*E*lectrical

*E*ngineering

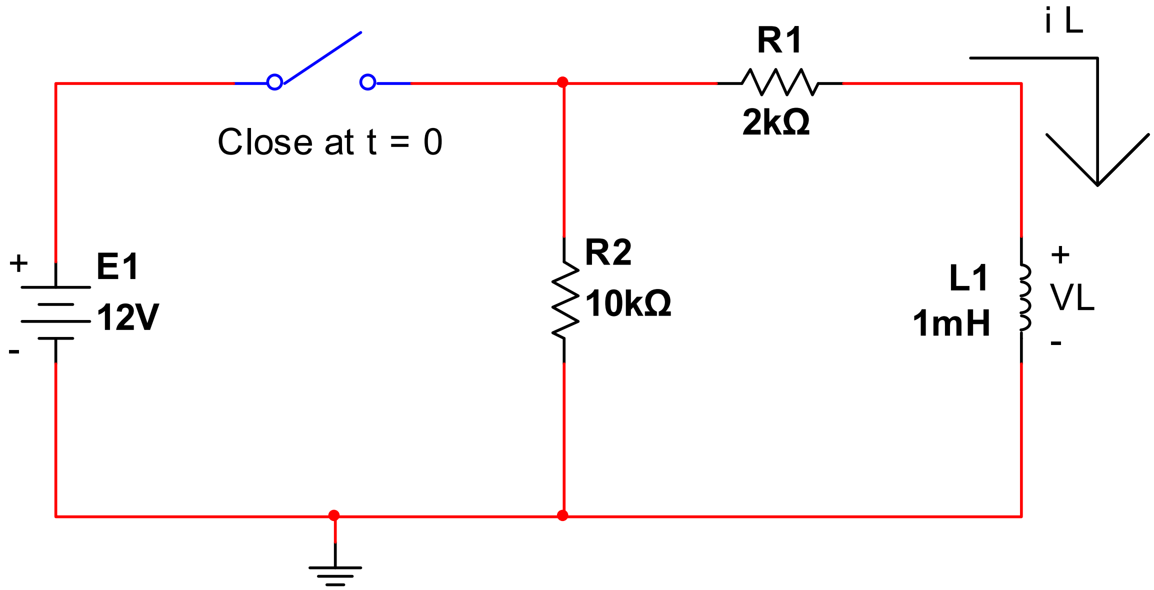
*T*echnology

Inductors – Decay Phase and

Series-Parallel Combinations

Fall 2018

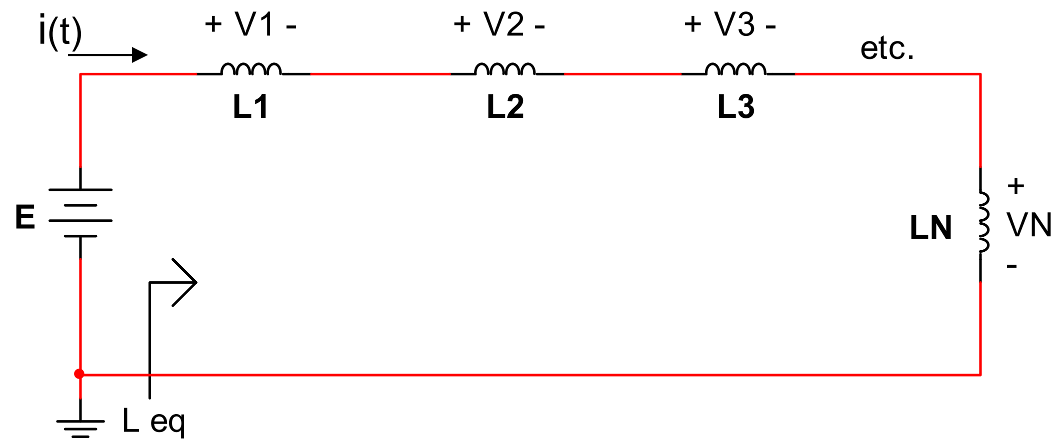
In Class Problem



Find

1. $v_L(t)$ & $i_L(t)$ for t >0
2. $v_L(t)$ & $i_L(t)$ if the switch is opened at t = 1μsec

Inductors in Series



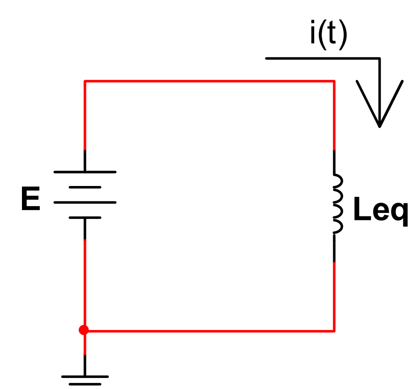
KVL: $E = V_1 + V_2 + V_3 + \ldots + V_N$

But, $V_1 = L_1 \frac{di}{dt}$, $V_2 = L_2 \frac{di}{dt}$, …

Therefore, $E = L_1 \frac{di}{dt} + L_2 \frac{di}{dt} + \ldots + L_N \frac{di}{dt}$

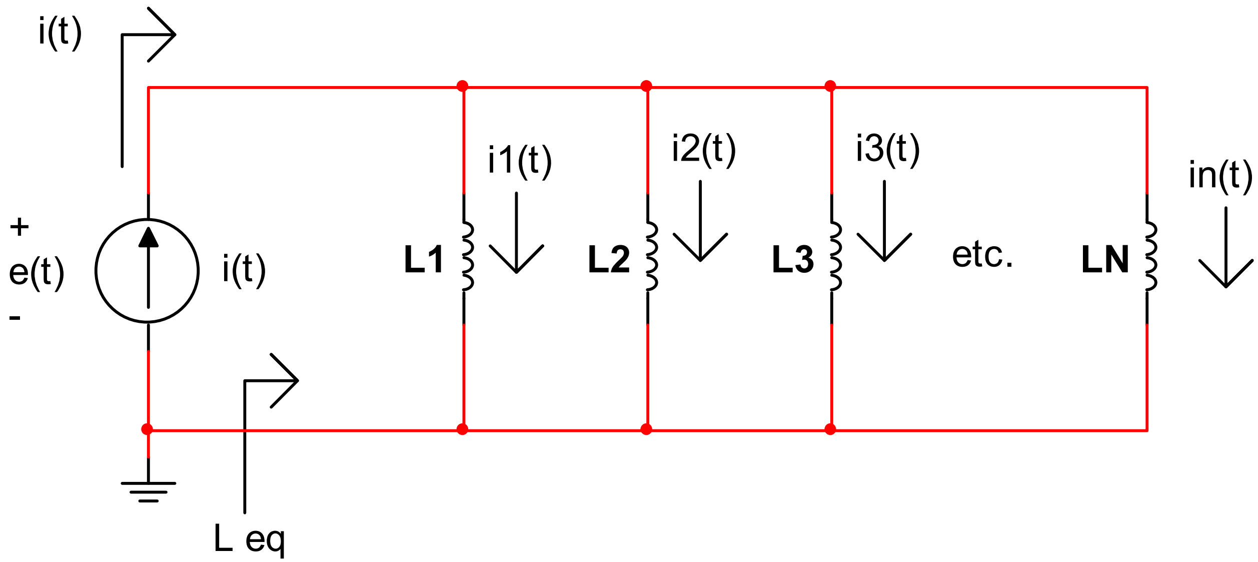
$= (L_1 + L_2 + L_3 + \ldots + L_N) \frac{di}{dt}$

Or $E = L_{EQ} \frac{di}{dt}$



$\boxed{\text{Hence: } L_{EQ} = L_T = L_1 + L_2 + L_3 + \ldots + L_N}$

Inductors in Parallel



KCL: $i(t) = i_1(t) + i_2(t) + i_3(t) + \ldots + i_N(t)$

But, $v_N = L_N \dfrac{di_N}{dt}$

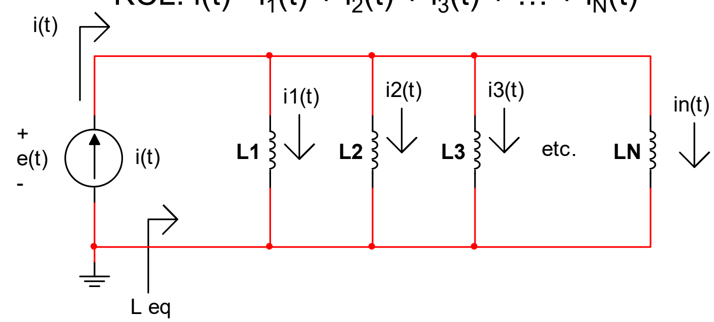
So $\dfrac{v_N}{L_N} = \dfrac{di_N}{dt}$

And $i_N(t) = \int \dfrac{v_N}{L_N}\,dt = \dfrac{1}{L_N}\int v_N\,dt$

Inductors in Parallel

$$i_N(t) = \int \frac{v_N}{L_N}\,dt = \frac{1}{L_N}\int v_N\,dt$$

KCL: $i(t) = i_1(t) + i_2(t) + i_3(t) + \ldots + i_N(t)$



Into our KCL equation yields:

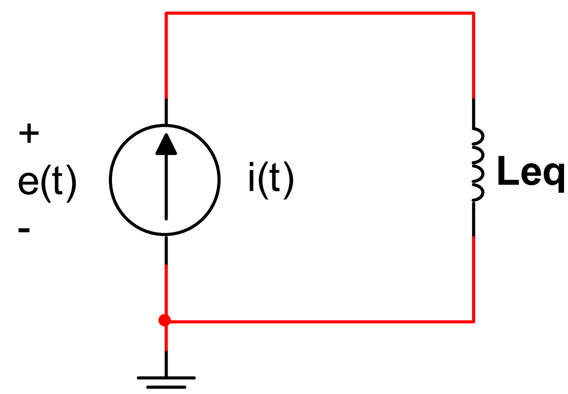
$$i(t) = \frac{1}{L_1}\int v_1(t)dt + \frac{1}{L_2}\int v_2(t)\,dt + \ldots + \frac{1}{L_N}\int v_N(t)\,dt$$

But, $e(t) = v_1(t) = v_2(t) = \ldots = v_N(t)$

$$\text{So } i(t) = \left(\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}\right)\int e(t)\,dt$$

$$\text{Hence: } i(t) = \frac{1}{L_{EQ}}\int e(t)\,dt$$

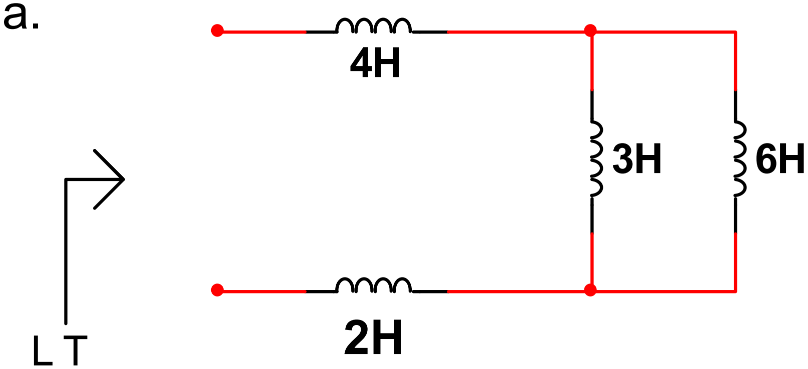
$$\boxed{\text{Where } L_{EQ} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}}}$$



In Class Problem

Find L_T

a.



b.