$$\frac{di}{dt} = \begin{cases} 0 & 0 \le t \le 2s \\ 0.2t & 2s \le t \le 6s \\ 0 & t \geq 6s \end{cases}$$

$$v = L\frac{di}{dt} = \begin{cases} 0 & 0 \le t \le 2s \\ 0.1 & 2s \le t \le 6s \\ 0 & t \geq 6s \end{cases}$$

---

what if insteid

$$v_L = \begin{cases} 0 & 0 \le t \le 2s \\ 0.2t - 0.4 & 2s \le t \le \\ 0.8 & \end{cases}$$

$L = 0.5H$

$i(0^-) = 0$

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

$0 \le t \le 2s$

$v(t) = 0 \Rightarrow i(t) = 0$

$i(2s) = 0$

$$i(6s) = 3,2\ A$$

$$t \geqslant 6$$

$$i(t) = \frac{1}{L}\int_6^t 0{,}8\,dt + \underbrace{i(6)}_{3,2\ A}$$

$$i(t) = \overset{\left(\frac{1}{15}\right)}{2}\left(0{,}8t\right)_6^t + 3{,}2\ A$$

$$i(t) = 1{,}6(t-6) + 3{,}2\ A$$

$$= 1.6t - 9{,}6 + 3{,}2$$

$$= 1.6t - 6{,}4$$

$$i(6) = 1.6(6) - 6{,}4 = 9{,}6 - 6{,}4 = 3{,}2 \checkmark$$

$2s \leq t \leq 6s$

$$i(t) = \frac{1}{L}\int_{2}^{t}(0.2\tau - 0.4)\,d\tau + i(2s)$$

$$i(t) = \frac{1}{.5H}\left[0.1t^2 - 0.4t\right]_2^t + 0$$

$$= 2\left[0.1t^2 - 0.4t - (0.1(2)^2 - 0.4(2))\right]$$

$$= 2(0.1t^2 - 0.4t - (\underbrace{.4 - .8}_{-.4})$$

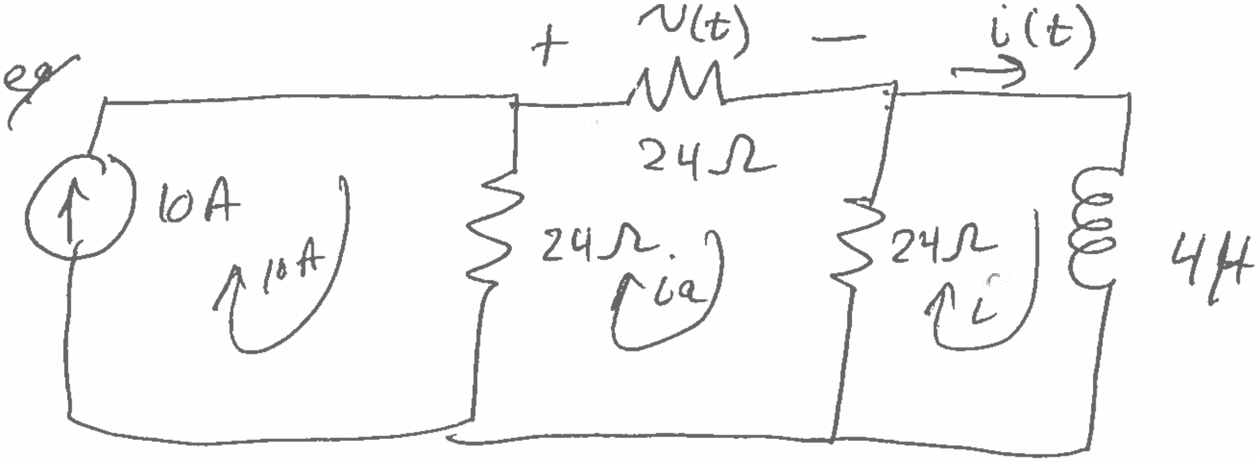
$$i(t) = 0.2t^2 - 0.8t + 0.8$$

$$i(2) = 0.2(2^2) - 0.8(2) + 0.8$$
$$0.8 - 0.8(2) + 0.8 = 0 \checkmark$$

$$i(6) = 0.2(6^2) - 0.8(6) + 0.8$$
$$7.2 - 4.8 + 0.8 \Rightarrow 3.2$$

$$
i(t) = \begin{cases} 0 & \cancel{0 \le t \le 2}s \quad 0s \le t \le 2 \\ 0.2t^2 - 0.8t + 0.8 & A \quad 2s \le t \le 6s \\ 1.6t - 6.4 & \cancel{t} \ge 6s \end{cases}
$$

eg



$$i(t) = 5 - e^{-4t}\ A \quad \text{for } t \geq 0$$

$$v(t) = ?$$

$$v(t) = i_a (24\Omega)$$

$$0 = i_a (24\Omega + 24\Omega + 24\Omega)$$

$$- 10A(24\Omega) - i(t)(24\Omega)$$

$$i_a(3) = +10A + (5 - e^{-4t}) = 15A - e^{-4t}\ A$$

$$i_a = 15A - e^{-4t}\ A = 5A - \tfrac{1}{3} e^{-4t}\ A$$

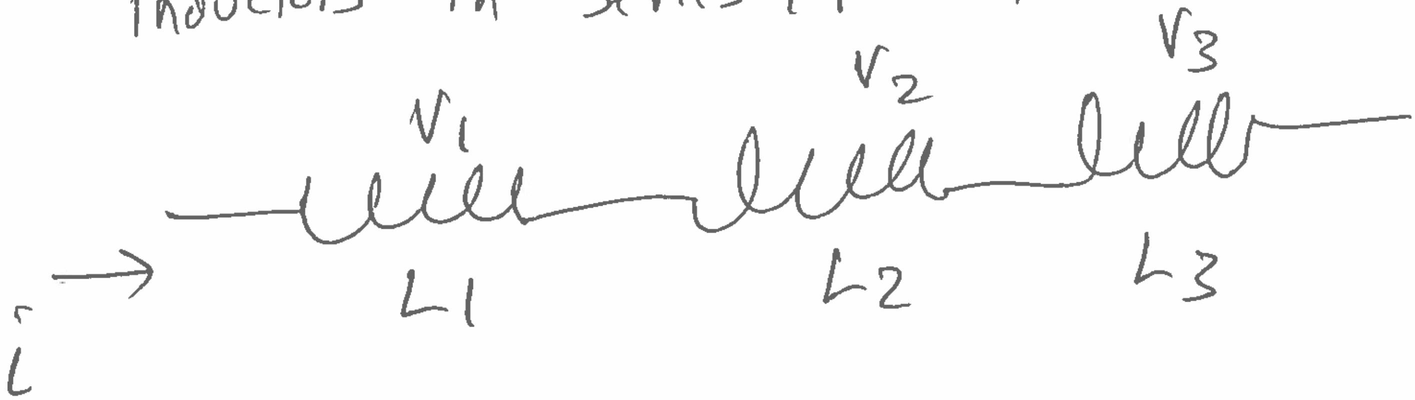
$$v(t) = 24\Omega\left(5 - \tfrac{1}{3} e^{-4t}\right) A = \underline{120 - 8e^{-4t}\ V}$$

$$P = vi = L\frac{di}{dt}\, i$$

$$W = \int p\,dt = L\int i\,di$$

$$\boxed{W_L = \frac{1}{2}Li^2} \qquad \boxed{W_c = \frac{1}{2}CV^2}$$

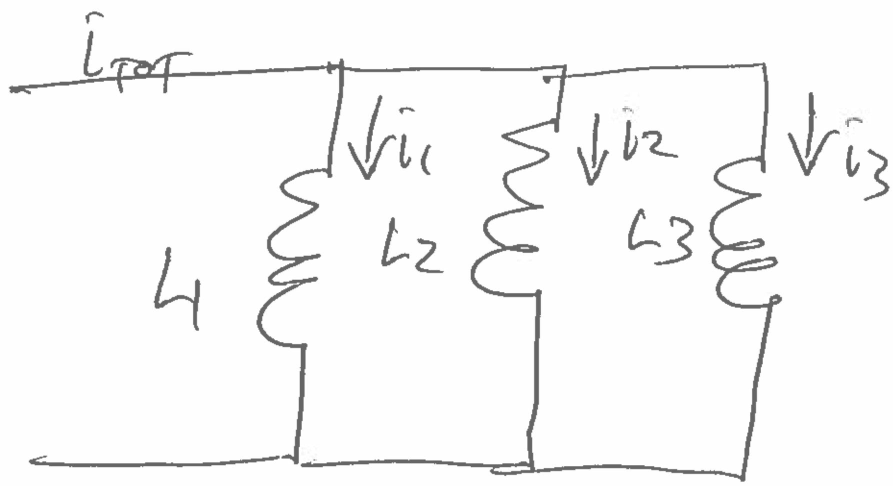
inductors in Series / Parallel



$$V_{total} = V_1 + V_2 + V_3$$

$$L_{TOT}\frac{di}{dt} = L_1\frac{di}{dt} + L_2\frac{di}{dt} + L_3\frac{di}{dt}$$

$$\boxed{L_{TOT\ series} = L_1 + L_2 + L_3}$$



$$i_{TOT} = i_1 + i_2 + i_3$$

$$\frac{1}{L_{TOT}} \int v_{TOT}\, dt = \frac{1}{L_1} \int v_1\, dt + \frac{1}{L_2} \int v_2\, dt + \frac{1}{L_3} \int v_3\, dt$$

but $V_{TOT} = V_1 = V_2 = V_3$

$$\Rightarrow \boxed{\frac{1}{L_{TOT\ \text{parallel}}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}}$$

Continuity Conditions

Remember $v_C(t_0^-) = v_C(t_0^+)$

$$i_L(t_0^-) = i_L(t_0^+)$$

Voltage cannot be discontinuous across a capacitor

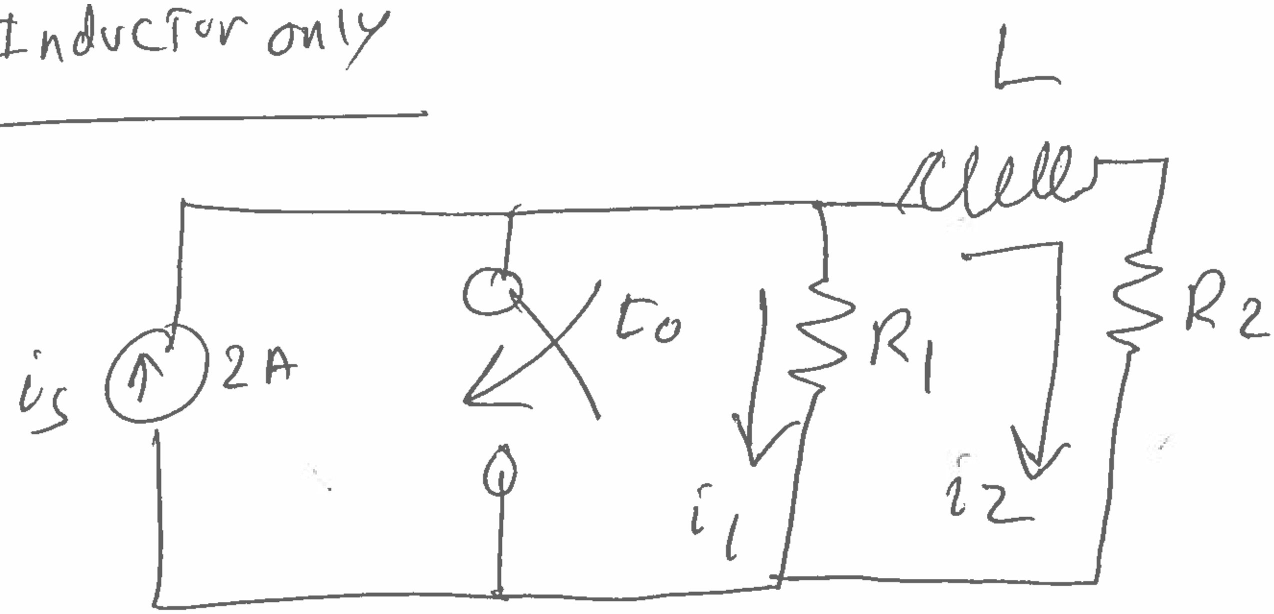
Current cannot be discontinuous through an inductor

At steady state (D.C. conditions)

inductors act like short circuits

capacitors act like open circuits

ex Inductor only



if $R_1 = R_2$ $\quad i_1(t \leq t_0) = ?$

$i_2(t \leq t_0) = ?$

$$i_1(t < t_0) = 1\,A = i_1(t_0^-)$$

$$i_2(t < t_0) = 1\,A = i_2(t_0^-)$$

After t_0

$$i_1(t_0^+) = 0$$

$$i_2(t_0^+) = 1\,A$$

$$\tau_L = \frac{L}{R} \qquad i_L(t) = i_0 e^{-t/\tau_L}$$

$$\tau_C = RC \qquad e^{-1} = \cancel{0.63}\ 0.37$$

$$e^{-t/\tau} \leftarrow \text{time constant} \qquad e^{-5} = 0.00$$

5 Time constants is Time to either fully charge or fully discharge