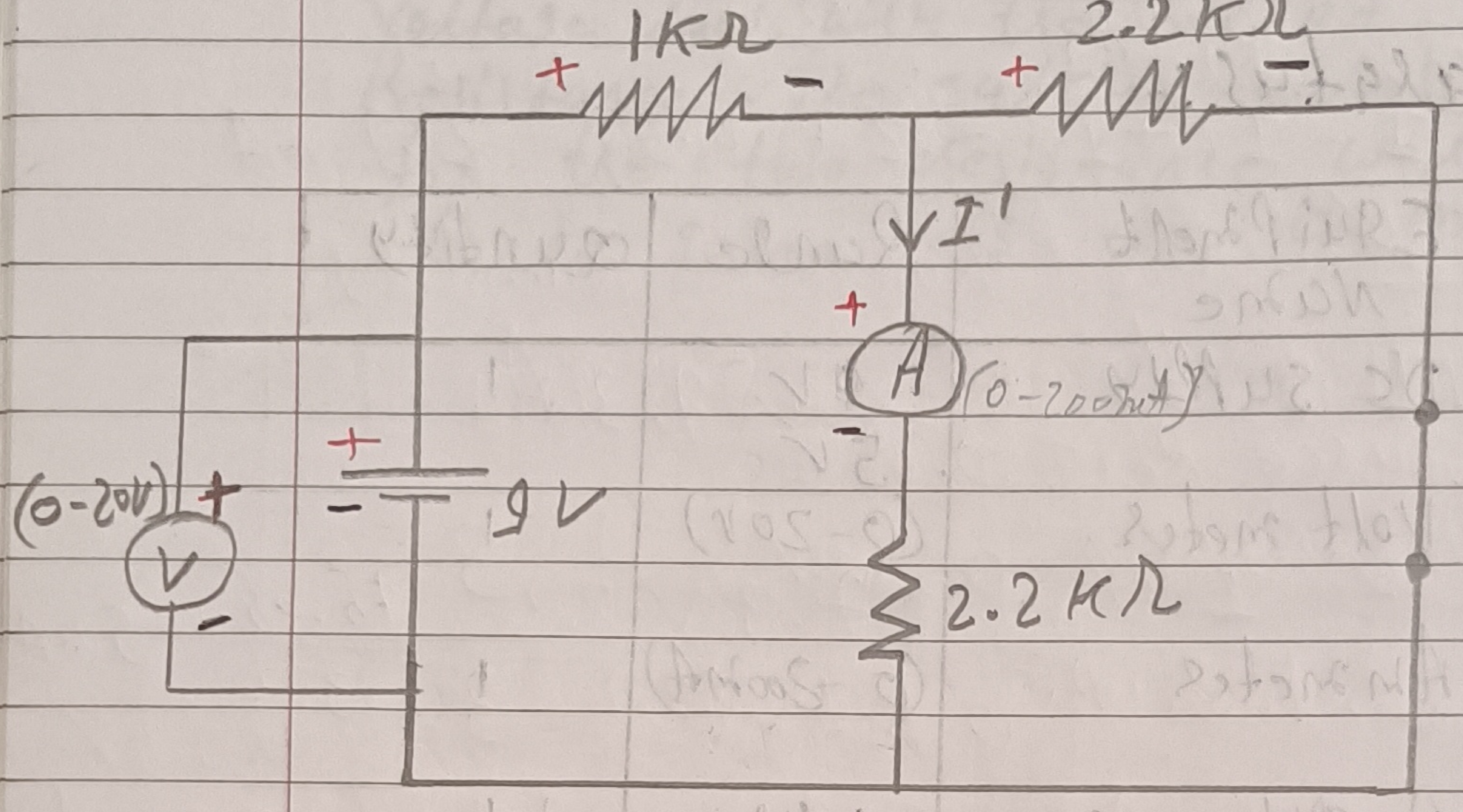
Apparatus:-

S.No.	Equipment Name	Range	Quantity
1	DC supply	9V 5V	1
2	Volt meter	(0-20V)	1
3	Ammeter	(0-200mA)	1
4	Resistances	1KΩ 2.2KΩ	1 ,
5	Patch corde	—	As Per Required
6	Power corde	—	1

Circuit Diagram



Case - 1



case-1 calculation

$$\cancel{R_{eq} = \left(\frac{2.2 \times 2.2}{2.2 + 2.2}\right) +}$$

$$R_{eq} = (R_2 \| R_3) + R_1$$

$$= \left(\frac{R_2 \times R_3}{R_2 + R_3}\right) + R_1$$

$$= \left(\frac{2.2 \times 2.2}{2.2 + 2.2}\right) + 1$$

$$= \frac{4.84}{4.4} + 1$$

$$= 1.1 + 1$$

$$\boxed{R_{eq} = 2.1\,\Omega}$$

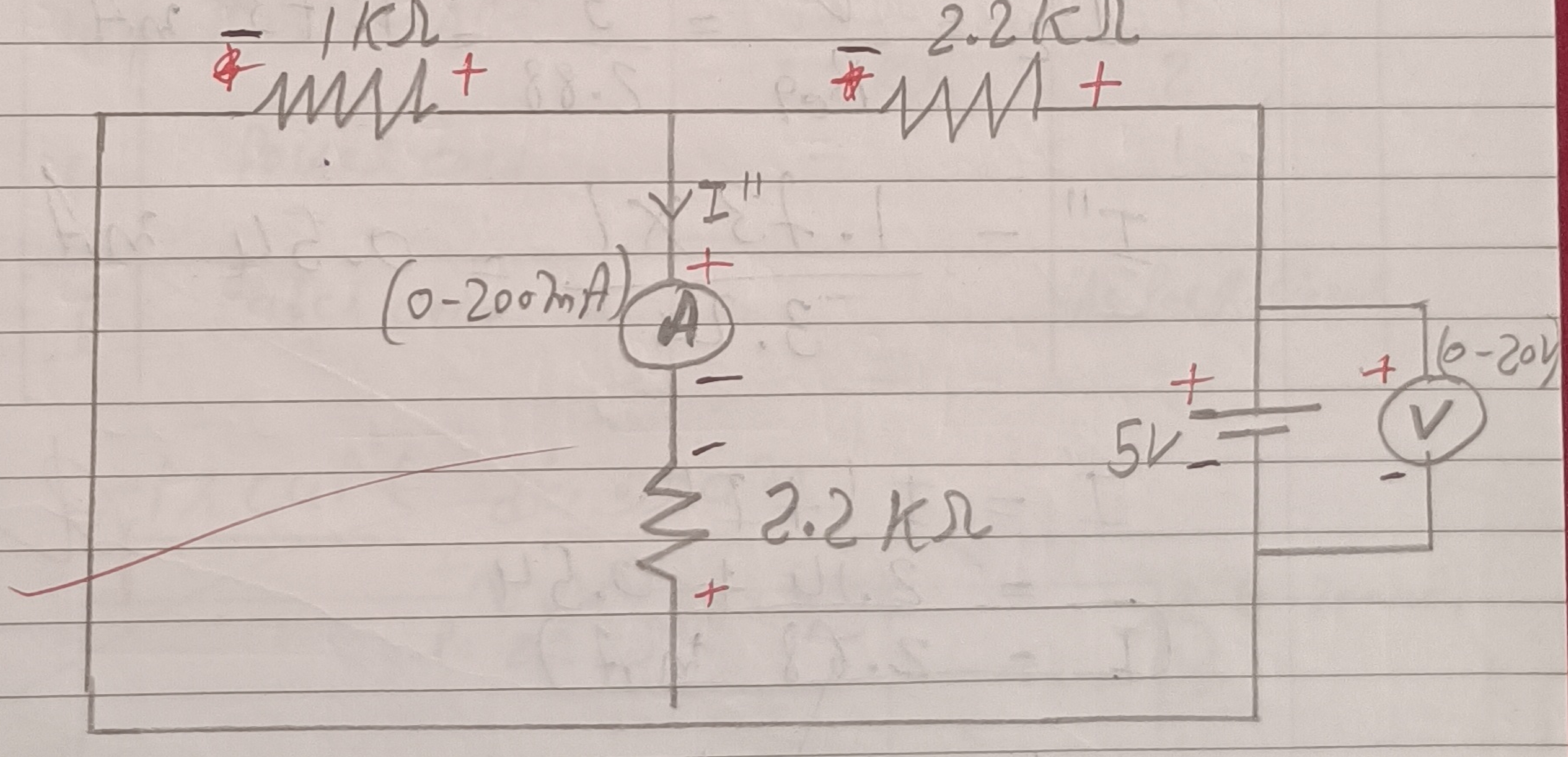
Observation table

	Volt across (R_s)	Current through resistor (I_1, I_2)	Current across resistor (I', I'')
1	9V	$I_1 = 3.125$ mA	$I' = 0.98$ mA
2	5V	$I_2 = 2.38$ mA	$I'' = 1.19$ mA

$$I_1 = \frac{9}{2.1} = 4.28\text{ mA}$$

$$I_1 = \frac{4.28 \times 2.2}{4.4} = \frac{9.416}{4.4} = 2.14\text{ mA}$$

case-2



case-2 calculation

$$R_{eq} = (R_1 \| R_3) + R_2$$

$$= \frac{R_1 \times R_3}{R_1 + R_3} + R_2$$

$$= \left(\frac{1 \times 2.2}{1 + 2.2}\right) + 2.2$$

$$= \left(\frac{2.2}{3.2}\right) + 2.2$$

$$= 0.68 + 2.2$$

$$\boxed{R_{eq} = 2.88 k\Omega}$$

$$I_2 = \frac{V}{R_{eq}} = \frac{5}{2.88} = 1.73 \text{ mA}$$

$$I'' = \frac{1.73 \times 1}{3.2} = 0.54 \text{ mA}$$

$$I = I' + I''$$

$$= 2.14 + 0.54$$

$$\boxed{I = 2.68 \text{ mA}}$$

Conclusion:- After performing this experiment we have verifed the superposition theorem by showing that the current trough resistor is equal to the sum of the current that passed through that ~~lofte~~ resistor by each source acting alone with an other source turned off.

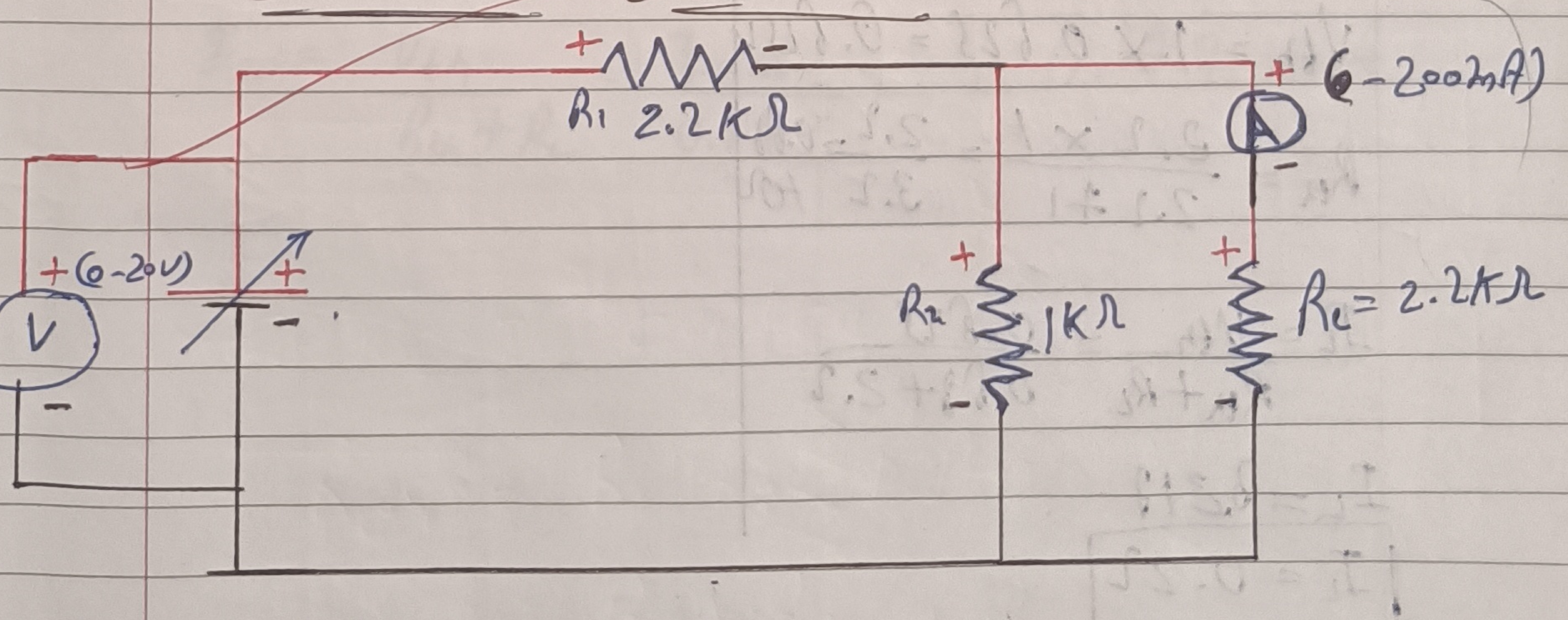
Experiment - 4

Aim:- To Valification of Thevenin theorem.

Apparatus:-

Sl No.	Equipment Name	Range	Quantity
1	DC Voltmeter	(0-20V)	1
2	DC Ammeter	(0 - 200mA)	
3	DC Power supply	(0-10V)	1
4	Resistance	1KΩ 2.2KΩ	1 2
5	Power cord	-	1
6	Patch cord	-	As Per Required

circuit diagram



other two circuits →

Observation table

Sr No.	Supply voltage [V_s]	V_{th}	R_{Th}	I_L
1	2V	0.625V	0.68 Ω	0.22 mA
2	5V	1.5V	0.68V	0.52mA
3	7V	2.18V	0.68V	0.77mA
4	9V	2.81V	0.68V	0.98 mA

Calculation

For V_{th}

1) 2V

$$I = \frac{V}{R_{eq}} = \frac{2}{3.2} = 0.625\ mA$$

$$V_{th} = 1 \times 0.625 = 0.625V$$

$$R_{th} = \frac{2.2 \times 1}{2.2+1} = \frac{2.2}{3.2} = 0.68\ k\Omega$$

$$I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{0.625}{0.68+2.2}$$

$I_L = 0.217$

$\boxed{I_L = 0.22}$

$$R_{eq} = \cancel{\frac{R_1 R_2}{R_1+R_2}} = \frac{2.2 \times 1}{2}$$

$$= R_1 + R_2 = 2.2 + 1$$

$$R_{eq} = 3.2\Omega$$

ii) 5V

$$I = \frac{V}{R_{eq}} = \frac{5}{3.2} = 1.5\ mA$$

$$V_{th} = 1 \times 1.5 = 1.5\ V$$

$$R_{th} = \frac{2.2 \times 1}{2.2 + 1} = \frac{2.2}{3.2} = 0.68\ k\Omega$$

$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{1.5}{0.68 + 2.2} = \frac{1.5}{2.88} = 0.52\ mA$$

iii) 7V

$$I = \frac{V}{R_{eq}} = \frac{7}{3.2} = 2.19\ mA$$

$$V_{th} = 1 \times 2.19 = 2.19\ V$$

$$R_{th} = \frac{2.2 \times 1}{2.2 + 1} = \frac{2.2}{3.2} = 0.68\ k\Omega$$

$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{2.19}{0.68 + 2.2} = 0.77\ mA$$

ix) 9V

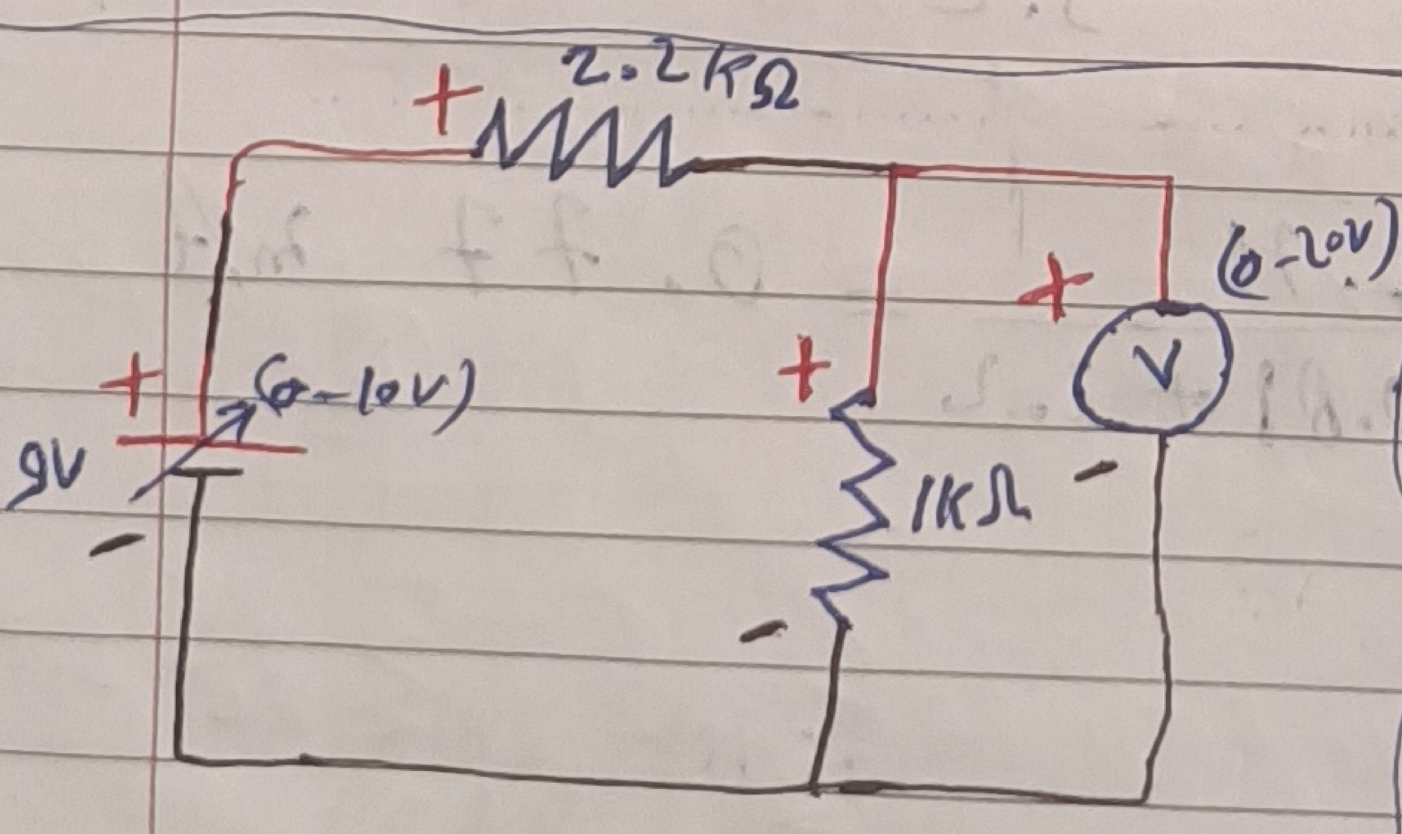
$I = \frac{V}{R_{eq}} = \frac{9}{3.2} = 2.81 \text{ mA}$

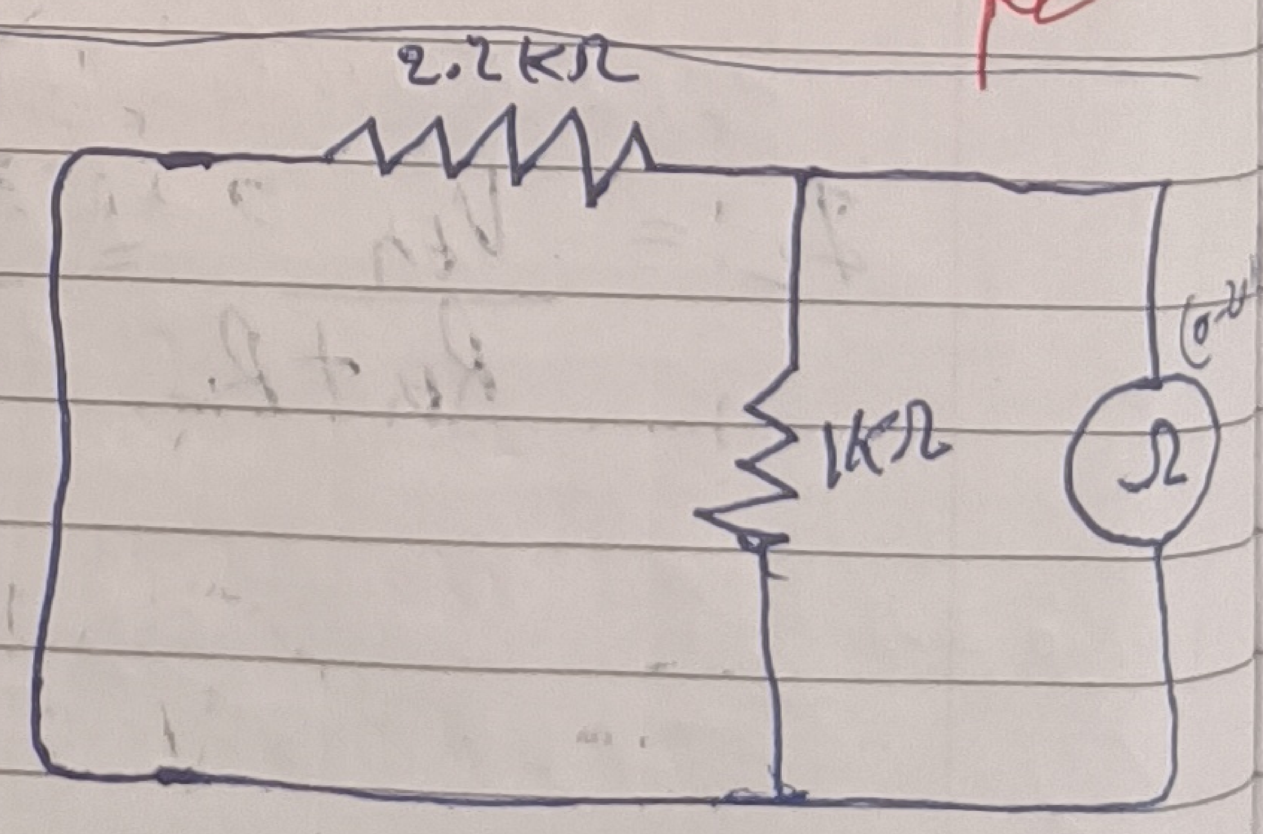
$V_{th} = 1 \times 2.81 = 2.81 \text{ V}$

$R_{th} = \frac{2.2 \times 1}{2.2+1} = \frac{2.2}{3.2} = 0.68 \text{ k}\Omega$

$I_L = \frac{V_{th}}{R_{th}+R_L} = \frac{2.81}{0.68+2.2} = 0.98 \text{ mA}$

Conclusion :- After performing this experiment we've found out that it's possible to simplify any linear circuit to an equivalent circuit with a voltage source and series resistance connected to the load resistance and the value we've calculated by formula was also as per value we got during experiment.





2 connections

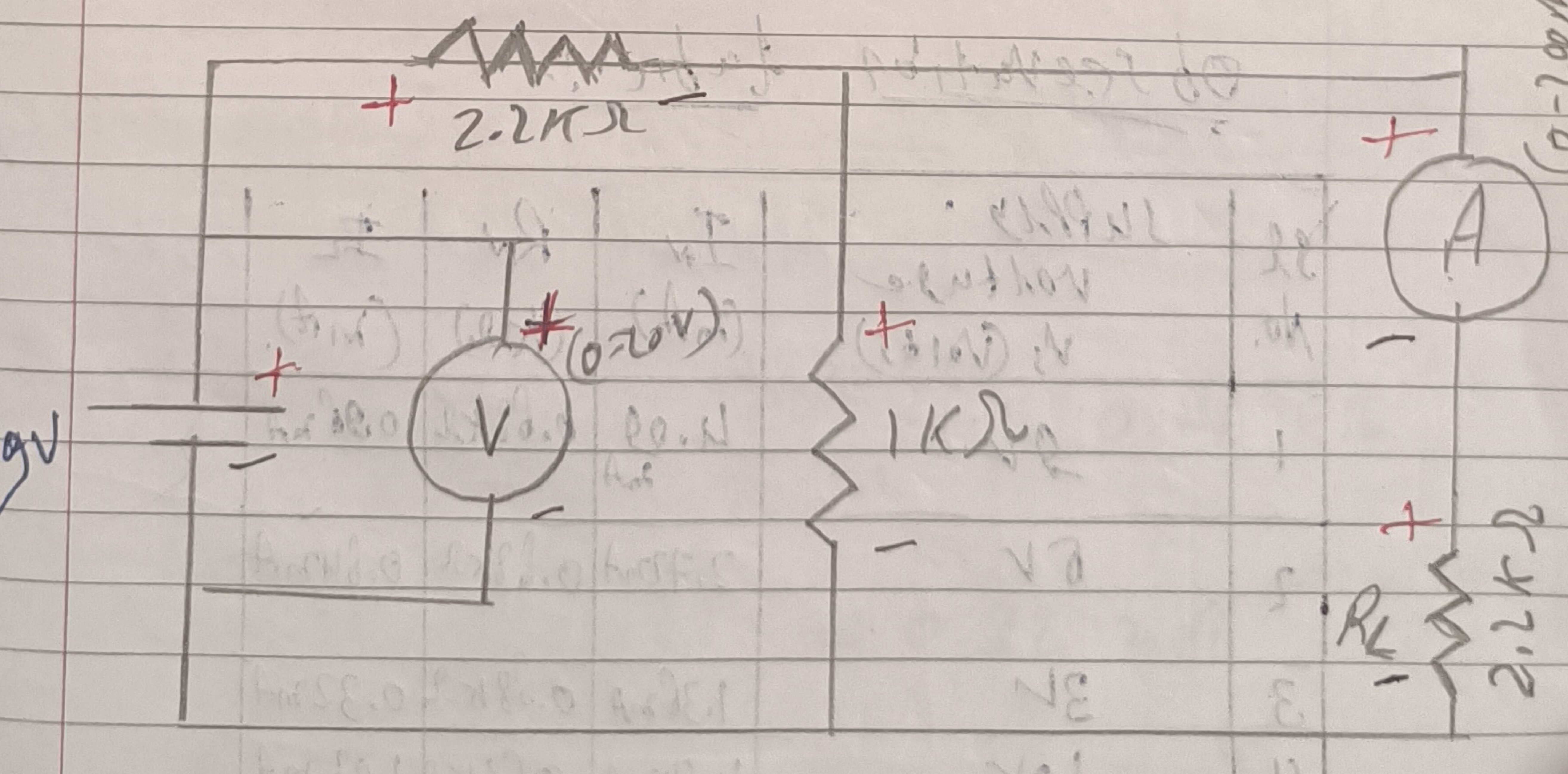
Experiment-5

Aim: To Varify Norton's theorem.

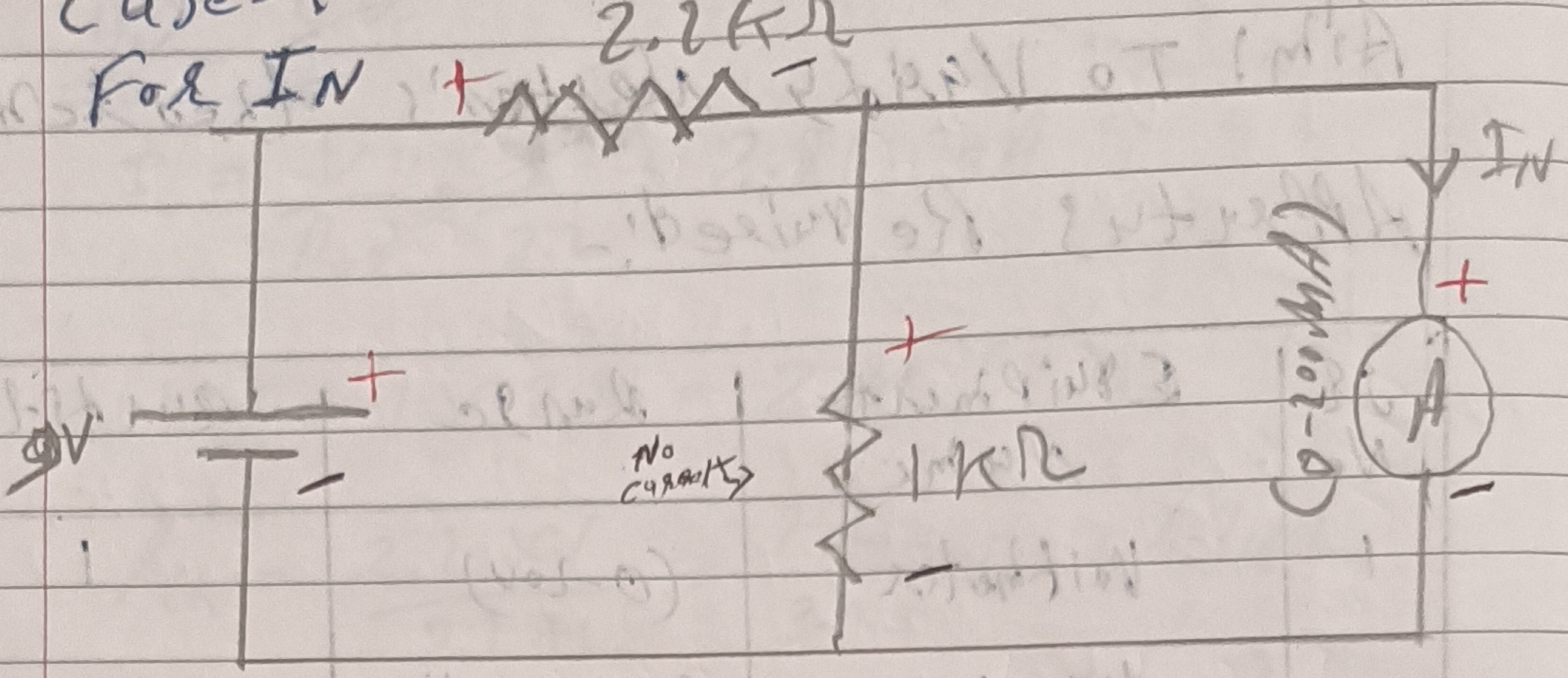
Appartus Required:-

Sr No	Equipment Name	Range	Quantity.
1	Voltmeter	(0-20V)	1
2	Ammeter	(0-200mA)	1
3	Resistance	1KΩ 2.2KΩ	1 2
4	Power cord	—	1
5	DC Power supply	(0-15V)	1
6	Patch cord	—	as per Required

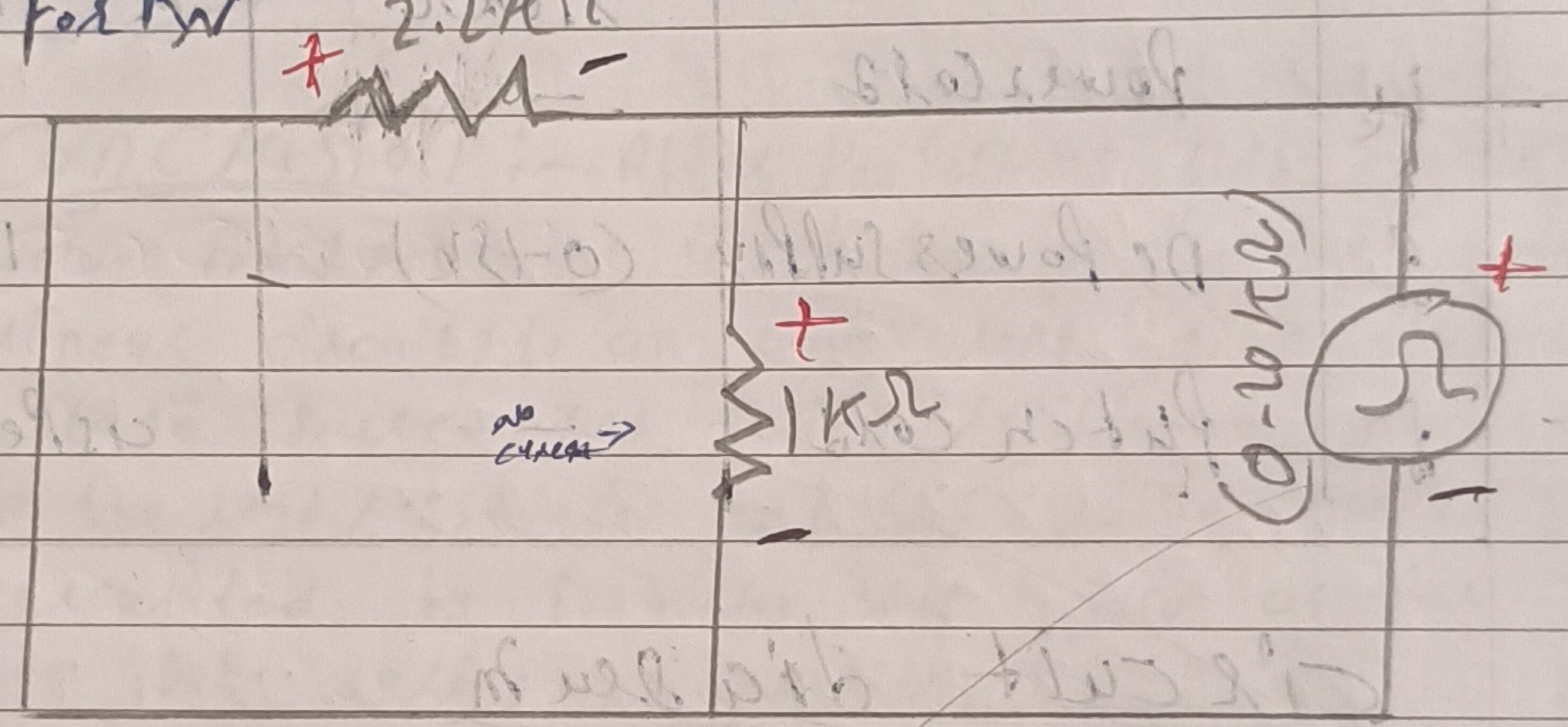
Circuit diagram



Case-1
For I_N



Case-2
for R_N



Observation table:-

Sl No.	Supply voltage V_s (Volts)	I_N (mA)	R_N (KΩ)	I_L (mA)
1	9V	4.09 mA	0.68KΩ	0.96 mA
2	6V	2.72mA	0.68KΩ	0.64mA
3	3V	1.36mA	0.68KΩ	0.32mA
4	10V	4.54mA	0.68KΩ	1.07mA

calculation

- For 9V

$$I_N = \frac{9}{2.2} = 4.09\ mA$$

$$R_N = \frac{2.2 \times 1}{2.2+1} = \frac{2.2 \times 1}{3.2} = 0.68\ k\Omega$$

$$I_L = \frac{4.09 \times 0.68}{0.68 + 2.2} = 0.96\ mA$$

- For 6V

$$I_N = \frac{6}{2.2} = 2.72\ mA$$

$$R_N = \frac{2.2 \times 1}{2.2+1} = 0.68\ k\Omega$$

$$I_L = \frac{2.72 \times 0.68}{0.68 + 2.2} = 0.64\ mA$$

- For 3V

$$I_N = \frac{3}{2.2} = 1.36\ mA$$

$$R_N = \frac{2.2 \times 1}{2.2+1} = \frac{2.2 \times 1}{3.2} = 0.68\ k\Omega$$

$$I_L = \frac{1.36 \times 0.68}{0.68 + 2.2} = 0.32\ mA$$

for 10 v

$$I_N = \frac{10}{2.2} = 4.54 \text{ mA}$$

$$R_N = \frac{2.2 \times 1}{2.2 + 1} = 0.68 \text{ k}\Omega$$

$$I_L = \frac{4.54 \times 0.68}{0.68 + 2.2} = 1.07 \text{ mA}$$

Conclusion:-

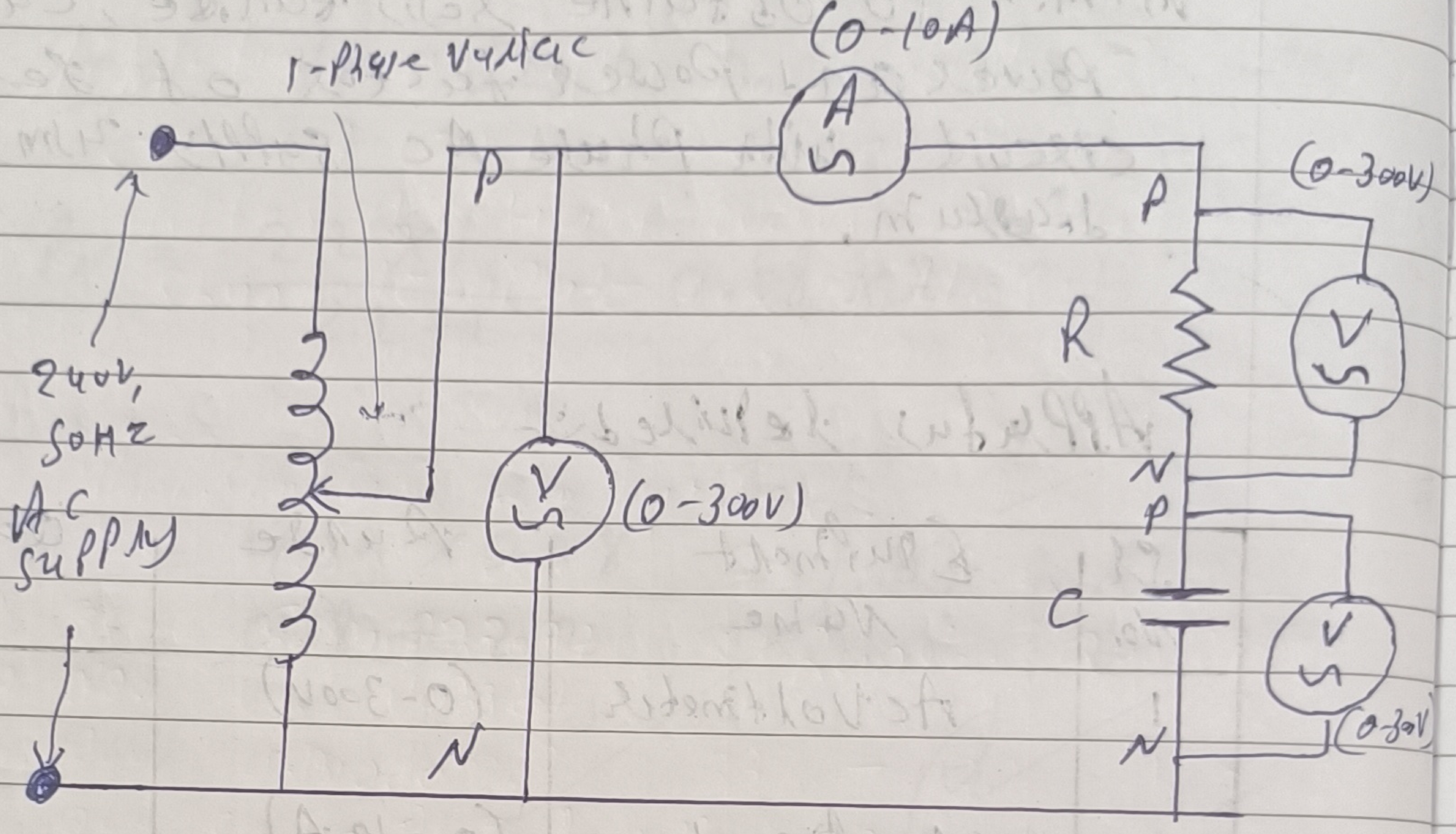
Experiment - 6

Aim:- To obtaine resistance, capacitance, power and power factor of series RC circuit with phase AC supply using phasor diagram.

Apparatus required:-

Sr No.	Equipment Name	Range	Quantity
1	AC Voltmeter	(0-300V)	3
2	AC Ammeter	(0-10A)	1
3	single phase variac	(0-270V)	1
4	AC power supply	(0-270V)	1
5	Resistance load	-	1
6	capacitive load	-	1
7	connecting wire	-	as per required

Circuit diagram



P = Phase

N = Neutral

Observation table

Sl No	Supply voltage V_S (Volt)	Current I (Amps)	Voltage across R-Load V_R (Volts)	Voltage across C-Load V_C (Volts)
1	100	0.4A	90V	32V
2	200	0.7A	186V	54V
3	150	0.6A	138V	42V

calculation table

Resistance $R = \frac{V_R}{I}$	capacitive Reactance $X_c = \frac{V_c}{I}$	Impedance $Z = \sqrt{R^2 + X_c^2}$	Power factor $\cos\phi = \frac{R}{Z}$	Power $P = VI\cos\phi$
250	80	262	0.95	38W
250	70	259	0.96	87W
285	77	295	0.96	126W

conclusion:-

Experiment-7

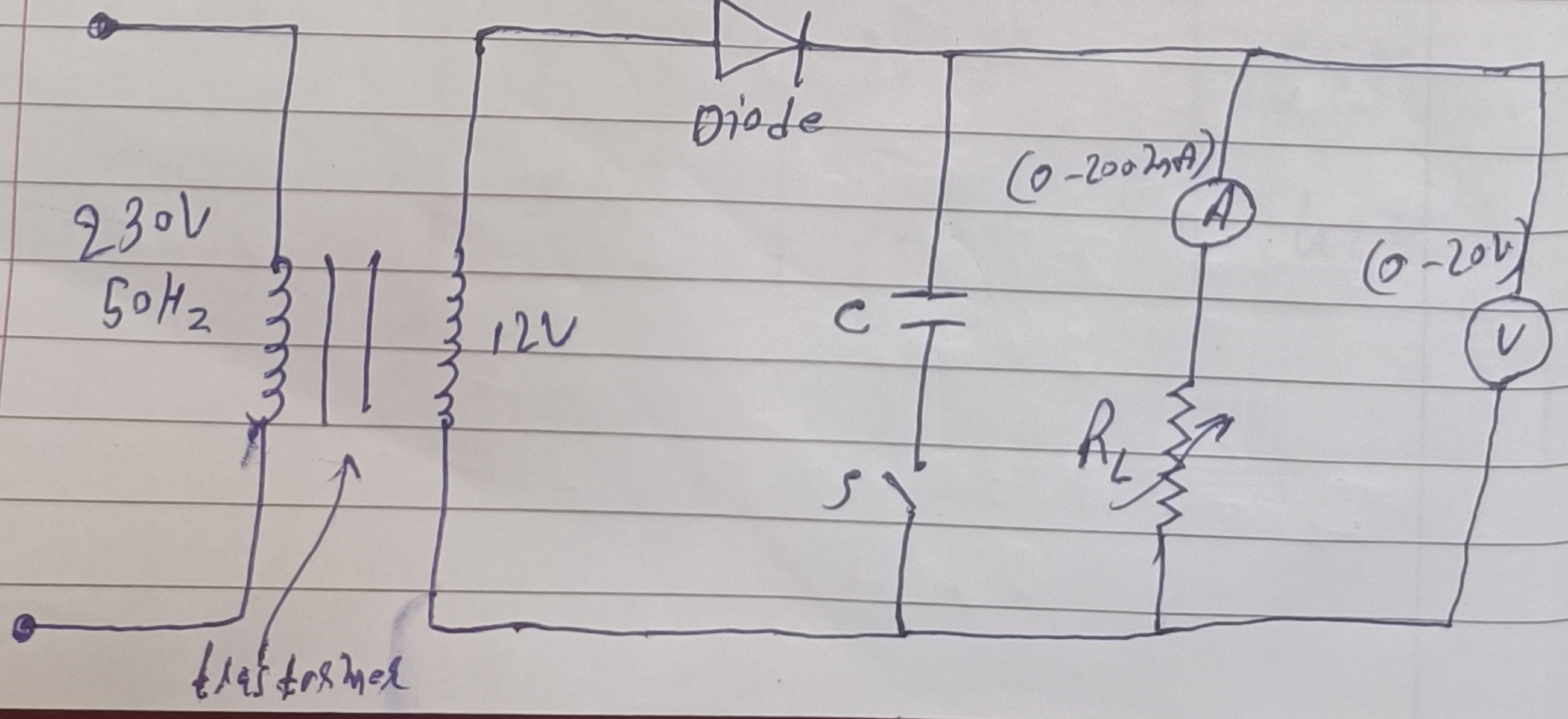
Aim:- To observe Half wave Rectifier circuit (a) Half wave Rectifier without filter (b) Half wave Rectifier with shunt capacitor filter.

Apparatus Required.

Sr No.	Equipment Name	Range	Quantity
1	Diode	—	1
2	Single Phase Ac supply	230V	1
3	Dc Voltmeter	0-20V	1
4	Ac Voltmeter	0-200V	1
5	Ammeter	0-200 mA	1
6	oscilloscope	30 MHz	1
7	Patch code	-	as per Required
8	Step Down transformer	(230-12V)	1

circuit diagram

(a) Half wave Rectifier without filter

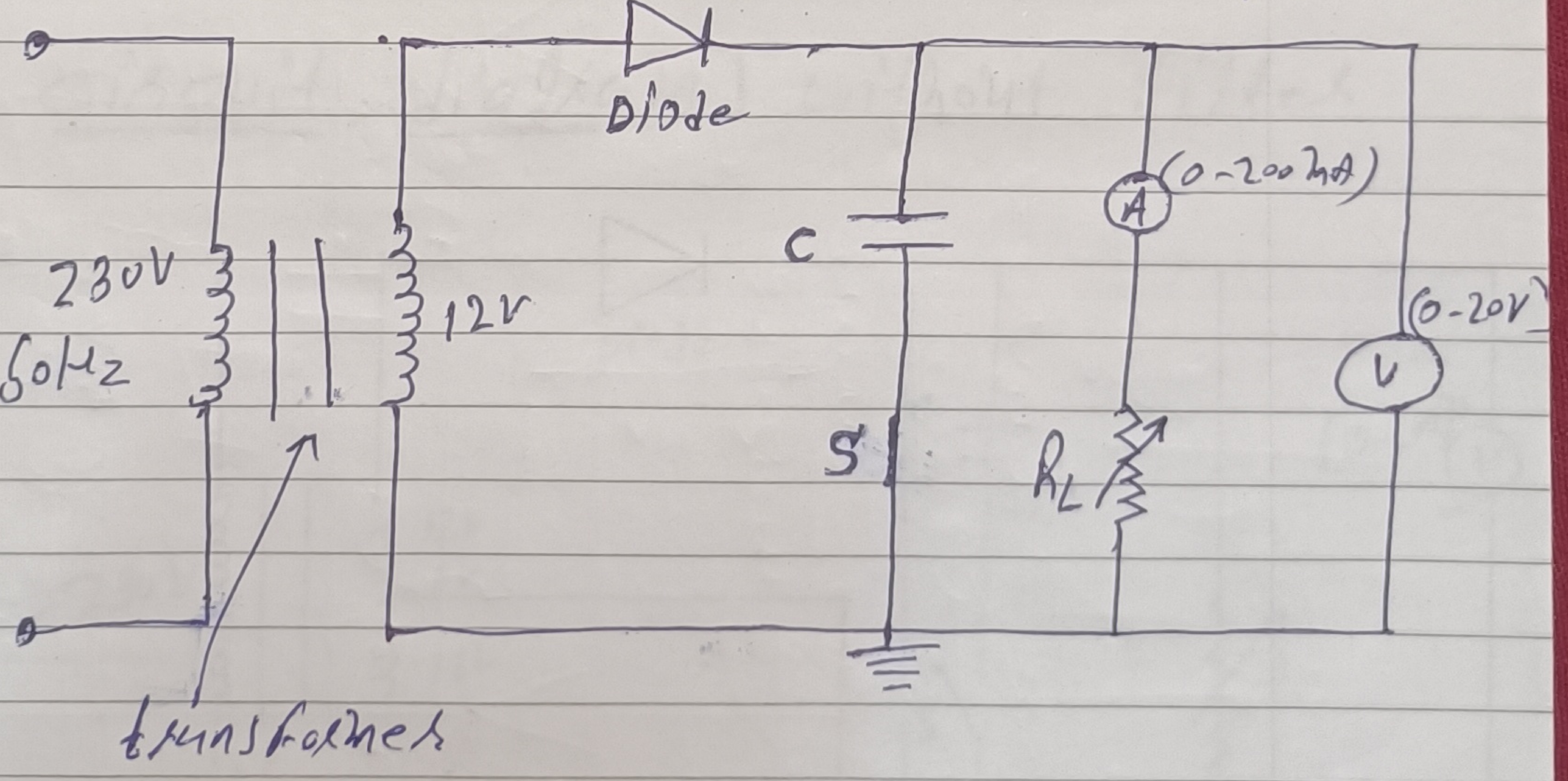


Observation table

(a) Half wave Rectifier without filter

Sr No	R_L	Input AC Voltage V_{AC}	Output AC Voltage V_{AC}	DC current I_D	Output DC Voltage V_{DC}	Ripple Factor $\frac{V_{AC}}{V_{DC}}$
1	100	14.5	2.13	0.1	14.16	0.15
2	200	14.5	6.4	.55	5.67	1.14
3	300	14.5	6.8	.29	5.8	1.17
4	400	14.5	7.3	.20	5.9	1.23
5	500	14.5	7.4	.15	6	1.23
6	600	14.5	7.4	.12	6	1.23
7	700	14.5	7.4	.10	6	1.23

(b) Half wave Rectifier with capacitor filter.



Observation table

(b) Half wave Rectifier with capacitor filter

Sl. No.	R_L	input Ac Voltage V_{AC}	output Ac Voltage V_{AC}	DC current I_D	output DC Voltage V_{DC}	Ripple Factor $\frac{V_{AC}}{V_{DC}}$
1	100	14.5	6.4	0.01	19.8	0
2	200	14.5	4.4	76	7.6	0.71
3	300	14.5	3.7	52	10.3	0.42
4	400	14.5	3.17	40	12.1	0.30
5	500	14.5	2.7	33	13.2	0.29
6	600	14.5	2.7	28	14.14	0.19
7	700	14.5	2.4	24	14.8	0.16

Conclusion :-

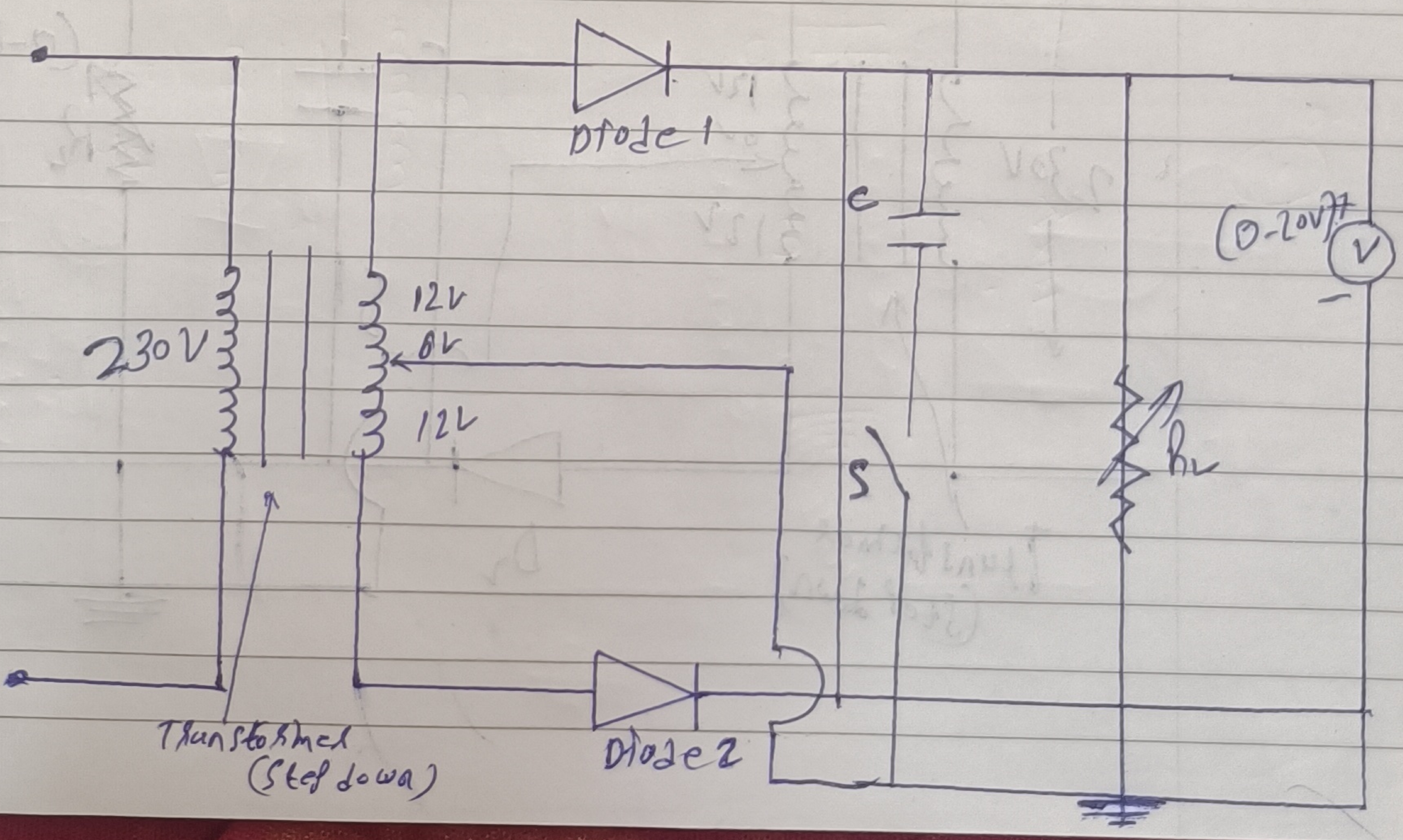
Experiment – 8

Aim :- To observe full wave rectifier circuit with and without capacitor

Apparatus Required :-

Sr No	Equipment Name	Range	Quantity
1	Diode	–	2
2	Oscilloscope	30 MHz	1
3	Load Resistance	100 – 700 Ω	1
4	Power supply	230 V	1
5	Transformer (Step down)	230 – 12 V	1
6	Patch code	–	As per Required
7	Voltmeter	0 - 20 V	1

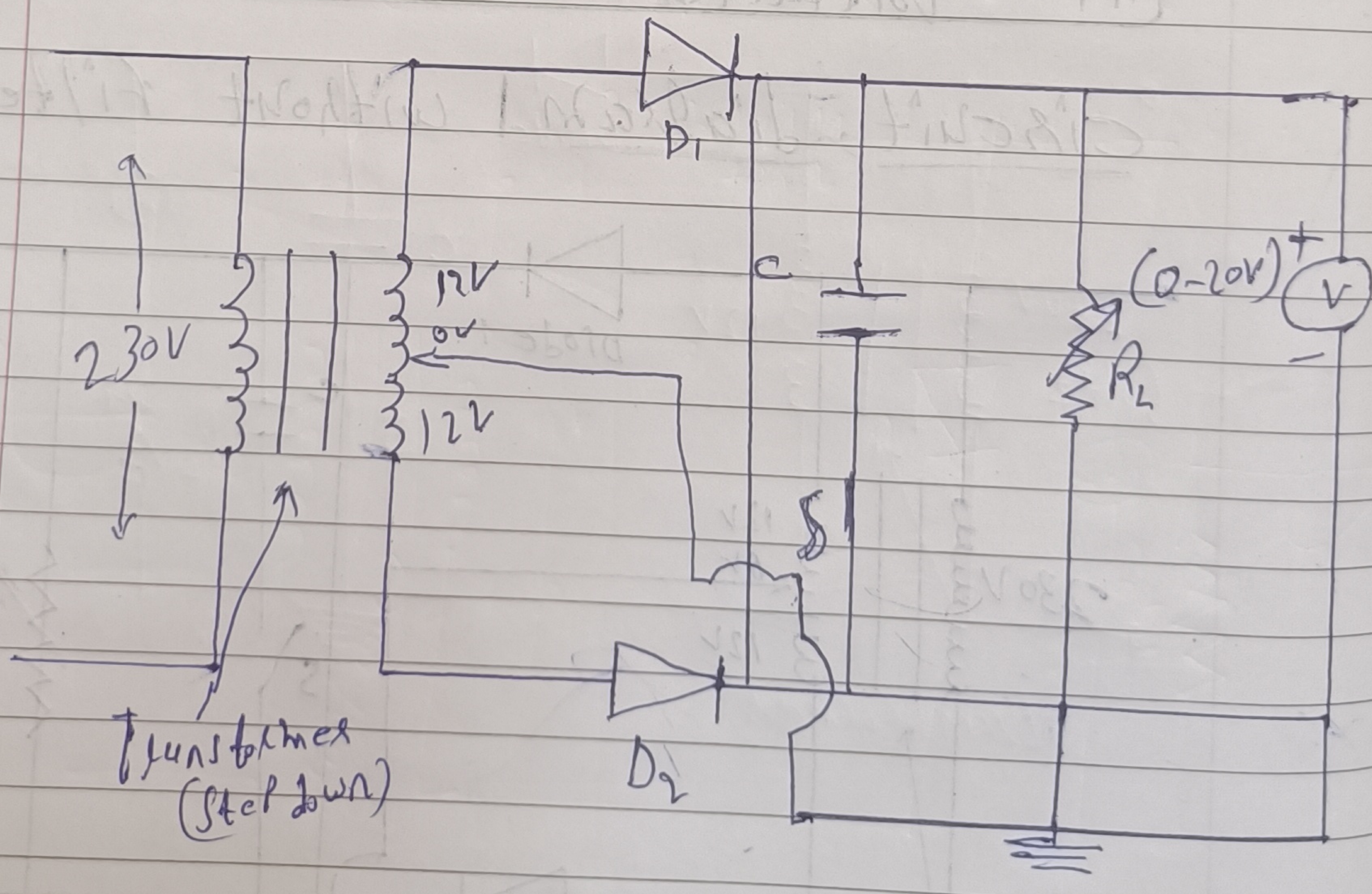
Circuit diagram | without filter



Observation table | without filter

Sl No	Load Resistance (R_L)	Output Voltage DC (V_{dc})	Output Voltage AC (V_{AC})	Ripple factor $\frac{V_{AC}}{V_{DC}}$
1	100	12.1	5.7	0.47
2	200	13.5	6.4	0.47
3	300	14.1	6.6	0.46
4	400	14.4	6.8	0.47
5	500	14.6	6.9	0.47
6	600	14.7	7.0	0.47
7	700	14.8	7.0	0.47

Circuit diagram | with filter



Observation table with filter

Sr No	Load Resistance R_L	Output Voltage AC (V_{AC})	DC V_{DC}	Ripple Factor $\frac{V_{AC}}{V_{DC}}$
1	100	3.7	13.6	0.2
2	200	2.8	16.6	0.1
3	300	2.3	18.2	0.1
4	400	1.9	19.1	0.09
5	500	1.6	19.8	0.08
6	600	1.4	20.4	0.06
7	700	1.2	20.2	0.05

Conclusion :-

Experiment - 9

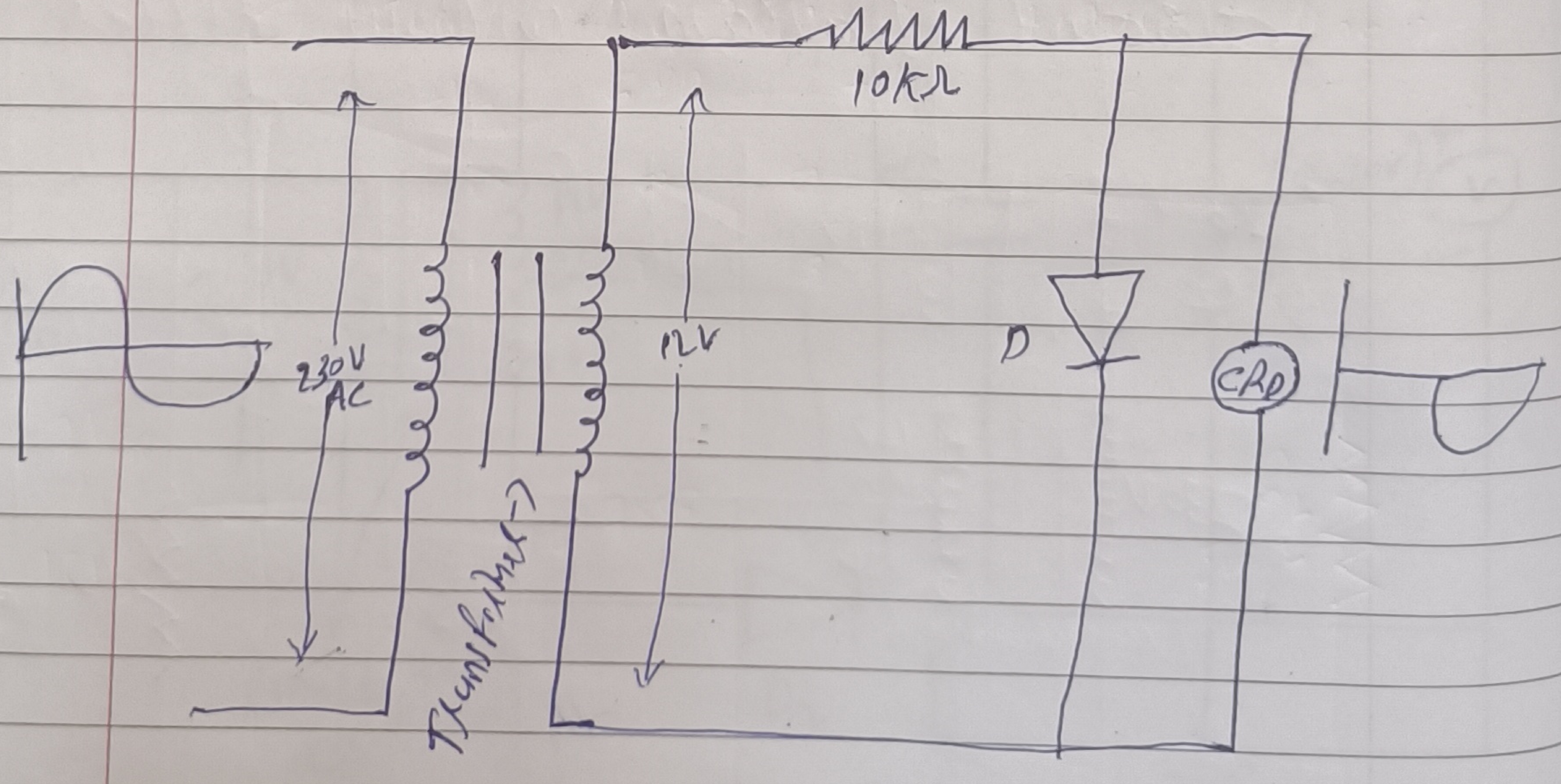
Aim:- To Observe Responce of clippers circuits using diodes.

Positive clipper and Negative clipper,

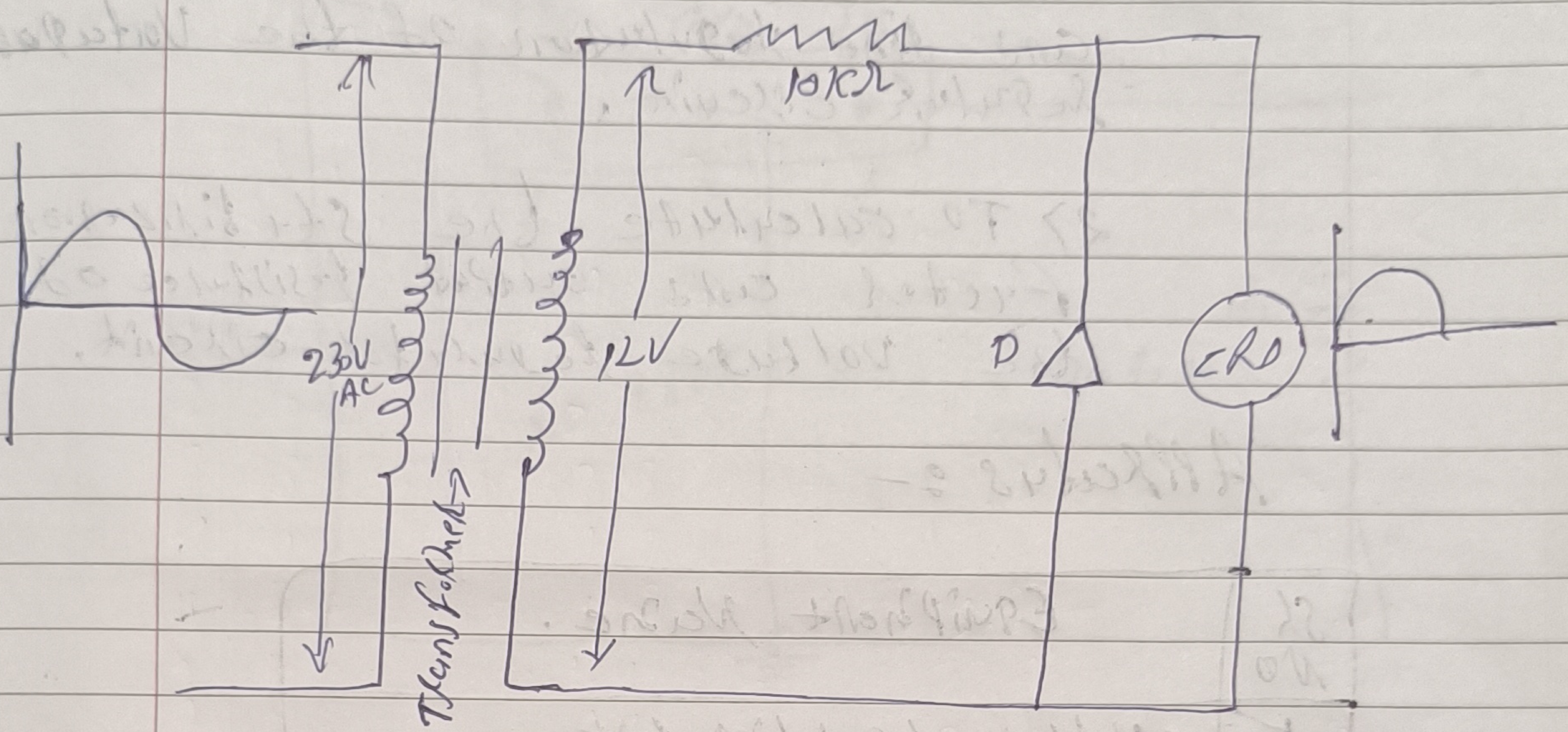
Apparatus:-

Sl No.	Equipment Name	Range	Quantity
1	Diode	–	1
2	Resistors	10KΩ	1
3	Single AC Supply	12V	1
4	Oscilloscope	13 MHz	1
5	Patch corde	–	As per required

Circuit Diagram | Positive clipper



Negative Clipper



Experiment- 10

Aim:- 1) To calculate the load regulation and line regulation of the voltage regulator circuit.

2) To calculate the stabilization factor and output resistance of the voltage regulator circuit.

Apparatus :-

Sr No	Equipment Name.
1	Voltage regulating kit
2	Digital multimeter (V_{DC})
3	Connecting wires
4	Digital mini Ammeter (mA_{DC})

Circuit Diagram :- Figure 1 (line Regulation)

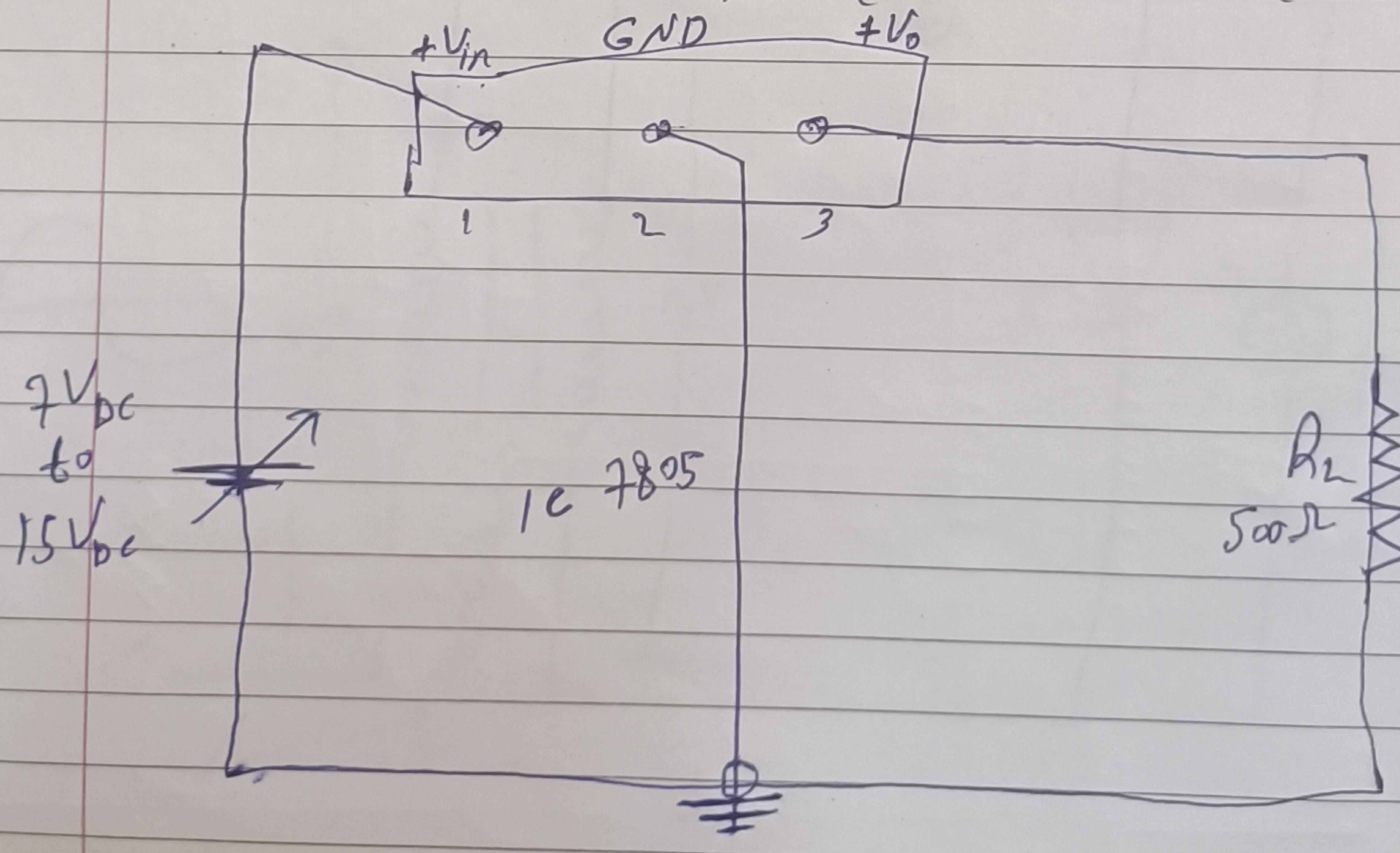
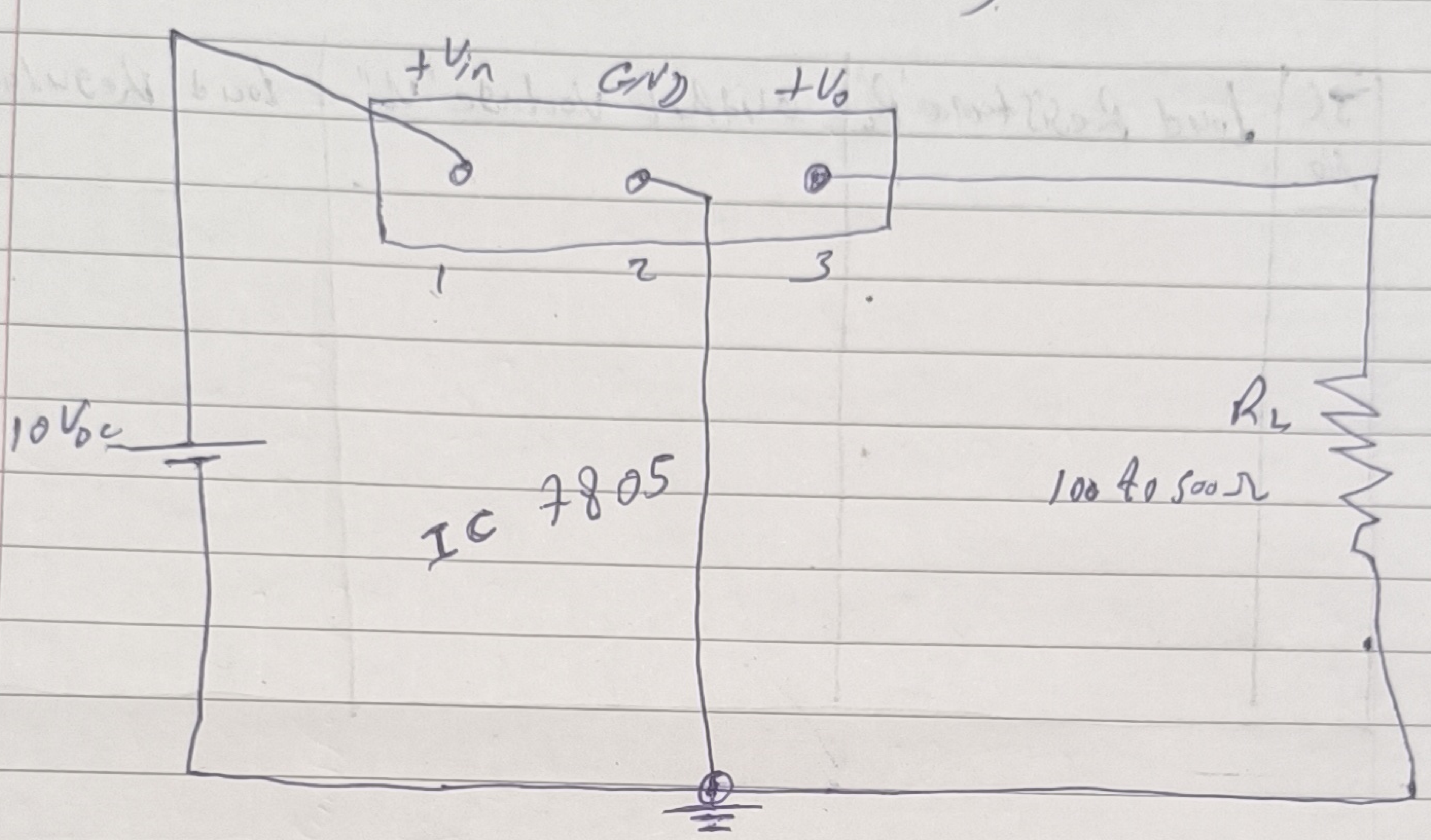


figure 2 (load Regulation)



observation table I line Regulation ($R_L = 500\Omega$)

Sr NO.	input Voltage (V_{in})	output Voltage (V_o)
	~~input Voltage~~ (V_{in})	

Load Regulation,

Sl No.	Load Resistance "R_L"	output Voltage "V_o"	Load Regulation

Conclusion :-