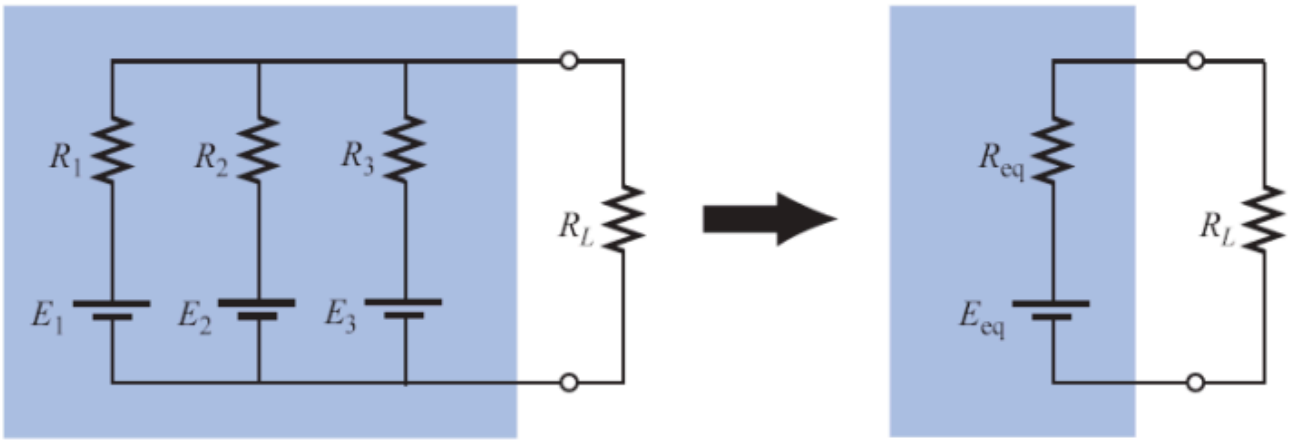
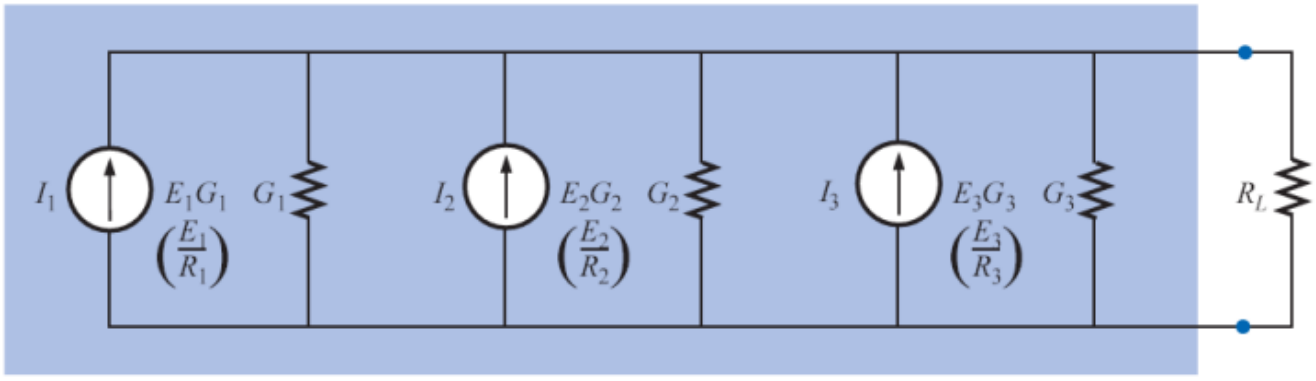
17 - Millman's Theorem

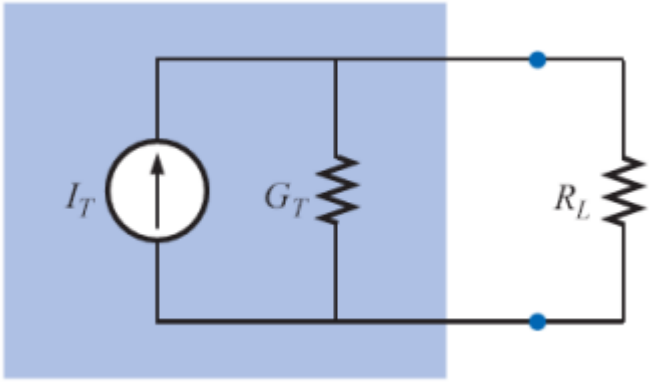
Through the application of Millman's theorem, any number of parallel voltage sources can be reduced to one



Firstly, we need to convert each of the voltage source to it's corresponding current source by applying source transformation



Then, we need to combine all the parallel current sources.

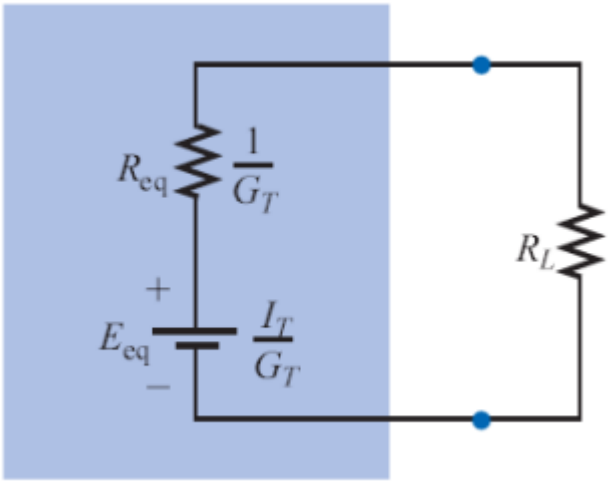


Where,

$I_T = I_1 + I_2 + I_3$

$G_T = G_1 + G_2 + G_3$

Next, we need to convert the resulting current source to a voltage source by using source transformation and that will result in the desired single-source network



$$E_{eq} = \frac{I_T}{G_T} = \frac{\pm I_1 \pm I_2 \pm I_3 \pm \ \ldots \ \pm I_N}{G_1 + G_2 + G_3 + \ \ldots \ G_N}$$

$$\therefore E_{eq} = \frac{\pm E_1 G_1 \pm E_2 G_2 \pm E_3 G_3 \pm \ \ldots \ \pm E_N G_N}{G_1 + G_2 + G_3 + \ \ldots \ G_N}$$

The plus-and-minus signs appear in those cases where the sources may not be supplying energy in the same direction.

The equivalent resistance would be,

$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ \ldots \ + \frac{1}{R_N}}$$