13.24

a). Charge : $i(t) = \frac{U}{R}\left(1 - e^{-\frac{t}{\tau}}\right)$; $i(t)$ est maximal lorsque $t \to \infty$

$$\Rightarrow i(t \to \infty) \cong \frac{U}{R} = \frac{20}{100} = \underline{\underline{0,2\,A}}$$

b). Energie électromagnétique contenue dans la bobine , $W = \frac{1}{2} L I^2 = \frac{1}{2} \frac{0,2}{1000} \cdot (0,2)^2 = \underline{\underline{4 \cdot 10^{-6}\,J}}$

c). Exactement à la coupure de l'alimentation , la puissance dissipée vaut $p_{max} = U_R \cdot i = R i^2$

$$= \underline{\underline{4W}}$$

Energie dissipée en fonction du temps . Considérons la puissance dissipée à l'instant t :

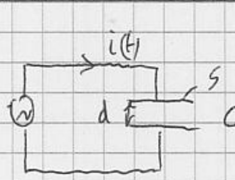
$$p(t) = U_R(t) \cdot i(t) = U(t) \cdot i(t) = U e^{-t/\tau} \cdot \frac{U}{R} e^{-t/\tau} = \frac{U^2}{R} e^{-2t/\tau}$$

L'énergie dissipée dE entre t et $t+dt$ (en un temps dt) vaut $dE = p(t)dt$

$$\Rightarrow E(t) = \int_0^t p(t^*)\,dt^* = \int_0^t \frac{U^2}{R} e^{-\frac{2}{\tau}t^*} dt^* = \frac{U^2}{R} \int_0^t e^{-\frac{2}{\tau}t^*} dt^* = \frac{U^2}{R}\left(-\frac{\tau}{2}\right) e^{-\frac{2}{\tau}t^*}\Big|_0^t$$

$$= \frac{U^2}{R} \cdot \frac{L}{2R}\left(-e^{-\frac{2}{\tau}t} + e^{-\frac{2}{\tau}0}\right) = \underline{\underline{\frac{LU^2}{2R^2}\left(1 - e^{-\frac{2}{\tau}t}\right)}}$$

13.33



$U_{eff} = 150\,V$

$\omega = 2\pi f = 2\pi\, 10'000$

$i_{eff} = 9,4 \cdot 10^{-6}\,A$

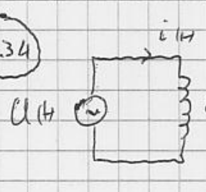
$E = \varepsilon_0 \frac{S}{d}$ (vide)

$S = 1\,cm^2 = 1 \cdot 10^{-4}\,m^2$

$\varepsilon_0 = 8,85 \cdot 10^{-12}$ (u.)

$$Z = \frac{\hat{U}}{\hat{I}} = \frac{U_{eff}}{I_{eff}} = \frac{1}{2\pi f C} \Rightarrow C = \frac{I_{eff}}{U_{eff}} \cdot \frac{1}{2\pi f} = \varepsilon_0 \frac{S}{d} \Rightarrow d = \varepsilon_0 S \cdot 2\pi f \cdot \frac{U_{eff}}{I_{eff}} \cong \underline{\underline{1\,mm}}$$

13.34



$f = 18'000\,Hz$

$i_{eff} = 3,6 \cdot 10^{-2}\,A$

$S = 3,1 \cdot 10^{-5}\,m^2$

$\ell = \frac{2,5}{100}\,m$

$N = 135$ spires

$Z = \frac{\hat{U}}{\hat{I}} = \frac{U_{eff}}{I_{eff}} = L\omega = 2\pi f L$

$L = \mu_0 N^2 \frac{S}{\ell}$

$$\Rightarrow U_{eff} = \frac{\hat{U}}{\sqrt{2}} \Rightarrow \hat{U} = \sqrt{2}\, U_{eff} = 2\pi f L \sqrt{2}\, i_{eff} = 2\pi f \mu_0 N^2 \frac{S}{\ell} \sqrt{2}\, i_{eff} \cong \underline{\underline{1,63 \cdot 10^{-1}\,V}}$$