Ques 10:- Kirchhoff's Law :-

Answer.

→ Derived by :- Gustav Robert Kirchhoff

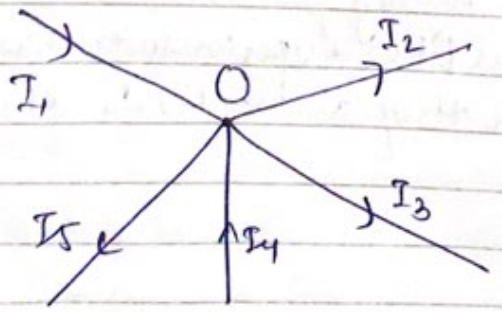
↓

Extension of ohm's law.

① Kirchhoff's 1st law or (KCL):-

States that, in any network of conductors, the algebric sum of currents meeting at a point is zero or the sum of incoming currents towards any point is equal to the sum of outgoing currents away from that point.

Let, I_1, I_2, I_3, I_4 & I_5 meet at O, flow in directions shown by arrow:-



Taking Incoming I as +ve & outgoing -ve, then, from KCL:-

$I_1 - I_2 - I_3 + I_4 - I_5 = 0$

or $I_1 + I_4 = I_2 + I_3 + I_5$

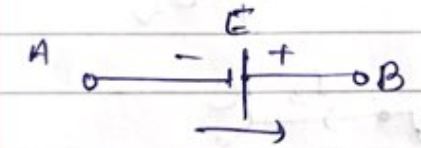
∴ Incoming I = Outgoing I

$\Sigma I = 0$ at junction (O).

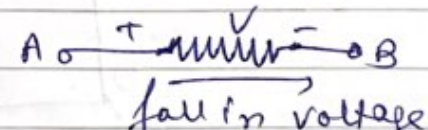
(2) Kirchhoff's 2nd Law or (KVL)s-

States that, the algebraic sum of the product of Current & Resistance in each of the conductors in any closed mesh (or path) in a network plus the algebraic sum of the e.m.f.'s in that path is Zero.

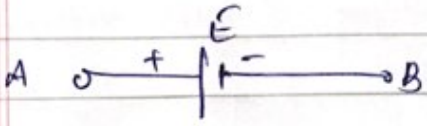
$$\Sigma IR + \Sigma \text{e.m.f.} = 0.$$



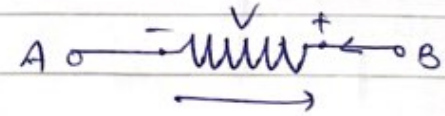
Rise in voltage
+E



fall in voltage
−V



fall in voltage
−E



Rise in voltage
+V

So, $I_1 R_1$ is Ove (fall in potential).

$I_2 R_2$ is Ove (" " ").

$I_3 R_3$ is ⊕ve (Rise in pot.)
$I_4 R_4$ is ⊖ve (fall in ")
E_2 is ⊖ve (fall in ")
E_1 is ⊕ve (Rise " ")

from KVL :-

$$-I_1 R_1 - I_2 R_2 + I_3 R_3 - I_4 R_4 - E_2 + E_1 = 0.$$

or, $I_1 R_1 + I_2 R_2 - I_3 R_3 + I_4 R_4 = E_1 + E_2$