$$Z_{12} = Z_{21} = \frac{1}{j\omega C_1} = \frac{1}{j2\pi f C_1}$$

$$Z_{11} = R_1 + \frac{1}{j\omega C_1} = R_1 - j\frac{1}{\omega C_1}$$

$$Z_{22} = R_2 + j\omega L_1 - j\frac{1}{\omega C_1}$$

$$Z = \begin{bmatrix} \overset{Z_{11}}{R_1 - j\frac{1}{\omega C_1}} & \overset{Z_{12}}{-j\frac{1}{\omega C_1}} \\ \overset{Z_{11}}{-j\frac{1}{\omega C_1}} & \overset{Z_{22}}{R_2 + j\omega L_1 - j\frac{1}{\omega C_1}} \end{bmatrix}$$

$$\omega = 2\pi f$$

$$A_{11} = \frac{R_1 + \frac{1}{j\omega C_1}}{\frac{1}{j\omega C_1}} = \boxed{R_1 j\omega C_1 + 1}$$

$$K(j\omega) = \frac{1}{A_{11}}$$

АЧХ $K(\omega) = |K(j\omega)| = \sqrt{1^2 + (-R_1 \omega C_1)^2}$

ФЧХ $\varphi(\omega) = -\operatorname{arctg}(-R_1 \omega C_1)$

$$\omega = 2\pi f$$

$$Y = \frac{1}{R_1 + \frac{1}{j\omega C_1}} + \frac{1}{R_2 + j\omega L_1} - \frac{1}{R_2 + j\omega L_1}$$

$$- \frac{1}{R_2 + j\omega L_1} \quad \frac{1}{R_2 + \frac{1}{j\omega C_1} + \frac{1}{R_2 + j\omega L_1}}$$

$$H(j\omega) = \frac{1}{1 + j\omega R_1 C_1} \cdot \frac{1 - j\omega R_1 C_1}{1 - j\omega R_1 C_1} = 1 - j\omega R_1 C_1$$

$$A + jB$$

$$\rho = \sqrt{\frac{L_1}{C}}$$

$$R_{ок} = \frac{\rho^2}{R_{L1}} = \rho \cdot Q$$

$$Q = \frac{\rho}{R_{L1}}$$

$$2\Delta f = f_{рез}/Q$$

$$f_{рез} = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

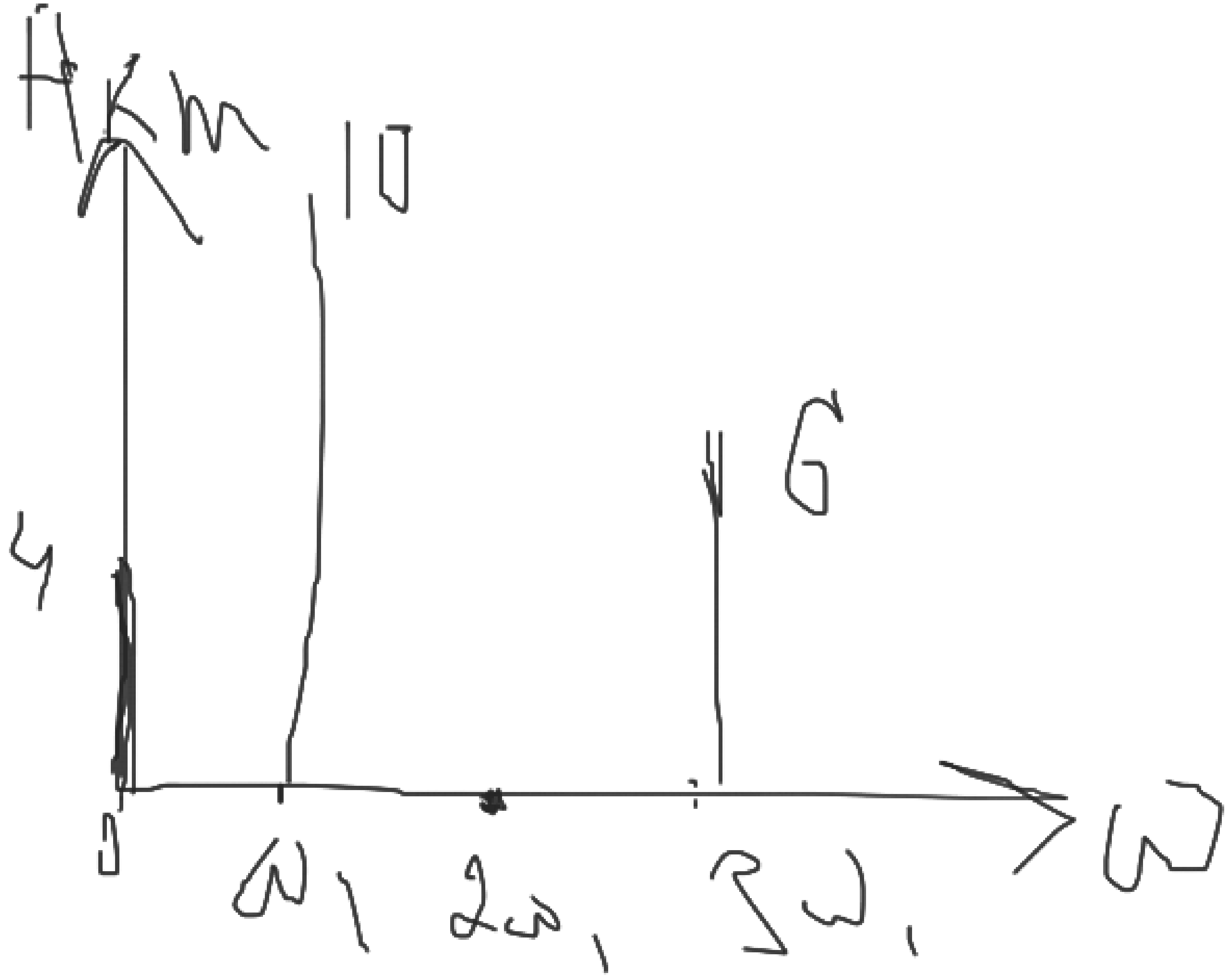
$$Q_e = \frac{\rho}{R_{L1} + R_н}$$

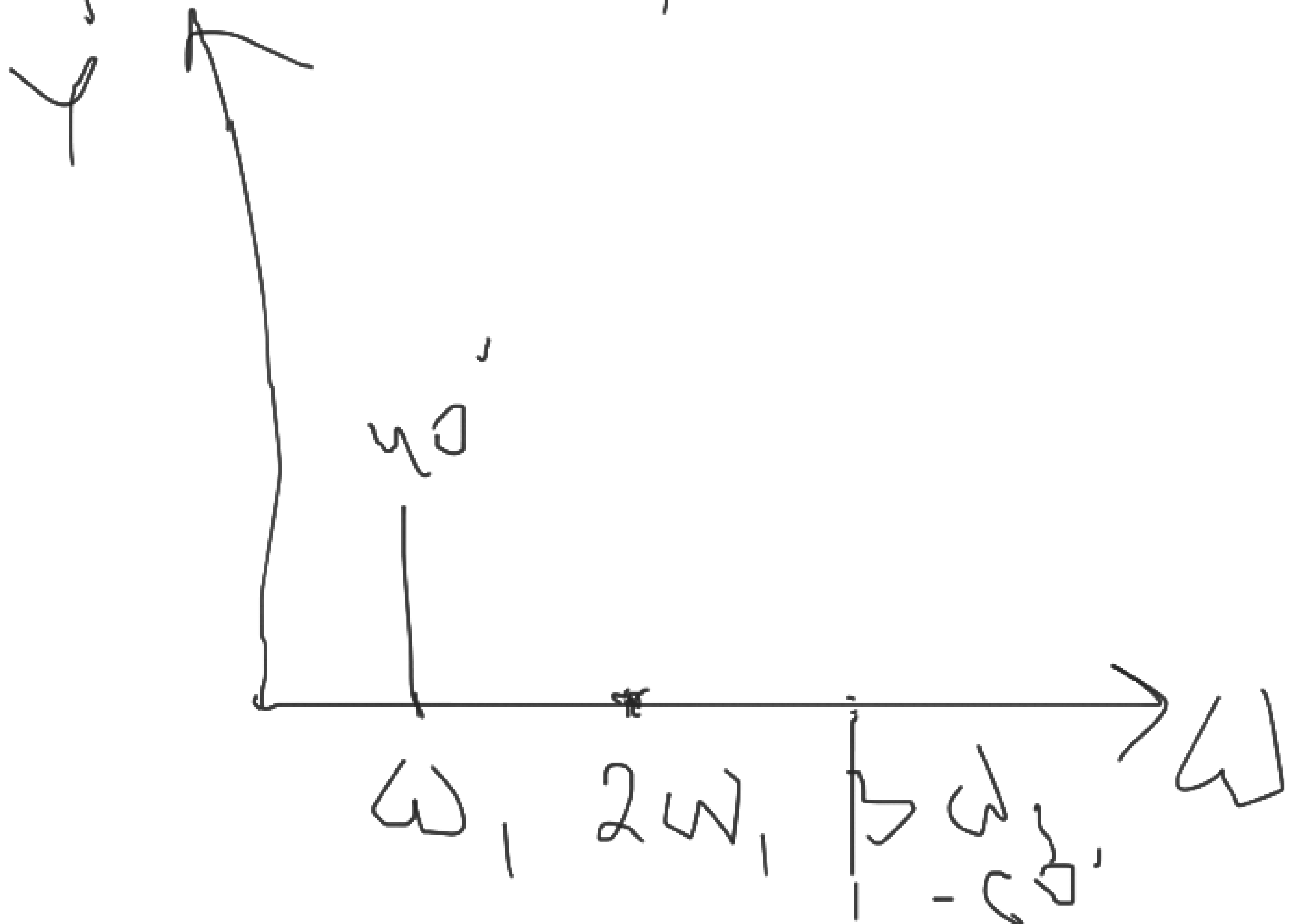
$$Z(j\omega) = \frac{(R_L + j\omega L)\frac{1}{j\omega C}}{R_L + j\left(\omega L - \frac{1}{\omega C}\right)}$$

$$R_{оке} = \frac{\rho^2}{R_{L1} + R_н}$$

$$2\Delta f_e = f_{рез}/Q_e$$

$$f(\omega t) = 4 + 10\sin(\omega_1 t + 40^\circ) +$$
$$+ 6\sin(3\omega_1 t - 60^\circ)$$





Задача 16.2.1. Для кола, схему якого наведено по рис.16.2.1.а), задані параметри: R=20 Ом; L=10мГн; C=33мкФ. До кола підведена напруга (графік приведений на рис.16.1.б)), яка характеризується параметрами: A=125,6В, $\omega_1 = 10^3\ c^{-1}$. Визначити: I_1, I_3, i_1, i_3, P .

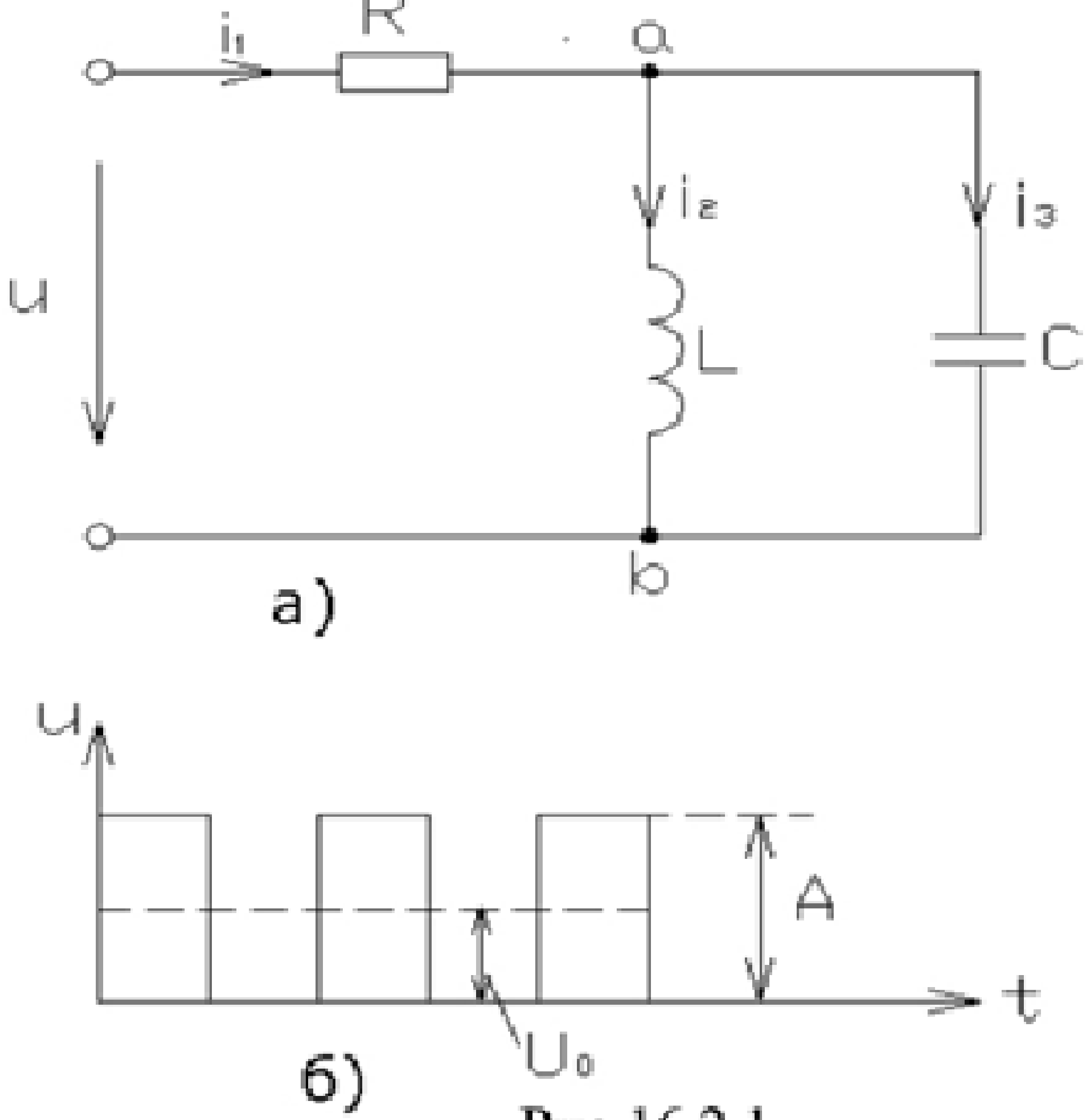


Рис.16.2.1.

$U_0 = 62,8$ В

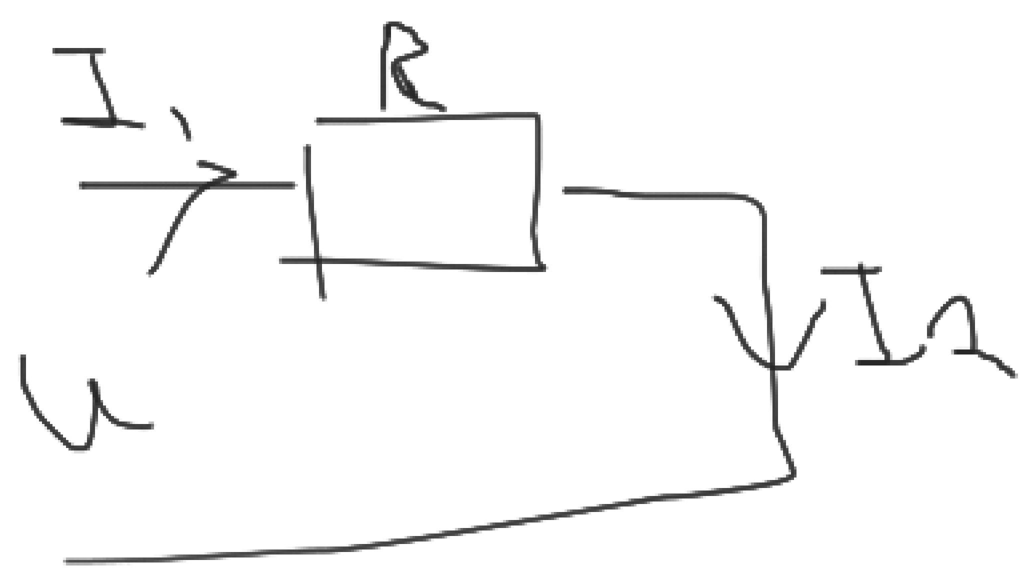
Z

I_1

$$u(t) = U_0 + \frac{4 U_m}{\pi}\left(\sin\omega_1 t + \frac{1}{3}\sin 3\omega_1 t + \frac{1}{5}\sin 5\omega_1 t + \dots\right) =$$

$$= 62{,}8 + 80\sin\omega_1 t + 26{,}7\sin 3\omega_1 t + 16\sin 5\omega_1 t + \dots)$$

$\omega_0 = 0$



$I_1(0) = \frac{U_0}{R} = \frac{62{,}8}{20} = 3{,}14$ A $\quad I_1(0) = I_2(0) \quad I_3(0) = 0$

$\omega_1 = 10^3$

$X_{L(1)} = \omega_1 L = 10^{-3}\cdot 10\cdot 10^{3} = 10$ Ом

$X_{C(1)} = \frac{1}{\omega_1 C} = \frac{1}{10^3\cdot 33\cdot 10^{-6}} = 30$ Ом

$$Z_{(1)} = R + \left(\frac{jX_{L(1)}(-jX_{C(1)})}{jX_{L(1)} - jX_{C(1)}} \right) = Z_{ab}$$

$$= 20 + \frac{10j(-30j)}{10j - 30j} = 20 + 15j = 25e^{j37}$$

$$I_{1(1)} = \frac{U_{(1)}}{Z_{(1)}} = \frac{80}{25e^{j37} \cdot \sqrt{2}} = 2{,}26e^{-j37^{\circ}}$$

$$U_{ab(1)} = I_{1(1)} \cdot Z_{ab} = 2{,}26 \cdot e^{-37j} \cdot 15 e^{j90} =$$

$$= 34 e^{53j}$$

$$I_{3(1)} = \frac{U_{ab(1)}}{Z_{c(1)}} = \frac{34 e^{53j}}{30 e^{-90j}} = 1{,}1 e^{143j}$$

$$\omega_3 = 3\omega_1 = 3 \cdot 10^3 \frac{1}{c}$$

$$X_{L(3)} = 3 \cdot 10^3 \cdot 10 \cdot 10^{-3} = 30 \text{ Ом}$$

$$X_{C(3)} = \frac{1}{33 \cdot 10^{-6} \cdot 3 \cdot 10^3} = 10 \text{ Ом}$$

$$Z(3) = 20 - 15j = 25e^{-37j}$$

$$I_1(3) = \frac{26{,}7}{25e^{-37j}} = \frac{1{,}07e^{37j}}{\sqrt{2}} = 0{,}76e^{37j}$$

$$U_{ap}(3) = \frac{1{,}07}{\sqrt{2}}e^{37j} \cdot 15e^{-90} = 11{,}3e^{-53j}$$

$$I_3(3) = \frac{11{,}3e^{-53j}}{10e^{90j}} = 1{,}13e^{-143j}$$

$$\omega_5 = 5\omega_1 = 5 \cdot 10^3$$

$$X_L(5) = 5\cdot 10^3 \cdot 10\cdot 10^{-3} = 50\ \text{Ом}$$

$$X_C(5) = \frac{1}{5\cdot 10^3 \cdot 33\cdot 10^{-6}} = 6\ \text{Ом}$$

$$Z = 20 + \frac{50j(-j6)}{44j} = 20 + 6{,}8j = 21{,}1e^{j19}$$

$$I_1(5) = \frac{16}{\sqrt{2}\cdot 21{,}1e^{j19}} = 0{,}54e^{-j19}$$

$$u_{ab}(5) = 0{,}54e^{-j19}\cdot 6{,}8e^{j90} = 3{,}7\cdot e^{71}$$

a) $K(j\omega) = \dfrac{\dot{U}_2}{\dot{U}_1} = \dfrac{\cancel{\dot{I}} \cdot 1/j\omega C}{\cancel{\dot{I}}(R_1 + 1/j\omega C)} =$

$$= \dfrac{1/\cancel{j\omega C}}{\dfrac{R\,j\omega C + 1}{\cancel{j\omega C}}} = \dfrac{1}{1 + j\omega RC} \cdot \dfrac{1 - j\omega RC}{1 - j\omega RC} =$$

$$= 1 - j\omega RC$$

АЧХ

$$K(\omega) = \sqrt{1^2 + (-\omega RC)^2}$$

ф4 X $\varphi(\omega) = -\operatorname{arctg}\left(\frac{-\omega RC}{1}\right)$

б) $K(j\omega) = \frac{R_1}{R_1 + 1/j\omega C}$

в) $K(j\omega) = \frac{j\omega L}{R_1 + j\omega L}$

г) $K(j\omega) = \frac{R}{R + j\omega L}$

$$\sqrt{1+(\omega RC)^2} = \frac{1}{\sqrt{2}}$$

$$1+(\omega RC)^2 = \frac{1}{2}$$

$$\omega_p = \sqrt{\frac{1-0.5}{(RC)^2}}$$

$$f_p = \frac{\omega}{2\pi}$$