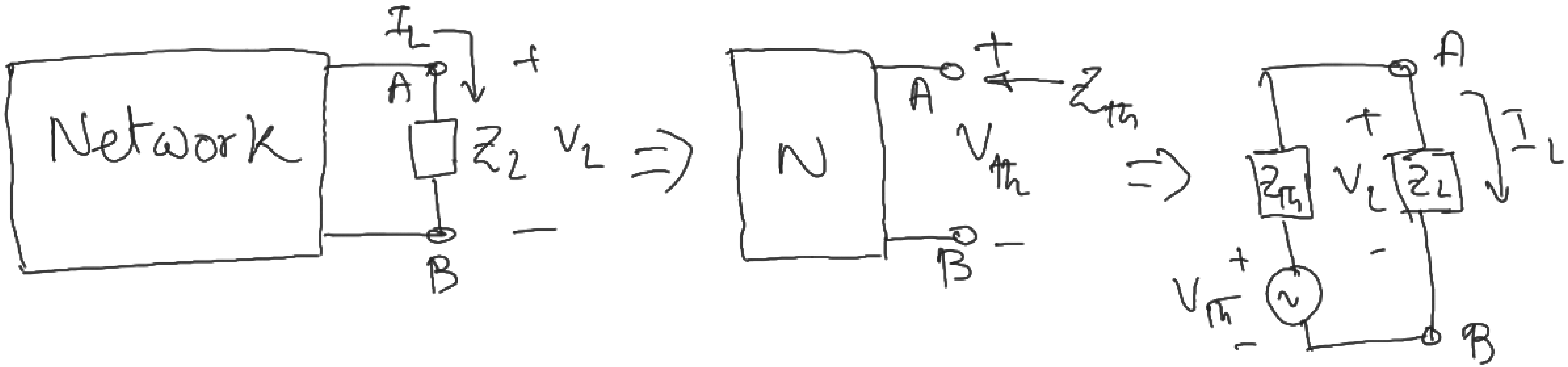
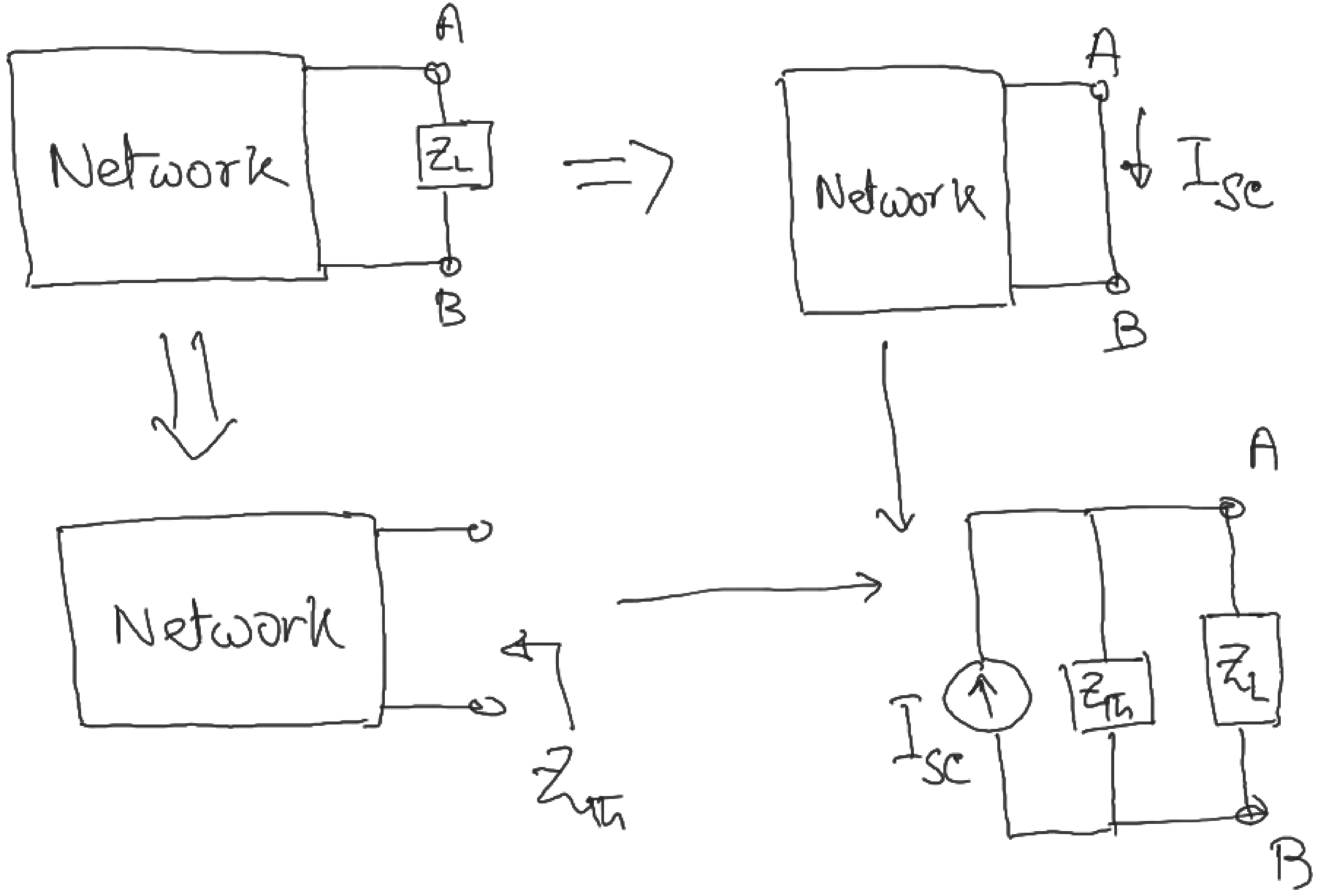
Thevenin's theorem:

Any two terminal linear network containing impedances and sources may be replaced by a single independent source of voltage V_{Th} and internal impedance Z_{Th}. Where V_{Th} is the open circuit voltage at the terminal and Z_{Th} is the impedance viewed at the terminal.

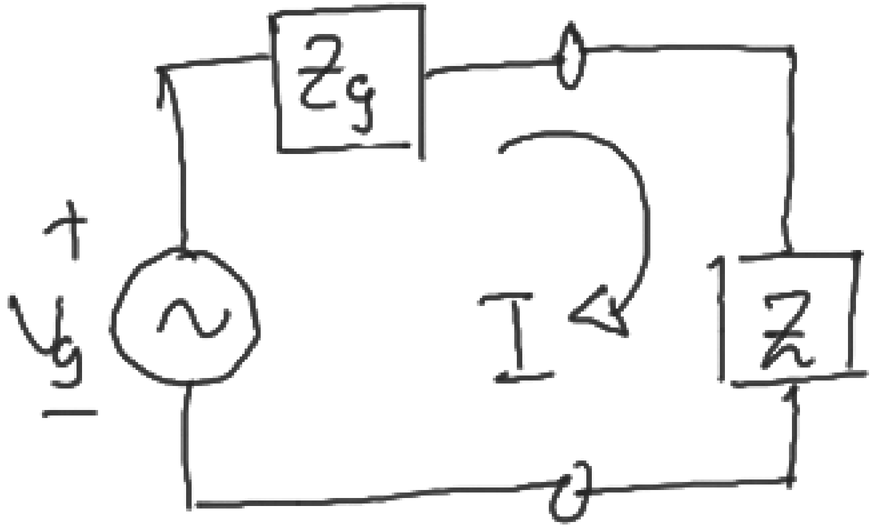


Norton's theorem

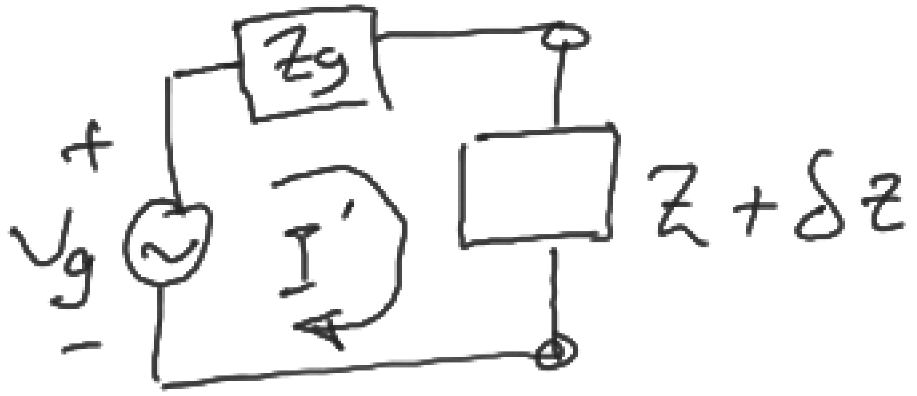


Compensation Theorem

Statement : Consider a linear network in which an independent source is delivering current 'I' to a load impedance Z. If Z is changed to $(Z+\delta Z)$ then the change in current 'δI' can be found by replacing the independent source by its internal impedance and placing a compensation voltage source has magnitude $V_c = I\,\delta Z$ and its polarity will oppose the current flow 'I'.



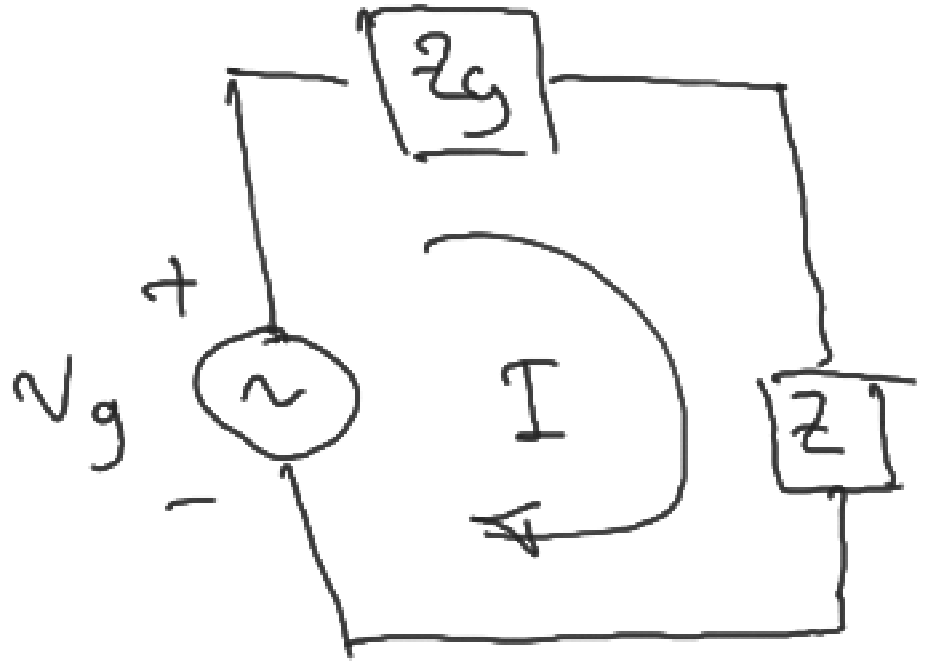
$\Longrightarrow$

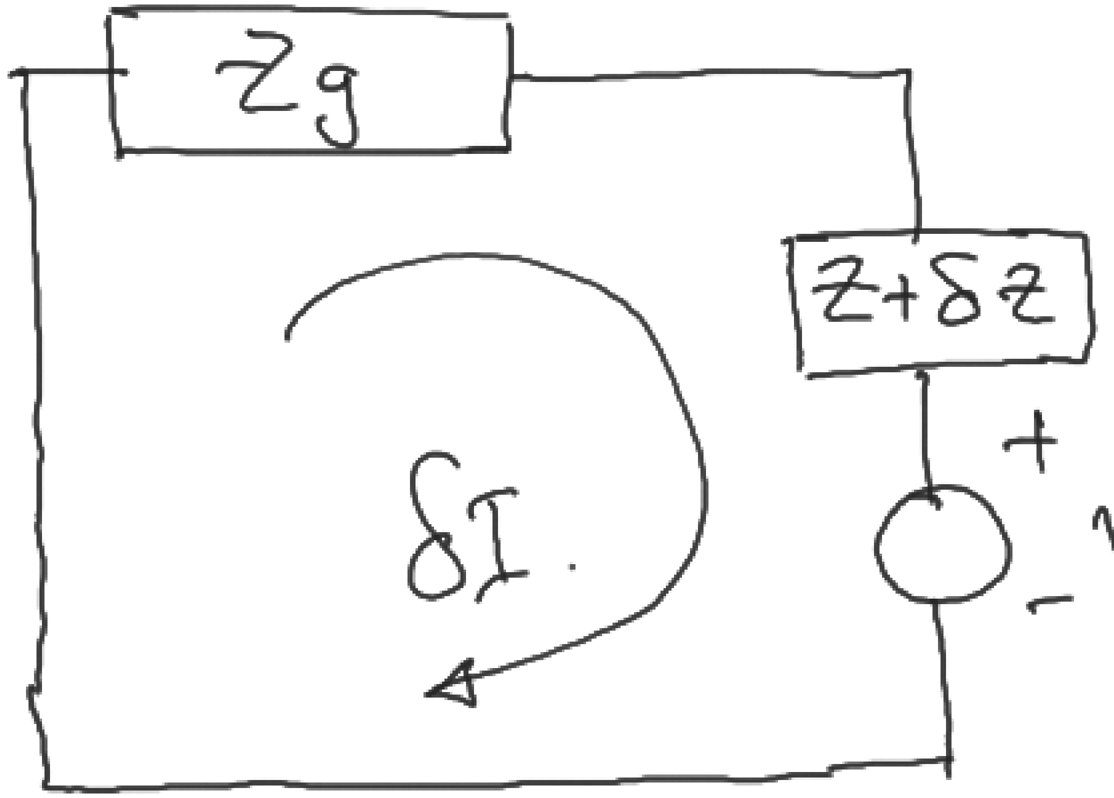


$$\delta I = I' - I = \frac{V_g}{(Z_g + Z + \delta Z)} - \frac{V_g}{(Z_g + Z)}$$

$$\delta I = I' - I = \frac{-V_g \, \delta Z}{(Z_g + Z)(Z_g + Z + \delta Z)} = -\frac{I \, \delta Z}{Z + Z_g + \delta Z}$$

$$\delta I = -\left(\frac{V_c}{Z + Z_g + \delta Z}\right).$$



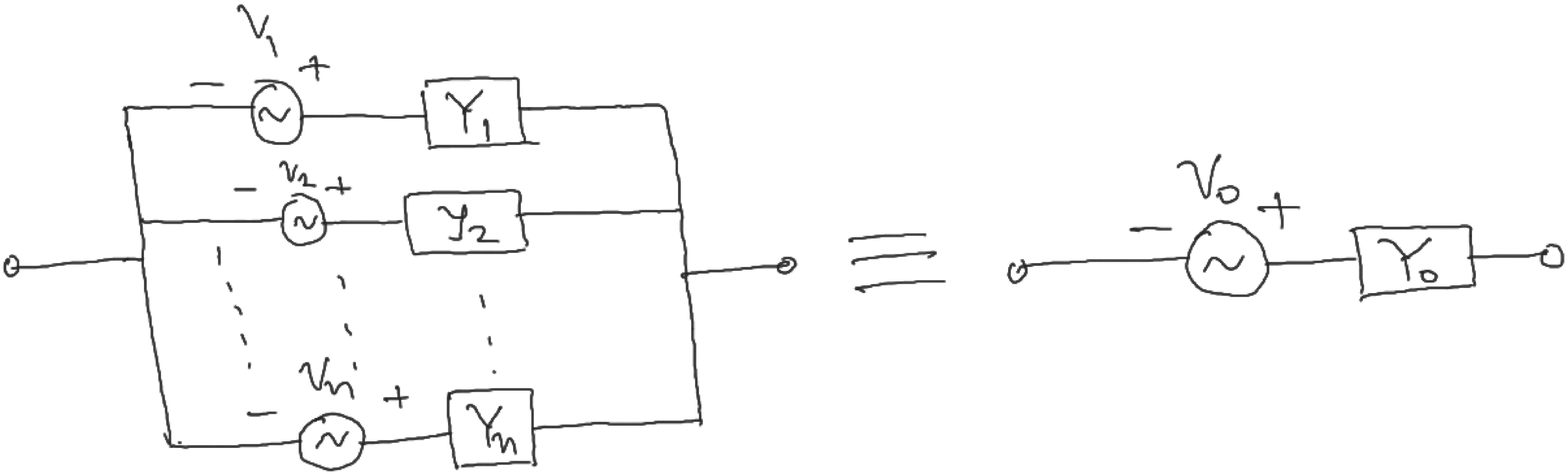


$$V_c = I \, \delta Z .$$

'δZ' is the change in load impedance.

Millman's Theorem

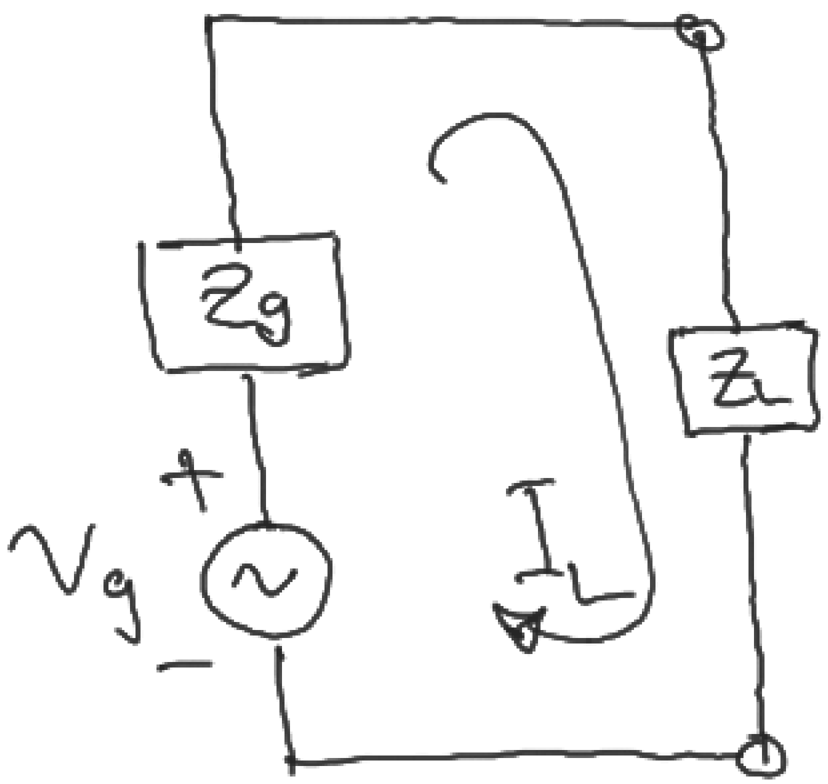
$$\boxed{Y = \frac{1}{Z}}$$



$$V_0 = \frac{V_1Y_1 + V_2Y_2 \cdots\cdots + V_nY_n}{Y_1 + Y_2 + \cdots\cdots Y_n} = \frac{\sum_i V_iY_i}{\sum_i Y_i}$$

$$Y_0 = Y_1 + Y_2 + \cdots\cdots + Y_n = \sum_i Y_i$$

Maximum Power Transfer Theorem



i) Z_L is a pure resistance $(Z_L = R_L)$.
$(Z_g = R_g)$

ii) Z_L is combination of resistance & reactance. $(Z_L = R_L + jX_L)$.
$(Z_g = R_g + jX_g)$

i) $Z_L = R_L$ and $Z_g = R_g$:

$$I_L = \frac{V_g}{R_g + R_L}$$

Power delivered to the load $(P_L) = I^2 R_L = \left(\frac{V_g}{R_g + R_L}\right)^2 \cdot R_L$.

If the P_L is maximum Then

$$\frac{dP_L}{dR_L} = 0.$$

$$\frac{dP_L}{dR_L} = \frac{V_g^2\left[(R_L+R_g)^2 - 2R_L(R_L+R_g)\right]}{(R_L+R_g)^4} = 0.$$

$$\boxed{R_L = R_g}$$

$$\boxed{P_{L,max} = \frac{V_g^2}{4R}}$$

Efficiency is <u>50%</u>

"Half power will be dissipated in the source resistance 'Rg'".

ii) $Z_g = R_g + jX_g$ and $Z_L = R_L + jX_L$:

$$I = \frac{V_g}{(R_L + R_g) + j(X_L + X_g)} \; ; \quad |I| = \frac{V_g^2}{(R_L + R_g)^2 + (X_L + X_g)^2}$$

Power delivered to the load $(P_L) = \underline{|I|^2 . R_L}$

$$P_L = \frac{V_g^2 R_L}{(R_L + R_g)^2 + \underline{(X_L + X_g)^2}}$$

for maximum power transfer by adjusting load reactance,

$\boxed{X_L = -X_g}$ can be set

$$P^*_{L,max} = \frac{V_g^2 R_L}{(R_L + R_g)^2}.$$

If $R_L = R_g$ Then $P^*_{L,max} = P_{max}$.

Therefore the conditions for maximum power transfer

a. $X_L = -X_g$

b. $R_L = R_g$

$$\boxed{Z_L = Z_g^*}$$