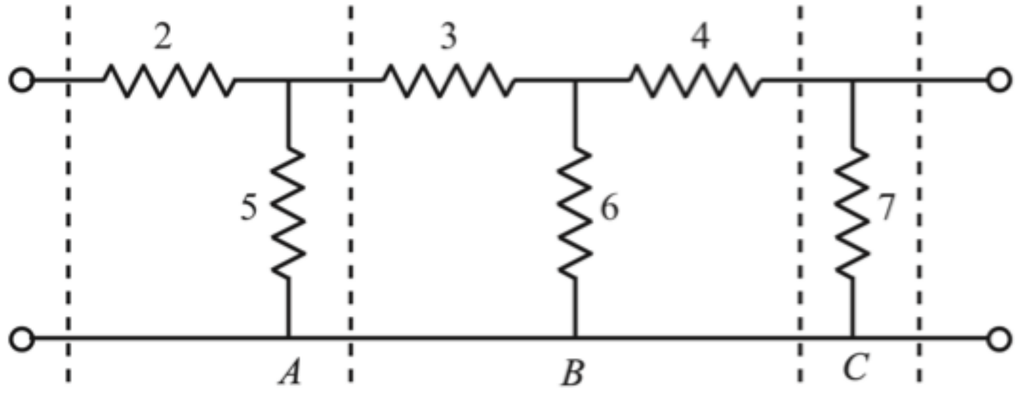
Q. Determine the ABCD-parameters of:



A. This is a cascade of three networks:

For the first network, the ABCD-parameters are: $\begin{bmatrix} 7/5 & 2 \\ 1/5 & 1 \end{bmatrix}$

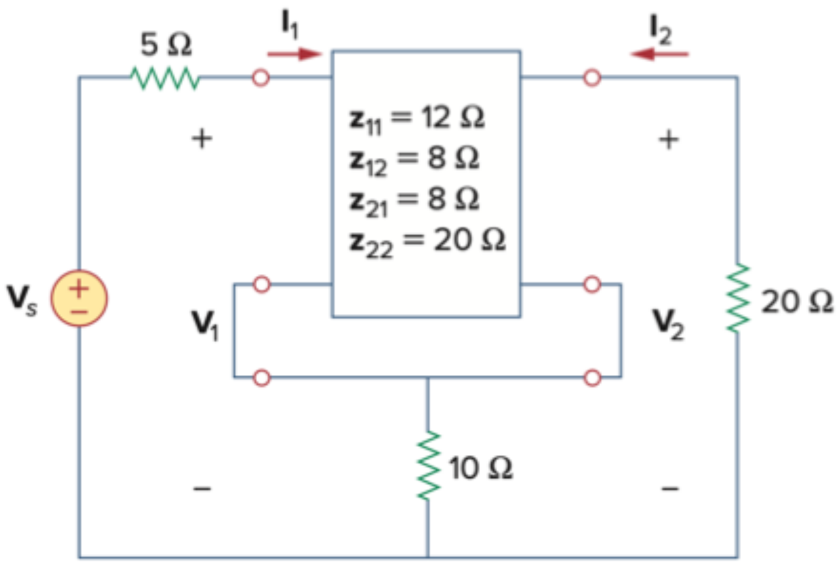
Similarly, for the second and third:

$$\begin{bmatrix} 3/2 & 9 \\ 1/6 & 5/3 \end{bmatrix} \quad \text{and} \quad \begin{bmatrix} 1 & 0 \\ 1/7 & 1 \end{bmatrix}$$

The overall ABCD parameters of the cascade is the product of three matrices:

$$\begin{bmatrix} 7/5 & 2 \\ 1/5 & 1 \end{bmatrix} \begin{bmatrix} 3/2 & 9 \\ 1/6 & 5/3 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 1/7 & 1 \end{bmatrix} = \begin{bmatrix} \frac{989}{210} & \frac{239}{15} \\ \frac{101}{105} & \frac{52}{15} \end{bmatrix}$$

Q. Find $\frac{V_2}{V_s}$:



A. The two networks are in series.

Hence, $[z] = \begin{bmatrix} 12 & 8 \\ 8 & 20 \end{bmatrix} + \begin{bmatrix} 10 & 10 \\ 10 & 10 \end{bmatrix} = \begin{bmatrix} 22 & 18 \\ 18 & 30 \end{bmatrix}$

$$\Rightarrow \begin{aligned} V_1 &= 22 I_1 + 18 I_2 \\ V_2 &= 18 I_1 + 30 I_2 \end{aligned}$$

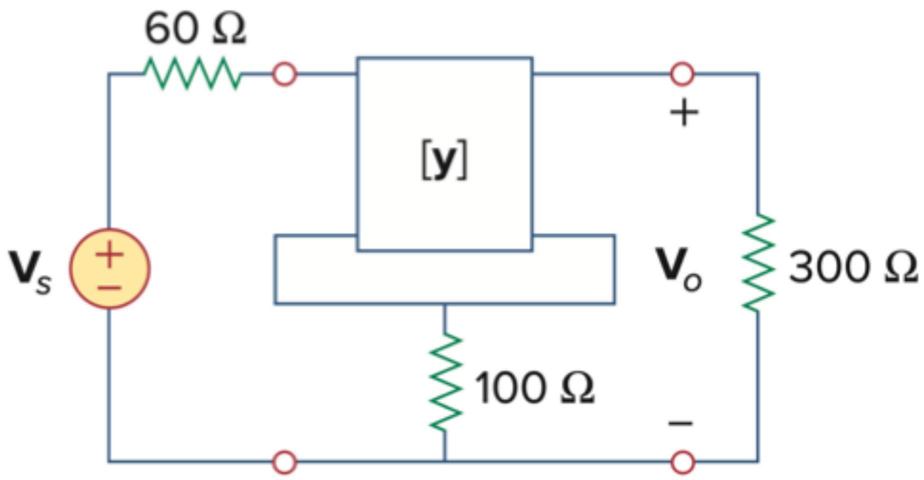
Substituting $V_1 = V_s - 5 I_1$ and $V_2 = -20 I_2$

$$\Rightarrow \quad I_2 = \frac{5}{36} V_2$$

$$\Rightarrow \quad V_s = \frac{57}{20} V_2$$

Hence, $\frac{V_2}{V_s} = \frac{20}{57}$

Q. Find $\frac{V_o}{V_s}$:



Given $[Y] = \begin{bmatrix} 0.002 & 0 \\ 0 & 0.01 \end{bmatrix} \Omega^{-1}$.

A. These two-port networks are in series.

Hence, let us calculate z-parameters first.

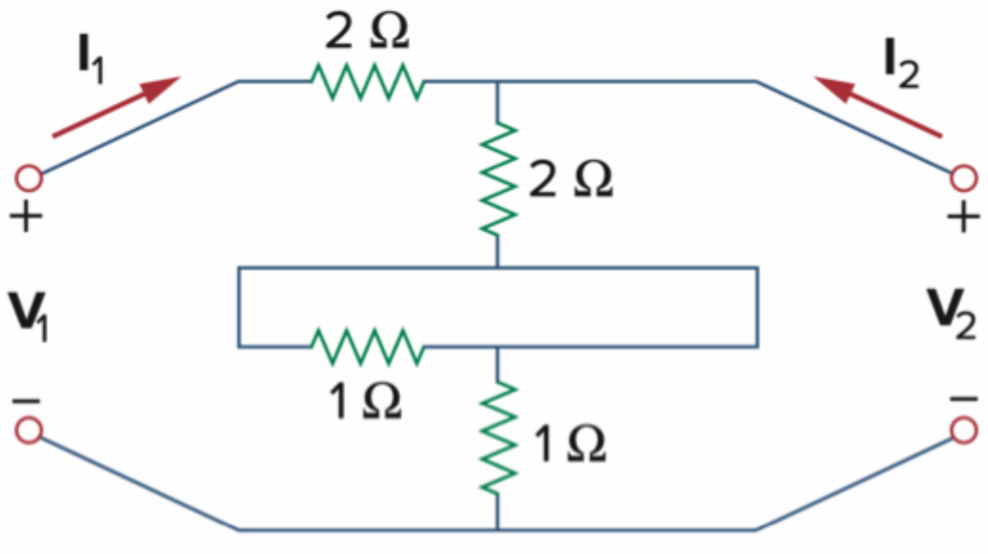
$$[z] = \begin{bmatrix} 500 & 0 \\ 0 & 100 \end{bmatrix} + \begin{bmatrix} 100 & 100 \\ 100 & 100 \end{bmatrix}$$

$$\Rightarrow [z] = \begin{bmatrix} 600 & 100 \\ 100 & 200 \end{bmatrix}$$

Hence,
$$V_s - 60 I_1 = 600 I_1 + 100 I_2$$
$$V_o = -300 I_2 = 100 I_1 + 200 I_2$$

$$\Rightarrow \frac{V_o}{V_s} = \frac{3}{32} = 0.09375$$

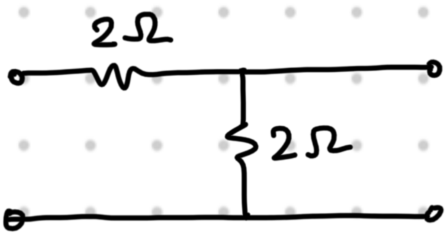
Q. Calculate the Y-parameters of :



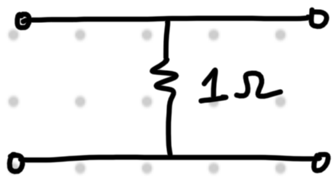
A. These two-port networks are in series. Hence, let us calculate z-parameters first.

However, note that 1 Ω is shorted.

We have,



and

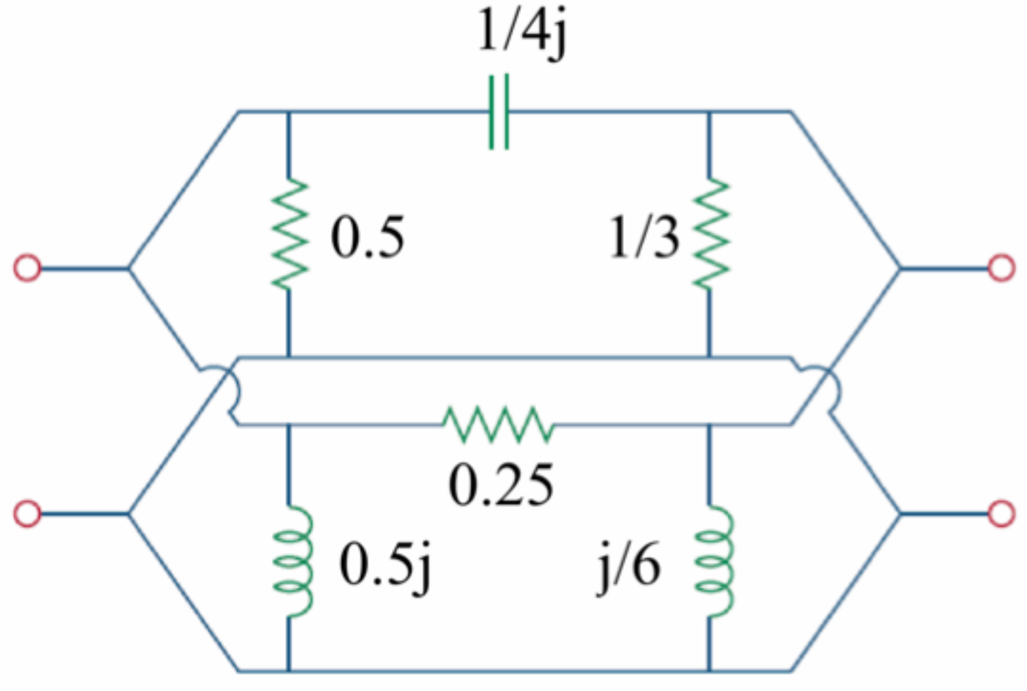


$$\Rightarrow [z] = \begin{bmatrix} 4 & 2 \\ 2 & 2 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 5 & 3 \\ 3 & 3 \end{bmatrix}$$

Converting them into y parameters :

$$[y] = \begin{bmatrix} \dfrac{z_{22}}{\Delta z} & \dfrac{-z_{12}}{\Delta z} \\ \dfrac{-z_{21}}{\Delta z} & \dfrac{z_{11}}{\Delta z} \end{bmatrix} = \begin{bmatrix} 1/2 & -1/2 \\ -1/2 & 5/6 \end{bmatrix} \Omega^{-1}$$

Q. Find the admittance parameters of :



A.

$$[y_a] = \begin{bmatrix} 2+4j & -4j \\ -4j & 3+4j \end{bmatrix}$$

$$[y_b] = \begin{bmatrix} 4-2j & -4 \\ -4 & 4-6j \end{bmatrix}$$

Hence, $$[y] = \begin{bmatrix} 6+2j & -4-4j \\ -4-4j & 7-2j \end{bmatrix}$$