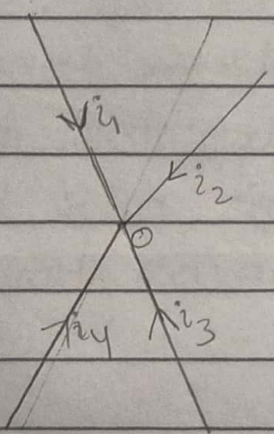
Objective :- Verification of Kirchoff's current law.

Apparatus Required :- Resistor, Battery, Lamp, voltmeter, wire, Ammeter, swith, non-contact Ammeter.

Theory :- According to Kirchoff's current law, in any network of wires carrying currents, the algebraic sums of all currents meeting at a junction (or node) is equal to the sums of the out going currents away from that Junction.



"The algebraic sums of current's flowing towards a junction in an electric circuit is zero."

An algebraic sum is one in which the sign of the quantity is taken into account, for example, consists of four conductors carrying current's i_1, i_2, i_3, and i_4 and meeting point 'O'. If we take the sign's of current flowing towards 'O' as positive, then current's flowing away from point "O" will be assigned negative sign. Thus, applying Kirchoff's 1^{st} law to Junction 'O'.

$$I_1 + I_2 + I_4 + (-I_3) = 0$$

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

Incoming current's = out going current's.

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Hence, Kirchoff's first law can also be stated as under.

The sum of the current's flowing towards any Junction in an electric circuit is equal to the sum of current's flowing away from the Junction.

Kirchoff's 1st law is true because electric current is the flow of electron's and they cannot accumulate at any point in the circuit. Thus, current's i_1, i_2 and i_4 are flowing towards point O and natuarally $(i_1+i_2+i_4)$ must flow out of point O. Therefore, $i_1+i_2+i_4=i_3$.
Also for current to flow either in (or) out of a node a closed circuit path must exist's. we can use Kirchoff's Recalling that current is a signed (+ve (or) −ve) quantity reflecting direction towards (or) away from a node, this principal can be succinctly states as:-

$$\sum_{k=1}^{n} I_k = 0$$ where, n is the total no. of Branches.

with current's flowing towards (or) away from the node. this law is based on the conservation of charge. where the charge (measured in coloumbs). is the product of the current (In ampheres) and the time (In seconds). If the net charge in a region is constant. The current law will hold on the boundaries of the region this means that the current law replies on the fact that the net charge in the wires and components is constant.

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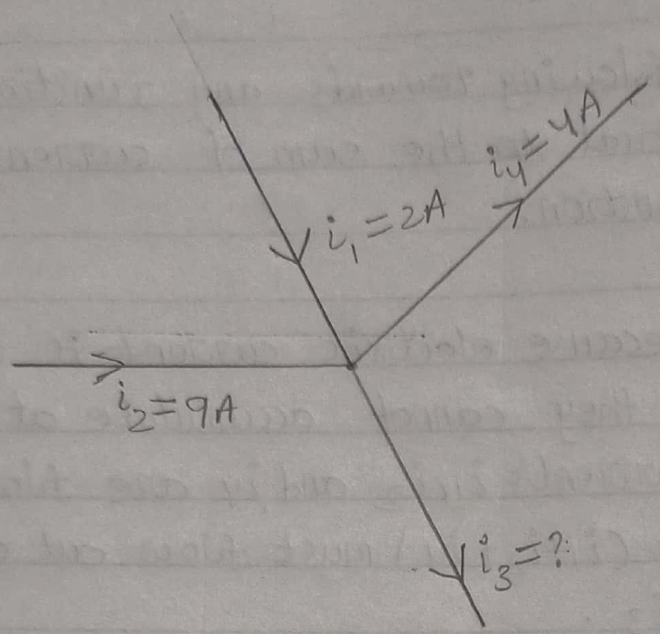
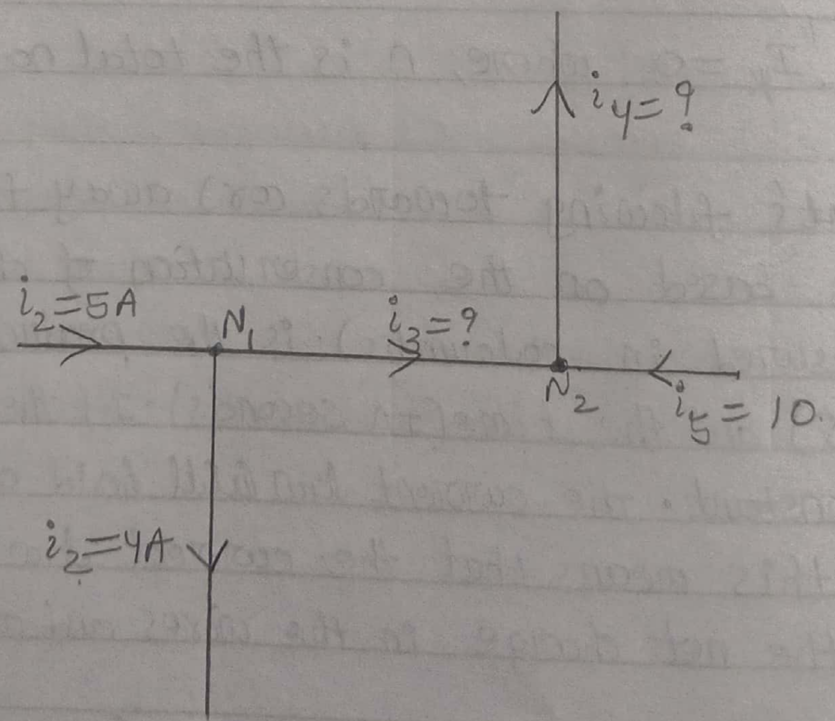
Example - 1



Example - 2



A matrix version of Kirchoff's current law is the basis of most circuit simulation software. The current is used with ohm's law to perform nodal analysis. The current law is applicable to any lumped network irrespective of the nature of the network.

Examples:-

① Find current's i_3 at the node. (Figure-(i)).

Solution:- current's i_1 and i_2 are flowing into the node and current's i_1 and i_2 are flowing into the node and currents i_3 and i_4 are flowing out of the node. Apply Kirchoff's law of current at given node.

$$i_1 + i_2 = i_3 + i_4.$$

substitute, the known quantities

$$2+9 = i_3 + 4$$

$$11 = i_3 + 4$$

$$\boxed{i_3 = 7A}.$$

② Find current's i_3 and i_4 at nodes N_1 and N_2 shown below.

Solution:- At node N_1, i_1 flows into N_1 and i_2 and i_3 flows out of N_1.

so,

$$i_1 = i_2 + i_3$$

$$\Rightarrow 5 = 9 + i_3$$

$$\boxed{i_3 = -4A}$$

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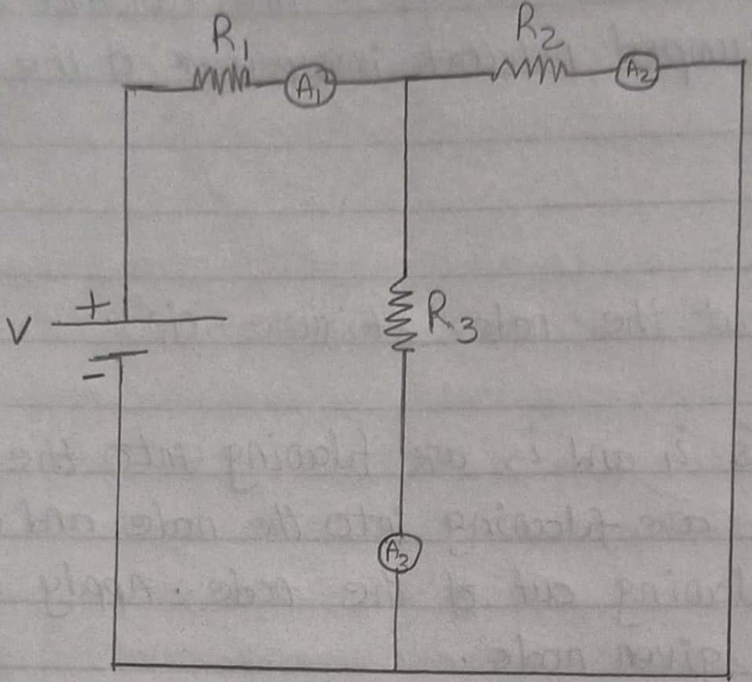
Circuit diagram :-



Observation's :-

S.NO	Reading of Ammeter (A_1)	Reading of Ammeter (A_2)	Reading of Ammeter (A_3)	$I_2 + I_3$
1.	1.333A.	0.667 A	0.667 A	1.334 A
2.	1.669A	0.833A	0.833 A	1.667A
3.	3.334A	1.667A	1.667A	3.334A
4.	2.083A	1.041A	1.042A	2.084A.

Because i_3 is $-ve$, i_3 flows into Node N_1.
At node N_2, i_3 and i_5 flows into N_2 and i_4 flows out of N_2.

$$i_3 + i_5 = i_4$$
$$-4 + 10 = i_4$$
$$\boxed{i_4 = 6A}$$

Because, i_4 is positive, ~~it the~~ i_4 flow's out of Node N_2.

Procedure :- Three rheostats R_1, R_2 and R_3 and ammeter A_1, A_2 and A_3 are connected to 24V battery (or) regulated power supply as shown in figure. The three rheostat's are set their maximum values. supply is switched on and the reacting of the ammeter. A_1, A_2, A_3 are noted The process may be repeated by varying either rheostat's R_1, R_2 and R_3.

Calculations :-

(i) $V_1 = 20V$, $i_1 = 1.333\,A$, $i_2 = 0.667$, $i_3 = 0.667$
$$i_2 + i_3 = 0.667 + 0.667 = 1.333A$$

(ii) $V_2 = 20V$, $i_2 = 0.833A$, $i_3 = 0.883\,A$, $i_1 = 1.667\,A$
$$i_2 + i_3 = 0.833A + 0.883A = 1.667\,A.$$

(iii) $V_3 = 40V$, $i_1 = 3.334\,A$, $i_2 = 1.667A$, $i_3 = 1.667A$.
$$i_2 + i_3 = 1.667 + 1.667 = 3.334\,A.$$

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(iv) $V_4 = 25V$, $i_1 = 2.083A$, $i_2 = 1.041A$, $i_3 = 1.042A$.

$$i_2 + i_3 = 1.041 + 1.042A = 2.083A.$$

Result and discussion :- It is found that current I_1 is equal to the sum of current's I_2 and I_3. Hence, Kirchoff's current law is verified.

Precaution :- (1) All connection's should be tight.
(2) All steps should be followed carefully.
(3) Readings and calculations should be taken carefully
(4) Don't touch the live terminals.

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