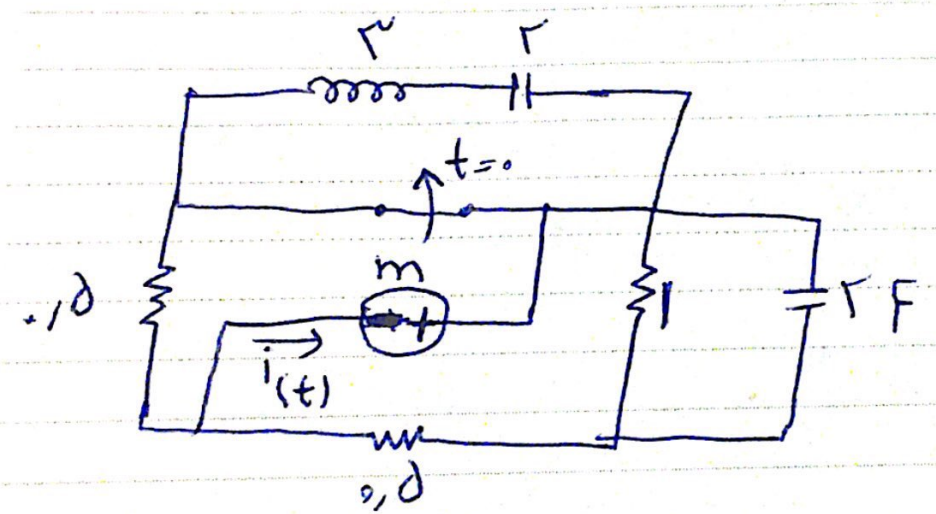
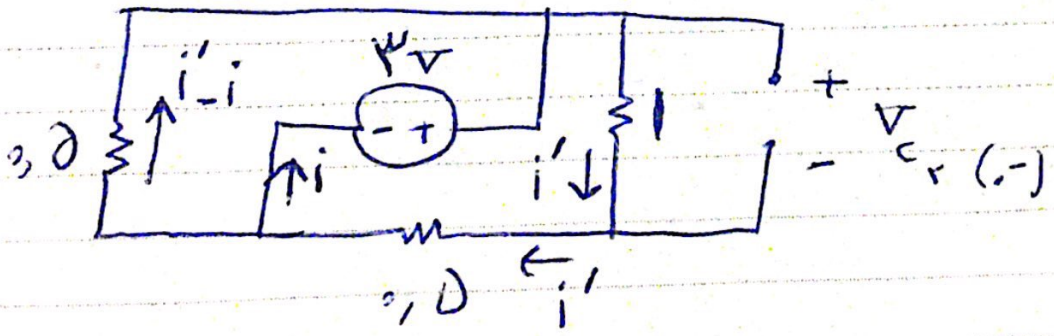
۱) در مدار شکل زیر در $t=0$ کلید که بازه می‌شود. بخش گذرای $i_{(t)}$ را محاسبه کنید.

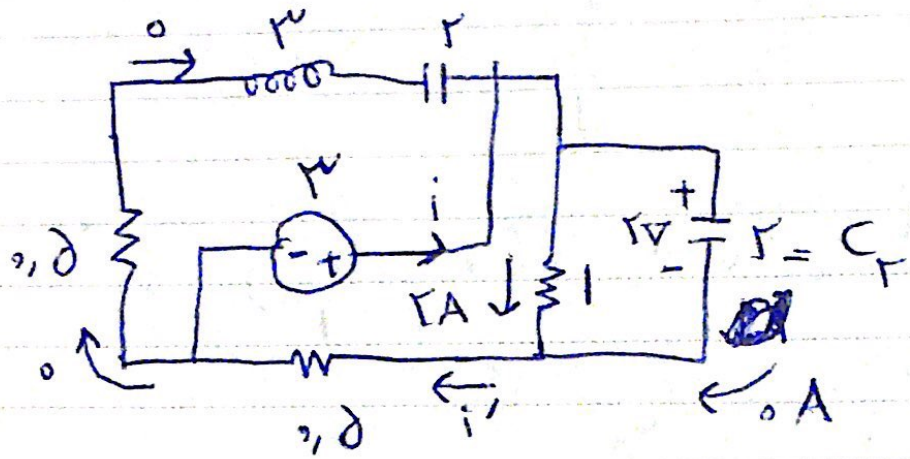


در $t=0^-$:



$$-۳+۱,۵i'=۰ \rightarrow i'=۲A \rightarrow V_{c_{۲(۰^-)}}=۲\times۱=۲V$$

$v_{c_1}(0^-) = 0$ و $i_L(0^-) = 0$



; $t = 0^+$ ⇒

$KVL: -3 + 2 + 0.5i' = 0 \rightarrow i'_{(0^+)} = 2A$

$i'_{(0^+)} = i_{(0^+)} + i_L(0^+) \Rightarrow \boxed{i_{(0^+)} = 2A}$

$i_{C_2}(0^+) + \frac{v_{C_2}(0^+)}{1} = i'_{(0^+)} \rightarrow i_{C_2}(0^+) = 0 \rightarrow \boxed{\frac{dv_{C_2}}{dt}(0^+) = 0}$

$KVL: 3 + 3\frac{di_L}{dt}(0^+) = 0 \rightarrow \frac{di_L}{dt}(0^+) = -1$

$i_{C_1}(0^+) = 0 \rightarrow \boxed{\frac{dv_{C_1}}{dt}(0^+) = 0}$

$t > 0$ ⇒

$$i_L + i = i_{C_2} + \frac{v_{C_2}}{1}$$

$$KVL: -3 + v_{C_2} + 0.5\left(i_{C_2} + \frac{v_{C_2}}{1}\right) = 0$$

$$\rightarrow 1.5\, v_{C_2} + 0.5\, i_{C_2} = 3$$

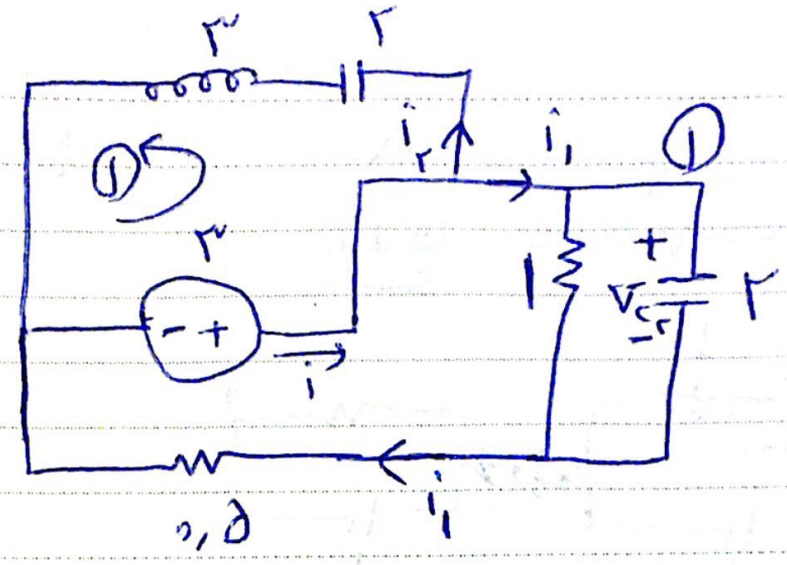
مشتق ⟶ $1.5 \dfrac{dv_{C_2}}{dt} + \dfrac{1}{2} \times 2 \dfrac{d^2 v_{C_2}}{dt^2} = 0 \rightarrow \boxed{\dfrac{d^2 v_{C_2}}{dt^2} = 0}$

($\frac{dv_{C_2}}{dt} \downarrow 0$)

مشتق ⟶ $\dfrac{di_L}{dt} + \dfrac{di}{dt} = 2\dfrac{d^2 v_{C_2}}{dt^2} + \dfrac{dv_{C_2}}{dt}$

($\frac{di_L}{dt} \downarrow -1$, $\frac{d^2 v_{C_2}}{dt^2} \downarrow 0$, $\frac{dv_{C_2}}{dt} \downarrow 0$)

$$\rightarrow \boxed{\frac{di}{dt}(0^+) = 1}$$



$$i = i_1 + i_2$$

① KVL: $-۳ + \frac{1}{۲}\int i_2(t)\,dt + ۲ + ۳\frac{di_2}{dt} = ۰$

مشتق $\Rightarrow$ $۳\frac{d^2 i_2}{dt^2} + \frac{1}{۲} i_2 = ۰$

$$\rightarrow \boxed{i_2(t) = A \sin\frac{1}{\sqrt{۶}}t + B\cos\frac{1}{\sqrt{۶}}t}$$

① KCL: $i_1 = ۲\frac{dV_{C_2}}{dt} + V_{C_2}$

KVL: $-۳ + V_{C_2} + \frac{1}{۲} i_1 = ۰ \rightarrow$

$$\begin{cases} \frac{dV_{C_2}}{dt} + \frac{۳}{۲} V_{C_2} = ۳ \\ V_{C_2}(۰^-) = ۲۷ \end{cases}$$

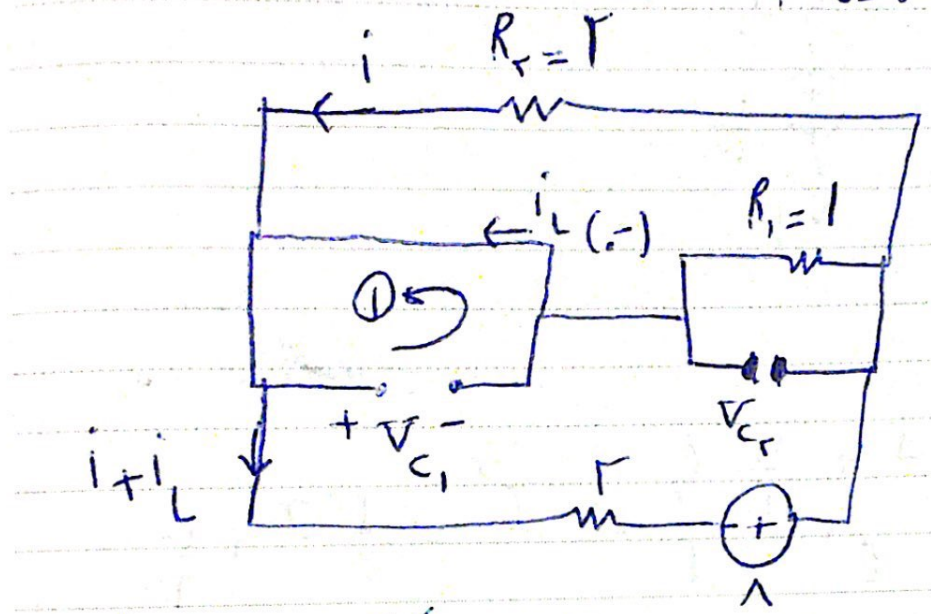
$$\Rightarrow v_{c_2}(t) = \left(k e^{-\frac{2}{2}t} + 2\right) u(t) \Big\} \rightarrow \boxed{k = -2}$$

$$v_{c_2}(0^+) = 2V$$

$$i_1 = 2\frac{dv_{c_2}}{dt} + v_{c_2}$$

$$\begin{cases} i_{(t)} = i_{1(t)} + i_{2(t)} \\ i_{(0^+)} = 2A \\ \frac{di}{dt}(0^+) = 1 \end{cases}$$

۱۲) تحلیل برای $t=0^-$:



کرشهف ولتاژ حلقه ① : $2(i+i_L)-8+2i=0 \rightarrow 4i+2i_L=8$

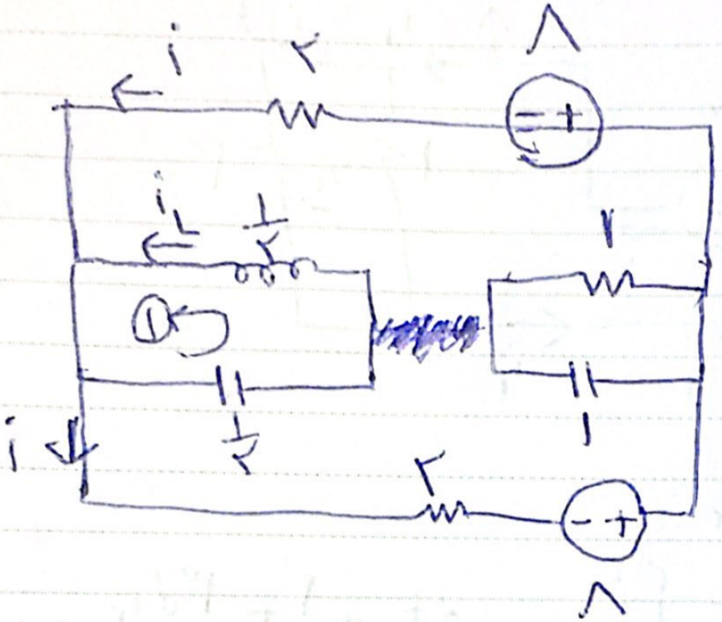
$$\rightarrow \boxed{i_L+2i=4} \Rightarrow \begin{cases} i=1\ A \\ i_L=2\ A \rightarrow i_{L(0^+)}=2A \end{cases}$$

از طرفی : $2i=i_L \times 1$

$$v_{c_1(0^-)}=v_{c_2(0^+)}=0\ V$$

① حلقه کرشهف : $0.5\frac{di}{dt}+v_{c_1(0^+)}=0 \Rightarrow \boxed{\frac{di}{dt}(0^+)=0}$; $t=0^+$

تحلیل برای $t>0$:



KVL در کل مدار : $8 + 2i + 2i - 8 = 0 \rightarrow i = 0$

KVL در ① : $\frac{1}{2}\frac{di_L}{dt} + \frac{1}{\frac{1}{2}}\int i_L(t) + 0 = 0$

$$\rightarrow \begin{cases} \frac{1}{2}\frac{d^2 i_L}{dt^2} + 2 i_L = 0 \\ i_L(0^+) = 2 \\ \frac{di_L}{dt}(0^+) = 0 \end{cases}$$

$$\frac{1}{2}s^2 + 2 = 0 \rightarrow s = \pm 2j\omega$$

$$\Rightarrow i_L(t) = A\sin 2t + B\cos 2t$$

$$i_L(0^+) = 2 \rightarrow \boxed{B = 2}$$

$$\frac{di_L}{dt}(0^+) = 0 \rightarrow 2A = 0 \rightarrow \boxed{A = 0}$$

$$\rightarrow \boxed{i_L(t) = 2\cos 2t\, u(t)}$$