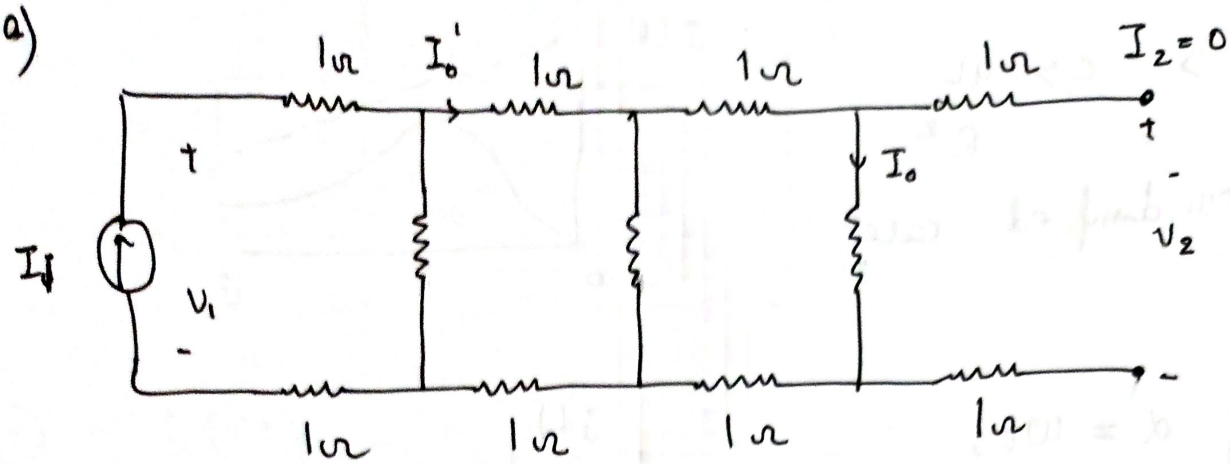
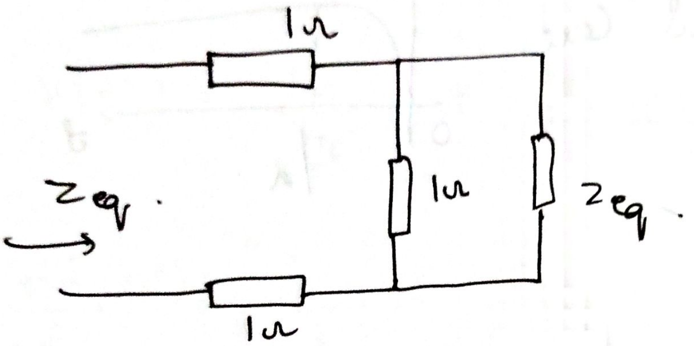
Q4

a)





$$Z_{eq} = \frac{(Z_{eq})(1)}{1 + Z_{eq}} + 1 + 1$$

$$\frac{Z_{eq}}{Z_{eq}+1} + 2$$

$$Z_{eq} = \frac{Z_{eq} + 2 + 2Z_{eq}}{1 + Z_{eq}} = \frac{2 + 3Z_{eq}}{1 + Z_{eq}}.$$

$$Z_{eq} = (1 + Z_{eq}) = 2 + 3Z_{eq}.$$

$$Z_{eq} + Z_{eq}^2 = 2 + 3Z_{eq}.$$

$$Z_{eq}^2 - 2Z_{eq} - 2 = 0$$

$$Z_{eq} = 1 \pm \sqrt{3}$$

$1 + 1.732$; $\underbrace{1 - 1.732}_{\text{Cannot be -ve.}}$

$\downarrow$

So $\boxed{Z_{eq} = 2.732}$

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(b) Image impedance of a network is the input impedance of an infinitely long chain of cascaded identical networks. This is directly analogous to the defination of characteristic impedance as the input impedance of an infinitely long line.

(c) $[V] = [Z][I]$ and $[I] = [Y][V]$

So,

$$\begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}^{-1}$$

$$= \frac{1}{|Z|} \begin{bmatrix} Z_{22} & -Z_{21} \\ -Z_{12} & Z_{11} \end{bmatrix}$$

So, $[Z] = Z_{11} \times Z_{22} - Z_{12} \times Z_{21}$

$100 \times 50 - (120)^2 = -9{,}400$

Then,

$$\left.\begin{aligned} Y_{11} &= \frac{Z_{22}}{|Z|} = -0.00532 \\ Y_{21} &= -\frac{Z_{21}}{|Z|} = 0.0128 \\ Y_{22} &= \frac{Z_{11}}{|Z|} = -0.0106 \\ Y_{12} &= -\frac{Z_{12}}{|Z|} = 0.0128 \end{aligned}\right\} \text{Y Parameter}$$

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