Aim: To verify Kirchhoff's Voltage Law

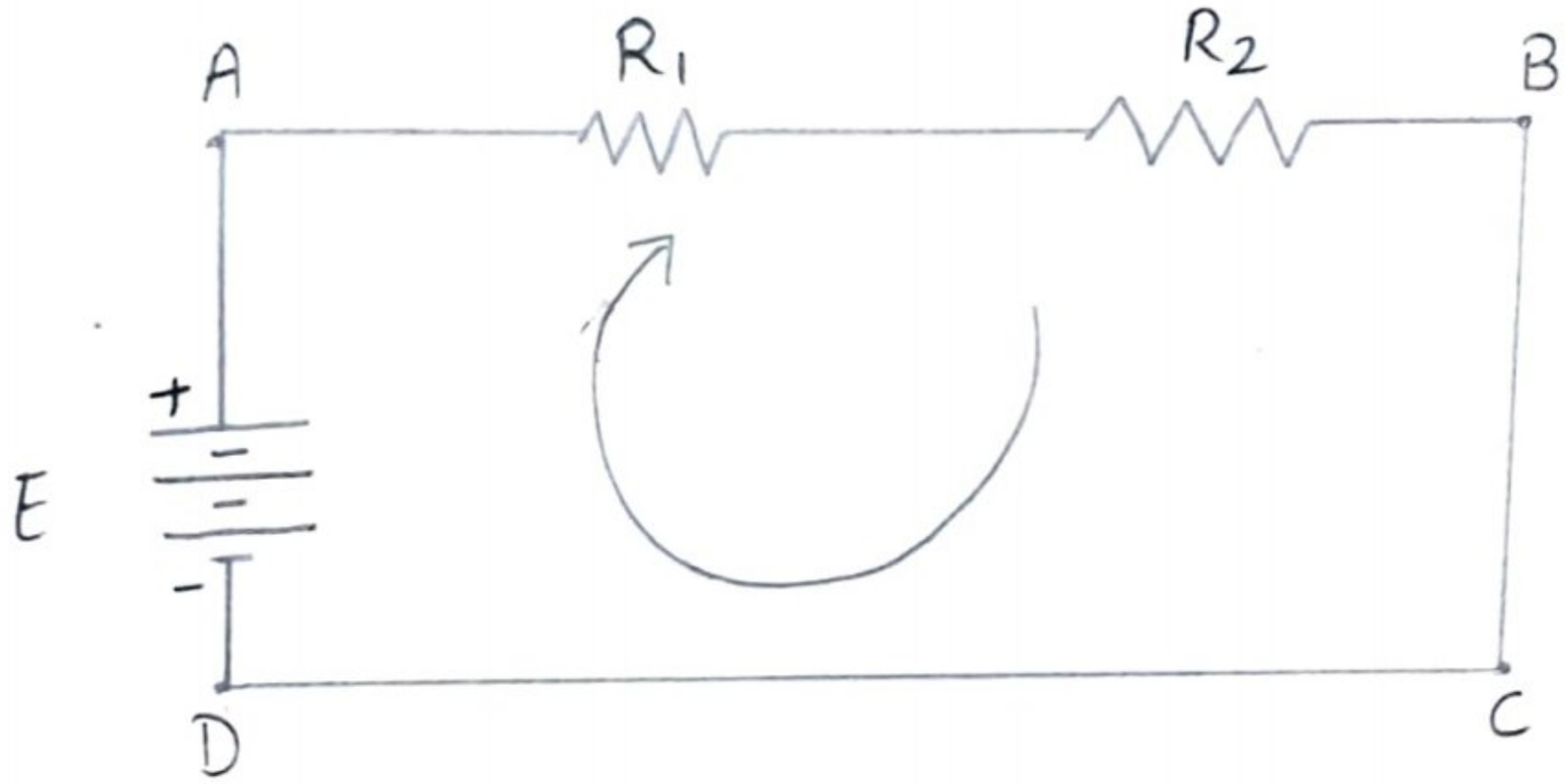

fig 1 => Electric Circuit

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Experiment 1.1

Aim ⇒ To verify Kirchhoff's Voltage Law (KVL)

Apparatus Required ⇒

S.no	Equipment Name	Specifications	Quantity
1	Regulated DC supply	⇒ 0-30V, 0-2A	⇒ 1
2	Digital Multimeter	⇒ 0-30V	⇒ 6
3	Resistor	⇒ of Different values	⇒ 6
4	Connecting wires	⇒ As per requirement	

Theory ⇒

Kirchoff's law are used to determine the current and voltage in different branches of an electric circuit which may not be easily solved by ohm's law. These laws are applicable to both AC and DC circuits.

Statement of KVL or Mesh Law ⇒

In any closed path (mesh or loop) of an electric circuit, the algebric sum of product

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of current and resistance in each of the conductors plus the algebric sum of electromotive forces (emfs) in that closed path is zero

i.e $\Sigma IR + \Sigma emf = 0$

where IR = Potential drop across resistor

Emf = Potential of battery used in the circuit

Σ = algebric Sum

Explanation ⇒

Consider the closed path ABCDA in fig 1.

Different voltage drop will have following signs.

IR_1 is negative (fall in potential)

IR_2 is negative (fall in potential)

E is positive (Rise in potential)

Using KVL, we get,

$-IR_1 - IR_2 + E = 0$ or

$E = IR_1 + IR_2$

Voltage rise = Voltage drops

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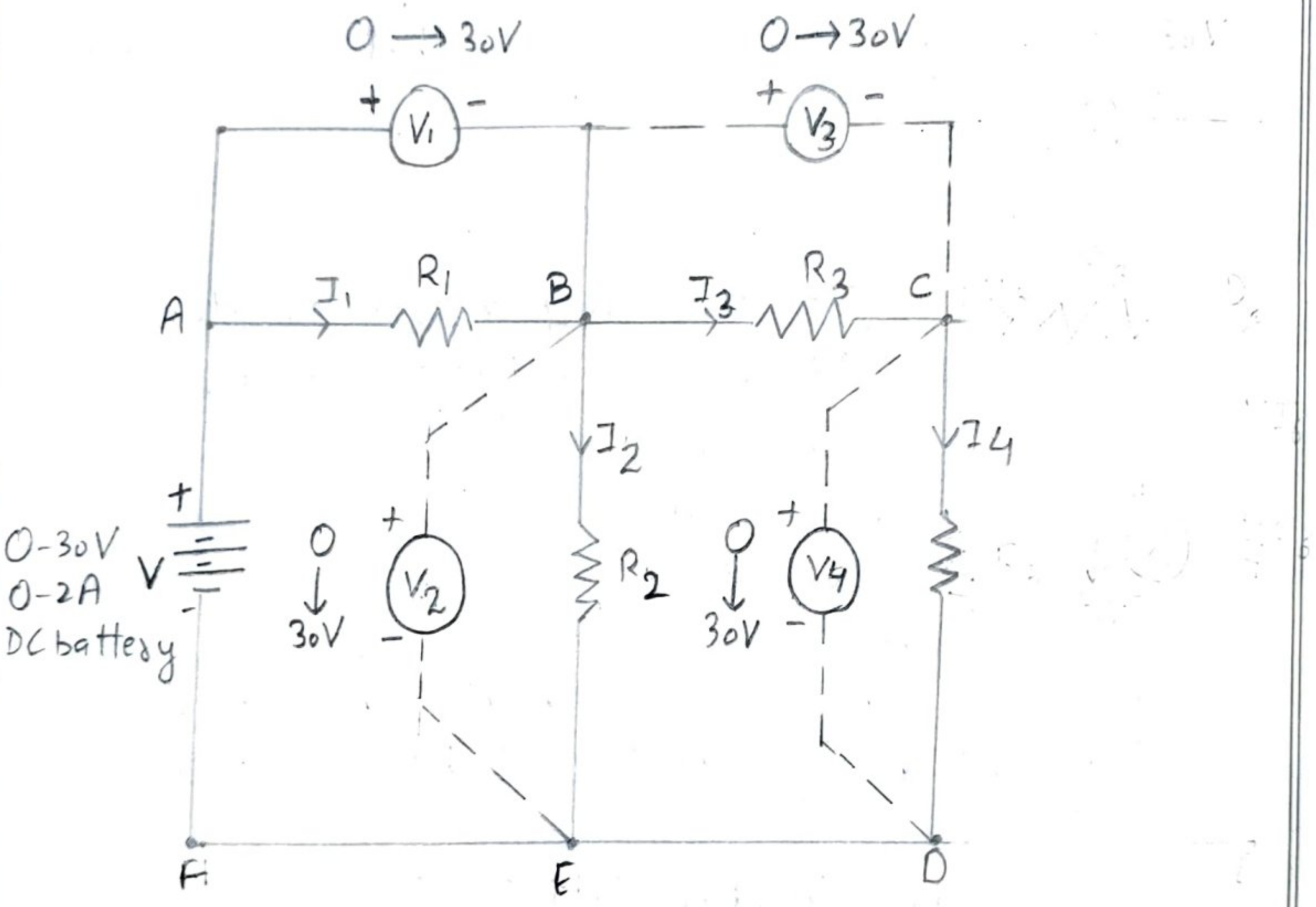

fig 2 circuit diagram of KVL

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Limitations ⇒

1. Not applicable in stray currents environment and in high frequency applications (even KCL is violated at 60 Hz frequency)
2. Not applicable to circuit having distributed elements.

Precautions ⇒

1. Switch of the supply first and then start making connections.
2. Meters of suitable range should be used as shown

PROCEDURE ⇒

1. The circuit is connected as shown.
2. The voltage of DC supply was set at 12 V DC supply.
3. Different values of R_1 to R_4 were taken and readings of V_1 to V_4 were noted down.
4. Accordingly, only one set of reading was taken at 12 V DC supply
5. The observations were recording in Table.

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Observation Table ⇒

S no.	Voltmeter $V_1(V)$	Voltmeter $V_2(V)$	Voltmeter $V_3(V)$	Voltmeter $V_4(V)$
1				

Result ⇒

S.no	Calculated Values (V)			Theoritical Values (V)		
	$V=V_1+V_2$	$V_3=V_2-V_4$		$V=V_1+V_2$	$V_3=V_2-V_4$	
1						

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Calculations ⇒

1

2 APPLY KVL IN LOOP ABEF V = I1R1 + I2R2 OR V = V1 + V2

3 APPLY KVL IN LOOP BCDF V = I3R3 + I4R4 OR V = V3 + V4 ;

Source of Error ⇒

1. Internal resistance of DC battery.
2. Internal resistance of multimeter viz. voltmeter and ammeter
3. Internal resistance of connecting wires.
4. Heating effect of rheostat coil
5. All the sources of error related to multimeter.

Result ⇒

As per Kirchhoff's Voltage Law, the theoretical and calculated values of algebraic sum of emfs and voltage drops are compared as shown

Conclusion ⇒

from Table, the difference in comparison of theoritical and calculated values. The percentage error for $V = V_1 + V_2$, $V_3 = V_2 - V_4$ _____ is found to be _____, _____ and _____. Thus KVL is verified.

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Aim ⇒ To verify Kirchhoff's Current Law (KCL)

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Experiment 1.2

Aim ⇒

To verify Kirchoff's Current Law (KCL)

Apparatus Required ⇒

S.no	Equipment Name	Specifications	Quantity
1	Regulated DC supply	0-30V, 0-2A	1
2	Digital Multimeter	0-2A	6
3	Resistor	of Different values	6
4	Connecting wires	As per requirements	

Theory ⇒

Kirchhoff's law are used to determine the current and voltage in different branches of an electric circuit which may not be easily solved by Ohm's law. These laws are applicable to both AC and DC circuits.

Statement of KCL or point Law ⇒

It states that the algebric sum of all the currents meeting at a junction or a node in any electric circuit at any instant is zero.

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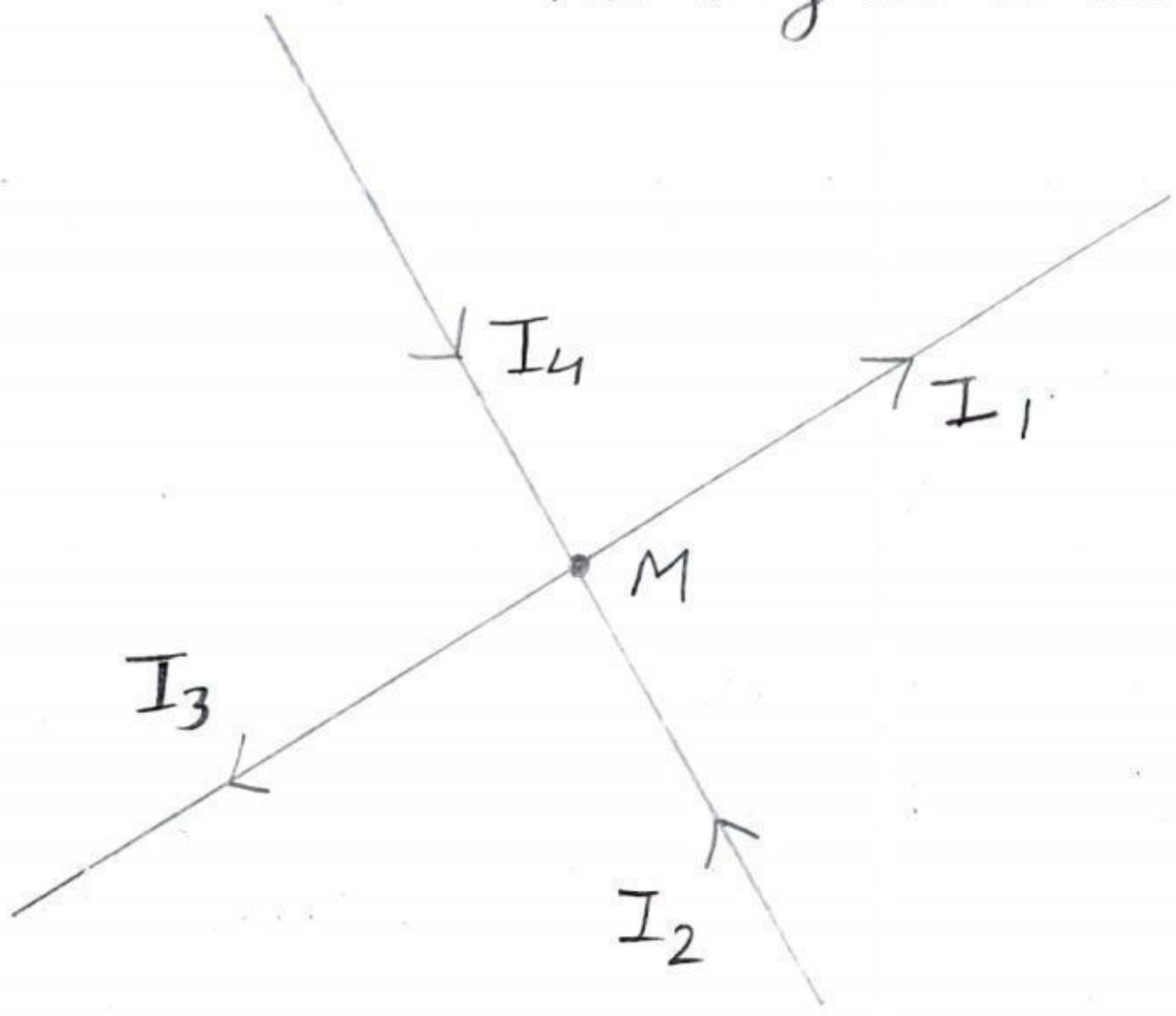
fig 3 ⇒ Current meeting at a node in KCL



Circuit Diagram =)

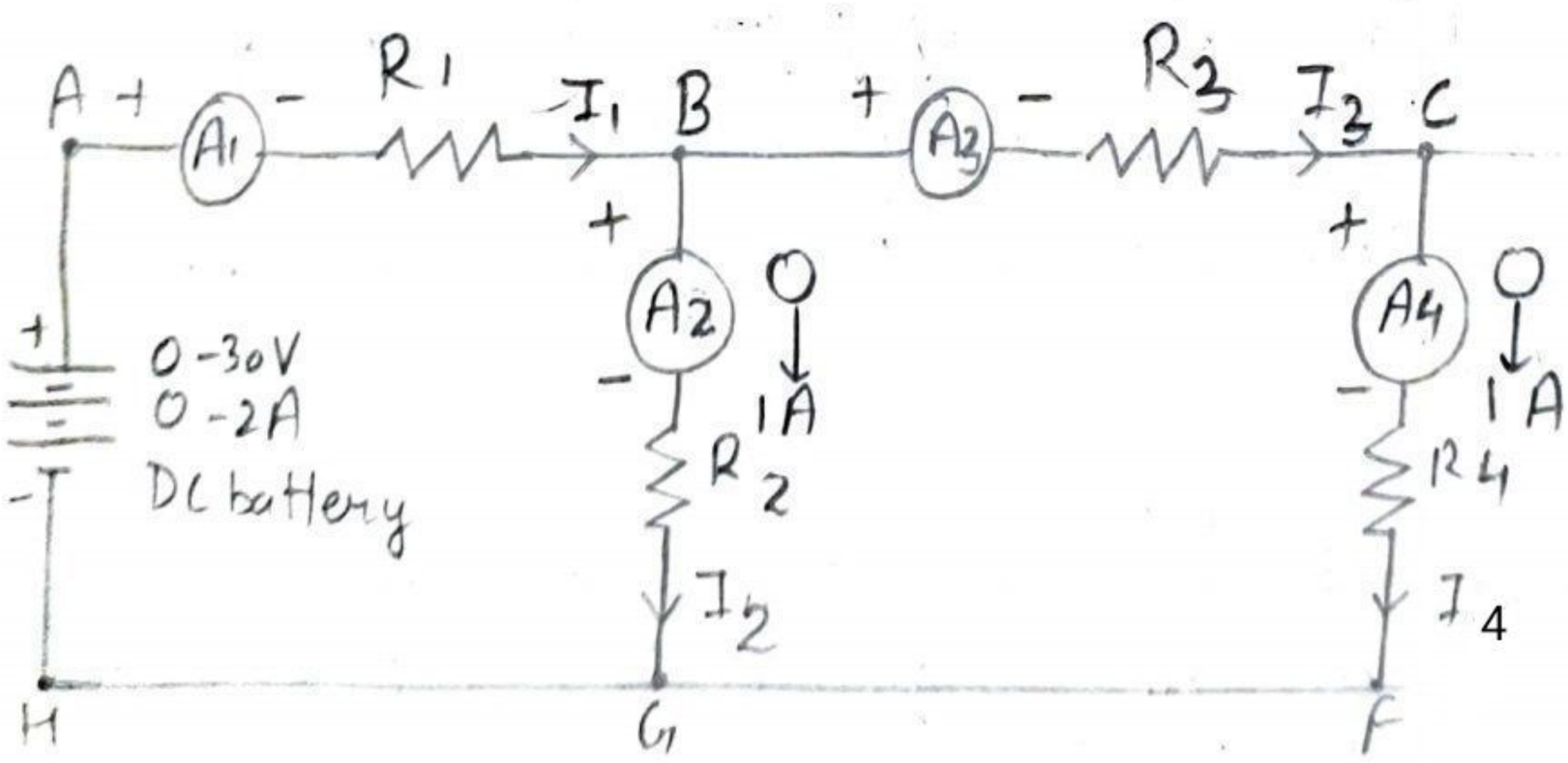


fig 4 Circuit Diagram of KCL

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Explanation ⇒

Consider that few conductors are meeting at point M as in fig. The arrows indicate the direction of current flow. The currents I_2 and I_4 are coming towards the junction M and I_1 and I_3 are going away from the junction. Assume positive sign for incoming currents and negative sign for outgoing currents.

According to KCL.

$\Sigma I = 0$

i.e $I_2 + I_4 = I_1 + I_3$

i.e Incoming currents = Outgoing currents.

Procedure ⇒

1. The circuit is connected as shown
2. The voltage of DC supply was set at 12V
3. Different values of R_1 to R_4 were taken and readings of A_1 to A_4 were noted down.
4. Accordingly, only one set of reading was taken at 12V DC supply.
5. The observation were recorded in table.

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Observation ⇒

Sr no.	Supply Voltage (V)	Ammeter I_1 (A)	Ammeter I_2 (A)	Ammeter I_3 (A)	Ammeter I_4 (A)
1					

Result ⇒

Sr no.	Calculated values (A)		Theoritical values (A)		Percentage error	
	$I_1 = I_2 + I_3$ (A)		$I_1 = I_2 + I_3$ (A)		$I_1 = I_2 + I_3$ (A)	
1						

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Calculations ⇒

1

2 APPLYING KCL AT JUNCTION B, I1 = I2 + I3

CALCULATIONS ARE DONE FOR ALL THE READINGS BEING TAKEN USING EQUATIONS TO BE APPLIED AT RESPECTIVE JUNCTION

Result ⇒

As per Kirchhoff's Current law, the theoretical and calculated values of algebraic sum of currents are compared as shown in table.

Conclusion ⇒

The difference in comparison of theoritical and calculated values should be analyzed and resulting difference if any. In both sets of readings is likely due to various sources of error mentioned in Section. from table, it is seen that error involved is very small and thus, KCL is verified.

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