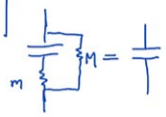
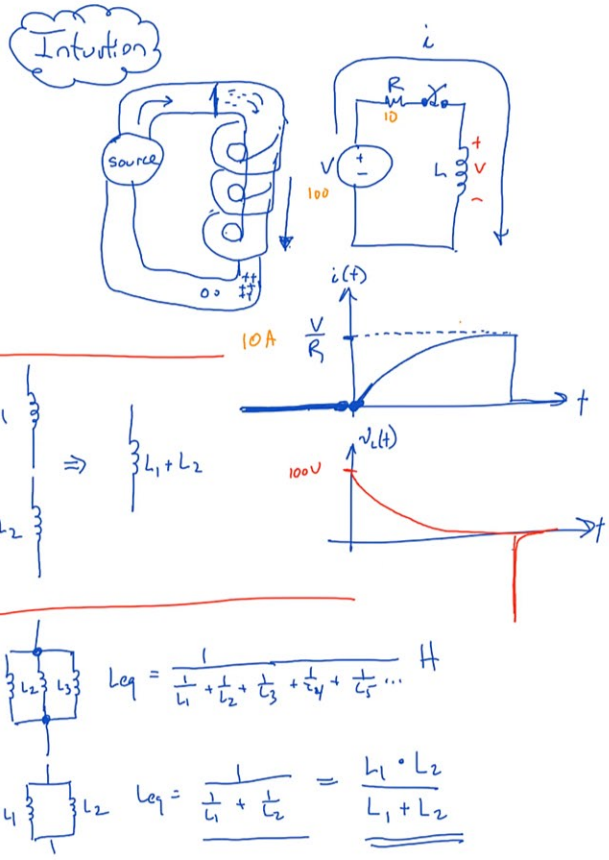
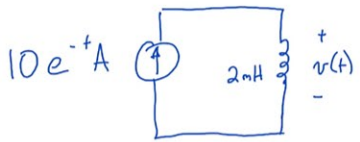
Overview

	Capacitors	Inductors
Symbols	$C = 2\mu F$	$L = 4mH$
intuition	stores energy in electric field diagram	store energy in magnetic field water inertia long pipe
tries to keep constant	voltage constant	current constant
math (p=i·v always)	$i = Cv'$ $v = \frac{1}{C}\int_{t_0}^{t} i(\tau)d\tau + v(t_0)$ $W = \frac{1}{2}Cv^2$	$v = Li'$ $i = \frac{1}{L}\int_{t_0}^{t} v(\tau)d\tau + i(t_0)$ $W = \frac{1}{2}Li^2$
DC response		
construction	$C = \frac{\epsilon}{t}\frac{A}{d}$	$L = \mu\frac{N^2 A}{l}$
series/parallel	opposite R	same R
opamps	KCL at inputs 	not used 



Math



Find $v(t)$

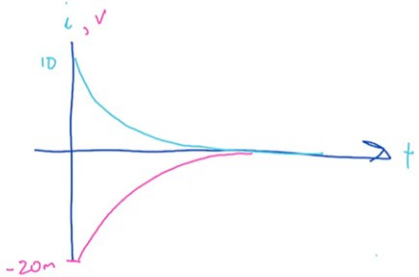
- $v(t) = L\,i'$

  $i(t) = \frac{1}{L}\int_{t_0}^{t} v(\tau)\,d\tau + i(t_0)$

$v(t) = (2m)(-10e^{-t})$ V

$= \boxed{-20e^{-t}\text{ mV}}$

$(0.002)(-10e$



engineering units

10^{9}	G
10^{6}	M
10^{3}	k
10^{0}	(1)
10^{-3}	m
10^{-6}	μ
10^{-9}	n
10^{-12}	p

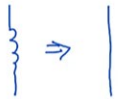
×	÷
$m \cdot k = 1$	$\frac{M}{k} = \mu$
$mM = k$	$\frac{k}{M} = m$
$kk = M$	$\frac{n}{m} = \mu$
$pM = \mu$	

$(6\mu)(12k) = 72m$

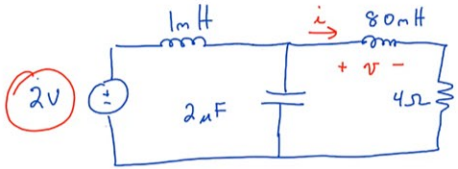
$0.000006 \cdot 12080 =$

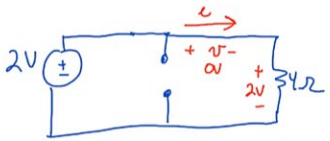
$6 \times 10^{-6} \times 12 \times 10^{+3} =$

DC Response



Ex





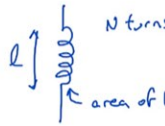
$i = \frac{V}{R} = \frac{2}{4} = \boxed{\frac{1}{2}A}$

$v = \boxed{0V}$

Find energy stored in the 80mH inductor

$$W_L = \frac{1}{2} L i^2$$
$$= \frac{1}{2}(80m)\left(\frac{1}{2}\right)^2$$
$$= \frac{1}{8}(80m)$$
$$= \boxed{10mJ}$$

Construction

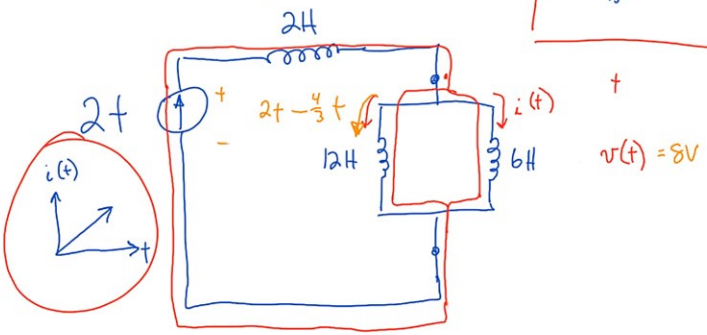


$L = \mu \frac{N^2 A}{l}$

↑ constant

Here are some examples of surface mount inductors

Ex $t>0$



$v = Li'$

$i = \frac{1}{L}\int_{t_0}^{t} v(\tau)\,d\tau + i(t_0)$

$v(t) = 8V$

Find
1. $v(t)$
2. $w(t)$ in 2H
3. $i(t)$ assuming $i(0) = 0A$

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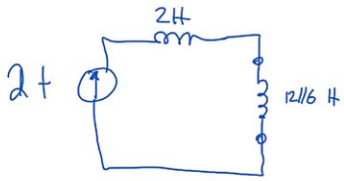
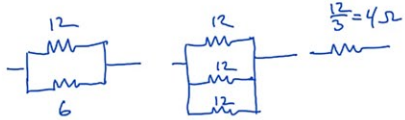
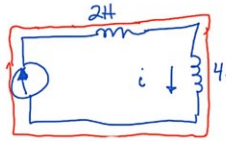
① Can we simplify $12 \| 6$?

$12\|6 = \frac{1}{\frac{1}{6}+\frac{1}{12}} = \frac{6\cdot 12}{6+12} = 4H$







$v = Li'$

$= (4)(2)$

$= 8V$

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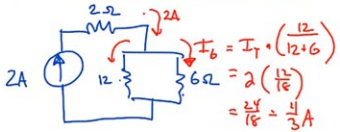
③ ~~$i(t) = 2t$~~



$I_6 = I_T \cdot \left(\frac{12}{12+6}\right) = 2\left(\frac{12}{18}\right) = \frac{24}{18} = \frac{4}{3}A$

$v_6 = 8V$

$i_6 = \frac{1}{L}\int_0^t v(\tau)\,d\tau + i(0)$

$= \frac{1}{6}\int_0^t 8\,d\tau + 0$

$= \frac{1}{6}\cdot 8 \int_0^t d\tau$

$\left.\frac{4}{3}\tau\right]_{\tau=0}^{t}$

$= \frac{4}{3}t\ A$

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② $w(t)$ in 2H

$w(t) = \frac{1}{2}Li^2$

$= \frac{1}{2}(2)(2t)^2$

$= 4t^2 J$