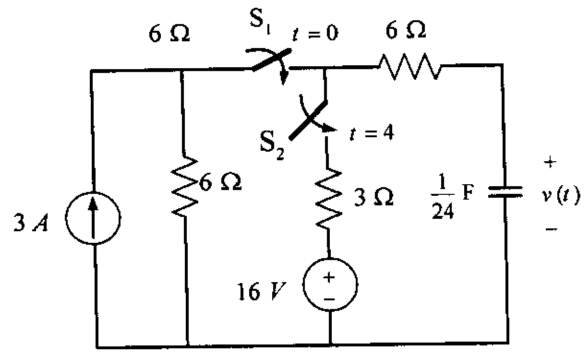
EE 201-02-Winter 2011(102)
QZ5

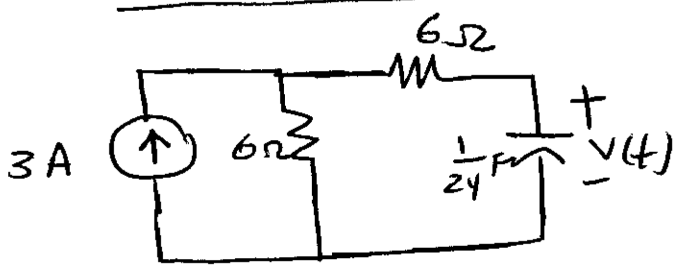
Ser	ID	Name KEY



For the circuit shown above the capacitor initially is uncharged, switch S_1 close at t =0 , then after 4 seconds switch S_2 close at t =4 , find $v(t)$ for all time ?

For $t \le 0$ $\Rightarrow$ $v(0^-) = 0 = v(0^+)$

For $0 \le t \le 4$

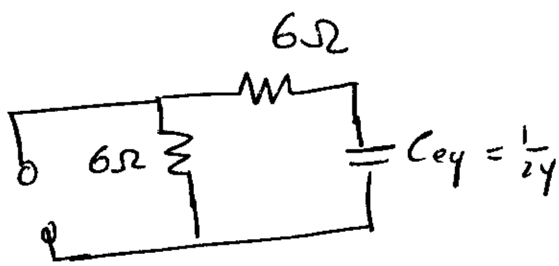


$$v(t) = v(\infty) + [v(0^+) - v(\infty)]\, e^{-t/\tau_1}$$

$$v(\infty) = (3)(6) = 18\,V$$

$$v(0^+) = v(0^-) = 0\,V$$

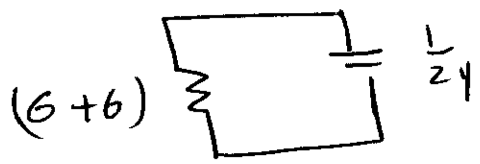
$$\tau_1 = R_{eq_1} C_{eq}$$



R_{eq_1} (seen by the Capacitor)

$$= 6+6 = 12\,\Omega$$

$$\tau_1 = 12 \cdot \frac{1}{24} = \frac{1}{2}\,s$$

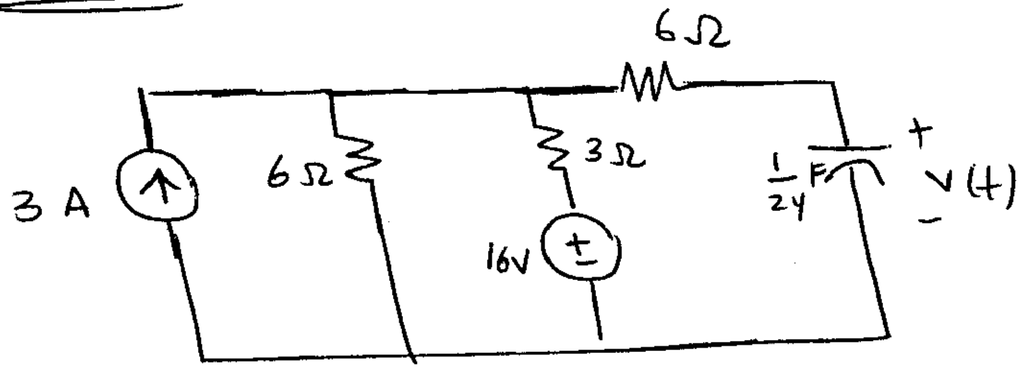


$$\Rightarrow\ v(t) = 18 + [0 - 18]\, e^{-2t}\ V$$

$$= 18\,[1 - e^{-2t}]\ V$$

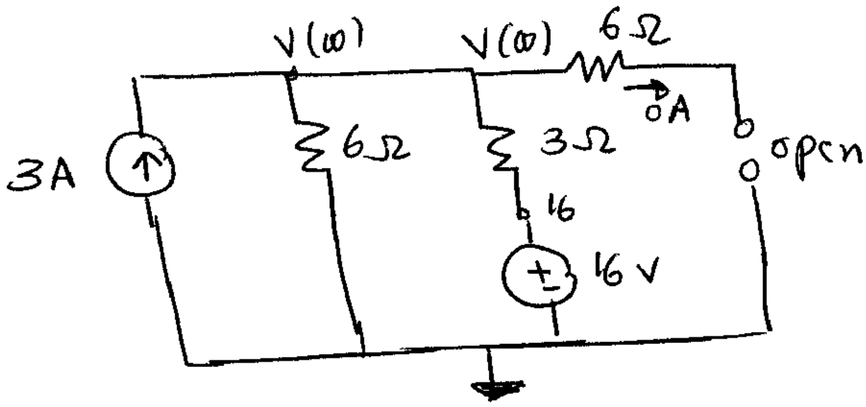
(Continue) $\Rightarrow$

For $t \geq 4$



$$v(t) = v(\infty) + [v(4^+) - v(\infty)]\, e^{-\frac{(t-4)}{\tau_2}}$$

v (∞)

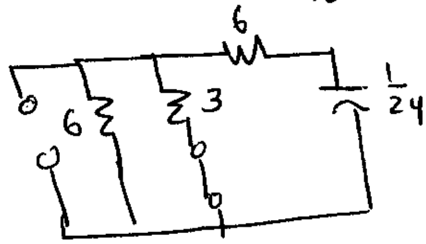


KCL $\quad -3 + \frac{v(\infty)}{6} + \frac{v(\infty) - 16}{3} = 0$

solving $\quad v(\infty) = \frac{50}{3} = 16.67\,V$

$$v(4^+) = v(4^-) = 18[1 - \underbrace{e^{-2(4)}}_{\approx 0}] \approx 18$$

$\tau_2 = R_{eq_2} C_{eq}$



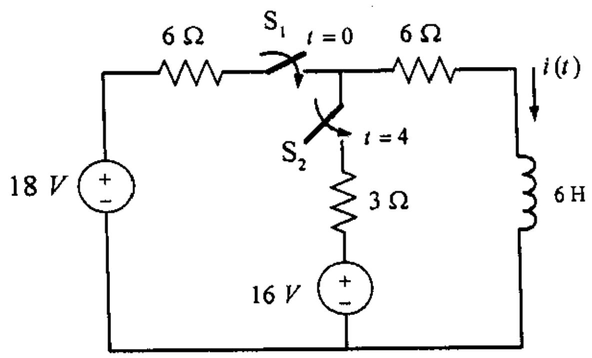
$R_{eq_2} = 6 + (3 \| 6) = 8\,\Omega$

$\tau_2 = 8 \cdot \frac{1}{24} = \frac{1}{3}\,s$

$$v(t) = 16.67 + [18 - 16.67]\, e^{-3(t-4)}$$
$$= 16.67 + 1.3\, e^{-3(t-4)} \quad V$$

EE 201-01-Winter 2011(102)
QZ5

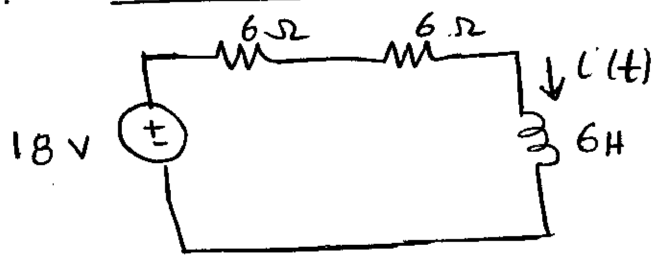
Ser	ID	Name KEY



For the circuit shown above, switch S_1 close at t =0 , then after 4 seconds switch S_2 close at t =4 , find $i(t)$ for all time ?

For $t \le 0$ $\quad i(t) = 0 \quad i(0^-) = i(0^+) = 0$ A

For $0 \le t \le 4$



$$i(t) = i(\infty) + [i(0^+) - i(\infty)]\, e^{-t/\tau_1}$$

$$i(\infty) = \frac{18}{6+6} = \frac{3}{2} = 1.5 \text{ A}$$

$$i(0^+) = i(0^-) = 0 \text{ A}$$

$$\tau_1 = \frac{L_{eq}}{R_{eq_1}}$$

R_{eq_1} (seen by the indictor)

$$= 6 + 6 = 12\ \Omega$$

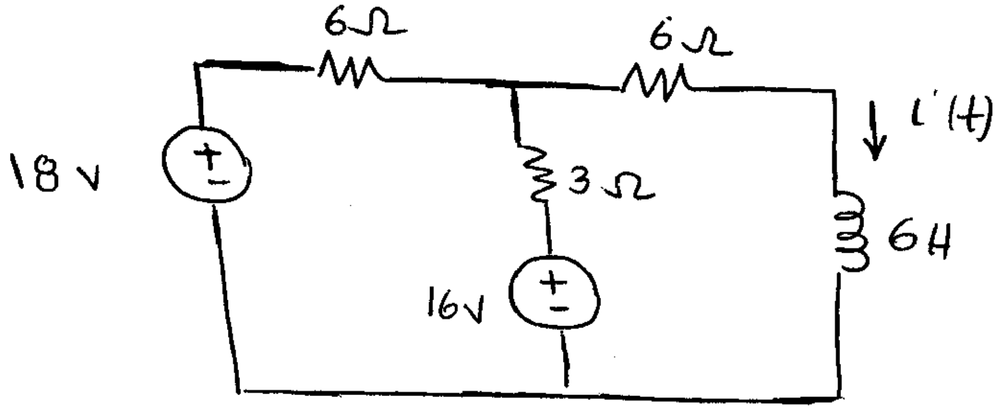
$$\tau_1 = \frac{6}{12} = \frac{1}{2} \text{ s}$$

$$\Rightarrow i(t) = 1.5 + [0 - 1.5]\, e^{-2t} \text{ A}$$

$$= 1.5\,[1 - e^{-2t}] \text{ A}$$

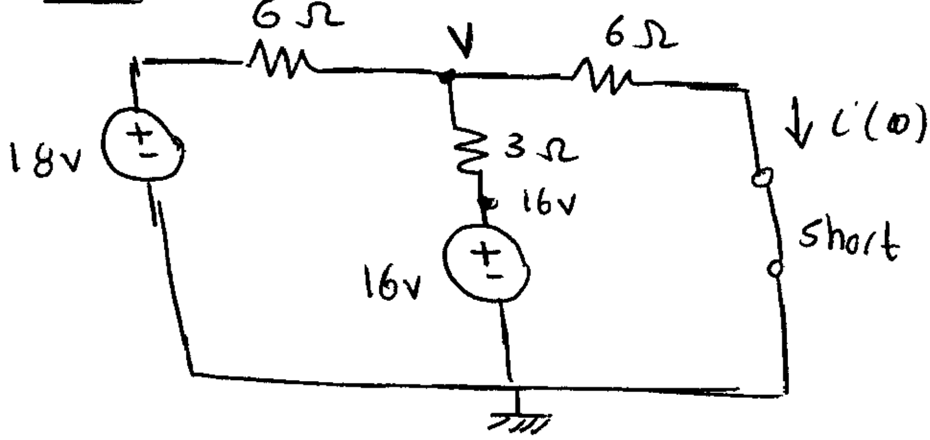
(continue)

For $t \geq 4$



$$i(t) = i(\infty) + [i(4^+) - i(\infty)]\, e^{-t/\tau_2}$$

$i(\infty)$



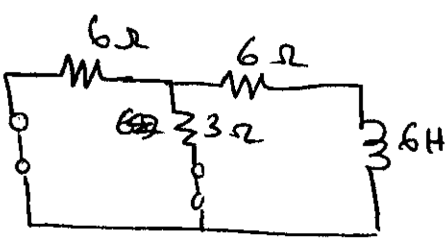
KCL $\quad \dfrac{V-18}{6} + \dfrac{V-16}{3} + \dfrac{V}{6} = 0 \Rightarrow V = \dfrac{25}{2}\ \text{V}$

$$i(\infty) = \frac{V}{6} = \frac{25/2}{6} = \frac{25}{12} = 2.08 \ \text{A}$$

$$i(4^+) = i(4^-) = 1.5\,[1 - \underbrace{e^{-2(4)}}_{\approx 0}] \approx 1.5$$

$\tau_2 = \dfrac{L_{eq}}{R_{eq_2}}$

$\tau_2 = \dfrac{6}{8} = \dfrac{3}{4}\ \text{s}$



R_{eq_2} (seen by indictor)

$= 6 + (6 \| 3) = 8\,\Omega$

$$i(t) = 2.08 + [1.5 - 2.08]\, e^{-\frac{4(t-4)}{3}}$$

$$= 2.08 + 0.583\, e^{-\frac{4(t-4)}{3}} \ \text{A}$$