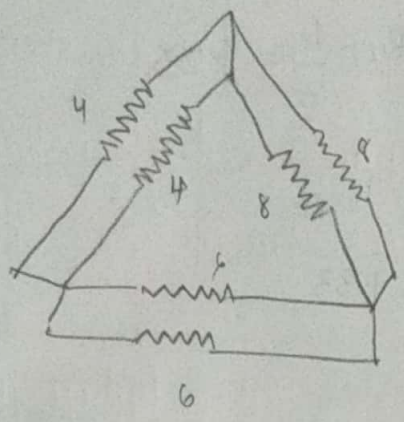


$$R_3 = (R_{31} + R_{23}) \times R_{12}$$

$$= \frac{(R_1 + R_{23})R_{12}}{R_{12} + R_{23} + R_{31}}$$

$$= \frac{R_{12}R_{31} + R_{23}R_{31}}{R_{12} + R_{21} + R_{31}}$$

Energy sources:

- Energy sources
  - Dependent sources
    - VCVS
    - CCVS
    - VCCS
    - CCCS
  - Independent sources
    - Ideal sources
      - Ideal voltage source
      - Ideal current source
    - practical sources
      - P. voltage source
      - P. current source

V → voltage
C → control
C → current
S → source

Idependent source:

In these type of sources the voltage or current do not change by any variation in a connected network.

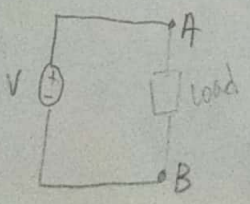
1. Ideal sources:

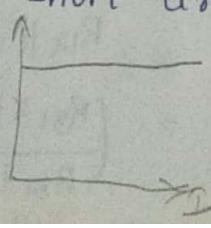
Which donot have any internal resistance.

(i) Ideal voltage source

The voltage in a given network is cont. irrespective of other parameters.

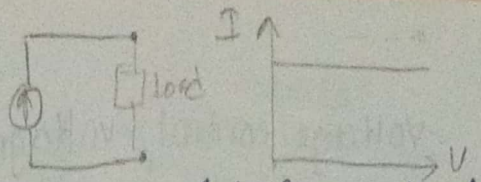
The internal resistance of the ideal voltage source is zero. Hence it is replaced by short circuit.





R∞

(ii) Ideal current source:

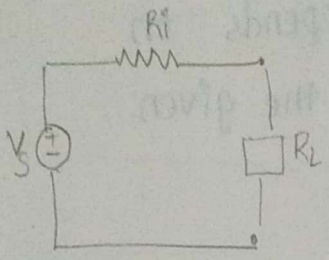


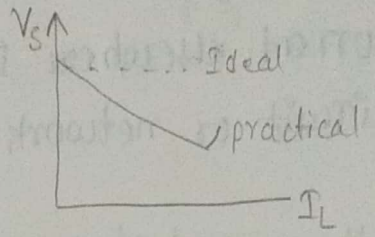
The current in the given network maintain constant irrespective of other parameters (voltage, R, L, C).

open circuit

2. (i) Practical voltage source:

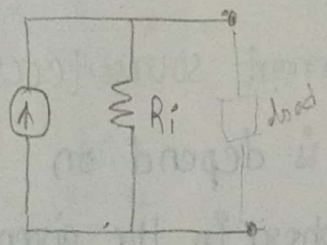
The voltage source which have some internal resistance in serie with practical voltage source

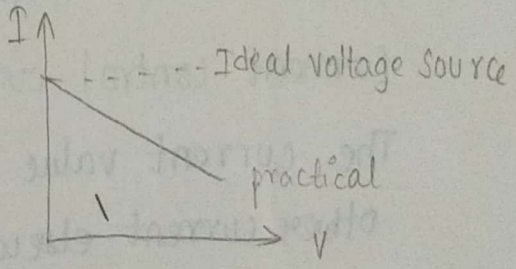




(ii) Practical current source:

The current source will have some internal resistance in parallel with ideal current source.



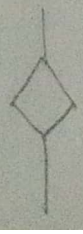


~~Internal resistance of~~

Dependent sources: [or] Controlled sources.

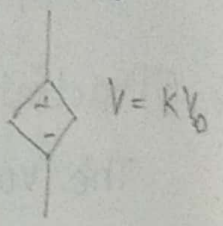
The voltage or current sources change due to any variation in a connected network. These sources are also called as controlled sources.

It is denoted by diamond symbol



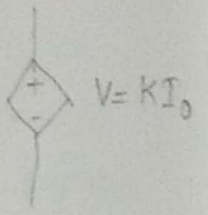
voltage control voltage source (VCVS):

The voltage value is depends on other voltage elsewhere in the given circuit or network.



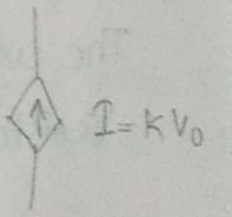
Current control voltage source (CCVS):

The voltage value is depends on current elsewhere in the given circuit or network



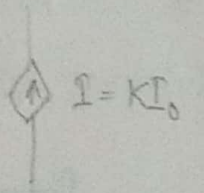
Voltage control current source (VCCS):

The current value depend on voltage elsewhere in the given circuit or network.

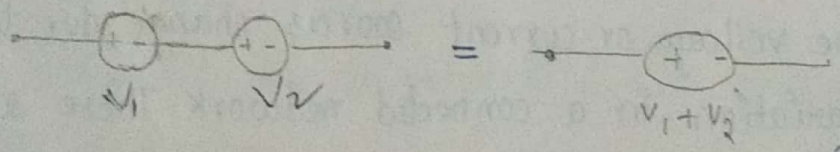


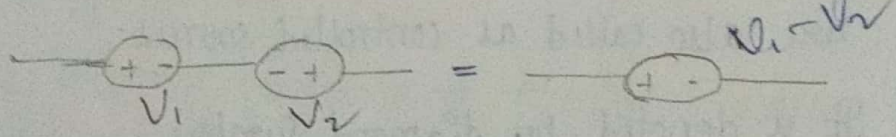
Current control current source (CCCS):

The current value is depend on other current elsewhere in the given circuit or network

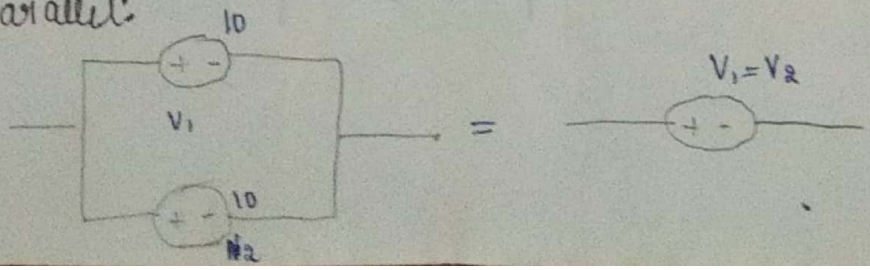


Voltage Sources:

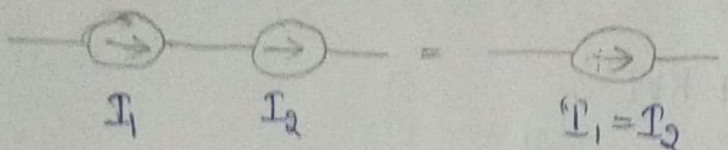




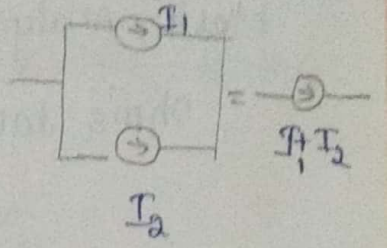
Parallel:



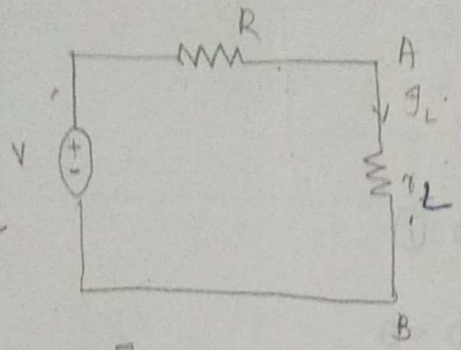
Current series:



Parallel:

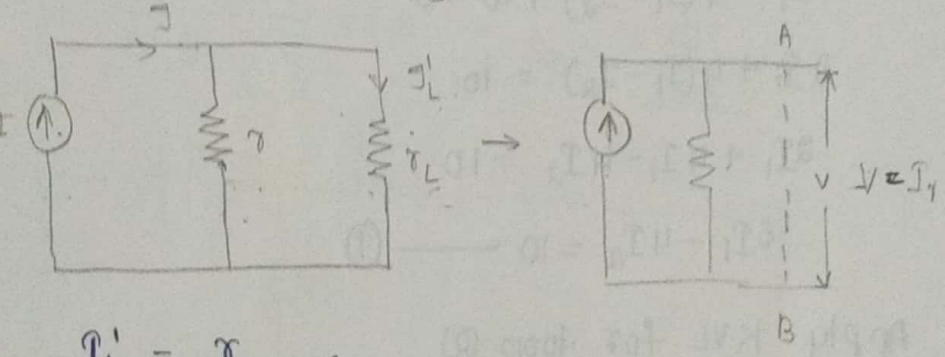


Source Transformation technique:



voltage

$$I_L = \frac{V}{R + r_L}$$



current

$$I_L' = \frac{r}{r + r_L} \times I$$

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

$$I_L' = \frac{Ir}{r + r_L}$$

$$I = I_L'$$

$\frac{I}{r} + \frac{I}{r_L}$

$$\frac{V}{R + r_L} = \frac{Ir}{r + r_L}$$

$$\frac{V}{R + r_L} = \frac{V}{r + r_L}$$

$$r + r_L = R + r_L$$

$$\boxed{r = R}$$