Ohm’sLaw:
Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference or voltage across the two points, and inversely proportional to the resistance between them. The mathematical equation that describes this relationship is:
I = V / R

$$I = \frac{V}{R}$$

where I is the current through the resistance in units of amperes, V is the potential difference measured across the resistance in units of volts, and R is the resistance of the conductor in units of ohms. More specifically, Ohm's law states that the R in this relation is constant, independent of the current.

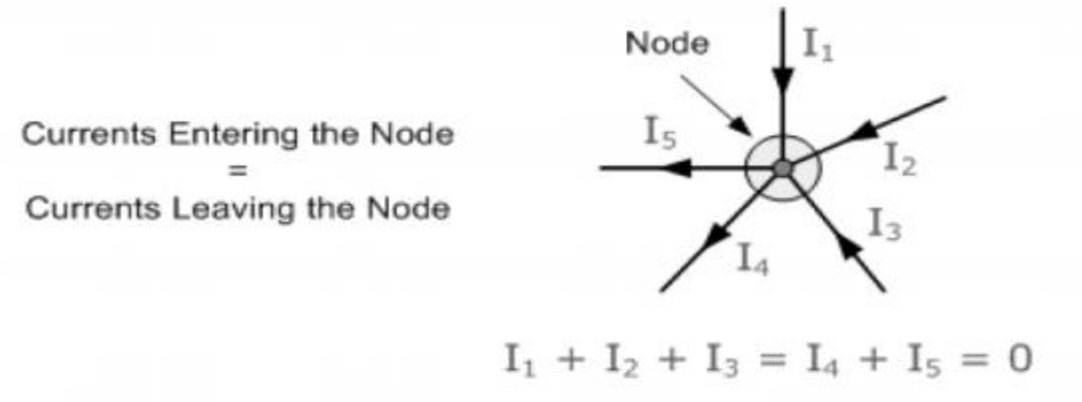
3. KIRCHOFF'S LAW
Kirchoff's First Law - The Current Law, (KCL)

"The total current or charge entering a junction or node is exactly equal to the charge leaving the node as it has no other place to go except to leave, as no charge is lost within the node".

In other words the algebraic sum of ALL the currents entering and leaving a node must be equal to zero,

I(exiting) + I(entering) = 0.

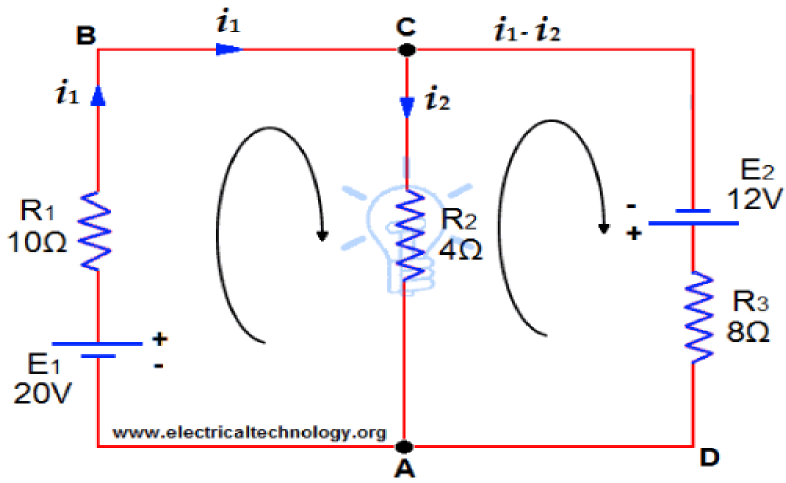
This idea by Kirchoff is known as the Conservation of Charge**.**



Here, the 3 currents entering the node, I1, I2, I3 are all positive in value and the 2 currents leaving the node, I4 and I5 are negative in value.

Then this means we can also rewrite the equation as; I1 + I2 + I3 - I4 - I5 = 0

Resistors of $R_1 = 10\Omega$, $R_2 = 4\Omega$ and $R_3 = 8\Omega$ are connected up to two batteries (of negligible resistance) as shown. Find the current through each resistor.



Solution:

Assume currents to flow in directions indicated by arrows.

Apply KCL on Junctions C and A.

Therefore, current in mesh ABC = i_1

Current in Mesh CA = i_2

Then current in Mesh CDA = $i_1 - i_2$

Now, Apply KVL on Mesh ABC, 20V are acting in clockwise direction. Equating the sum of IR products, we get;

$$10i_1 + 4i_2 = 20 \quad \ldots \quad (1)$$

In mesh ACD, 12 volts are acting in clockwise direction, then:

$8(i_1 - i_2) - 4i_2 = 12$

$8i_1 - 8i_2 - 4i_2 = 12$

$$8i_1 - 12i_2 = 12 \quad \ldots \quad (2)$$

Multiplying equation (1) by 3;

$30i_1 + 12i_2 = 60$

Solving for i_1

$30i_1 + 12i_2 = 60$

$8i_1 - 12i_2 = 12$

$38i_1 = 72$

The above equation can be also simplified by Elimination or Cramer's Rule.

$\boldsymbol{i_1}$ = 72 ÷ 38 = **1.895 Amperes** = Current in 10 Ohms resistor

Substituting this value in (1), we get:

$10\,(1.895) + 4i_2 = 20$

$4i_2 = 20 - 18.95$

$\boldsymbol{i_2}$ = **0.263 Amperes** = Current in 4 Ohms Resistors.

Now,

$\boldsymbol{i_1 - i_2}$= 1.895 – 0.263 = **1.632 Amperes**