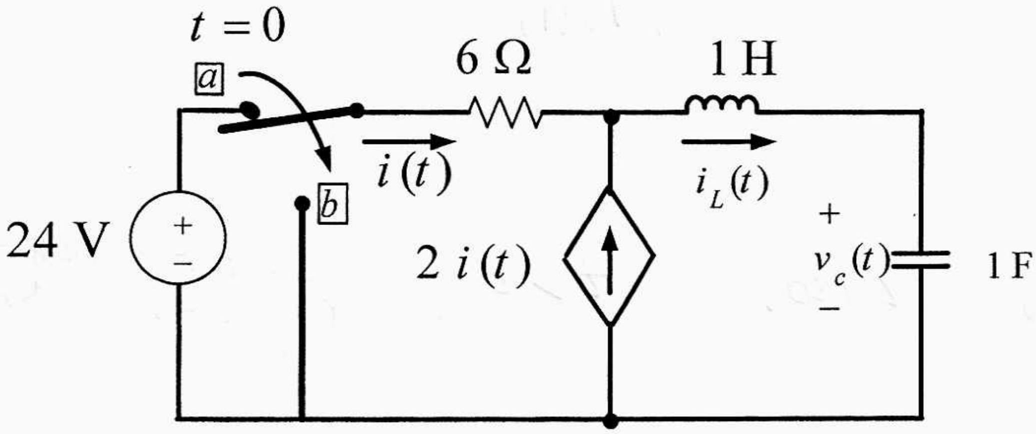
EE 202-02-Fall 2013(131)

QZ5

Sec	Ser	ID	Name



For the circuit shown above, the switch was in position **a** for a long time, then at time t=0 the switch move to position **b** . Find the followings :

(a) α ?

(b) ω_0 ?

(c) $i(\infty)$?

(d) $i_L(0^+)$?

(e) $v_C(0^+)$?

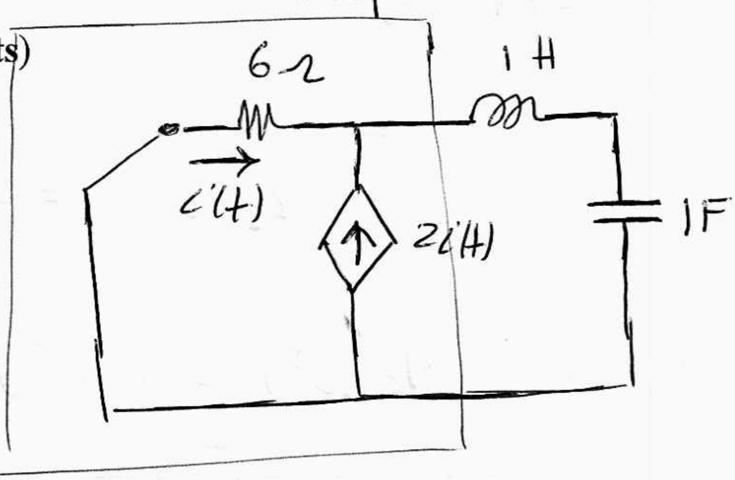
(f) $i(0^+)$?

(g) $\dfrac{di(0^+)}{dt}$?

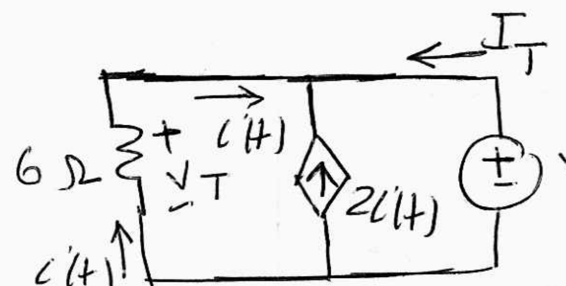
(h) General expersion for $i(t)$?
 (**Do not evaluate the costants**)

$$x(t) = X_f + \begin{cases} A_1 e^{s_1 t} + A_2 e^{s_2 t} \\ e^{-\alpha t}\left\{B_1\cos(\omega_d t) + B_2\sin(\omega_d t)\right\} \\ D_1 t e^{-\alpha t} + D_2 e^{-\alpha t} \end{cases}$$

Req



(a) $\alpha = \dfrac{R_{eq}}{2L}$ $t > 0$



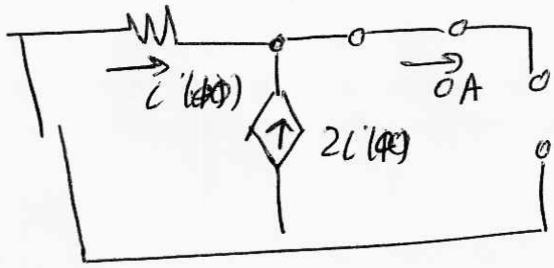
KCL $I_T = -3i(t) = -3\left(-\dfrac{V_T}{6}\right) = \dfrac{V_T}{2} \Rightarrow R_{eq} = \dfrac{V_T}{I_T} = 2\,\Omega$

$\Rightarrow \alpha = \dfrac{2}{2(1)} = 1$ rad/s

(b) $\omega_0 = \dfrac{1}{\sqrt{LC}}$ $t > 0$

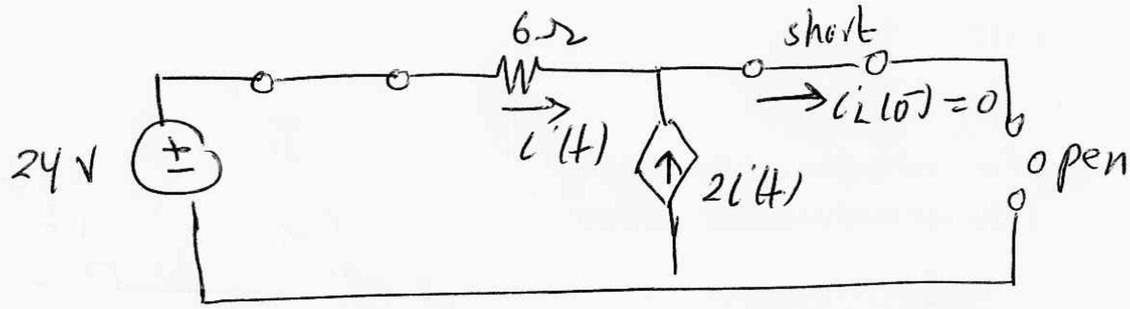
$= \dfrac{1}{\sqrt{(1)(1)}} = 1$ rad/s

(c) $i(\infty)$ $t > 0$ inductor short
capacitor open



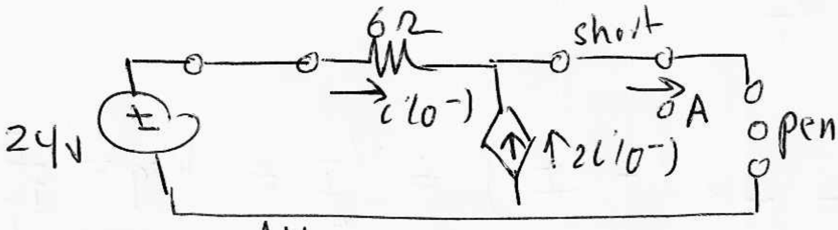
$3i(\infty) = 0$
$\Rightarrow i(\infty) = 0$

(d) $i_L(0^+) = i_L(0^-)$ $(t < 0)$



$i_L(0^-) = 0$

(e) $V_c(0^+) = V_c(0^-)$ $(t < 0)$

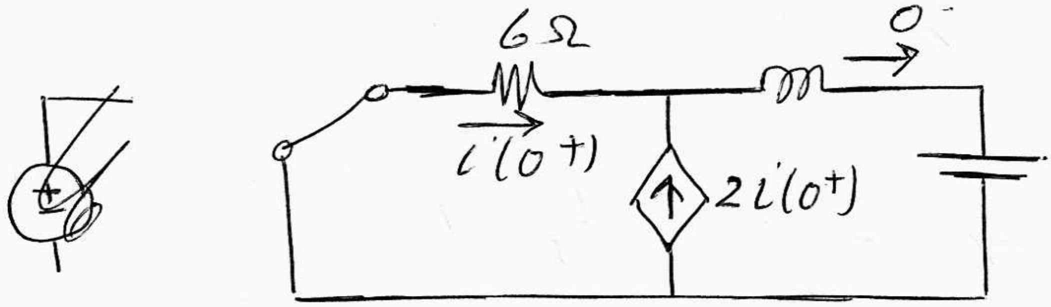


$3i(0^-) = 0$
$\Rightarrow i(0^-) = 0$
$\Rightarrow V_c(0^-) = 24V$
$= V_c(0^+)$

$\Rightarrow$ 

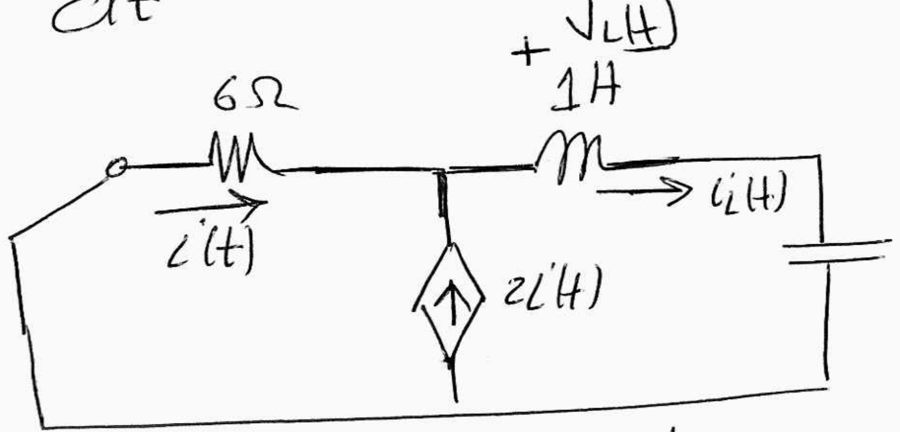
(f) $i(0^+) \stackrel{?}{=} i(0^-)$ NO

$\Rightarrow$ look at $t = 0^+$



$$3i(0^+) = 0 \Rightarrow i(0^+) = 0$$

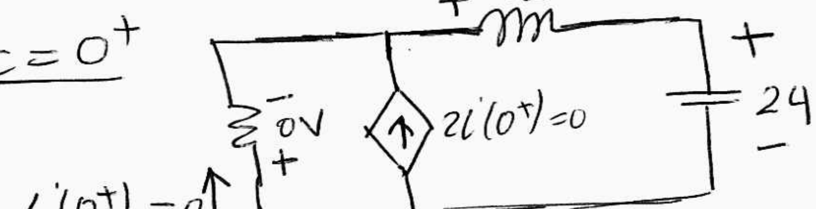
(g) $\frac{di(0^+)}{dt}$? Look at $t > 0$



$$3i(t) = i_L(t) \Rightarrow 3\frac{di(t)}{dt} = \frac{di_L(t)}{dt} = \frac{V_L(t)}{(1)}$$

$$\Rightarrow \frac{di(t)}{dt} = \frac{1}{3} V_L(t) \Rightarrow \frac{di(0^+)}{dt} = \frac{V_L(0^+)}{3}$$

Now Look at $t = 0^+$



$$\Rightarrow V_L(0^+) = -24 \Rightarrow \frac{di(0^+)}{dt} = \frac{-24}{3} = -8 \text{ A/s}$$

$\Rightarrow$

(h) since $\alpha = \omega_0 = 1$ rad/s

$\Rightarrow$ Critical damped

$$\Rightarrow i(t) = i_f + D_1 t e^{-\alpha t} + D_2 e^{-\alpha t}$$

$$= 0 + D_1 t e^{-t} + D_2 e^{-t}$$

$$= \cancel{D_2 e^{-\alpha t}}$$

$$= e^{-t}\left[D_1 t + D_2\right] \quad A$$