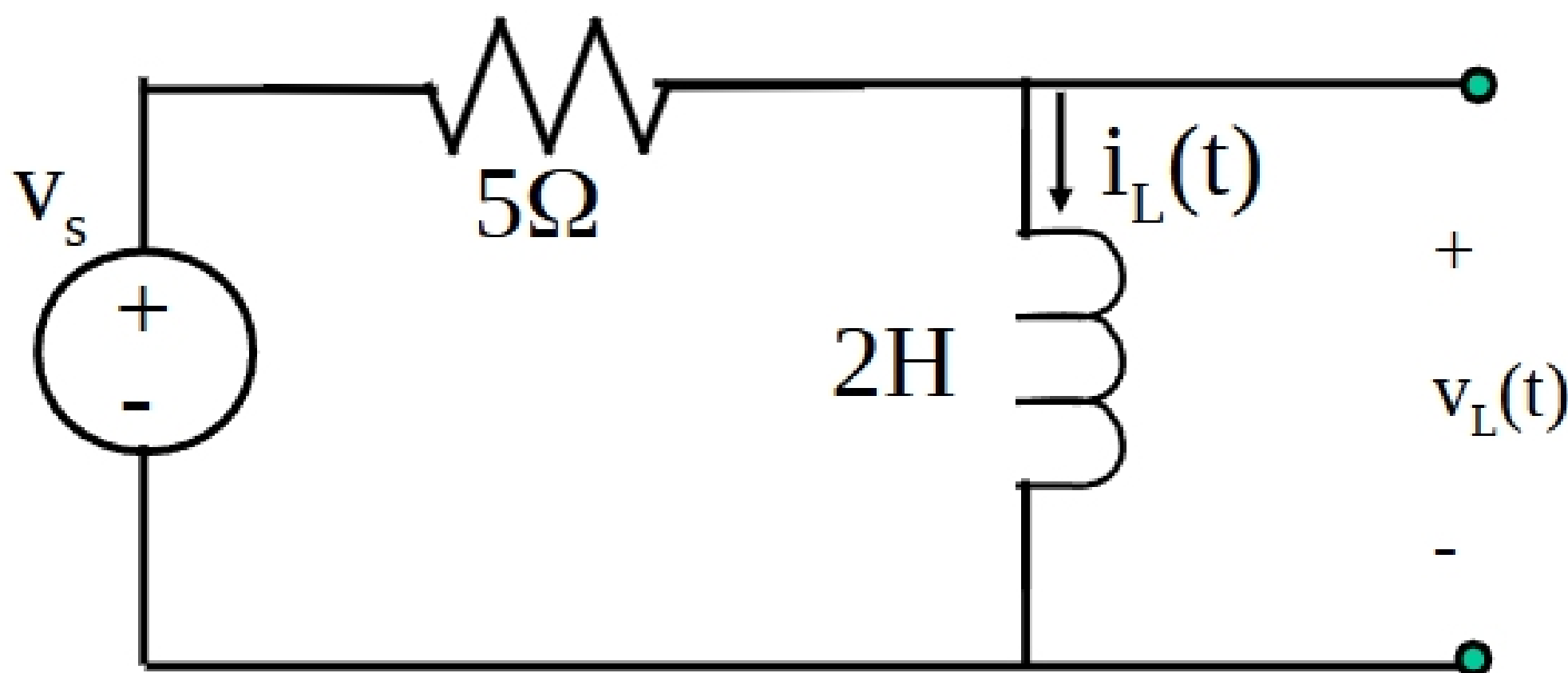

Step Response (continued)

Example: Find $i_L(t)$ for $t \geq 1$ given $v_s = 10 u(t-1)V$ and $i_L(1^-) = 1A$.



Step 1 : Write differential equations to model circuit.

$$\frac{di_L(t)}{dt} + \frac{R}{L} i_L(t) = \frac{10 u(t-1)}{L}$$

Step 2: Evaluate $i_L(t)$.

$$i_L(t) = i_L(\infty) + [i_L(1^+) - i_L(\infty)]e^{-(t-1)/\tau}$$

$$i_L(1^+) = i_L(1^-) = 1 \text{ A}$$

Step 3: Calculate $v_L(\infty)$ and $i_L(\infty)$.

$$v_L(t) = L \frac{di_L(t)}{dt} = \frac{-L}{\tau} [i_L(1^+) - i_L(\infty)] e^{-(t-1)/\tau}$$

Lim $v_L(t) = 0$ (short circuit)
 $t \rightarrow \infty$

$$i_L(\infty) = \frac{10 u(t-1) \text{ V}}{5\Omega} = 2 \text{ A}$$

Step 4: Solve for $i_L(t)$ for $t \geq 1$.

$$\tau = \frac{L}{R_{TH}} = \frac{2\text{H}}{5\Omega} = 0.4\text{s}$$

$$\frac{1}{\tau} = 2.5 \text{ s}^{-1}$$

$$i_L(t) = 2 + [1 - 2]e^{-2.5(t-1)} \text{ A}$$

$$i_L(t) = [2 - e^{-2.5(t-1)}] \text{ A}$$

Example: Find $v_c(t)$ for $t \geq 0$ if $v_c(0^-) = -12\text{V}$.

