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№23

TE₁₃

$$a = 66,37 \text{ мк}$$

$$b = 29,5 \text{ мк}$$

TE₁₃ = H₁₃

$$m = 1$$

$$n = 3$$

$$a) \omega_{кр.} = \sqrt{\epsilon} c \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2} = 96,9 \text{ ГГц}$$

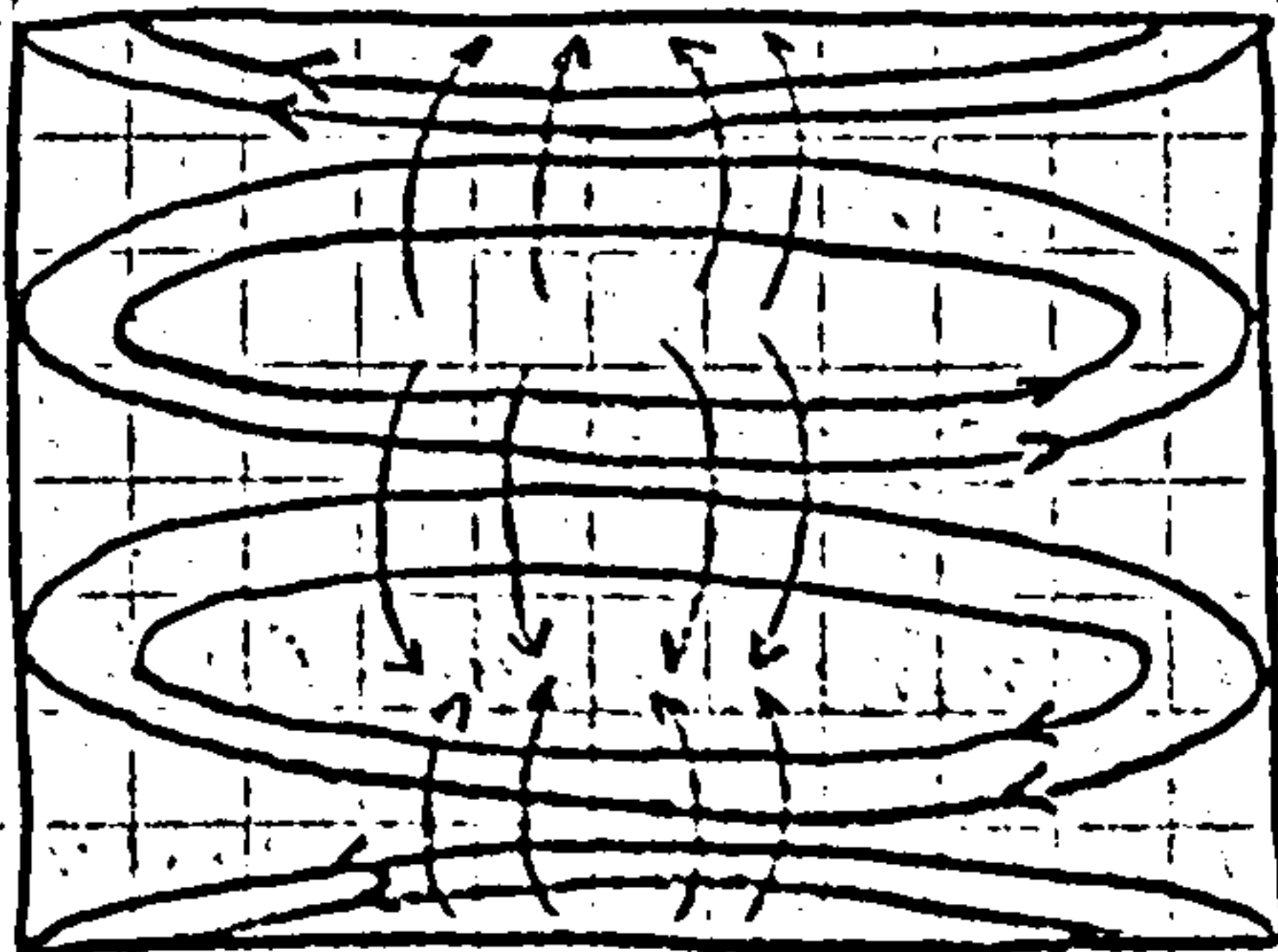
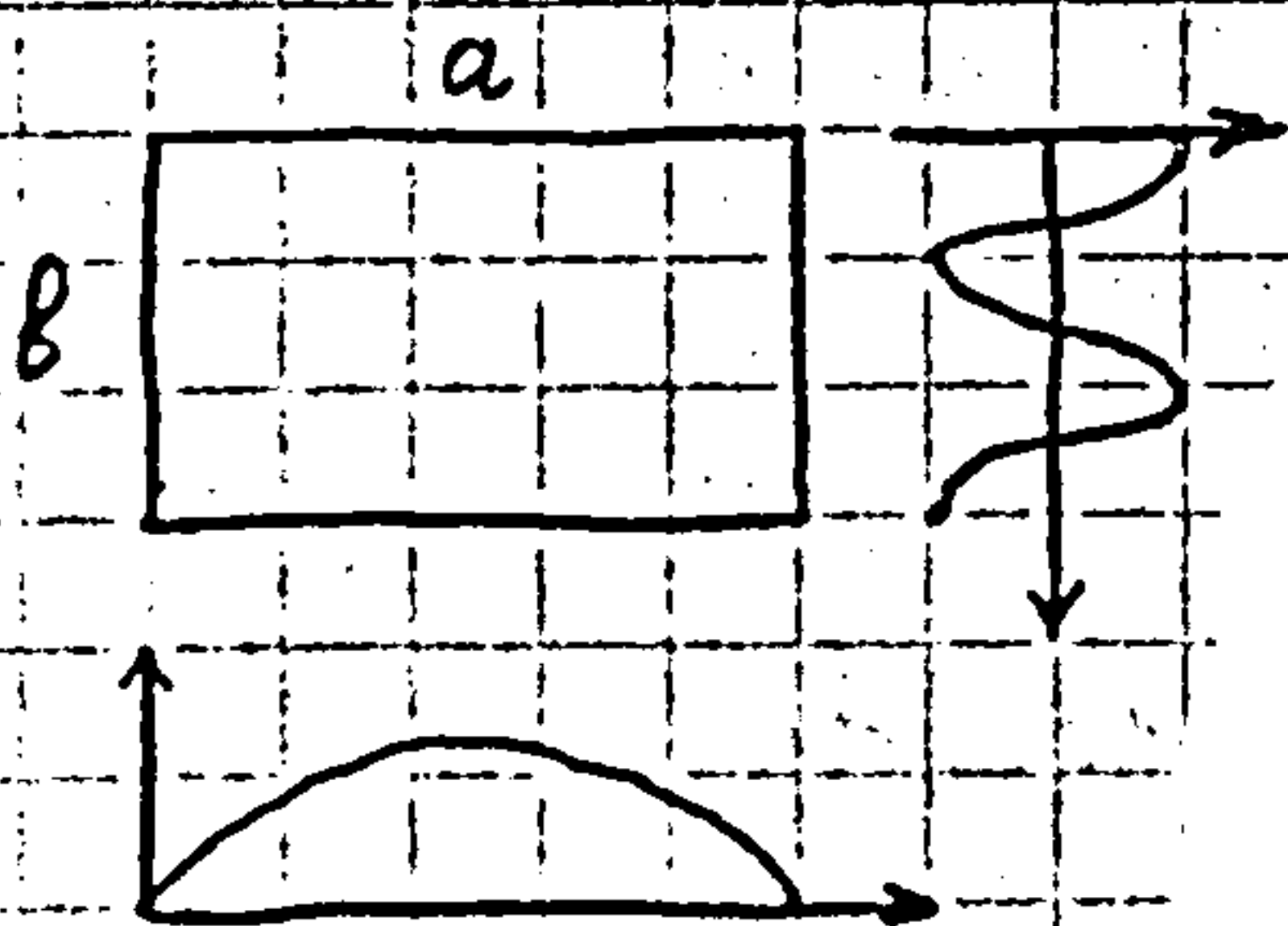
$$f_{кр.} = \frac{\omega_{кр.}}{2\pi} = 15,4 \text{ ГГц}$$

$$b) v_{ф} = \frac{v_0}{\sqrt{1 - \left(\frac{\omega_{кр.}}{\omega}\right)^2}} = \frac{c}{\sqrt{1 - \left(\frac{\omega_{кр.}}{1,3 \cdot \omega_{кр.}}\right)^2}} = \frac{c}{\sqrt{1 - \left(\frac{10}{13}\right)^2}} = 4,7 \cdot 10^8 \text{ м/с}$$

$$v_{ф} \cdot v_{гp} = v_0^2 = c^2$$

$$v_{гp} = \frac{c^2}{v_{ф}} = c \sqrt{1 - \left(\frac{10}{13}\right)^2} = 1,9 \cdot 10^8 \text{ м/с}$$

в)



$$2) p = p_0 \cdot e^{-2\alpha x}$$

$$p_0 = p(z=0)$$

$$d = \frac{K_{ш} \cdot K \cdot \mu_{пр} \cdot \Delta}{\alpha \cdot \beta \cdot \sqrt{K}} \left[(\alpha + \beta) \frac{f^2}{f_{кр}^2} + \left(1 - \frac{f^2}{f_{кр}^2} \right) \cdot \frac{\alpha \beta (m^2 \beta + n^2 \alpha)}{m^2 \beta^2 + n^2 \alpha^2} \right]$$

$$K_{ш} = 1,4$$

$$\sqrt{K} = \sqrt{1 - \left(\frac{f_{кр}}{f} \right)^2}$$

$$k = \frac{2\pi f}{v_{ЭМ}}$$

$$\Delta = \sqrt{\frac{2}{\omega \cdot \mu H_0 \cdot \sigma_{сш}}}$$

$$\sigma_{сш} = 5,7 \cdot 10^7$$

$$\Delta = 1,88 \cdot 10^{-7}$$

$$k = 2,64 \cdot 10^3$$

$$\sqrt{K} = 0,639$$

$$d = 0,078$$

Ослабление СВЧ - мощности:

$$\frac{P}{P_0} = e^{-2dZ} = e^{-2 \cdot 0,078 \cdot 1,4} = 0,803$$