Problems

Section 6.1

6.1 The current in a 150 μH inductor is known to be

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$$i_L = 25te^{-500t}\text{ A} \quad \text{for } t \geq 0.$$

a) Find the voltage across the inductor for $t > 0$. (Assume the passive sign convention.)

b) Find the power (in microwatts) at the terminals of the inductor when $t = 5$ ms.

c) Is the inductor absorbing or delivering power at 5 ms?

d) Find the energy (in microjoules) stored in the inductor at 5 ms.

e) Find the maximum energy (in microjoules) stored in the inductor and the time (in milliseconds) when it occurs.

6.2 The triangular current pulse shown in Fig. P6.2 is applied to a 500 mH inductor.

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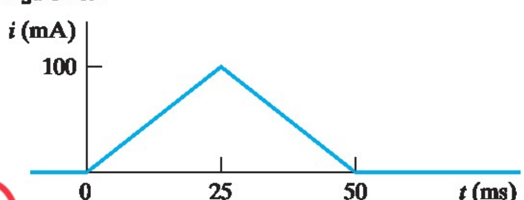
a) Write the expressions that describe $i(t)$ in the four intervals $t < 0$, $0 \leq t \leq 25$ ms, $25 \text{ ms} \leq t \leq 50$ ms, and $t > 50$ ms.

b) Derive the expressions for the inductor voltage, power, and energy. Use the passive sign convention.

Figure P6.2



6.3 The current in a 50 mH inductor is known to be

$$i = 120\text{ mA}, \qquad t \leq 0;$$

$$i = A_1e^{-500t} + A_2e^{-2000t}\text{A}, \qquad t \geq 0.$$

The voltage across the inductor (passive sign convention) is 3 V at $t = 0$.

a) Find the expression for the voltage across the inductor for $t > 0$.

b) Find the time, greater than zero, when the power at the terminals of the inductor is zero.

6.4 Assume in Problem 6.3 that the value of the voltage across the inductor at $t = 0$ is -18 V instead of 3 V.

a) Find the numerical expressions for i and v for $t \geq 0$.

b) Specify the time intervals when the inductor is storing energy and the time intervals when the inductor is delivering energy.

c) Show that the total energy extracted from the inductor is equal to the total energy stored.

6.5 The current in a 200 mH inductor is

$$i = 75\text{ mA}, \qquad t \leq 0;$$

$$i = (B_1 \cos 200t + B_2 \sin 200t)e^{-50t}\text{ A}, \qquad t \geq 0.$$

The voltage across the inductor (passive sign convention) is 4.25 V at $t = 0$. Calculate the power at the terminals of the inductor at $t = 25$ ms. State whether the inductor is absorbing or delivering power.

6.6 Evaluate the integral

$$\int_0^\infty p\,dt$$

for Example 6.2. Comment on the significance of the result.

6.7 The voltage at the terminals of the 750 μH inductor in Fig. P6.7(a) is shown in Fig. P6.7(b). The inductor current i is known to be zero for $t \leq 0$.

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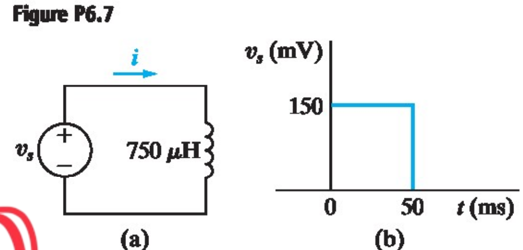
a) Derive the expressions for i for $t \geq 0$.

b) Sketch i versus t for $0 \leq t \leq \infty$.

Figure P6.7



6.8 The current in the 50 mH inductor in Fig. P6.8 is known to be 100 mA for $t < 0$. The inductor voltage for $t \geq 0$ is given by the expression

$$v_L(t) = 2e^{-100t}\text{ V}, \qquad 0^+ \leq t \leq 100\text{ ms}$$

$$v_L(t) = -2e^{-100(t-0.1)}\text{ V}, \qquad 100\text{ ms} \leq t < \infty$$

Sketch $v_L(t)$ and $i_L(t)$ for $0 \leq t < \infty$.

6.1

a) $V(t) = L \dfrac{di}{dt}$

$$\frac{di}{dt} = 25 e^{-500t} - 12500 t e^{-500t}$$

$$v(t) = 150 \times 10^{-6} \left[25 e^{-500t} - 12500 t e^{-500t} \right]$$

$$\boxed{v(t) = e^{-500t} \left[3{,}75 - 1875 t \right] mV}$$

b) $P = vi$ $\qquad t = 5ms$

$$P = e^{-500 \times 5 \times 10^{-3}} \left[3{,}75 - 1875 \times 5 \times 10^{-3} \right] \times 10^{-3} \times \left[25 \times 5 \times 10^{-3} \right] e^{-500 \times 5 \times 10^{-3}}$$

$$\boxed{P = -4{,}7376 \ \mu w}$$

c) the sign of power is negative $\Longrightarrow$ delivering power

d) $w = \frac{1}{2} L i^2$ $\quad t = 5ms$

$$w = \frac{1}{2} \times 150 \times 10^{-6} \times \left[25 \times 5 \times 10^{-3} e^{-500 \times 5 \times 10^{-3}}\right]^2$$

$$\boxed{w = 0{,}00780\ \mu J}$$

d) $\frac{di}{dt} = 0 \rightarrow (25 - 12500t) e^{-500t} = 0$

$$\Longrightarrow t = \frac{25}{12500} = \boxed{2ms}$$

$$w = \int p(t)$$

$$w = \int_{0}^{2\times10^{-3}} e^{-1000t} \left[25t\right] \times \left[3.75 - 1875t\right] \times 10^{-3}$$

$$\boxed{w = 0{,}0254 \ \mu J}$$

<u>OR</u> we can use

$$W_{max} \underset{t_{max} = 2ms}{\downarrow} = \frac{1}{2} L i^2$$

$$w = \frac{1}{2} \times 150 \times 10^{-6} \times \left[25 \times 2 \times 10^{-3} \times e^{-500 \times 2 \times 10^{-3}}\right]^2$$

$$\Longrightarrow \boxed{w = 0{,}0254 \ \mu J}$$

6.3 $i(t) = \begin{cases} 120\text{ mA} & t \le 0 \\ A_1 e^{-500t} + A_2 e^{-2000t} & t \ge 0 \end{cases}$

$v(0) = 3V$

a) $i(0) = \boxed{A_1 + A_2 = 120 \times 10^{-3}}$ → 1

$v(t) = L \frac{di}{dt}$

$\frac{di}{dt} = \begin{cases} 0 & t \le 0 \\ -500A_1 e^{-500t} - 2000A_2 e^{-2000t} & t \ge 0 \end{cases}$

$\Rightarrow \boxed{v(t) = -25A_1 e^{-500t} - 100A_2 e^{-2000t}}$

also $v(0) = \boxed{-25A_1 - 100A_2 = 3}$

→ 2

two equation

$$A_1 + A_2 = 120 \times 10^{-3}$$

$$-25 A_1 - 100 A_2 = 3$$

$$\Longrightarrow \quad A_1 = 0{,}2$$

$$A_2 = -0{,}08$$

$$\Longrightarrow \boxed{v(t) = -5 e^{-500t} + 8 e^{-2000t}} \ V$$

$$\boxed{i(t) = 200 e^{-500t} - 80 e^{-2000t}} \ mA$$

b) $p = 0 \Longrightarrow i = 0$ or $v = 0$

$$200 e^{-500t} - 80 e^{-2000t} = 0$$

$$\Longrightarrow \frac{200}{80} = e^{-1500t} = 2{,}5$$

$$\Longrightarrow t = \frac{\ln(2{,}5)}{-1500} = -610{,}8\,\mu s$$

لكن هو يريد الزمن أكبر من صفر

$$\Longrightarrow v = 0 \longrightarrow -5 e^{-500t} + 8 e^{-2000t} = 0$$

$$\Longrightarrow e^{-1500t} = \frac{5}{8} = 0{,}625$$

$$t = \frac{\ln(0{,}625)}{-1500} = \boxed{313{,}34\,\mu s}$$

وهو الصحيح $t > 0$

6.8 $L = 50mH$

$$v_L(t) = \begin{cases} 2e^{-100t} & 0^+ \le t \le 100\,ms \\ -2e^{-100(t-0.1)} & 100\,ms \le t \le \infty \end{cases}$$

$i_L(t=0) = 100mA$

$$i_L(t) = \frac{1}{L}\int_{t_0}^{t} v_L(\tau)\, d\tau + \underline{\underline{i_L(t_0)}}$$

for $0^+ \le t \le 100ms$

$$i_L = \frac{1}{50\times10^{-3}}\int_{0}^{t} 2e^{-100\tau}\, d\tau + 100\times10^{-3}$$

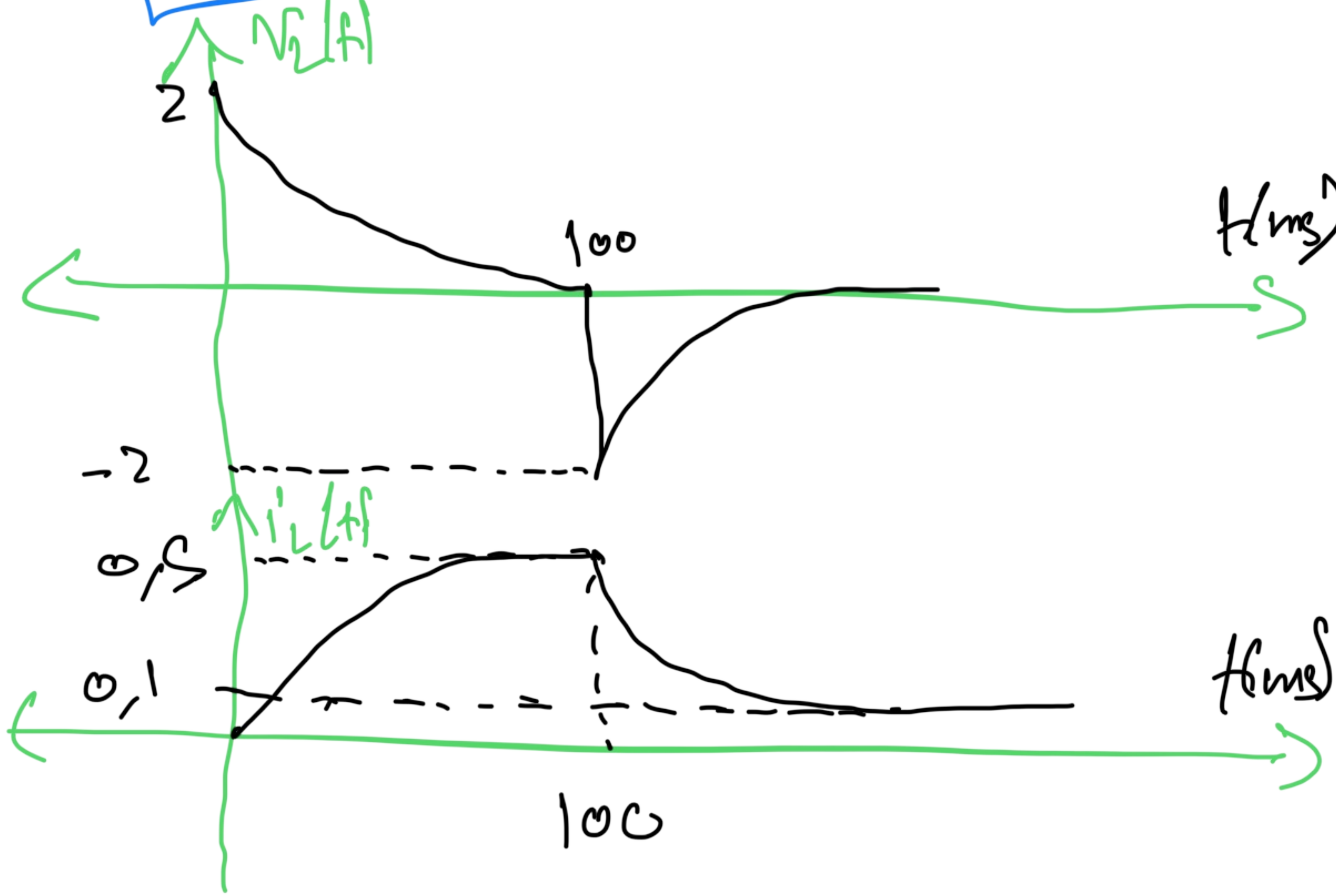
$$\boxed{i_L(t) = -0{,}4\, e^{-100t} + 0{,}5 \quad A}$$

at $i_L(t=100ms) = 0{,}5\,A$

for $100ms \leq t \leq \infty$

$$i_L = \frac{1}{50\times10^{-3}} \int_{100\times10^{-3}}^{t} -2e^{-100(t-0,1)}\,d\tau + 0,$$

$$\Rightarrow \boxed{i_L(t) = 0,4\,e^{-100(t-0,1)} + 0,1\ A}$$



6.20 The current shown in Fig. 6.20 is applied to a 2 μF capacitor. The initial voltage on the capacitor is zero.
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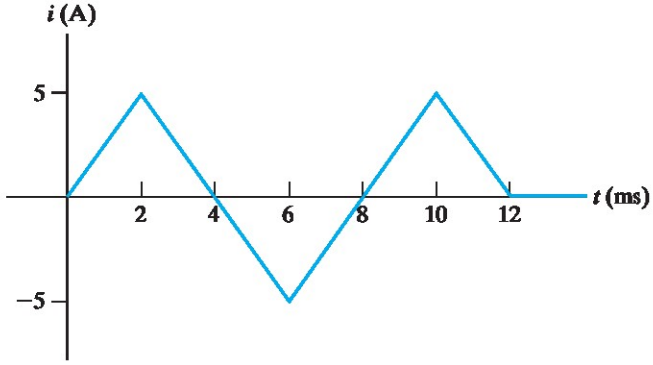
a) Find the charge on the capacitor at $t = 6$ ms.

b) Find the voltage on the capacitor at $t = 10$ ms.

c) How much energy is stored in the capacitor by this current?

Figure P6.20



6.21 The rectangular-shaped current pulse shown in Fig. P6.21 is applied to a 0.1 μF capacitor. The initial voltage on the capacitor is a 15 V drop in the reference direction of the current. Derive the expression for the capacitor voltage for the time intervals in (a)–(d).
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a) $0 \le t \le 10\ \mu s$;

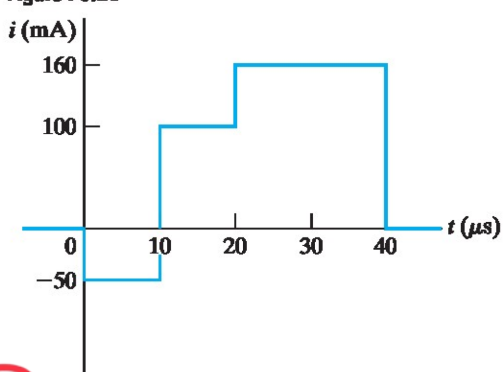
b) $10\ \mu s \le t \le 20\ \mu s$;

c) $20\ \mu s \le t \le 40\ \mu s$

d) $40\ \mu s \le t < \infty$

e) Sketch $v(t)$ over the interval $-10\ \mu s \le t \le 50\ \mu s$.

Figure P6.21



Section 6.3

6.22 Assume that the initial energy stored in the inductors of Figs. P6.22(a) and (b) is zero. Find the equivalent inductance with respect to the terminals a, b.
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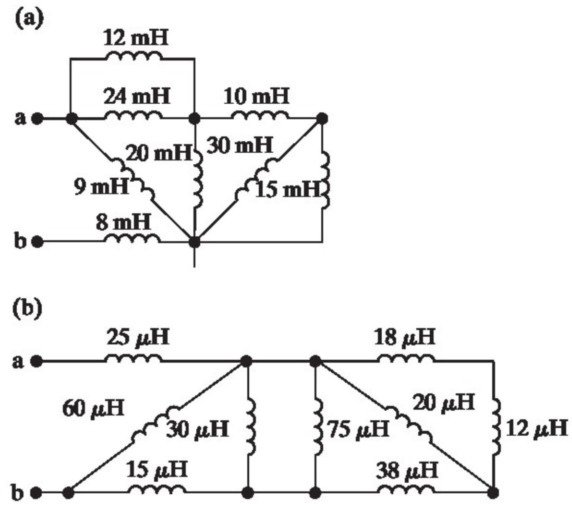
Figure P6.22



6.23 Use realistic inductor values from Appendix H to construct series and parallel combinations of inductors to yield the equivalent inductances specified below. Try to minimize the number of inductors used. Assume that no initial energy is stored in any of the inductors.

a) 8 mH

b) 45 μH

c) 180 μH

6.24 The two parallel inductors in Fig. P6.24 are connected across the terminals of a black box at $t = 0$. The resulting voltage v for $t > 0$ is known to be $64e^{-4t}$ V. It is also known that $i_1(0) = -10$ A and $i_2(0) = 5$ A.

a) Replace the original inductors with an equivalent inductor and find $i(t)$ for $t \ge 0$.

b) Find $i_1(t)$ for $t \ge 0$.

c) Find $i_2(t)$ for $t \ge 0$.

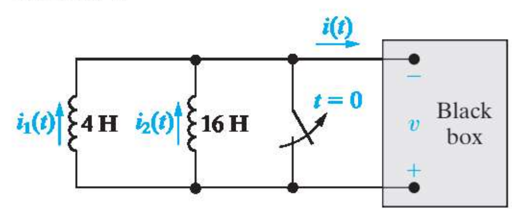
d) How much energy is delivered to the black box in the time interval $0 \le t < \infty$?

e) How much energy was initially stored in the parallel inductors?

f) How much energy is trapped in the ideal inductors?

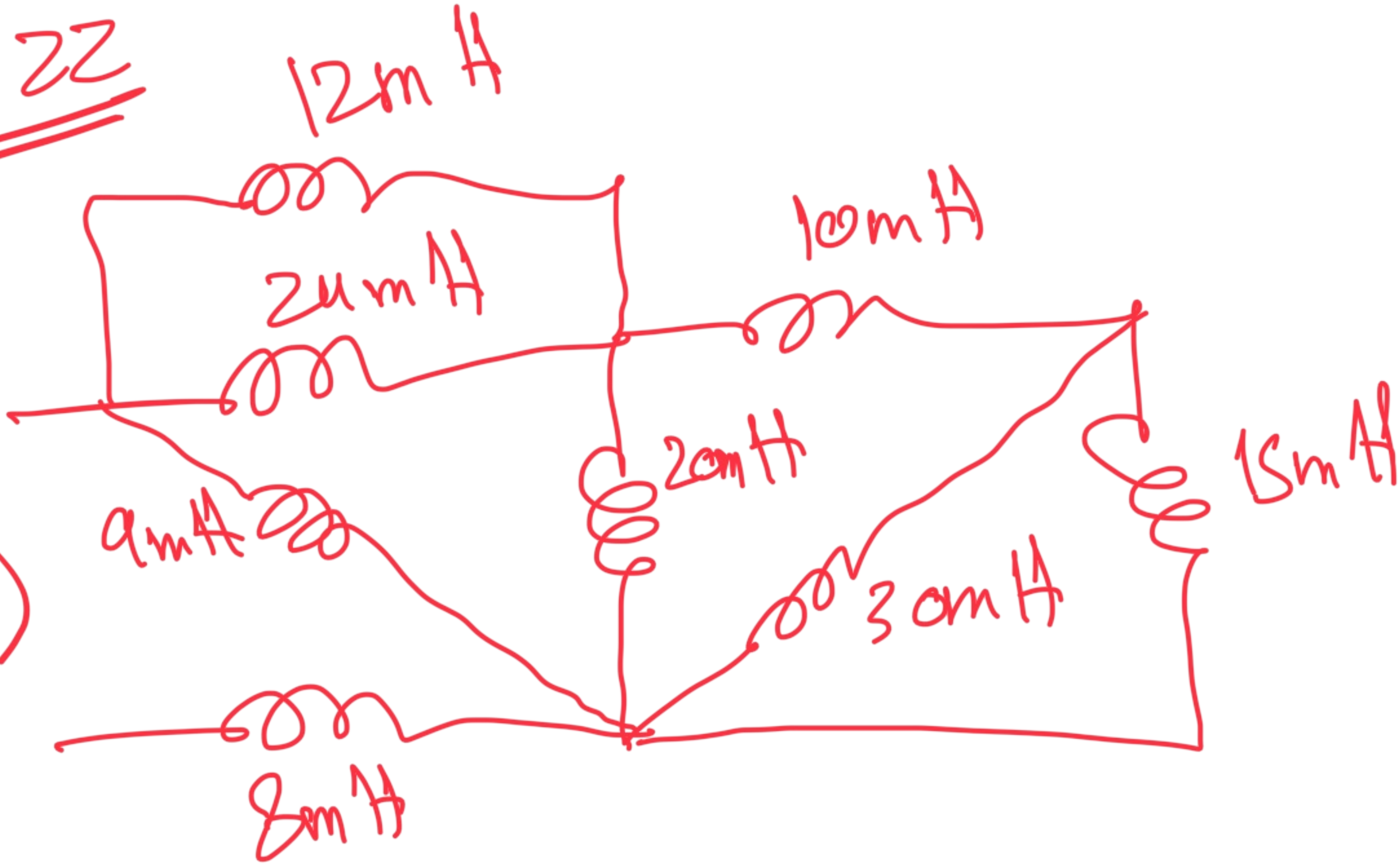
g) Show that your solutions for i_1 and i_2 agree with the answer obtained in (f).

Figure P6.24

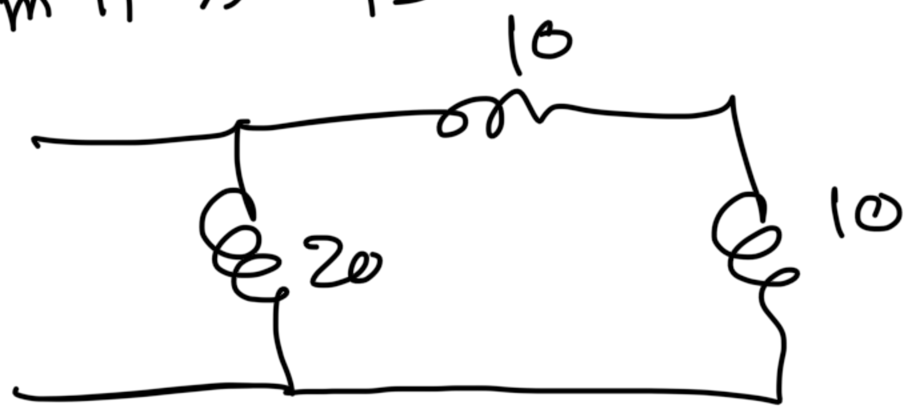


6.22

a)

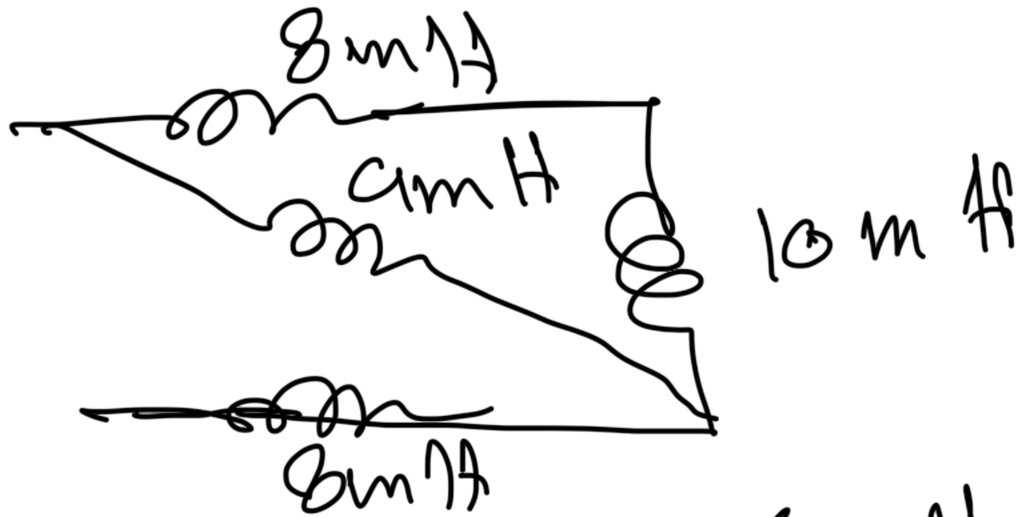


a) 30mH // 15mH = 10mH

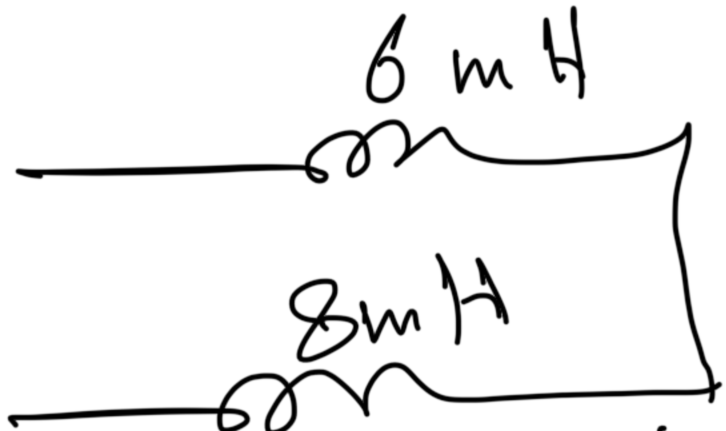


20 // (10+10) = 10mH

12 // 24 = 8mH

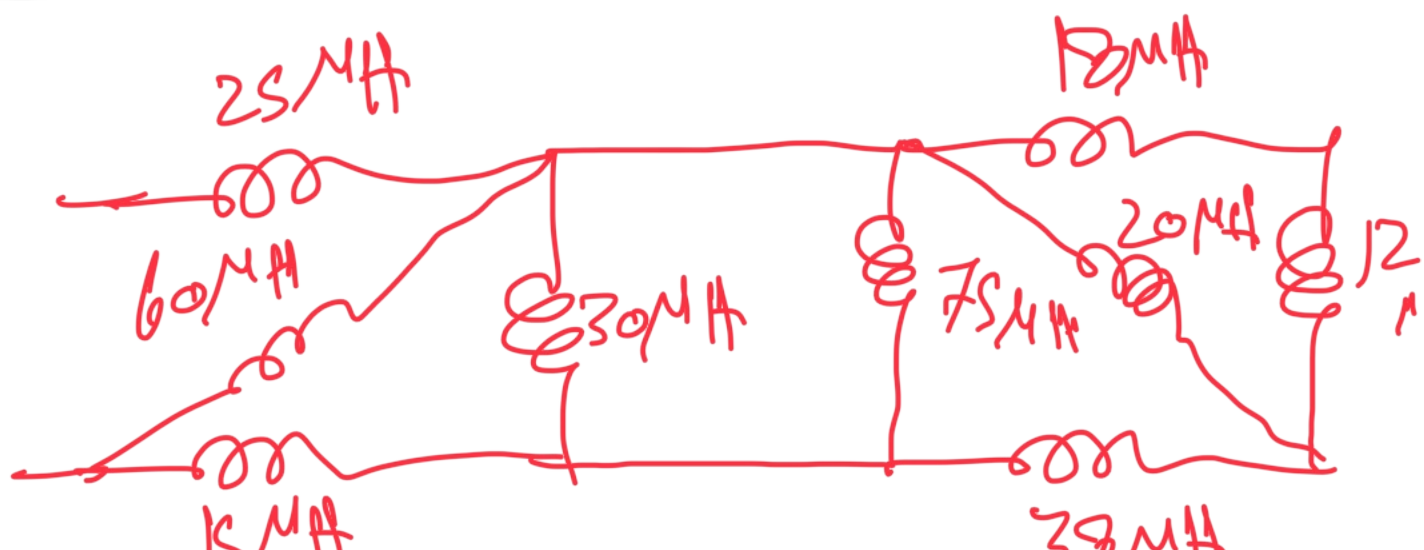


$$9 \parallel (8+10) = 6\text{ mH}$$

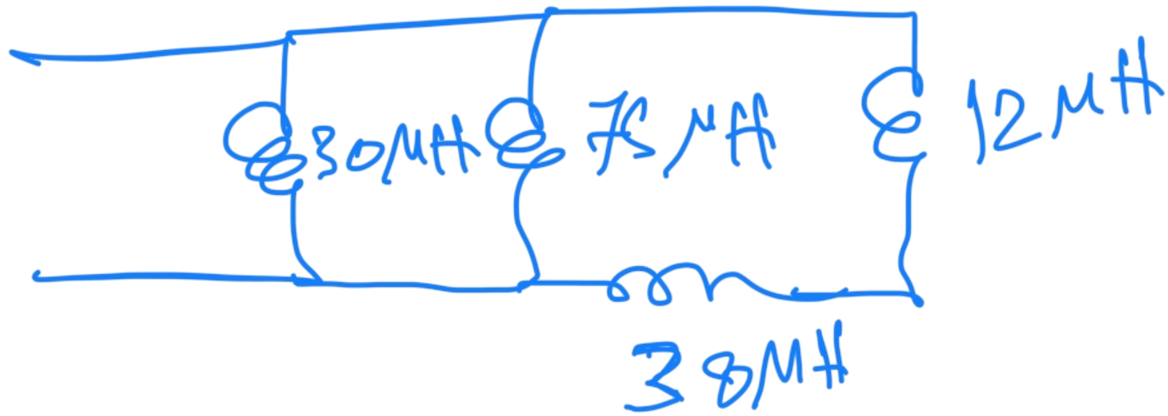


$$\boxed{L_{eq} = 6 + 8 = 14\text{ mH}}$$

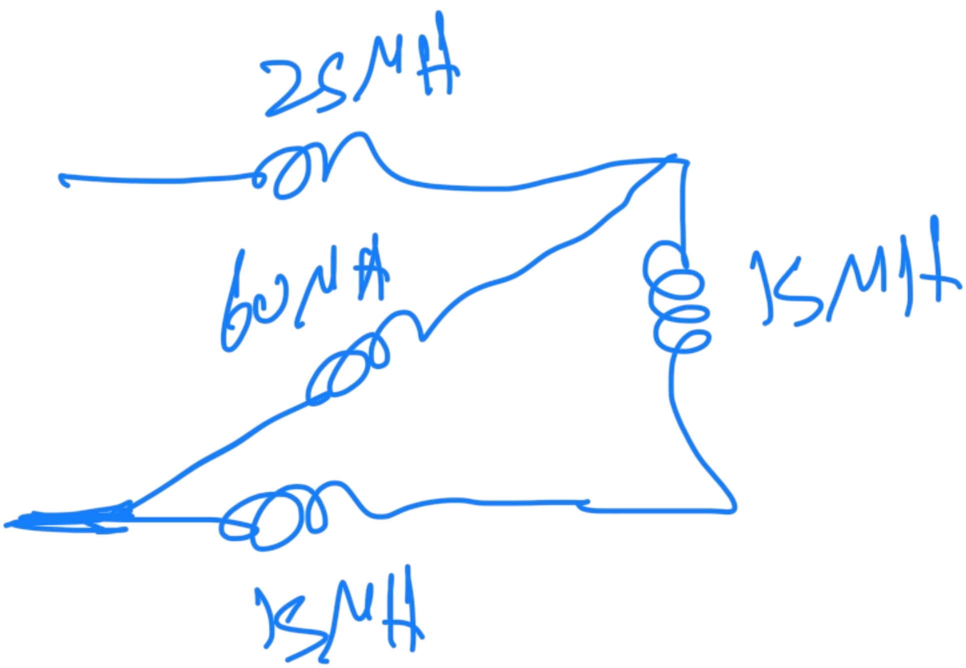
b)



b) $20 \parallel (12+18) = 12\ \mu H$



$30 \parallel 75 \parallel (12+38) = 15\ \mu H$



$(15+15) \parallel 60 = 20\ \mu H$

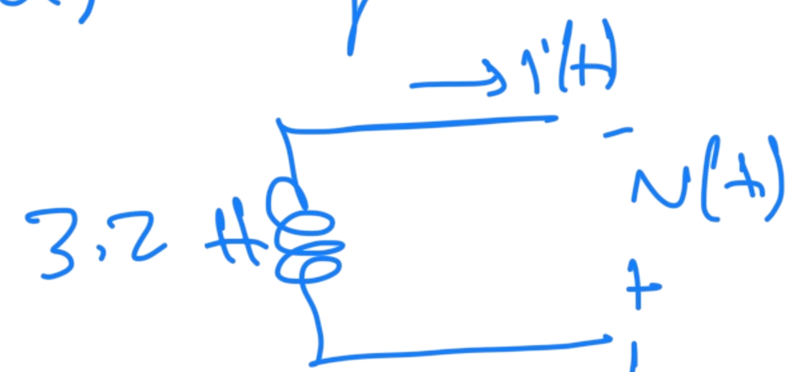
$$\boxed{L_{eq} = 25 + 20 = 45\ \mu H}$$

6.24

$v(t) = 64 e^{-4t}$ V

$i_1(0) = -10$ A , $i_2(0) = 5$ A

a) $L_{eq} = 4 \parallel 16 = 3.2$ H



$i_L(0) = i_1(0) + i_2(0)$

$= -10 + 5 = -5$ A

$$i_L(t) = \frac{1}{L}\int_0^t v_L(\tau)\,d\tau + i_L(0)$$

$$= \frac{1}{3.2}\int_0^t 64 e^{-4\tau}\,d\tau - 5$$

$$\Longrightarrow \boxed{i_L(t) = -5e^{-4t} \text{ A} \quad t \geq 0}$$

---

b) $$i_1(t) = \frac{1}{L_1}\int_0^t v_L(\tau)\, d\tau + i_1(0)$$

$$= \frac{1}{4}\int_0^t 64\, e^{-4\tau}\, d\tau - 10$$

$$\Longrightarrow \boxed{i_1(t) = -4e^{-4t} - 6 \text{ A}}$$

---

c) $$i_2(t) = \frac{1}{L_2}\int_0^t v_L(\tau)\, d\tau + i_2(0)$$

$$= \frac{1}{16}\int_0^t 64\, e^{-4\tau}\, d\tau + 5$$

$$\boxed{i_2(t) = -e^{-4t} + 6 \text{ A}}$$

d) $i_2(t) = -5e^{-4t}$

$$\frac{di}{dt} = 20e^{-4t} \neq 0$$

$$\Rightarrow \quad w = \int_0^{\infty} p(t)\,dt \qquad P = -vi$$

لأنه دخل
من الجهد سالب

$$w = \int_0^{\infty} -(64e^{-4t})(-5e^{-4t})\,dt$$

$$= \left.\frac{320\,e^{-8t}}{-8}\right]_0^{\infty}$$

$$\Rightarrow \quad \boxed{w = 40\,J}$$

e) $$w_{initial} = \frac{1}{2} L_1 i_1(0)^2 + \frac{1}{2} L_2 i_2^2(0)$$

$$w = \frac{1}{2} \times 4 (-10)^2 + \frac{1}{2} \times 16 (5)^2$$

$$\boxed{w = 400\ J}$$

f) $$w_{trapped} = w_{initial} - w_{delivered}$$

$$= 400 - 40 = 360\ J$$

g) $$w_{trapped} = \frac{1}{2} L_1 i_1(\infty)^2 + \frac{1}{2} L_2 i_2(\infty)^2$$

$$i_1(\infty) = -4e^{-\infty} - 6 = -6A$$

$$i_2(\infty) = -e^{-\infty} + 6 = 6A$$

$$W_{trapped} = \frac{1}{2} \times 4(-6)^2 + \frac{1}{2} \times 16(6)^2$$

$$\Rightarrow W_{trapped} = 360\ J$$

Same answer

6.25 The three inductors in the circuit in Fig. P6.25 are connected across the terminals of a black box at $t = 0$. The resulting voltage for $t > 0$ is known to be

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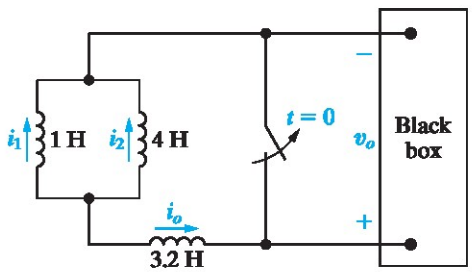
$$v_o = 2000e^{-100t} \text{ V}.$$

If $i_1(0) = -6$ A and $i_2(0) = 1$ A, find

a) $i_o(0)$;
b) $i_o(t), t \geq 0$;
c) $i_1(t), t \geq 0$;
d) $i_2(t), t \geq 0$;
e) the initial energy stored in the three inductors;
f) the total energy delivered to the black box; and
g) the energy trapped in the ideal inductors.

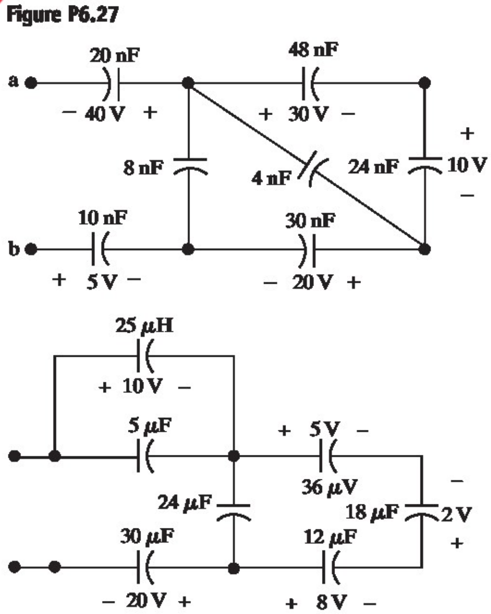
Figure P6.25



6.26 For the circuit shown in Fig. P6.25, how many milliseconds after the switch is opened is the energy delivered to the black box 80% of the total energy delivered?

6.27 Find the equivalent capacitance with respect to the terminals a, b for the circuits shown in Fig. P6.27.

Figure P6.27



6.28 Use realistic capacitor values from Appendix H to construct series and parallel combinations of capacitors to yield the equivalent capacitances specified below. Try to minimize the number of capacitors used. Assume that no initial energy is stored in any of the capacitors.

a) 480 pF
b) 600 nF
c) 120 μF

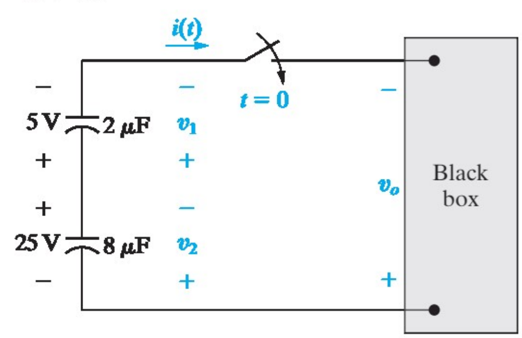
6.29 Derive the equivalent circuit for a series connection of ideal capacitors. Assume that each capacitor has its own initial voltage. Denote these initial voltages as $v_1(t_0)$, $v_2(t_0)$, and so on. (*Hint*: Sum the voltages across the string of capacitors, recognizing that the series connection forces the current in each capacitor to be the same.)

6.30 Derive the equivalent circuit for a parallel connection of ideal capacitors. Assume that the initial voltage across the paralleled capacitors is $v(t_0)$. (*Hint*: Sum the currents into the string of capacitors, recognizing that the parallel connection forces the voltage across each capacitor to be the same.)

6.31 The two series-connected capacitors in Fig. P6.31 are connected to the terminals of a black box at $t = 0$. The resulting current $i(t)$ for $t > 0$ is known to be $800e^{-25t}$ μA.

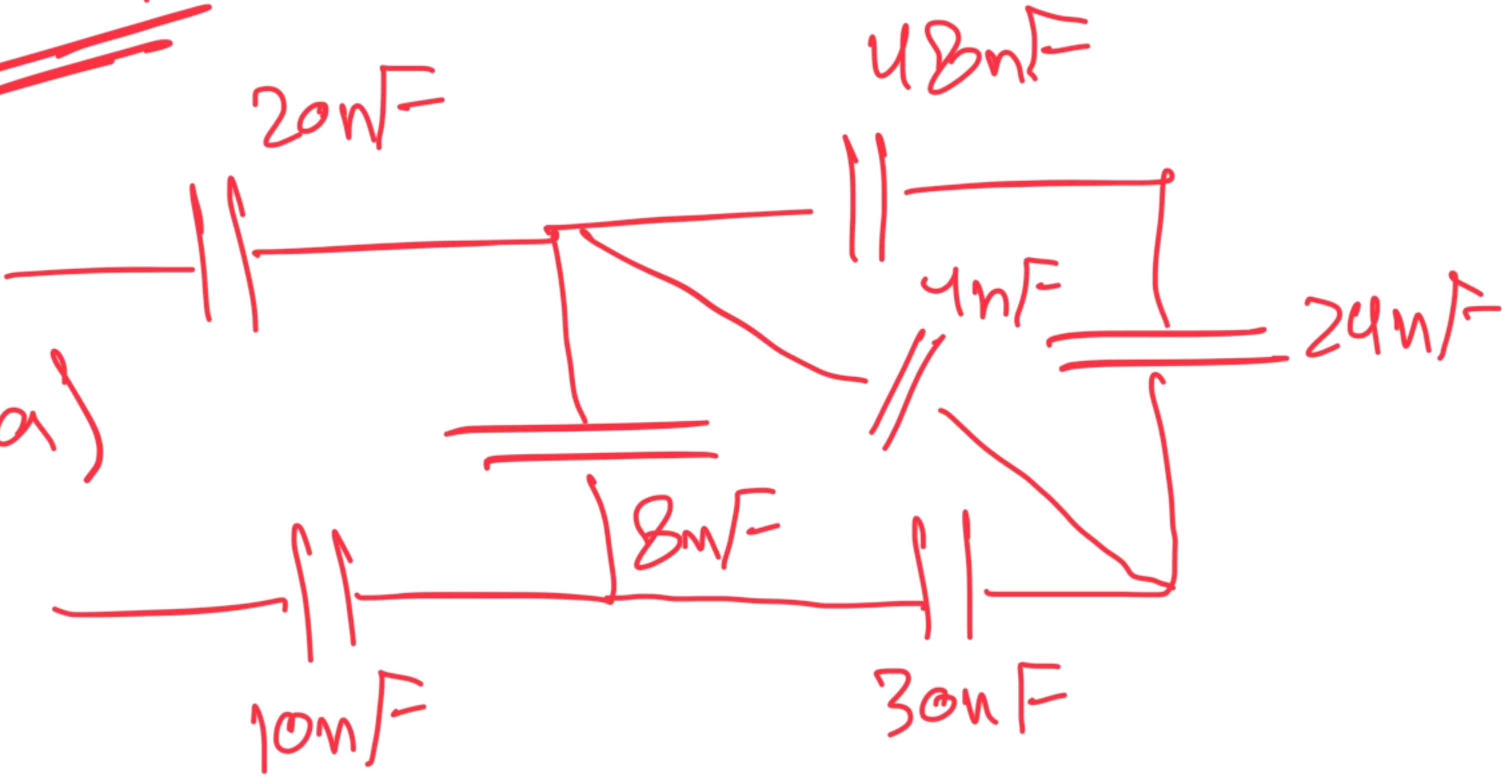
a) Replace the original capacitors with an equivalent capacitor and find $v_o(t)$ for $t \geq 0$.
b) Find $v_1(t)$ for $t \geq 0$.
c) Find $v_2(t)$ for $t \geq 0$.
d) How much energy is delivered to the black box in the time interval $0 \leq t < \infty$?
e) How much energy was initially stored in the series capacitors?
f) How much energy is trapped in the ideal capacitors?
g) Show that the solutions for v_1 and v_2 agree with the answer obtained in (f).

Figure P6.31

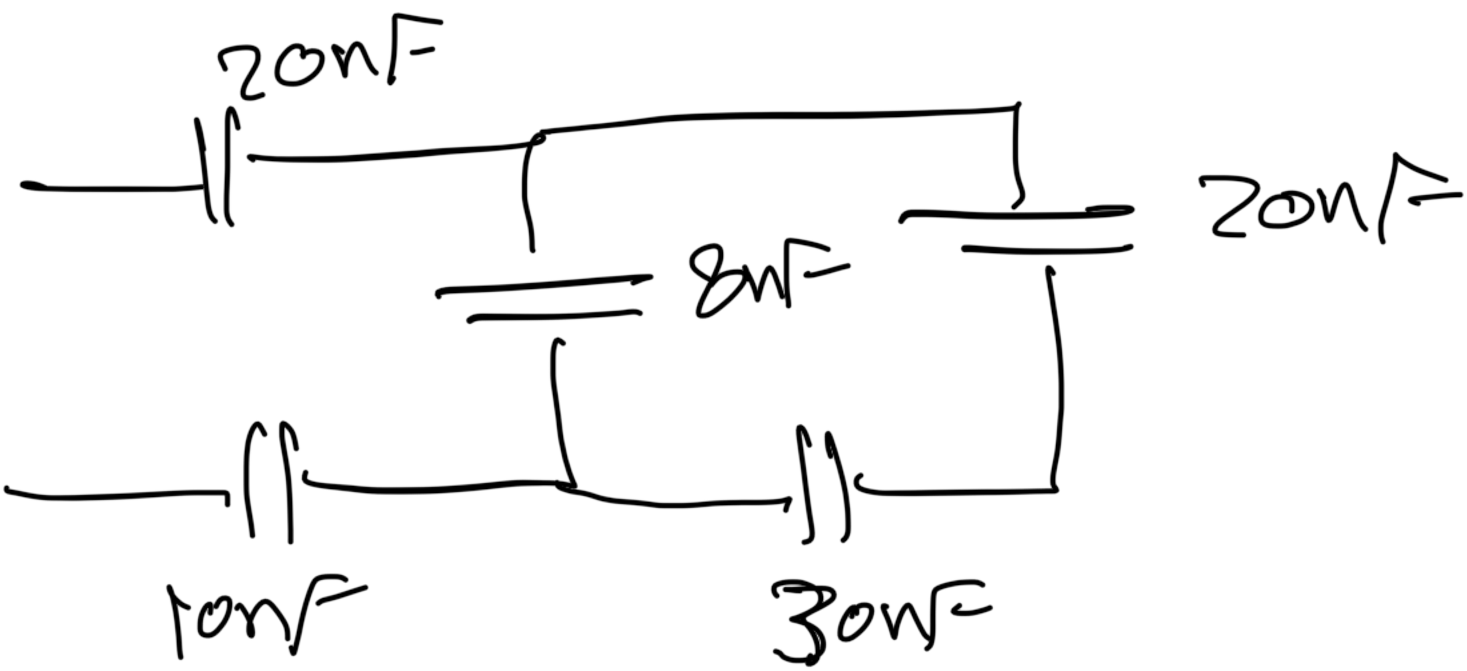


6.27

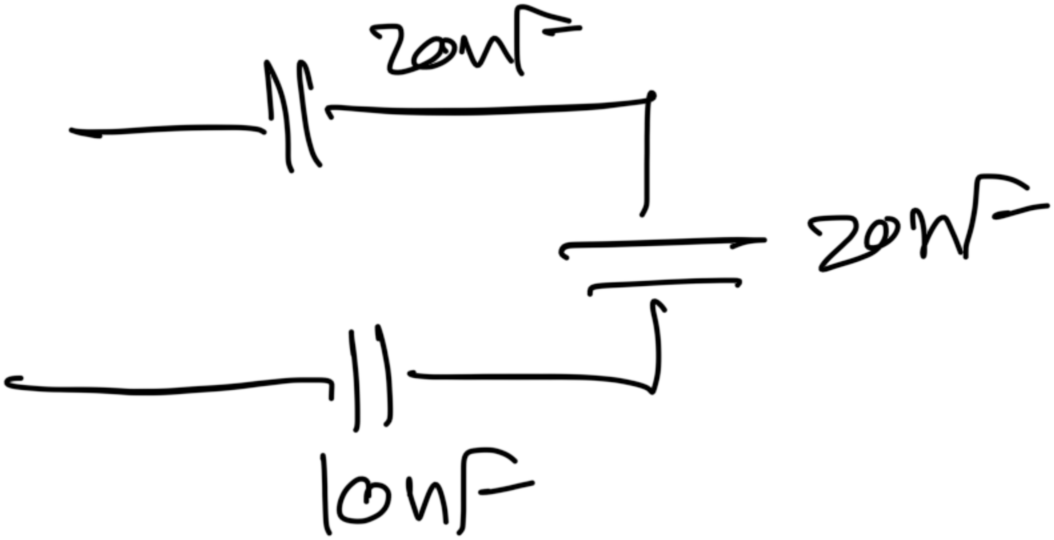
a)



$$\frac{1}{\frac{1}{48}+\frac{1}{24}} + 4 = 20nF$$



$$8 + \frac{1}{\frac{1}{30} + \frac{1}{20}} = 20nF$$



$$C_{eq} = \frac{1}{\frac{1}{10} + \frac{1}{20} + \frac{1}{20}} = 5nF$$

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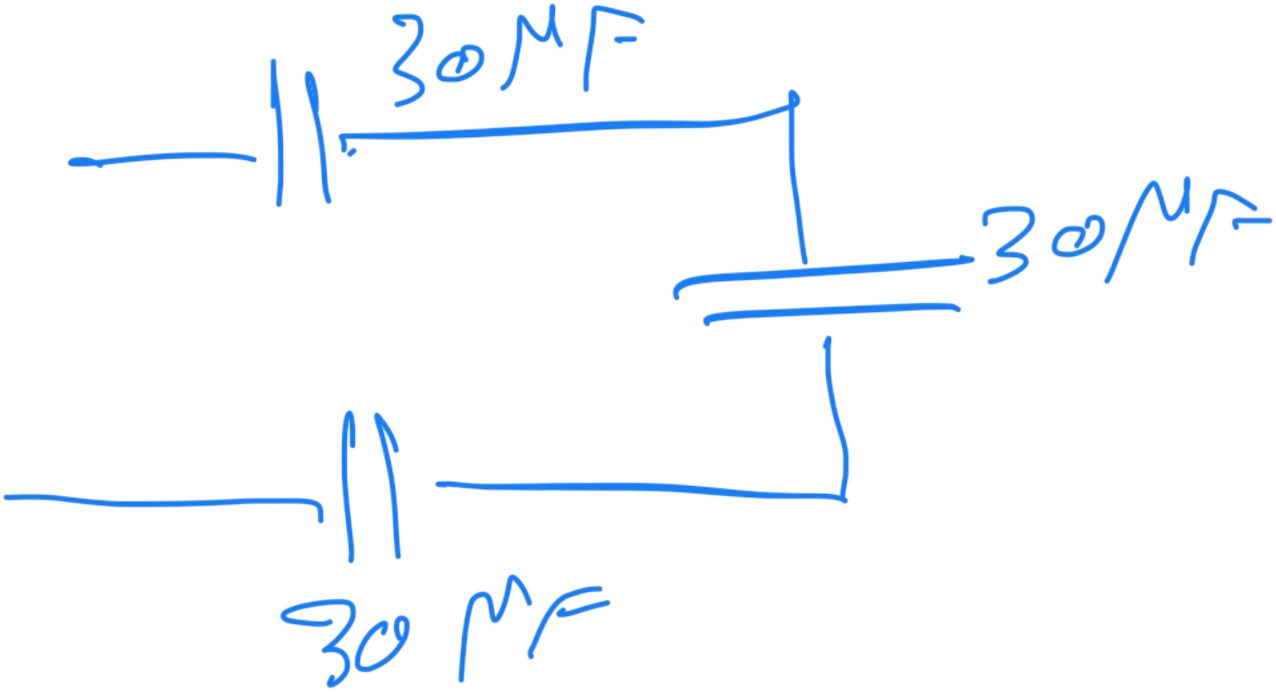
b)

$25+5 = 30\mu F$

$$24 + \frac{1}{\frac{1}{36} + \frac{1}{12} + \frac{1}{18}} = 30\mu F$$



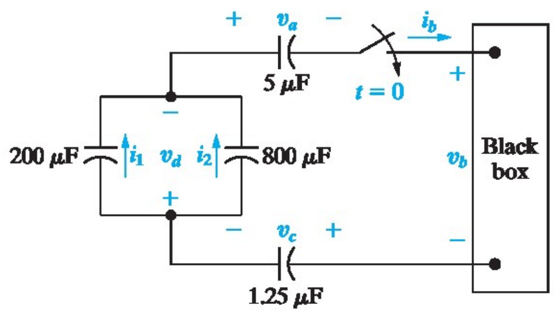
$$C_{eq} = \frac{1}{\frac{1}{30} + \frac{1}{30} + \frac{1}{30}} = \boxed{10\mu F}$$

6.32 The four capacitors in the circuit in Fig. P6.32 are connected across the terminals of a black box at $t = 0$. The resulting current i_b for $t > 0$ is known to be

$$i_b = -5e^{-50t} \text{ mA}.$$

If $v_a(0) = -20$ V, $v_c(0) = -30$ V, and $v_d(0) = 250$ V, find the following for $t \geq 0$: (a) $v_b(t)$, (b) $v_a(t)$, (c) $v_c(t)$, (d) $v_d(t)$, (e) $i_1(t)$, and (f) $i_2(t)$.

Figure P6.32



6.33 For the circuit in Fig. P6.32, calculate

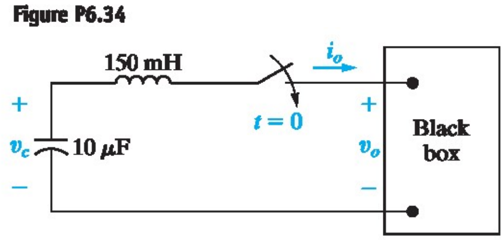
a) the initial energy stored in the capacitors;
b) the final energy stored in the capacitors;
c) the total energy delivered to the black box;
d) the percentage of the initial energy stored that is delivered to the black box; and
e) the time, in milliseconds, it takes to deliver 7.5 mJ to the black box.

6.34 At $t = 0$, a series-connected capacitor and inductor are placed across the terminals of a black box, as shown in Fig. P6.34. For $t > 0$, it is known that

$$i_o = 200e^{-800t} - 40e^{-200t} \text{ mA}.$$

If $v_c(0) = 5$ V find v_o for $t \geq 0$.

Figure P6.34

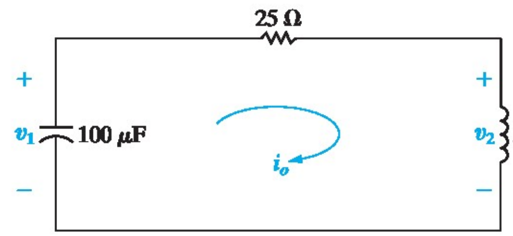


6.35 The current in the circuit in Fig. P6.35 is known to be

$$i_o = 2e^{-5000t}(\cos 1000t + 5 \sin 1000t) \text{ A}$$

for $t \geq 0^+$. Find $v_1(0^+)$ and $v_2(0^+)$.

Figure P6.35



Section 6.4

6.36 a) Show that the differential equations derived in (a) of Example 6.6 can be rearranged as follows:

$$4\frac{di_1}{dt} + 25i_1 - 8\frac{di_2}{dt} - 20i_2 = 5i_g - 8\frac{di_g}{dt};$$

$$-8\frac{di_1}{dt} - 20i_1 + 16\frac{di_2}{dt} + 80i_2 = 16\frac{di_g}{dt}.$$

b) Show that the solutions for i_1, and i_2 given in (b) of Example 6.6 satisfy the differential equations given in part (a) of this problem.

6.37 Let v_o represent the voltage across the 16 H inductor in the circuit in Fig. 6.25. Assume v_o is positive at the dot. As in Example 6.6, $i_g = 16 - 16e^{-5t}$ A.

a) Can you find v_o without having to differentiate the expressions for the currents? Explain.
b) Derive the expression for v_o.
c) Check your answer in (b) using the appropriate current derivatives and inductances.

6.38 Let v_g represent the voltage across the current source in the circuit in Fig. 6.25. The reference for v_g is positive at the upper terminal of the current source.

a) Find v_g as a function of time when $i_g = 16 - 16e^{-5t}$ A.
b) What is the initial value of v_g?
c) Find the expression for the power developed by the current source.
d) How much power is the current source developing when t is infinite?
e) Calculate the power dissipated in each resistor when t is infinite.

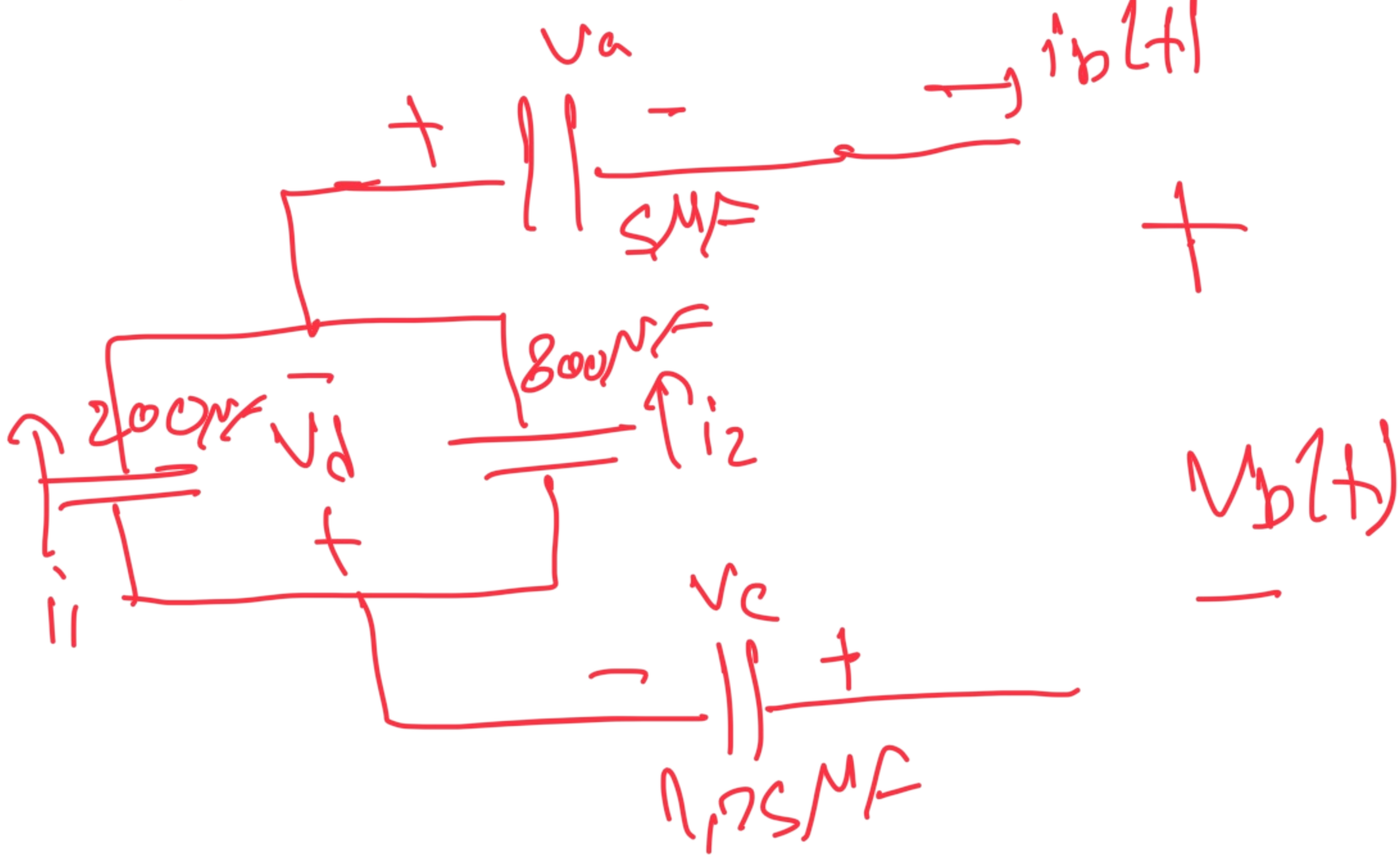
6.39 There is no energy stored in the circuit in Fig. P6.39 at the time the switch is opened.

a) Derive the differential equation that governs the behavior of i_2 if $L_1 = 5$ H, $L_2 = 0.2$ H, $M = 0.5$ H, and $R_o = 10\ \Omega$.

6.32 $\quad i_b = -5e^{-50t}$ mA

$V_a(0) = -20V \quad , V_c(0) = -30V$

$V_d(0) = 250V$



$$C_{eq} = \frac{1}{\frac{1}{1000} + \frac{1}{5} + \frac{1}{1{,}25}}$$

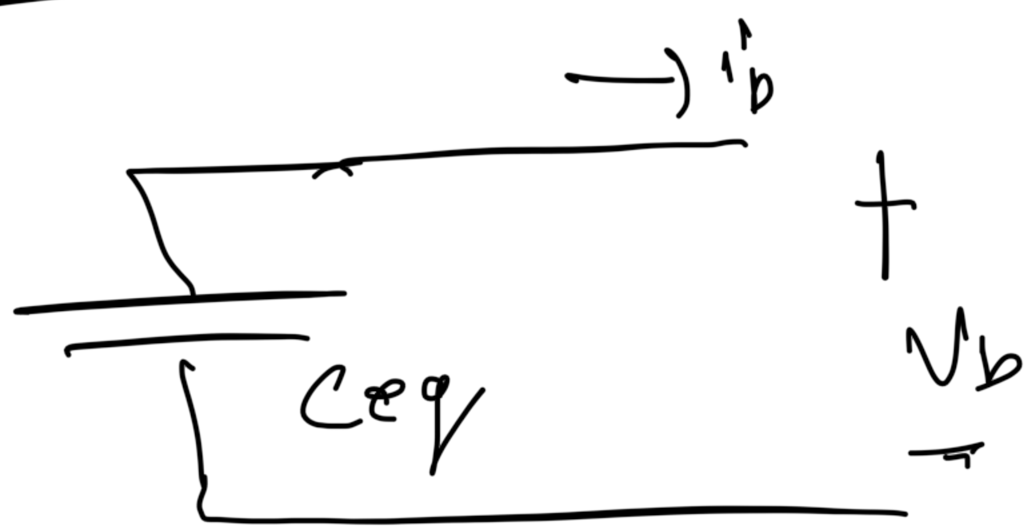
$$C_{eq} = \frac{1000}{1001} = 0{,}99\ \mu F$$

Using KVL $\Longrightarrow \sum v(0) = 0$

$$-v_b(0) - v_a(0) - v_d(0) - v_c(0) = 0$$

$$\Longrightarrow v_b(0) = -(-20) - (250) - (-30)$$

$$\boxed{v_b(0) = -200\ V}$$



a) $i = C\frac{dv}{dt}$

$$\Rightarrow V_b(t) = \frac{1}{C_{eq}}\int_0^t i_b(t) + V_b(0)$$

$$V_b(t) = \frac{1001}{1000}\times 10^6 \int_0^t -5\times 10^{-3} e^{-50\tau} d\tau - 200$$

$$V_b(t) = 100.1\left[e^{-50t} - 1\right] - 200$$

$$\Rightarrow \boxed{V_b(t) = 100.1\, e^{-50t} - 300.1}\ V$$

b) $V_a(t) = \frac{1}{C_a}\int_0^t i_b(t) + V_a(0)$

$$= \frac{1}{5\times 10^{-6}}\int_0^t -5\times 10^{-3} e^{-50\tau} d\tau - 20$$

$$\Rightarrow \boxed{V_a(t) = 20e^{-50t} - 40\ V}$$

$$c)\ V_c(t) = \frac{1}{C_c}\int_0^t i_b(t) + V_c(0)$$

$$= \frac{1}{1{,}25\times10^{-6}}\int_0^t -5\times10^{-3}e^{-50\tau}d\tau - 30$$

$$\Rightarrow \boxed{V_c(t) = 80e^{-50t} - 110\ V}$$

$$V_d(t) = \frac{1}{C_d}\int i_b(t)\,d\tau + V_d(0)$$

$$= \frac{1}{1000\times10^{-6}}\int_0^t -5\times10^{-3}e^{-50\tau}d\tau + 250$$

$$\Rightarrow \boxed{V_d(t) = 0.1 e^{-50t} + 249.9 \ V}$$

Same result $V_b = -V_a - V_c - V_d$

e) $i_1(t) = C_1 \frac{dV_d(t)}{dt}$

$$i_1(t) = 200 \times 10^{-6} \times 0.1 \times -50 \ e^{-50t}$$

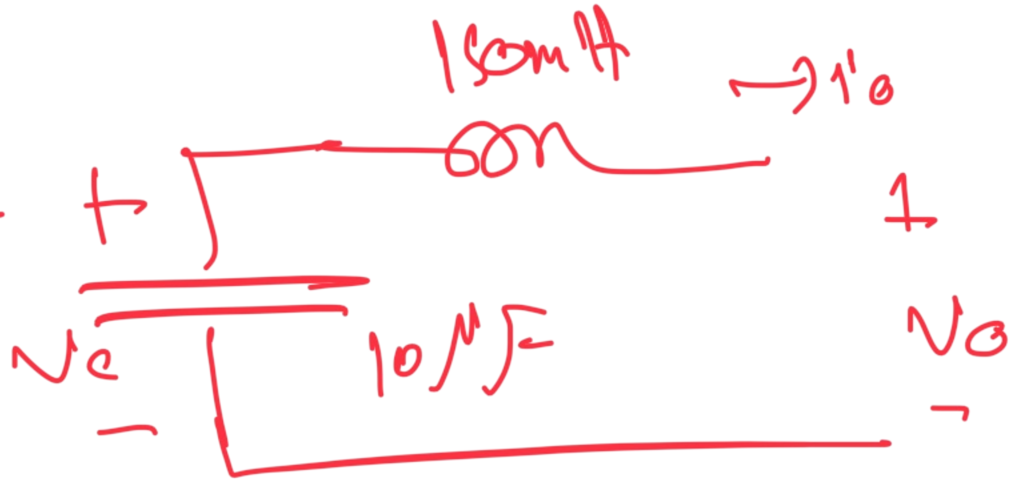
$$\Rightarrow \boxed{i_1(t) = -1 \ e^{-50t} \ mA}$$

f) $i_2(t) = C_2 \frac{dV_d(t)}{dt}$

$$i_2(t) = 800 \times 10^{-6} (0.1) \times -50 \ e^{-50t}$$

$$\Rightarrow \boxed{i_2(t) = -4 \ e^{-50t} \ mA}$$

6.34



$$i_o = 200e^{-800t} - 40e^{-200t} \text{ mA}$$

$v_C(0) = 5V$ find $v_o(t)$

$$v_C(t) = \frac{-1}{C}\int_0^t i_o(t)\,d\tau + v_C(0)$$

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$$= \frac{-1\times10^{-3}}{10\times10^{-6}}\int_0^t 200e^{-800\tau} - 40e^{-200\tau} + 5$$

$$v_C(t) = -100\left[\frac{200}{-800}e^{-800\tau} - \frac{40}{-200}e^{-200\tau}\right]_0^t + 5$$

$$V_C(t) = \left[25e^{-800\tau} - 20e^{-200\tau}\right]_0^t + 5$$

$$V_C(t) = \left(25e^{-800t} - 20e^{-200t}\right) - (25 - 20) + 5$$

$$\Longrightarrow \boxed{V_C(t) = 25e^{-800t} - 20e^{-200t} \, V}$$

$$V_L(t) = L \frac{di_o}{dt}$$

$$V_L(t) = 150\times10^{-3}\left[200\times -800e^{-800t} - 40\times -200e^{-200t}\right]\times10^{-3}$$

$$\Longrightarrow \boxed{V_L(t) = -24e^{-800t} + 1.2e^{-200t} \, V}$$

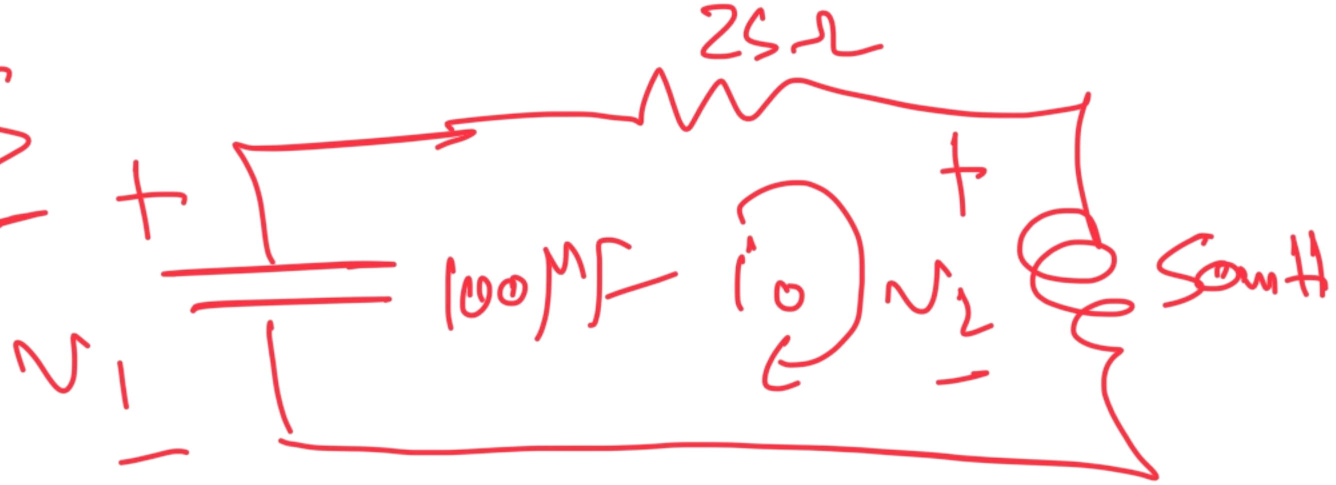
Using KVL $\Rightarrow \Sigma V = 0$

$$V_o = V_C - V_L$$

$$V_o(t) = \left(25e^{-800t} - 20e^{-200t}\right) - \left(-24e^{-800t} + 1.2e^{-200t}\right)$$

$$\boxed{V_o(t) = 49e^{-800t} - 21.2e^{-200t}\ V}$$

6.35



$$i_0 = 2e^{-5000t}(\cos 1000t + 5\sin 1000t)\ A$$

Using KVL $\Rightarrow$ $\Sigma V = 0$

$$v_2 - v_1 + 25 i_0 = 0$$

$$\Rightarrow \boxed{v_1 = v_2 + 25 i_0} \rightarrow (1)$$

$$v_2(t) = L\frac{di}{dt} = 2 \times 50 \times 10^{-3} e^{-5000t}$$

$$[-5000[(\cos 1000t) + 5\sin(1000t)] + -1000\sin(1000t) + 5000\cos 1000t$$

$$\Longrightarrow \boxed{V_2(t) = 100\, e^{-5000t}\,(-26 \sin 1000t)}$$

$$\text{so } \boxed{V_2(0) = 0\ \text{V}}$$

$$\boxed{i_0(0) = 2A}$$

$\sin(0) = 0$

$\cos(0) = 1$

$e^0 = 1$

$$\Longrightarrow V_1(0) = V_2(0) + 25\, i_0(0)$$

$$V_1(0) = 0 + 25(2)$$

$$\boxed{V_1(0) = 50\ \text{V}}$$

$$\boxed{V_2(0) = 0\ \text{V}}$$