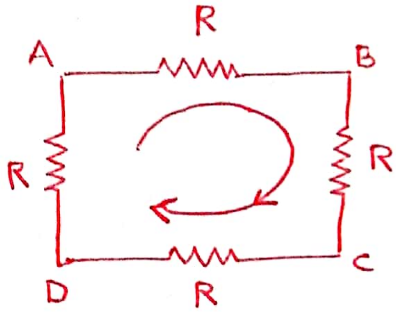
Gustav KIRCHOFF'S LAWS → 1845 → German Scientist

(i) Kirchoff's Voltage Law (KVL)

(ii) Kirchoff's Current Law (KCL)

KVL → The sum of all voltages around a loop is equal to zero.

Mathematically:-

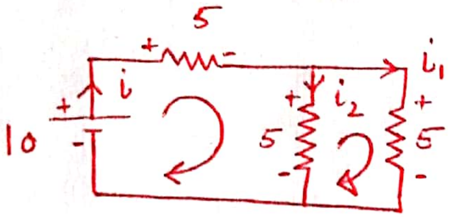


$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$

[Note: $V = IR$]

Method-1

Example: 1



$10 - 5i - 5i_2 = 0$

$5i + 5i_2 = 10$ —(1)

$5i_2 - 5i_1 = 0$

$i_1 = i_2$ —(2)

$i_1 + i_2 = i$ —(3)

$2i_1 = i$

$i_1 = i/2 = i_2$ —(4)

From (1) and (4)

$5 \times 2i_2 + 5i_2 = 10$

$15i_2 = 10$

$i_2 = \frac{10}{15} = \frac{2}{3} = i_1$

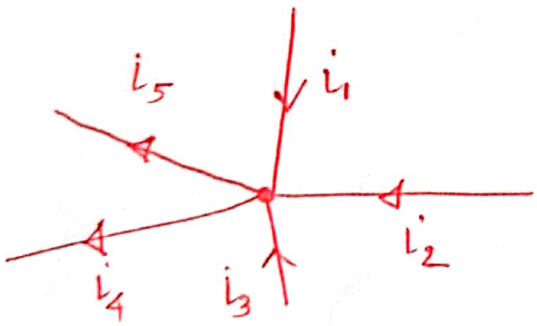
from-(3)

$\frac{2}{3} + \frac{2}{3} = i \Rightarrow \frac{4}{3}$

(ii) KCL states that, total current or charge entering a junction or Node is exactly equal to the charge leaving the node.

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

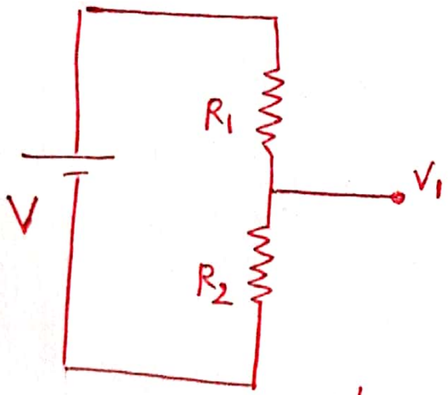
$I_{going} + I_{entering} = 0$ Conservation of Charge.



$i_1 + i_2 + i_3 = i_4 + i_5$ —(i)

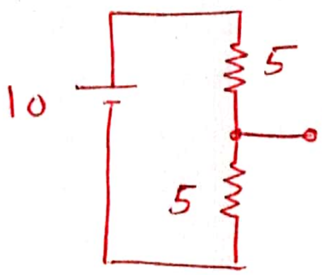
$i_1 + i_2 + i_3 - i_4 - i_5 = 0$ —(2)

Voltage Devider Rule.



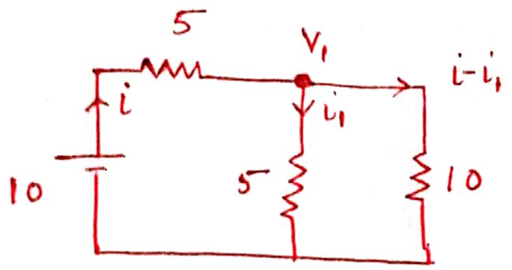
$$V_1 = \frac{V R_2}{R_1 + R_2}$$

ex. 1



$$V_1 = \frac{10 \times 5}{10}$$
$$= 5V$$

Example-1

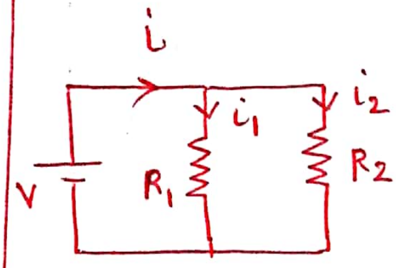


$$V_1 = \frac{10 \times 10/3}{5 + 10/3} = \frac{100 \times \cancel{3}}{\cancel{3}[15+10]}$$
$$= \frac{100}{25} = 4V$$

i_1 $V_1 = i_1 \times 5 \Rightarrow i_1 = \frac{4}{5} = 0.8$

$i - i_1 = 4/10 = 0.4$

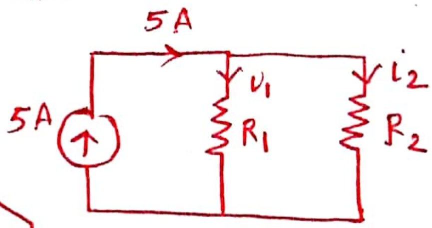
Current Devider Rule.



$$i_1 = \frac{R_2 \, i}{R_1 + R_2}$$

$$i_2 = \frac{i \times R_1}{R_1 + R_2}$$

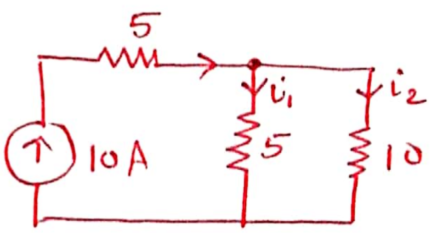
ex. 1



$$i_1 = \frac{5 \times R_2}{R_1 + R_2}$$

$$i_2 = \frac{5 \times R_1}{R_1 + R_2}$$

Example-1



KVL ✗

$$10 = i_1 + i_2$$

$$i_1 = \frac{10 \times 10}{25}$$

$$i_2 = \frac{10 \times 5}{25}$$