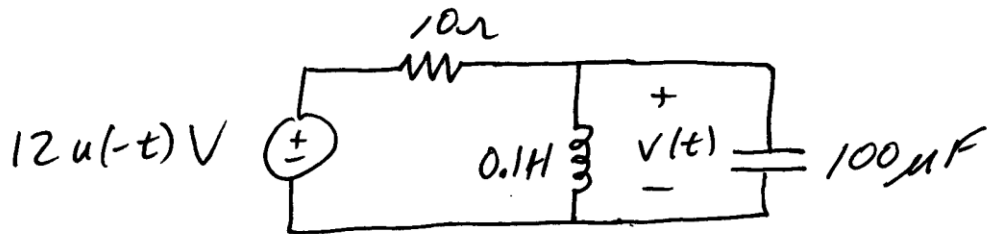
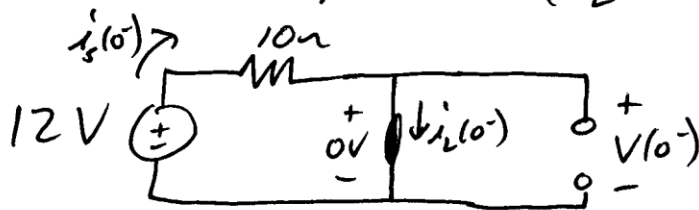


ex. Source-free parallel RLC circuit.  
Find  $v(t)$  for  $t \geq 0$ .



Find initial conditions

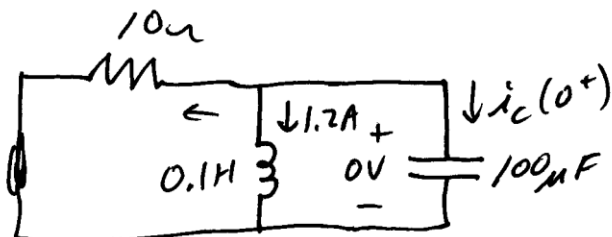
@  $t=0^-$   $12u(-t)V = 12V$  and circuit is at steady-state ( $V_L = 0$  and  $i_C = 0$ )



$$V(0^-) = V_L(0^-) = \underline{\underline{0 = V(0)}}$$

$$i_L(0^-) = i_S(0^-) = \frac{12V}{10\Omega} = \underline{\underline{1.2A = i_L(0)}}$$

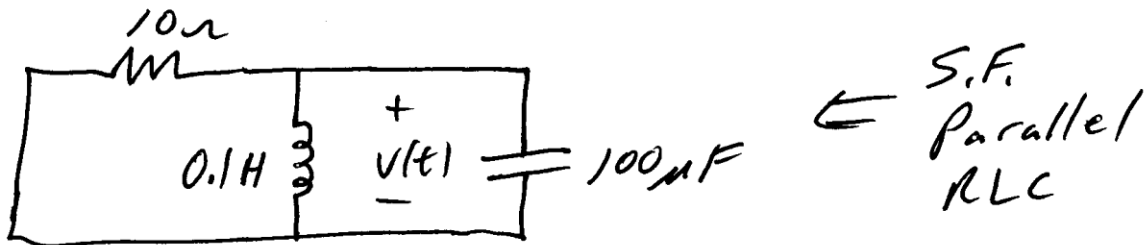
@  $t=0^+$   $12u(-t)V = 0V$  (OFF) + ckt in transition



Apply KCL to top node:  $\frac{0V}{10\Omega} + 1.2A + i_C(0^+) = 0$

$$\hookrightarrow i_C(0^+) = -1.2A = 100 \times 10^{-6} \frac{dV}{dt} \Big|_{t=0^+} \Rightarrow \frac{dV}{dt} \Big|_{t=0^+} = \underline{\underline{-12000 \frac{V}{s}}}$$

The ckt for  $t > 0$  is:



The characteristic equation (8.30) is

$$s^2 + \frac{1}{RC} s + \frac{1}{LC} = 0$$

$$s^2 + \frac{1}{10(100 \times 10^{-6})} s + \frac{1}{0.1(100 \times 10^{-6})} = 0$$

$$s^2 + 1000s + 100,000 = 0$$

$$s_1 = -112.701665 \text{ Np/s}$$

$$s_2 = -887.298335 \text{ Np/s} \quad \leftarrow \text{Overdamped!}$$

Find roots  
using  
calculator

General Sol'n  $v(t) = A_1 e^{-112.702t} + A_2 e^{-887.298t}$

Apply initial conditions

$$v(0) = 0 = A_1 e^0 + A_2 e^0 \Rightarrow \underline{A_1 + A_2 = 0}$$

$$\left. \frac{dv}{dt} \right|_{t=0^+} = -12000 = -112.702 A_1 \left. e^0 \right|_{t=0^+} - 887.298 A_2 \left. e^0 \right|_{t=0^+}$$

$$\hookrightarrow \underline{-112.702 A_1 - 887.298 A_2 = -12000}$$

Two equations & two unknowns

Solve for  $A_1$  &  $A_2$  using calculator

$$A_1 = -15.4919 \quad \text{and} \quad A_2 = 15.4919$$

$$\underline{V(t) = -15.4919 e^{-112.702t} + 15.4919 e^{-887.298t} \quad \forall t \geq 0}$$

### Plot using MathCad

$$n := 0..799$$

$$t_n := n \cdot 0.00005$$

$$v_n := -15.4919 \cdot e^{-112.702 \cdot t_n} + 15.4919 \cdot e^{-887.298 \cdot t_n} \quad \text{V}$$

