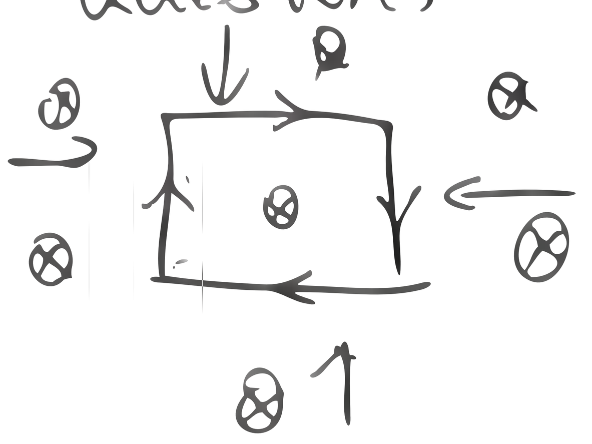
~~Hu~~ Yibei 519510910123

Concept Questions

1). A)



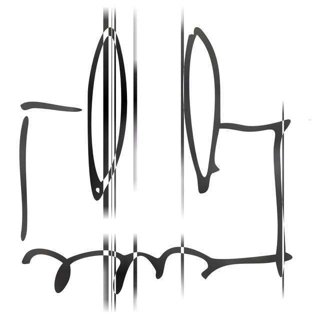
We assume the magnetic field is into the paper
According to the Faraday's theorem, the current is clockwise
The current is such as to oppose the process of its generation

a) the energy came from the hand

b) The energy will almost remain the same but will have some loss.

$\varepsilon = -\frac{d\phi_B}{dt}$ $I = \frac{\varepsilon}{R}$ $P = I^2R$.
$W = I^2Rt$.

2).



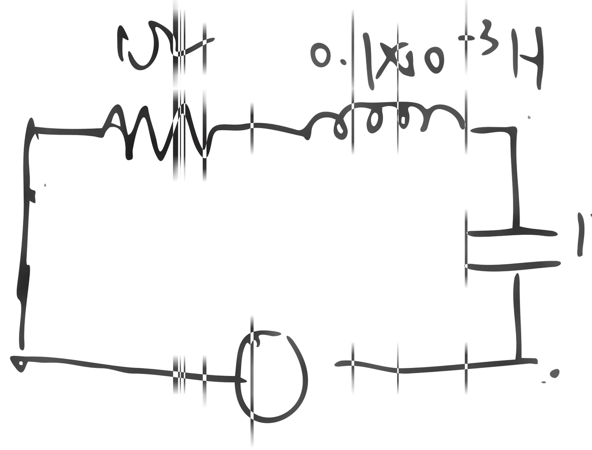
$C = \frac{\varepsilon A}{d}$. $d \downarrow$ $C \uparrow$ $\omega = \sqrt{\frac{1}{LC}}$ $\Rightarrow \omega \downarrow$ $C = \frac{Q}{V_C}$ $\Rightarrow V_C \downarrow$.

$U = \frac{1}{2}\frac{Q^2}{C^2}$ $U \downarrow$. $U = \frac{1}{2}LI^2$ $\Rightarrow I \downarrow$.

$i = -\omega Q \sin(\omega t + \phi)$ $I \downarrow$. $\varepsilon = -L\frac{di}{dt}$ $\Rightarrow \varepsilon \downarrow$.

$\Rightarrow$ all decreases

3).



(a) $f = \cancel{\frac{1}{2\pi\sqrt{LC}}}$ $\cancel{\frac{\sqrt{LC}}{2\pi}}$ $= \frac{1}{2\pi\sqrt{LC}}$ $= \cancel{503.55\,Hz}$ $503.3\,Hz$.

(b) $\left(\frac{R}{2L}\right)^2 + \frac{1}{LC} < 0.$ $\Rightarrow$ under ~~over~~ damped.

(c). The energy turned into the heat energy in resistor

$X_L = \omega L = 2\pi f L = 3\times10^{-2}\,\Omega$.

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = 3.18\,\Omega$

$X_C > R > X_L$ $\Rightarrow$ capacitive.

Han Yibei 5437591023

Essay Question

$f = 5.5 \times 10^{14}\,Hz$. $f = \frac{1}{2\pi\sqrt{LC}} \Rightarrow LC = 0.8 \times 10^{-31}\,Hz^{-2}$

$L = \frac{N^2 \mu A}{l}$, $\mu A = \mu_r \mu_0$. $N=1$ $A = \pi r^2 \Rightarrow L = \frac{\mu_r \mu_0 \pi r^2}{2\pi r^2 \cdot d}$

Calculation.

(A) $\mathcal{E} = -N \frac{\Delta \varphi}{\Delta t}$

$\mathcal{E} = -NA \frac{\Delta B}{\Delta t} = \frac{-1 \times \pi \times (3485 \times 10^3)^2 \times (0 - 60 \times 10^{-6})}{365 \times 24 \times 60 \times 60} = 21 \times 10^{-6}\,V$.

(B) $B = \frac{\mu_0 I}{2\pi} \Rightarrow I = \frac{B \cdot 2\pi}{\mu_0} = \frac{60 \times 10^{-6} \times 2 \times 3485\,km}{4\pi \times 10^{-7}} = 3.33 \times 10^8\,A$.

(C) counter clock wise $\Rightarrow$ flux is decrease

Calculation 2.

$I = 10\cos(2\pi t)\,A$. $M_1 = M_2 = 1 \times 10^{-3}\,H$

1). $e_2 = -M_2 \frac{dI}{dt} = -(1 \times 10^{-3}) \times (-10 \cdot 2\pi \sin(2\pi t))$

$= 20 \times 10^{-3}\,\pi \sin(2\pi t)\,V$.

2). $R = 1\,\Omega$ $e_1 = -M_1 \frac{dI'}{dt} \Rightarrow \int dI' = -\int \frac{e_1\,dt}{M_1} = -\frac{1}{M_1} \int 10\cos(2\pi t) \cdot dt$

$= -\frac{5 \times 10^3}{\pi} \sin(2\pi t)\,A$.

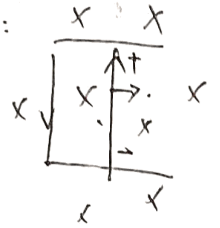
3) $P = V \cdot I = 100\,W$.

$P_2 = V \cdot I = 20 \times 10^{-3} \times \pi \times \frac{5 \times 10^3}{\pi} = 100\,W$.

$P = P_2 \Rightarrow$ the same.

Hanyi bei 5937091023

29.56. (a):



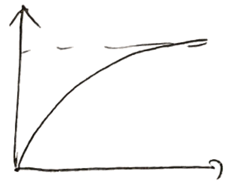
$\Rightarrow I = \frac{\varepsilon - BLv}{R}$ ~~$\frac{12V - 2.4T \times I \times 0.36m}{5\Omega}$~~ $\Rightarrow I = 2.01A$

$a = \frac{F}{m} = \frac{BIl \cdot \sin 90°}{m} \Rightarrow \dot{v} \cdot m = \varepsilon \cdot (Bl \cdot \frac{\varepsilon}{R}) - v \cdot \frac{B^2 l^2}{R}$

$\Rightarrow v = \frac{13.9}{14}(1 - e^{-0.166t})$

(b). after the switch closed $v = 0$ $I = \varepsilon / R = 2.4A$ $F = ILB = 2.07N$ $a = \frac{F}{m} = 2.3\, m/s^2$

(c). when $v = 2m/s$. $a = 2m/s^2$



d). $V_t = \frac{\varepsilon}{BL} = 13.9 m/s$.

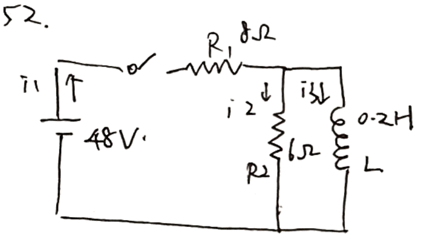
30.45

spot

$u_B = \frac{B^2}{2\mu_0} = 6.4 \times 10^4 J/m^3$. $U_B = u_B \cdot V$.

$K = U_B = \frac{1}{2}mv^2 \Rightarrow \frac{1}{2}\rho V v^2 = u_B \cdot V \Rightarrow v = \sqrt{\frac{2u_B}{\rho}} = 1 \times 10^4 m/s$

30.52.



(a) $\begin{cases} i_2 + i_3 = i_1 \\ i_1 \cdot R_1 + i_2 \cdot R_2 = 48 \\ -i_2 \cdot R_2 + L\frac{di_3}{dt} = 0. \end{cases}$ (*)

just after ~~steady~~: $i_1 = i_2 = \frac{48}{14} = 3.43A$.

$i_3 = 0$.

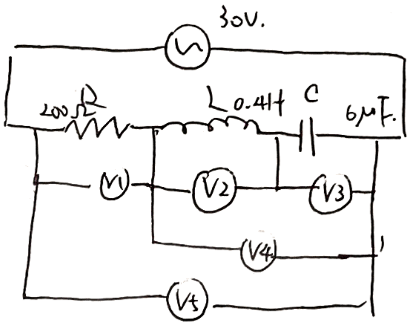
(b). steady: $i_2 = 0$ $i_1 = i_3 = \frac{48}{8} = 6A$

(c) According to (*) $i_2 = \frac{\varepsilon - i_3 R_1}{R_1 + R_2}$. $i_3 = \frac{\varepsilon}{R_1}(1 - e^{\frac{-R_1R_2 t}{L(R_1+R_2)}})$.

(d). $t = \frac{L(R_1 + R_2)}{R_1 R_2} \ln 2 = 0.04s$.

e) $i_2 = \frac{\varepsilon - i_3 R_1}{R_1 + R_2} = 1.71A$ $i_1 = i_3 + i_2 = 4.71A$.

31. 40



$U_{rms} = \frac{V}{\sqrt{2}} = 21.2V$.

$\omega =$ rad/s $\Rightarrow X_L = \omega L = 80\Omega$

$X_C = \frac{1}{\omega C} = 833\Omega$ $Z = \sqrt{R^2 + (X_L - X_C)^2} = 779\Omega$.

$I_{rms} = \frac{V_{rms}}{Z} = 0.0272A$. ~~$U_R$~~ $U_1 = R \cdot I_{rms} = 5.44V$.

$V_2 = X_L \cdot I_{rms} = 2.18V$ $V_3 = I_{rms} \cdot X_C = 22.7V$.

$V_4 =$ ~~$\frac{V_L - V_C}{\sqrt{2}}$~~ $|U_2 - V_3| = 20.5V$ $V_5 = U_{rms} = 21.2V$.

(b). $\omega = 1000$ rad/s $X_L = \omega L = 400\Omega$ $X_C = \frac{1}{\omega C} = 167\Omega$

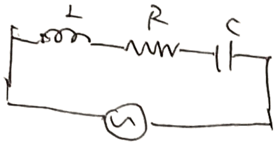
$Z = \sqrt{R^2 + (X_C - X_L)^2} = 307\Omega$ ~~且~~ $I_{rms} = \frac{V_{rms}}{Z} = 0.0691A$

$V_1 = R \cdot I_{rms} = 13.8V$ $V_2 = I_{rms} \cdot V_L = 27.6V$ $V_3 = I_{rms} V_C = 11.5V$.

$V_4 = |V_L - V_C| = 16.1V$ $V_5 = V_{rms} = 21.2V$.

Han Yibei: 51437510122

31.50.



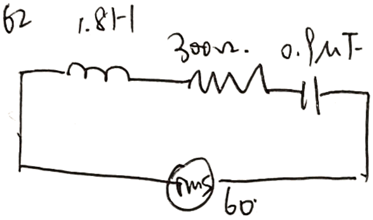
According to 31.49.

(a) $V_L = I\omega L = \dfrac{V\omega L}{\sqrt{R^2 + [\omega L - \frac{1}{\omega C}]^2}}$

(b). $V_C = \dfrac{I}{\omega C} = \dfrac{V}{\omega C\sqrt{R^2 + [\omega L - \frac{1}{\omega C}]^2}}$

(c).

31.62



(a) $\omega_0 = \dfrac{1}{\sqrt{LC}} = \dfrac{1}{\sqrt{(1.8H)(9 \times 10^{-7} F)}} = 786 rad/s$

(b) $Z = \sqrt{(300\Omega)^2 + (786 \times 1.8 - \frac{1}{786 \times 9 \times 10^{-7}})^2} = 300\Omega$

$I_{ms} = \dfrac{V_{ms}}{Z} = 0.2A.$

(c) $I = \frac{1}{2} I_{rms-0} = \dfrac{4V_{rms}^2}{I^2}$

$\omega^2 L^2 + \frac{1}{\omega^2 C^2} - \frac{2L}{C} + R^2 - \dfrac{4V_{ms}^2}{I_{rms0}^2} = 0 \Rightarrow (\omega^2)^2 L^2 + \omega^2 (R - \frac{2L}{C} - \frac{4V_{rms}^2}{I_{rms}^2}) + \frac{1}{C^2} = 0.$

$\Rightarrow \omega^2 = 8.9 \times 10^5 / 4.28 \times 10^5 \Rightarrow \omega = 943 rad/s / 654 rad/s.$

d) i $R = 300\Omega$ $I_{rms} = 0.2A$ $|\omega_1 - \omega_2| = 289 rad/s.$

ii $R = 30\Omega$ $I_{rms} = 2A$ $|\omega_1 - \omega_2| = 28 rad/s$

iii $R = 3\Omega$ $I_{rms} = 20A$ $|\omega_1 - \omega_2| = 3 rad/s.$