

Fizika 2i ZH

2013.11.04.

1.

$$U = 10 \text{ V}$$

$$R = 5 \Omega$$

$$L = 10 \text{ H}$$

$$P = ?$$

$$E = ?$$

$$P = \frac{U^2}{R} = \frac{10^2 \text{ V}^2}{5 \Omega} = 20 \text{ W}$$

$$E = \frac{1}{2} LI^2 = \frac{1}{2} L \left(\frac{U}{R} \right)^2 = \frac{1}{2} \cdot 10 \text{ H} \cdot \left(\frac{10 \text{ V}}{5 \Omega} \right)^2 = 20 \text{ J}$$

2.

$$U_{\max} = 400 \text{ V}$$

$$f = 50 \text{ Hz}$$

$$P = 480 \text{ W}$$

$$\cos \varphi = 0,7$$

$$\cos \varphi_{\text{új}} = 1$$

$$C = ?$$

$$P = U_{\text{eff}} I_{\text{eff}} \cos \varphi = \frac{U_{\max}}{\sqrt{2}} I_{\text{eff}} \cos \varphi \Rightarrow I_{\text{eff}} = \frac{\sqrt{2} P}{U_{\max} \cos \varphi}$$

$$Z = \frac{U_{\text{eff}}}{I_{\text{eff}}} = \frac{U_{\max}^2 \cos \varphi}{2P}$$

$$\cos \varphi = \frac{R}{Z} \Rightarrow R = Z \cos \varphi = \frac{U_{\max}^2 \cos^2 \varphi}{2P}$$

$$Z^2 = X_L^2 - R^2 \Rightarrow X_L = \sqrt{Z^2 - R^2} = \frac{U_{\max}^2 \sqrt{\cos^2 \varphi - \cos^4 \varphi}}{2P}$$

$$\cos \varphi_{\text{új}} = 1 \Rightarrow X_C = X_L \Rightarrow \frac{1}{2\pi f C} = \frac{U_{\max}^2 \sqrt{\cos^2 \varphi - \cos^4 \varphi}}{2P}$$

$$C = \frac{P}{\pi f U_{\max}^2 \sqrt{\cos^2 \varphi - \cos^4 \varphi}} = \frac{480 \text{ W}}{\pi \cdot 50 \text{ Hz} \cdot 400^2 \text{ V}^2 \cdot \sqrt{0,7^2 - 0,7^4}} = \frac{\sqrt{51}}{59500\pi} \text{ F} \approx 38,2 \mu\text{F}$$

3.

$$R = 0,02 \text{ m}$$

$$J = 2 \cdot 10^6 \frac{\text{A}}{\text{m}^2}$$

$$r = 0,01 \text{ m}$$

$$H = ?$$

$$I = Jr^2\pi$$

$$H = \frac{I}{2\pi r} = \frac{Jr}{2} = \frac{2 \cdot 10^6 \frac{\text{A}}{\text{m}^2} \cdot 0,01 \text{ m}}{2} = 10^4 \frac{\text{A}}{\text{m}}$$

4.

$$N_1 = 1600$$

$$N_2 = 800$$

$$U_1 = 220 \text{ V}$$

$$I_1 = 0,025 \text{ A}$$

$$R_2 = ?$$

$$\frac{U_2}{U_1} = \frac{N_2}{N_1} \Rightarrow U_2 = \frac{N_2}{N_1} U_1$$

$$\frac{I_2}{I_1} = \frac{N_1}{N_2} \Rightarrow I_2 = \frac{N_1}{N_2} I_1$$

$$R_2 = \frac{U_2}{I_2} = \left(\frac{N_2}{N_1} \right)^2 \frac{U_1}{I_1} = \left(\frac{800}{1600} \right)^2 \frac{220 \text{ V}}{0,025 \text{ A}} = 2200 \Omega$$

5.

$$l = 0,5 \text{ m}$$

$$R = 0,015 \text{ m}$$

$$B = 0,08 \text{ T}$$

$$I = 5 \text{ A}$$

$$N = 50$$

$$r = 0,005 \text{ m}$$

$$\alpha = 30^\circ$$

$$\Delta t = 0,005 \text{ s}$$

$$U = ?$$

$$\Delta \Phi = \Delta B r^2 \pi \cos \alpha = B r^2 \pi \cos \alpha$$

$$U = N \frac{\Delta \Phi}{\Delta t} = N \frac{B r^2 \pi \cos \alpha}{\Delta t} = 50 \cdot \frac{0,08 \text{ T} \cdot 0,005^2 \text{ m}^2 \cdot \pi \cdot \cos 30^\circ}{0,005 \text{ s}} =$$

$$= \frac{\sqrt{3}\pi}{100} \text{ V} \approx 0,054 \text{ V}$$

6.

$$U = 12 \text{ V}$$

$$B = 0,65 \text{ T}$$

$$m = 0,05 \text{ kg}$$

$$l = 0,2 \text{ m}$$

$$g = 9,81 \frac{\text{m}}{\text{s}^2}$$

$$R = ?$$

$$Bil = mg \Rightarrow B \frac{U}{R} l = mg$$

$$R = \frac{BUl}{mg} = \frac{0,65 \text{ T} \cdot 12 \text{ V} \cdot 0,2 \text{ m}}{0,05 \text{ kg} \cdot 9,81 \frac{\text{m}}{\text{s}^2}} \approx 3,18 \Omega$$

7.

$$P = 0,025 \text{ W}$$

$$r = 7,5 \cdot 10^{-4} \text{ m}$$

$$\lambda = 6,328 \cdot 10^{-7} \text{ m}$$

$$l = 1 \text{ m}$$

$$c = 3 \cdot 10^8 \frac{\text{m}}{\text{s}}$$

$$p = ?$$

$$c = \frac{l}{t} \Rightarrow t = \frac{l}{c}$$

$$E = Pt = P \frac{l}{c}$$

$$E = mc^2 = pc$$

$$pc = P \frac{l}{c} \Rightarrow p = P \frac{l}{c^2} = 0,025 \text{ W} \cdot \frac{1 \text{ m}}{(3 \cdot 10^8)^2 \frac{\text{m}^2}{\text{s}^2}} = \frac{25}{9} \cdot 10^{-19} \text{ Ns} \approx$$

$$\approx 2,77 \cdot 10^{-19} \text{ Ns}$$

8.

$$t = 2 \cdot 10^{-8} \text{ s}$$

$$W = 1,5 \text{ J}$$

$$r = 1,25 \cdot 10^{-3} \text{ m}$$

$$c = 3 \cdot 10^8 \frac{\text{m}}{\text{s}}$$

$$\epsilon_0 = 8,854 \cdot 10^{-12} \frac{\text{As}}{\text{Vm}}$$

$$E = ?$$

$$c = \frac{l}{t} \Rightarrow l = ct$$

$$w_e = \frac{W}{r^2 \pi l} = \frac{W}{r^2 \pi ct}$$

$$w_e = \frac{1}{2} \epsilon_0 E^2$$

$$\frac{W}{r^2 \pi ct} = \frac{1}{2} \epsilon_0 E^2$$

$$E = \sqrt{\frac{2W}{r^2 \pi ct \epsilon_0}} =$$

$$= \sqrt{\frac{2 \cdot 1,5 \text{ J}}{(1,25 \cdot 10^{-3})^2 \text{ m}^2 \cdot \pi \cdot 3 \cdot 10^8 \frac{\text{m}}{\text{s}} \cdot 2 \cdot 10^{-8} \text{ s} \cdot 8,854 \cdot 10^{-12} \frac{\text{As}}{\text{Vm}}}} \approx$$

$$\approx 1,06 \cdot 10^8 \frac{\text{V}}{\text{m}}$$

9.

$$E_m = 3,2 \cdot 10^{-16} \text{ J}$$

$$B = 5 \cdot 10^{-5} \text{ T}$$

$$e = 1,6 \cdot 10^{-19} \text{ C}$$

$$m = 9,1 \cdot 10^{-31} \text{ kg}$$

$$T = ?$$

$$evB = m \frac{v^2}{r}$$

$$r = \frac{mv}{eB}$$

$$v = \frac{2r\pi}{T} \Rightarrow T = \frac{2r\pi}{v} = \frac{2m\pi}{eB} = \frac{2 \cdot 9,1 \cdot 10^{-31} \text{ kg} \cdot \pi}{1,6 \cdot 10^{-19} \text{ C} \cdot 5 \cdot 10^{-5} \text{ T}} =$$

$$= \frac{91\pi}{40} \cdot 10^{-7} \text{ s} \approx 7,1 \cdot 10^{-7} \text{ s}$$

10.

$$r = 0,1 \text{ m}$$

$$N = 1500$$

$$I = 1,5 \text{ A}$$

$$A = 4 \cdot 10^{-4} \text{ m}^2$$

$$\mu_0 = 4\pi \cdot 10^{-7} \frac{\text{Vs}}{\text{Am}}$$

$$\mu_r = 200$$

$$\Phi = ?$$

$$B = \mu_0 \mu_r \frac{IN}{2r\pi}$$

$$\Phi = BA = \mu_0 \mu_r \frac{IN}{2r\pi} A = 4\pi \cdot 10^{-7} \frac{\text{Vs}}{\text{Am}} \cdot 200 \cdot \frac{1,5 \text{ A} \cdot 1500}{2 \cdot 0,1 \text{ m} \cdot \pi} \cdot 4 \cdot 10^{-4} \text{ m}^2 =$$

$$= 3,6 \cdot 10^{-4} \text{ Tm}^2$$