

# Exp 6: Capacitors and inductors

• Three circuits :-

↳ first circuit :- RC-Circuit

$V_c$  :-

$$\mathcal{E} - RI - \frac{q}{C} = 0$$

$$q(t) = C\mathcal{E}(1 - e^{-t/RC})$$

$$V_c(t) = \mathcal{E}(1 - e^{-t/RC})$$

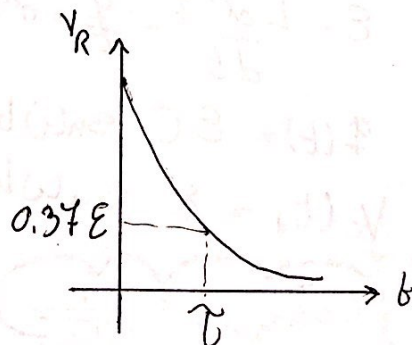
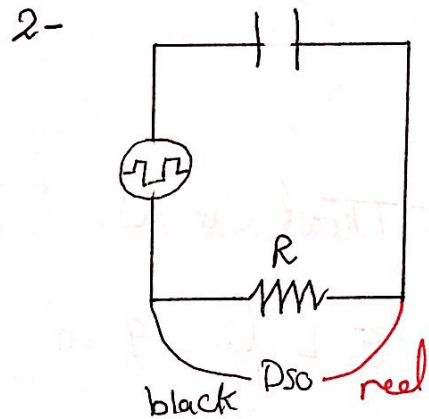
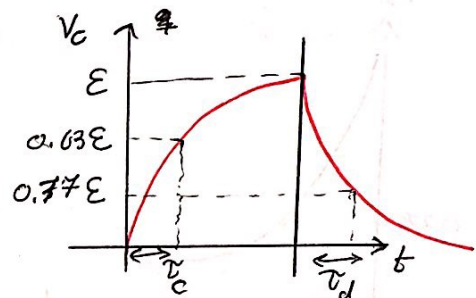
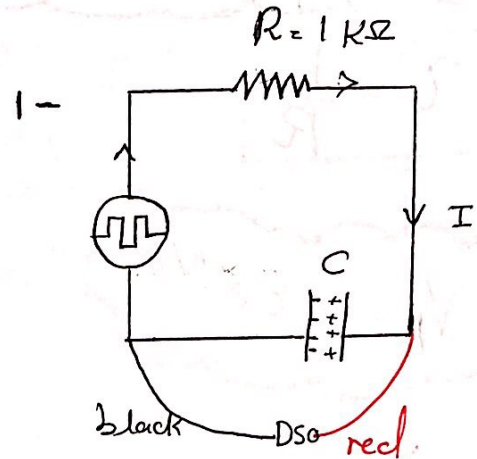
→  $V_c = 0.63 \mathcal{E}$

$$\tau_c = RC$$

$V_c(t) = 0.37 \mathcal{E}$   
disch

$$V_R(t) = IR$$

$$V_R(t) = \mathcal{E} e^{-t/RC}$$



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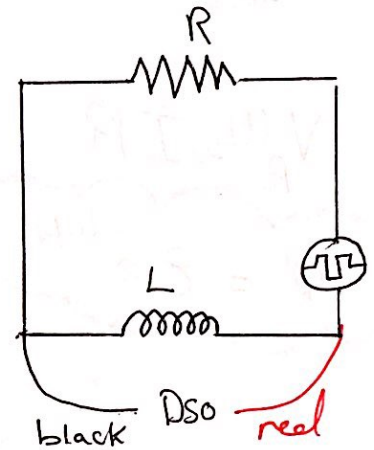
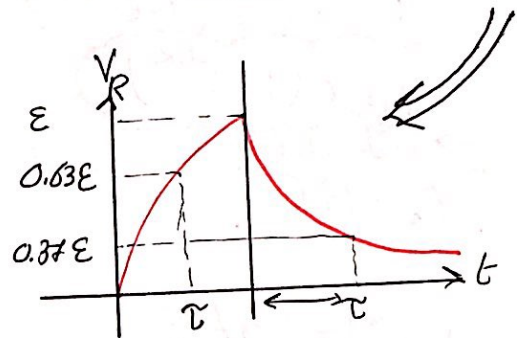
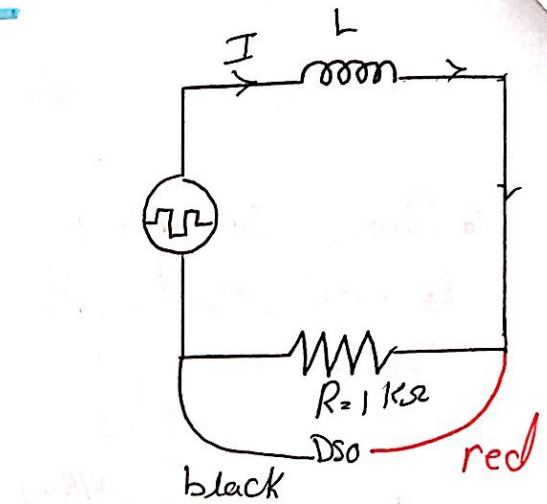
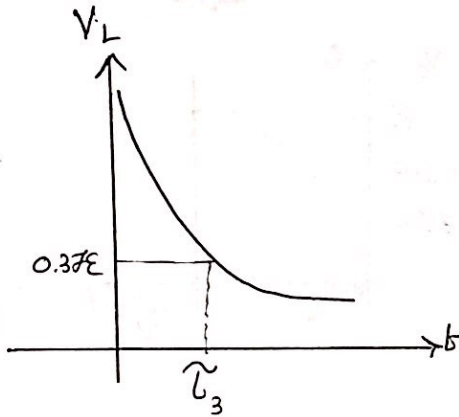
## Second circuit: RL - Circuit

$$\mathcal{E} - L \frac{dI}{dt} - IR = 0$$

$$V(t) = \mathcal{E} (1 - e^{-Rt/L})$$

$$\tau = \frac{L}{R}$$

$$V_L = \mathcal{E} e^{-t/\tau}$$



## Third Circuit: LC - Circuit

$$\mathcal{E} - L \frac{dI}{dt} - \frac{q}{C} = 0$$

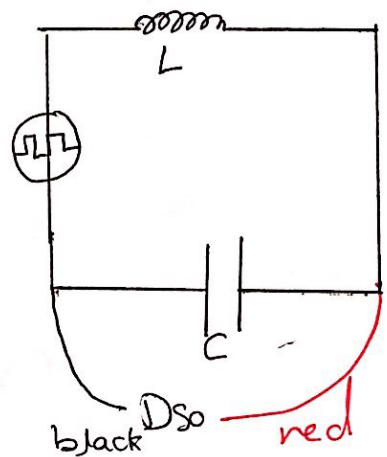
$$\mathcal{E} - L \frac{d^2q}{dt^2} - \frac{q}{C} = 0$$

$$q(t) = EC \sin(\omega t)$$

$$V_C(t) = \mathcal{E} \sin(\omega t)$$

$$\omega_{\text{Theory}} = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$



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لدينا ٢ دوائر :-

1- RC Circuits

- What we use :-
- A Resistance
- A Capacitor
- An inductor
- signal Generator.
- oscilloscope

• قم بوصول الموصل مع جهاز DSO  
 • قم بوصول مولد الموجات مع المقادير

• يظهر لك رسمه charging & discharging على الشاشة (V<sub>e</sub>)

• قم بحساب الثابت الزمني  $\tau$  ( $\tau_c$  و  $\tau_d$ )

$\tau_{discharging}$     $\tau_{charging}$

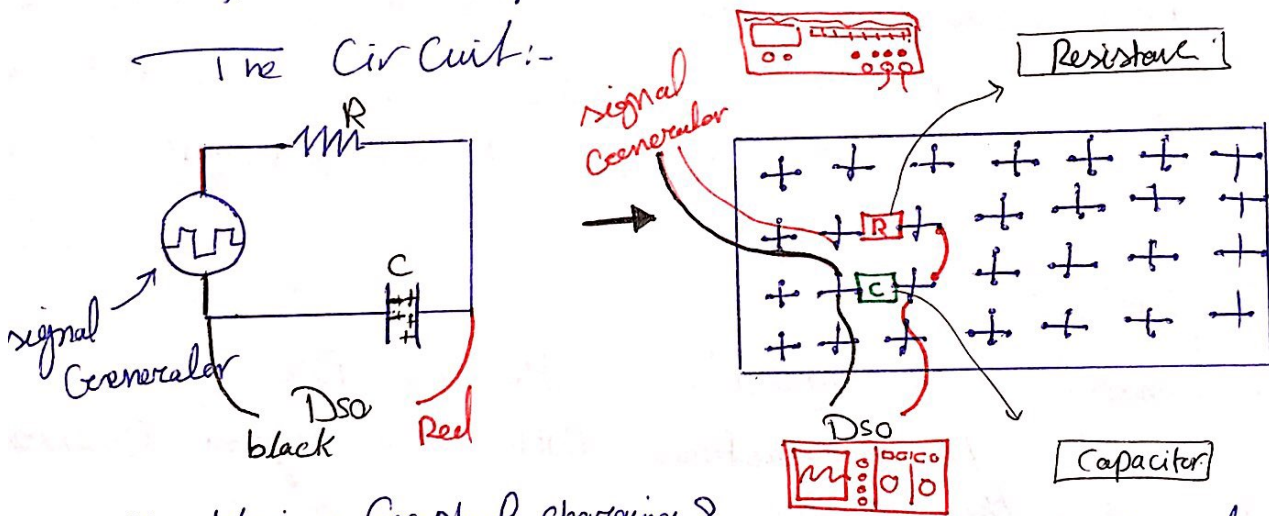
• Procedure :-  
 • قم بتوصيل R و C بحيث تصح R موصوله مع DSO و قم بحساب  $\tau$  من رسمه V<sub>R</sub>

- We have three circuits to make :-

A-1- R-C circuit :-

- You connect the capacitor with the DSO (oscilloscope)
- You connect a signal generator and a Resistance with the the capacitor

The circuit :-



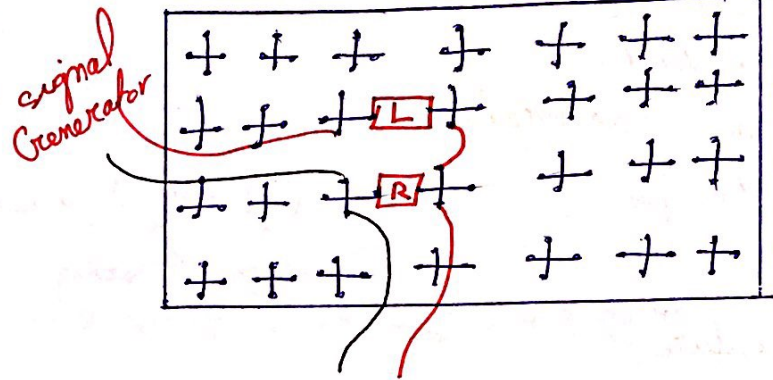
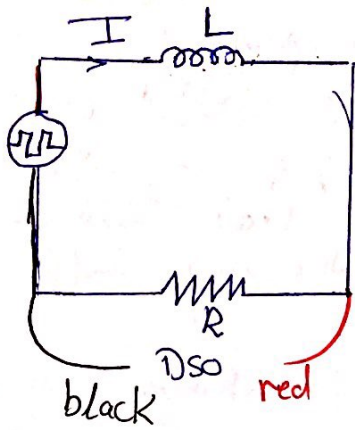
- You obtain a Graph of charging & discharging / you find  $\tau_{1,2}^{exp}$  As I explained in Page
- 2- You connect R with the DSO and C with the signal generator to obtain  $\tau_3$

B-1- L-R circuit :-

- You connect R with the DSO
- You connect L with signal generator & R

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The Circuit :-



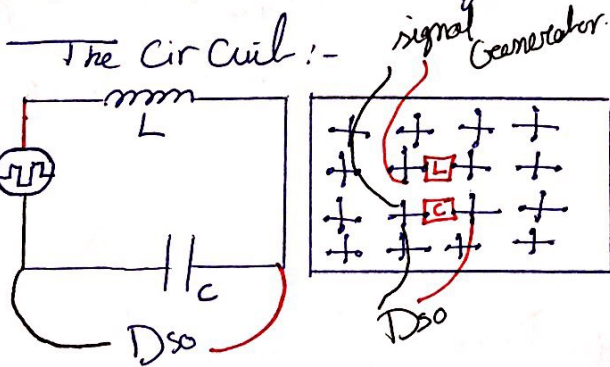
- You obtain the Graph of  $V_R$  <sup>DSO</sup>. Calculate  $V_C$  and  $V_L$
- Replace R with L and obtain  $V_L$  to get  $V_3$

L-R circuit.

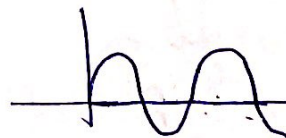
- 1- قم بوصول المقاومة مع جهاز DSO
- 2- قم بوصول كبلات مولد الاشارة مع المقاومة كما هو موضح في الشكل
- 3- احصل على رسمه  $V_R$  على شاشة ال DSO وعيّن له  $V_C$  و  $V_L$  فيهما
- 4- تبديل R مع L و احصل على رسمه  $V_L = V_3$

L-C Circuit:-

- You connect the Capacitor with the DSO
- You connect the Resistance with the signal Generator and with the Capacitor.



قم بوصول الدارة كما هو موضح  
 عيّن له رسمه على شاشة ال DSO  
 فيهما



- obtain  $f_{exp}$  from the DSO
  - By increasing  $f$  until Amplitude is maximized
- قم بزيادة  $f$  حتى تصل الى اعلى  
 الى اعداد  $f$  التي عندها يكون الرسم  $f = f_{max}$

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