Experiment: To study the Kirchhoff's Voltage and Current law.

Objective: To verify experimentally (i) Kirchhoff's Voltage law (KVL) and (ii) Kirchhoff's current law (KCL)

Apparatus: Virtual Lab using Tinkercad (https://www.tinkercad.com)

Circuit Diagram:

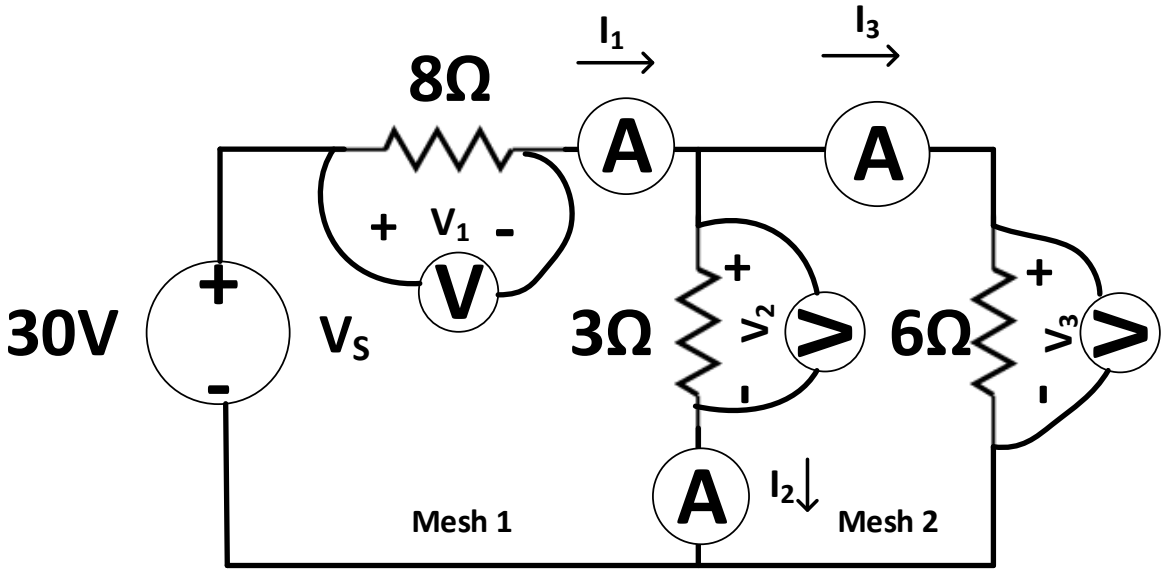

Fig. 1 Circuit diagram for verification for KVL and KCL

Theory:

The two basic laws that give the voltage across and current through an element (resistance, capacitance or inductance) arranged in a network are known as Kirchhoff's voltage law and Kirchhoff's current law respectively and are stated as:

(I) **Kirchhoff's voltage law:** Algebraic sum of voltage drops in a closed mesh is zero.

(II) **Kirchhoff's current law:** Algebraic sum of currents at a node is equal to zero.

Procedure: -

Kirchhoff's current law:

For verification of KCL, the circuit provided is to be simulated in Tinkercad. The steps are as follows:

1. Choose appropriate resistors and power supply from the library of tinkercad. Keep the supply voltage as 10V.

2. For measurement of current in the branches, choose the digital multimeter and set it to Ampere mode. Multiple multimeters would be required to measure current in each branch.
3. Connect the circuit as provided in the circuit diagram. The current is always measured by connecting an ammeter in series with the circuit.
4. Once the circuit is made, press start simulation to take the readings of different ammeters and record the readings. Also for depicting resistance values on the figure, take labels and name them. Take a snapshot of the circuit and paste in manual.
5. For next reading stop the simulation and vary the supply voltage.
6. Increase the voltage in steps of 5V and take 5 readings.
7. Add the currents $\mathbf{I_2+I_3}$ and compare it with I_1 to verify KCL.
8. Also calculate the theoretical values of currents to verify KCL and compare the simulated and theoretical results

Observation Table for KCL:

Sr. No.	Simulation				Theoretical				Error
	I_1	I_2	I_3	$I_1=I_2+I_3$ (a)	I_1	I_2	I_3	$I_1=I_2+I_3$ (b)	(b)-(a)
1.									
2.									
3.									
4.									
5.									

Circuit diagram on Tinkercad for KCL

(paste the snapshot here)

Kirchhoff's voltage law

For verification of KVL, the circuit provided is to be simulated in Tinkercad. The steps are as follows:

1. Choose appropriate resistors and power supply from the library of tinkercad. Keep the supply voltage as 10V.
2. For measurement of voltage across the resistances, choose the digital multimeter and set it to voltage mode. Multiple multimeters would be required to measure voltage in each branch.
3. Connect the circuit as provided in the circuit diagram. The voltage is always measured by connecting a voltmeter in parallel.
4. Once the circuit is made, press start simulation to take the readings of different voltmeters and record the readings. Also for depicting resistance values on the figure, take labels and name them. Take a snapshot of the circuit and paste in manual.
5. For next reading stop the simulation and vary the supply voltage.
6. Increase the voltage in steps of 5V and take 5 readings.
7. Find the algebraic sum of voltages in Mesh 1. Verify KVL.
8. Also calculate the theoretical values of voltages to verify KVL and compare the simulated and theoretical results

Observation Table for KVL:

Observation Table for KVL: Sr. No.	**Simulation**				**Theoretical**				**Error**
	V_S	**V_1**	**V_2**	**$Vs+V_1+V_2$ (a)**	**V_S**	**V_1**	**V_2**	**$Vs+V_1+V_2$ (a)**	**(b)-(a)**
1.									
2.									
3.									
4.									
5.									

Circuit diagram on Tinkercad for KVL

(paste the snapshot here)

Conclusion: *(Write appropriate conclusion here)*