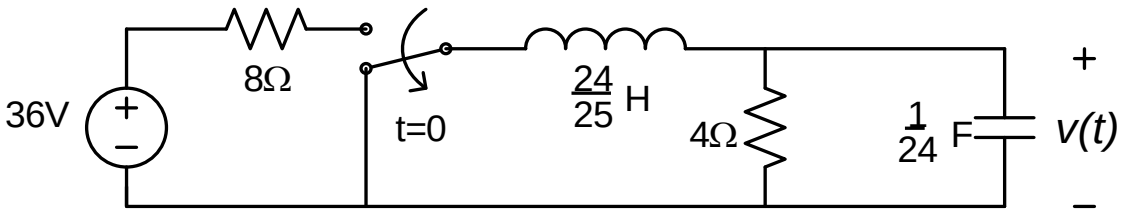
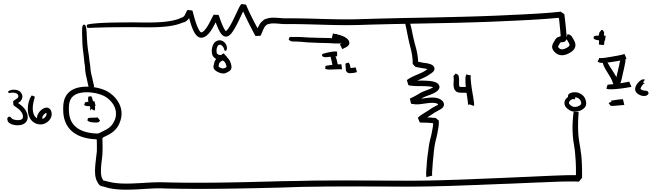
1. Find the initial conditions $v(0^+)$, $v'(0^+)$.



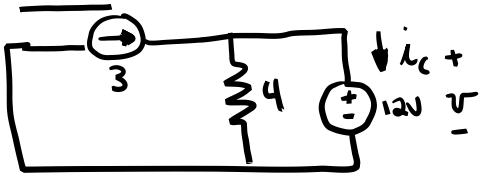
$v(0) \Rightarrow t < 0$



$I_c = \frac{36}{12} = 3A$

$V_c = 36\frac{4}{4+8} = 12V$

$v'(0) \Rightarrow t = 0^+$



$i_c = C v'$

$v'(0) = \frac{1}{C} i_c$

$= \frac{1}{C}(3 - 12/4)$

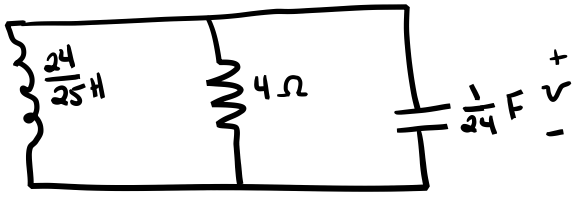
$= 0$ V/s

$v(0) = 12V$

$v'(0) = 0$ V/s

2. Find $v_{nat}(t)$

$v_{nat} \Rightarrow t > 0$



$\alpha = \frac{1}{2RC} = 3$

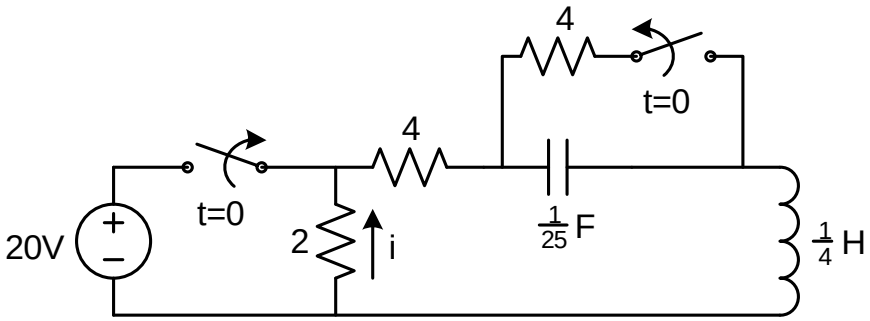
$\omega_0 = \frac{1}{\sqrt{LC}} = 5$

$s = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$

$= -3 \pm j4$

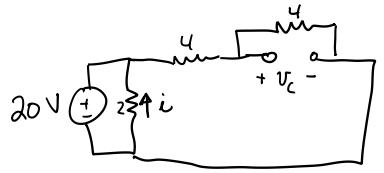
$v_{nat}(t) = e^{-3t}[C_1 \cos 4t + C_2 \sin 4t]$

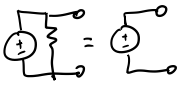
3. Find i(t) for $t \geq 0$.

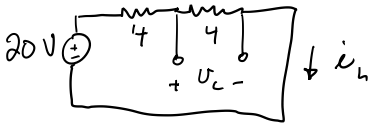


① Find IC

a) $t<0$ Find v_c, i_L



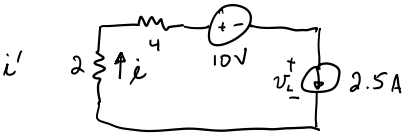
but  =



$v_c = 10V$ by $V_{divider}$ $20\left(\frac{4}{4+4}\right)$

$i_L = 2.5A$ by Ω's Law $\frac{20}{8}$

b) $t=0^+$ Find i, i'



by inspection $\boxed{i = 2.5A}$

$v_L = L i' \Rightarrow i' = \frac{1}{L} v_L$

by KVL, $2(2.5) + 4(2.5) + 10 + v_L = 0$

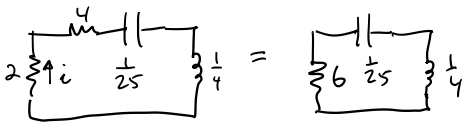
$\Rightarrow v_L = -25V$

so $i' = \frac{1}{L} v_L = 4(-25)$

$\boxed{i' = -100 A/s}$

② Find natural solution

a) $t > 0$



$\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{1}{100}}} = 10$

$\alpha = \frac{R}{2L} = \frac{6.4}{2} = 12$

$s = -\alpha \pm \sqrt{\alpha^2 - \omega_o^2}$

$= -18.6, -5.37$

b) $\alpha > \omega_o \Rightarrow$ overdamped

$\Rightarrow i_n(t) = C_1 e^{-18.6t} + C_2 e^{-5.37t}$

③ Find forced solution $t = \infty$ there are no sources $\Rightarrow i_f = 0$ by inspection

④ Find total response

a) $i(t) = C_1 e^{-18.6t} + C_2 e^{-5.37t} \Rightarrow i(0) = C_1 + C_2 = 2.5$

b) $i'(t) = -18.6 C_1 e^{-18.6t} - 5.37 C_2 e^{-5.37t} \Rightarrow i'(0) = -18.6 C_1 - 5.37 C_2 = -100$

$$\begin{bmatrix} 1 & 1 \\ -18.6 & -5.37 \end{bmatrix} \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ -100 \end{bmatrix} \quad \text{by calc or Matlab} \quad \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} = \begin{bmatrix} 6.53 \\ -4.03 \end{bmatrix}$$

$$\Rightarrow \boxed{i(t) = 6.53 e^{-18.6t} - 4.03 e^{-5.37t} \text{ A}}$$