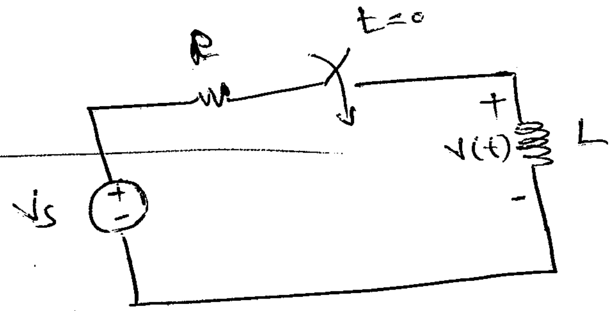
* step Response of RL circuit.



KVL

$$-V_s + i.R + L\frac{di}{dt} = 0$$

$$L\frac{di}{dt} = V_s - i.R$$

$$\frac{di}{dt} = \frac{V_s - iR}{L}$$

$$\frac{di}{dt} = \frac{-R}{L}\left(i - \frac{V_s}{R}\right) \quad] * dt$$

$$di = -\frac{R}{L}\left(i - \frac{V_s}{R}\right) dt$$

$$\frac{di}{\left(i - \frac{V_s}{R}\right)} = \frac{-R}{L} dt$$

$$\int_{I_0}^{i(t)} \frac{1}{\left(i - \frac{V_s}{R}\right)} di = \frac{-R}{L}\int_0^t dt$$

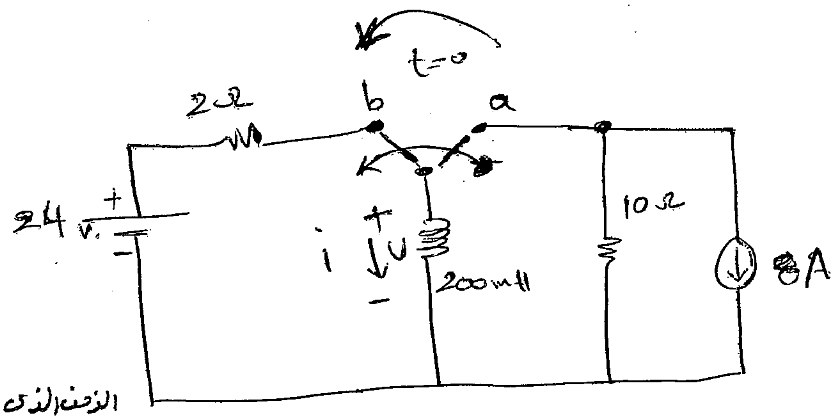
$$Ln\frac{i(t) - (V_s/R)}{I_0 - (V_s/R)} = e^{-(R/L)t}$$

$$\therefore \boxed{i(t) = \frac{V_s}{R} + \left(I_0 - \frac{V_s}{R}\right) e^{-(R/L)t}}$$ step Response of RL cct.

$$v_L = L\frac{di}{dt}$$

Ex:

1. $i(t)$
2. V_L at $t \geq 0$
3. does the initial voltage make sense in terms of circuit behavior ?
4. How many ms after the switch الزمن الذي has been moved does the يجعل inductore voltage = 24 v. $24 = v(t)$
5. Plot both $i(t)$ & $v(t)$ versus t.



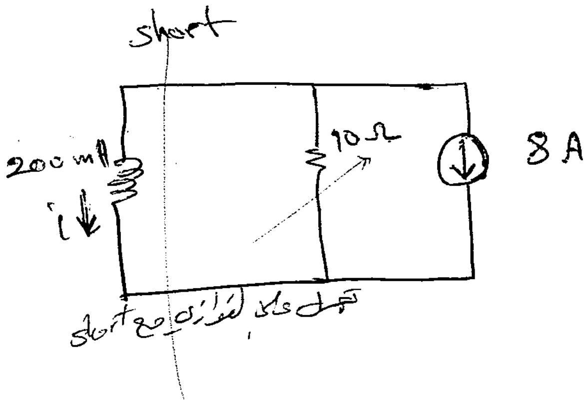
SoL

1. at $t < 0$

at steady state the inductor will be short ckt.

So R will ignored

$$\therefore \boxed{I_0 = -8 \text{ A}}$$



at $t > 0$

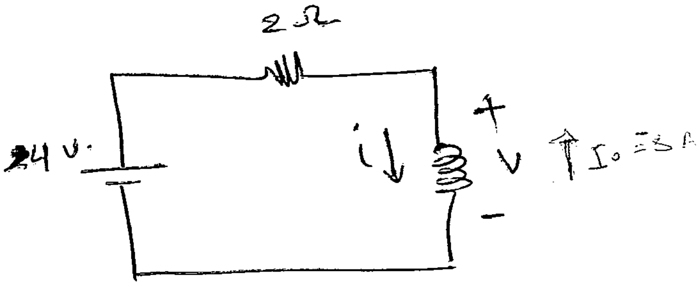
$$\tau = \frac{L}{R} \rightarrow \frac{200 \text{ mH}}{2} = 0.1 \text{s}$$

$$i(t) = \frac{V_s}{R} + \left(I_0 - \frac{V_s}{R}\right) e^{-t/\tau}$$

$$= \frac{24}{2} + \left(-8 - \frac{24}{2}\right) e^{-t/0.1}$$

$$= 12 + (-8 - 12) e^{-10t}$$

$$\boxed{i(t) = 12 - 20 e^{-10t}}$$



2) $V_L = L \dfrac{di(t)}{dt}$

$= L \dfrac{d(12 - 20e^{-10t})}{dt}$

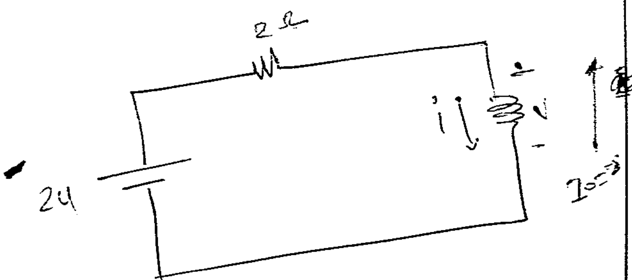
$= L(2e^{-10t})$

$= (200 \times 10^{-3})(2e^{-10t})$

$\boxed{V_{L(t)} = 40e^{-10t}}$ v. at $t > 0$

$V_L = 40$ v.

(3)



Yes, نعم، كافية لتغطية حاجة الدائرة

لأن Io تيار المخزون في الملف هو 8A صرف يعطي فولتية للمقاومة

$\underline{\underline{16}}^{V_R} = (8 \times 2)$ (I, R)

$\overset{V_R}{16} + \overset{V_S}{24} = \overset{V_L}{40}$ v.

∴ تلبي حاجة الدائرة

---

(4) $V_L(t) = 40e^{-10t}$ $t = ?$

$24 = 40e^{-10t}$

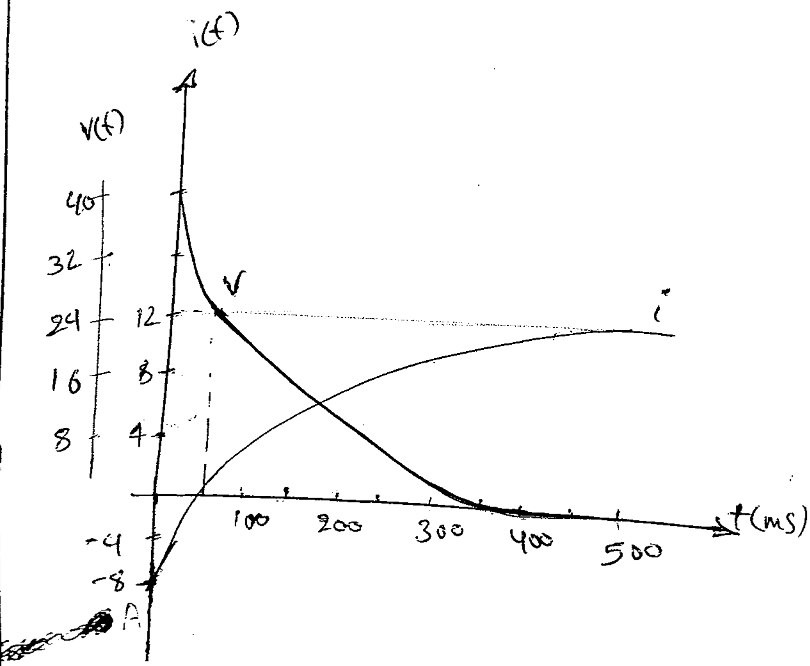
$\ln[24 = 40e^{-10t}]$

$\ln \dfrac{24}{40} = -10t$

$-0.5 = -10t$

$t = 51.08$ ms

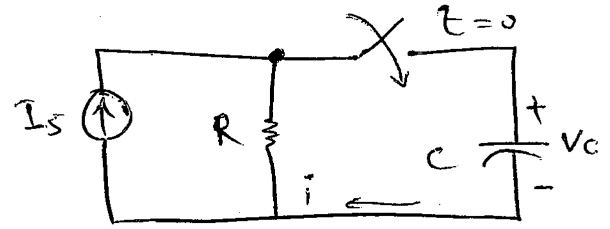
(5)



(3)

The step Response of an RC circuit.

KIL:



$I_s = C\frac{dV_c}{dt} + \frac{V_c}{R} \quad] \div C$

$\frac{dV_c}{dt} + \frac{V_c}{RC} = \frac{I_s}{C} \quad] * dt$

$dV_c = \left(\frac{I_s}{C} - \frac{V_c}{RC}\right)dt$

$dV_c = \frac{1}{RC}(I_s.R - V_c)\,dt$

$\frac{dV_c}{I_s.R - V_c} = \frac{1}{RC}\cdot dt \quad] \int$ integral

$\int_{V(0)}^{V(t)} \frac{dv}{I_s - V_c} = \int_0^t \frac{dt}{RC}$

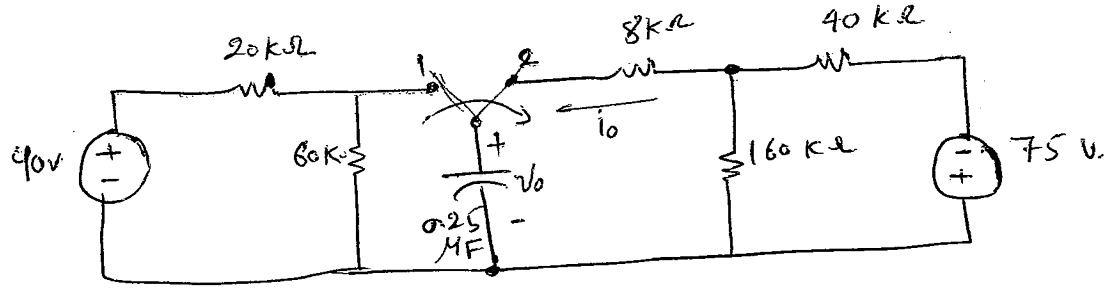
$\boxed{V_c = I_s.R + (V_o - I_s.R)\,e^{-t/RC}}$ at $t \geq 0$

$\boxed{i_c = C\frac{dv}{dt}}$

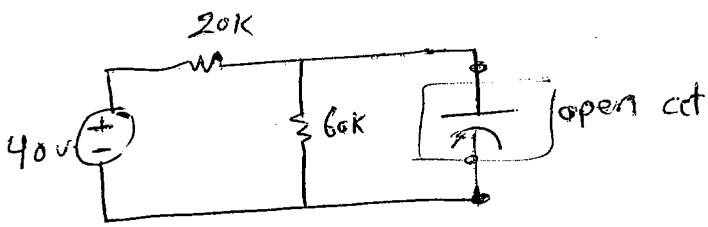
Ex:

a) $V_o(t)$

b) $i_o(t)$



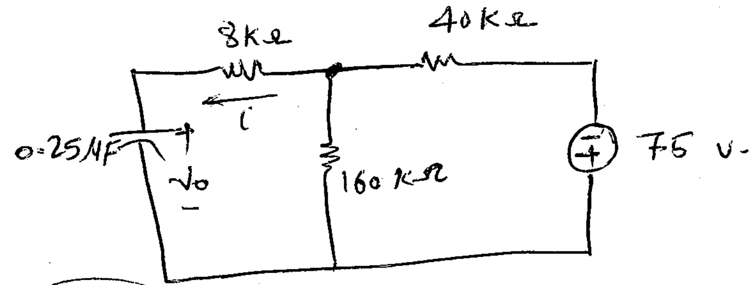
at $t < 0$



$V_o = V_{60k\Omega} \Longrightarrow V_o = 40 * \left(\frac{60}{60+20}\right) k\Omega$

$V_o = 30$ V.

at $t > 0$



$$R_{eq} = \left((160 \,//\, 40) + 8 \right) k\Omega$$

$$= 40 \ k\Omega$$

$$V_{o.c} = (-75) * \frac{160 \cdot 10^3}{(160 + 40) * 10^3} = -60 \ V.$$

نجد V بعد 7ح

$$\tau = RC \Rightarrow (40 * 10^3) * 0.25 * 10^{-6} = 10 \ ms$$

$$\boxed{V_o(t) = I_s.R + (V_o - I_s.R) \ e^{-t/\tau}}$$

$$= -60 + [30 + 60) \ e^{-100t}$$

$$\boxed{V_o(t) = -60 + 90 \ e^{-100t}} \quad t \geq 0$$

b) $i_o(t) = i_c = C \frac{dv_c(t)}{dt}$

$$= (0.25 * 10^{-6}) * \frac{d \left(-60 + 90 e^{-100t} \right)}{dt}$$

$$= 0.25 * 10^{-6} (-9000 \ e^{-100t})$$

$$\boxed{i_o(t) = -2.25 e^{-100t} \ mA}$$