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10/13/21
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$i = C\frac{dv}{dt}$

$v = L\frac{di}{dt}$

HW2

a) KVL: $Ri(t) + V_L(t) = 0$

$Ri(t) + L\frac{di}{dt} = 0$

$L\frac{di}{dt} = -Ri(t)$ Separation of variables...

$\frac{1}{i(t)}\,di = -\frac{R}{L}\,dt$

$\int_{i(0)}^{i(t)} \frac{1}{i(t)}\,di = -\frac{R}{L}\int_0^t dt$

$\left[\ln(i(t))\right]_{i(0)}^{i(t)} = -\frac{R}{L}[t]_0^t$

$\ln(i(t)) - \ln(i(0)) = -\frac{R}{L}t$

$\ln\left(\frac{i(t)}{i(0)}\right) = -\frac{R}{L}t$

$\frac{i(t)}{i(0)} = e^{-\frac{R}{L}t}$

$\boxed{i(t) = i(0)\cdot e^{-\frac{R}{L}t}}$

b) $i(t) = i(0)\cdot e^{-\frac{R}{L}t}$ (Find $i(0)$)

Inductor: $i(0^-) = i(0^+)$

Current through conductor $= \frac{V_S}{R}$

$i(0) = \frac{V_S}{R}$ $(V = IR)$

$\boxed{i(t) = \frac{V_S}{R}\cdot e^{-\frac{R}{L}t}}$

c) Use $V_L(t) = L\frac{di(t)}{dt}$

$= L\cdot\frac{d}{dt}\left(\frac{V_S}{R}\cdot e^{-\frac{R}{L}t}\right)$

$= L\cdot\frac{V_S}{R}\cdot\left(-\frac{R}{L}\right)e^{-\frac{R}{L}t}$

$= -V_S e^{-\frac{R}{L}t}$

$\boxed{V_L(t) = -V_S e^{-\frac{R}{L}t}}$