第九次普物作業 E94086107 張玥鳴

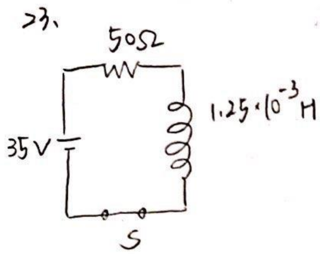
17、

(a) $B = \mu_0 n I = \mu_0 \frac{400}{0.25} \cdot 80 = \underline{0.161\,T}$ (b) $u_B = \frac{1}{2\mu_0} B^2 = \underline{10313.64\, J/m^3}$

(c) $E = \frac{1}{2} L I^2 = \frac{1}{2} \frac{B^2}{\mu_0} A l = \frac{1}{2} \frac{0.161^2}{\mu_0} \times 0.5 \times 10^{-4} \times 0.25 = \underline{0.129\ J}$

(d) $E = \frac{1}{2} L I^2$ $L = \underline{4.03 \times 10^{-5}\ H}$

23、



(a) $V - IR - L\frac{dI}{dt} = 0$

$\int_0^I \frac{dI}{V-IR} = \int_0^t \frac{dt}{L}$

$I = \frac{V}{R}(1 - e^{-\frac{R}{L}t})$

maximum when $t=0$ $I = \frac{V}{R} = I_0 = 0.7A$

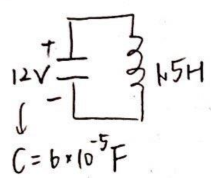
now $I = \frac{1}{2} I_0$, find t

$\frac{1}{2}\frac{V}{R} = \frac{V}{R}(1 - e^{-\frac{R}{L}t})$ $e^{-\frac{R}{L}t} = \frac{1}{2}$

$t = \underline{1.73 \times 10^{-5} s}$

(b) $E = \frac{1}{2} L I_{max}^2 = E_M$ now $E = \frac{1}{2} E_M$ $I = \frac{1}{\sqrt{2}} I_{MAX}$ $\frac{1}{\sqrt{2}}\frac{V}{R} = \frac{V}{R}(1 - e^{-\frac{R}{L}t})$ $t = \underline{3.07 \times 10^{-5} s}$

35



(a) for a L-C circuit $\omega_0 = \frac{1}{\sqrt{LC}} = \underline{105.41\ rad/s}$ $T = \frac{2\pi}{\omega} = \underline{5.96 \times 10^{-2} s}$

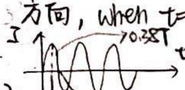
(b) initial charge: $V_0 = \frac{Q_0}{C}$ $12 = \frac{Q_0}{6 \times 10^{-5}}$ $Q_0 = \underline{7.2 \times 10^{-4} C}$

(c) $E_C = \frac{1}{2} C V^2$ $E_{C\,initial} = \frac{1}{2} C V_0^2 = \underline{4.32 \times 10^{-3} J}$

(d) $q(t) = Q_0 \cos(\omega_0 t + \phi)$ $q(0.023) = \underline{-5.4 \times 10^{-4} C}$ negative signed means capacitor is fully discharged, then it charged by the current in the inductor.

$(q(0) = Q_0,\ \phi = 0)$

(e) $I(t) = -\omega_0 Q_0 \sin(\omega_0 t + \phi)$ $I(0.023) = \underline{4.99 \times 10^{-2} A}$



方向, when $t=0.023$, is in $\frac{0.023}{5.96 \times 10^{-2}} = 0.38T$ so direction is the same as begining

(f) $E_C = \frac{Q_0^2}{2C} \cos^2(\omega_0 t + \phi)$ $E_C(0.023) = \underline{2.45 \times 10^{-3} J}$ 4T 2T $E_I = E_{C0} - E_C = \underline{1.87 \times 10^{-3} J}$

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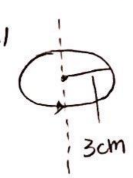
$i(t) = I_0 \sin(2\pi f t)$ $I_0 = 1.2A$ $f = 69\ Hz$ radius $= 3\ cm$

(a)



$\Phi_B = B_{center} \cdot A_{coil}$ $A_{coil} = R^2 \pi$

$N \frac{d\Phi_B}{dt} = L \frac{dI}{dt}$ $\Phi_B = \frac{\mu_0 \pi R}{2} i(t)$

$B_{center} = \frac{\mu_0 I}{2R}$ $N \frac{d\Phi_B}{dt} = L \frac{dI}{dt}$

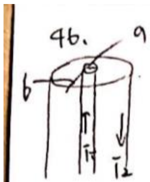
$N \cdot \frac{\mu_0 \pi R}{2} \frac{di(t)}{dt} = \frac{di(t)}{dt} L$

$L = 1 \cdot \frac{\mu_0 \pi \cdot 0.3}{2} = \underline{59.2 \times 10^{-9}\ H}$

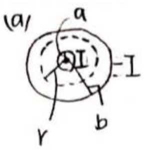
(b) $\mathcal{E}_L = L \cdot \frac{dI}{dt} = 59.2 \times 10^{-9} \times \frac{di(t)}{dt} = 59.2 \times 10^{-9} \times I_0 \times 2\pi f \times \cos(2\pi f t)$

maximum $\mathcal{E}_L$ = when $\sin(2\pi f t) = 1$, $\mathcal{E}_{L\,max} = \underline{2.68 \times 10^{-5}\ V}$

46.



(a)

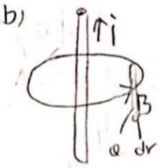


$\oint B\cdot d\vec{l} = \mu_0 I$

$B\cdot 2\pi r = \mu_0 I$

$B = \frac{\mu_0 I}{2\pi r}$

(b)



$\Phi_B = B\cdot A$

$d\Phi_B = B\cdot dA$

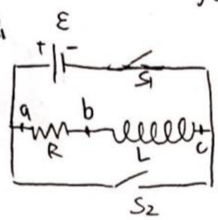
$= \frac{\mu_0 I}{2\pi r}\times l\,dr$

(c) $\Phi_B = \int d\Phi_B = \int_a^b \frac{\mu_0 i}{2\pi r}\, l\cdot dr = \frac{\mu_0 i l}{2\pi}\int_a^b \frac{dr}{r} = \frac{\mu_0 i l}{2\pi}\ln\left(\frac{b}{a}\right)$

(d) $L = \frac{N\Phi}{I}$, $N=1$ $\quad L = \frac{\frac{\mu_0 i l}{2\pi}}{i}\ln\left(\frac{b}{a}\right) = \frac{\mu_0 l}{2\pi}\ln\left(\frac{b}{a}\right)$

(e) $U = L\int_0^I i\,di = \frac{1}{2}LI^2 = \frac{1}{2}\frac{\mu_0 l}{2\pi}\ln\left(\frac{b}{a}\right)\cdot i^2 = \frac{\mu_0 l i^2}{4\pi}\ln\left(\frac{b}{a}\right)$

48.



(a) eq 30.14

$i = \frac{\varepsilon}{R}\left(1-e^{-\frac{R}{L}t}\right)$

$P_R = I_R V_R = I_R\cdot I_R R$

$= I_R^2 R$

$I_R = i$

$P_R = \left(\frac{\varepsilon}{R}\right)^2\left(1-e^{-\frac{R}{L}t}\right)^2 R$

$= \frac{\varepsilon^2}{R}\left(1-e^{-\frac{R}{L}t}\right)^2$

$P_{R\,Max}$ when $t=0$

$\underline{P_{R\,Max} = \frac{\varepsilon^2}{R}}$

$t=0$ S_1 closed S_2 open

(b) eq 30.15 $\frac{di}{dt} = \frac{\varepsilon}{L}e^{-\frac{R}{L}t}$ $\quad P_L = IV_L = IL\frac{dI}{dt} = \frac{\varepsilon}{R}\left(1-e^{-\frac{R}{L}t}\right)\times L\times\frac{\varepsilon}{L}e^{-\frac{R}{L}t} = \underline{\frac{\varepsilon^2}{R}\left(1-e^{-\frac{R}{L}t}\right)\left(e^{-\frac{R}{L}t}\right)}$

(c) $t=0$, $P_L(0) = \frac{\varepsilon^2}{R}(1-e^0)(e^0) = 0$ $\quad t\to\infty$ $\quad P_L = \frac{\varepsilon^2}{R}\cancelto{1}{(1-e^{-\infty})}\cancelto{0}{(e^{-\infty})} = 0$ A: both 0

(d) P_L Max, $\frac{dP_L}{dt} = \frac{\varepsilon^2}{R}\frac{d\left(1-e^{-\frac{R}{L}t}\right)\left(e^{-\frac{R}{L}t}\right)}{dt} = \frac{\varepsilon^2}{R}\frac{d\left(e^{-\frac{R}{L}t} - e^{-\frac{2R}{L}t}\right)}{dt} = \frac{\varepsilon^2}{R}\left(-\frac{R}{L}e^{-\frac{R}{L}t} + \frac{2R}{L}e^{-\frac{2R}{L}t}\right)$

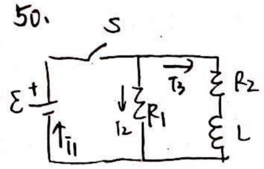
$\frac{dP_L}{dt} = 0$ $\quad e^{-\frac{R}{L}t} = \frac{1}{2}$ $\quad t = -\frac{L}{R}\ln\left(\frac{1}{2}\right)$ when $t = \underline{-\frac{L}{R}\ln\left(\frac{1}{2}\right)}$ $= 0.69\frac{L}{R}$, $P_L = \frac{\varepsilon^2}{R}\underbrace{\left(1-e^{\ln\frac{1}{2}}\right)\left(e^{\ln\frac{1}{2}}\right)}_{=\frac{1}{4}} = \underline{0.25\frac{\varepsilon^2}{R}}$ is max

(e)

$P_\varepsilon = P_R + P_L = \frac{\varepsilon^2}{R}\left(1-e^{-\frac{R}{L}t}\right)^2 + \frac{\varepsilon^2}{R}\left(1-e^{-\frac{R}{L}t}\right)\left(e^{-\frac{R}{L}t}\right) = \underline{\frac{\varepsilon^2}{R}\left(1-e^{-\frac{R}{L}t}\right)}$

P_ε max, $1-e^{-\frac{R}{L}t} = 1$ $\quad e^{-\frac{R}{L}t} = 0$ $\quad \underline{t\to\infty}$, $\underline{P_{\varepsilon\,max} = \frac{\varepsilon^2}{R}}$

50.　$L = 0.3H$　$R_1 = 12\Omega$　$R_2 = 16\Omega$　emf $= 96V$　$t=0$, S closed

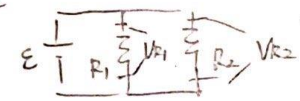


(a) before S closed $I=0$; and just after S closed, I in L still $=0$.

So $I_{R_2} = I_L = 0$　$I_3 = I_{R_2} = 0$, it will like

as for i_1, i_2　$I_1 = I_2 + I_3 = I_2$　$I_2 = \frac{\varepsilon}{R} = 8A$　A: $I_1 = I_2 = 8A$　$I_3 = 0$

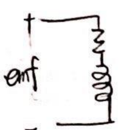
(b) after for a long time, $I_L = C^t$，不會有反應，just like



$I_1 = I_2 + I_3$　$I_2 = \frac{V_{R_1}}{R_1}$　$I_3 = \frac{V_{R_2}}{R_2}$　$V_{R_1} = V_{R_2} = \varepsilon$

$I_2 = \frac{96}{12} = 8$　$I_3 = \frac{96}{16} = 6$　$I_1 = 8 + 6 = 14A$　A: $I_1 = 14A$　$I_2 = 8A$　$I_3 = 6A$

(c) we can see I_3 as R-L circuit　$\frac{1}{2}\frac{\varepsilon}{R} = \frac{\varepsilon}{R}(1 - e^{-\frac{R}{L}t})$



$I_3 = I = \frac{\varepsilon}{R}(1 - e^{-\frac{R}{L}t})$　$e^{-\frac{R_2}{L}t} = \frac{1}{2}$　$t = 1.30 \times 10^{-2} s$

$t \to \infty$　$I_3 = \frac{\varepsilon}{R}$

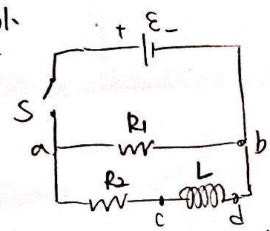
find t when $I_3 = \frac{1}{2}\frac{\varepsilon}{R}$

(d) I_2 still 8A since it is a circuit like this

$I_2 = \frac{emf}{R_1} = 8A$

$I_1 = I_2 + I_3$,　$I_1 = 8 + \frac{1}{2} \cdot 6 = 11A$

61.　$\varepsilon = 60V$　$R_1 = 40\Omega$　$R_2 = 25\Omega$　$L = 0.3H$



$t=0$, switch is closed

(a) $V_{ab} = 60V$, since R_1 in parallel to R_2 and L　$V_{R_1} = V_{R_2} + V_L = \varepsilon$

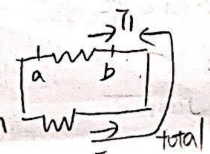
(b) point a has higher potential.

(c) just after s closed, $I_L = 0$.　$\varepsilon - I_2R_2 - V_L = 0$.　$\varepsilon - 0 - V_L = 0$
$(V_L = V_{cd})$

$V_L = V_{cd} = \varepsilon = 60V$

(d) c is higher point.　(e) just after switch is closed, $V_{R_1} = \varepsilon = 60V$

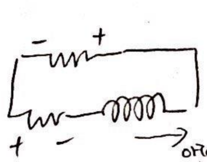
(f) after a long time of closing the switch, the inductor has zero voltage,



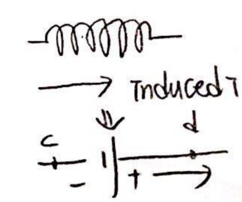
and since $I_1 = \frac{60}{40} = 1.5$　$I_2 = \frac{60}{25} = 2.4$, the current will flow in opposite direction through the branch of R_1. So b has higher potential.

(g) $V_L - I_2R_2 - I_2R_1 = 0$　$(V_L = I_2(R_1 + R_2) = 2.4(65) = 156V$

(h)



I is decreasing, this will enduce emf s.t. this emf produce same direction current.

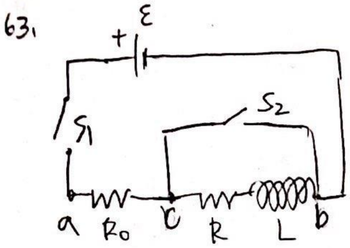


⇒ got d has higher pote

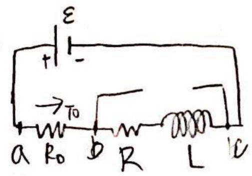
補：

50.(d)$i_2 = \frac{emf}{R_1} = 8A$

61(h)最右邊：d has higher potential

63. 

$\varepsilon = 36V \quad R_0 = 50\Omega \quad R = 150\Omega \quad L = 4H$

(a) 

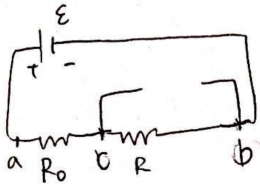
just after swith S_1 closed, $I_L(0^-) = 0$, so $I_L(0^+) = 0$

current can't increasing suddenly in inductor

so $i_0 = 0$ (they are series now)

then $V_{ac} = 0$

Since no voltage drop in R_0, $V_{cb} = emf = 36\,V$

(b) 

$\Sigma R = R_0 + R = 200\Omega$

$I = \frac{\varepsilon}{\Sigma R} = 0.18A$

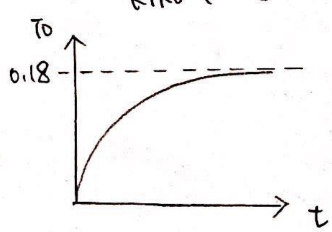
$i_0 = I = 0.18A$

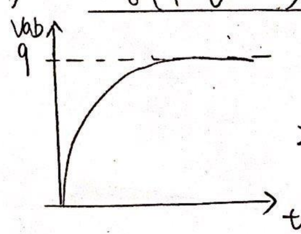
$V_{ac} = i_0 R_0 = 9\,V$

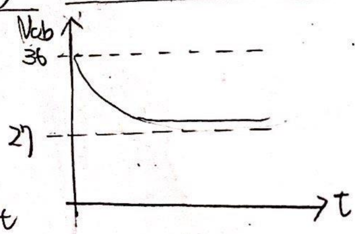
$V_{cb} = i_0 R = 27\,V$

(c) $\varepsilon - V_{ac} - V_{cb} = 0 \quad \varepsilon - IR_0 - IR - L\frac{dI}{dt} = 0 \quad L\frac{dI}{dt} = \varepsilon - i(R_0 + R) \quad \int_0^{i_0} \frac{dI}{I - \frac{\varepsilon}{R_0+R}} = \int_0^t \frac{dt}{L}$

$i_0 = \frac{\varepsilon}{R+R_0}\left(1 - e^{-\frac{R+R_0}{L}t}\right) = 0.18\left(1 - e^{-\frac{t}{0.02}}\right)$ $\quad V_{ac} = i_0 R_0 = 9\left(1 - e^{-\frac{t}{0.02}}\right)$ $\quad V_{cb} = emf - i_0 R_0 = 36 - 9\left(1 - e^{-\frac{t}{0.02}}\right)$







63(c)：$V_{cb} = 36 - 9\left(1 - e^{-\frac{t}{0.02}}\right)$