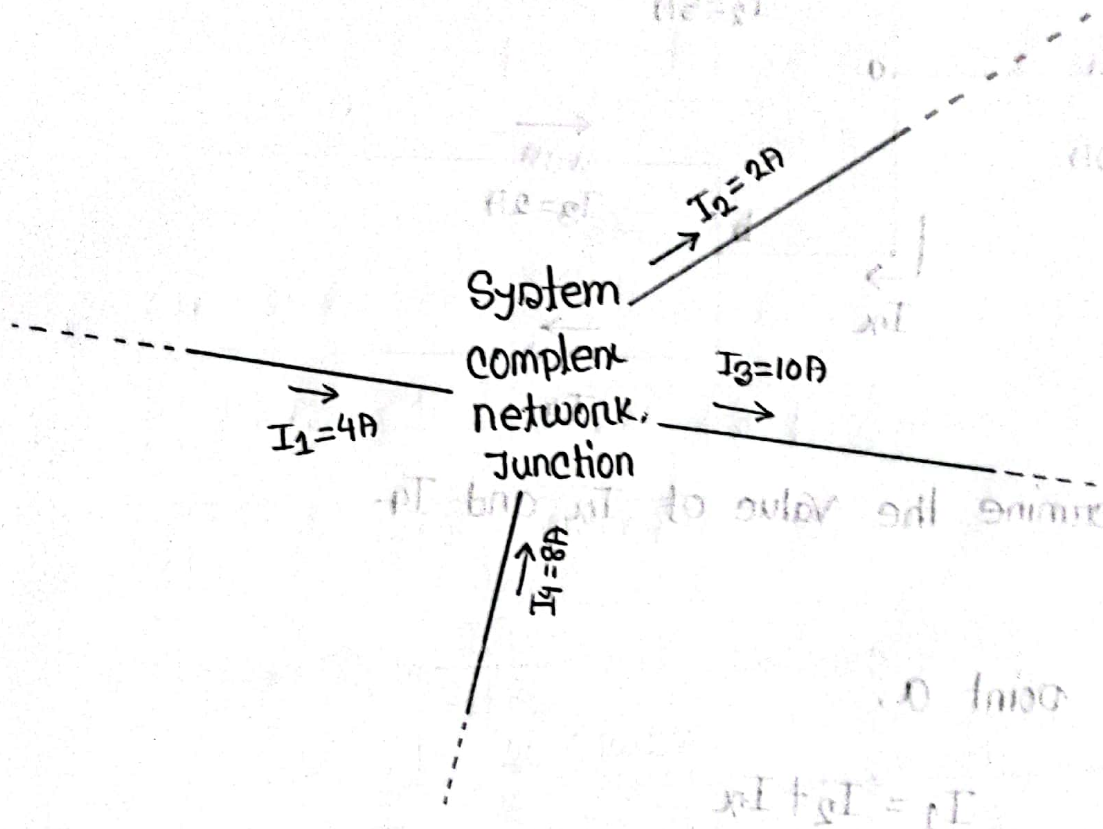
*** KCL:** The algebric sum of the currents entering and leaving a junction of a network is zero.



In equation form, the above statement can be written as follows:

$$\sum I_{in} = \sum I_{out}$$

$$\downarrow \qquad \downarrow$$

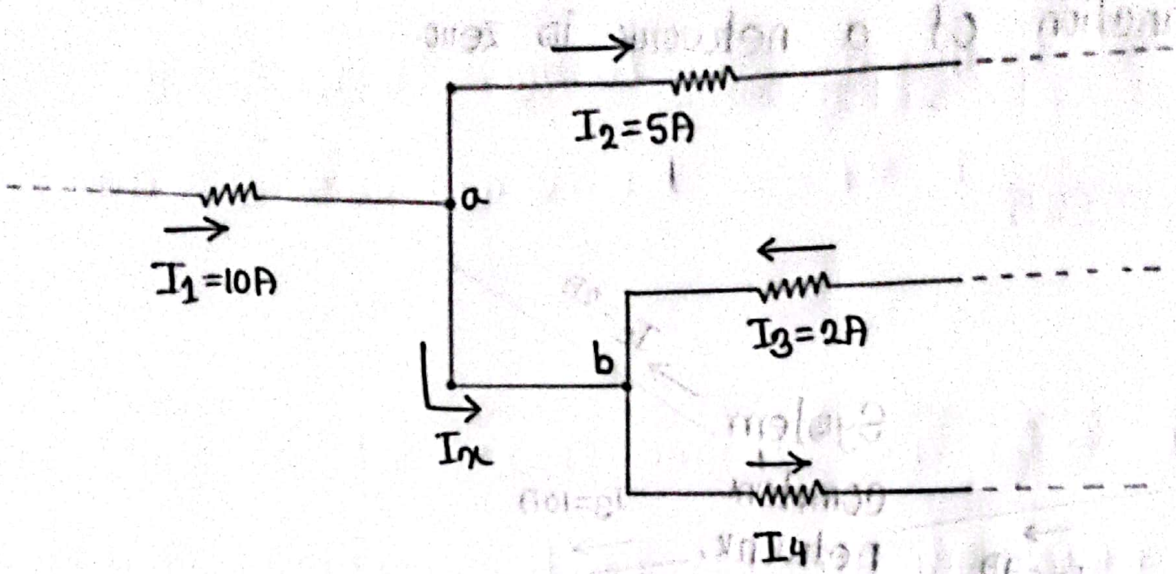
$$I_i \qquad I_o$$

$\Rightarrow I_1 + I_4 = I_2 + I_3$

$\Rightarrow 4A + 8A = 2A + 10A$

$\therefore 12A = 12A$ (checks)

Problem:



Q: Determine the value of I_x and I_4.

Soln:

At point a,

$$I_1 = I_2 + I_x$$

$$\Rightarrow I_x = I_1 - I_2 = 10 - 5 = 5A$$

$$\therefore I_x = 5A$$

At point b,

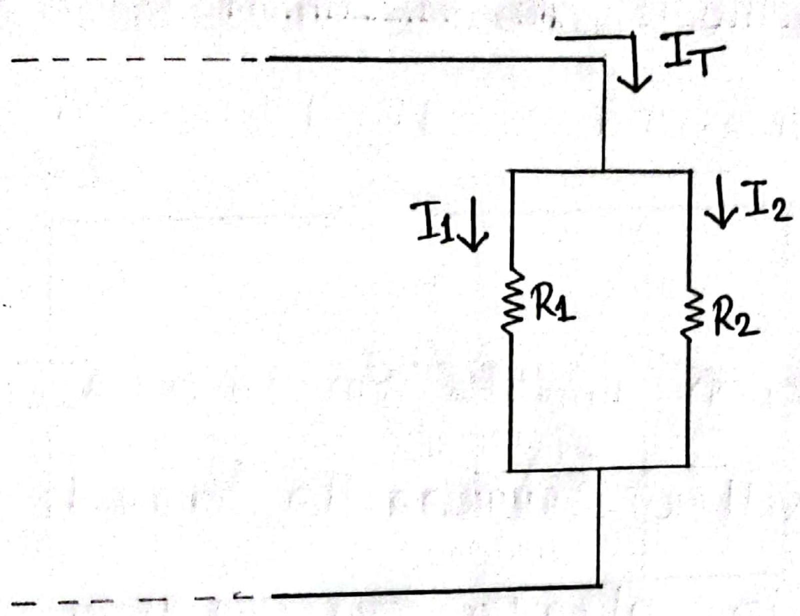
$$I_4 = I_x + I_3$$

$$= 5A + 2A$$

$$= 7A$$

$$\therefore I_4 = 7A$$

Current Divider Rule: [CDR]



$$\rightarrow R_T = \frac{R_1 R_2}{R_1 + R_2}$$

* $I_1 = \dfrac{E}{R_1}$

$$= \frac{I_T \times R_T}{R_1}$$

$$= \frac{I_T\left(\frac{R_1 R_2}{R_1+R_2}\right)}{R_1}$$

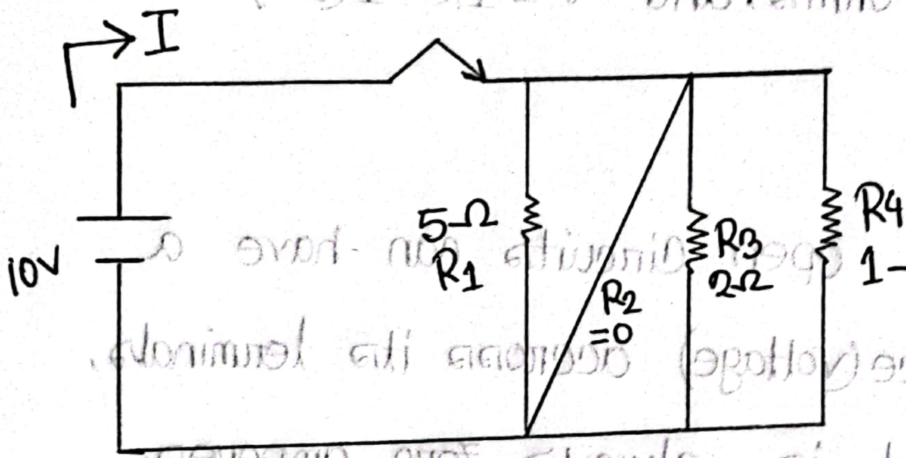
$$\therefore\ I_1 = \left(\frac{R_2}{R_1+R_2}\right) I_T \quad **$$

$$\text{and } I_2 = \left(\frac{R_1}{R_1+R_2}\right) I_T \quad **$$

*Ratio Rule:

$$\rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1}$$

☐ **Short Circuit:** A short circuit is a very low resistance, direct connection between two terminals of a network.



$$\frac{1}{R_T} = \frac{1}{5} + \frac{1}{0} + \frac{1}{2} + \frac{1}{1}$$

$$\Rightarrow \frac{1}{R_T} = \infty$$

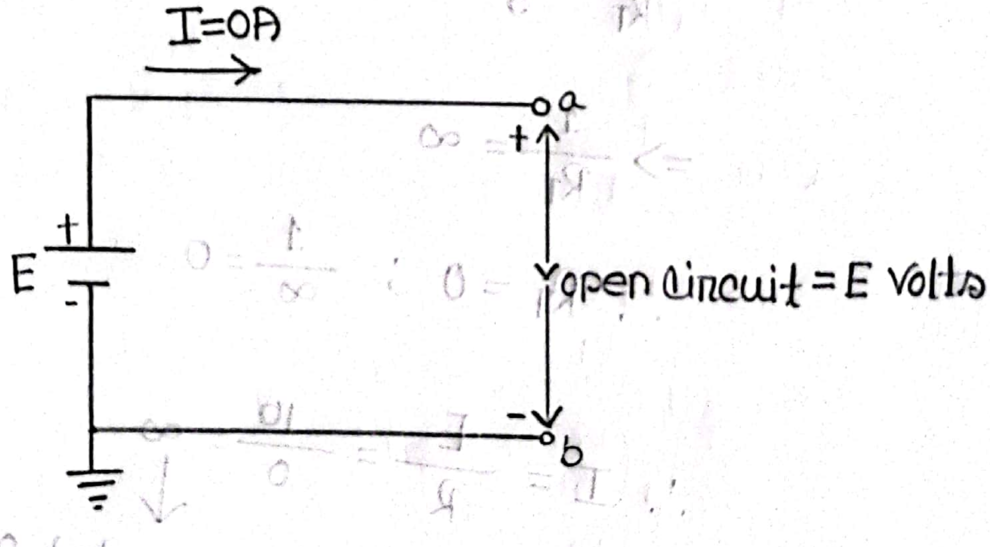
$$\therefore R_T = 0 \;;\; \frac{1}{\infty} = 0$$

$$\therefore I = \frac{E}{R} = \frac{10}{0} = \infty$$

Shorted out

The current throught the short circuit can be any value, as determined by the system it is connected to, but the voltage accross the short circuit is always zero volts because the resistance of the short circuit is assumed to be essentially zero ohm's, and $V = IR = I(0\Omega) = 0V$.

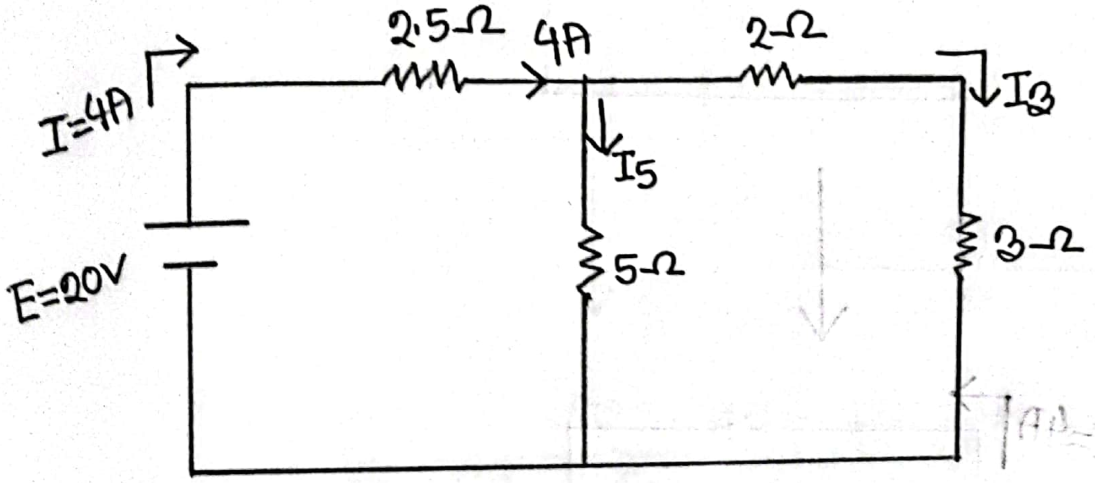
Open Circuits: An open circuits can have a potential difference (voltage) accross its terminals, but the current is always zero amperes.



Chapter-7

Series-Parallel Circuit:

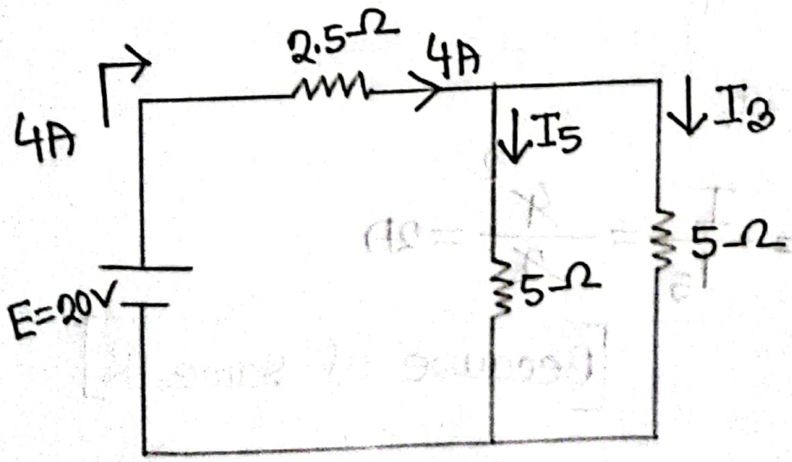
Reduce and Return Approach:



Find I_5 and I_3.

Here, $R_T = 5\Omega$; $\begin{cases} R_S = 3+2 = 5\Omega \\ R_P = \frac{5\times5}{5+5} = \frac{25}{10} = 2.5\Omega \end{cases}$

$\therefore R_T = 2.5 + 2.5\Omega$
$= 5\Omega$

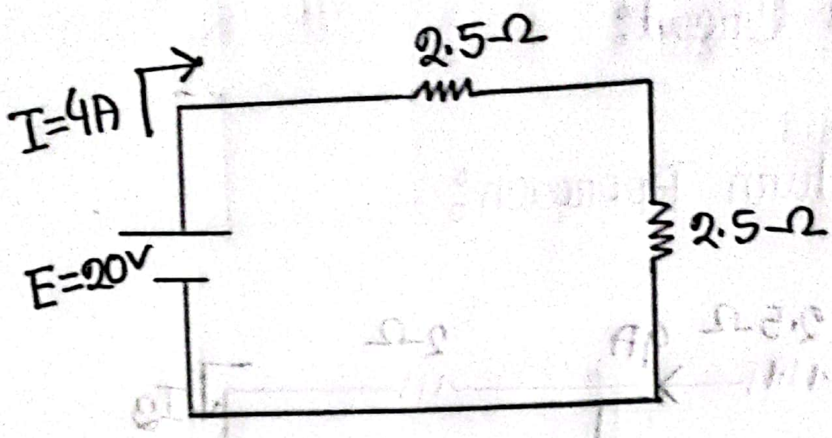


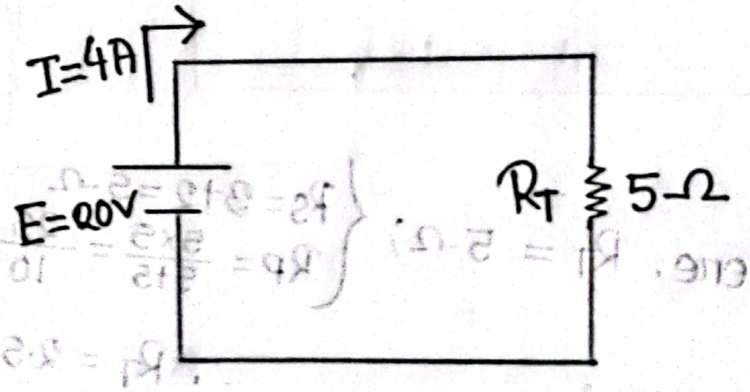
$* I_5 = \frac{5}{5+5} \times I_T$

$= \frac{\cancel{5}^{1}}{\cancel{10}_{\cancel{2}}} \times \cancel{4}^{2}$

$= 2A$

$\therefore I_5 = 2A$





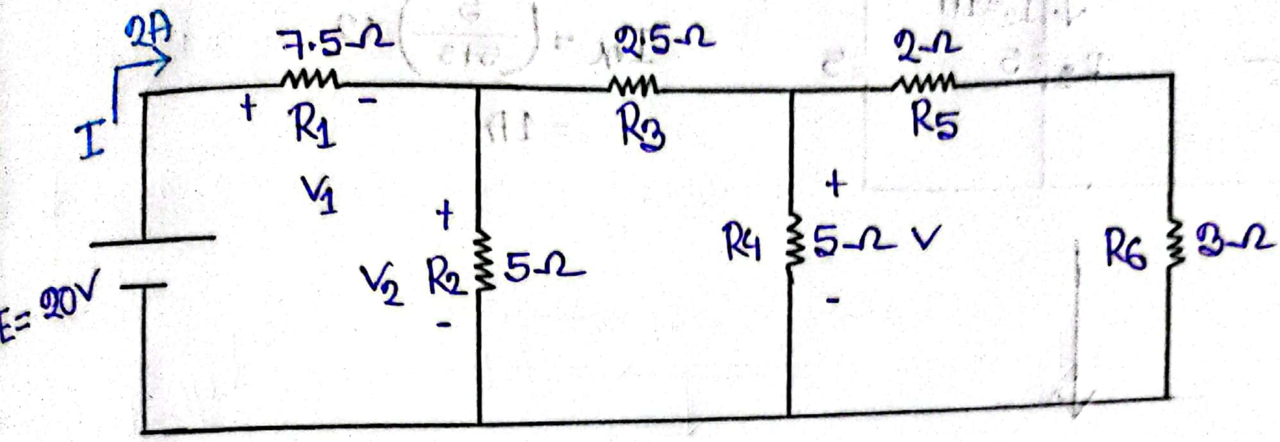
- $I = \frac{E}{R_T} = \frac{20}{5} = 4A$

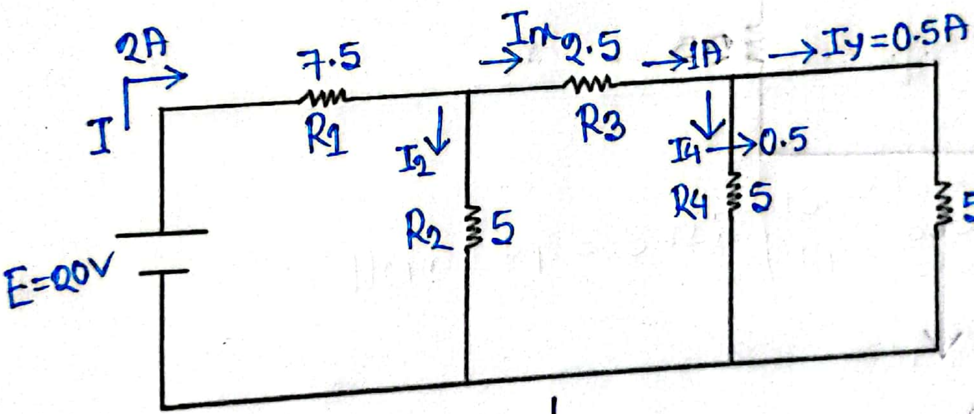
- $I_5 = 2A$

$\therefore I_3 = \frac{I}{I_5} = \frac{\cancel{4}^{2}}{\cancel{2}} = 2A$

[Because of Same R]

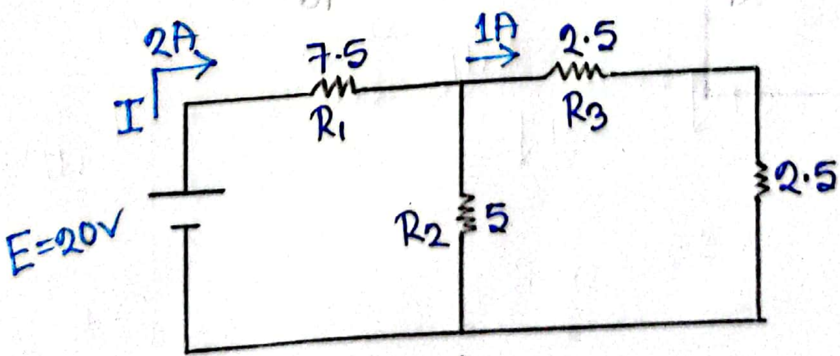
Ladder Network:

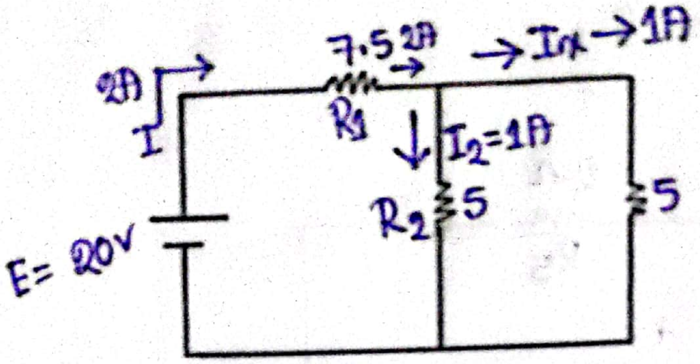




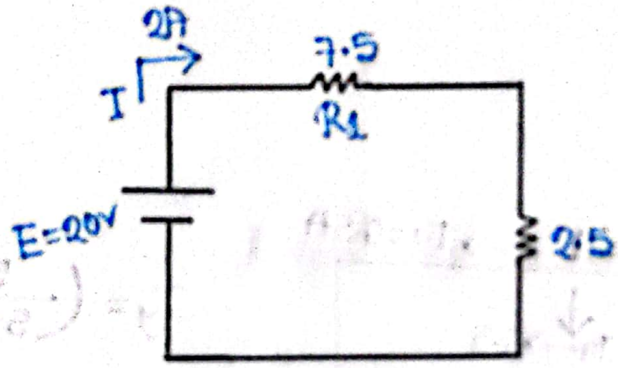
$$I_y = \left(\frac{5}{5+5}\right) \times 1$$

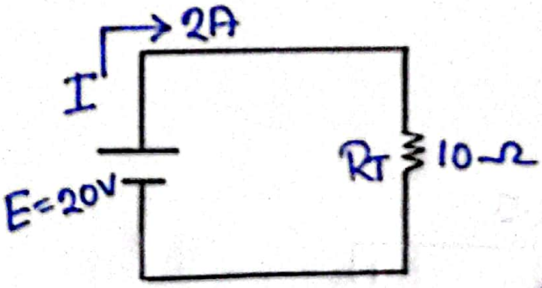
$$= 0.5\ A$$





$$I_x = \left(\frac{5}{5+5}\right)\times 2$$
$$= 1A$$





$$I = \frac{20}{10} = 2A$$