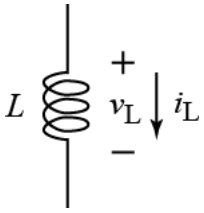
HOMEWORK #7 prob 4 solution

EX: In (a) and (b), the current $i_L(t)$ flowing into a 20 μH inductor is listed. Find the voltage, $v_L(t)$, across the inductor in each case as a function of time:



a) $i_L(t) = 5$ mA

b) $i_L(t) = 5e^{-t/20\,\text{ms}}$ mA

SOL'N: a) The inductor voltage depends on the inductor current:

$$v_L = L\frac{di_L}{dt}.$$

The derivative is zero for a constant current in the inductor. Thus, the voltage is zero.

$$v_L = 20\,\mu\text{H}\frac{d\,5\,\text{mA}}{dt} = 0\,\text{V}$$

b) Again, we used the derivative formula.

$$v_L = 20\,\mu\text{H}\cdot\frac{d5e^{-t/20\,\text{ms}}\,\text{mA}}{dt}$$

or

$$v_L = 20\,\mu\text{H}\cdot\frac{-1}{20\,\text{ms}}\cdot 5e^{-t/20\,\text{ms}}\,\text{mA}$$

or

$$v_L = -5e^{-t/20\,\text{ms}}\,\mu\text{V}$$