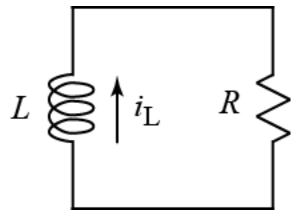
**Ex:**




a) Write a differential equation for the above circuit in terms of variable $i_L$. Hint: use a $v$-loop.

b) Find an expression for the current, $i_L(t)$, through the inductor in the circuit for $t > 0$ if $R = 5$ kΩ, $L = 2$ μH, and $i_L(t = 0) = 8$ A.

**SOL'N:** a) The same current flows in both the L and R, and the voltages are the same except for a minus sign (+ sign on top for both $v$ measurements):

$$v_L = L\frac{di_L}{dt} = -i_L R = -v_R$$

The differential equation is the center portion of the equation:

$$L\frac{di_L}{dt} = -i_L R$$

b) The form of solution is an exponential (or exponentials if the circuit has more than just one $L$ or $C$) for linear circuits with only $R$'s, $L$'s, and $C$'s. (If there is an independent source in the circuit for all time greater than zero, then the solution is an exponential or exponentials plus a constant.)

$$i_L(t) = Ae^{-t/(L/R)}$$

The value of the constant, $A$, is chosen to match the initial voltage on L, since the exponential has a value of unity at $t = 0$: $e^0 = 1$.

$$i_L(t) = 8e^{-t/(2\,\mu\text{H}/5\,\text{k}\Omega)}\ \text{A}$$

or

$$i_L(t) = 8e^{-t/0.4\,\text{ns}}\ \text{A}$$