302.1A.

$$
\begin{aligned}
U_a &= 24\,\mathrm{e}^{j0^\circ}\ \mathrm{V}\\
U_b &= 18\,\mathrm{e}^{-j120^\circ}\ \mathrm{V}\\
U_c &= 18\,\mathrm{e}^{j120^\circ}\ \mathrm{V}
\end{aligned}
$$

$$
\begin{aligned}
U_0 &= ?\ [\mathrm{V}]\\
U_1 &= ?\ [\mathrm{V}]\\
U_2 &= ?\ [\mathrm{V}]
\end{aligned}
$$

$$a = \mathrm{e}^{j120^\circ}$$

$$\underline{\underline{\boldsymbol{T}}}^{\boldsymbol{-1}} = \frac{\mathbf{1}}{\mathbf{3}}\begin{bmatrix} \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \boldsymbol{a} & \boldsymbol{a^2} \\ \mathbf{1} & \boldsymbol{a^2} & \boldsymbol{a} \end{bmatrix}$$

$$\begin{bmatrix} \boldsymbol{U_0} \\ \boldsymbol{U_1} \\ \boldsymbol{U_2} \end{bmatrix} = \underline{\underline{T}}^{-1}\begin{bmatrix} U_a \\ U_b \\ U_c \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} 24 \\ 18a^2 \\ 18a \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 24+18a^2+18a \\ 24+18+18 \\ 24+18a+18a^2 \end{bmatrix} = \begin{bmatrix} \mathbf{2} \\ \mathbf{20} \\ \mathbf{2} \end{bmatrix}\mathbf{V}$$

302.2A.

$$
\begin{aligned}
I_a &= 18\,\mathrm{e}^{j0^\circ}\ \mathrm{A}\\
I_b &= 15\,\mathrm{e}^{-j120^\circ}\ \mathrm{A}\\
I_c &= 15\,\mathrm{e}^{j120^\circ}\ \mathrm{A}
\end{aligned}
$$

$$
\begin{aligned}
I_0 &= ?\ [\mathrm{A}]\\
I_1 &= ?\ [\mathrm{A}]\\
I_2 &= ?\ [\mathrm{A}]
\end{aligned}
$$

$$a = \mathrm{e}^{j120^\circ}$$

$$\underline{\underline{\boldsymbol{T}}}^{\boldsymbol{-1}} = \frac{\mathbf{1}}{\mathbf{3}}\begin{bmatrix} \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \boldsymbol{a} & \boldsymbol{a^2} \\ \mathbf{1} & \boldsymbol{a^2} & \boldsymbol{a} \end{bmatrix}$$

$$\begin{bmatrix} \boldsymbol{I_0} \\ \boldsymbol{I_1} \\ \boldsymbol{I_2} \end{bmatrix} = \underline{\underline{T}}^{-1}\begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} 18 \\ 15a^2 \\ 15a \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 18+15a^2+15a \\ 18+15+15 \\ 18+15a+15a^2 \end{bmatrix} = \begin{bmatrix} \mathbf{1} \\ \mathbf{16} \\ \mathbf{1} \end{bmatrix}\mathbf{A}$$

302.3A.

$$\begin{aligned} U_0 &= 2\ \text{V} \\ U_1 &= 15\ \text{V} \\ U_2 &= 2\ \text{V} \end{aligned}$$

$$\begin{aligned} U_a &= ?\ [\text{V}] \\ U_b &= ?\ [\text{V}] \\ U_c &= ?\ [\text{V}] \end{aligned}$$

$a = \mathrm{e}^{j120^\circ}$

$$\underline{\underline{\boldsymbol{T}}} = \begin{bmatrix} \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \boldsymbol{a^2} & \boldsymbol{a} \\ \mathbf{1} & \boldsymbol{a} & \boldsymbol{a^2} \end{bmatrix}$$

$$\begin{bmatrix} \boldsymbol{U_a} \\ \boldsymbol{U_b} \\ \boldsymbol{U_c} \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} U_0 \\ U_1 \\ U_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} 2 \\ 15 \\ 2 \end{bmatrix} = \begin{bmatrix} 2+15+2 \\ 2+15a^2+2a \\ 2+15a+2a^2 \end{bmatrix} \approx \begin{bmatrix} \mathbf{19} \\ \mathbf{-6{,}5-j11{,}26} \\ \mathbf{-6{,}5+j11{,}26} \end{bmatrix} \mathbf{V}$$

302.4A.

$$\begin{aligned} I_0 &= 3\ \text{A} \\ I_1 &= 18\ \text{A} \\ I_2 &= 3\ \text{A} \end{aligned}$$

$$\begin{aligned} I_a &= ?\ [\text{A}] \\ I_b &= ?\ [\text{A}] \\ I_c &= ?\ [\text{A}] \end{aligned}$$

$a = \mathrm{e}^{j120^\circ}$

$$\underline{\underline{\boldsymbol{T}}} = \begin{bmatrix} \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \boldsymbol{a^2} & \boldsymbol{a} \\ \mathbf{1} & \boldsymbol{a} & \boldsymbol{a^2} \end{bmatrix}$$

$$\begin{bmatrix} \boldsymbol{I_a} \\ \boldsymbol{I_b} \\ \boldsymbol{I_c} \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} I_0 \\ I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} 3 \\ 18 \\ 3 \end{bmatrix} = \begin{bmatrix} 3+18+3 \\ 3+18a^2+3a \\ 3+18a+3a^2 \end{bmatrix} \approx \begin{bmatrix} \mathbf{24} \\ \mathbf{-7{,}5-j12{,}99} \\ \mathbf{-7{,}5+j12{,}99} \end{bmatrix} \mathbf{A}$$

209.1A.

$$\begin{array}{lllll} u_1^h & & & = & 1 \\ x_1^{tr} & = & x_2^{tr} = x_0^{tr} & = & 0{,}12 \\ x_1^v & = & x_2^v & = & 0{,}4 \\ x_0^v & & & = & 0{,}6 \\ i_a & & & = & ? \end{array}$$

$$\begin{array}{l} u_a = 0 \\ i_b = 0 \\ i_c = 0 \end{array} \Rightarrow \begin{array}{c} u_0 + u_1 + u_2 = 0 \\ i_0 = i_1 = i_2 \end{array} \wedge \begin{array}{c} \text{trafó} \\ \text{zérus sorrendű} \\ \text{modellje} \end{array} \Rightarrow i_0 = 0$$

$$\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} i_0 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} i_0 \\ i_0 \\ i_0 \end{bmatrix} = \begin{bmatrix} i_0 + i_0 + i_0 \\ i_0 + a^2\, i_0 + a\, i_0 \\ i_0 + a\, i_0 + a^2\, i_0 \end{bmatrix} = \begin{bmatrix} 3i_0 \\ 0 \\ 0 \end{bmatrix}$$

$$\boldsymbol{i_a} = 3i_0 = \mathbf{0}$$

209.2A.

$$\begin{array}{lllll} u_1^h & & & = & 1 \\ x_1^{tr} & = & x_2^{tr} = x_0^{tr} & = & 0{,}12 \\ x_1^v & = & x_2^v & = & 0{,}4 \\ x_0^v & & & = & 0{,}6 \\ i_a & & & = & ? \end{array}$$

$$\begin{array}{lll} u_b & = & u_c \\ i_a & = & 0 \\ i_b & = & -i_c \end{array} \Rightarrow \begin{array}{lll} u_1 & = & u_2 \\ i_0 & = & 0 \\ i_1 & = & -i_2 \end{array} \Rightarrow i_1 = \frac{u_1^h}{j\, x_1^{tr} + j\, x_2^{tr}}$$

$$\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} i_0 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} 0 \\ i_1 \\ -i_1 \end{bmatrix} = \begin{bmatrix} i_1 - i_1 \\ a^2\, i_1 - a\, i_1 \\ a\, i_1 - a^2\, i_1 \end{bmatrix} = \begin{bmatrix} 0 \\ -j\sqrt{3}\, i_1 \\ j\sqrt{3}\, i_1 \end{bmatrix}$$

$$\boldsymbol{i_b} = -j\sqrt{3}\, i_1 = -j\sqrt{3}\, \frac{u_1^h}{j\, x_1^{tr} + j\, x_2^{tr}} = -j\sqrt{3}\, \frac{1}{j0{,}12 + j0{,}12} \approx \mathbf{-7{,}22}$$

209.3A.

$$\begin{array}{lllll} u_1^h & & & = & 1 \\ x_1^{tr} & = & x_2^{tr} = x_0^{tr} & = & 0{,}12 \\ x_1^v & = & x_2^v & = & 0{,}4 \\ x_0^v & & & = & 0{,}6 \\ i_a & & & = & ? \end{array}$$

$$\begin{array}{l} u_b = 0 \\ u_c = 0 \\ i_a = 0 \end{array} \Rightarrow \begin{array}{c} u_0 = u_1 = u_2 \\ i_0 + i_1 + i_2 = 0 \end{array} \wedge \begin{array}{c} \text{trafó} \\ \text{zérus sorrendű} \\ \text{modellje} \end{array} \Rightarrow \begin{array}{lll} i_0 & = & 0 \Rightarrow i_1 = -i_2 \\ i_1 & = & \dfrac{u_1^h}{j\, x_1^{tr} + j\, x_2^{tr}} \end{array}$$

$$\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} i_0 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} 0 \\ i_1 \\ -i_1 \end{bmatrix} = \begin{bmatrix} i_1 - i_1 \\ a^2\, i_1 - a\, i_1 \\ a\, i_1 - a^2\, i_1 \end{bmatrix} = \begin{bmatrix} 0 \\ -j\sqrt{3}\, i_1 \\ j\sqrt{3}\, i_1 \end{bmatrix}$$

$$\boldsymbol{i_b} = -j\sqrt{3}\, i_1 = -j\sqrt{3}\, \frac{u_1^h}{j\, x_1^{tr} + j\, x_2^{tr}} = -j\sqrt{3}\, \frac{1}{j0{,}12 + j0{,}12} \approx \mathbf{-7{,}22}$$

209.4A.

$$
\begin{array}{lllll}
u_1^h & & & = & 1 \\
x_1^{tr} & = & x_2^{tr} = x_0^{tr} & = & 0{,}12 \\
x_1^v & = & x_2^v & = & 0{,}4 \\
x_0^v & & & = & 0{,}6 \\
i_a & & & = & ?
\end{array}
$$

$$
\begin{array}{lll}
u_a = 0 \\
i_b = 0 \\
i_c = 0
\end{array}
\quad \Rightarrow \quad
\begin{array}{c}
u_0 + u_1 + u_2 = 0 \\
i_0 = i_1 = i_2
\end{array}
\quad \wedge \quad
\begin{array}{c}
\text{trafó} \\
\text{zérus sorrendű} \\
\text{modellje}
\end{array}
\quad \Rightarrow \quad
i_0 = \frac{u_1^h}{j\,x_1^{tr} + j\,x_2^{tr} + j\,x_0^{tr}}
$$

$$
\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} i_0 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} i_0 \\ i_0 \\ i_0 \end{bmatrix} = \begin{bmatrix} i_0 + i_0 + i_0 \\ i_0 + a^2\,i_0 + a\,i_0 \\ i_0 + a\,i_0 + a^2\,i_0 \end{bmatrix} = \begin{bmatrix} 3i_0 \\ 0 \\ 0 \end{bmatrix}
$$

$$
\boldsymbol{i_a} = 3i_0 = 3\,\frac{u_1^h}{j\,x_1^{tr} + j\,x_2^{tr} + j\,x_0^{tr}} = 3\,\frac{1}{j0{,}12 + j0{,}12 + j0{,}12} \approx \boldsymbol{-j8{,}33}
$$

209.5A.

$$
\begin{array}{lllll}
u_1^h & & & = & 1 \\
x_1^{tr} & = & x_2^{tr} = x_0^{tr} & = & 0{,}12 \\
x_1^v & = & x_2^v & = & 0{,}4 \\
x_0^v & & & = & 0{,}6 \\
i_a & & & = & ?
\end{array}
$$

$$
\begin{array}{lll}
u_b = u_c \\
i_a = 0 \\
i_b = -i_c
\end{array}
\quad \Rightarrow \quad
\begin{array}{lll}
u_1 = u_2 \\
i_0 = 0 \\
i_1 = -i_2
\end{array}
\quad \Rightarrow \quad
i_1 = \frac{u_1^h}{j\,x_1^{tr} + j\,x_2^{tr}}
$$

$$
\begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = \underline{\underline{T}} \begin{bmatrix} i_0 \\ i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} \begin{bmatrix} 0 \\ i_1 \\ -i_1 \end{bmatrix} = \begin{bmatrix} i_1 - i_1 \\ a^2\,i_1 - a\,i_1 \\ a\,i_1 - a^2\,i_1 \end{bmatrix} = \begin{bmatrix} 0 \\ -j\sqrt{3}\,i_1 \\ j\sqrt{3}\,i_1 \end{bmatrix}
$$

$$
\boldsymbol{i_b} = -j\sqrt{3}\,i_1 = -j\sqrt{3}\,\frac{u_1^h}{j\,x_1^{tr} + j\,x_2^{tr}} = -j\sqrt{3}\,\frac{1}{j0{,}12 + j0{,}12} \approx \boldsymbol{-7{,}22}
$$

304.1A.

$$\begin{aligned} Z_{\ddot{o}n} &= (2+j4)\ \Omega \\ Z_k &= (0{,}1+j2)\ \Omega \\ \underline{\underline{\underline{\underline{Z_{ss}}}}} &= ?\ [\Omega] \end{aligned}$$

$$\underline{\underline{\underline{\underline{Z_{ss}}}}} = \underline{\underline{\underline{T}}}^{-1}\,\underline{\underline{\underline{\underline{Z_{ff}}}}}\,\underline{\underline{\underline{T}}} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} Z_{\ddot{o}n} & Z_k & Z_k \\ Z_k & Z_{\ddot{o}n} & Z_k \\ Z_k & Z_k & Z_{\ddot{o}n} \end{bmatrix}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} = \begin{bmatrix} Z_{\ddot{o}n}+2Z_k & 0 & 0 \\ 0 & Z_{\ddot{o}n}-Z_k & 0 \\ 0 & 0 & Z_{\ddot{o}n}-Z_k \end{bmatrix}$$

$$\boldsymbol{Z_0} = Z_{\ddot{o}n}+2Z_k = (2+j4+2\,(0{,}1+j2))\ \Omega = \mathbf{(2{,}2+j8)\ \Omega}$$

$$\boldsymbol{Z_1} = \boldsymbol{Z_2} = Z_{\ddot{o}n}-Z_k = (2+j4-(0{,}1+j2))\ \Omega = \mathbf{(1{,}9+j2)\ \Omega}$$

304.2A.

$$\begin{aligned} Z_0 &= (2{,}2+j8)\ \Omega \\ Z_1 &= (1{,}9+j2)\ \Omega \\ \underline{\underline{\underline{\underline{Z_{ff}}}}} &= ?\ [\Omega] \end{aligned}$$

$$\underline{\underline{\underline{\underline{Z_{ff}}}}} = \underline{\underline{\underline{T}}}\,\underline{\underline{\underline{\underline{Z_{ss}}}}}\,\underline{\underline{\underline{T}}}^{-1} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix}\begin{bmatrix} Z_0 & 0 & 0 \\ 0 & Z_1 & 0 \\ 0 & 0 & Z_1 \end{bmatrix}\frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} = \frac{1}{3}\begin{bmatrix} Z_0+2Z_1 & Z_0-Z_1 & Z_0-Z_1 \\ Z_0-Z_1 & Z_0+2Z_1 & Z_0-Z_1 \\ Z_0-Z_1 & Z_0-Z_1 & Z_0+2Z_1 \end{bmatrix}$$

$$\boldsymbol{Z_{\ddot{o}n}} = \frac{Z_0+2Z_1}{3} = \frac{2{,}2+j8+2\,(1{,}9+j2)}{3}\ \Omega = \mathbf{(2+j4)\ \Omega}$$

$$\boldsymbol{Z_k} = \frac{Z_0-Z_1}{3} = \frac{2{,}2+j8-(1{,}9+j2)}{3}\ \Omega = \mathbf{(0{,}1+j2)\ \Omega}$$

305.1A.

$Z_{\ddot{o}n} = (2 + j4)\ \Omega$
$Z_k = (0{,}1 + j2)\ \Omega$
$\underline{\underline{\underline{Z_{ss}}}} = ?\ [\Omega]$

$$\underline{\underline{\underline{Z_{ss}}}} = \underline{\underline{T}}^{-1}\,\underline{\underline{\underline{Z_{ff}}}}\,\underline{\underline{T}} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} Z_{\ddot{o}n} & Z_k & Z_k \\ Z_k & Z_{\ddot{o}n} & Z_k \\ Z_k & Z_k & Z_{\ddot{o}n} \end{bmatrix}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} = \begin{bmatrix} Z_{\ddot{o}n} + 2Z_k & 0 & 0 \\ 0 & Z_{\ddot{o}n} - Z_k & 0 \\ 0 & 0 & Z_{\ddot{o}n} - Z_k \end{bmatrix}$$

$\boldsymbol{Z_1} = Z_{\ddot{o}n} - Z_k = (2 + j4 - (0{,}1 + j2))\ \Omega = \mathbf{(1{,}9 + j2)\ \Omega}$

305.2A.

$Z_{\ddot{o}n} = (2 + j4)\ \Omega$
$Z_k = (0{,}1 + j2)\ \Omega$
$\underline{\underline{\underline{Z_{ss}}}} = ?\ [\Omega]$

$$\underline{\underline{\underline{Z_{ss}}}} = \underline{\underline{T}}^{-1}\,\underline{\underline{\underline{Z_{ff}}}}\,\underline{\underline{T}} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} Z_{\ddot{o}n} & Z_k & Z_k \\ Z_k & Z_{\ddot{o}n} & Z_k \\ Z_k & Z_k & Z_{\ddot{o}n} \end{bmatrix}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} = \begin{bmatrix} Z_{\ddot{o}n} + 2Z_k & 0 & 0 \\ 0 & Z_{\ddot{o}n} - Z_k & 0 \\ 0 & 0 & Z_{\ddot{o}n} - Z_k \end{bmatrix}$$

$\boldsymbol{Z_0} = Z_{\ddot{o}n} + 2Z_k = (2 + j4 + 2\,(0{,}1 + j2))\ \Omega = \mathbf{(2{,}2 + j8)\ \Omega}$

305.3A.

$Z_{\ddot{o}n} = (2 + j4)\ \Omega$
$Z_k = (0{,}1 + j2)\ \Omega$
$\underline{\underline{\underline{Z_{ss}}}} = ?\ [\Omega]$

$$\underline{\underline{\underline{Z_{ss}}}} = \underline{\underline{T}}^{-1}\,\underline{\underline{\underline{Z_{ff}}}}\,\underline{\underline{T}} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} Z_{\ddot{o}n} & Z_k & Z_k \\ Z_k & Z_{\ddot{o}n} & Z_k \\ Z_k & Z_k & Z_{\ddot{o}n} \end{bmatrix}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a^2 & a \\ 1 & a & a^2 \end{bmatrix} = \begin{bmatrix} Z_{\ddot{o}n} + 2Z_k & 0 & 0 \\ 0 & Z_{\ddot{o}n} - Z_k & 0 \\ 0 & 0 & Z_{\ddot{o}n} - Z_k \end{bmatrix}$$

$\boldsymbol{Z_2} = Z_{\ddot{o}n} - Z_k = (2 + j4 - (0{,}1 + j2))\ \Omega = \mathbf{(1{,}9 + j2)\ \Omega}$

390.1A.

$$
\begin{array}{lcl}
S_n & = & 100\ \text{MVA} \\
\varepsilon & = & 10\ \% \\
U_n^N\,/\,U_n^K & = & 120\,/\,10\ \text{kV} \\
U_n^{\text{alap}} & = & 120\ \text{kV} \\
S_{3f}^{\text{alap}} & = & 100\ \text{MVA} \\
x_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{x_0^{tr}} \;=\; x_1^{tr} \;=\; \frac{Z_1}{Z_1^{\text{alap}}} \;=\; \frac{\frac{\varepsilon}{100}\cdot\frac{\left(U_n^N\right)^2}{S_n}}{\frac{\left(U_n^{\text{alap}}\right)^2}{S_{3f}^{\text{alap}}}} \;=\; \frac{\frac{10}{100}\cdot\frac{120^2}{100}}{\frac{120^2}{100}} \;=\; \mathbf{0{,}1}
$$

390.2A.

$$
\begin{array}{lcl}
S_n & = & 100\ \text{MVA} \\
\varepsilon & = & 10\ \% \\
U_n^N\,/\,U_n^K & = & 400\,/\,220\ \text{kV} \\
U_n^{\text{alap}} & = & 400\ \text{kV} \\
S_{3f}^{\text{alap}} & = & 100\ \text{MVA} \\
x_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{x_0^{tr}} \;=\; x_1^{tr} \;=\; \frac{Z_1}{Z_1^{\text{alap}}} \;=\; \frac{\frac{\varepsilon}{100}\cdot\frac{\left(U_n^N\right)^2}{S_n}}{\frac{\left(U_n^{\text{alap}}\right)^2}{S_{3f}^{\text{alap}}}} \;=\; \frac{\frac{10}{100}\cdot\frac{400^2}{100}}{\frac{400^2}{100}} \;=\; \mathbf{0{,}1}
$$

390.3A.

$$
\begin{array}{lcl}
S_n & = & 100\ \text{MVA} \\
\varepsilon & = & 10\ \% \\
U_n^N\,/\,U_n^K & = & 120\,/\,20\ \text{kV} \\
U_n^{\text{alap}} & = & 120\ \text{kV} \\
S_{3f}^{\text{alap}} & = & 100\ \text{MVA} \\
x_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{x_0^{tr}} \;=\; x_1^{tr} \;=\; \frac{Z_1}{Z_1^{\text{alap}}} \;=\; \frac{\frac{\varepsilon}{100}\cdot\frac{\left(U_n^N\right)^2}{S_n}}{\frac{\left(U_n^{\text{alap}}\right)^2}{S_{3f}^{\text{alap}}}} \;=\; \frac{\frac{10}{100}\cdot\frac{120^2}{100}}{\frac{120^2}{100}} \;=\; \mathbf{0{,}1}
$$

390.4A.

$$
\begin{array}{lcl}
S_n & = & 100\ \text{MVA} \\
\varepsilon & = & 10\ \% \\
U_n^N\,/\,U_n^K & = & 15\,/\,120\ \text{kV} \\
U_n^{\text{alap}} & = & 15\ \text{kV} \\
S_{3f}^{\text{alap}} & = & 100\ \text{MVA} \\
x_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{x_0^{tr}} \;=\; x_1^{tr} \;=\; \frac{Z_1}{Z_1^{\text{alap}}} \;=\; \frac{\dfrac{\varepsilon}{100}\cdot\dfrac{\left(U_n^N\right)^2}{S_n}}{\dfrac{\left(U_n^{\text{alap}}\right)^2}{S_{3f}^{\text{alap}}}} \;=\; \frac{\dfrac{10}{100}\cdot\dfrac{15^2}{100}}{\dfrac{15^2}{100}} \;=\; \mathbf{0{,}1}
$$

390.5A.

$$
\begin{array}{lcl}
Z_1^{tr} & = & Z_{TR} \\
Z_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{Z_0^{tr}} \;=\; \mathbf{Z_{TR} + 3R}
$$

390.6A.

$$
\begin{array}{lcl}
Z_1^{tr} & = & Z_{TR} \\
Z_0^{tr} & = & ?
\end{array}
$$

$$
\boldsymbol{Z_0^{tr}} \;=\; \mathbf{Z_{TR} + 3jX_P}
$$