$\boxed{1}$ $\mu_r = 1$

$$H = \frac{e^{-200y}}{10}\cos(2\pi \cdot 10^{10} t - 350 y)\, a_x \ [A/m]$$

$\Rightarrow \alpha = 200 \qquad \beta = 350$

① $$Z = \frac{\omega\mu}{\sqrt{\alpha^2+\beta^2}}\, e^{j\,\mathrm{arctg}\left(\frac{\alpha}{\beta}\right)} = \frac{2\pi \cdot 10^{10} \cdot 1 \cdot 4\pi \cdot 10^{-7}}{\sqrt{200^2 + 350^2}}\, e^{j\,\mathrm{arctg}\left(\frac{200}{350}\right)}$$

$$\boxed{= 196 \angle 30^\circ}$$

② $E = ?$ $\quad t = 2ns \quad y = 0.1m \quad [nV/m]$

$$Z = \frac{E}{H} \Rightarrow E = Z \cdot H$$

$$= \mathrm{Re}\{Z\} = 196 \cdot \cos(30^\circ) \cdot \frac{e^{-20}}{10} \cos(2\pi \cdot 10^{10} \cdot 2 \cdot 10^{-9} - 35)$$

$$\underline{\underline{= -40.3}}$$

$\boxed{II}$ $E(x,y,z,t) = E_0(x,y)\, e^{j(1.5\cdot 10^8 t - kz)}$

$B(x,y,z,t) = B_0(x,y)\, e^{j(1.5\cdot 10^8 t - kz)}$

3.

$\nabla \times E = \frac{\partial B}{\partial t}$

$\left(\cancel{\frac{\partial}{\partial y} E_z} + \frac{\partial}{\partial z} E_y\right) a_x + \left(\underbrace{\cancel{\frac{\partial}{\partial x} E_z}}_{=0} - \frac{\partial}{\partial z} E_x\right) \vec{a_y} = + \frac{\partial B}{\partial t}$

$= 0$

samo po jednoj kordinati uzmemo

$E_0 \cancel{j} k e^{j(\omega t - kz)} = \frac{\partial B}{\partial t} \quad / \int$

$B = \frac{-E_0 k e^{j(\omega t - kz)} \cancel{j}}{\cancel{j}\omega}$

$B = \mu_0 H$

$H = \frac{B}{\mu_0}$

$\nabla \times H = \frac{\partial D}{\partial t}$

$\frac{\partial H}{\partial z} = \varepsilon \frac{\partial E}{\partial t}$

$\frac{-1}{\mu_0} \frac{\cancel{E_0} j^2 k^2 \cancel{e^{j(\omega t - kz)}}}{\omega} = \frac{\varepsilon \cancel{E_0} \omega \cancel{e^{j(\omega t - kz)}}}{j\omega}$

$k^2 = \varepsilon_0 \omega^2 \mu_0 \cancel{j^2}$

$\boxed{k = \sqrt{\varepsilon_0 \mu_0}\, \omega = \underline{\underline{0.5}}}$

alternativno:

iz formule vidimo

$k = \beta$

$\beta = \omega \sqrt{\varepsilon \mu}$

$k = \omega \sqrt{\mu_0 \varepsilon_0} = 0.5$

4. $\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{0.5} = \underline{\underline{4\pi}}$

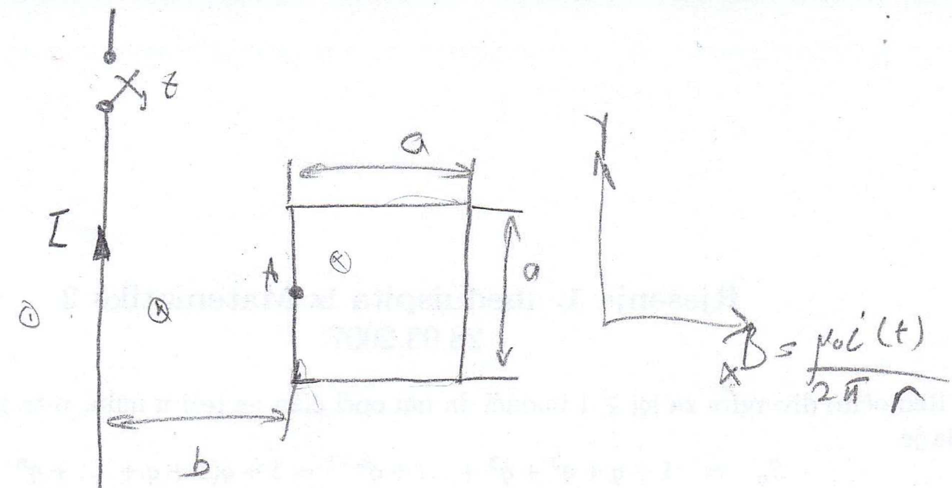
III

$a = 1\,m$

$b = 1\,m$

$I = 1\,A$

$R = 1\,\Omega$



$$\varepsilon_{ind} \quad \frac{\mu_0 \cdot i}{2\pi b} \cdot a^2 = \frac{\overset{2}{\cancel{4\pi}} \cdot 10^{-7} \cdot 1}{\cancel{2\pi} \cdot 1} = 200\,nV$$

$$Q = \int i(t)\,dt$$

$$= \int \frac{\varepsilon_{ind}(t)}{R}\,dt$$

$$= \int \frac{-\frac{\partial \phi(t)}{\partial t}}{R}\,dt = \frac{\phi}{R} \qquad \phi = \int B \cdot n\,dS$$

$$Q = \frac{\mu_0 I}{2\pi} \iint \frac{1}{x}\,dx\,dy = \frac{\mu_0 I}{2\pi} \int_1^2 \frac{1}{x} \int_0^1 dy\,dx = \frac{\mu_0 I}{2\pi} \cdot \ln\left(\frac{2}{1}\right) \cdot 1$$

$$= 200 \cdot 10^{-9} \cdot \ln(2) = \underline{138.62\,nC}$$

$\boxed{IV}$ $\varepsilon_r = 6$ $\mu_r = 1$ $\kappa = 0.5$ $f = 150MHz$ $E_0 = 200\ V/m$

$$\frac{\kappa}{\omega\varepsilon} = 10$$

$$\alpha = \frac{\omega}{\sqrt{2}c}\sqrt{\sqrt{1+\left(\frac{\kappa}{\omega\varepsilon}\right)^2}-1}$$

$$\beta = \frac{\omega}{\sqrt{2}c}\sqrt{\sqrt{1+\left(\frac{\kappa}{\omega\varepsilon}\right)^2}+1}$$

$$= \frac{\omega}{\sqrt{2}c}\,3$$

$$\beta = \frac{\omega}{\sqrt{2}c}\cdot 3.32$$

$$E = E_0 e^{-\alpha x}\cos(\omega t - \beta x)$$

6. $\frac{E(x=0)}{E(x=2\lambda)}$ $\lambda = \frac{2\pi}{\beta}$

$$= \frac{\cancel{E_0} e^0 \cos(\omega t)}{\cancel{E_0} e^{-2\alpha\lambda}\cos(\omega t - \beta\cdot 2\lambda)}$$

istí su

$$= \frac{\cos(\omega t)}{e^{-2\pi 2\frac{\alpha}{\beta}}\cdot\cos(\omega t - \cancel{\beta}\cdot 2\cdot\frac{2\pi}{\cancel{\beta}})} = \frac{\cancel{\cos\omega t}}{e^{-4\pi\frac{3}{3.32}}\cancel{\cos(\omega t - 4\pi)}}$$

$$= e^{4\pi\frac{3}{3.32}} = \frac{85000}{e^{11.35}} \simeq \frac{86767}{e^{11.37}}$$ → odtud ta razlika

„JA" „ONI"

7. $$Z = \frac{\omega\mu\, e^{j\arctan\left(\frac{\alpha}{\beta}\right)}}{\sqrt{\alpha^2+\beta^2}} = \frac{\cancel{\omega\mu}}{\frac{\cancel{\omega}}{\sqrt{2}c}\sqrt{3^2+3.32^2}} e^{j\arctan\left(\frac{3}{3.32}\right)} = \frac{\sqrt{2}c}{4.47}e^{j42} = 48.5\angle 42^\circ$$

---

8. $d = \frac{1}{\alpha}$ ⇒ $x = 0.8d = \frac{0.8}{\alpha}$

$$N_{sr} = \frac{1}{2}\frac{E_0^2}{|Z|}e^{-2\alpha x}\cos\varphi = \frac{1}{2}\frac{200^2}{48.5}e^{-2\alpha\frac{0.8}{\alpha}}\cos(42^\circ)$$

$$= \frac{1}{2}\frac{200^2}{48.5}e^{-1.6}\cdot\cos(42^\circ) = \underline{\underline{27.8}}$$

IV

$$E = \frac{50 \sin\vartheta}{r} \cos(10^9 t - 2r)\, a_\vartheta \quad [V/m]$$

$$H = \frac{50 \sin\vartheta}{120\pi \cdot r} \cos(10^9 t - 2r)\, a_\varphi \quad [A/m]$$

[mW/m²]

9. $N = ?$ $r = 3\,m$ $t = 3\,ns$ $\vartheta = \pi/5$

$$N = E \times H = \left| \begin{array}{ccc|cc} a_r & a_\varphi & a_\vartheta & a_r & a_\varphi \\ 0 & E & 0 & 0 & E \\ 0 & 0 & H & 0 & H \end{array} \right| = HE\,\vec{a_r}$$

$$N = \frac{50^2 \sin^2\vartheta}{120\pi\, r^2} \cos^2(10^9 t - 2r)\, \vec{a_r} \Big|_{\substack{r=3 \\ \vartheta=\pi/5 \\ t=3ns}} = 0{,}249.5 = 249.5\ mW/m^2$$

10. $P_{uk} = ?$

$$dV = 2\pi R^2 \cdot \sin\vartheta\, d\vartheta$$

$$P = \int_V N_{sr}\, dV$$

$$N_{sr} = \frac{1}{2} \frac{50^2 \sin^2\vartheta}{120\pi \cdot R^2}$$

$$P = \frac{1}{2} \frac{50^2}{120\cancel{\pi} \cdot \cancel{R^2}} \cancel{2\pi R^2} \underbrace{\int_0^\pi \sin^3\vartheta\, d\vartheta}_{4/3} = \frac{50^2 \cdot \cancel{4}}{\cancel{120}_{30} \cdot 3} = \boxed{\frac{50}{90}}$$

$$= 27.8$$

$$\boxed{P = \frac{V^2}{90}} \text{ (za sferne kord.)}$$

$$E = \frac{V \sin\vartheta}{r} \cos(\omega t - \beta r)$$