

## 11. cvičení

1.

$$Q = \int_{t_1}^{t_2} I dt = \frac{1}{R} \int_{t_1}^{t_2} U_F dt = -\frac{1}{R} \int_{t_1}^{t_2} \frac{d\Phi}{dt} dt = -\frac{1}{R} [\Phi(t_2) - \Phi(t_1)]$$

$$\Phi(t_1) = \int_b^{b+a} \frac{\mu_0 I}{2\pi r} a \cos 0 dr = \frac{\mu_0 I a}{2\pi} [\ln r]_b^{b+a} = \frac{\mu_0 I a}{2\pi} \ln \left( \frac{b+a}{b} \right)$$

$$\Phi(t_2) = \int_{b-a}^a \frac{\mu_0 I}{2\pi r} a \cos \pi dr = -\frac{\mu_0 I a}{2\pi} [\ln r]_{b-a}^a = -\frac{\mu_0 I a}{2\pi} \ln \left( \frac{a}{b-a} \right)$$

$$Q = \frac{\mu_0 I a}{2\pi R} \left[ \ln \left( \frac{a}{b-a} \right) + \ln \left( \frac{b+a}{b} \right) \right] = \frac{\mu_0 I a}{2\pi R} \ln \left( \frac{a^2 + ab}{b^2 - ab} \right)$$

2.

a)

$$\Phi = \int_a^{a+L} \frac{\mu_0 i}{2\pi r} Lx dr = \frac{\mu_0 i Lx}{2\pi} \ln \left( \frac{a+L}{a} \right)$$

$$U_F = -\frac{d\Phi}{dt} = -\frac{d}{dt} \left[ \frac{\mu_0 i Lx}{2\pi} \ln \left( \frac{a+L}{a} \right) \right] = -\frac{\mu_0 i Lv}{2\pi} \ln \left( \frac{a+L}{a} \right)$$

$$U_F = -2,4 \cdot 10^{-5} \text{ V}$$

b)

$$I = \frac{U_F}{R} = -\frac{\mu_0 i}{2\pi R} Lv \ln \left( \frac{a+L}{a} \right)$$

$$I = -6 \cdot 10^{-5} \text{ A}$$

c)

$$P_T = I^2 R = \frac{\mu_0^2 i^2}{4\pi^2 R} L^2 v^2 \ln^2 \left( \frac{a+L}{a} \right)$$

$$P_T = 1,4 \cdot 10^{-9} \text{ W}$$

d)

$$F_V = F_L = IL \int_a^{a+L} B dr = -\frac{\mu_0 i}{2\pi R} Lv \ln \left( \frac{a+L}{a} \right) L \int_a^{a+L} \frac{\mu_0 i}{2\pi r} dr = -\frac{\mu_0^2 i^2}{4\pi^2 R} L^2 v \ln^2 \left( \frac{a+L}{a} \right)$$

$$F_V = -2,9 \cdot 10^{-10} \text{ N}$$

e)

$$P_V = F_V v = -\frac{\mu_0^2 i^2}{4\pi^2 R} L^2 v^2 \ln^2 \left( \frac{a+L}{a} \right)$$

$$P_V = -1,4 \cdot 10^{-9} \text{ W}$$